Center for robotics
Physics-Mathematics Lyceum 30

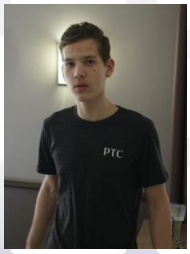
Engineering book of
Competition First FTC

Team PML30-φ 9746

Saint-Petersburg, Russia
2015

Team PML30-phi

Physics and Mathematics Lyceum №30, Saint-Petersburg, Russia



Georgiy Krylov
Captain, responsible for efficiency of working in the team

Evgeniy Maksimyshev
Operator №1, engineer, responsible for programming

Nikita Safronov
Operator №2, engineer, responsible for technical documentation

Ivan Fokin
Engineer, responsible for purchasing materials

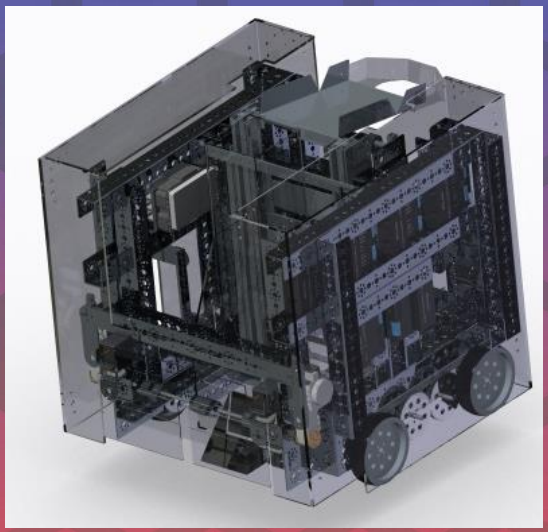
Maksim Radionov
Engineer, responsible for public relations

Strategy(number of scoring points is noted in brackets)**:**

1. Autonomus period (2 options):
   1.1. Riding out from the ramp, scoring autonomus balls into 60 and 90 cm rolling goals and delivering them to the parking zone. (**120**)
   1.2. Start from the parking zone, scoring autonomus balls into 30 and 90 cm rolling goals and delivering them to the parking zone. (**100**)
2. Driver control period: carrying 90 cm rolling goal and filling it with balls (**200 - 270**). During end game scoring 4 big balls into central goal(**180**) or delivering rolling goals to the ramp (**120**).

Construction features(numbers of following pages in engineering notebook is noted in brackets)**:**

1. Strength:
   1.1. Most of construction elements are made of metal (aluminum or steel).
   1.2. Elevator works stable, because it is made of furniture rails. (pages 27 and 41)
   1.3. Robot is heavy, so it's hard to turn it over.
   1.4. Robot is protected from collisions with Plexiglas.
2. Mobility:
   2.1. Robot has 6-wheel drive. Six motors and gear 2:1 for speed provide maximum power and maneuverability of moving. (page 198)
   2.2. With standard TETRIX omniwheels robot easily turns, and because of special construction it has no problems with riding up to the ramp. (pages 169 and 200)
3. Balls control:
   3.1. Gripper for balls consists of two fast rotating vanes. (pages 26, 122 and 176)
   3.2. The bucket for balls rises up with elevator and overturns backwards. (pages 103 and 178)
   3.3. Balls from the bucket move to the guide with hole at the end of it. Balls fall down from the hole vertically, so they always get into the goal.(pages 82 and 108)
   3.4. Robot captures the rolling goal with a special mechanism and carries it with itself. (pages 124, 202)



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Финист

Contact information:

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https://www.facebook.com/pages/FTC-team-PML30-PHI/1410799752560522

Contents

1 Team PML 30 φ

Team PML 30 φ was assembled in September 2014 in the Russian city of St. Petersburg from 3 novices and 2 participants with experience. Tasks and roles were distributed among the participants, and we established safety rules. In the first place the team put spreading principles of gracious professionalism to others. All decisions were made collectively inside team with discussion to find the most optimal solutions. During the year we took part in many events and everywhere we have tried to attract attention to our team and encourage people to take part in FTC. Also we pursued and distributed the principles of honorable professionalism. Talking to the press, we hoped to attract more attention to our team and to the competition in general, as well as attracting sponsors. The latter was important because of the need for funds - purchasing materials and equipment costs a lot. The team took part in the three qualifying competitions and in the regional finals. In all of them we made new contacts, shared experience and provided mutual assistance to other teams. In the first qualifying rounds in Sochi we met Stuy Fission 310 from USA and maintain contact with them to this day. On regional finals, we met with a team from Romania, Auto Vortex, and keep in touch with them through Facebook. Also, there is an active group chat with a large number of Russian teams. You can find the team page in Facebook at the address https://www.facebook.com/pages/FTC-team-PML30-PHI. To increase the efficiency of our team work we used the version control system GitHub, which allows the entire team to work simultaneously on a single projects without losing files and providing easy way to resolve roblems. Also for writing technical books we been used professional typesetting system LaTeX.

[H]

1.0.1 Instructors

:

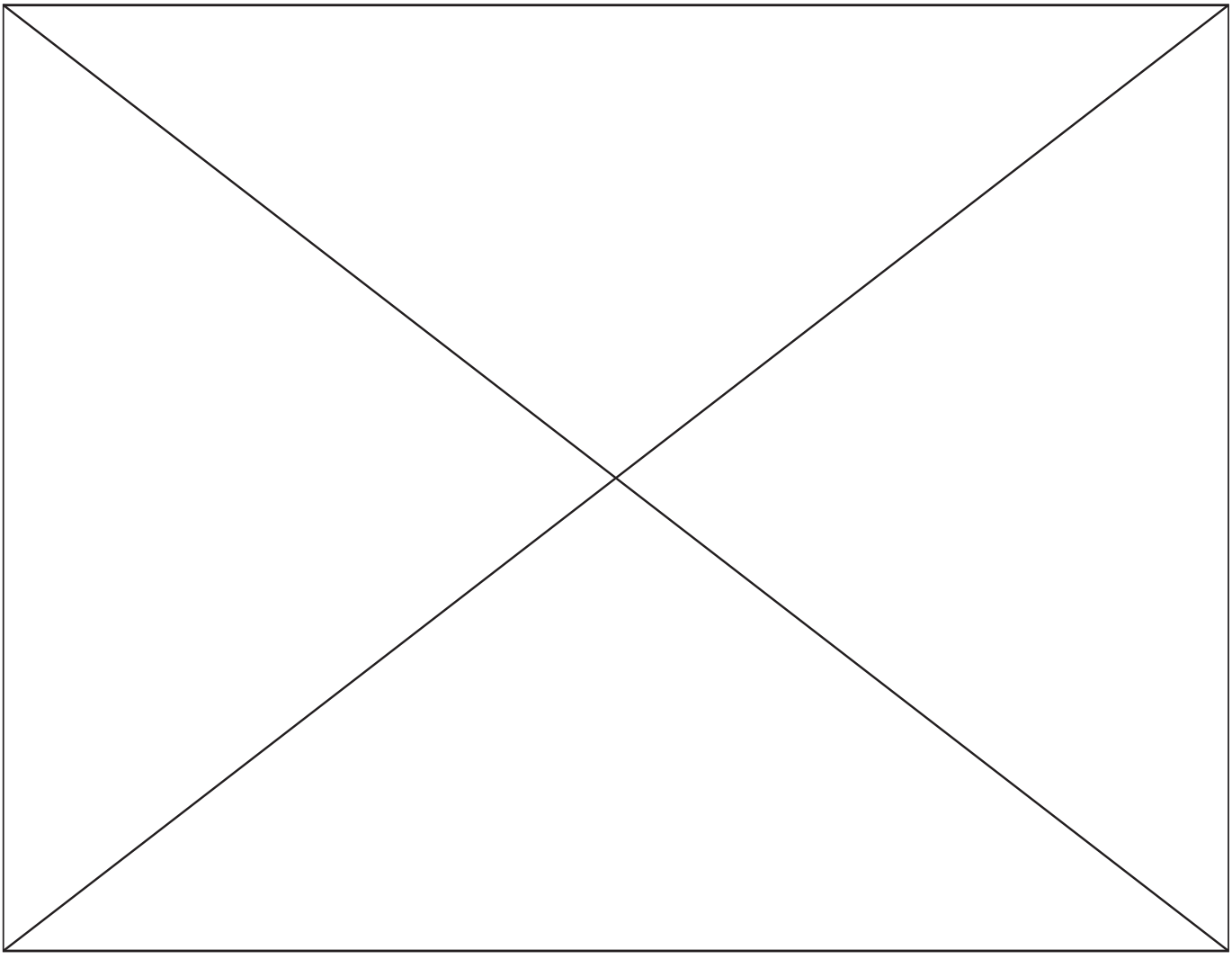
Luzin Dmitry
Head of Robotics Department in Phys-Math Lyceum 30, Saint-Peterburg, Russia. Main coach of FTC team.
Information: 25 years old, in robotics 5 years, in FTC 3 years.

Luzina Ekaterina
Professor of Robotics Department in Phys-Math Lyceum 30, Saint-Peterburg, Russia. Tutor of FTC team.
Information: 25 years old, in robotics 5 years, in FTC 3 years.

Fedotov Anton

Professor of Robotics Department in Phys-Math Lyceum 30, Saint-Peterburg, Russia. Tutor of FTC team.

Information: 22 years old, in robotics 4 years, in FTC 3 years.



1.0.2 Team members

Krylov Georgii
Role in team: captain, coordinator of the action operators in game, responsible for the modification of robot.
Information: 17 years old, in robotics 3 years, in FTC 3 years.
Why I chose FTC: "I chose the FTC, because I like to come up with the design of robots and turn their ideas into reality, because every time I feel the Creator, who created a new creature."

Radionov Maxim
Role in team: communication with the team and community, decorating robot, Power Design, reserve operator.
Information: 16 years old, in robotics 3 years, in FTC 1 year.
Why I chose FTC: "Because I like to create a robot from scratch, from somethink, I can do with my hands: cut, drill and assemble."

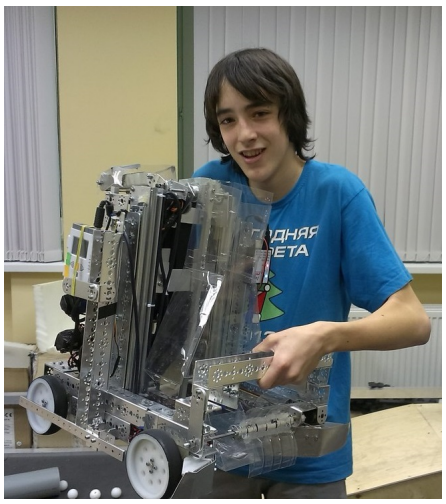
Safronov Nikita
Role in team: manipulator-1, creation of 3D models, chief engineer, responsible for the assembly robot.
Information: 16 years old, in robotics 3 years, in FTC 1 years.
Why I chose FTC: "I have chosen FIRST because I enjoy working with mechanisms and finding unusual technical decisions for solving problems. Also working on this project helps me to get new skills in a sphere of engineering. In this case I know, that I don,t spend my time in vain."

Maksimychev Evgeny

Role in team: manipulator-2, responsible for the technic of safety, responsible for the writting of technical book.

Information: 15 years old, in robotics 2 years, in FTC 1 year.

Why I chose FTC: "This is an interesting project that allows to implement some innovative solutions. In addition to the skills of designing robots, we also obtain the skills of the technical documentation and communication with colleagues which makes this competition as close to real engineering problems."

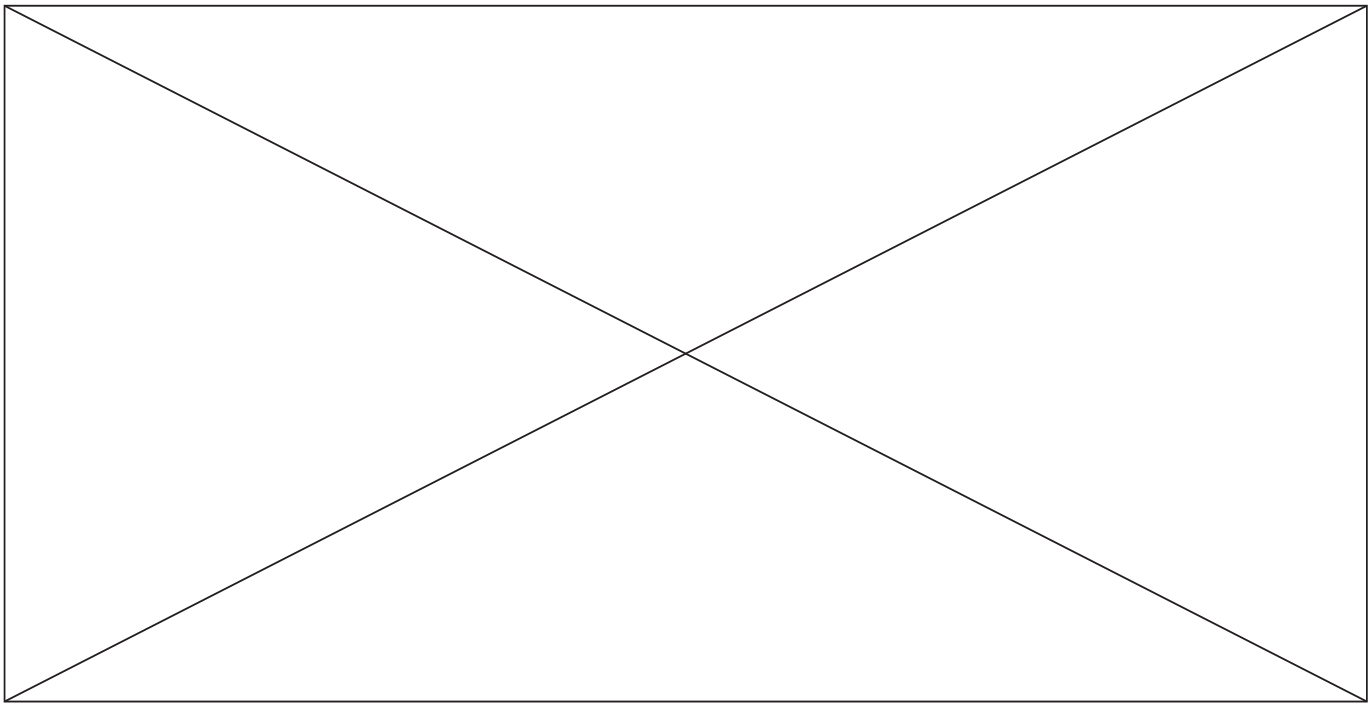


Fokin Ivan

Role in team: purchase of materials, development strategy in the game, communication with the press, reserve manipulator.

Information: 17 years old, in robotics 5 years, in FTC 3 years.

Why I chose FTC:" When I first I attended the event FTC saw hefty metal robots, with enthusiasm and without hesitation decided that I would like to do this."



2 Events

2.0.3 Qualifying competitions

1. Sochi. 21-23.11.2014. Sochi was the first time the team participated in a comptetition. There, our team felt the spirit of FTC comptetion and noble professionalism for the first time. We got work experience all day and all night, began to make acquaintance among the teams, and providing all possible help we could. The planning and organization were all very nice. The most memorable contact we made was with the American team Stuy Fission 310, with which we now keep in touch. As a result we won a Think Award and a pass to the Regional final.

2. Ryazan. 13-14.12.2014. Our first priority was to train on a real field. These competitions were quite small and quiet, all the teams communicated abundantly and shared ideas freely. We all felt comfortable there. The team helped to assemble and disassemble the field. As a result - Winner Alliance Award and Think Award.

3. Perm. 27-29.01.2015. Dress rehearsal before the regional final. It was great organized event where we were able to practice all aspects of the competition. Including such important skills as the choice of Composes alliances finale. Also we strongly helped to organized technical part. As a result - the Winner Alliance Award and Inspire Award.

2.0.4 Regional final. 11-13.02.2015

This was the event, to which the team had been preparing for for six months. Approaching the competition with fully finished. At competitions communicated with all the teams that were there, discussing strategy and offering their help. During the competition statistics were conducted on all the teams. It helped in choosing allies for the final. Was also had an action plan for an alliance with any team. In the final, having received a the choice of allies, we chose the team with the most stable results, and the bet was at collaborative interaction of any pair of robots. Results: Winner Alliance Award, Inspire Award and the pass to World Championship in Saint Louis.

2.0.5 CRDI RTC. 24.11.2014

Central Russian Institute of Robotics and Technical Cybernetics. A tour was organized for the team in the institute, where we could see the real processes of development of detailed design for robotics. There we saw several project summaries at different stages of development - from drawings to finished models, as well as commercially ready products. From there we learned some ways on how to organize. Internet adress http://www.rtc.ru.

2.0.6 PML30 POLYGON. 08.02.2015

PML30 POLYGON competitions are carried out by our organization. Their main misrepresented that participant receives a rear and parts for its decision merely on the competition, compliance with the maximum being equal. We also demonstrated the FTC involving the participation.

2.0.7 GeoScan. 10.03.2015

A Russian company thatproduces and sells unmanned aerial photography systems. There we were clearly shown how the office is designed, as well as the distribution of responsibilities and tasks, and what the internal

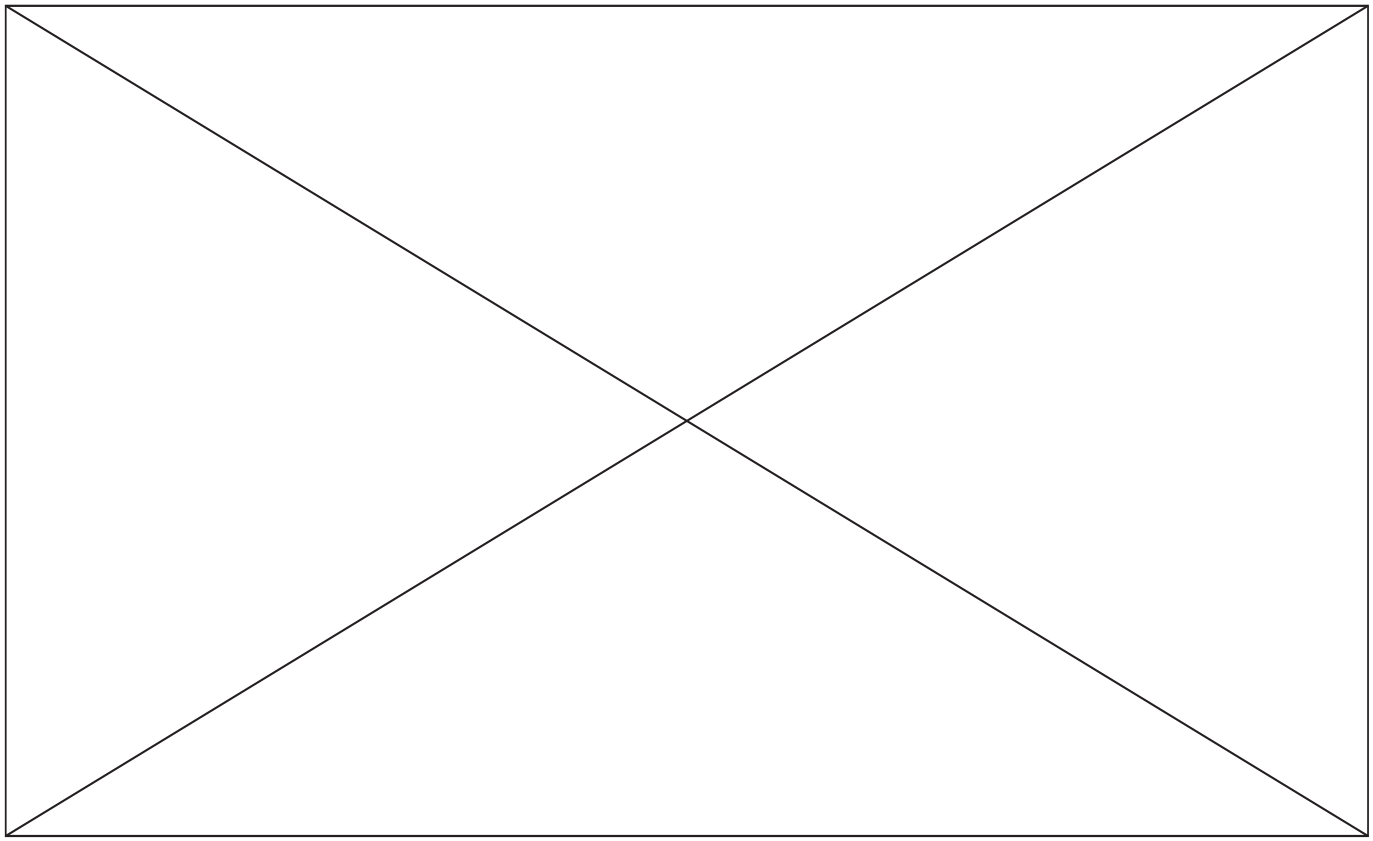
interaction is like. Also, we were shown the whole production line. Internet adress http://geoscan.aero/.

2.0.8 PTC live Tech Forum. 24.03.2015

The team was invited to participate in PTC Live Tech Forum. We will present the successfull path of 3D model creation in Creo Parametric, tell about important tips and show how CAD modelling helped us to build the robot.

2.0.9 Summer camp on Robotics

In the camp in 2015, team members will conduct a robotics engineering course based on constructor TETRIX, attracting more people to the FTC.



3 Business plan

3.1 introduction

We take a responsible approach to finding sponsors. And also try to spend money effectively advance thinking through the details and equipment, finding ways to get them maximum benefit. Some sets we received as prizes in competitions.

3.2 Our sponsors and their support

3.2.1 PTC and Irisoft

PTC and Irisoft representative in Russia is the one company that has helped us to begin to engage FTC. They provided us the first set of Tetrx within the program's Score Thehnic which involved our Lyceum. They provide us with a different command symbols plus small gifts for other teams. They help us with the delivery of details from U.S.A. We use them programa Creo for creating 3D models. We also take part in events organized by them.

3.2.2 Robofinist

Robofinist Charitable Foundation organized by Temur Amindzhanov and by Starline. They offered us its assistance as an organization in our city with outstanding achievements. They help to financially each month to give us 2000 Dolars, parts and equipment.

3.2.3 Volnoe Delo

Volnoe Delo is one of the largest charitable foundations in Russia. It was established by Oleg Deripaska. We are participants of the program ROBOTOTEHNIKA.As support they sent us free game field.They also engaged in training teachers and judges, including our own.They engaged in the organization of competitions FTC in Russia and are sponsoring a trip this year's winners to St. Louis.

3.2.4 Physics-Mathematics Lyceum 30

Physics-Mathematics Lyceum 30 is a school in which is our organization. It provides us with a comfortable space and material assistance, as well as leaders.

3.3 Purchase of materials.

3.3.1 Our method

When we started robotics we had not a lot of money and we used only some basic materials. Now we found sponsors and firstly plan the details and equipment that we need to buy and then buy them.Such an approach allows us to find more effective solutions.

3.3.2 Our materials

We have 6 primary kits and 3 resource kits.We buy individual parts we need.At this point was made 2 large purchases from U.S.A for 1600 Dolar in November 2014 and March 2015.

4 Engineering section

4.1 Concept of robot

4.1.1 Construction

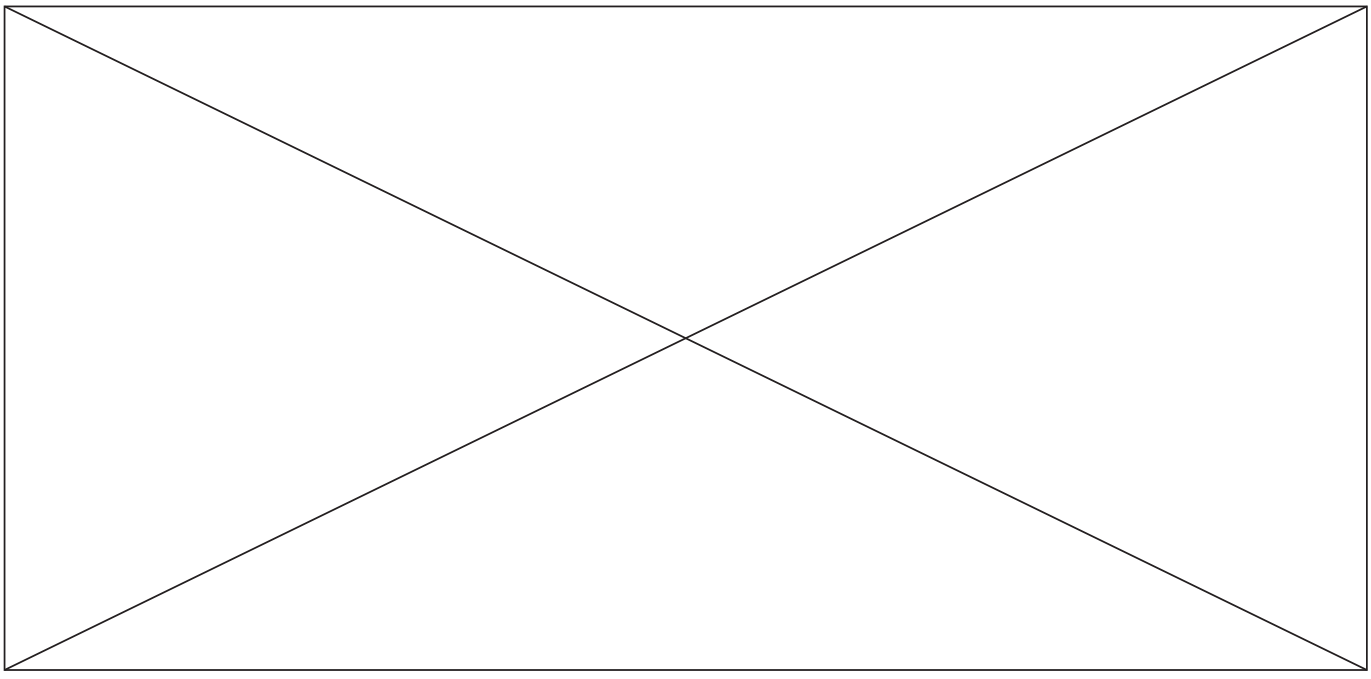
- Robot should be mobile, move quickly, and, if possible, in all four directions.
- Robot should have four sensors of angle (encoders) to use in the autonomous period.
- Robot should be compact not fill too much space, since it shouldn't hinder allies.
- Robot must be able to monitor all five (5) goals simultaneously.
- The robot must have a special device for moving the movable baskets.
- If possible, the robot should be lightweight. It will be easier to carry.
- The construction of the robot should allow for quick change of some parts.

4.1.2 Autonomous period

- Robot should have different versions of the autonomous period and use them depending on the ally's capabilities, its start place, and other conditions.
- The autonomous period program should be simple.

4.1.3 Driver-controlled period

- Robot control should be simple and convenient
- One operator is fully responsible for the movement of the robot, the other for all another functions.
- Some steps in the controlled period may be implemented independently to help the operator.
- Operator should control speed of robot, since the robot should be able to perform precise manipulation.



4.2 Strategy

4.2.1 Autonomous period

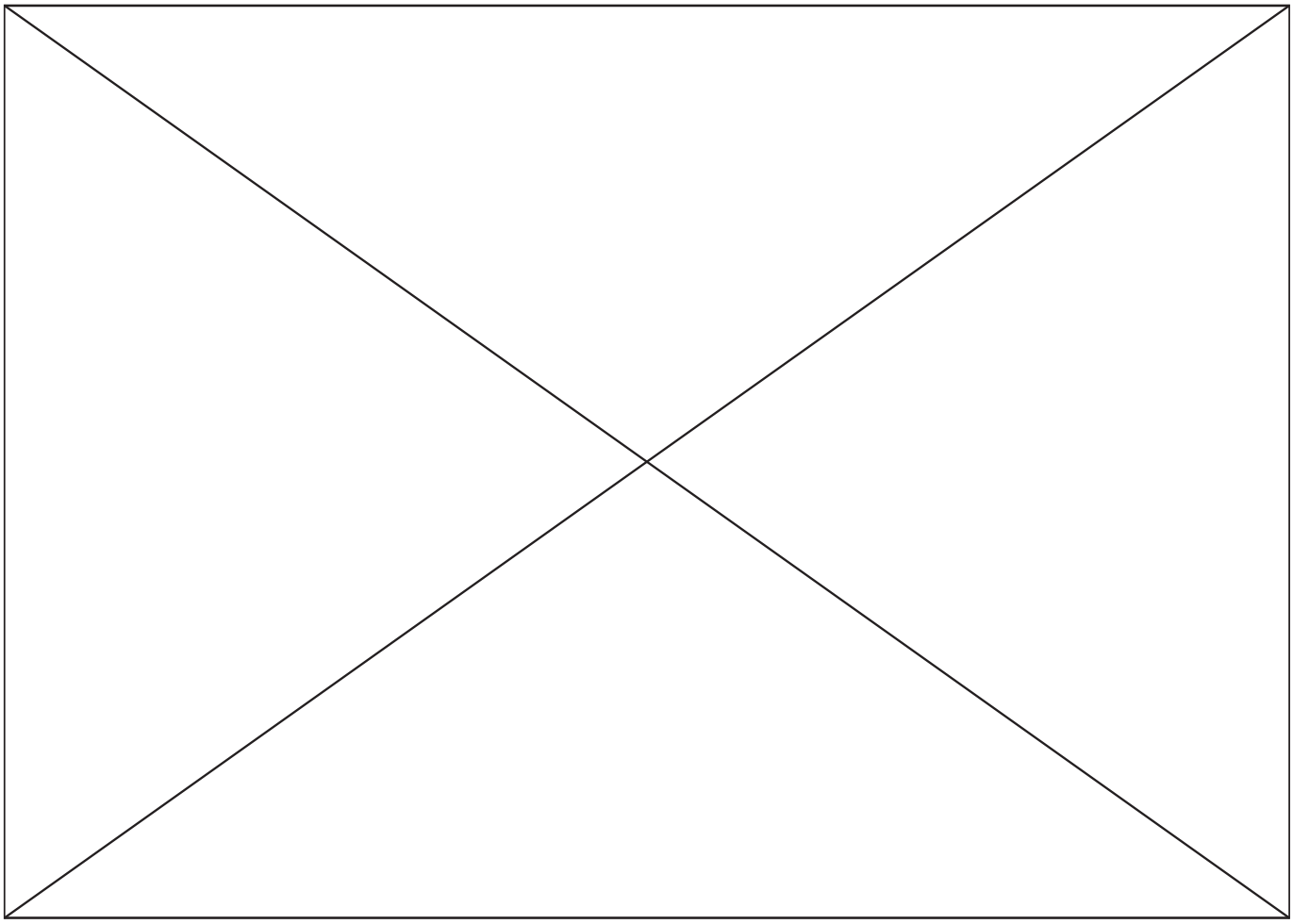
1. Put two balls in two different baskets.
2. Take the maximum number of mobile baskets and place them next to the parking area.
3. On the way to the parking area, the mechanism of ball release should be activated.

4.2.2 Driver-controlled period - main part

1. Allow our ally free access to the moving baskets. But, at the same time, it should carry one basket, because we have to save time.
2. First the 90-cm basket should be filled with balls, then the 60-cm one and 30-cm one.
3. Avoid collisions with ally and opponents, it is a waste of time.

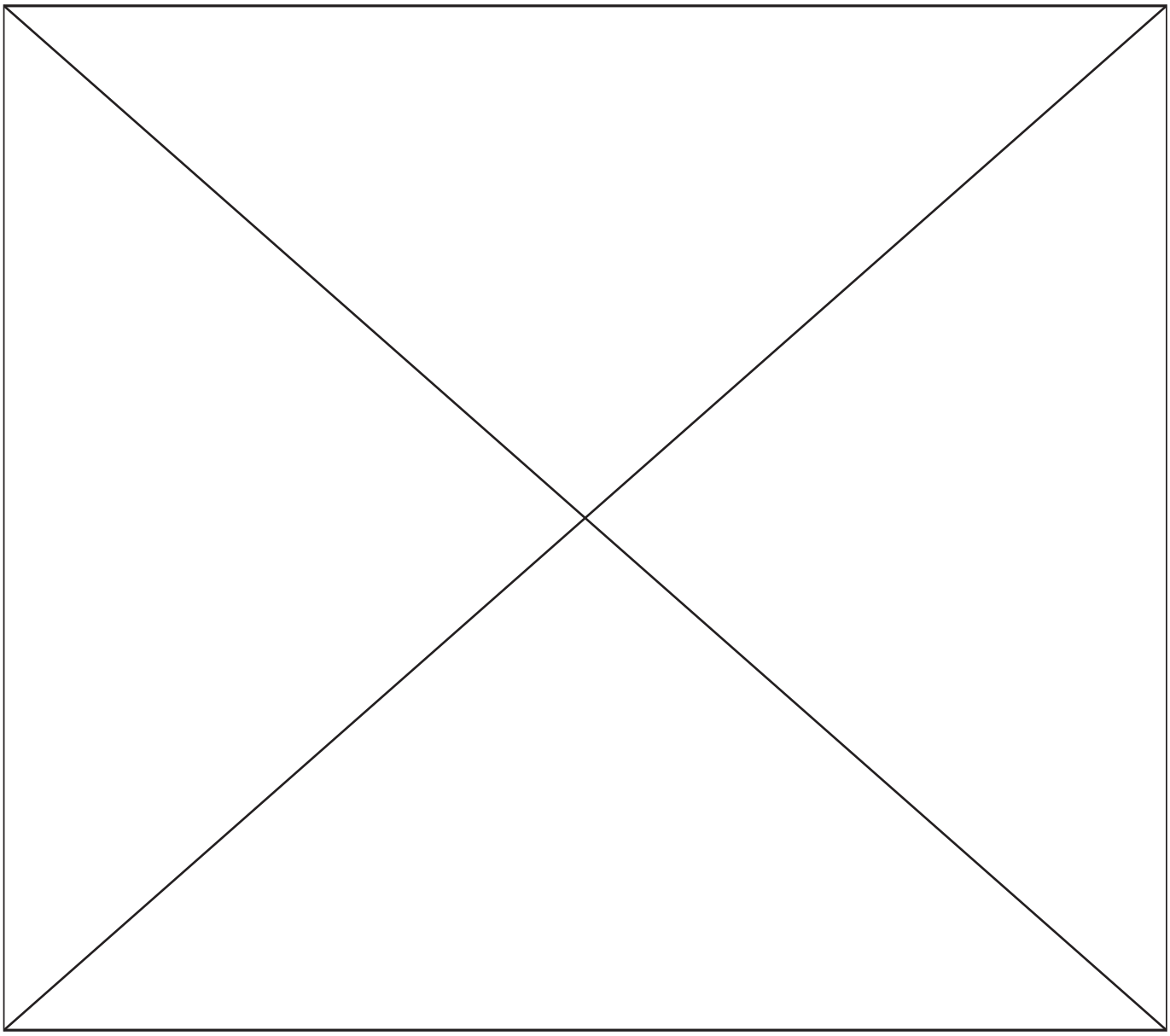
4.2.3 Driver-controlled period - final

1. Fill the central basket with balls.
2. Place maximum possible number of mobile baskets on the ramp.
3. Call the robot to the ramp.



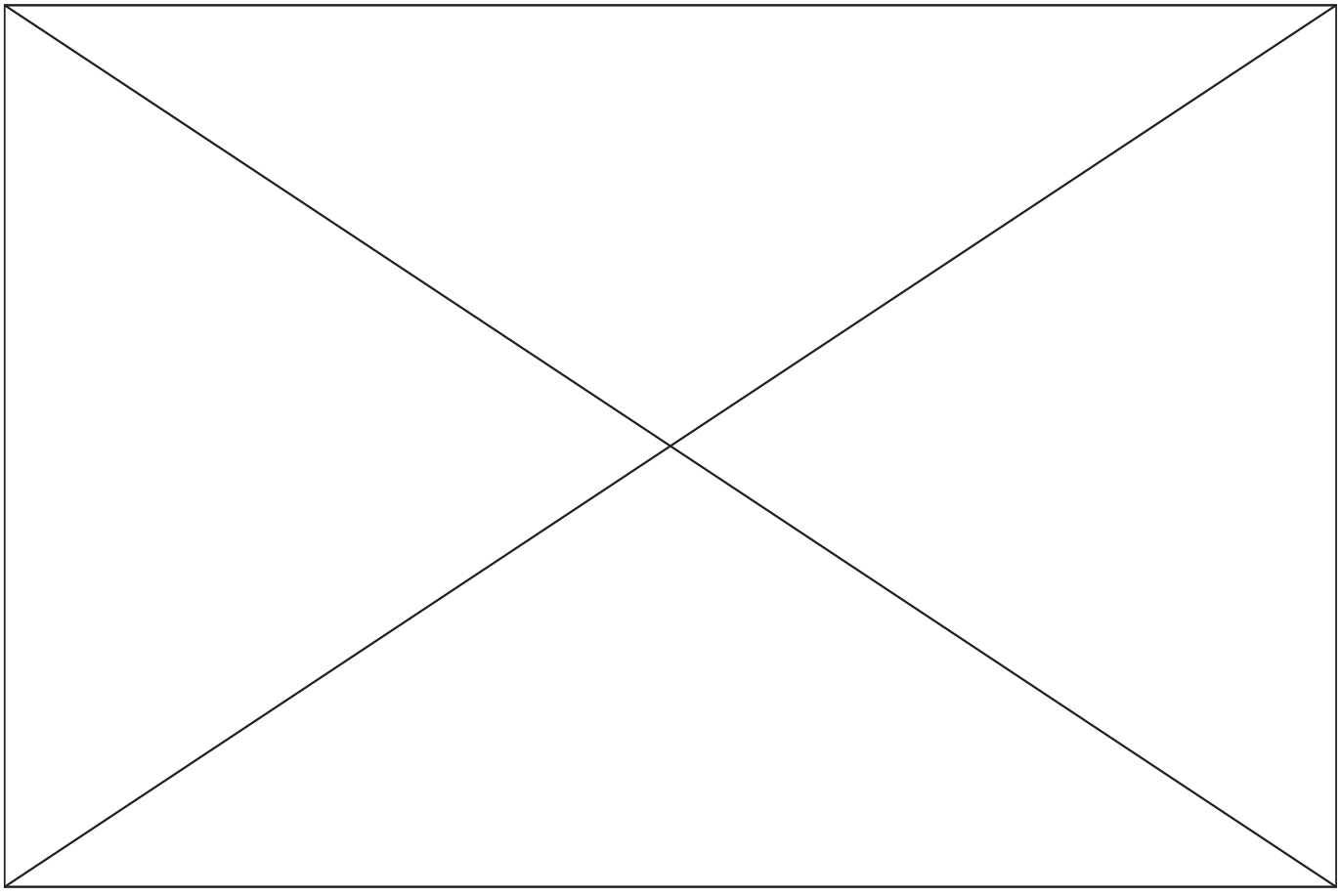
4.3 Planned steps for creating of the robot

1. Creating a wheel (or track) base of the robot.
2. Writing a program for controlling the wheelbase through one (1) joystick.
3. Creating a system of goal control.
4. Writing a programm for robot control through two (2) joysticks.
5. Writing a programm for the autonomous period.
6. Creating additional decorative elements.
7. Installating protection elements on the robot to prevent damage during an accidental collision.
8. Trainings (alone or with another robots).
9. Making improvements on the based on preformance in first competition.



4.4 Supplementary materials which were used in the robot's construction

1. Aluminium axis 1m 8mm. 2 pieces.
2. Steel axis 3m 8mm. 1 piece.
3. Aluminium strip 2m 50mm 2mm. 1 piece.
4. Aluminium strip 1m 40mm 3mm. 1 piece.
5. Aluminium profile 1m 10mm 10mm. 1 piece.
6. Furniture slats 30m. 2 pieces.
7. Furniture slats 35m. 4 pieces.
8. Belt 2,5m. 1 piece.
9. Plastic clamps.
10. Plastic bottle. 1 piece.
11. List of PET 1 m 80 cm. 1 piece.
12. Hot melt adhesive.
13. Tape.
14. List of plexiglass 3m x 2m (cut). 1 piece.



4.5 Team meetings

4.5.1 29.09.14

1. The time of beginning and ending of the meeting: 18:00 - 21:30
2. Purposes of the meeting:
   - 2.1. Discuss the rules of FTC Cascade Effect.
   - 2.2. Discuss the main aspests of robot's construction.
   - 2.3. Elaborate strategy of our team's play.
3. Work, that has been done
   - 3.1. Was discussed in part 2 of rules.
   - 3.2. During the discussion of construction of robot there have been several ideas:
     - 3.2.1. Dimensions of the robot:
       - 3.2.1.1. Body of robot must be compact enough. Body and gripper for balls must fit at the regulated dimentions.
       - 3.2.1.2. Robot must be compact not to bother alliance partner.
       - 3.2.1.3. Body of robot shouldn't be too small,otherwise t will be unstable when the lift is raised to maximum height (120cm)
     - 3.2.2. Wheel base:
       - 3.2.2.1. Construction with four standard wheels from set Tetrix. This system can move in a straight line and turn on the spot very good. A minor defect of this construction is that when the robot is turning wheels jump and robot shakes.
       - 3.2.2.2. Construction with two caterpillars. This construction's advantage is that it can move in a straight line and turn on the spot. The disadvantage of this system is that caterpillar can get off. Otherwise there is no caterpillars in Tetrix set so we have to make to their ourself.
       - 3.2.2.3. Construction with four omni wheels from Tetrix set fixed at angle of 45 degrees to the body of robot. The advantage of this construction is that it can move to any direction and can turn very fast but it move badly in a straight line. That could adversely affect the Autonomous period.
       - 3.2.2.4. Construction with four mechanum wheels that fixed as standard wheels. Advantages: good moving in a straight direction, fast turning, possibility of moving to any direction. Disadvantages: they have low accuracy when turning we have to buy this wheels separately from the set.
     - 3.2.3. System of control of balls:
       - 3.2.3.1. Basket for balls is fixed to the system of retractable slats that are interconnected with help of servomotors. Advantages: the absence of a line that can tear. Disadvantages: the complexity and low reliability.
       - 3.2.3.2. Basket for balls is fixed to system of retractable slats that are fixed to body of robot. DC-motors reel up the line and extract the lift. Advantages: this construction is simple and reliable (except the line). Disadvantages: line can tear.
       - 3.2.3.3. Basket for balls is fixed to system of retractable slats that are fixed to DC motor so it can rotate slats in the vertical plane. Advantages: opportunity of extracting in horizontal position that relieves the load from the line. Disadvantages: line can tear.

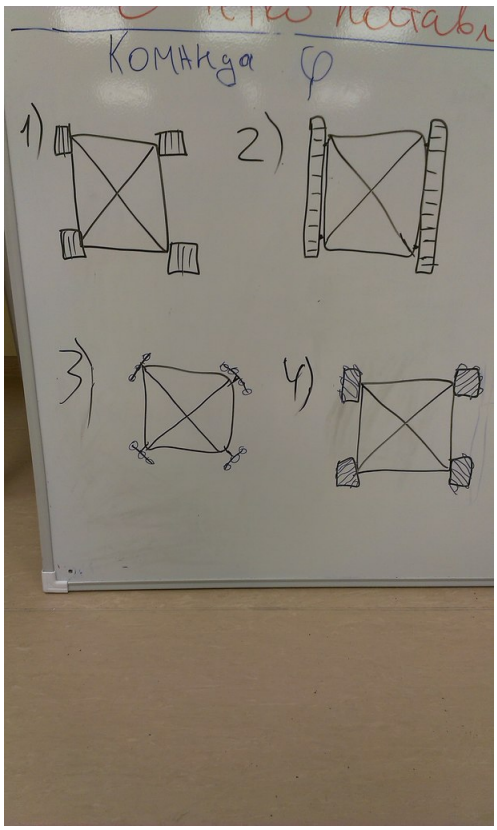


Figure 1: Ideas of wheel base: 1)Construction with four standard wheels 2)Construction with two caterpillars 3) Construction with four omny wheels from Tetrix set 4)Construction with four mechanum wheels

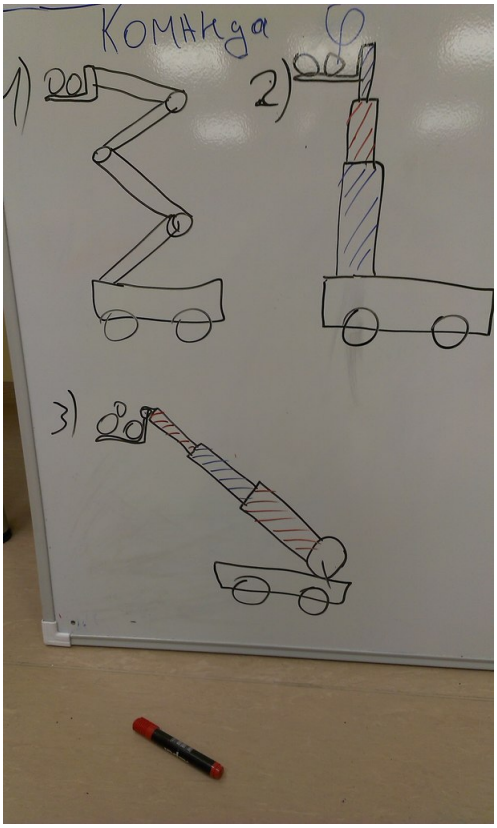


Figure 2: Ideas of the lift 1)Construction 1 2)Construction with stationary slats 3) Construction with slats that fixed to DC motor

3.2.4. System of fixing the moving basket (for more accurate throwing of balls to basket and for moving it):

3.2.4.1. -shaped gripper with two servomotors fix basket between the beams. Servomotors are located at DC motor that can rotate them in vertical plane. Advantages: opportunity of raising basket. Disadvantages: takes a lot of space.

3.2.4.2. The hooks that can capture basket for small holes in it's base are used in the same gripper. Advantages: more compact than previous variant. Disadvantages: it could be difficult to get the hooks into the holes

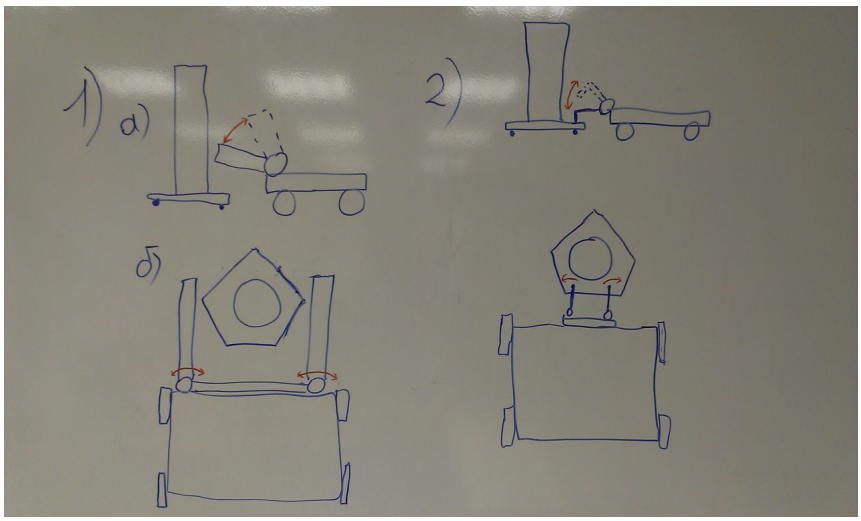


Figure 3: Ideas of fixing of moving baskets: 1)Gripper shaped 2)Gripper with hooks

4. Results:

4.1. As the result of discussion were generated ideas that described in sections "Concept of robot", "Strategy" and "Planned steps for creating of the robot".

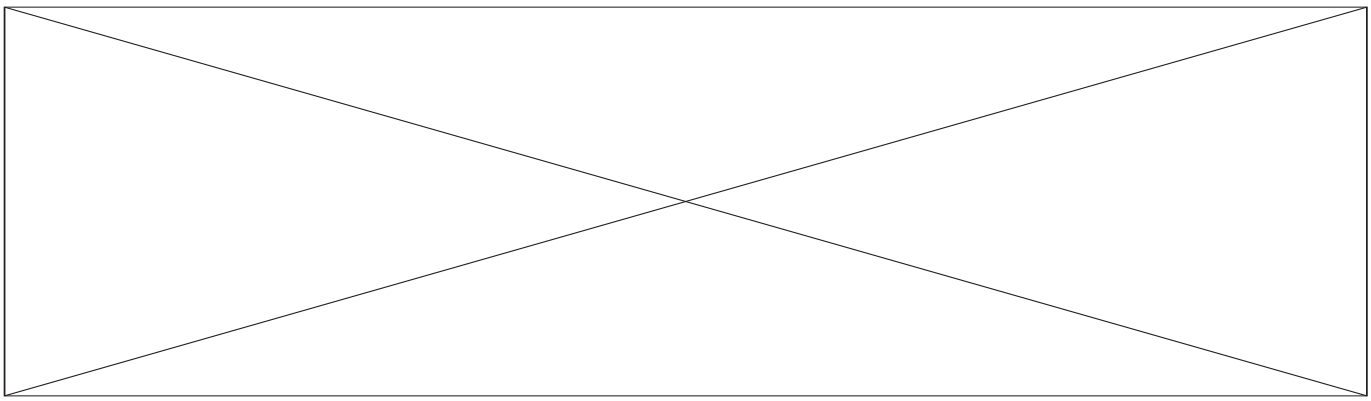
5. Tasks for the next meetings:

5.1. To choose the wheels base.

5.2. To choose the optimal sizes of robot.

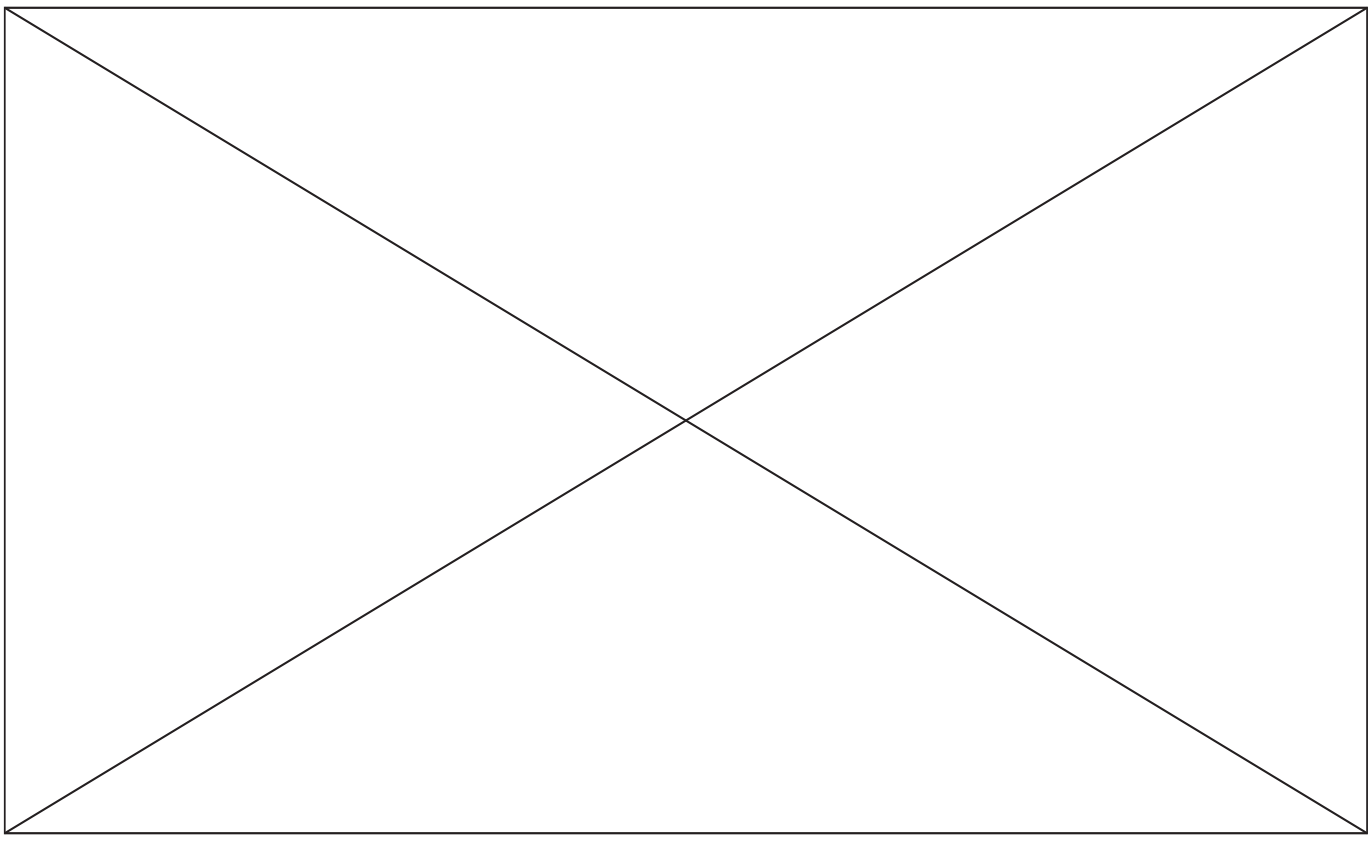
5.3. To choose the best system of control of balls.

5.4. To choose the most effective way of fixing of moving basket.



4.5.2 06.10.14

1. The time of beginning and ending of the meeting: 21:00 - 21:30
2. Purposes of the meeting:
   2.1. To begin writing a program to control the robot by joystick.
3. Work that has been done:
   3.1. Two programs were written to test the wheel base: moving in a straight line and turning around. It showed great results driving in a straight direction, not deviating from the original trajectory. During the turning around robot jitters due to the high coefficient of friction between the wheels and the floor. So the wheels could not slip on the floor and jumped up and down. In general it does not affect the accuracy of the turn. The robot rotates exactly around its center of mass, but the latter is located not in the center of the robot, but closer to its tail part. For ease of control, perhaps the center of mass could be shifted closer to the intersection of the diagonals of the square to which the wheels are attached. Then the space needed to turn would be smaller and we would not hinder allies.
   3.2. As a result of the discussion we made our choice of lift type - sliding rails the bases of which are rigidly fixed to the frame of the robot. This design is most reliable and the easiest to implement.
4. Results:
   4.1. Type of lift was choosen.
5. Tasks for the next meetings:
   5.1. To buy furniture slats to create lift.



4.5.3 07.10.14

1. The time of beginning and ending of the meeting: 17:00 - 21:30

2. Purposes of the meeting:

   2.1. Writ a program to control the robot by joystick.

   2.2. Begin creating the lift.

3. Work, that has been done:

   3.1. Control of the robot by joystick was implemented. Motor control is carried out by the left stick. During the tests we found that when a small current was supplied on motors, they could not be rotate and are too loud, leading us to conclude that they are only wearing out. Because of this it was decided to put a limit to how small the signal could be.

   3.2. In order to raise the basket to 120 cm, it was decided to assemble two guides, each of which consists of four furniture rails: two by 30 cm and two by 35 cm. Thus the lifting height is 130 cm. The guides were installed on the robot.



Figure 4: Guides for the lift

   3.3. It was decided to install a lift in the central part of the robot. Electronics were installed in the rear part and protected from damage by the lifting mechanism. Some space was left for the bucket in the front of the robot.

   3.4. Since the bucket is lowered inside the robot, it is protected from collisions. But in this case, the location of the bucket raises the question of how the balls will get into the bucket. It was decided to increase the distance between the floor and the bottom of the front frame of beam to 7 cm so that a big ball could go. This was achieved by turning the motors around in their mounts. In addition, this decision to increase clearance increased the stability of the robot.

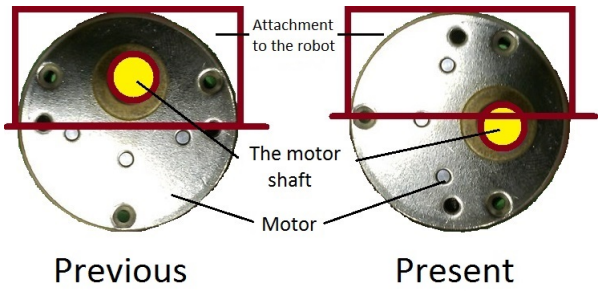
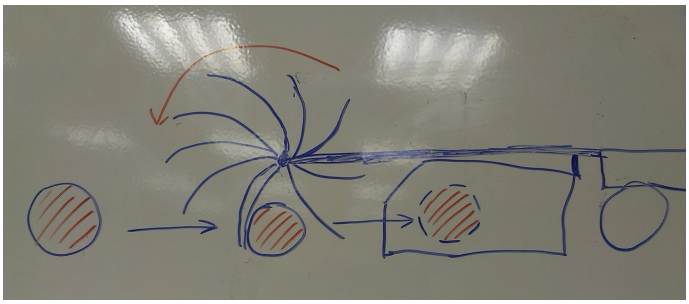


Figure 5: Increase clearance

3.5. In front of the robot we decided to install a soft brush, such as those installed on snow-clearing machines, that will rotate and capture balls. In the case when the robot has collected the maximum number of balls, the operator can stop the rotation of the brushes so other balls will not accidentally get into the bucket.

appearance



The principle of operation

Figure 6: The idea to capture balls

4. Results:

   4.1. Implemented a simple program to control the robot.

   4.2. Created and assigned rails for the lift.

   4.3. Battery and motor drivers are properly fixed on the robot. NXT block has not been fixed, as it requires periodical removal for battery replacement.

   4.4. Clearance of the robot has been increased.

5. Tasks for the next meetings:

   5.1. To finish the program of robot control.

   5.2. To implement control of the robot by Bluetooth.

   5.3. To create a mechanism for moving the guides apart.

4.5.4 08.10.14

1. Time of beginning and ending of meeting: 18:30 - 21:40.
2. Purposes of meeting:
   2.1. Making the programme of control of robot via Bluetooth.
   2.2. Choosing of the optimal way of extracting the lift.
3. Work, that has been done:
   3.1. Programme of control of the robot was changed. Limit was set so that when joystick's deviation is small the robot doesn't move. It allowed to avoid heavy load from the motors.
   3.2. It was carried out connection to robot via Bluetooth.
   3.3. The test of programme was successfull. We couldn't make the programme of autonomous period because we didn't connect encoders to drivers of motors. But we'll need encoders in a competition.
   3.4. We tested the ability of robot to climb to inclined plane. Robot can climb to hill with a slope angle of 30 degrees.
   3.5. We decided to use the construction with the eight transverse axes for extracting of the lift (hereinafter they will be called as crossbars). They fixed between the slats. One crossbar is at the bottom of slate and one crossbar at the top of slate. In this case the line that is fixed at the bottom crossbar and thrown through the top crossbar extracts slat during the reeling of it.

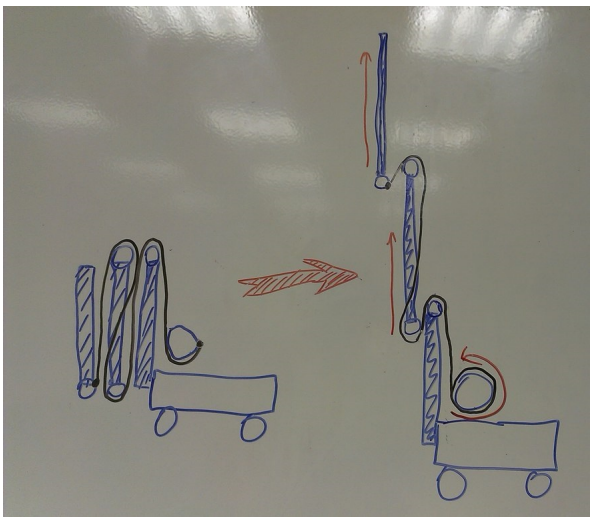


Figure 7: Mechanism of extraction of the lift

   3.6. It was decided to use the belt instead of the line because it is more strong and it can't entangle.
4. Results:
   4.1. It was made the programme of control robot via Bluetooth
   4.2. It was elaborated the concept of mechanism of extraction of lift.
5. Tasks for the next meetings:
   5.1. To buy the belt for extracting of the lift.
   5.2. To buy the aluminum profile for making the mounts of crossbars.

4.5.5 10.10.14

1. The time of beginning and ending of the meeting: 18:30 - 21:40

2. Purposes of the meeting:

   2.1. To choose the optimal diameter of the crossbars.

   2.2. To cut the aluminum profile into segments of desired length. To drill the holes in the segments and to install them between the rails.

3. Work that has been done:

   3.1. The belt for extracting the lift was bought.

Figure 8: Belt

   3.2. It was bought aluminum strip with dimensions 200 x 5 x 0.2 cm for creation mounts of crossbars.

   3.3. It was reviewed 2 variants of crossbars: cylindrical rollers 15 mm diameter and axis diameter 5 mm from the Tetrix set. It was decided to use the axles because they are more compact.

   3.4. The axis of the smaller diameter has a cut edge. It could prevent the movement of the belt. So it was decided to impose the sleeve on the axis. Preliminary tests demonstrated the viability of the idea.

   3.5. After that it was decided to take action:

      3.5.1. The guides of the lift were previously disassembled.

      3.5.2. Aluminum strip was cut into 6 piecies: 2 to 30 cm and 4 to 35 cm.

      3.5.3. When we were drilling details some troubles appeared. All drills were ground off. It was decided to buy a new drill.

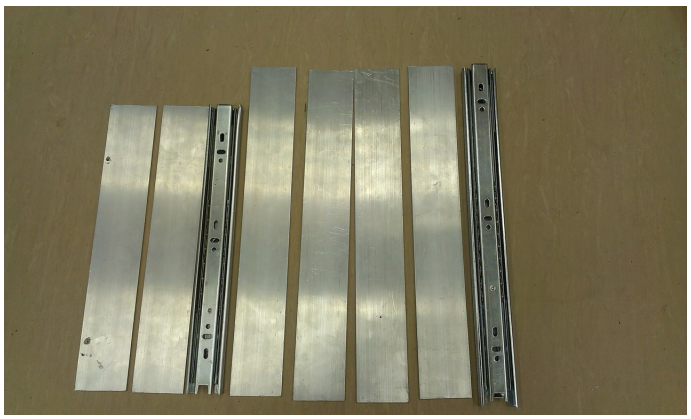
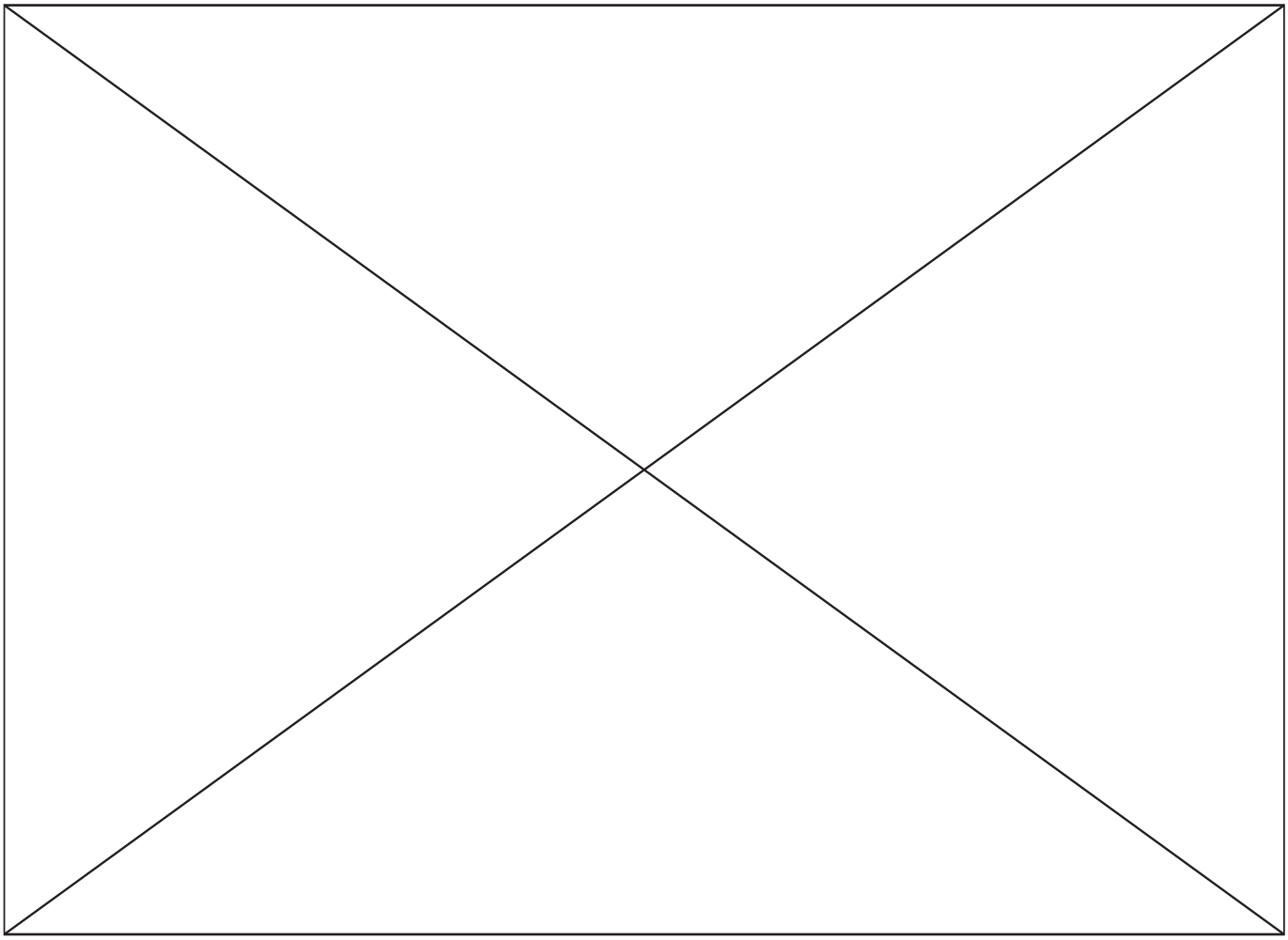


Figure 9: Aluminum strip was cut into 6 portions

4. Results:
   - 4.1. Tracks for the lift were choosed.
   - 4.2. Beam have sawed into segments of desired length.
5. Tasks for the next meetings:
   - 5.1. To buy the new drill for metal.



4.5.6 11.10.14

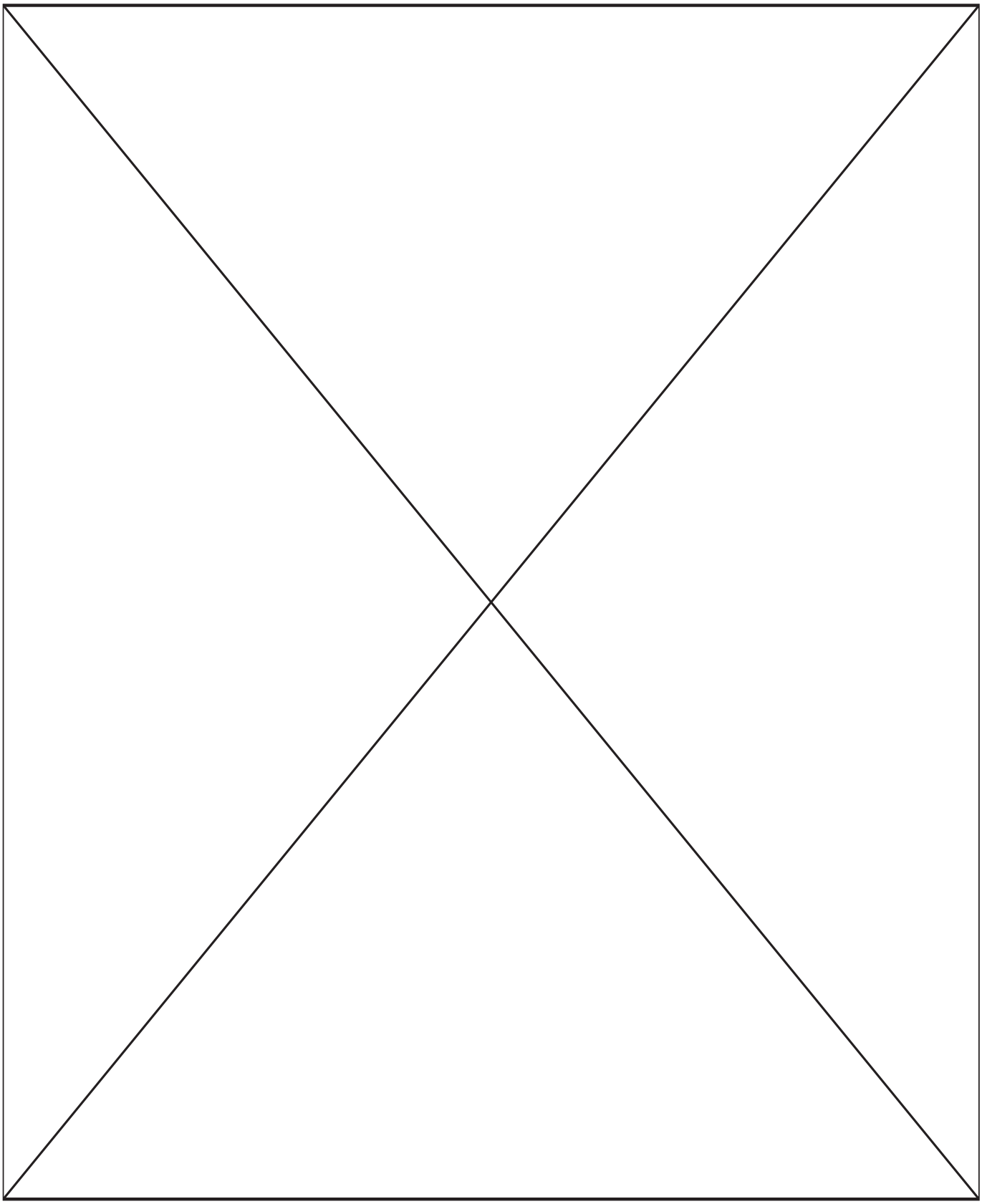
1. Time of beginning and ending of meeting: 16:40 - 21:40
2. Purposes of meeting:
   2.1. To make the holes in the mounts of beams in the lift.
   2.2. To assemble the guides of lift with new mounts.
   2.3. To install guides at robot.
3. Work that has been done:
   3.1. All mounts were finished and installed to slats.
   3.2. During the installation mounts for crossbars it turned out that screws have bothered movement of slats. It was decided to whittle away the screws.

Figure 10: Slats with mounts for crossbars

4. Results:
   4.1. Guides of the lift were assembled but weren't installed at robot.

5. Tasks for the next meetings:

   5.1. To install guids, assemble the lift and test it.



4.5.7 13.10.14

1. Time of beginning and ending of meeting: 21:00 - 21:30

2. Purposes of meeting:

   2.1. To install guides at the robot.

   2.2. To elaborate concept of throwing of balls to baskets.

3. Work that has been done:

   3.1. It was decided to install axle around which rotates bucket with the balls on the top guide because our strategy is to carry movable basket behind the robot. There is tube which diametr is slighly larger than the diametr of big ball at the top of the bucket. The bucket rotates and the balls rolls to the basket.

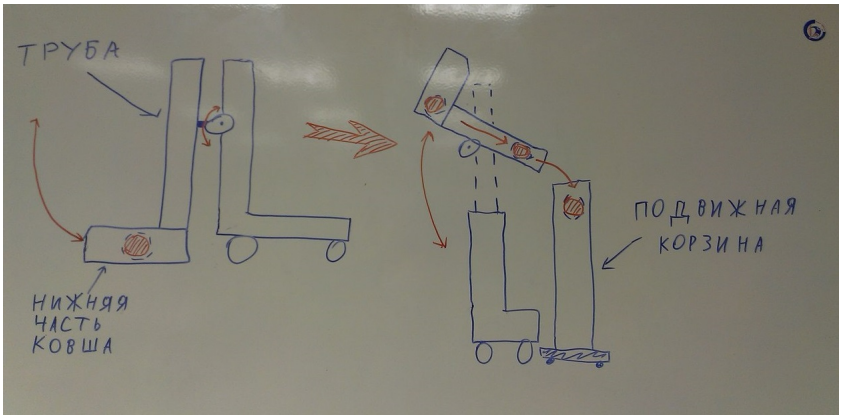


Figure 11: Idea of the bucket

   3.2. It has been estimated that optimal location of the axil around which will rotate the bucket is 20cm from the bottom of guide. Additional lifting height allowed to refuse from the one pair of slats. So three slats left.

   3.3. The guides were installed to the robot.

   3.4. It was decided to test the working of the lift after installation of the guides. The belt coped with this task but the axles bended. It was decided to install the more strong axles. In addition pairs of slats extracted to the different heights. So it was decided to connect the pairs of slats rigidly.

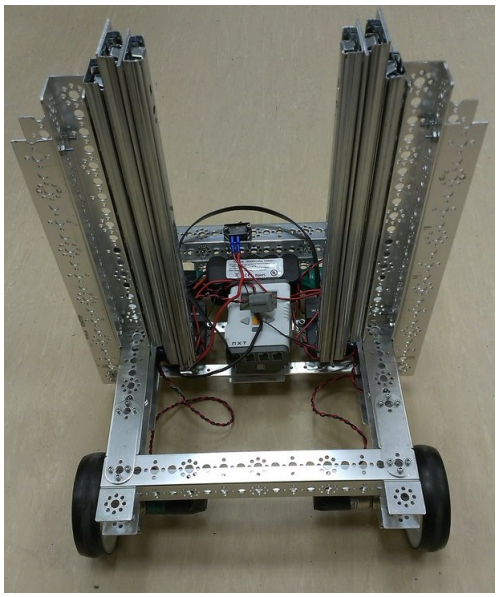
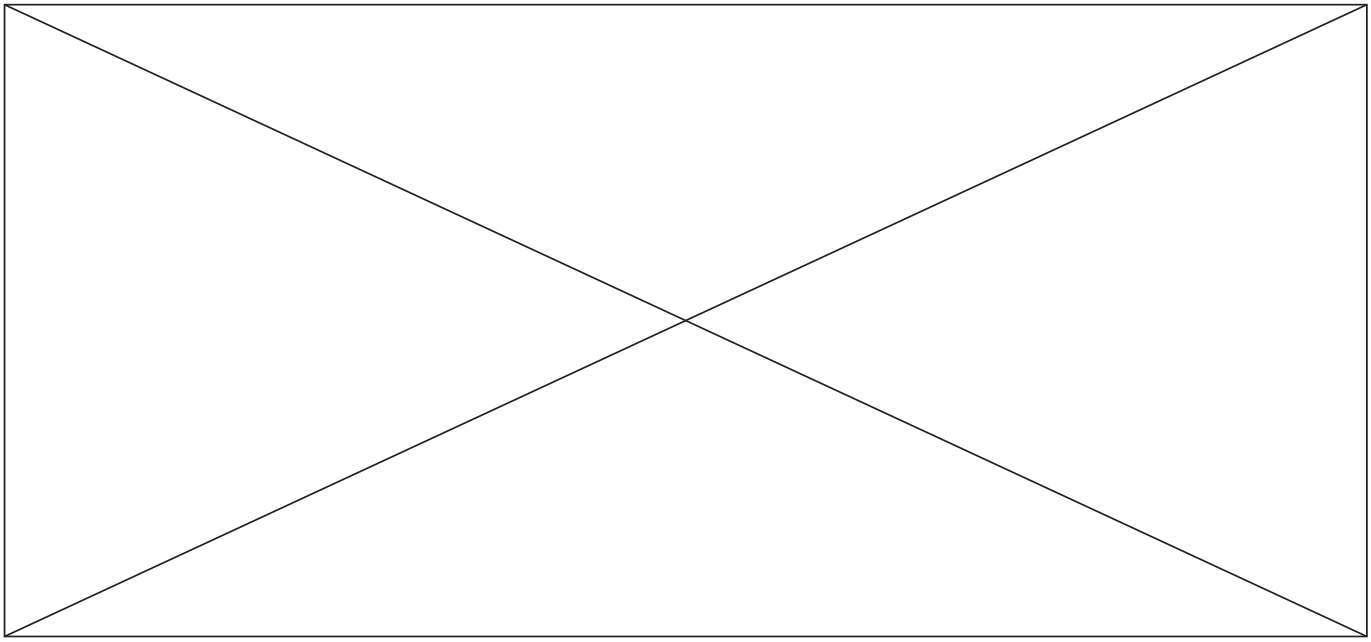


Figure 12: Robot with installed guides

4. Results:
   - 4.1. Guides were installed to the robot.
   - 4.2. It was elaborated concept of the throwing balls to the baskets.
5. Tasks for the next meetings:
   - 5.1. To assemble device that will rotate the bucket.
   - 5.2. To buy the more strong axles.
   - 5.3. To buy the aluminium profile for connection guides.



4.5.8 15.10.14

1. Time of beginning and ending of meeting: 17:00 - 21:30
2. Purposes of meeting:
   2.1. To change the crossbars at more strong.
   2.2. To connect the guids of lift for good extracting.
3. Work that has been done:
   3.1. We didn't buy aluminium profile for improvement of the lift. So it was decided start elaboration gripper for balls.
   3.2. It was installed servomotor of the free rotation with axle at the front of robot. On this axle it was decided to fix the the brush. Screeds will be use as the bristles of this brush.

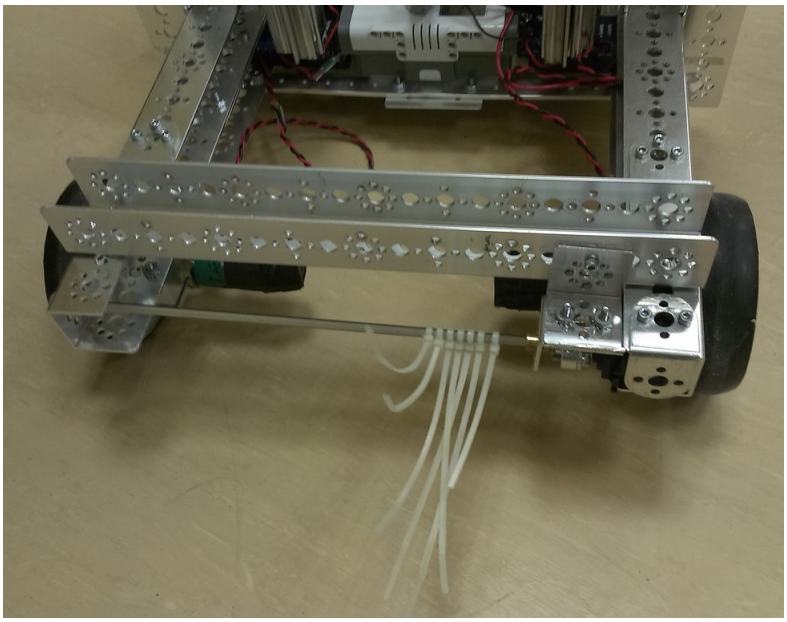
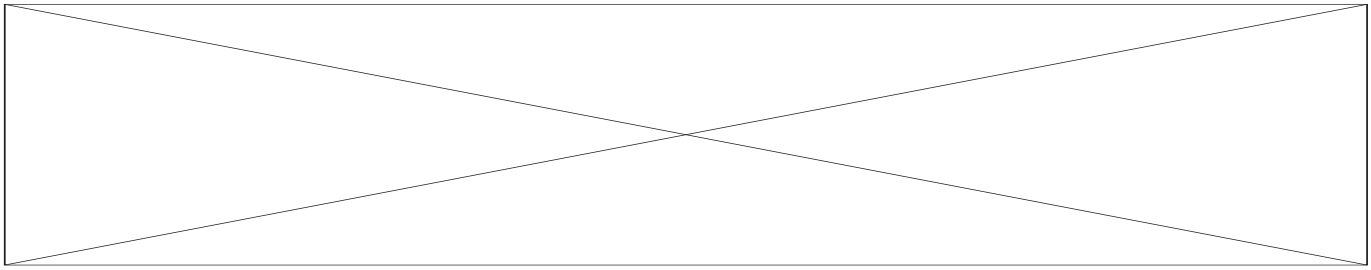


Figure 13: Gripper for the balls

4. Results:
   4.1. It was started creating of gripper for balls.
5. Tasks for the next meetings:
   5.1. To buy materials for improvement of the lift.
   5.2. To finish creating of gripper for balls and to write the programme of control it.



4.5.9 16.10.14

1. Time of beginning and ending of meeting: 17:00 - 21:00
2. Purposes of meeting:
   2.1. To connect controller for servomotors and link servomotor that rotates gripper for balls to it .
   2.2. To include to the programme of control robot control gripper for balls.
   2.3. To improve the lift.
3. Work that has been done:
   3.1. To date it was bought aluminium strip 100 x 4 x 0.3cm for creating transverse beams for connection guides of the lift and aluminium axle length 100 cm and a diameter 8 mm for creating crossbars.
   3.2. Strip wac cut at 4 segments with neded leigth. It was decided to buy L-shaped profile and cut to it on the corners of needed size for installation transverse beams to guides.
   3.3. Axle was enough for 4 crossbars of the required 6. Two axles were installed to lift with help of elements from Tetrix set. They were made holes for another one axis but it wasn't installed to the lift. It was decided not to install the last crossbar for the top pair of slats because we have not yet figured out how to do it and it would make difficult the improvement of lift.
   3.4. Controller for servos was installed and it was connected to servo of continuous rotation. This servo rotates gripper of the balls.

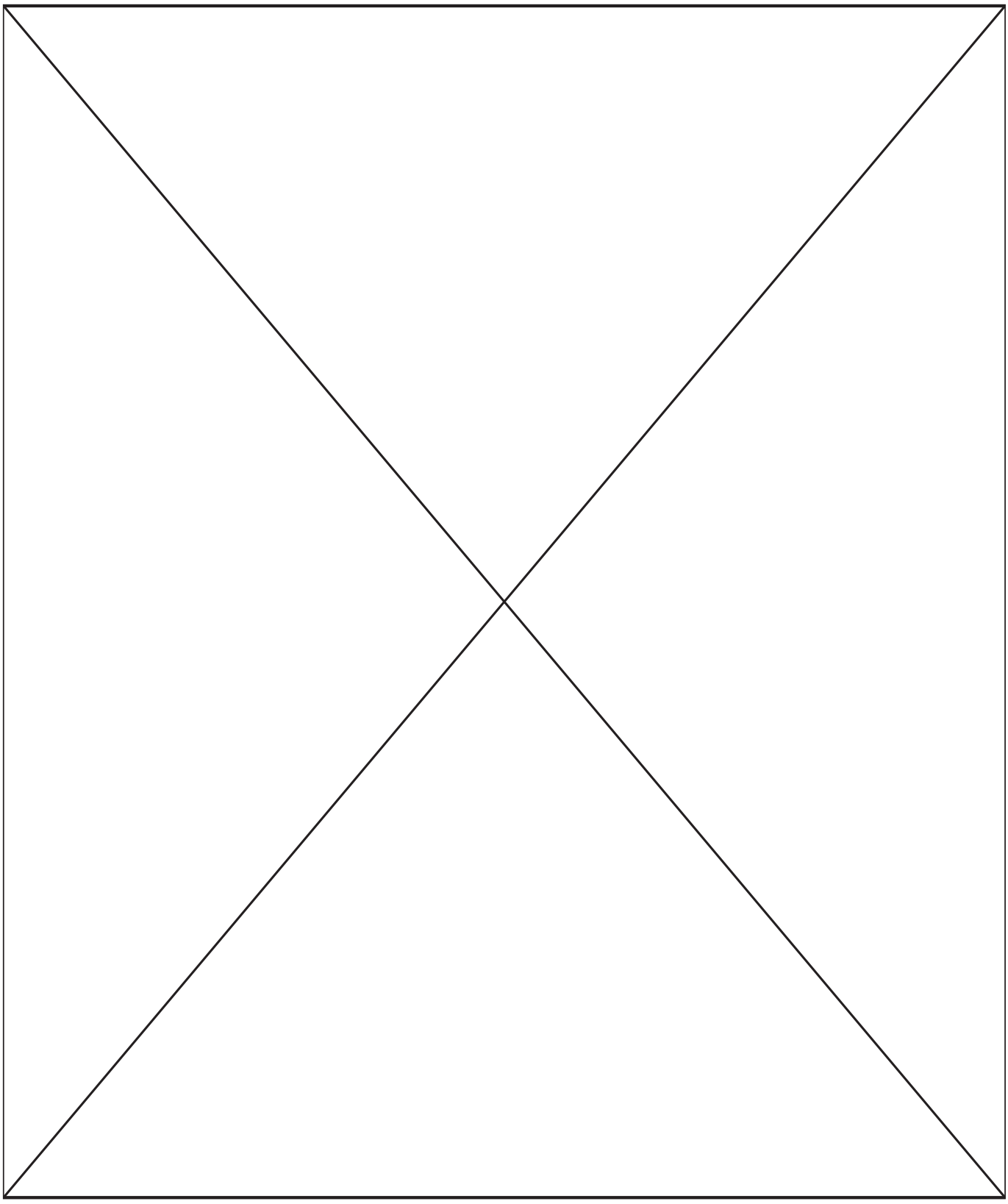
Figure 14: Crossbars that were installed to robot

4. Results:
   4.1. Controller for servo was installed.
   4.2. The programme of control servo wasn't wrote.
   4.3. Aluminium strip was cut at the beams with needed length.
   4.4. Axle was cut at crossbars.

5. Tasks for the next meetings:

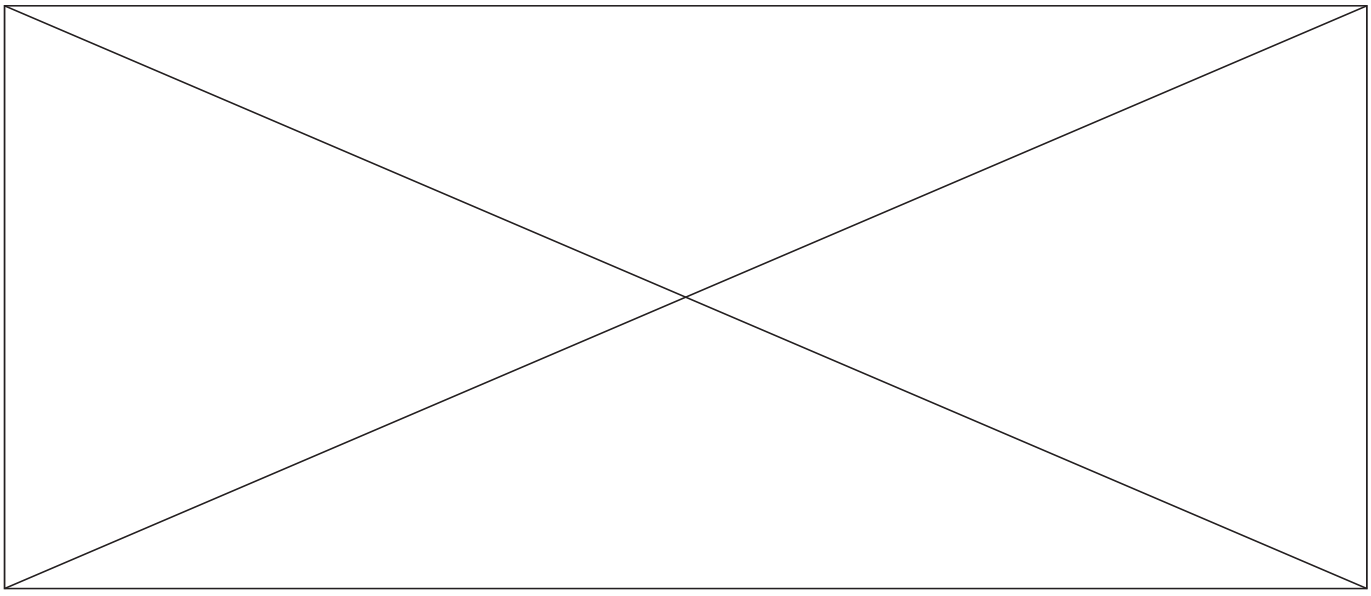
   5.1. To buy another one aluminium axle and make the rest of crossbars.

   5.2. To buy L-shaped profile and to cut it into the corners for fixing beams to the lift.



4.5.10 17.10.14

1. The time of beginning and ending of the meeting: 17:00 - 20:00
2. Purposes of the meeting:
   2.1. To write a program of control the gripper and include it to the robot control program.
3. Work that has been done:
   3.1. Program of servo control was wrote. Servo rotates by pressing the button. It stops after the operator removes his hand from the button. During the tests it turned out that it uncomfortable for operator. All commands are served from one joystick at the moment. But later the first operator will be responsible for only traffic control and everything else will make by the second operator.
   3.2. During the tests of gripper on banks (balls we haven't at that time) it turned out that it instead of capturing them repels them. We understood that ties are fixed on the contrary.
   3.3. It was decided to relocate the front crossmember further from the axis so that it does not prevent the movement of the brush-ties.
   3.4. It was decided to fix ties on the axis by a hot-melt adhesive. But we didn't have a hot-melt adhesive on this meeting so it was decided to make it on the next meeting.
   3.5. It was turned out that the travel stops furniture racks can not withstand weight of lift. It was decided to strengthen the stops.
4. Results:
   4.1. A simple program of control the capture has been written.
   4.2. Gripper was tested in action. They was developed ideas to improve it.
5. Tasks for the next meetings:
   5.1. To create a final version of gripper.
   5.2. To change management program for the gripper of more convenient.
   5.3. To strengthen the travel stops furniture racks.



4.5.11 18.10.14

1. Time of beginning and ending of meeting: 16:30 - 21:40

2. Purposes of meeting:

   2.1. To create the finished version of gripper for balls.

   2.2. To change the programme of control of gripper to more comfortable.

3. Work that has been done:

   3.1. Screeds were located at the axle in 4 rows through every 90 degrees and fixed by the hot-melt adhesive.

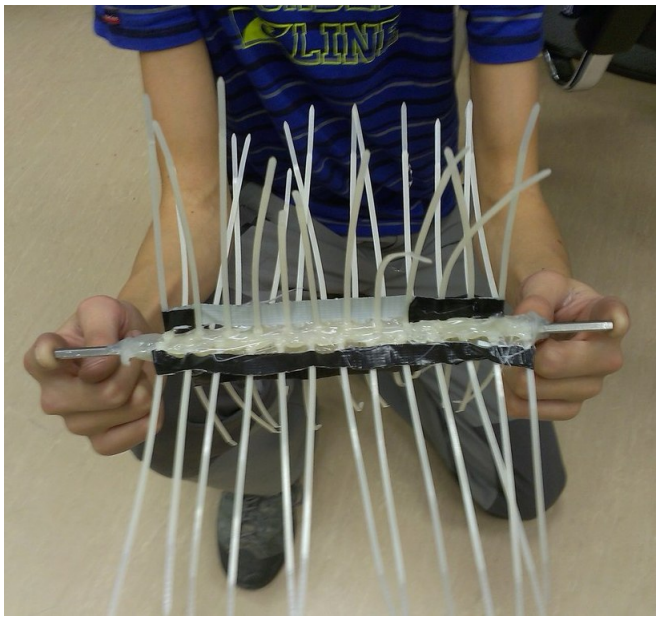


Figure 15: Brush of gripper

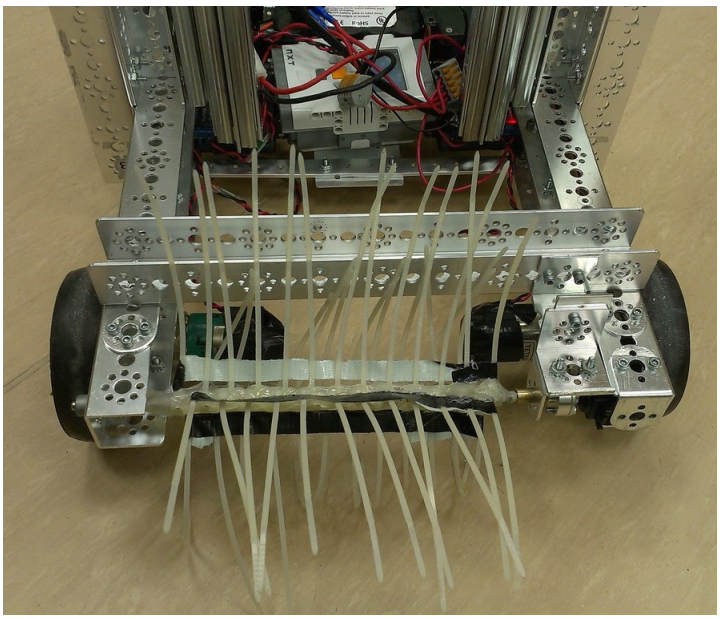


Figure 16: The finished version of gripper for balls

   3.2. Programme of control of gripper was changed. Now servo changes state (stop or running) by pressing the button. It allows to operator don't distracted to maintaining of gripper at working condition.

   3.3. Gripper was tested on two balls from NXT set diametr 5cm. Robot can to capture balls at the open space and near the walls. There was one problem: brush locates only at the center of robot and for capture of ball it need to aim to it. We planned to install on each side of the gripper beams located like a funnel (hereinafter they will be called as slopes) for solving this problem. It allows to balls to roll to gripper.

   3.4. It was turned out that when servo is stopping it try to keep angle,so it rattles. This needs to be corrected.

   3.5. It was turned out that robot stop to shake when it turns around. It happened because a large part of it's mass was concentrated in the back part of robot. So the front wheels slipped freely.

   3.6. In addition the start tasks it was made mechanism of overturning bucket.

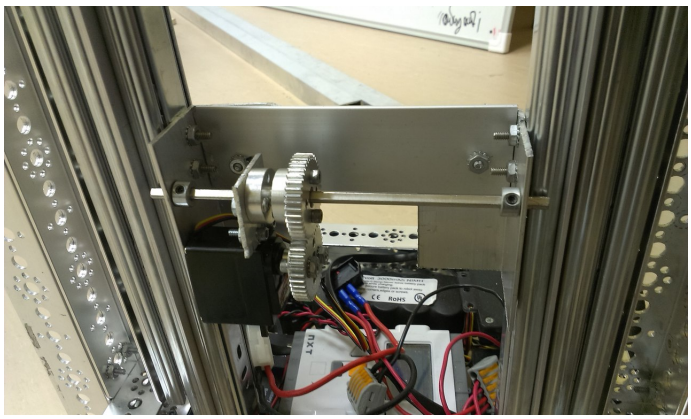
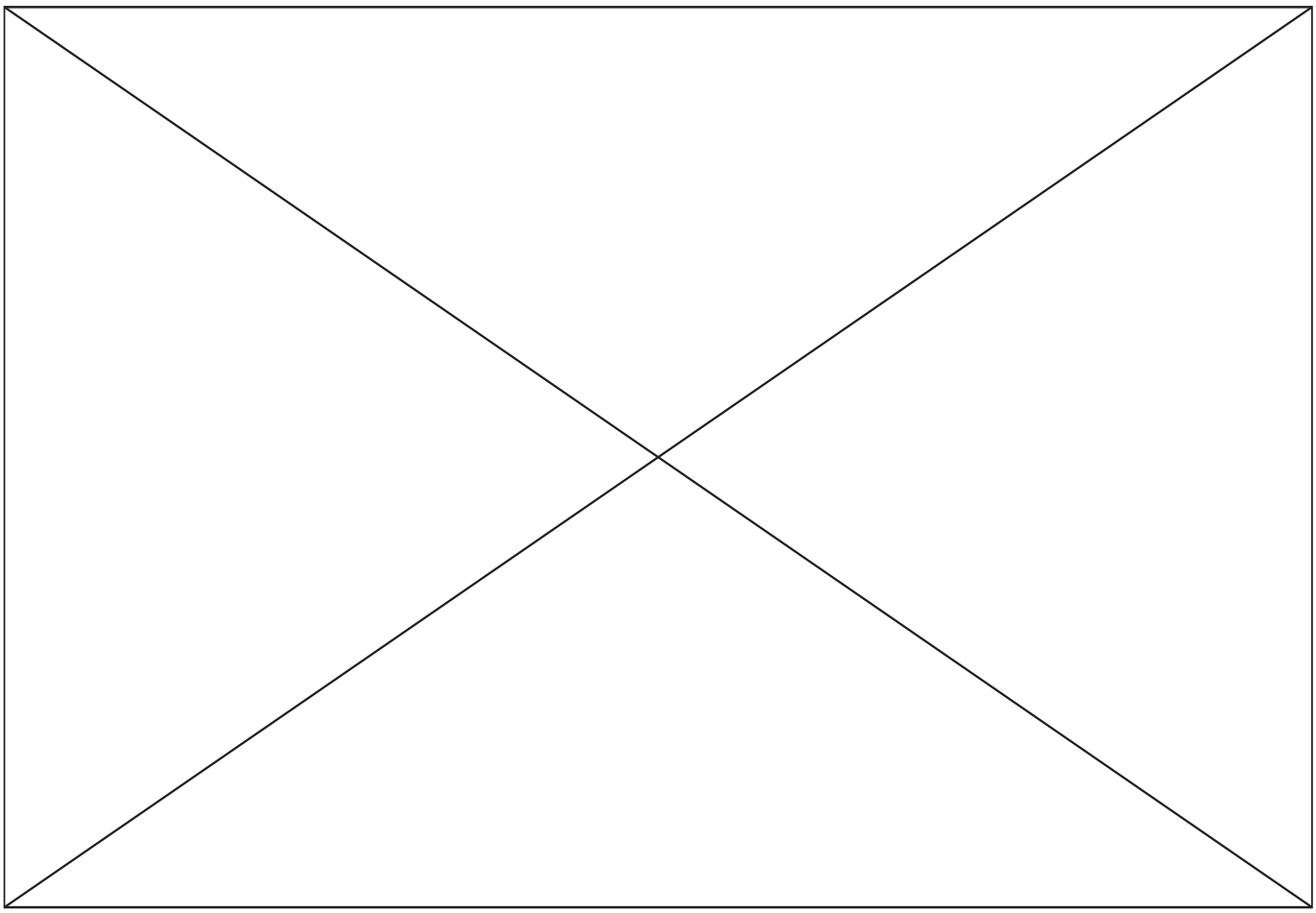


Figure 17: Mechanism of overturning bucket

4. Results:
   - 4.1. The gripper was finished.
   - 4.2. It was created more comfortable programme of control the gripper.
5. Tasks for the next meetings:
   - 5.1. To correct the problem with servo.
   - 5.2. To install the slopes.



4.5.12 20.10.14

1. Time of beginning and ending of meeting: 20:30 - 21:30
2. Purposes of meeting:
   2.1. To correct the problem of servo.
   2.2. To fix transverse beams at the lift.
3. Work that has been done:
   3.1. We tried to make that before stop it slightly rotate to back for correction of problem with servo. But it wouldn't work.
   3.2. L-shaped profile was cut on corners of needed length.
   3.3. Transverse beams were made. One from their was installed at robot.

Figure 18: Transverse beams

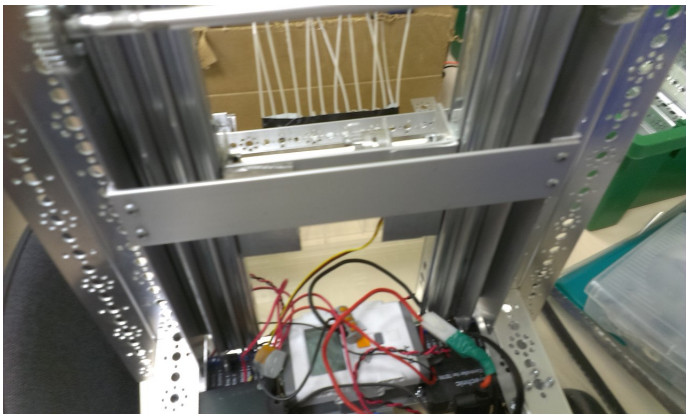


Figure 19: Transverse beam that was installed at robot

   3.4. Today we learned that 21 - 23 of November will be the competition FTC in Sochi. It was decided that our team will take part in this competition.Until the next meeting every participants of team will have to give an answer, will he be able to go to Sochi.
4. Results:
   4.1. Problem with servo not corrected.
   4.2. All ready to fixing of transverse beams to guides.
   4.3. One transverse beam was installed.
5. Tasks for the next meetings:
   5.1. To finish fastening transverse beams to guides of lift.
   5.2. To correct the problem with servo.
   5.3. To decide who can go to Sochi.

4.5.13 21.10.14

1. The time of beginning and ending of the meeting: 17:00 - 19:00

2. Purposes of the meeting:

   2.1. To rethink the strategy of autonomous and final periods and, if necessary, be amended.

   2.2. To complete the installation of transverse beams on the rails lift.

   2.3. To set the lower limit for furniture slats.

3. Work that has been done:

   3.1. Transverse beams had been installed on the lift.

   3.2. Travel stops furniture racks were strengthened by hot melt adhesive.

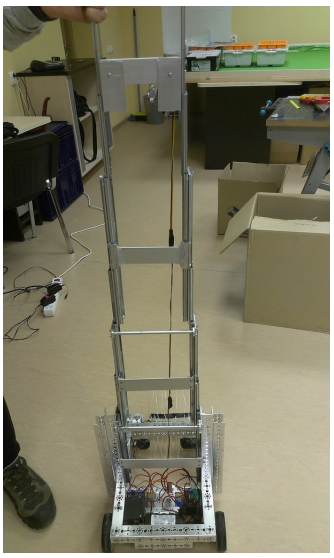


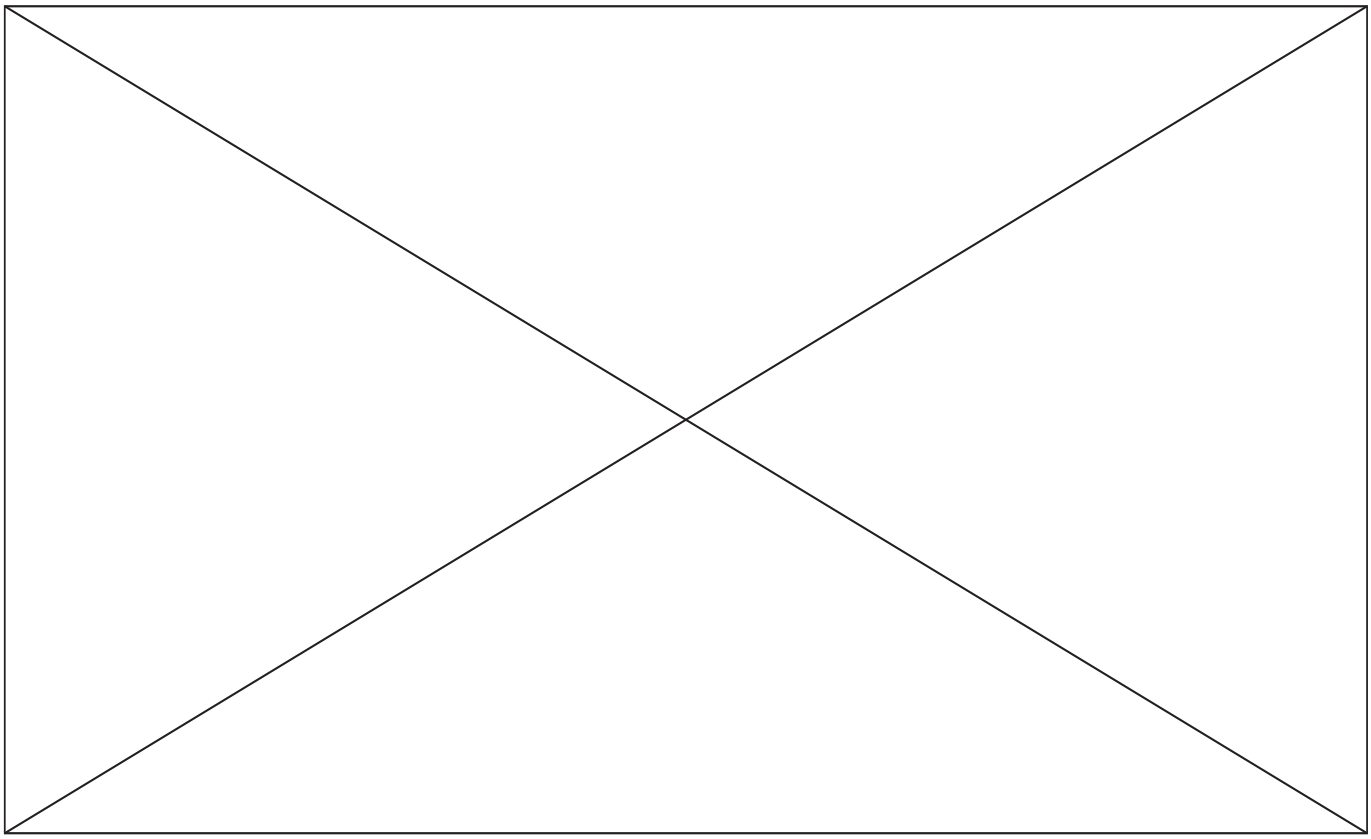
Figure 20: The transeverse beams had been mounted on the robot

Figure 21: Travel stops furniture racks reinforced with hot melt adhesive

   3.3. At the end of the meeting there was a breakdown of the one furniture rack. It needs to be corrected.

Figure 22: Broken furniture rail (right)

4. Results:
   4.1. All transeverse beams have been installed.
   4.2. The travel stop of furniture slat was strengthened.
5. Tasks for the next meetings:
   5.1. To correct damaged slats to understand what the cause and how to avoid it in the future.



4.5.14 22.10.14

1. Time of beginning and ending of meeting: 18:00 - 21:40
2. Purposes of meeting:
   2.1. To understand what causes the breakage of the guide.
   2.2. To repair the guide.
   2.3. To undersnand how to prevent this failure in the future.
3. Work, that has been done:
   3.1. After research of construction of the lift it was found that failure happened due to the excessive voltage. This voltage is creating by the transverse beam. It was decided to increase the distance between the guide and beam.
   3.2. Repair the slat failed so that it was replaced.

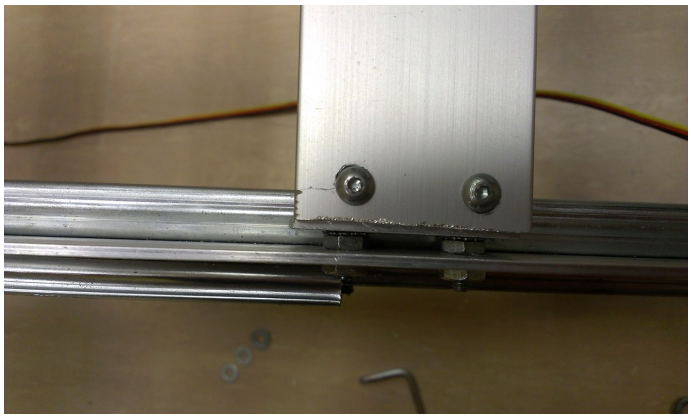


Figure 23: Layer between beam and guide

   3.3. It was decided to buy spare slats because it is impossible to repair broken rakes.
   3.4. In addition it was created the mount for the last crossbar.

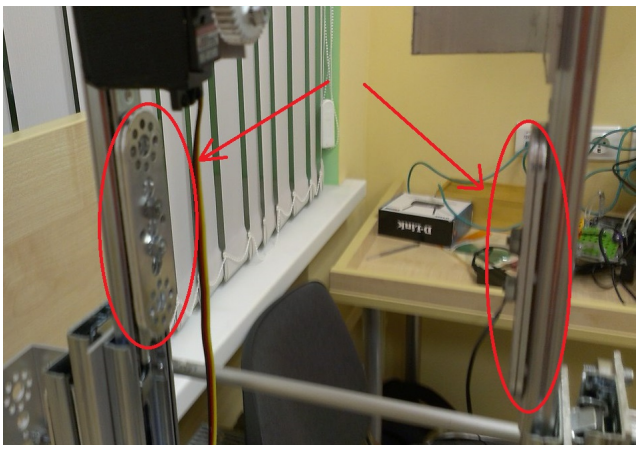


Figure 24: Mount for crossbar

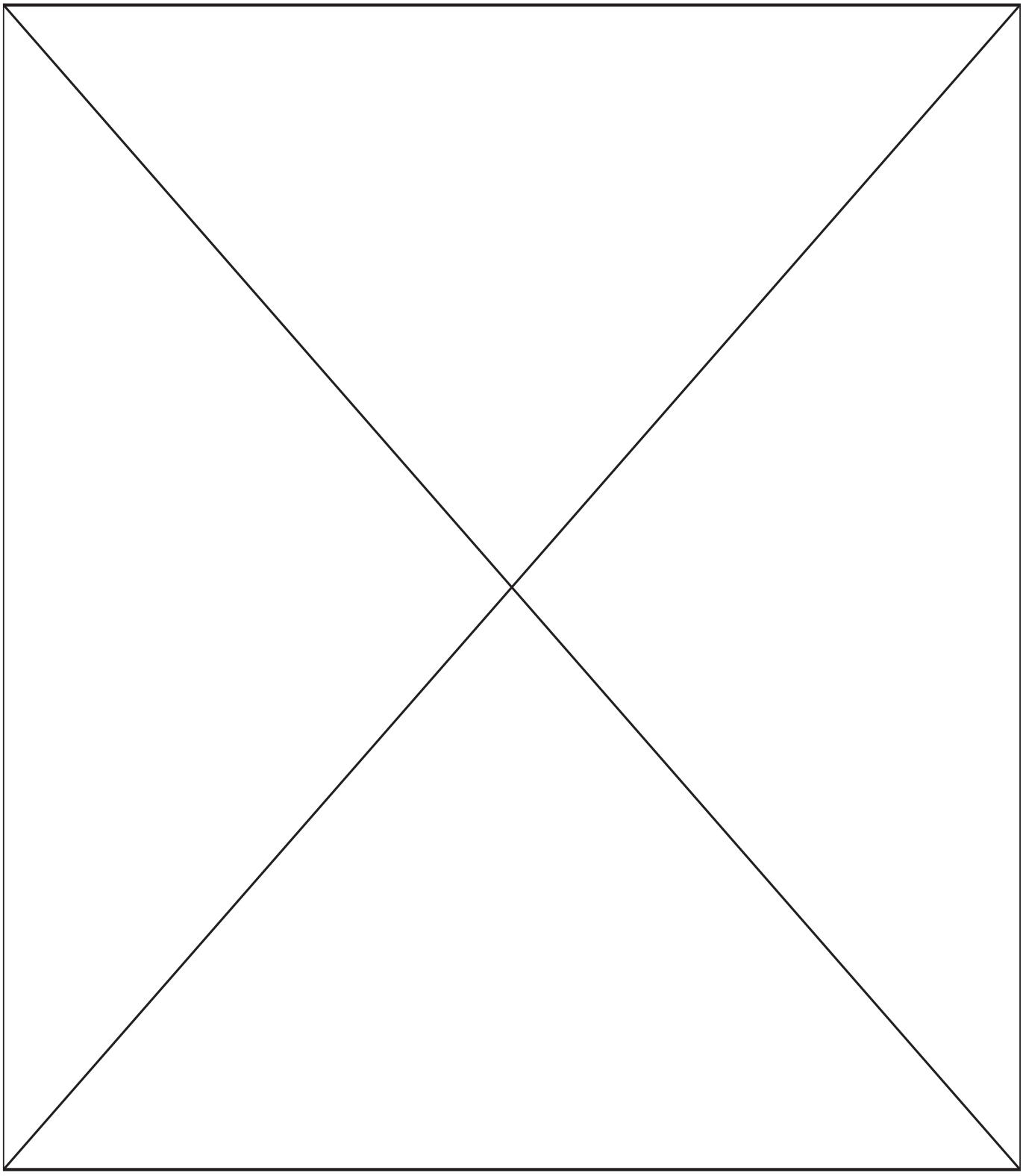
4. Result:

4.1. Repair of lift completed.

4.2. It was created the mount for top crossbar.

5. Tasks for the next meetings:

5.1. To buy the spare furniture slats.



4.5.15 24.10.14

1. The time of beginning and ending of the meeting: 16:00 - 20:00
2. Purposes of the meeting:
   2.1. To correct the problem with servo that rotates gripper for balls.
   2.2. To make the slopes for ball and install their at the robot.
3. Work, that has been done:
   3.1. Problem with servo was corrected. This problem appeared because after stopping servo rotated with low speed and can't to overcome elastic force of screeds. It happened due to the wrong value servo's position in the programme (value where servo stops - 127 instead of 135 that was in our programme).
   3.2. Aluminium sheet was sawn to strips of needed dimentions.
   3.3. Slopes were installed to robot and tested. The result is positive.
   3.4. It was seen that slopes bends when they faces with a rigid obstacle. They were installed stops that made of the aluminium strip for prevent this situation.

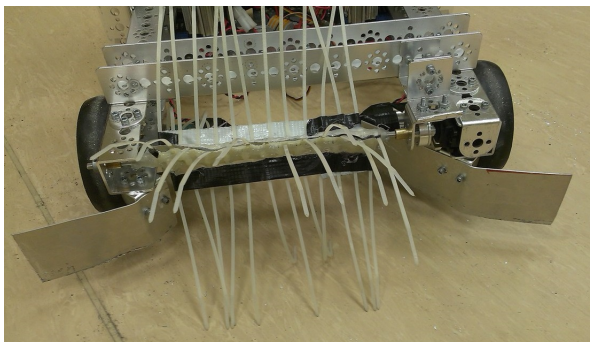


Figure 25: Gripper with slopes

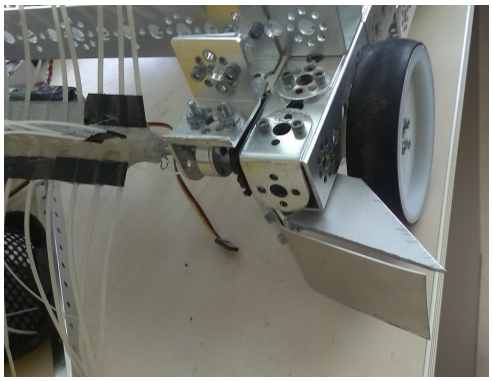
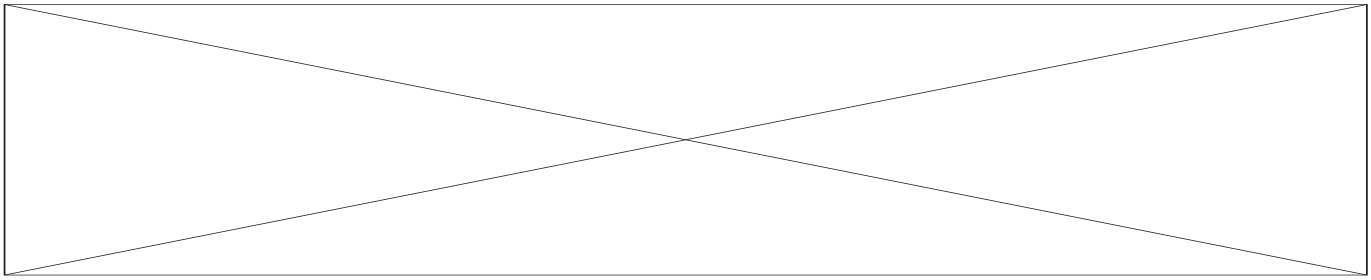


Figure 26: Slopes with stops

   3.5. The holes for installation of the remaining pair of crossbars at the lift were prepared.
4. Results:
   4.1. Problem with servo was corrected.
   4.2. Slopes for balls were installed to robot.
5. Tasks for the next meetings:
   5.1. To elaborate and create the mechanism of capture movable baskets.



4.5.16 25.10.14

1. The time of beginning and ending of the meeting: 16:00 - 20:00
2. Purposes of the meeting:
   2.1. To elaborate and create the mechanism of capture movable baskets.
3. Work that has been done:
   3.1. They was considered 2 options of mechanism capture movable baskets (hereinafter it will be called MCB):
      3.1.1. Servo with the beam. When servo rotates beam turns and lowers.
      3.1.2. The furniture slat which connected with servo by the fishing line is fixed to the rear edge of robot. When servo rotates slat lowers.

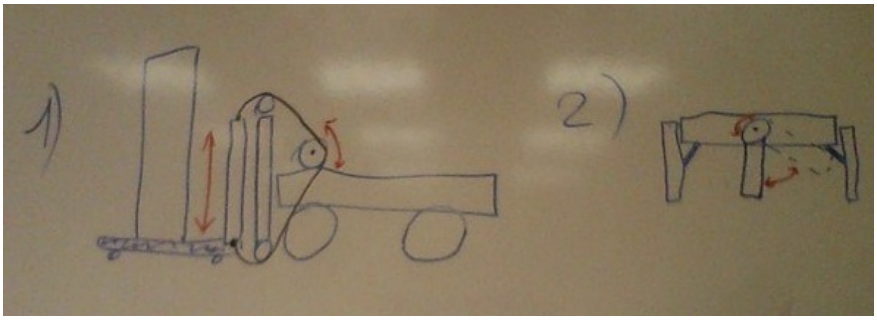


Figure 27: Ideas of MCB 1)Slat 2)Servo with beam

   3.2. It was decided to make MCB with slat because this variant more compact.
   3.3. The furniture slat was sawn for reduction it's length.

Figure 28: Shortened furniture slat(the sawn part is hatched)

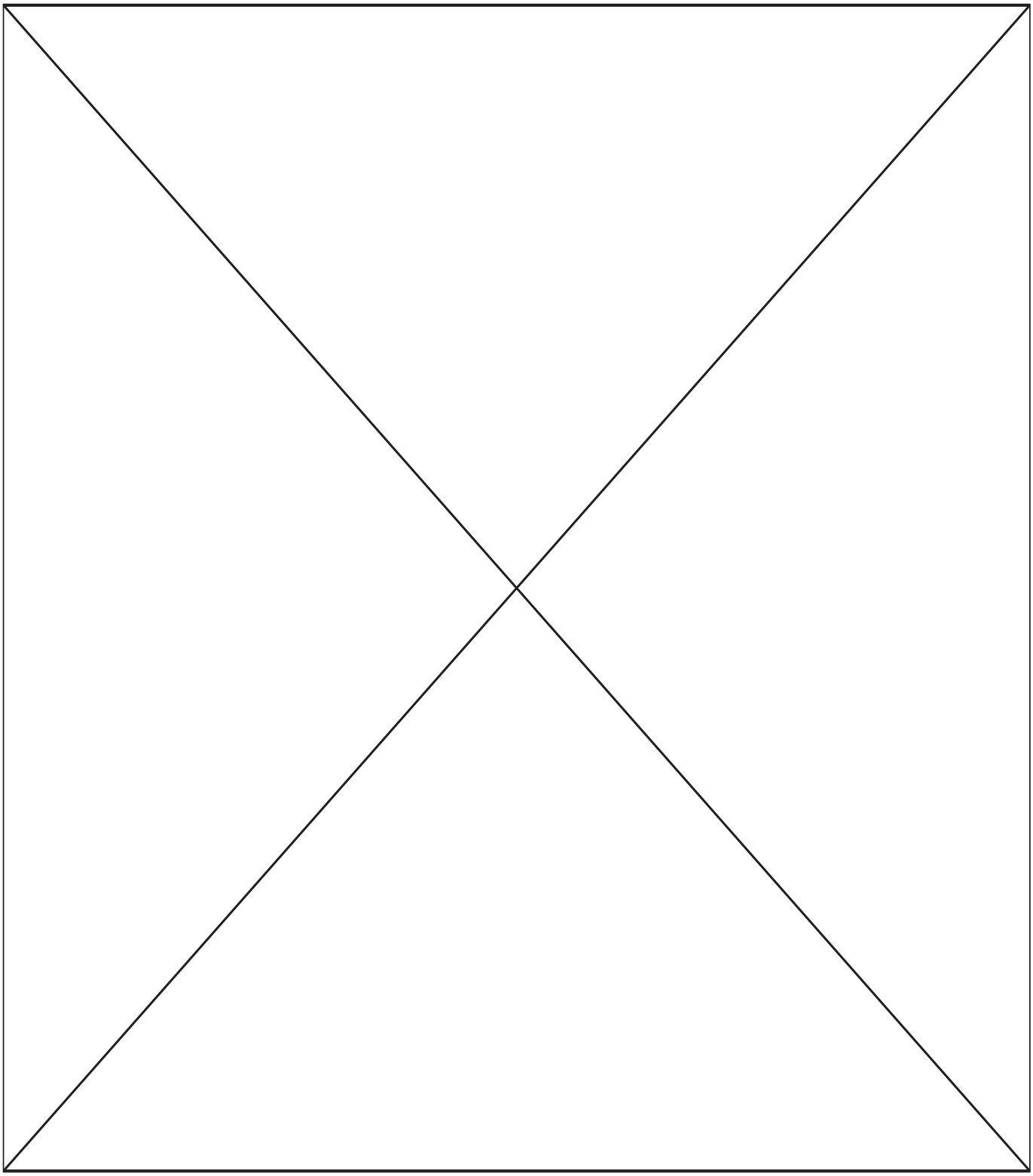
   3.4. They were marked location for drilling holes for mounts on the slat. The holes weren't drilled because we didn't have the drill.

4. Results:

   4.1. MCB was elaborated but didn't installed.

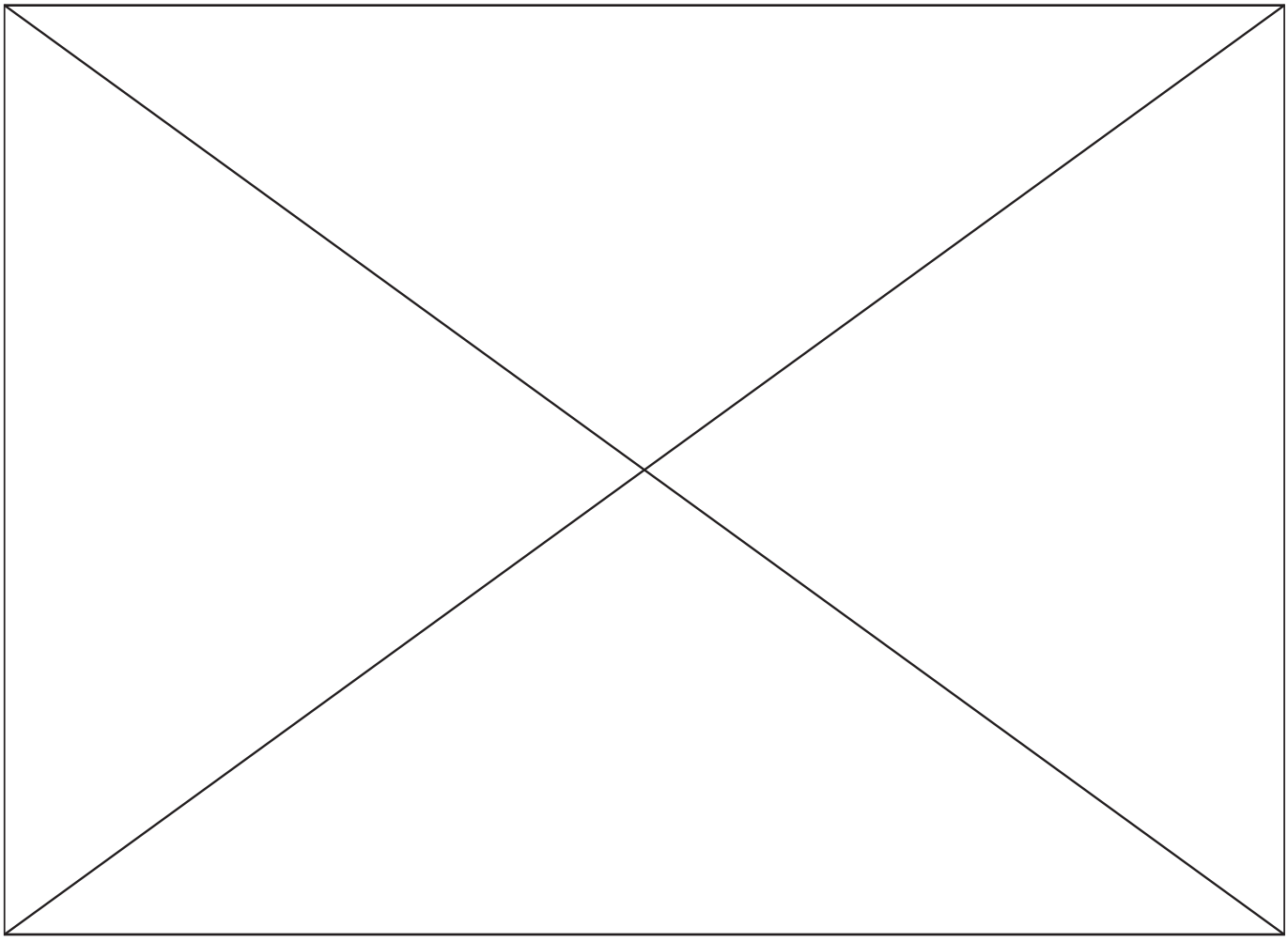
5. Tasks for the next meetings:

   5.1. To finish creating of MCB.



4.5.17 27.10.14

1. The time of beginning and ending of the meeting: 18:00 - 19:00
2. Purposes of the meeting:
   2.1. To finish MCB.
   2.2. To discuss the enginering book, make corrections.
3. Work that has been done:
   3.1. It was decided to refuse from MCB with furniture slat due to complexity of this construction and the need understatement clearance (for lowering of the slat it need to install axle through which will go fishing line in the bottom part of robot).
   3.2. The egineering book was discussed and correction was made.
4. Results:
   4.1. It was decided to change MCB.
   4.2. They were made needed corrections in engineering book.
5. Tasks for the next meetings:
   5.1. To finish MCB.



4.5.18 28.10.14

1. The time of beginning and ending of the meeting: 17:00 - 19:00
2. Purposes of the meeting:
   2.1. To finish MCB.
3. Work that has been done:
   3.1. Servo which rotates the beam must be fixed as low as possible for maximum accuracy of capture.
   3.2. It was decided to fix servo in the following way: make hole diametr as the shaft of the servo. It need for location the servo so that it doesn't go beyond the robot's body (otherwise the robot did not meet in regulated dimentions) and able to rotate freely.
   3.3. The hole was made.

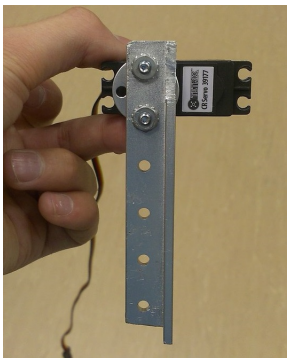


Figure 29: Servo

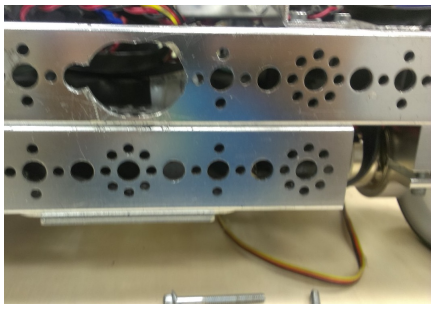


Figure 30: Hole for servo

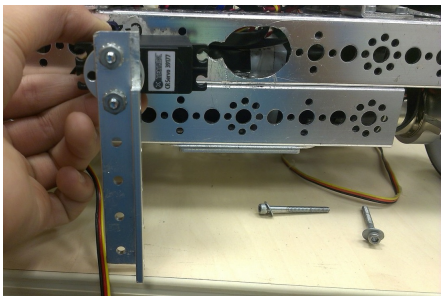
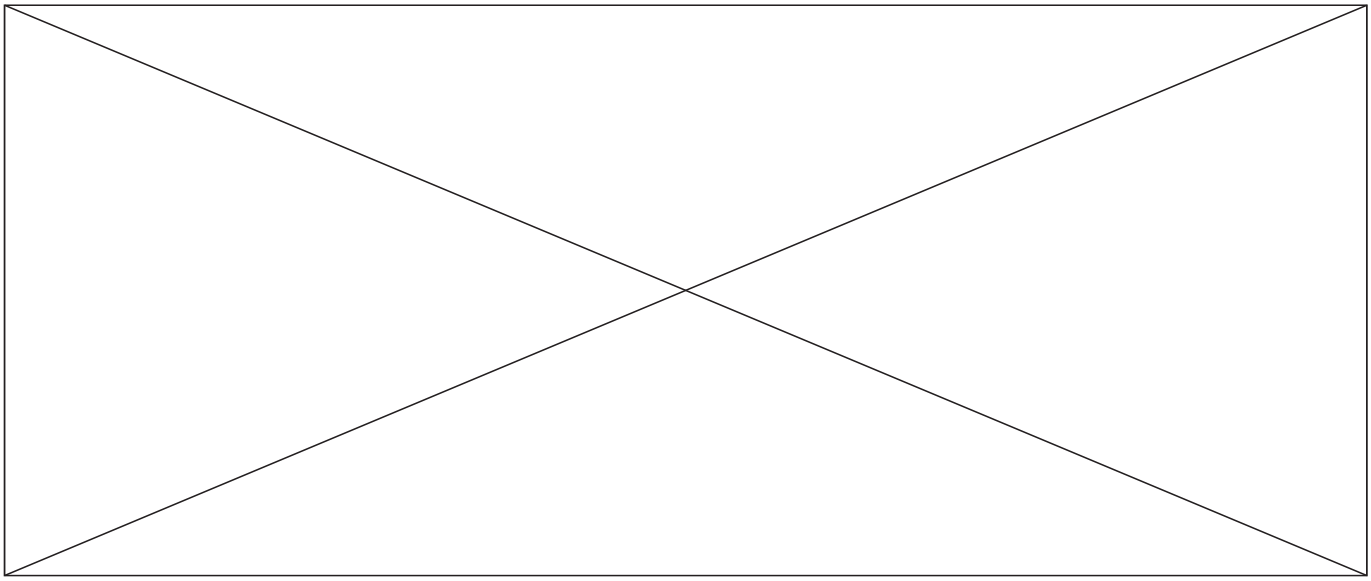


Figure 31: Planned mount

4. Results:
   4.1. It was elaborated and partially implemented plan of fixing servo that rotates MCB.
5. Tasks for the next meetings:
   5.1. To finish MCB.



4.5.19 01.11.14

1. The time of beginning and ending of the meeting: 16:00 – 21:40

2. Purposes of the meeting:

   2.1. To fix rigidity rib that was broken on the last lesson.

   2.2. To set up two axes on the lift.

   2.3. To fix the belt on the lift.

   2.4. To test the lift.

3. Work that has be done:

   3.1. We decided to fix the rib with bolts because it is more fixed than hotmelt.

   3.2. Two other crossbars were fixed in holes and fixed with hot melt.

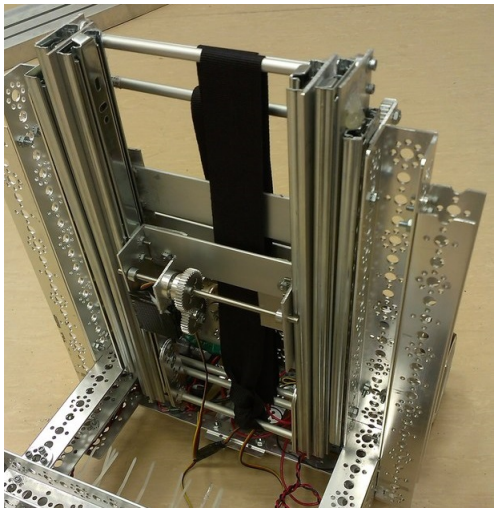


Figure 32: Lift is finished

   3.3. Lift was tested by pulling the belt by hands. We found that extracting the lift demands some effort. 2 drives must cope with this task. Inner pair rails did not fall under their own weight during the lowering. We decided to increase their weight and reduce friction.

   3.4. Mechanism of extracting the lift was installed on the robot (hereinafter it will be called as MEL).

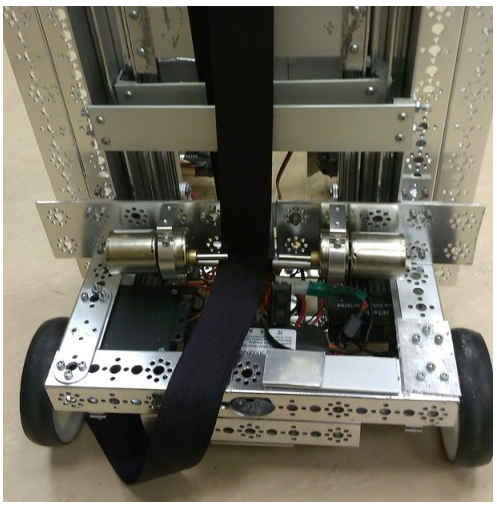
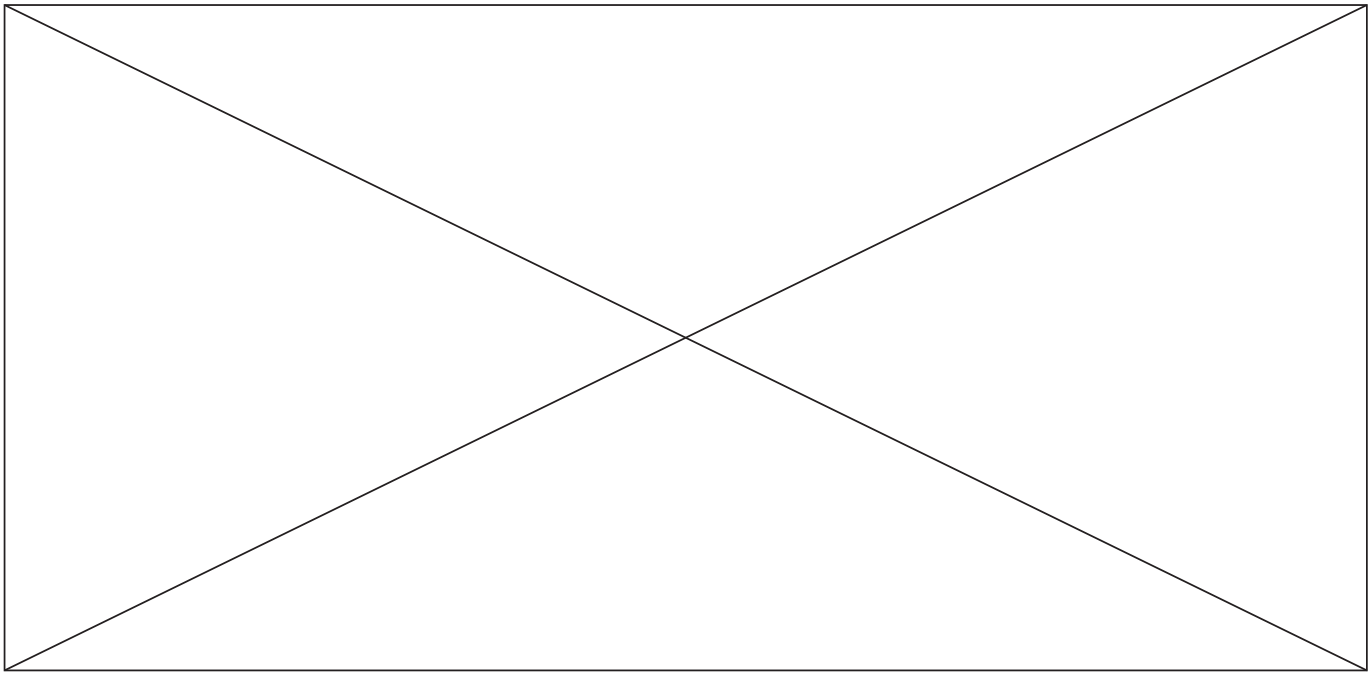


Figure 33: Drives for moving lift

4. Results:
    4.1. The rib was installed.
    4.2. MEL was done.
    4.3. The lift was tested.
    4.4. Installation of the MEL was started.
5. Tasks for the next meetings:
    5.1. Finalize the MEL.
    5.2. Install the drivers for the winch.
    5.3. Fix the belt with thread.
    5.4. Replce NXT-brick.



4.5.20 03.11.14

1. The time of beginning and ending of the meeting: 14:00 – 21:40
2. Purposes of the meeting:
   2.1. To finish the MEL.
   2.2. To install the drivers for MEL.
   2.3. To write a program to control MEL.
   2.4. To fix the the belt with threads.
3. Work that has been done:
   3.1. Driver has been installed on the robot.
   3.2. Actuators have been interconnected by a shaft which reels the belt.
   3.3. The belt was firmly sewn to the last axle and to the shaft of MEL.

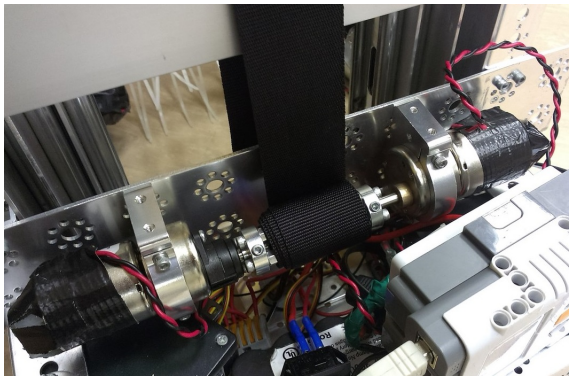
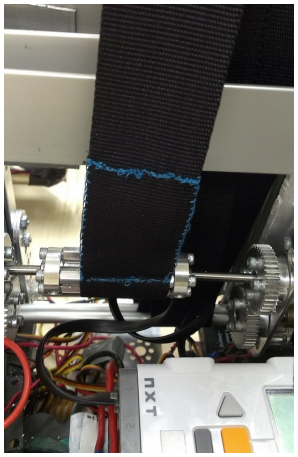


Figure 34: Lift



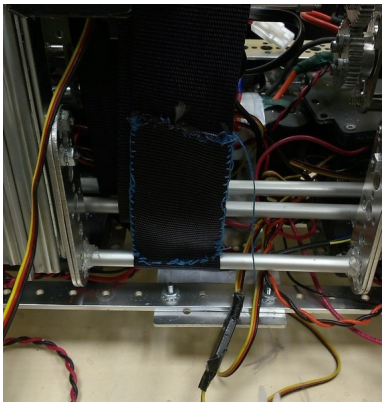


Figure 35: Belt was fixed

   3.4. Wrote a simple programm that can rotate the MEL with a maximum speed in each direction or stand still. The movement of the MEL is monitored by the right analog sensor.
   3.5. It has been found that the drive shafts are not arranged coaxially, so the construction staggered. It was decided to change the design of the MEL so that the spool would be located on a separate axe. Motors will be connected to spool by the gears with a gear ratio of 1: 1. This will eliminate the problems with non-coaxial arrangement of motors.
4. Results:
   4.1. The drivers have been installed on the robot.
   4.2. Belt is securely fastened to the MEL.
   4.3. MEL has been tested. Two drives have enough power to widen the lift.
5. Tasks for the next meetings:
   5.1. To alter the design of the MEL so that it will be reliable.
   5.2. To connect the encoder to one of the drives.

4.5.21 04.11.14

1. Time of beginning and ending of meeting: 14:00 – 20:30
2. Purposes of meeting:
   2.1. To change the construction of lift.
   2.2. To connect the encoder to one of motors which moves the lift.
   2.3. To add a restriction of movement to the lift control program.
3. Work that has been done:
   3.1. Construction of the lift was changed.
   3.2. Encoder was installed to left motor of the MEL.

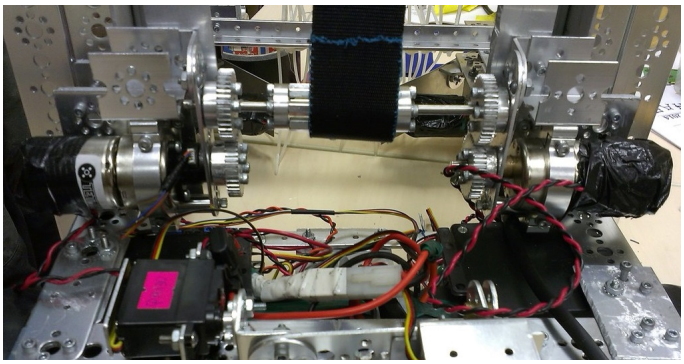


Figure 36: The finished version of the MEL

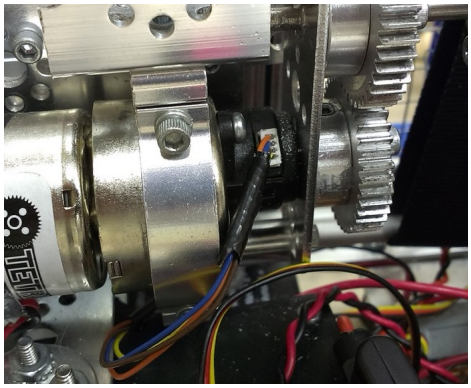
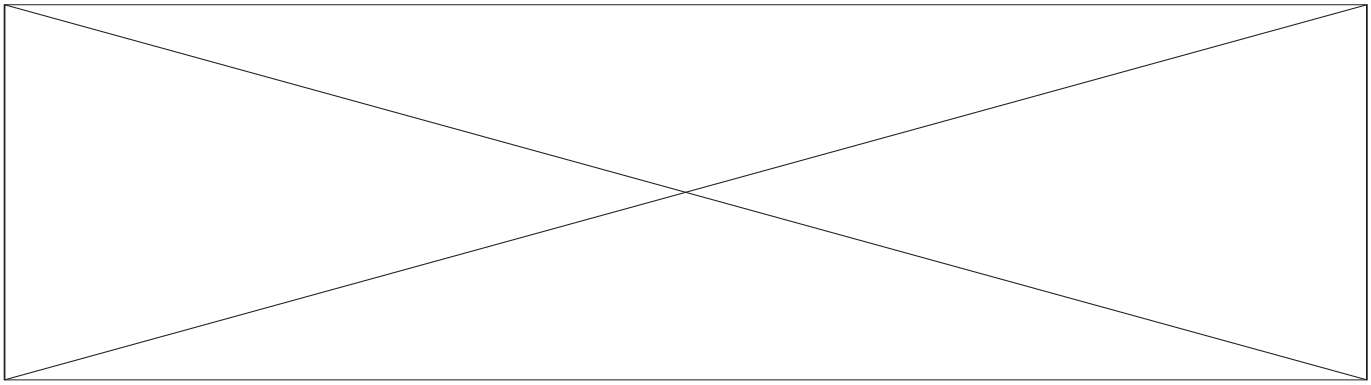


Figure 37: Encoder

   3.3. Restriction of movemnt was added to the lift control programme. If the encoder's readings exceed the allowable value, the lift stops.
   3.4. Tests of the lift were successful. The new construction has no problem with widening the lift.
4. Results:
   4.1. The lift was finished.
   4.2. Tests of the lift were succsessful.
5. Tasks for the next meetings:
   5.1. To continue working on the mechanism of overturning the bucket and MCB.



4.5.22 08.11.14

1. The time of beginning and ending of the meeting: 16:00 - 20:00
2. Purposes of the meeting:
   2.1. To elaborate new ideas for MCB.
   2.2. To start creating MCB.
3. Work that has been done:
   3.1. Ideas of the capture mechanism's construction:
      3.1.1. Mechanism that consist of two vertical rails that can turn. Then beams move apart in hand and pumps on the base of basket. Pluses: compact and easy assembly. Minus of this construction is that it can capture only one basket (it is not profitable in the autonomous period and in the final). Also it will need to aim for capture basket.
      3.1.2. The mechanism that consists two beams that can fall on both sides of the movable baskets. Then the basket base compress between the two beams. Pluses: beams may additionally lengthen so robot will be able to capture two baskets. This mechanism is simpler because it does not need to aim carefully. Minuses: uncompact, heaviness.

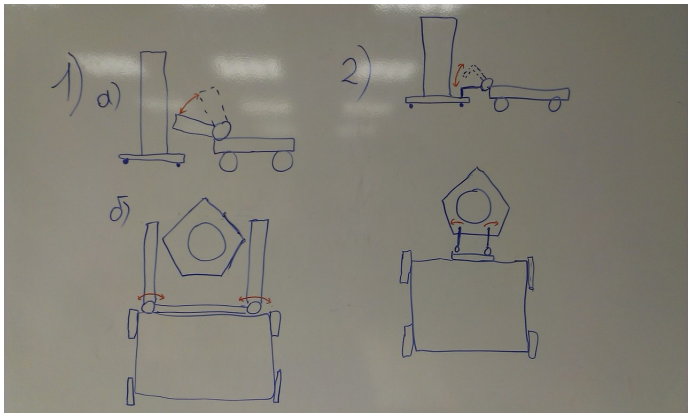


Figure 38: Ideas of capture of movable baskets: 1)Two beams 2)Vertical slats

   3.2. Asembly of MCB is not started because we didn't choose it.
   3.3. It was decided to use the hole for servo for power button.

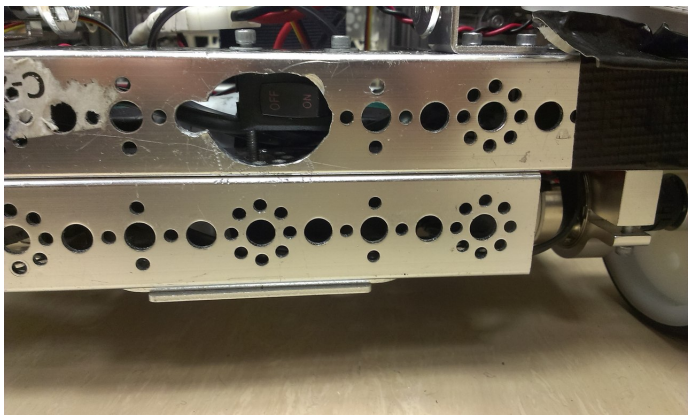
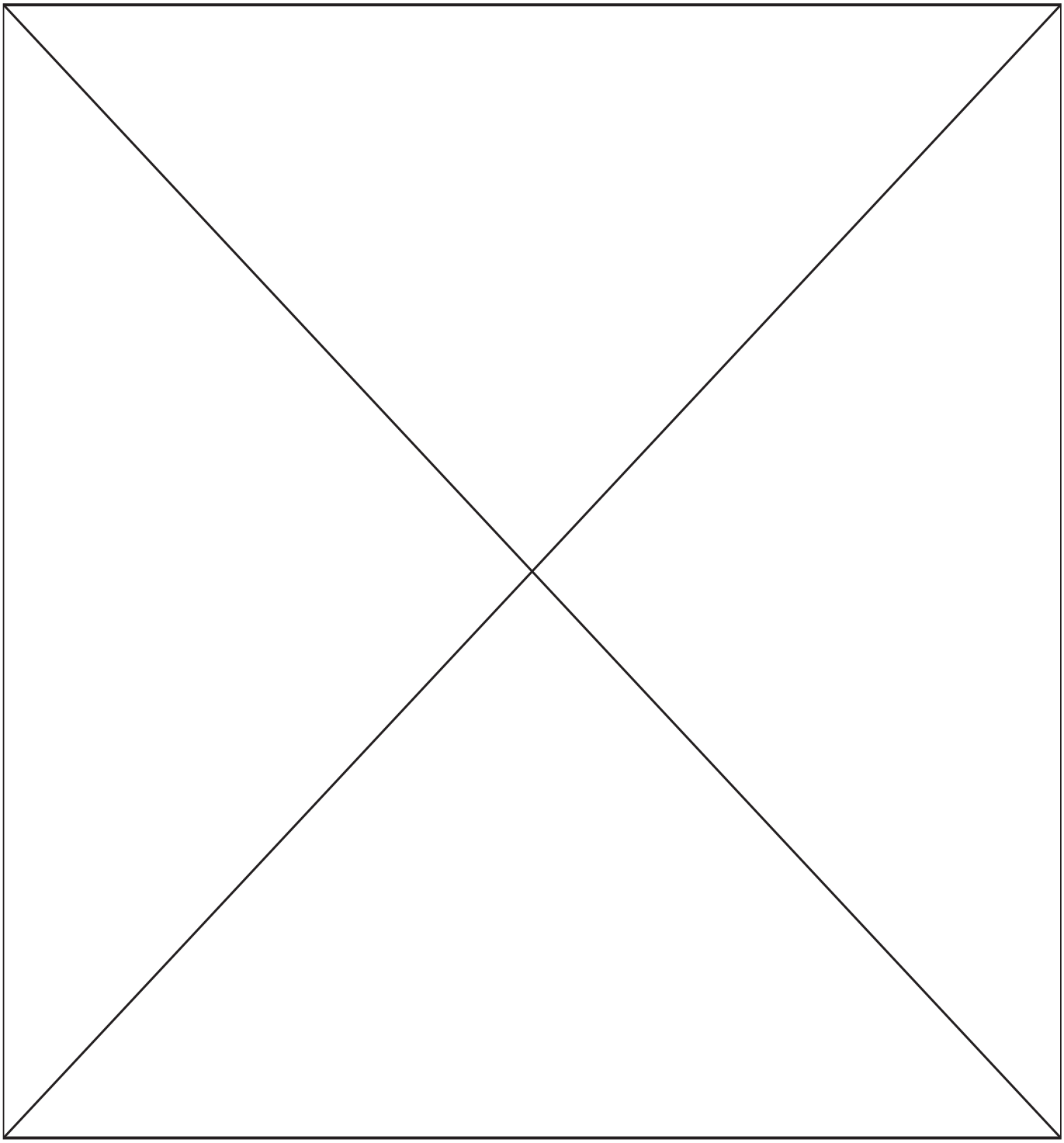


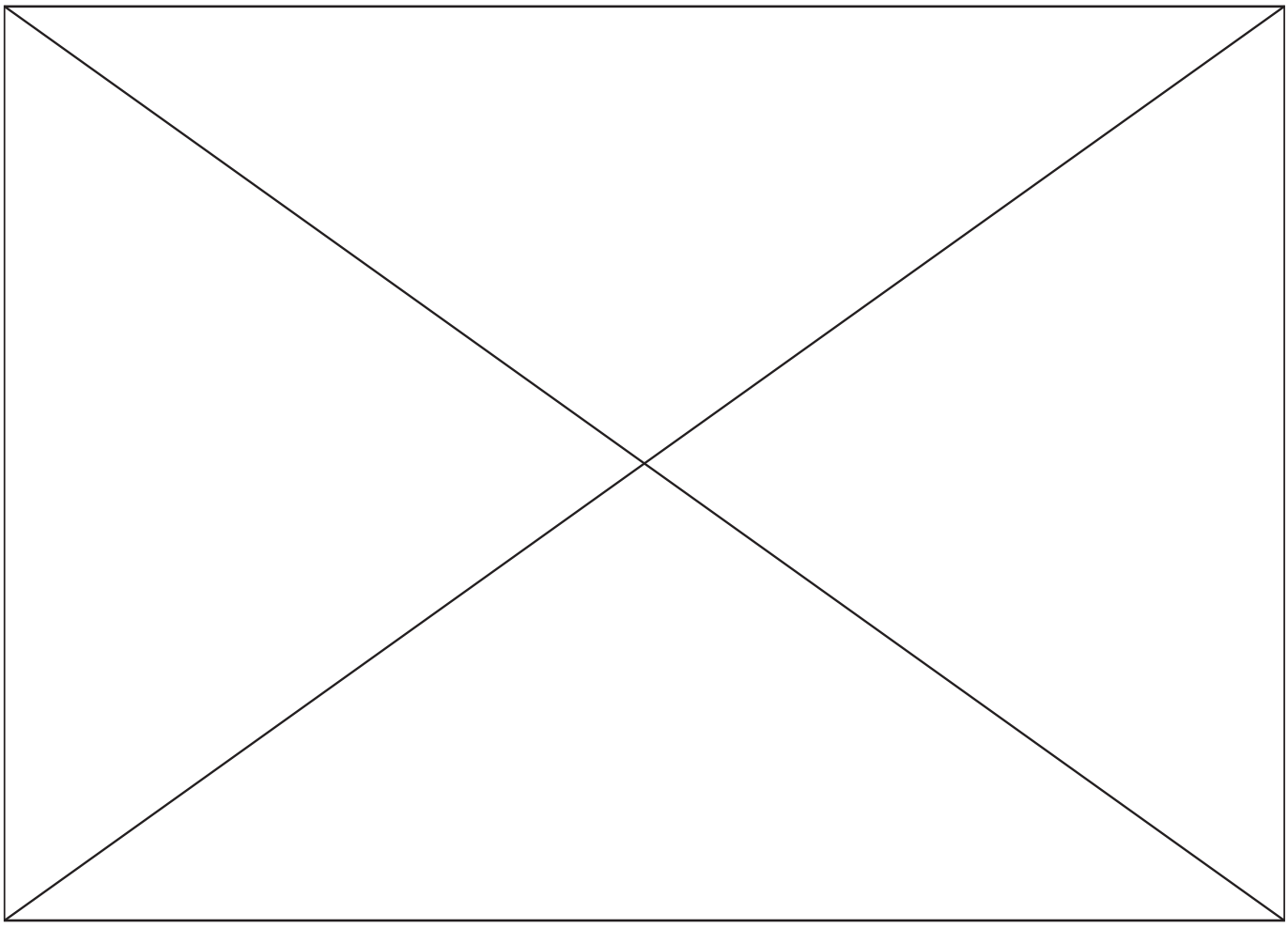
Figure 39: Button of power

4. Results:
   4.1. Three ideas of design have been suggested.
   4.2. The MCB is not implemented.
5. Tasks for the next meetings:
   5.1. To choose the optimal variant of MCB.
   5.2. To assemble MCB.



4.5.23 10.11.14

1. The time of beginning and ending of the meeting: 17:30 - 20:30
2. Purposes of the meeting:
   2.1. To choose the best option of design a capture mechanism basket.
   2.2. To begin creating the capture mechanism basket.
3. Work, that has been done:
   3.1. Preference was given to the design with vertical rails as the most simple and compact.
   3.2. It was decided to use two servos: one will be on the stand to lower the rack baskets, and the second - to push the two rails. Assembling of a capture mechanism basket was started but not completed.
4. Results:
   4.1. The design of the MCB was selected.
   4.2. MCB was partially assembled.
5. Tasks for the next meetings:
   5.1. Complete assembly MCB.
   5.2. To write a program to control the capture mechanism basket.



4.5.24 11.11.14

1. Time of beginning and ending of meeting: 17:00 - 20:30
2. Purposes of meeting:
   2.1. To finish MCB.
   2.2. To add to programme of control of robot control of MCB.
   2.3. To write the programme of control of robot with two joysticks.
3. Work that has been done:
   3.1. MCB was finished.

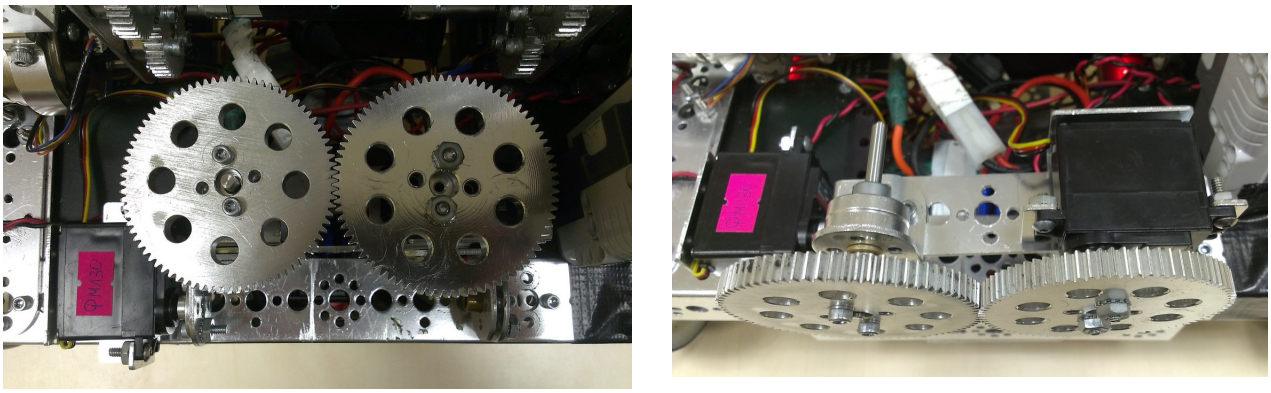


Figure 40: Finished MCB

   3.2. Programme of control MCB is not implemented.
   3.3. Today it was chosen the place for NXT. Now it was fixed by scotch but we planned to fix it more reliable.

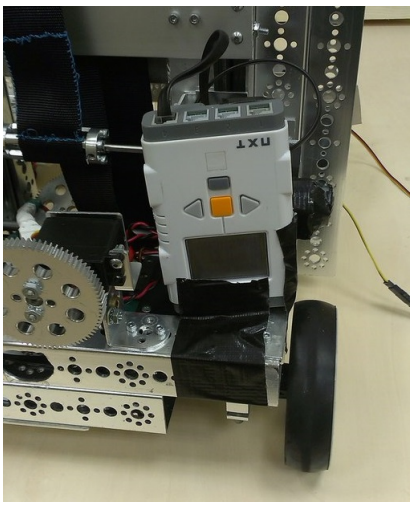


Figure 41: Place for mount of NXT

   3.4. We noticed that the wire of servo that overturns the bucket touches the floor when lift is folded. It can to prevent of bucket's moving. It was decided to create special coil that works as the roulette and uncoil wire when it is not in tension or fix the wire in several places at the guides of lift.

3.5. It was decided to create a special programme which allows to us control one of the nodes of robot by NXT's buttons without control with joystick because we often needs to test some one node.

3.6. The programme of control with two joysticks was created but wasn't tested. In the new programme the first operator responsible for everything except moving and the second responsible for moving.

3.7. It was elaborated the mechanism of the churning stops and releasing balls in autonomous period: servo of continuous rotation at which will fixed two chains of beams from set Lego-NXT. Every two beams connected by one pin. When it folded this construction doesn't take up much space. When servo starts rotation it will be straight. So for churning stops it will enough to get in the distance of action mechanism. It more easy than write programme of finding stop by IR sensor.

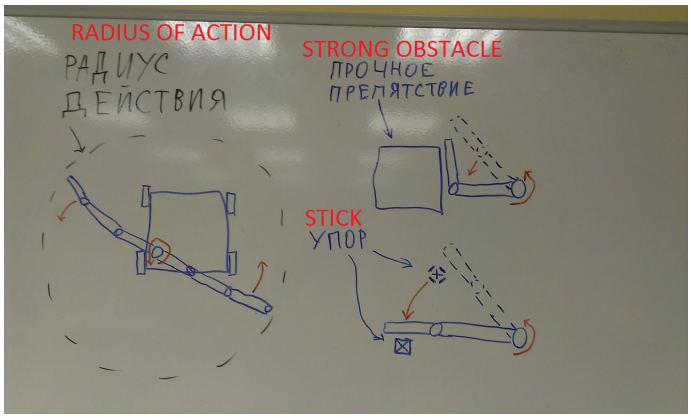


Figure 42: Idea of mechanism of churing the stop

4. Results:

4.1. MCB was almost finished.

4.2. Programme of control MCB wasn't implemented.

4.3. Programme of control robot with two joysticks was created.

4.4. NXT was fixed at the robot.

4.5. It was elaborated concept of mechanism of churing of the stops.

5. Tasks for the next meetings:

5.1. To test programme of control robot with two joysticks.

5.2. To include to the programme of control robot the control MCB.

5.3. To fix the wire of servo, that turn bucket (hereinafter it will call STB) so that it doesn't prevent to moving of lift and bucket.

5.4. To make the programme of control nodes of robot by buttons of NXT.

5.5. To create and test the mechanism of churing of the stop.

4.5.25 12.11.14

1. The time of beginning and ending of the meeting: 19:00 - 20:30
2. Purposes of the meeting:
   2.1. To test program of the robot control by two joysticks.
   2.2. To include in the program of the robot control program of management MCB.
   2.3. To replace the gears in the MCB into smaller.
   2.4. To choose materials for bucket for balls.
3. Work that has been done:
   3.1. MCB takes up too much space because there were the large gear on the second servo. So it was decided to replace them to smaller ones. It was decided to remove two small gears that were used to mount for crossbar since all small gears have been used. It was created special attachment instead of the gears.

Figure 43: Mount for crossbar was changed

   3.2. Gears in the MCB were replaced to smaller ones.

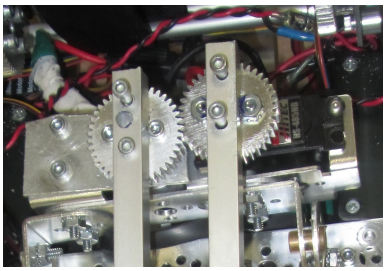
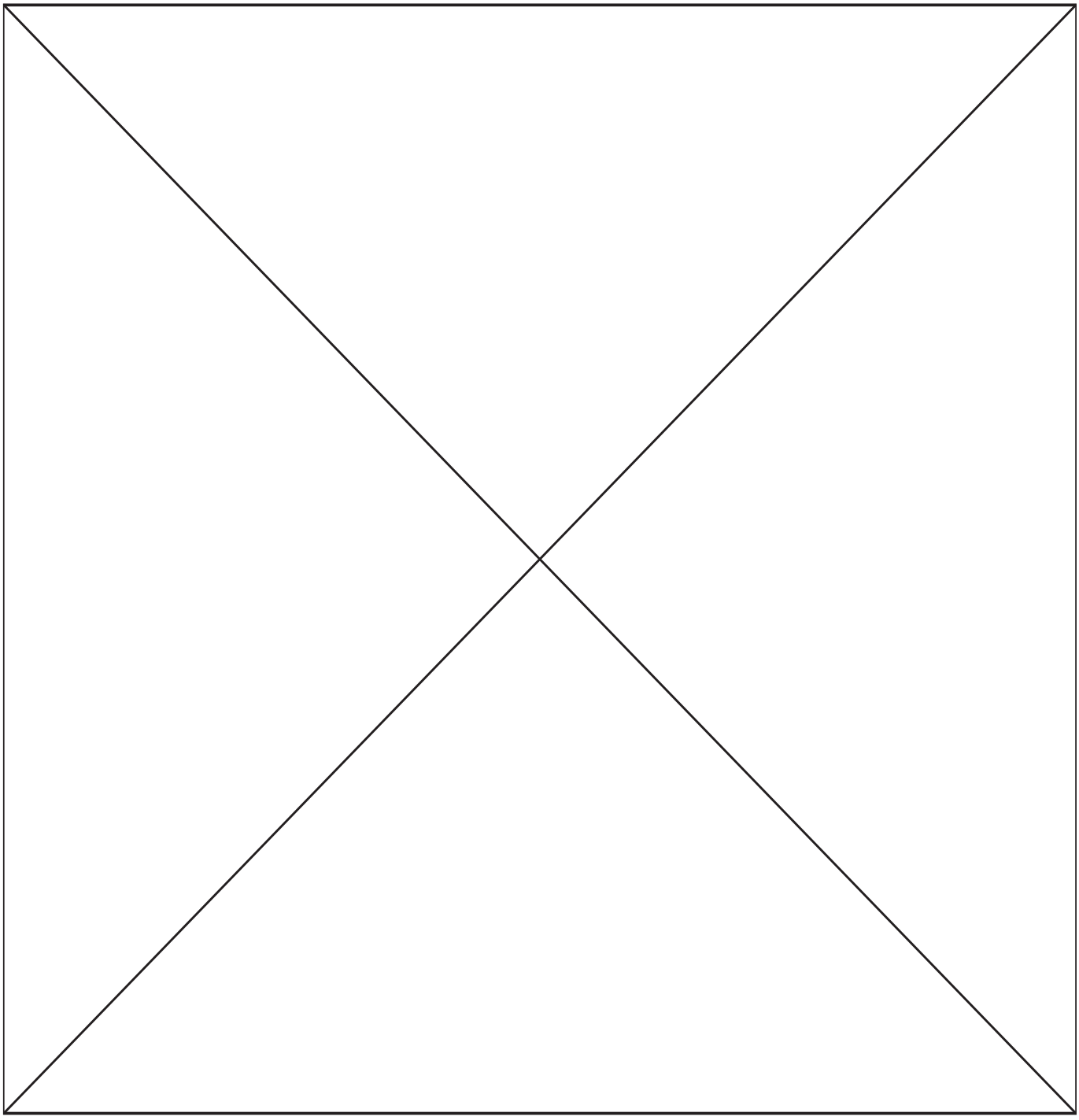


Figure 44: Smaller gears

   3.3. It was decided to use metal mesh with small cells for creation a ball's bucket. It has sufficient rigidity and it bends easy. Also the grid has a low weight. That is important because it will be rise to 120 cm. Additionally we'll can see how much balls are in the bucket through the grid cell.
   3.4. Program of the control MCB has not been written.
   3.5. Program of the robot control by two joysticks has not been tested.

4. Results:
   4.1. The MCB was finished.
   4.2. Programme of control MCB wasn't wrote.
   4.3. Program of the robot control by two joysticks wasn't tested.
5. Tasks for the next meetings:
   5.1. To add to program of the robot control program of the management MCB.
   5.2. To test program of the robot control by two joysticks.



4.5.26 14.11.14

1. The time of beginning and ending of the meeting: 16:00 - 20:30
2. Purposes of the meeting:
   2.1. To test the programme of control robot with two joysticks.
   2.2. To start working on the bucket.
3. Work, that has been done:
   3.1. Programme of control robot with two joysticks was tested. Result positive. Control from two joysticks allowed share the responsibility in the control between two operators. It contributed to the increase of efficiency of working of the robot. In order to show good results in competitions it will need trainings to develop teamwork of the two operators.
   3.2. It was purchased metal mesh with sizes of cells 14 x 14mm and thickness of wire 0.9 mm. It was created framework for the bucket.

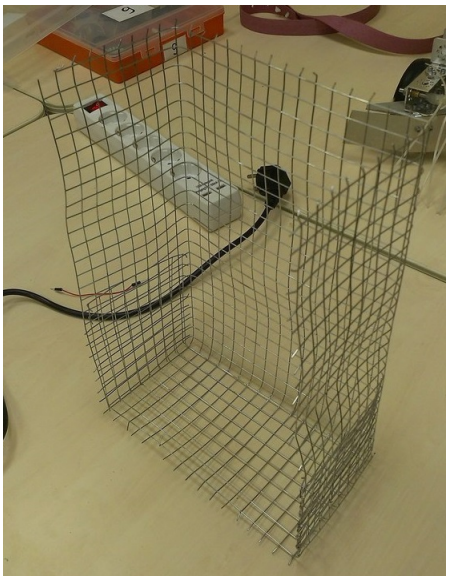


Figure 45: Preparation for the bucket

4. Results:
   4.1. Programme of control from two joysticks was tested. Result positive.
   4.2. It was created preparation for bucket.
5. Tasks for the next meetings:
   5.1. To finish the bucket.
   5.2. To test working of mechanism of overturning bucket (hereinafter it will be called as MOB).

4.5.27 15.11.14

1. The time of beginning and ending of the meeting: 16:00 - 20:00
2. Purposes of the meeting:
   2.1. To finish MCB.
   2.2. To fix MOB.
   2.3. To add to programme of control robot control of MCB.
3. Work, that has been done:
   3.1. It was decided use aluminium beams for MCB.
   3.2. Beams were fixed at servo.
   3.3. It was decided cut the beams to the desired size at the competition because the dimentions of the basis of rolling goal do not specify in regulations. Due to this it impossible to choose optimal length of beams.
   3.4. MOB was fixed with help mount for servo from set Tetrix and hot melt adhesive.

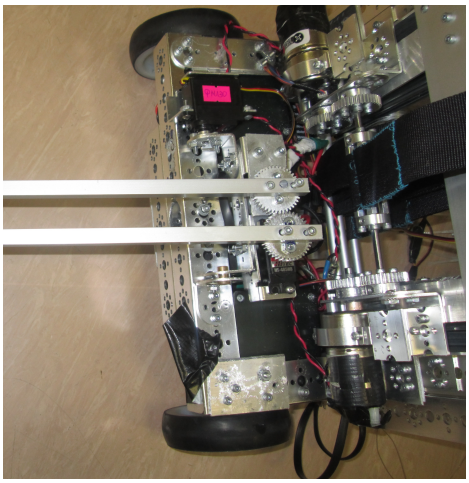


Figure 46: Beams at MCB

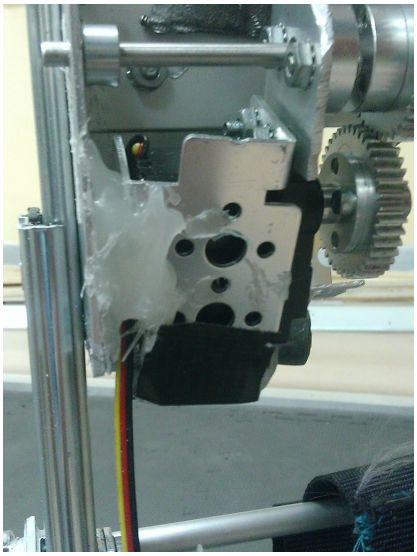


Figure 47: Mount for MOB

4. Results:
   4.1. MCB was almost finished.
   4.2. MOB was fixed.
5. Tasks for the next meetings:
   5.1. To finish working on the bucket.

4.5.28 16.11.14

1. The time of beginning and ending of the meeting: 19:00 - 20:30
2. Purposes of the meeting:
   2.1. To finish working on the bucket.
   2.2. To fix the bucket on MOB.
3. Work, that has been done:
   3.1. Framework of the bucket was changed: it's top part was bended so that it formed pipe. The balls will roll on this pipe during overturning the bucket. The bottom part wasn't changed.
   3.2. It was decided to fix plastic bottle inside the tube. It will allow to the balls to slide over the pipe easier. We couldn't make it today because we didn't have the bottle.
   3.3. Bucket was fixed at MOB.
   3.4. It was found that transverse beam in front part of robot prevents to lowering the bucket to maximum bottom position. So that this beam was changed on a more subtle which doesn't prevent to moving of bucket.

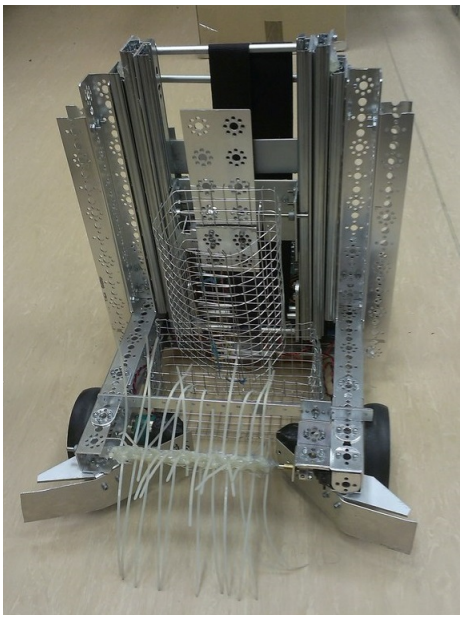


Figure 48: Bucket in a start position

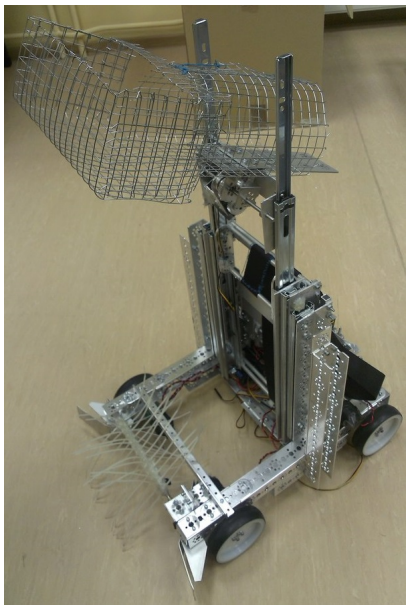


Figure 49: Bucket in the overturned position

4. Results:
   4.1. Framework of bucket was created and installed to robot.
5. Tasks for the next meetings:
   5.1. To improve the bucket's construction.
   5.2. To test the bucket.

4.5.29 17.11.14

1. The time of beginning and ending of the meeting: 18:00 - 20:40
2. Purposes of the meeting:
   - 2.1. To improve the construction of bucket.
   - 2.2. To test the working of bucket.
3. Work, that has been done:
   - 3.1. Bucket was improved:
     - 3.1.1. Inside the tube was placed plastic bottle. Tube was extended by another one bottle for more accuracy of throwing the balls into the basket.
     - 3.1.2. They were fixed plastic stripes at the bottom part of bucket. They will help to balls to enter the pipe and not get stuck.
     - 3.1.3. The bottom of bucket was bended as a boat. It allowed to balls doesn't fall outside the bucket during the raise of it.
     - 3.1.4. It was left only hole at center of bucket for hit the balls inside. It also allows to reduce risk of falling balls outside the bucket during the rise.

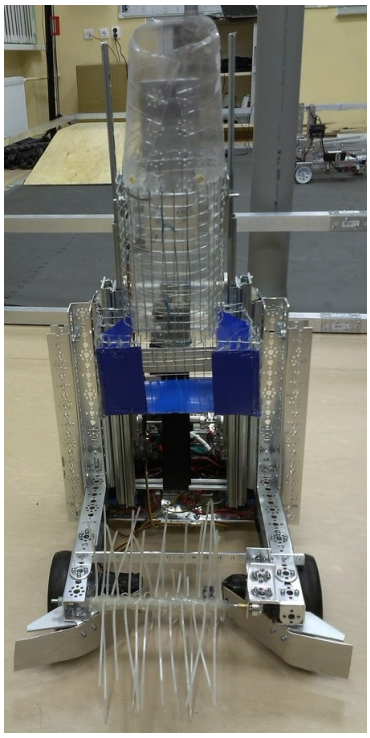


Figure 50: Bucket in vertical position

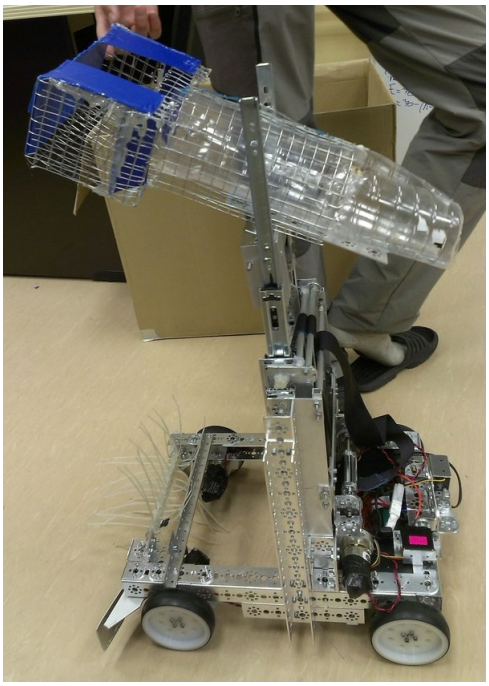
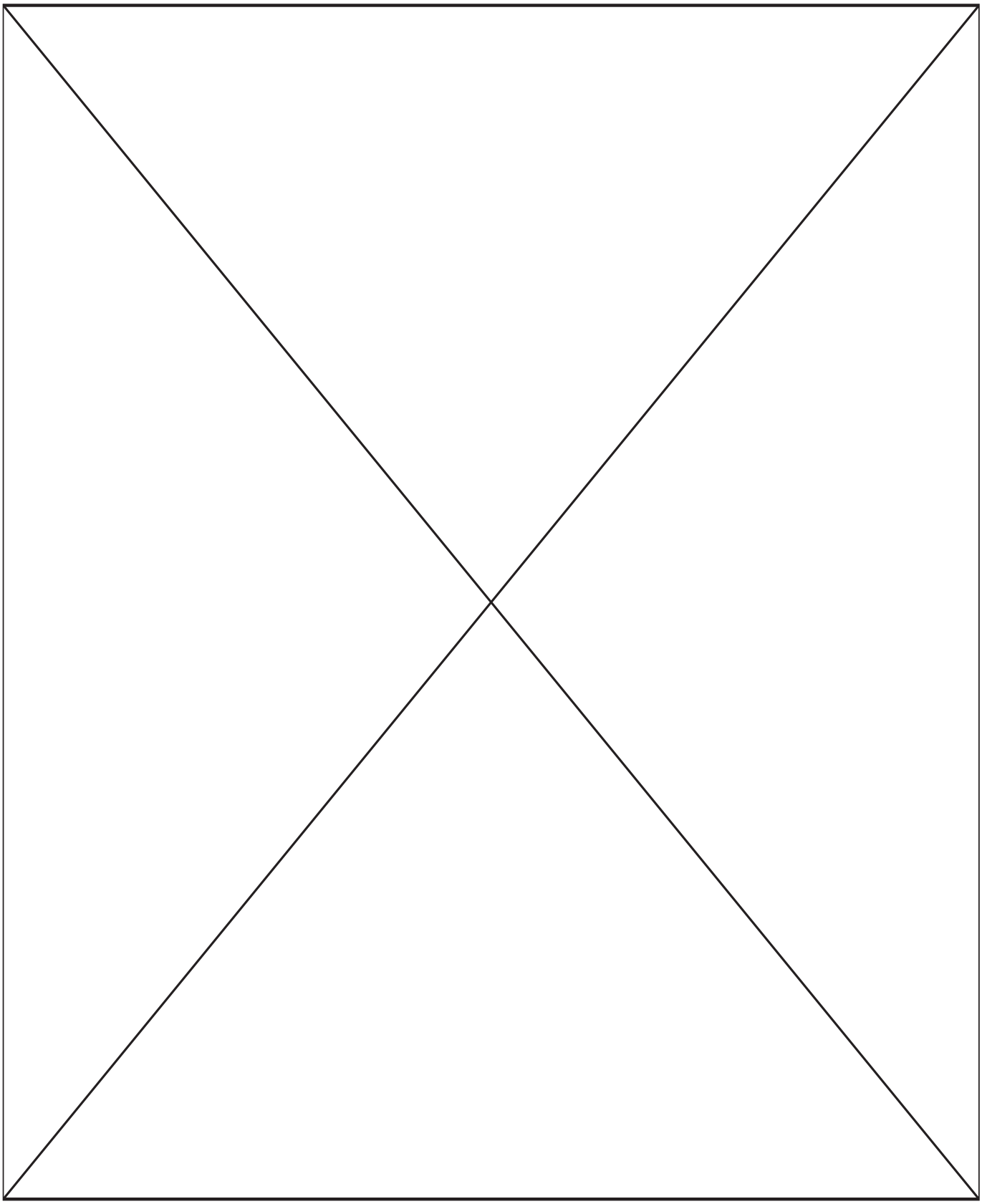


Figure 51: Bucket in overturned position

   - 3.2. The bucket was tested manually. Bucket can fill 2 big and 3 small balls. It is enough because at every big ball there is 3 small. Balls doesn't fall outside the bucket during the rise.
4. Results:
   - 4.1. Construction of the bucket was finished.
   - 4.2. Problems weren't detected during the tests of bucket.

5. Tasks for the next meetings:

   5.1. To test the bucket with help programme.



4.5.30 18.11.14

1. The time of beginning and ending of the meeting: 16:00 - 1:00
2. Purposes of the meeting:
   2.1. To train on the control of robot.
3. Work, that has been done:
   3.1. The first tests of the robot showed the failure of the idea installation inside the tube plastic bottle. It reduced internal diameter so the balls stuck in the pipe. It was decided to remove the bottle. It solved this problem but now the length of tube is too small for throwing of balls to baskets.
   3.2. It was turned out that MOB can't turn the bucket when it filled with balls. It was installed fishing cargo mass 100g on the top part of bucket. So this problem was solved.

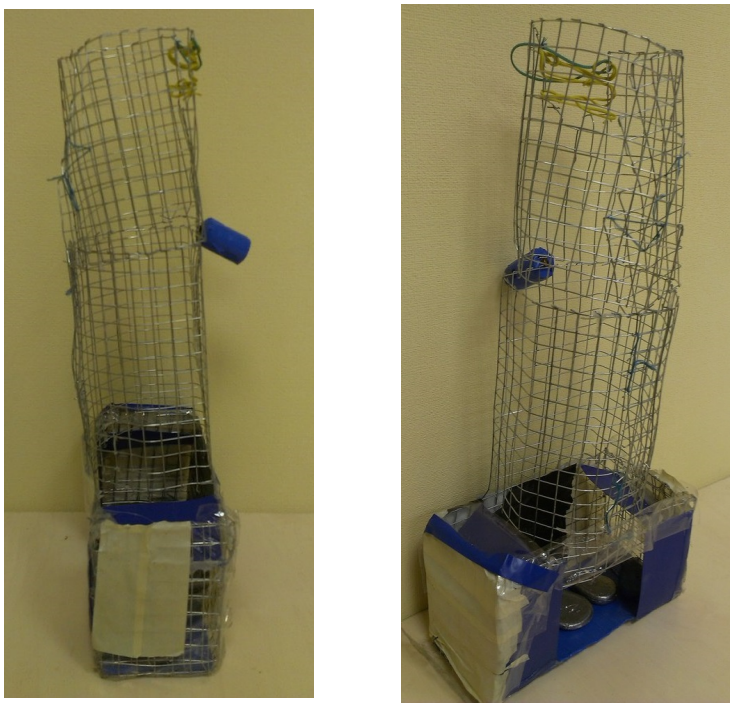


Figure 52: Fishing cargo on bucket

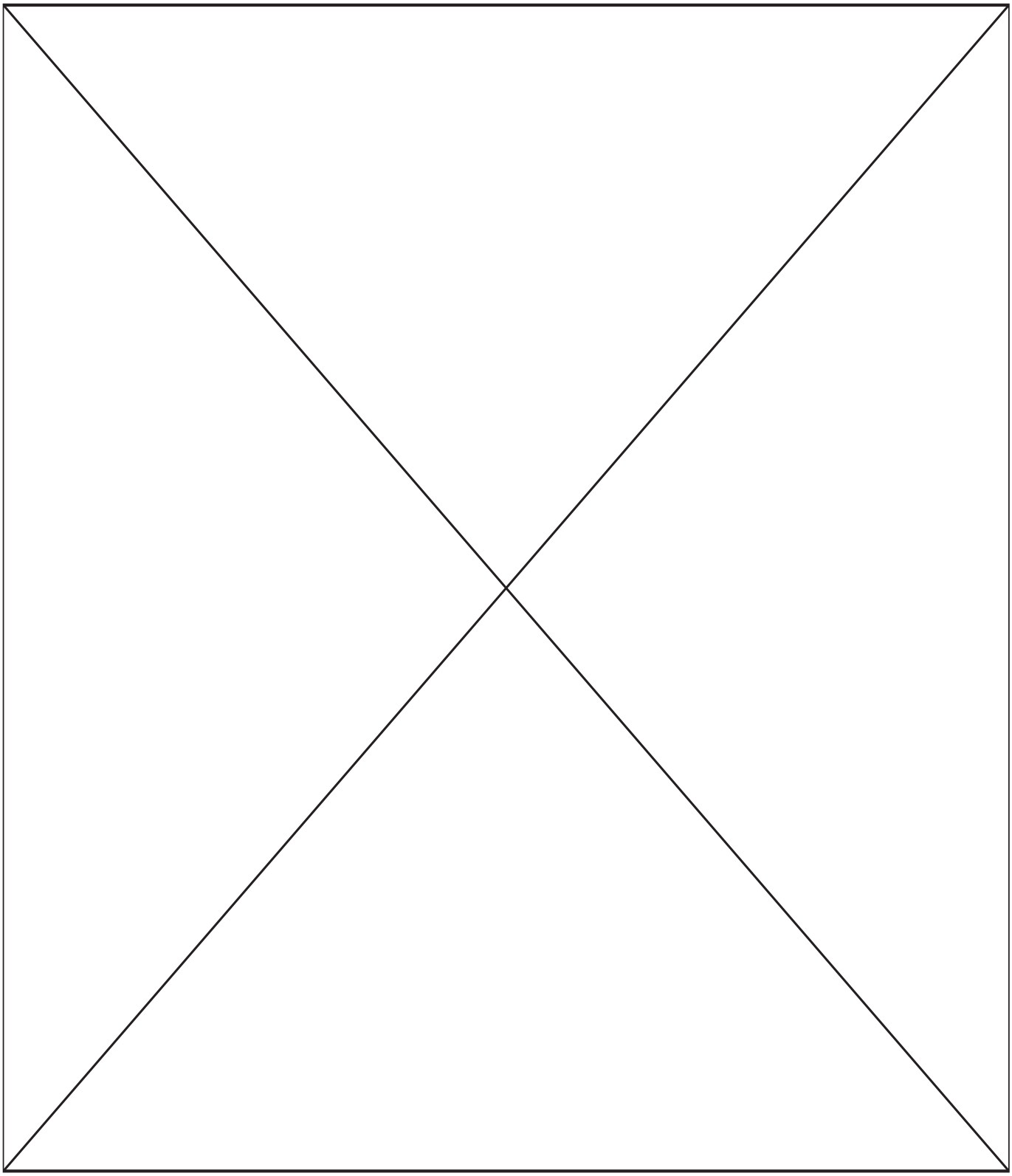
   3.3. Also it was turned out that two motors can't extract the lift. Fuses are heated and unlock the chain so the operator loses the control of lift. It was decided install transmission with the gear ratio 1:2 for reducing of load to motors .
   3.4. Motors copes with extracting the lift after installation of transmission but sometimes the lift was jammed. It happens due to the clamping of the belt between top crossbar of the bottom slat and bottom crossbar of the second slat. It was decided to install limiters that will not allow to bottom crossbar of the second slat raise too highly.
4. Results:
   4.1. Plastic bottles were removed from the bucket.
   4.2. It was installed transmission with the ratio 1:2 on the motors which extracts the lift .
   4.3. It was installed the cargo for normaly working of MOB.

5. Tasks for the next meetings:

   5.1. To install the limiters of moving of crossbar at the lift.

   5.2. To extend the tube of bucket for throwing of balls to baskets.

   5.3. To train on the control of robot.



4.5.31 19.11.14

1. The time of beginning and ending of the meeting: 18:00 - 22:00
2. Purposes of the meeting:
   2.1. To install limiters of movement of the crossbar.
   2.2. To fix NXT-brick at the robot.
   2.3. To train on the control of robot.
3. Work, that has been done:
   3.1. It was installed limiters of crossbar's movement.
   3.2. It was turned out that metal mesh can to hook a lift and interfere with it's movement. The bucket was covered by tape. It allowed make it's surface smooth.
   3.3. NXT-brick was fixed at the robot stationary. The new place is better than previous because now it locates higher and it will be harder to damage it in the event of a collision.

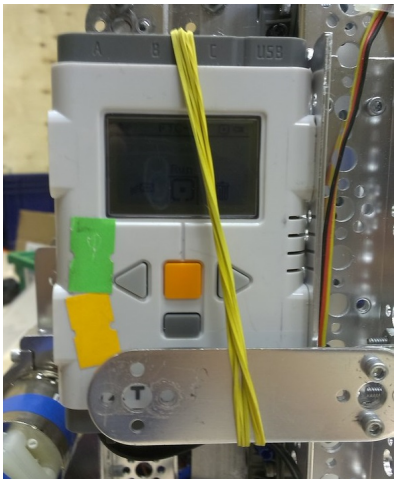


Figure 53: Fixed NXT-brick (there is more last version at the photo)

   3.4. We couldn't train on the control robot due to working on robot's construction.
4. Results:
   4.1. Trainings at the control of robot were not conducted.
   4.2. NXT-brick was fixed on the robot.
   4.3. It was corrected the problem with hooking of bucket during the lift.
   4.4. Limiters of crossbar's movement was installed on the lift.
5. Tasks for the next meetings:
   5.1. To continue the trainings on the control of robot.

4.5.32 20.11.14

1. The time of beginning and ending of the meeting: 16:00 - 22:00
2. Purposes of the meeting:
   2.1. To train on the control of robot
   2.2. To connect the encoders for orientation of robot in the autonomuos period.
   2.3. To extend the tube of the bucket for throwing balls to baskets.
   2.4. Packaging robot for transportation to the competition "Robofest-South".
3. Work, that has been done:
   3.1. It was turned out that some balls don't get into the bucket and stay in the inner space of the robot. So the slopes was extended to reach the bucket. So balls get into the bucket.
   3.2. Encoders were connected to the motors that move two back wheels. Programme of autonomous period wasn't made.
   3.3. Tube of the bucket was extended. Now we can throw the balls to baskets.

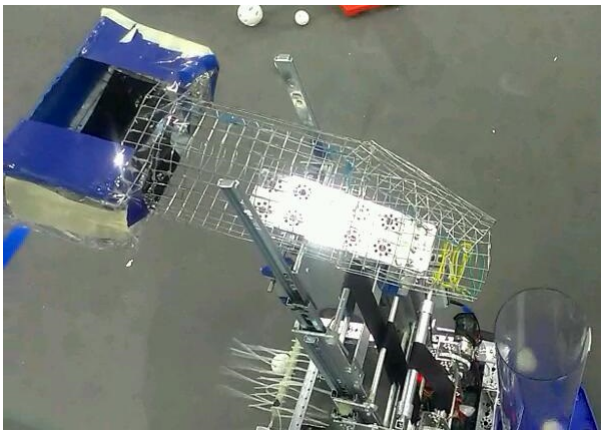


Figure 54: Changes in the construction of the bucket

   3.4. Robot was packed into the box for transportation it to the place of competition in the Sochi.
4. Results:
   4.1. Slopes were improved. Now all balls reach the bucket.
   4.2. Encoders were connected to the back wheels.
   4.3. Tube of the bucket was extended.
   4.4. Robot is ready to the transportation.
5. Tasks for the next meetings:
   5.1. To gain experience during performances at competitions.

4.5.33 21.11.14 (Competition)

1-nd day of competition "Robofest-South"

Today there was training matches.

Improvements that were done:

1. It was turned out that robot loses clutch with the floor when small ball gets under the wheel. It was installed protection of wheels from the balls.

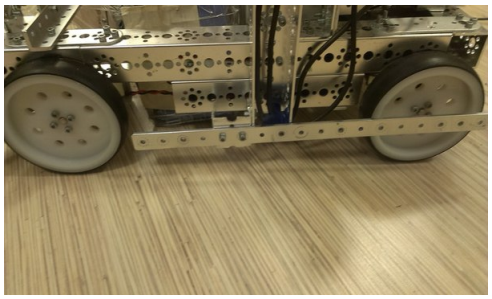


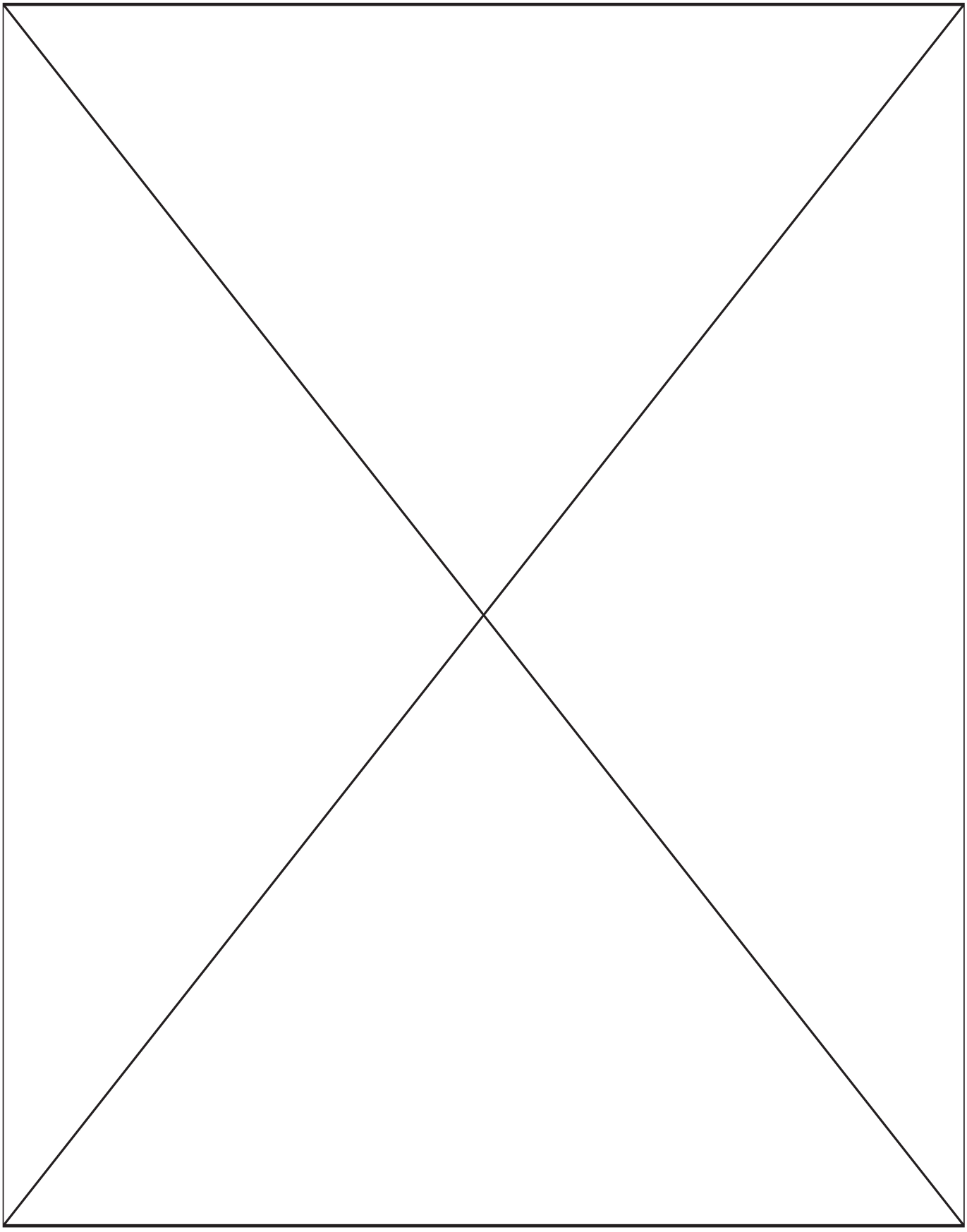
Figure 55: Protection of wheels from the balls

2. It was turned out that base of rolling goal does not pass under the bottom of the robot. It doesn't allow to bring the goal to the robot as close as possible. It was decided to increase clearance of back part of robot.
3. Beams on the MCB was sawed to desired length and were fixed. But MCB was changed due to problems with second servo that bursting with beams. Faulty servo was removed and beams were fixed rigidly.

Figure 56: Changed MCB

4. It was installed Samanta-module and it was conducted one training match on the field for competitions.

Figure 57: Mount of Samanta



4.5.34 22.11.14 (Competition)

2-nd day of the competition "Robofest-South".

Today there were qualifying matches and protection of engineering books.
Results of matches: 2 wins from 4.
Results of protection of engineering books still unknown.
Main problems identified during matches:

1. There is low accuracy during throwing balls to the rolling goal. This was due to we didn't give enough time to trainings.

2. The wire of MOB often hooked to slats and torned. Due to this it was impossible throw balls to baskets.

Improvements that were done:

1. It was wrote programme of autonomous period that includes exit from the ramp and throwing autonomous balls to 60cm rolling goal.

2. It was wrote the programme that allows to control the lift by buttons of NXT. This programme convenient if we need to extract the lift for working on the construction of robot.

3. Also it was wrote the programme of autonomous period from the parking zone. It allows to knock down the fence when it is in the one position from three.

4. One crossbar bended due to the high loads. So it was strengthened by the metallic tube from set Tetrix. It corrected this problem but it was decided to replace aluminium crossbars to steel.

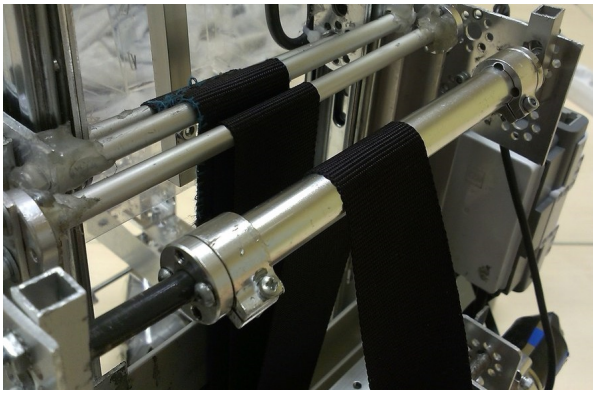


Figure 58: Metallic tube on the crossbar

5. There was installed on MCB the slopes of the tie-rods for aligning rolling goals. In the future we planned to replace the screeds to plastic strips because they often brokes.

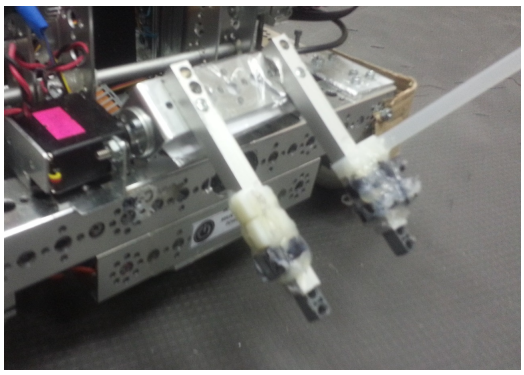


Figure 59: Slopes for alignment of rolling goals.

6. Protection of wheels was improved . Now there is a cardboard protection but we planned make to it metallic.

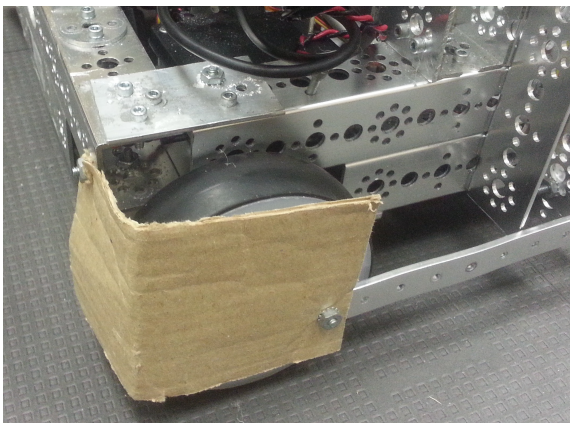


Figure 60: Protection of wheels

7. During the one match NXT-brick fell off from the robot. So we fixed it as effectively as possible.

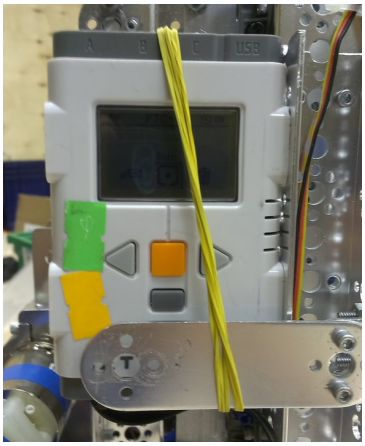
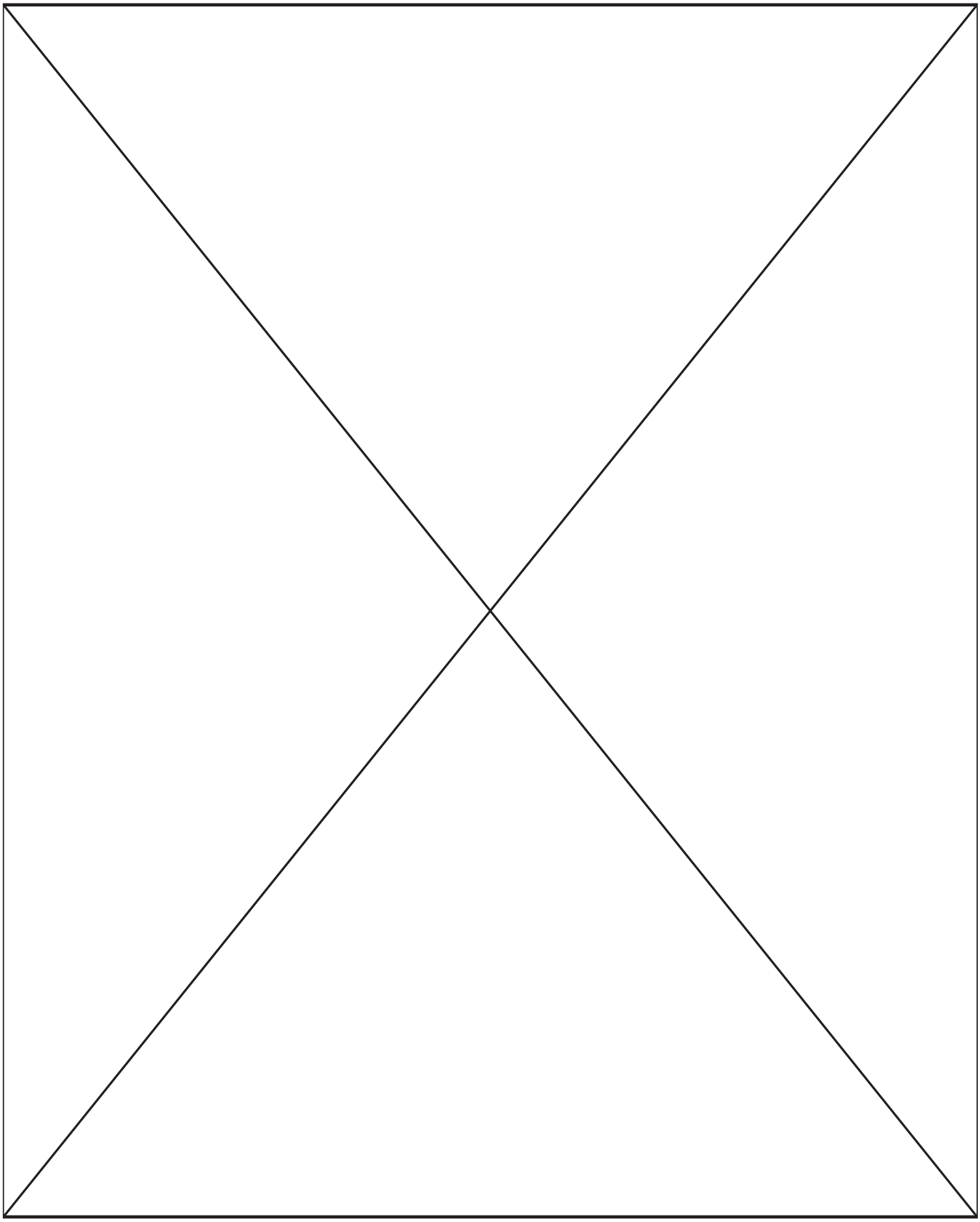


Figure 61: Improved fixing of NXT

8. It was turned out that during extracting the lift the top pair of slats rises on the last. It doesn't allow to overturn the bucket up until the lift wasn't extracted fully. We must to extract the lift fully and then

to lower this to needed heigh for throwing balls to any goal. We waste a lot of time so it was decided to correct this problems after returning from the competition.



4.5.35 23.11.14 (Competition)

3-nd day of competition "Robofest-South"

Today there where final matches.

Results of competition:

1. We didn't hit to "top 4" by the results of qualifying matches.
2. We didn't take part in the final matches because we communicate with other team too little.
3. We won in the nomination "The best engineering book". So we got two TETRIX MAX sets: main set and resourse one.

Improvements that were done:

1. It was started programme of autonomous period that include exit from the ramp throwing the autonomous balls to 60cm goal and moving it to the parking zone. But it was turned out that robot can turn to angle that bigger than a threshold but can't turn to smaller. We need to solve this problem after returning.

Results:

1. Successfully of performances on the competition:
   - 1.1. We didn't take the prizes by the results of matces.
   - 1.2. We took the first place in the nomination "The best engineering book".
   - 1.3. We made it to regionals that will be in Moscow 12th-13th of February.
2. Useful ideas that we took from another teams:
   - 2.1. We met the captain of the team "Stuy Fission 310" (Stuversant High School, New York) James Chin. We had an interesting conversation and got some useful ideas:
     - 2.1.1. We can use construction profiles instead of furniture slats in the construction of the lift. They are more reliable than slats.
     - 2.1.2. Wheel base with 3 pairs of standard wheels. The central pair is lower than others. So in each period of time robot stands on two pairs. It allows to it turn around without problems because the directions of their rotation are closer to the tangent to a circle around which robot turns.
     - 2.1.3. When we need hydraulic drive we can to change it by screw with a nut. When nut rotates the screw moves on a straight direction.
   - 2.2. We looked robots for basketball competition "BasketBot" and noticed some ideas:
     - 2.2.1. They had a mechanism for throwing balls. It consists of wheel that rotates with high speed. This wheel accelerates balls and they fly on a big heght. So we thought that we can use this mechanism for rising balls and throwing them to rolling goal. It will work faster than the construction with the bucket.
   - 2.3. One of the team had a fixture that resemble a folding basketball basket that directs balls vertically. It allows much increase accuracy of throwing balls to the goals.
3. Our mistakes and disadvantages of construction:
   - 3.1. We did not spend enough trainings. It need to train more.
   - 3.2. We communicate with other team too little. It didn't allow to us to agree with ohter team on accession to the alliance.

3.3. It was turned out that it hard to knock down the fence and mechanism that we planned to make doesn't cope with it.

3.4. We decided to refuse from installation mechanum wheels because robot with mechanum wheels has a lot of problems with riding to the ramp.

4. Tasks for the next meetings:

4.1. To improve the programmes of autonomous period.

4.2. To move the MOB to the top of the slat in order to we can overturns the bucket when the lift is in any position.

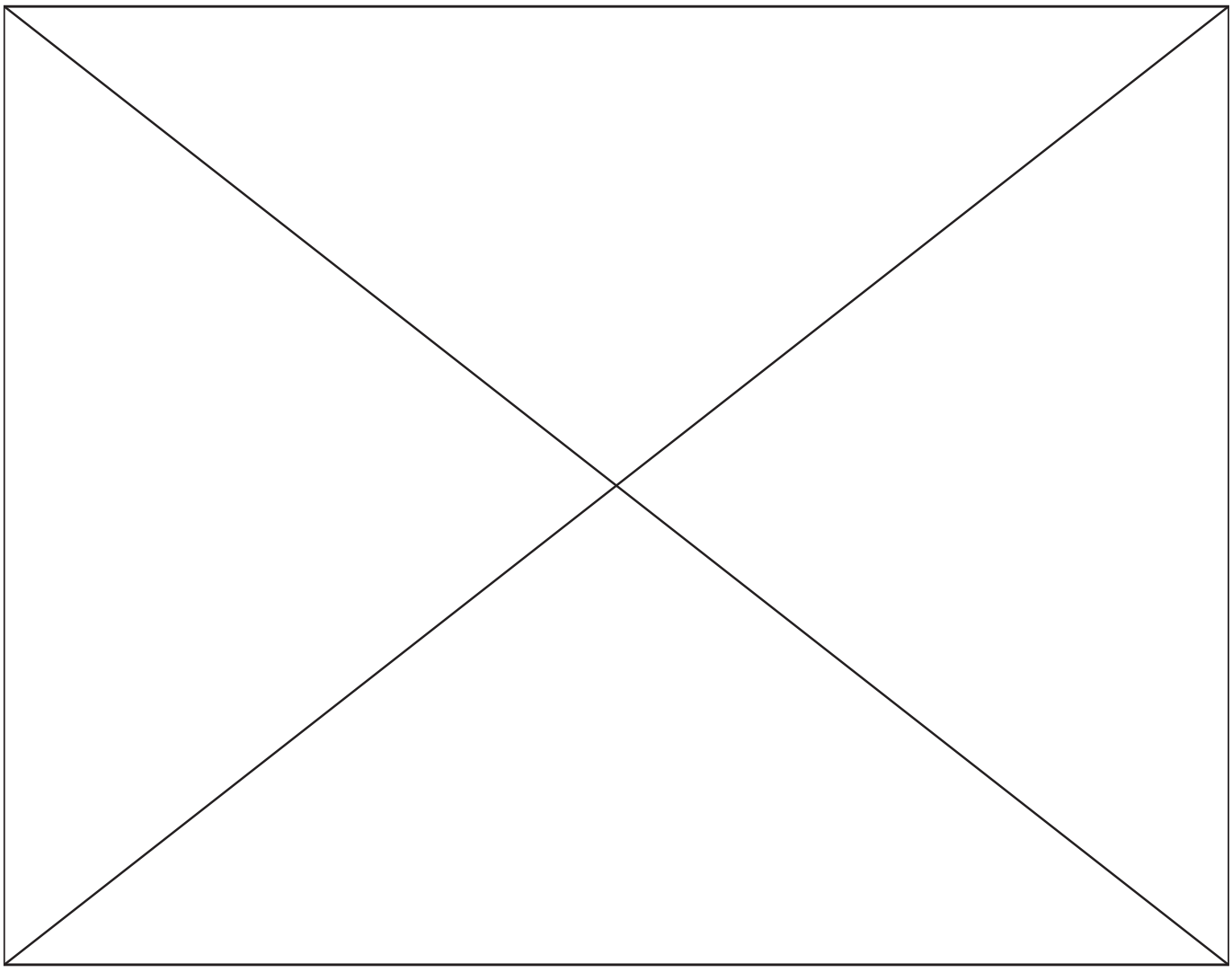
4.3. To install mechanism that will direct balls vertically. It will increase the accuracy of throwing balls to goals because balls will fall straightly.

4.4. To install 4 motors instead 2 on the mechanism of extracting the lift (hereinafter it will call MEL).

4.5. To improve the gripper for balls: change the couplers to something that captures the balls more securely and less fragile (a lot of couplers were broke during the competition). For example pieces of plastic bottle.

4.6. To practice the skills of effective control of robot.

4.7. To unravel the wires of power of motors and controllers and to hold their more gently.



4.5.36 25.11.14

1. The time of beginning and ending of the meeting: 17:00 - 21:00
2. Purposes of the meeting:
   2.1. To unravel wiers and hold to their by the most accurate way.
   2.2. To increment count of motors, which move the lift, from two to four.
   2.3. Remove the transmission from the mechanism of extracting lift.
3. Work, that has been done:
   3.1. The wiring was reheld, so wire didn't mixed and not filled too much place inside the robot and didn't prevent from changing of the battery.

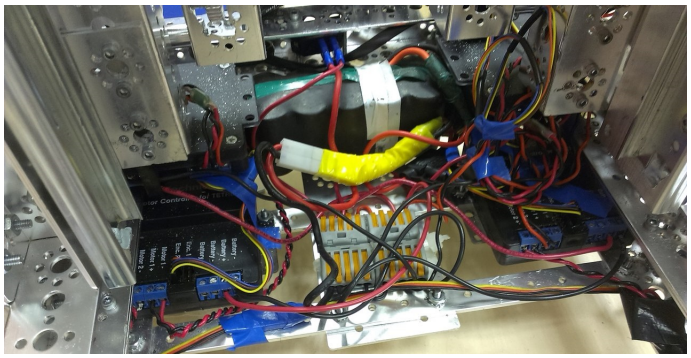


Figure 62: The inner space after optimize the wiring

   3.2. It was started alteration of MEL.
   3.3. We add to construction two motors. So it was need to install another one driver of motors for control their. It was installed driver instead of the servo controller. Servo controller was installed to more available place. It will be easier to connect additional servos.
   3.4. All drivers of motors were connected to NXT-brick to the port 1. Servo controller was connected to port 2. Initialization of controllers was changed in all programmes.

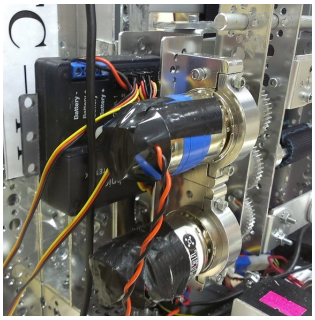


Figure 63: Servo controller

4. Results:
   4.1. Wiring was optimized.
   4.2. Driver of motors was installed.

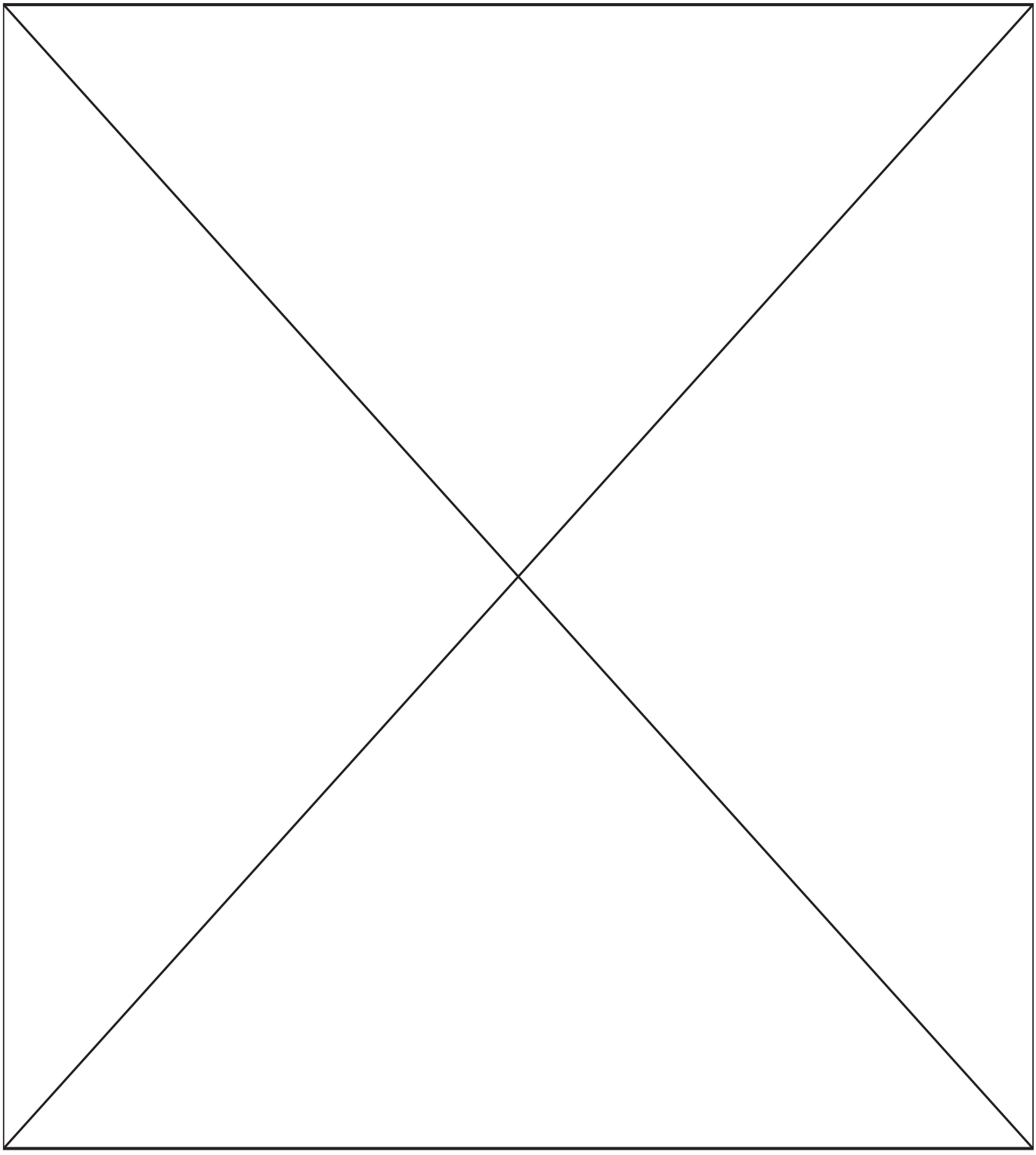
4.3. Servo controller was installed on more available place.

4.4. It was started alteration of mechanism of extracting of the lift.

5. Tasks for the next meetings:

5.1. To finish the alteration of MEL.

5.2. To elaborate concept of the new gripper for balls.



4.5.37 29.11.14

1. The time of beginning and ending of the meeting: 16:00 - 20:10
2. Purposes of the meeting:
   2.1. To finish the alteration of MEL.
   2.2. To elaborate concept of the new gripper for balls.
   2.3. To test the MEL.
3. Work, that has been done:
   3.1. MEL was finished. Now it moves by four motors with gear ratio 1:1.

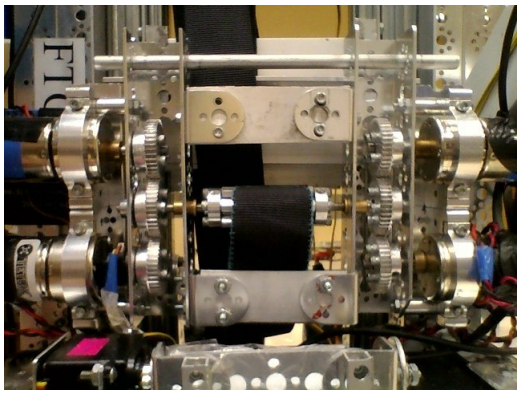


Figure 64: Changed MEL

   3.2. MEL was tested. Speed of extracting increased twice. Motors not experiences undue stress during the working.
   3.3. Ties has too small stiffness and not always captures balls and often break. It was decided use blades that cut from the plastic bottle. It was designed that optimal count of blades - 3. In addition it was decided to improve the bucket so that the bucket has a ramp 7cm in hight in the front part. It will allow to us capture 5 big balls. Also the balls will not fall from the bucket. It was created schematic drawing of gripper and bucket.

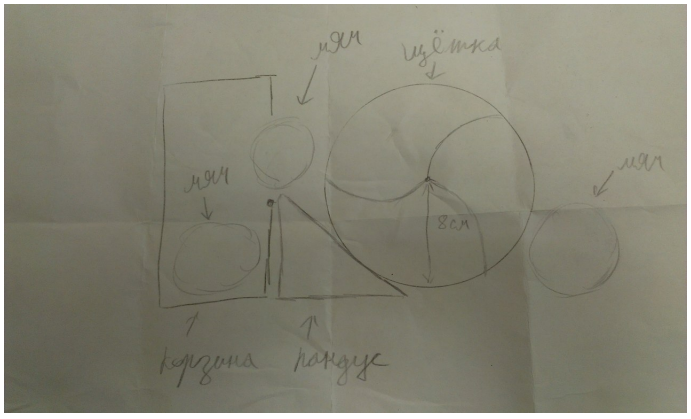


Figure 65: Drawing of gripper and bucket

4. Results:

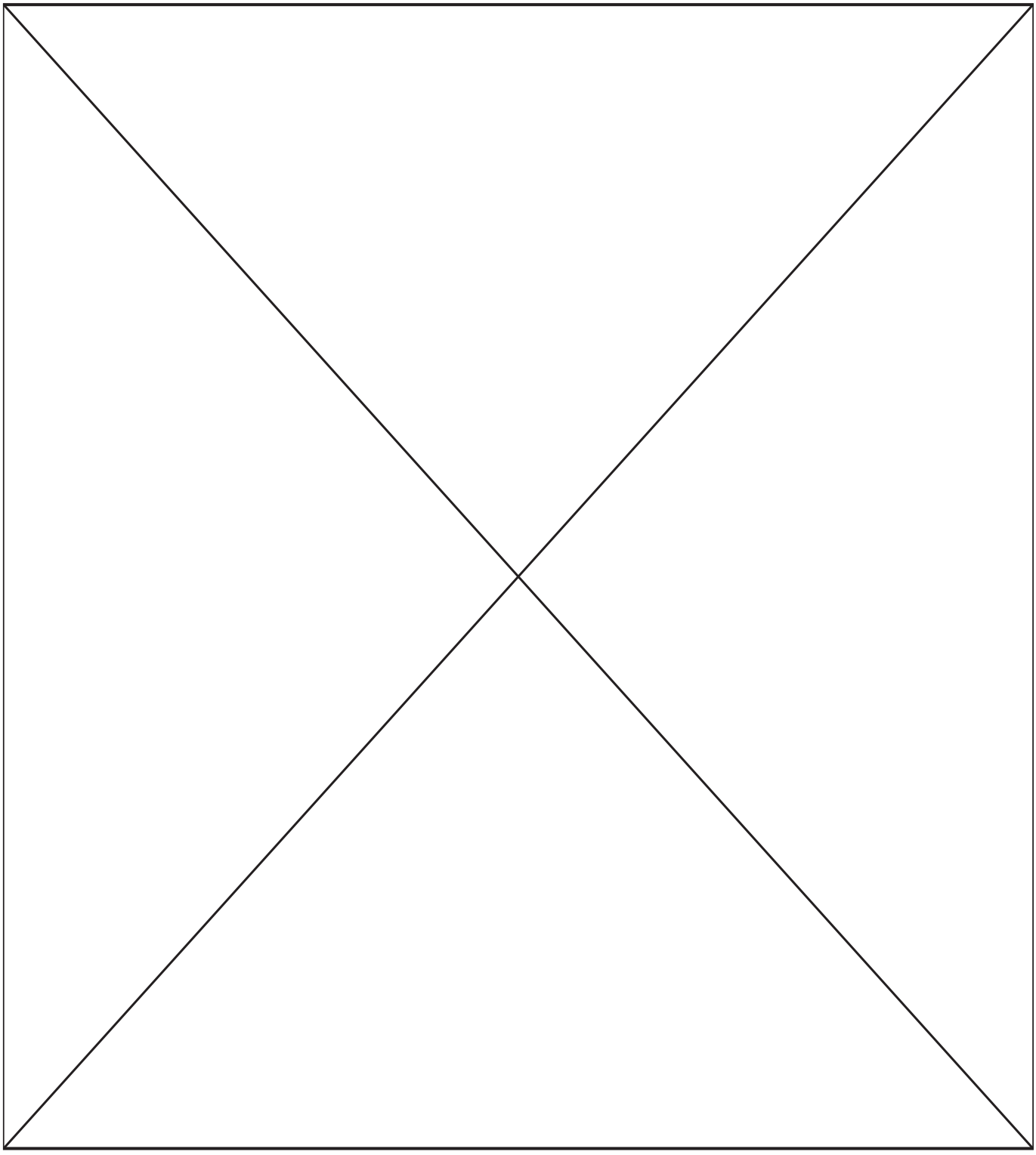
4.1. The alteration of MEL was finished.

4.2. MEL was tested. The speed of rising increased twice.

4.3. Construction of new gripper for balls was elaborated.

5. Tasks for the next meetings:

5.1. To change the gripper for balls.



4.5.38 30.11.14

1. The time of beginning and ending of the meeting: 14:00 - 20:00
2. Purposes of the meeting:
   2.1. To change the gripper for balls.
   2.2. To test the new gripper.
3. Work that has been done:
   3.1. They were installed plastic blades on the axle.

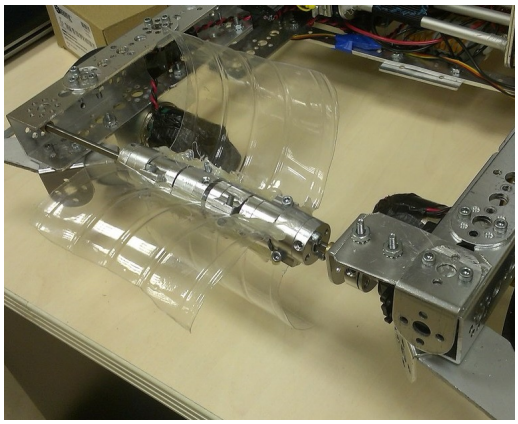


Figure 66: The new gripper for balls

   3.2. Tests.
   3.3. The transverse beam prevented to working of gripper because blades more stiffness than ties. So the beam was removed. It was decided to install U-shaped rib of rigidity. Horizontal crossbar of it will locate higher and will not prevent to working of the gripper.
   3.4. The axle of gripper was located too low. So it was decided to increase clearance of front wheels. After incrementation of clearance gripper hasn't any problem with capture of big balls.
4. Results:
   4.1. Gripper for balls was changed.
   4.2. Clearance of front wheels was increased.
   4.3. Gripper was tested.Result positive.
   4.4. Transverse rib of rigidity was removed.
5. Tasks for the next meetings:
   5.1. To move the MOB to top of the last slat.
   5.2. To install -shaped rib of rigidity.
   5.3. To start elaboration of concept of the new bucket.

4.5.39 01.12.14

1. The time of beginning and ending of the meeting: 15:30 - 19:00
2. Purposes of the meeting:
   2.1. To move the STB to the top of the last slat.
   2.2. To install -shaped rigidity rib.
   2.3. To start elaborating the concept of the new bucket.
3. Work that has been done:
   3.1. MOB was moved to the top of the last slat.

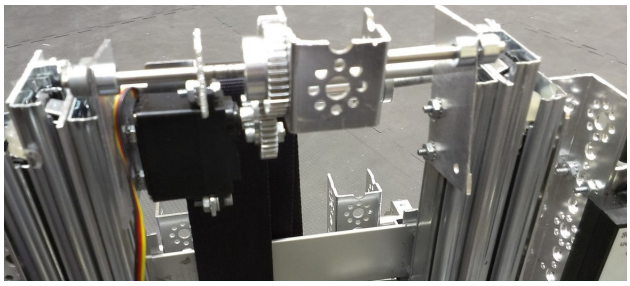


Figure 67: MOB

   3.2. -shaped rigidity rib wasn't installed.
   3.3. It was decided to create the bucket so that on the bottom of the bucket there is pallet 7cm in height. A ramp is fixed on a front part of it. Then there is the part that opens on the front. It is needed for getting balls into the bucket. Then the bucket starts to narrow and at the top there is the hole slightly bigger than the big ball. The uniform narrowing doesn't allow the balls to get stuck inside the tube. After the bucket, there is a gutter that is fixed on the top pair of slats so that balls fall from the overturned bucket into the goal. The gutter ends by a folding element that directs balls to fall vertically - this increases the accuracy.

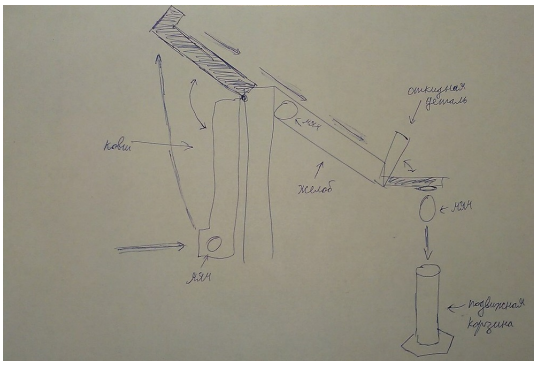


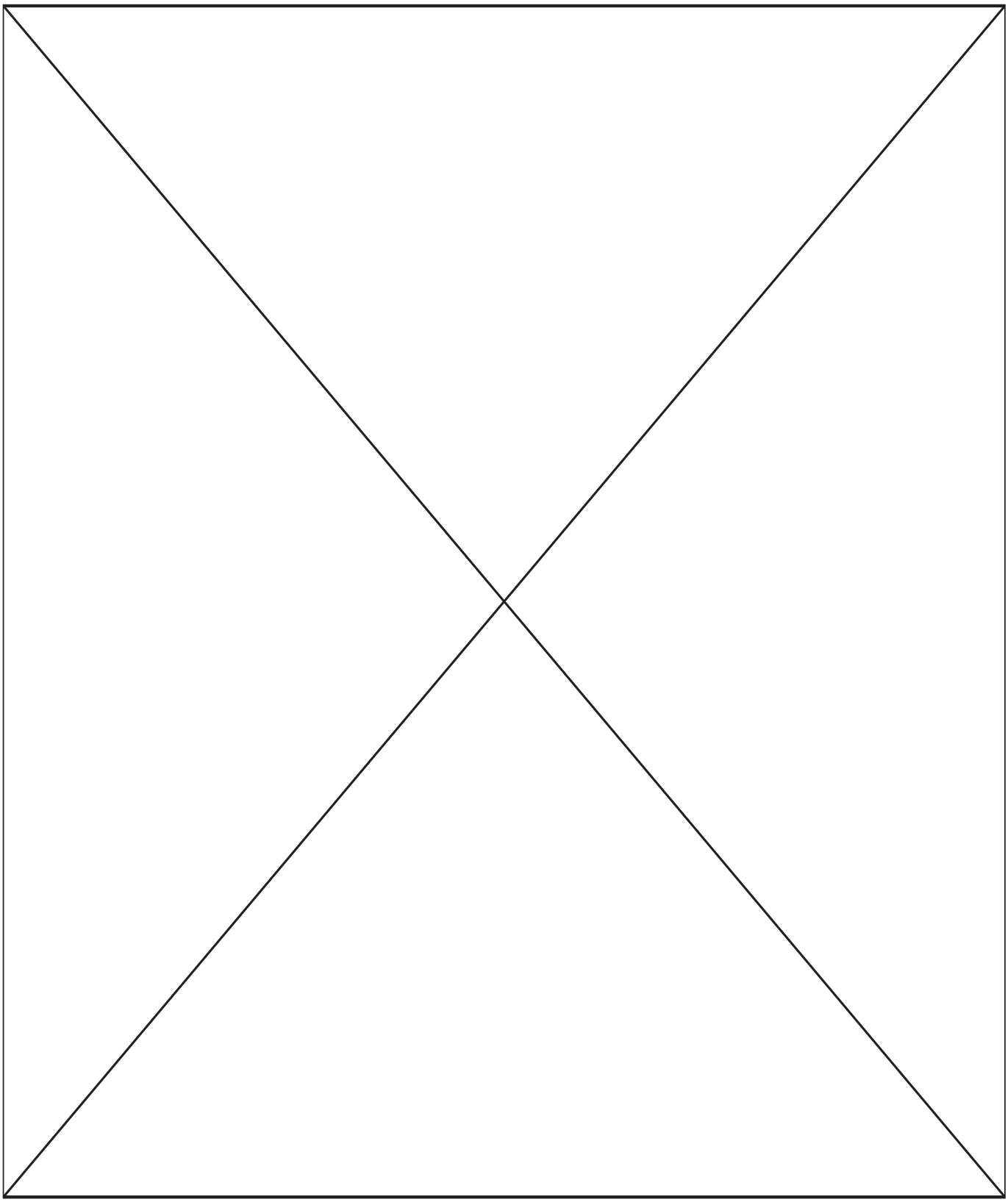
Figure 68: Concept of the bucket

4. Results:
   4.1. MOB was moved to the top of the last slat.
   4.2. Rib of rigidity wasn't installed.
   4.3. Concept of the bucket elaborated

5. Tasks for the next meetings:

   5.1. To install -shaped rib of rigidity.

   5.2. To start implementation of the bucket.



4.5.40 05.12.14

1. The time of beginning and ending of the meeting: 16:00 - 20:00
2. Purposes of the meeting:
   2.1. To install U-shaped rib of rigidity.
   2.2. To measure the inner space of the robot and choose the optimal size of the bucket.
3. Work that had been done:
   3.1. U-shaped rib of rigidity had been installed.

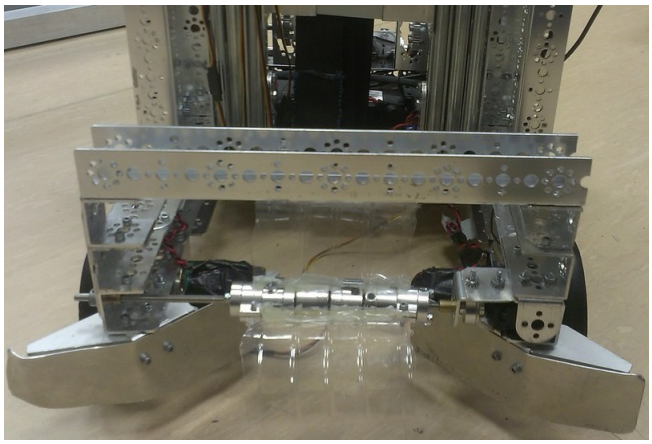
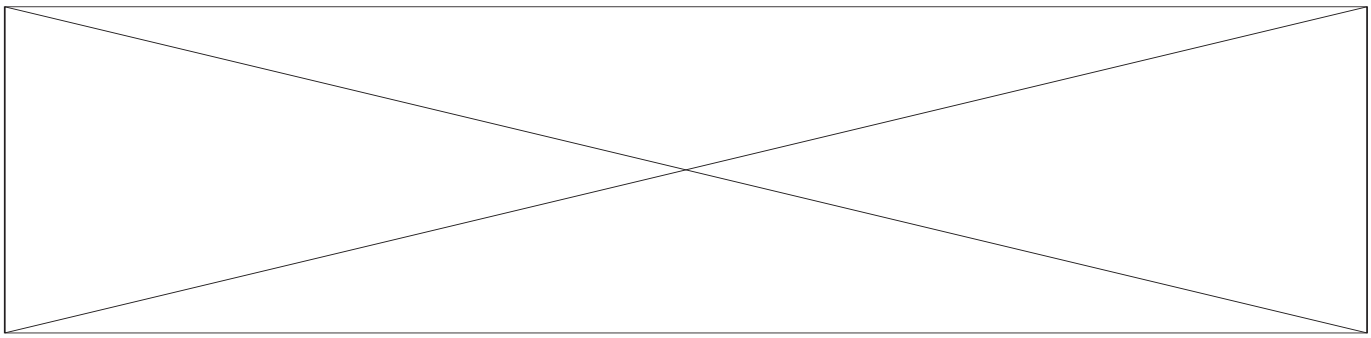


Figure 69: U-shaped rib of rigidity

   3.2. We measured the space allocated for bucket and chose optimal sizes for it.
   3.3. improved the program of autonomous period. Removed function that converted reading of encoder to centimeters. This increased the speed of the program and allowed the robot to accurately turn around and return to the parking zone.
4. Results:
   4.1. U-shaped rib of rigidity installed.
   4.2. Program of autonomous period improved.
5. Tasks for the next meetings:
   5.1. To draw out the design for the new bucket.
   5.2. To choose and buy the material for the new bucket.



4.5.41 06.12.14

1. The time of beginning and ending of the meeting: 16:10 - 20:10
2. Purposes of the meeting:
   2.1. To create the drawing for new bucket.
   2.2. To choose the material for bucket.
3. Work, that has been done:
   3.1. Drawing of projection of bucket was created.

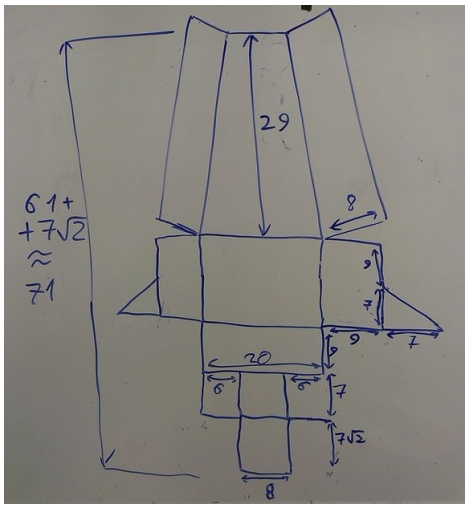


Figure 70: Drawing of projection of bucket with sizes in cm

   3.2. For creation of bucket it was decided use PET (type of plastic).
   3.3. It was turned out that MEL staggers. It was installed transeverse rib of rigidity.

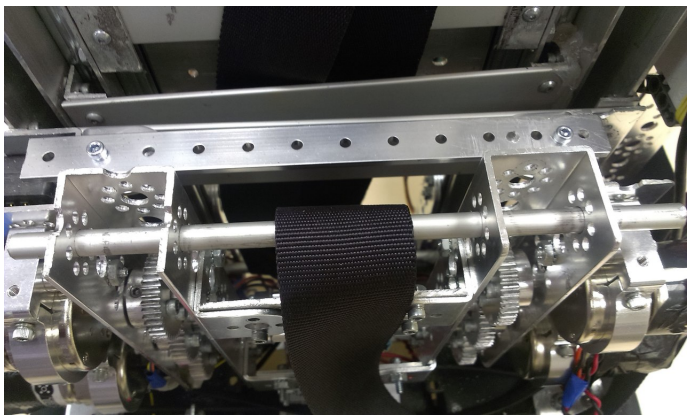


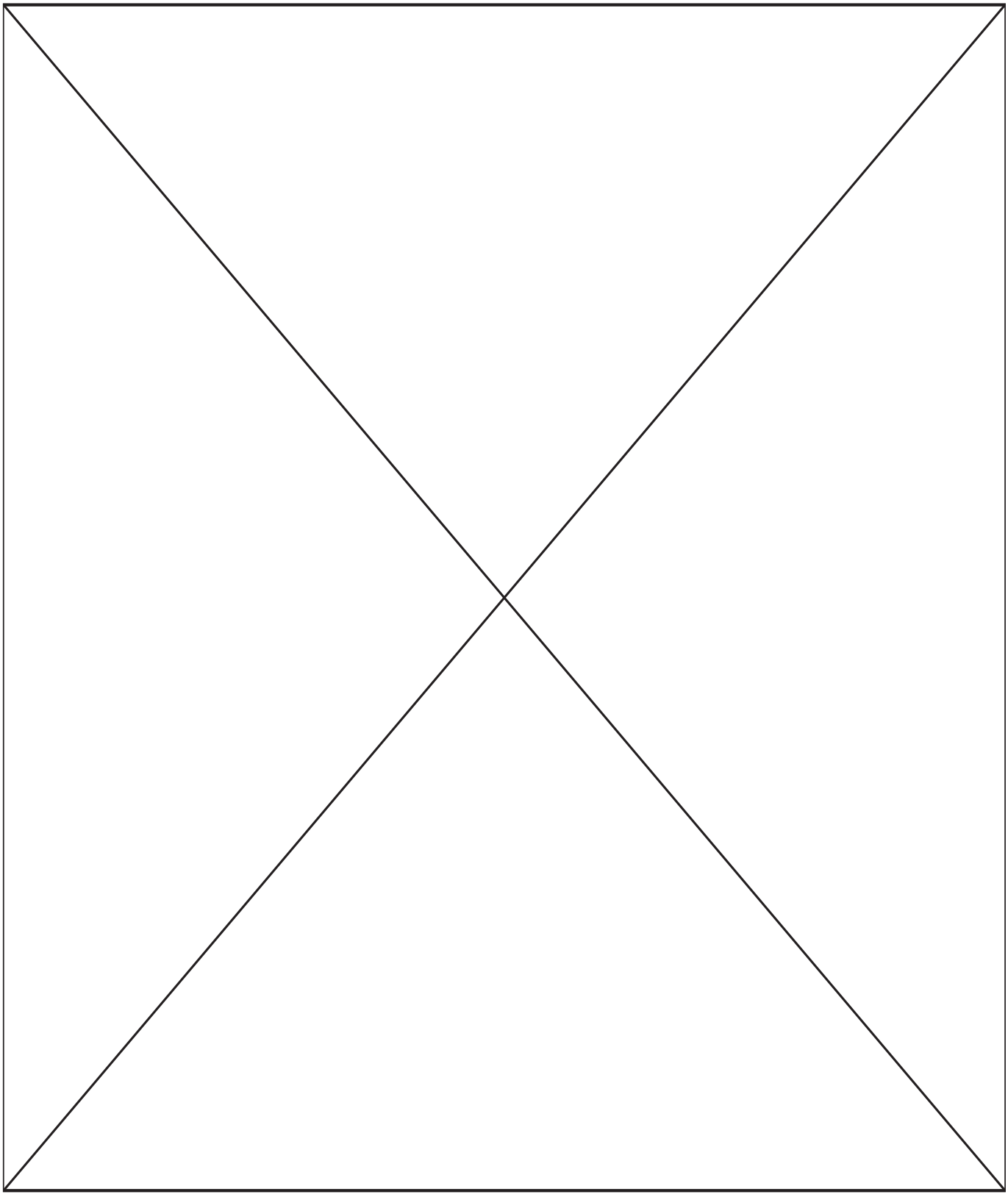
Figure 71: Rib of rigidity

4. Results:
   4.1. Drawing for bucket was created.
   4.2. Material for bucket was chose.

4.3. MEL was strengthened.

5. Tasks for the next meetings:

5.1. To make a new bucket.



4.5.42 08.12.14

1. The time of beginning and ending of the meeting: 17:00 - 20:30
2. Purposes of the meeting:
   2.1. To make the new bucket.
   2.2. To test the new bucket.
3. Work that has been done:
   3.1. We use as a material for bucket packaging of PET because we couldn't buy list of PET.
   3.2. Projection of bucket was cut out. Bucket was fastened by duct tape. We planned to strengthen it by superglue.

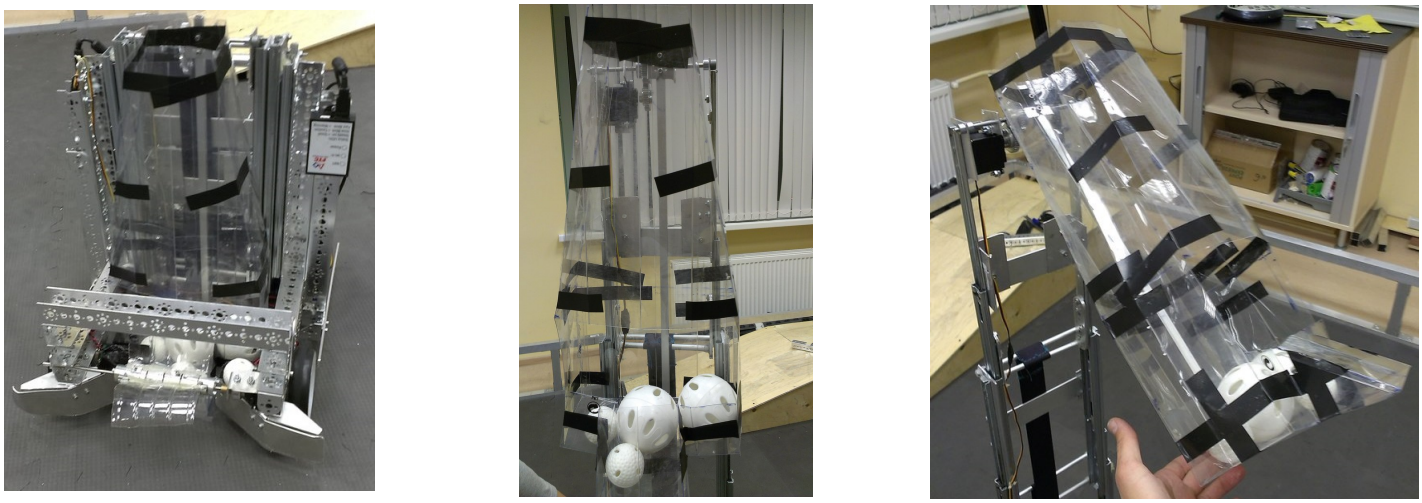


Figure 72: New bucket

   3.3. Bucket was tested for picking up balls. In most cases balls gets into the bucket. Some balls gets to the side and stuck on the robot. It was decided to make slopes which will prevent to balls get to side. Some balls doesn't leave the gripper and throws outside. It was decided to install limiters which prevent to balls move outside. Balls doesn't fall from the bucket after getting to it.
   3.4. It was turned out that small balls can get under the bottom of robot due to the increase of clearance. So the slopes were fixed lower.
   3.5. Bucket was bended due to the weight of balls. So it was fixed aluminium profile to back part of bucket. After that bucket stop to bend.
4. Results:
   4.1. Bucket was created and installed on the robot.
   4.2. Tests of bucket were succsessful.
   4.3. Slopes were fixed lower.
5. Tasks for the next meetings:
   5.1. To test MOB with the bucket.
   5.2. Install limiters that will prevent to balls move outside the bucket.

4.5.43 09.12.14

1. The time of beginning and ending of the meeting: 15:50 - 20:30
2. Purposes of the meeting:
   2.1. To strengthen the bucket with superglue.
   2.2. To test MOB with the new bucket.
3. Work that has been done:
   3.1. Seams of bucket were fastened by superglue.
   3.2. It was turned out that MOB can't turn the bucket because now the length of bucket's lever is 40cm. It impossible to install the sinker due to that MOB is 1cm from maximum height. Now we don't know how to solve this problem but to the next meeting we'll think about it and discuss our ideas.
   3.3. By today we bought steel axis with diametr 8mm. It was started replacing of the crossbars. Axis was sawned on pieces with desired length.
   3.4. It was decided to make holes in the axis and insert screws in them for fixing it on the lift.

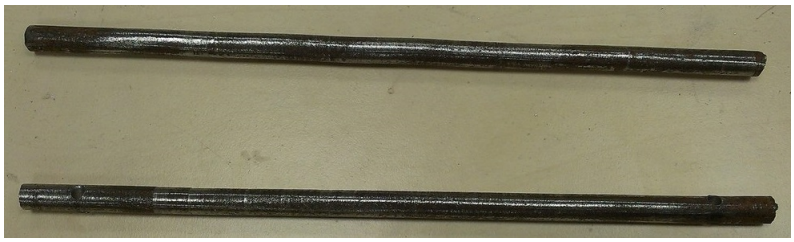
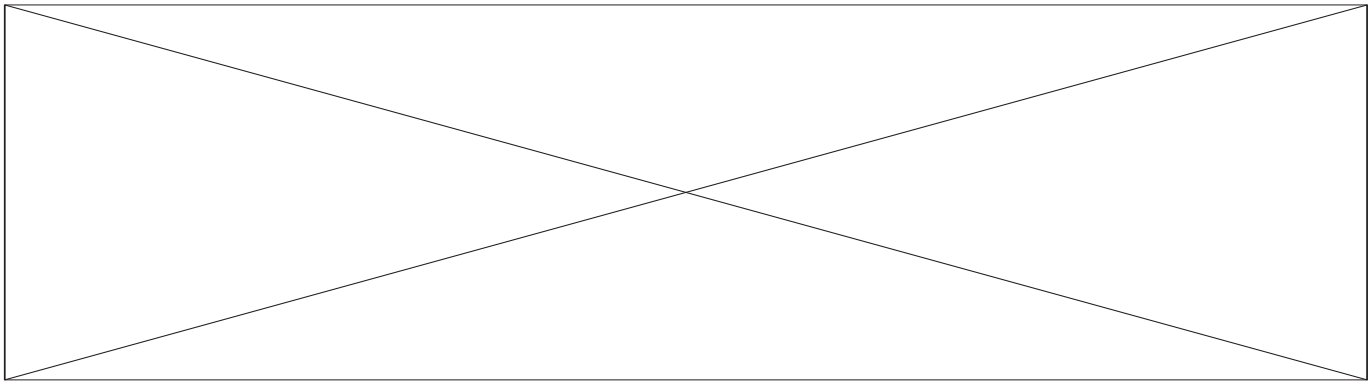


Figure 73: Axis was sawn

4. Results:
   4.1. The bucket was strengthened by superglue.
   4.2. MOB was tested. Now it can't overturn the bucket.
   4.3. Steel axis was sawn on the pieces with desired length.
5. Tasks for the next meetings:
   5.1. To fix steel crossbars on the lift.
   5.2. To solve the problem with overturning the bucket.



4.5.44 10.12.14

1. The time of beginning and ending of the meeting: 17:30 - 21:00
2. Purposes of the meeting:
   2.1. To fix the steel crossbars on the lift.
   2.2. To solve the problem with overturning the bucket.
3. Work that has been done:
   3.1. One steel crossbar was installed on the robot.

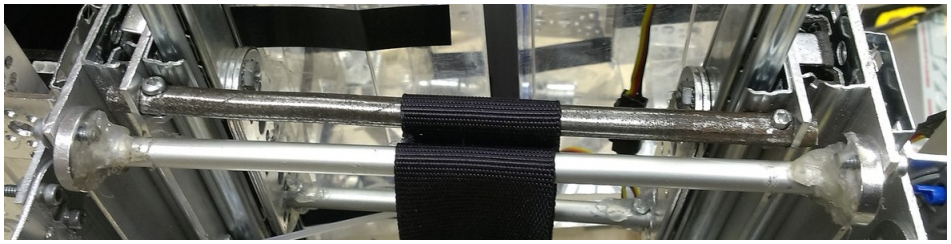
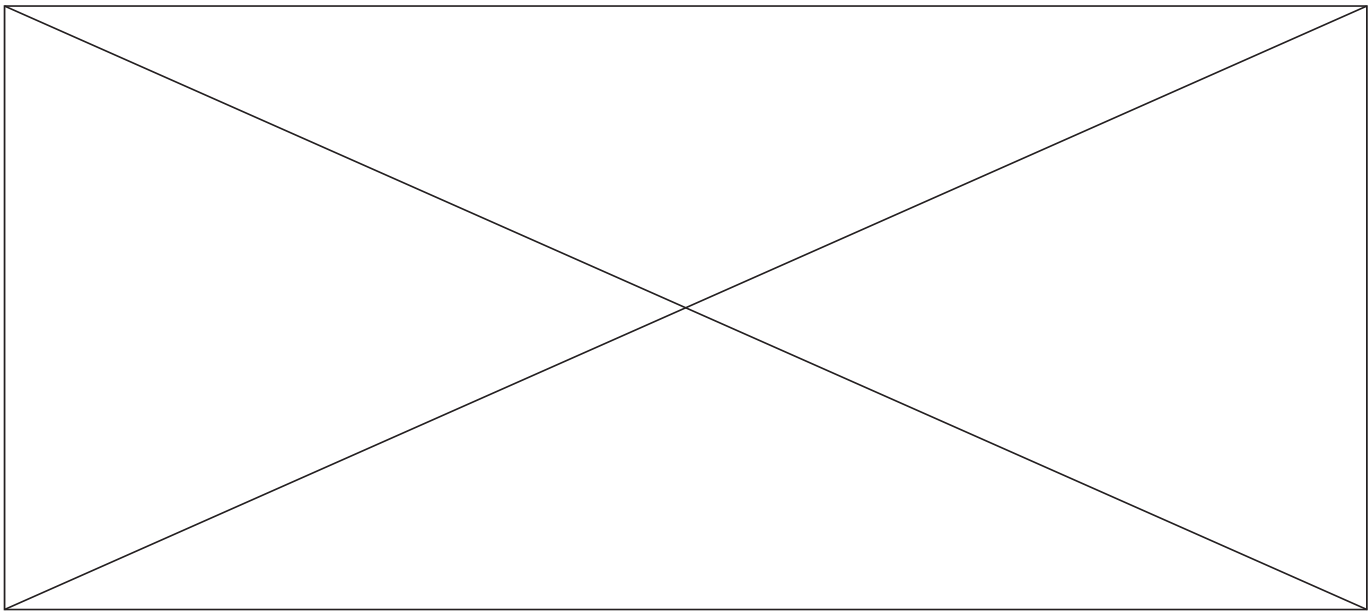


Figure 74: Steel crossbar

   3.2. It was decided to install on the MOB two servos for solution problem with overturning the bucket.
4. Results:
   4.1. One steel crossbar were installed.
   4.2. It was proposed the idea for solution problem with overturning the bucket.
   4.3. Second servo wasn't installed.
5. Tasks for the next meetings:
   5.1. To finish installation of steel crossbar on the lift.
   5.2. To add second servo on the MOB.



4.5.45 11.12.14

1. The time of beginning and ending of the meeting: 17:30 - 23:30
2. Purposes of the meeting:
   2.1. To finish installation of steel crossbar on the lift.
   2.2. To add second servo on the MOB.
   2.3. To package the robot for transportation it to competition "Robofest-Ryazan".
3. Work that has been done:
   3.1. It was installed another one crossbar. It was decided to leave aluminium axis with the tube on the bottom crossbar because steel axis can't get into the tube. In addition aluminium axis doesn't bend due to the tube. Also the tube reduces the friction becaise it can rotate on the axis.
   3.2. The aluminium axis with the tube was oiled for additional redusing the friction.

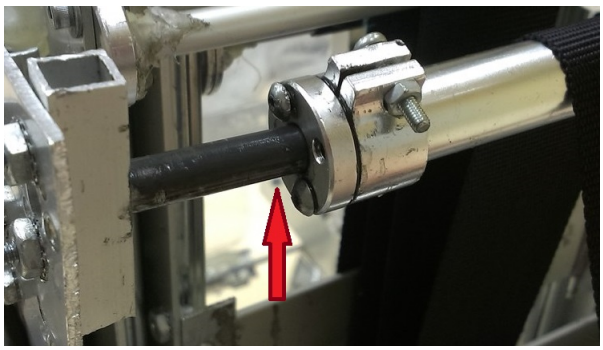


Figure 75: The bottom crossbar was oiled

   3.3. Two servos can't to overturn the bucket. So it was decided to return MOB to the previous position (in the center part of the top slat).
   3.4. Robot was packaged for transportation.
4. Results:
   4.1. Steel crossbars were installed.
   4.2. It was decided to move MOB to the previous position.
   4.3. MOB wasn't moved.
5. Tasks for the next meetings:
   5.1. To move MOB to the previous position.
   5.2. To train on the control of the robot.
   5.3. To install mechanism that will direct balls vertically.

4.5.46 13.12.14 (Competition)

1-nd day of competition "Robofest-Ryazan"

Today there were training day. Improvements that were done:

1. MOB was moved to the previous position.

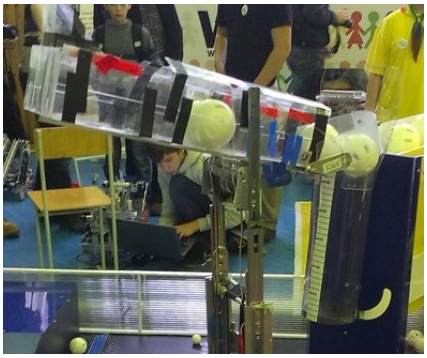


Figure 76: Mount of MOB (on the photo robot put the balls into 120cm goal)

2. It was turned out that bucket can't pass between the slats. So it was cut.

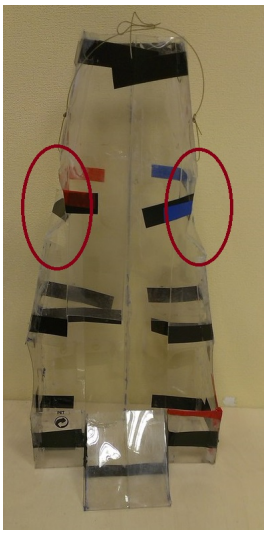


Figure 77: Bucket was cut

3. It was installed screw that stops the blades of gripper for increase quality capturing small balls. So that blades sharply turns and due to elastic force of blades ball gets into the bucket.

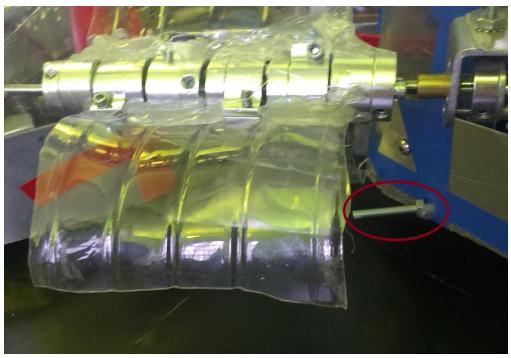


Figure 78: Screw

4. It was installed mechanism that directs balls vertically.

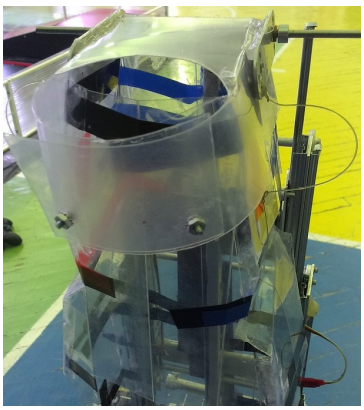
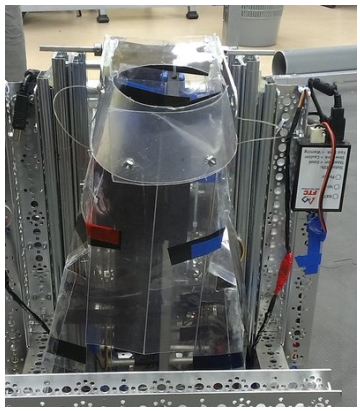
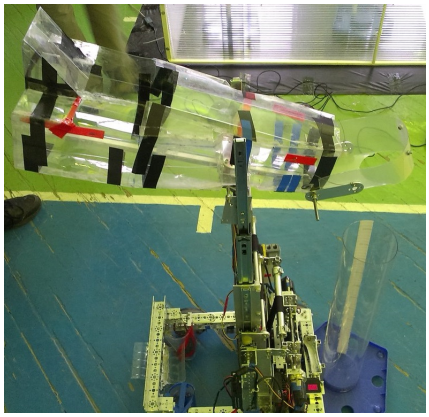




Figure 79: Mechanism that directs balls vertically

5. During the trainings mount of one axis was broke. It happend due to that the axis was fixed too close to edge of the plate. So the axis was moved.

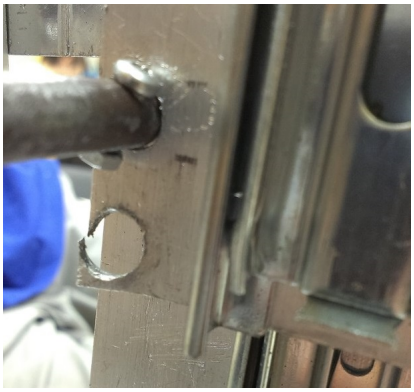
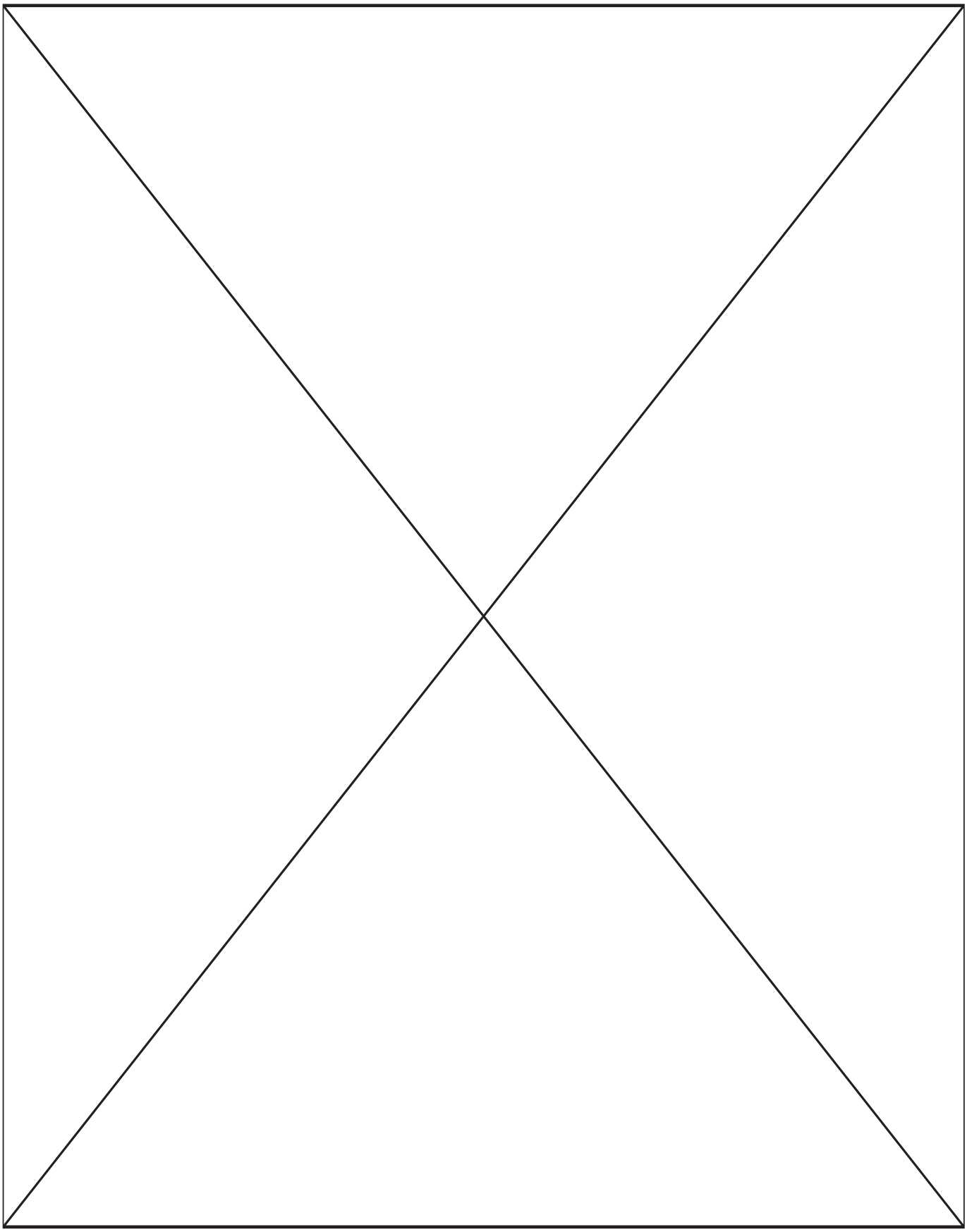


Figure 80: Broken mount for axis

6. All slats were oiled.

7. They were installed slopes that prevents balls stuck on the front motors. They were not closed from the top. We think that it's not a problem because the slopes has enough heigh and balls can't to stuck on the motor.

8. Programme of autonomous period was corrected in accordance with friction on this field.



4.5.47 14.12.14 (Competition)

2-nd day of competition "Robofest-Ryazan"

Today there were qualification and final matches and protection of engineering books.

Main problems that were found during the matches:

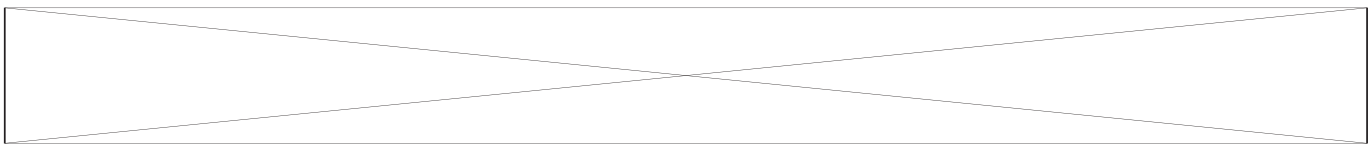
1. Wires that connect MOB with servocontroller often loses contact between themselves. So operator couldn't to control it.
2. Wires that connects drivers of motors and battery were closed on each other. So battery started to hot.
3. Bucket was cracked due to kicks on rigid obstacles (for example center goal).
4. It was found that the lift shakes during the rising. So some balls fall outside the bucket.
5. Sometimes balls stuck on the additional slopes because they wasn't closed from the top.

Results:

1. We didn't get to "top 2" by the results of qualification matches.
2. We took part in the final match becauce team "PML 30 ψ" choosed us. Our alliance took first place.
3. We took first place in nomination "Engineering book".

Summing up:

1. Succsess of performance on competition:
   1.1. Our alliance took first place. It is mainly due to our teammate - "PML 30 ψ".
   1.2. We took first place in nomination "Engineering book".
2. Our mistakes and disadvantages in construction:
   2.1. Wiring was not reliable. So we often had problems with MOB and motors.
3. Tasks for the next meetings:
   3.1. To replace wiring to more reliable.
   3.2. To make more comfortable programme of control robot's moving.
   3.3. To make bucket of quality plastic.
   3.4. To make additional slopes that will be closed from the top.
   3.5. It was found that it unprofitable to capture small balls. So we should to remove the screw that stops the blades.
   3.6. To make MCB that can to keep the rolling goal when robot is on the ramp after power off.
   3.7. To install slopes for alignment rolling goal.
   3.8. One motor that moves robot broke during the final match. It must be raplaced.

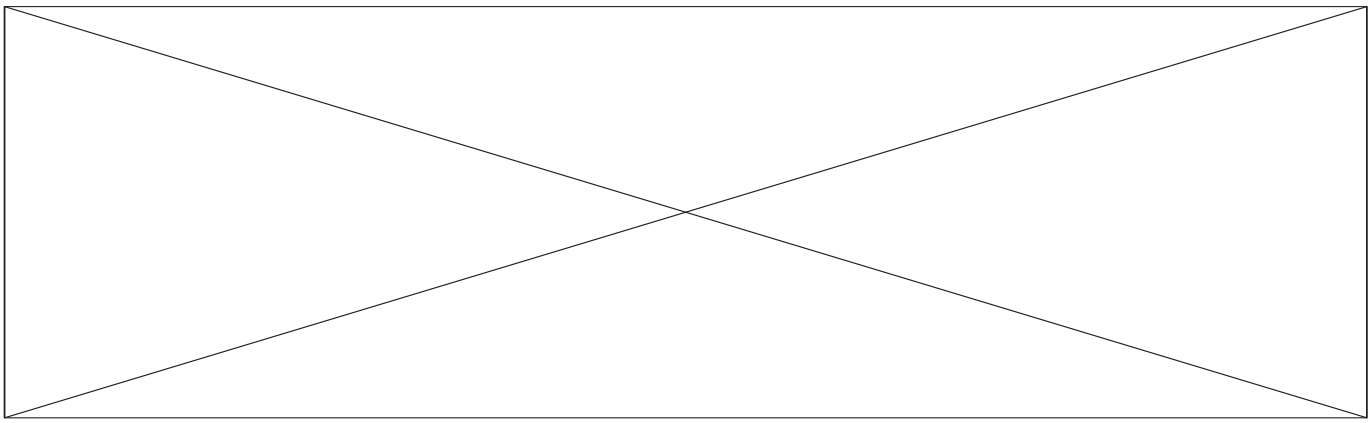


4.5.48 19.12.14

1. Time of beginning and ending of meeting: 16:00 - 20:00.
2. Purposes of meeting:
   2.1. To check and correct contacts on the drivers of motors.
   2.2. To make framework of the new bucket.
3. Work that has been done:
   3.1. Length of bare parts of wires that connect battery with drivers of motors was corrected. So that they can't to contact with each other. We also plan to solder the ends of this wires. Today we couldn't to make it because we didn't have soldering iron.
   3.2. It was cut framework of the bucket. In the future we plan to fasten it by stapler.

Figure 81: Framework of the bucket

4. Results:
   4.1. Length of contacts on the drivers was corrected but they weren't soldered.
   4.2. It was created the framework of the new bucket.
5. Tasks for the next meetings:
   5.1. To solder the ends of wires that connect battery with drivers.
   5.2. To fasten the bucket by stapler.



4.5.49 20.12.14

1. Time of beginning and ending of meeting: 17:00 - 20:00.
2. Purposes of meeting:
   2.1. To fasten the bucket by stapler.
   2.2. To install strengthening plates to the bottom slat of the lift.
3. Work that has been done:
   3.1. The new bucket was fastened by stepler. It was tested quality of ball's moving through the bucket. Result positive: balls roll from it without problems.

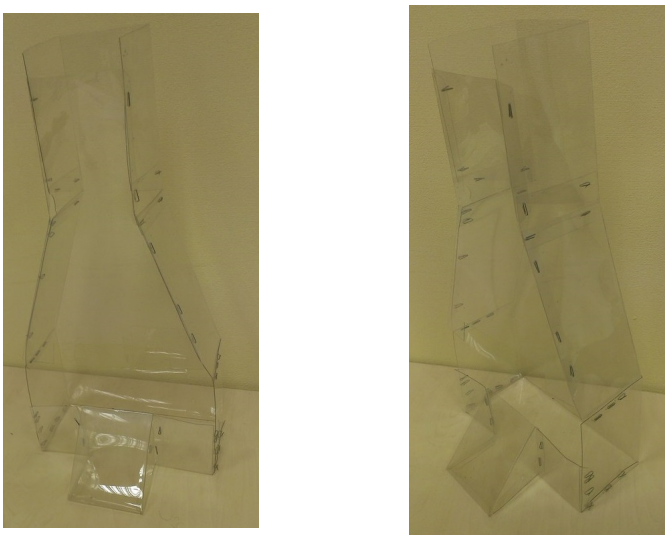
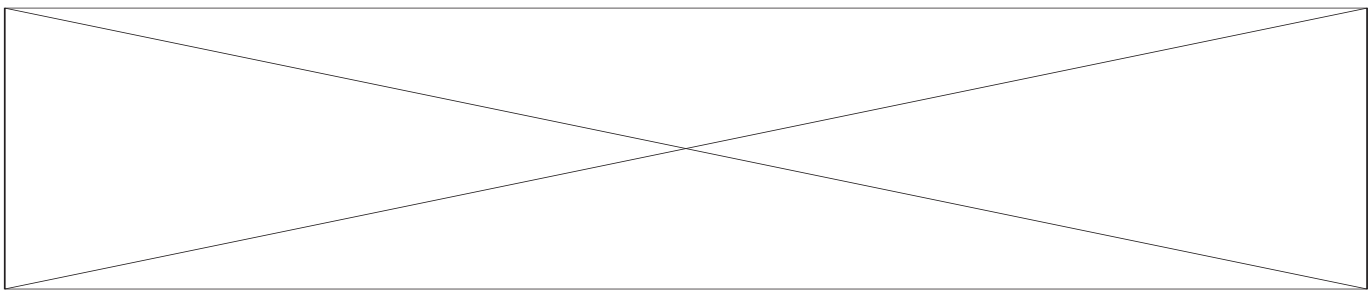


Figure 82: The new bucket

   3.2. Strengthening plates were sawned but not installed.
4. Results:
   4.1. Bucket was finished.
   4.2. Strengthening plates were sawned but not installed.
5. Tasks for the next meetings:
   5.1. To install strengthening plates.
   5.2. To replace broken motor.
   5.3. To solder the ends of wires that connect battery with drivers.



4.5.50 22.12.14

1. Time of beginning and ending of meeting: 16:00 - 19:00; 20:30 - 21:00.
2. Purposes of meeting:
   2.1. To install strengthening plates.
   2.2. To replace broken motor.
   2.3. To change an additional slopes so that the ball can't stuck on the motor.
3. Work that has been done:
   3.1. Additional slopes were changed. Now they protect space where stuck the balls from all sides.

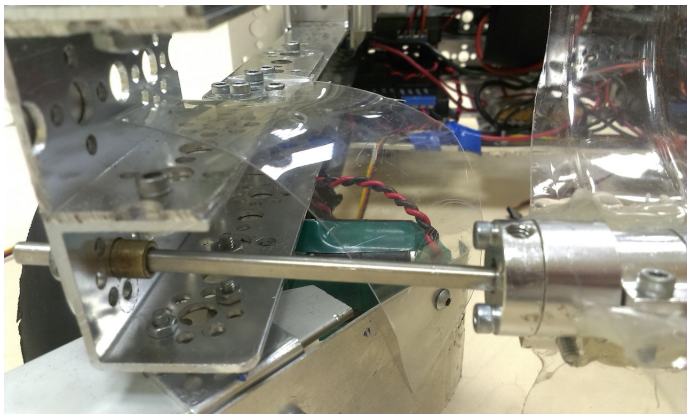
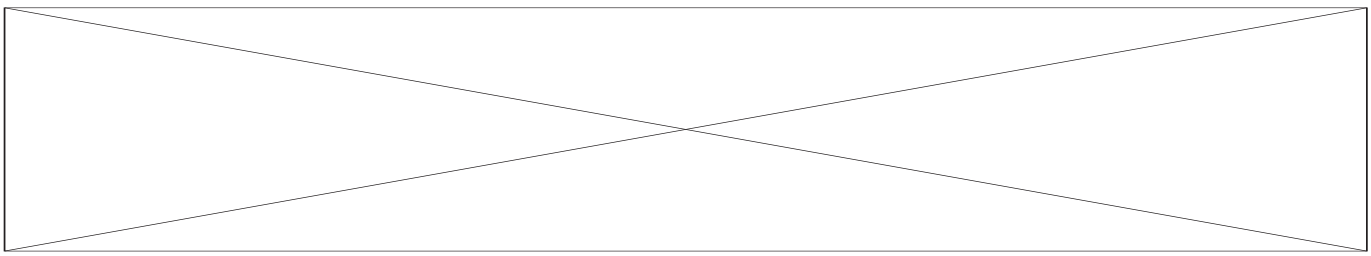


Figure 83: New slopes

   3.2. Broken motor was repaired (it was rebuilt reducer).
   3.3. It was made holes for fixing strengthening plates. One plates was fixed.
4. Results:
   4.1. Slopes were changed.
   4.2. Broken motor was repaired.
   4.3. Strengthening plates partically were fixed.
5. Tasks for the next meetings:
   5.1. To install strengthening plates.
   5.2. To solder the ends of wires that connect battery with drivers.
   5.3. Buy more powerful servo for MOB.
   5.4. To make wire that will connect servoconroller with MOB.

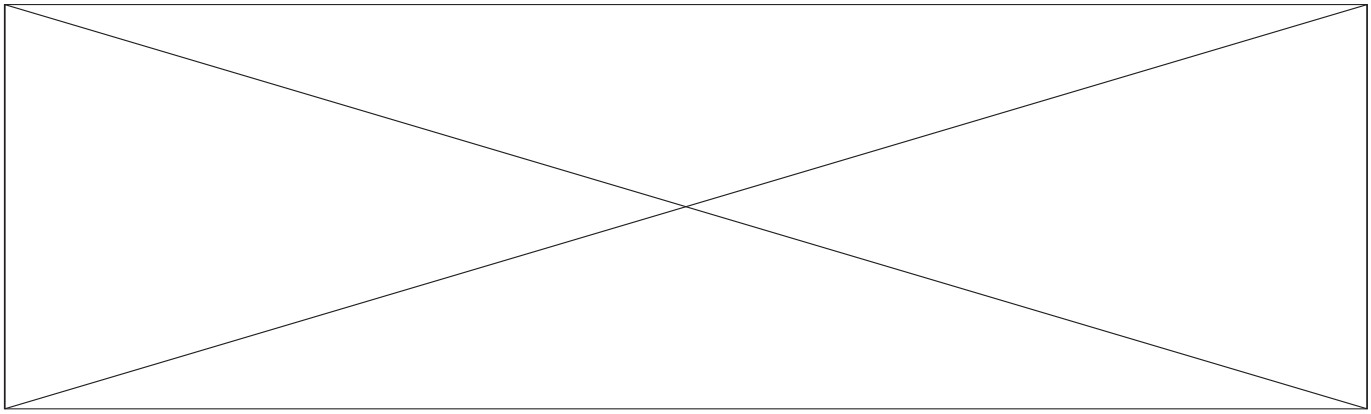


4.5.51 24.12.14

1. Time of beginning and ending of meeting: 18:00 - 20:30.
2. Purposes of meeting:
   2.1. To install strengthening plates.
   2.2. To solder the ends of wires that connect battery with drivers.
3. Work that has been done:
   3.1. Strengthening plates were installed. Each plate was fixed on the main plate by two screw.

Figure 84: Mount for axis

   3.2. On today we bought solder iron.
   3.3. They were soldered ends of some wires. After that solder iron broke. It was decided to buy good solder iron.
   3.4. One furniture slat broke. It need to replace it.
4. Results:
   4.1. Strengthening plates were installed.
   4.2. Part of wires were soldered.
   4.3. One slat broke.
5. Tasks for the next meetings:
   5.1. To replace broken slat.
   5.2. To finish soldering wires.



4.5.52 27.12.14

1. Time of beginning and ending of meeting: 16:15 - 20:00.
2. Purposes of meeting:
   2.1. To finish soldering wires.
   2.2. To elaborate MCB that can to keep rolling goal when power off.
   2.3. To write more comfortable programme of control robot.
3. Work that has been done:
   3.1. Ends of all wires were soldered.
   3.2. It was decided to install on MCB two stickers so that MCB doesn't open due to weight of rolling goal when robot is on the ramp. Stickers were installed but didn't tested because we hasn't got original rolling goals.

Figure 85: Stickers on MCB

   3.3. It was wrote more comfortable programme of control robot. Now control of moving is by multi positional button "TopHat". Robot can move by 8 ways: forward, backward, clockwise rotation, counterclockwise rotation and turning by only one pair of wheels (left or right). Also robot moves slower when operator presses button 7.

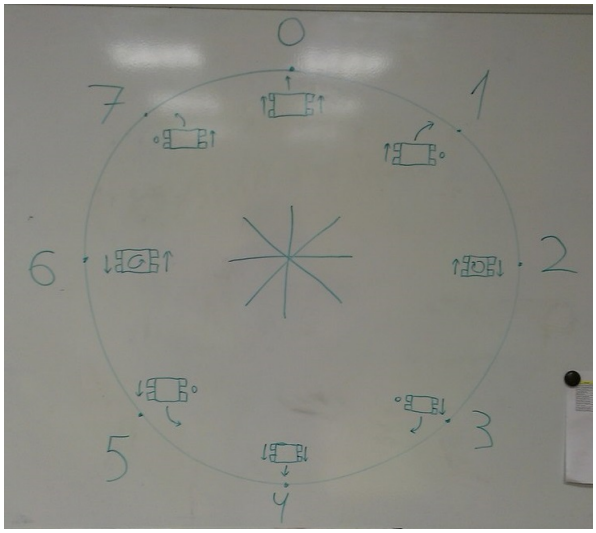


Figure 86: The scheme of control moving

3.4. During the tests of programme it was found that repaired motor doesn't work on the field. It works when robot above the floor but doesn't work under the load. It was found that the problem is in the motor and not in the driver or wire. We need to replace it.

4. Results:

4.1. Ends of all wires were soldered.

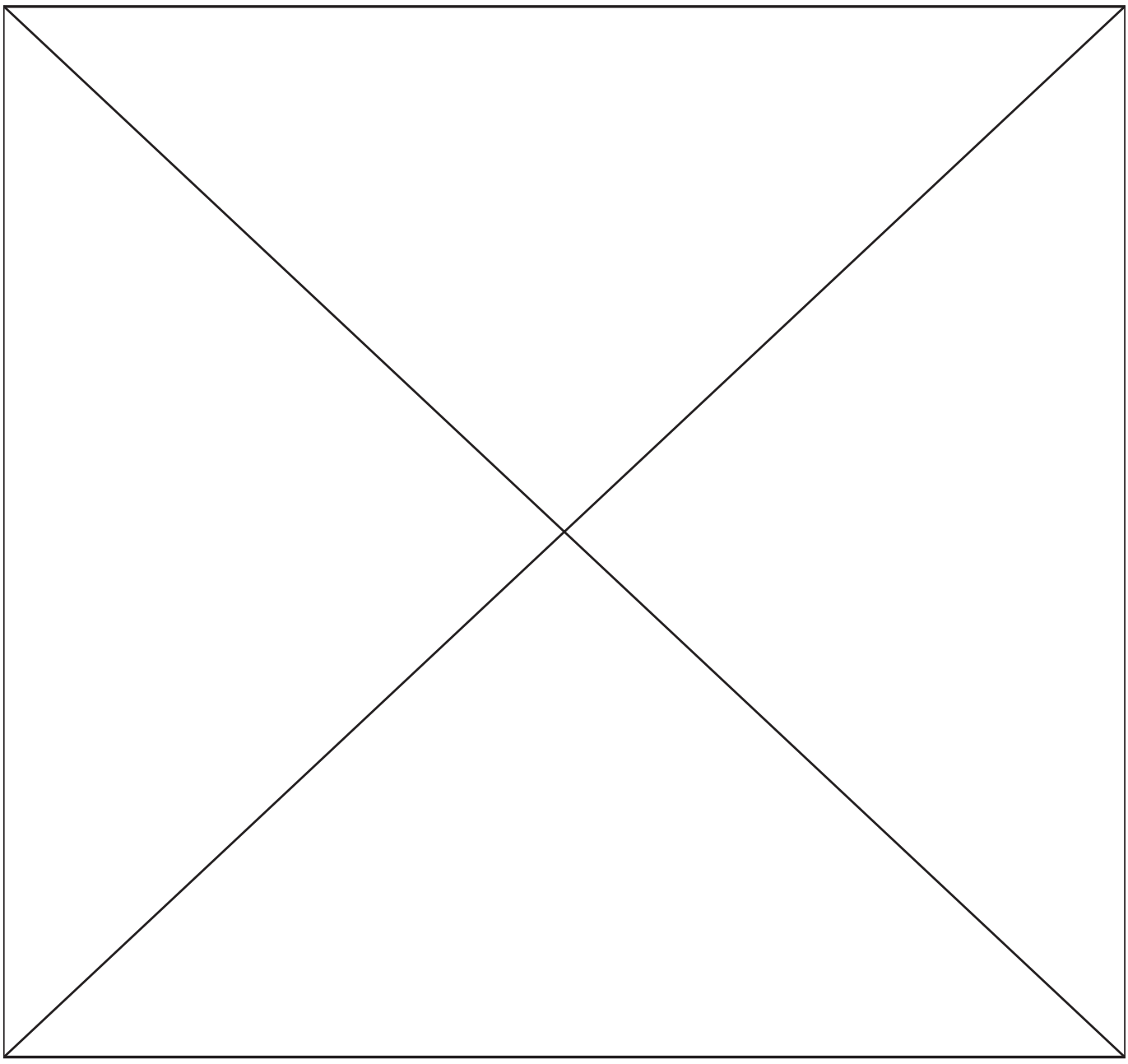
4.2. MCB was improved but wasn't tested.

4.3. New programme of control robot was tested. Result positive.

5. Tasks for the next meetings:

5.1. To replace broken motor.

5.2. To replace broken slat.



4.5.53 07.01.15

1. Time of beginning and ending of meeting: 15:00 - 20:00
2. Purposes of meeting:
   2.1. To install powerful servo on the MOB.
   2.2. To replace broken motor.
   2.3. To install slopes for aligning the rolling goal.
3. Work that has been done:
   3.1. After the last competition we decided to return to concept of the bucket that was elaborated on 01.12.14. Now we have all the resources needed for making it.
   3.2. Bought a more powerful servo. We choose the servo that had the dimensions of the servo from the Tetrix set but a force 17kg/cm (versus the servo from Tetrix set, which had a force 4kg/cm). This servo wasn't installed today.

Figure 87: New servo

   3.3. Broken motor was replaced and tested. Result positive
   3.4. Decided to make slopes for aligning rolling goal with pieces of plastic bottles. They were installed on MCB.

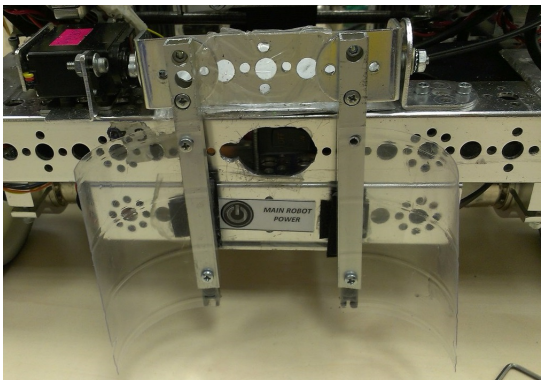


Figure 88: Slopes for alignment rolling goal

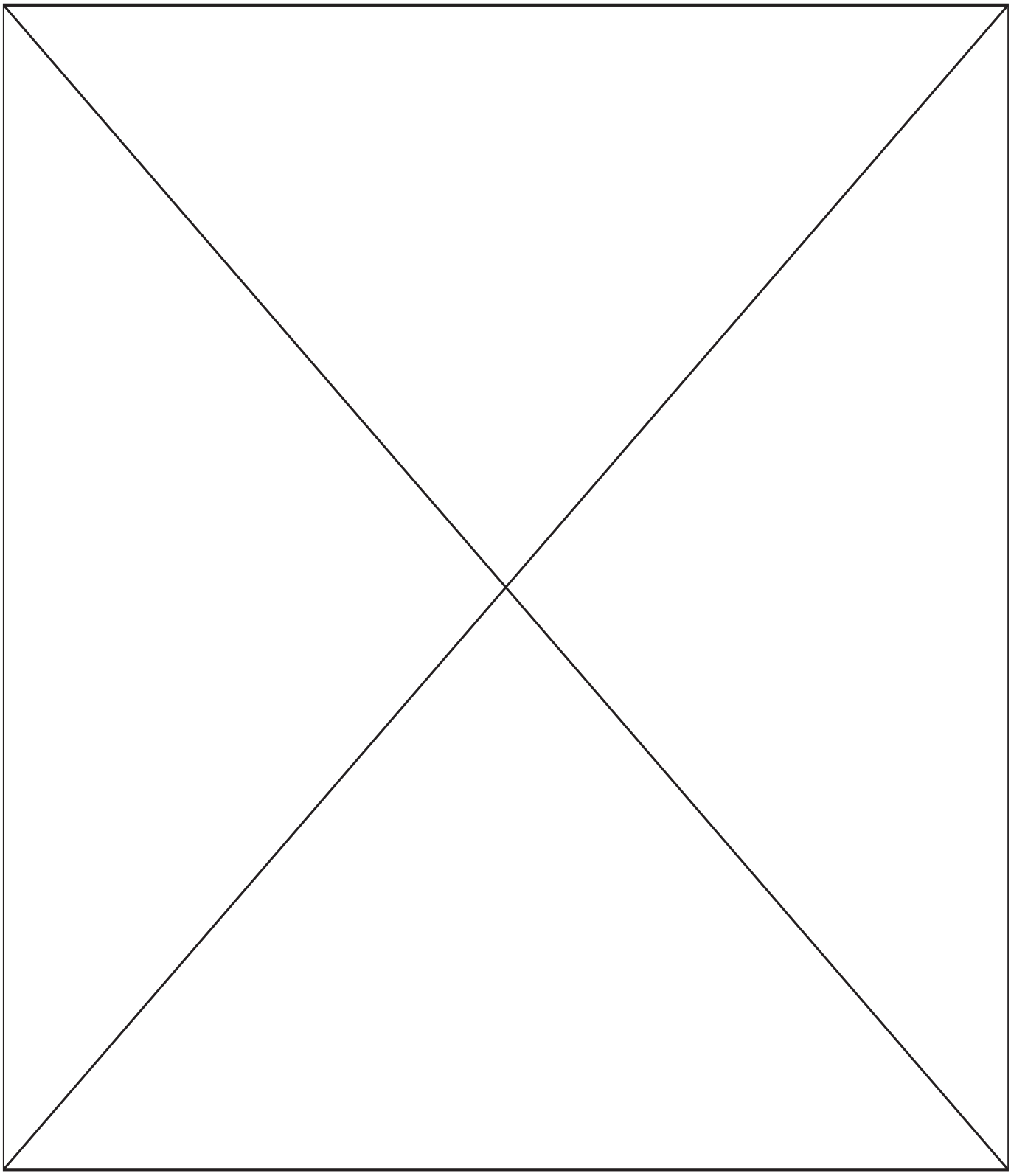
4. Results:
   4.1. New servo wasn't installed on MOB.
   4.2. Broken motor was replaced.
   4.3. Slopes for aligning rolling goal were installed.

5. Tasks for the next meetings:

   5.1. To replace broken slat.

   5.2. To install more powerful servo on MOB.

   5.3. To install the bucket on the new MOB and test it.

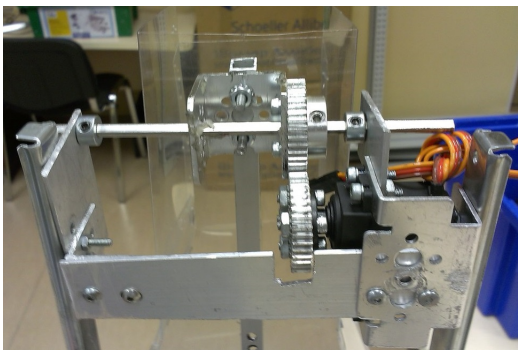


4.5.54 08.01.15

1. Time of beginning and ending of meeting: 14:00 - 23:00
2. Purposes of meeting:
   2.1. To install powerful servo on MOB.
   2.2. To install the bucket on the new MOB and test it.
3. Work that has been done:
   3.1. The beam from Tetrix set was fixed on the servo. It was decided to fasten the bucket on it.
   3.2. New servo was tested. Result positive: servo can to overturn the bucket with five balls when it fixed to the servo to a top part. It allows to us install MOB on the top of slat and crossbars will not to preclude overturning bucket. So we will not should to raise the lift to the top position and then lower it on height of the basket for throwing balls to any basket.
   3.3. Servo was installed on the lift.

Figure 89: Servo with the beam

   3.4. It was decided to fix beam to the servo by transmission with gear ratio 1:1. It will reduce the load on the shaft of servo.
   3.5. Leading gear was installed on the servo.
   3.6. Axis with the driven gear was fixed by two plates. One plate was fixed to the slat and the second - to mount for servo.
   3.7. The bucket was installed to MOB.



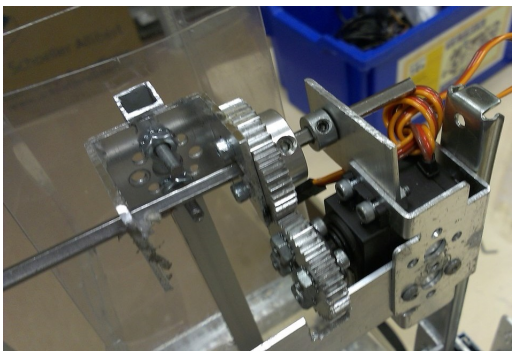


Figure 90: The final version of MOB

3.8. It was found that screws on the mount for servo can to unwind. So the second plate stagger and driven gear moves away from the leading gear and MOB can't to work. It was decided to connect the shaft of servo with the axis by additional plate.

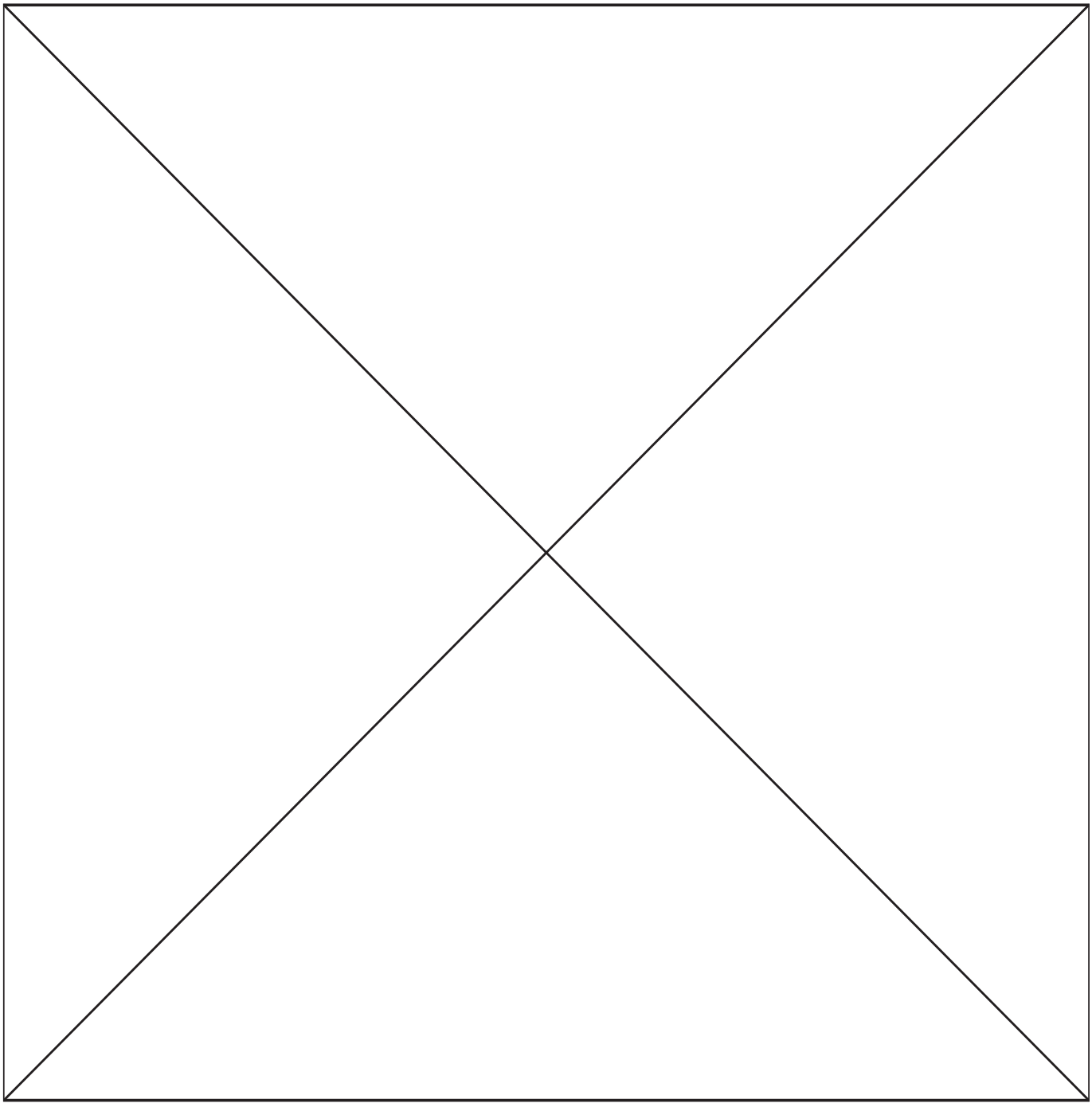
4. Results:

4.1. MOB almost finished.

5. Tasks for the next meetings:

5.1. To make and install plate that will connect shaft of servo with the axis.

5.2. To make and install the wire that connect MOB with servocontroller.



4.5.55 09.01.15

1. Time of beginning and ending of meeting: 15:30 - 21:30.
2. Purposes of meeting:
   2.1. To replace broken slat.
   2.2. To test the programme of control robot when all motors works.
   2.3. To make and install plate that will connect shaft of servo with the axis with driven gear.
3. Work that has been done:
   3.1. Strenghening plate was made and installed on MOB.

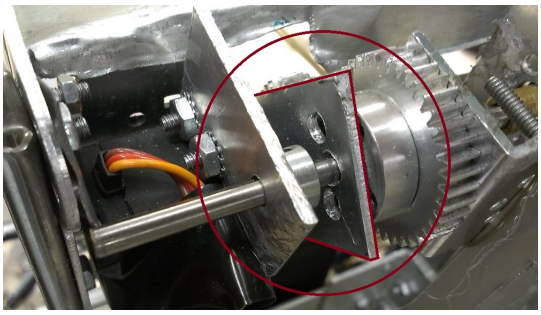
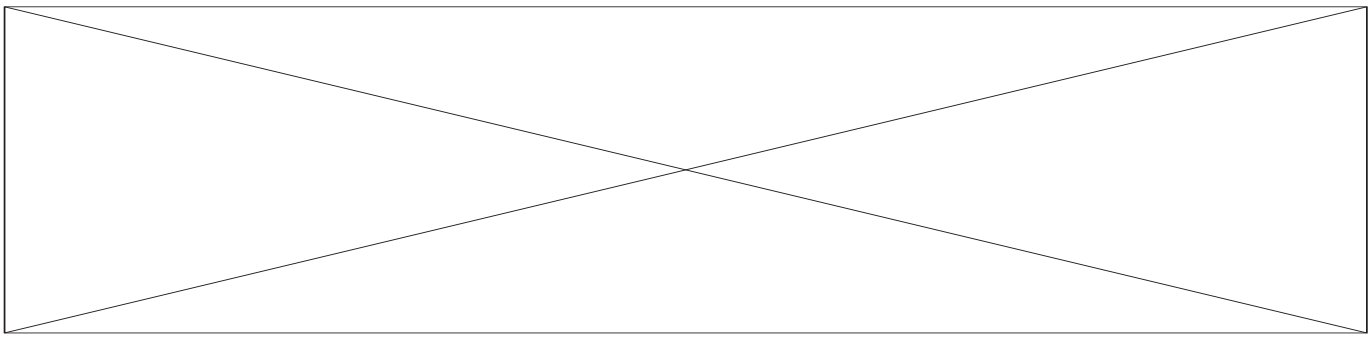


Figure 91: Strenghening plate

   3.2. Broken slat was replaced. Now we also has another one spare slat 30cm because furniture slats solds in pairs.
   3.3. It was decided to make the gutter that will fix on the top pair of slat by galvanized steel with thickness 0.5mm. The balls will roll from the overturned bucket to the goal. It was decided to make drawing of the gutter and then make it.
   3.4. We couldn't test the programme of control robot because all batteries discharged.
4. Results:
   4.1. Broken slat was replaced.
   4.2. The programme of control robot wasn't tested.
5. Tasks for the next meetings:
   5.1. To make the drawing of the gutter and make it.
   5.2. To test the programme of control robot.



4.5.56 10.01.15

1. Time of beginning and ending of meeting: 14:30 - 21:00.
2. Purposes of meeting:
   2.1. To make the drawing of the gutter and make it.
   2.2. To make and install the wire that connect servo that moves MOB with servocontroller.
3. Work that has been done:
   3.1. Drawing of the gutter was created.

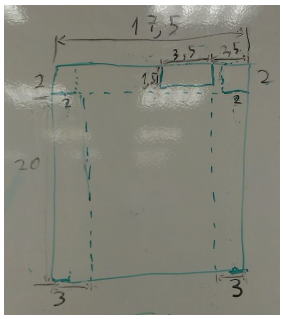


Figure 92: Drawing of the gutter (cuts marked by a solid line and bends marked by the dashed line)

   3.2. It was decided to make one durable wire because standard wires often brokes. We took USB-wire and cut it's ends. This wire was threaded into the elastic tube (the hose for a aquarium) for additional protection. Then plugs were soldered on the wire for connection this wire with the servo controller or another wire. After that the wire was tested by multitester for fractures. Fractures weren't found.

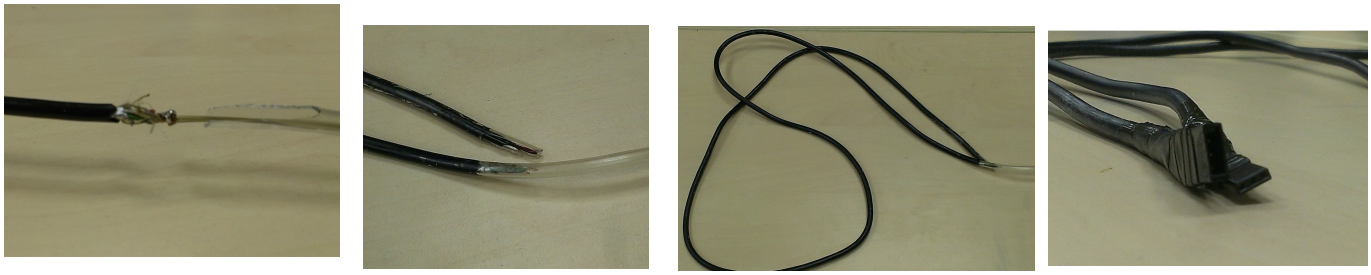


Figure 93: Stages of creation the wire

4. Results:
   4.1. Drawing of the gutter was created.
   4.2. Wire for servo was installed.
5. Tasks for the next meetings:
   5.1. To make and install the gutter.
   5.2. To fix the new wire on the lift.

4.5.57 12.01.15

1. Time of beginning and ending of meeting: 17:00 - 21:30.
2. Purposes of meeting:
   2.1. To make and install the gutter.
   2.2. To fix the new wire on the lift.
   2.3. To test the gutter.
3. Work that has been done:
   3.1. The wire was held and servo was connected.

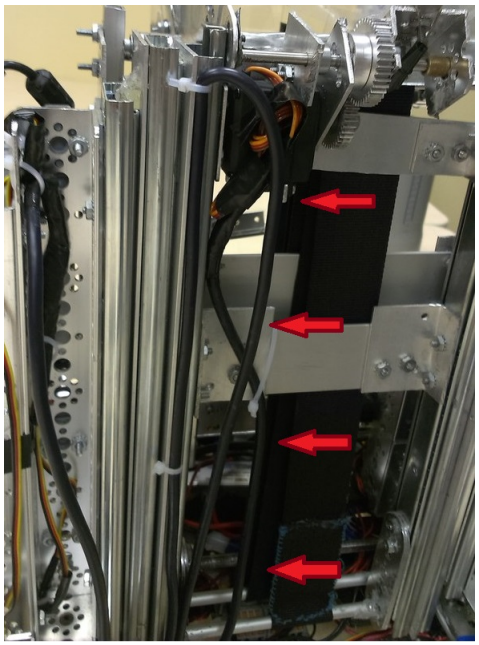


Figure 94: The wire on the lift

   3.2. It was decided to replace slopes on MCB. They were installed metalic slopes instead of plastic. Metalic slopes will not bend and align rolling goal better than plastic.

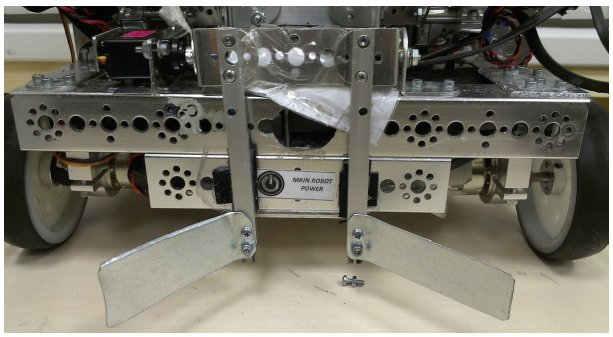


Figure 95: New slopes

   3.3. The gutter was made and installed on the robot.

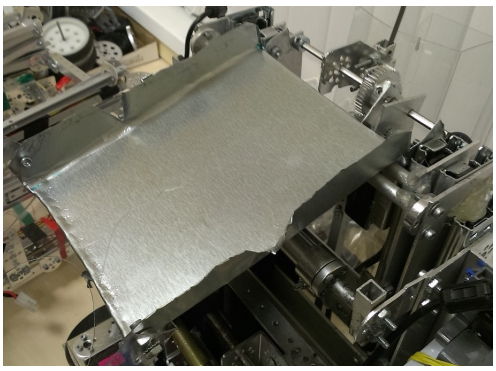
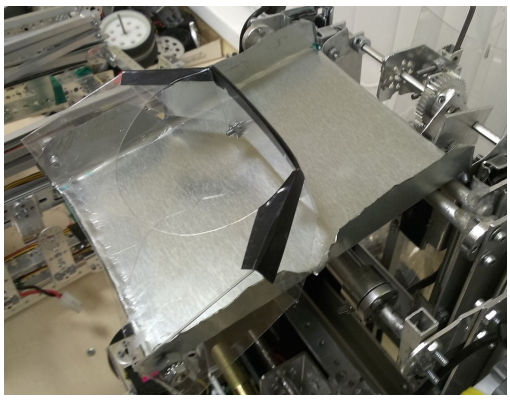


Figure 96: The gutter

3.4. Mechanism that direct balls vertically was installed on the gutter.



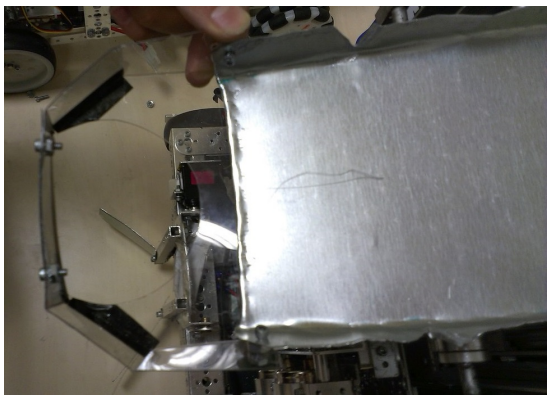


Figure 97: Gutter with a folding element

3.5. Gutter with folding part was tested. Balls falls vertically. It allows high accuracy of throwing balls into the basket.

3.6. The folding part of the gutter must be folded because otherwise robot doesn't get into regulated dimensions. It was decided to connect it with bucket by fishing line. When bucket overturns line stretched and this element reclines. It was decided to make it on the next meeting.

4. Results:

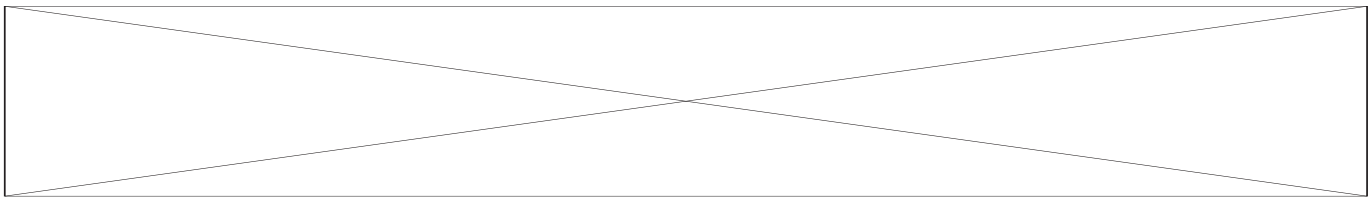
4.1. The wire was held and servo was connected.

4.2. They were made metalic slopes for alignment rolling goal.

4.3. The gutter and folding element were made and installed on the robot.

5. Tasks for the next meetings:

5.1. To connect the folding element (hereinafter it will call as guideway for balls) of the gutter with the bucket.



4.5.58 13.01.15

1. Time of beginning and ending of meeting: 16:00 - 20:00.
2. Purposes of meeting:
   2.1. To connect the folding element of the gutter with the bucket.
3. Work that has been done:
   3.1. The gutter and guideway for balls were improved. The mount of the gutter to the slats was strengthened. Guideway for balls was cut so that it get to regulated dimensions. The guideway was connected with the bucket by fishing line.

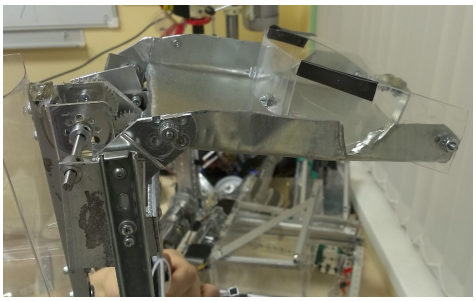
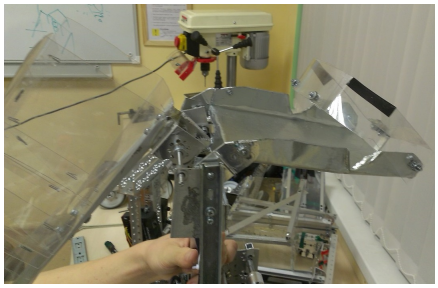
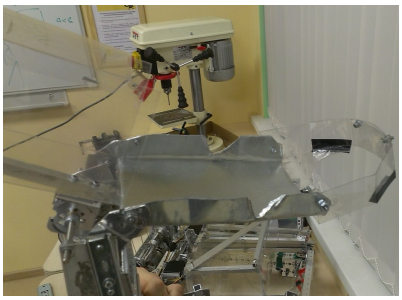
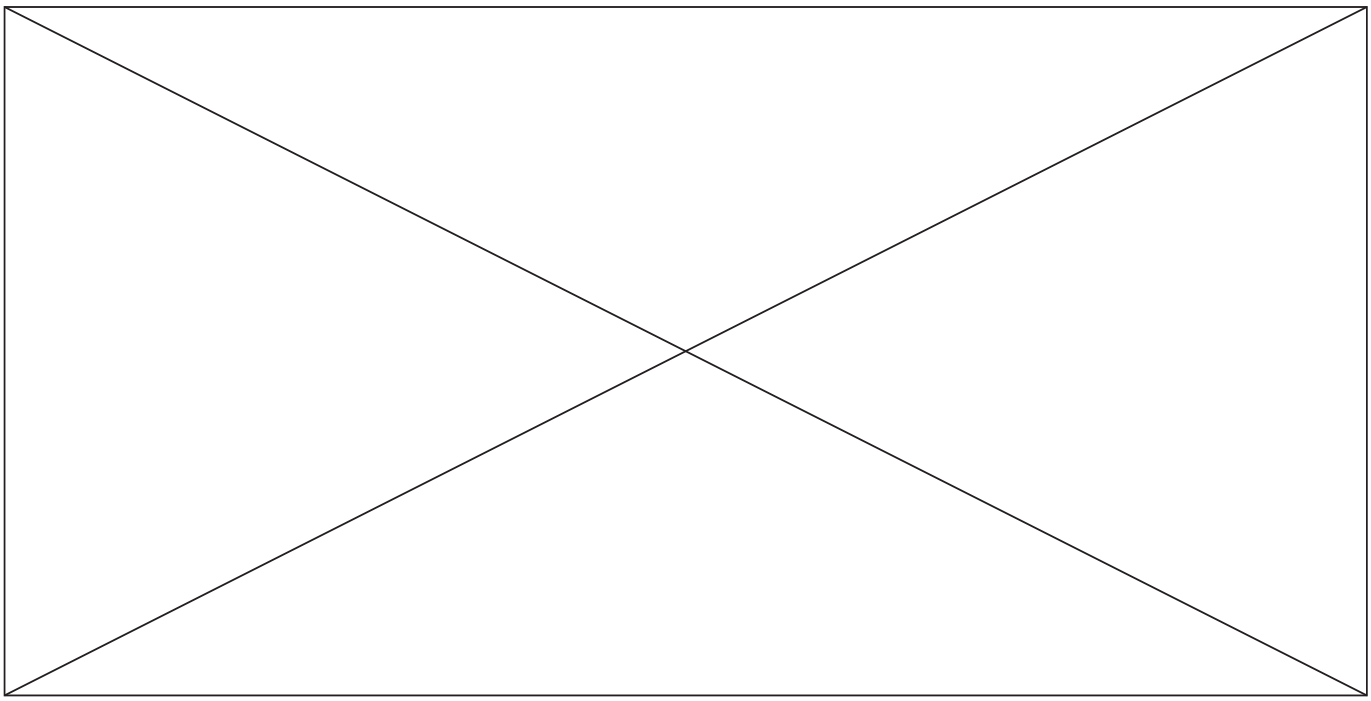




Figure 98: Process of oppening guideway

4. Results:
   4.1. The system of throwing balls into the baskets was finished.
5. Tasks for the next meetings:
   5.1. To test the system of throwing balls into the baskets.



4.5.59 14.01.15

1. Time of beginning and ending of meeting: 18:10 - 21:00.
2. Purposes of meeting:
   2.1. To move the crossbar that fixed stationary higher.
3. Work that has been done:
   3.1. In Ryazan it was found that the lift shakes during the rising. It was found out that it happens due to that the bottom crossbar that fixed on the bottom slat rises higher than the stationary crossbar. So the bottom slat rises not fully but it tries to rise during the extracting the lift. So the lift shakes. To prevent this it was decided to move the stationary crossbar higher. So that the bottom slat raises fully and lift doesn't shakes.

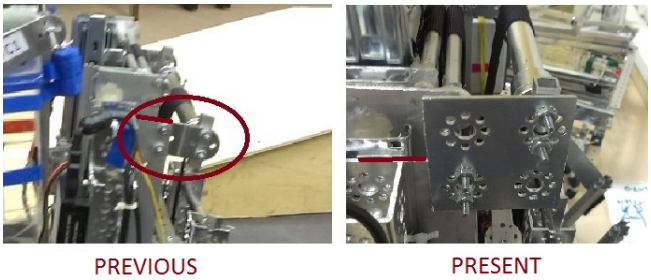
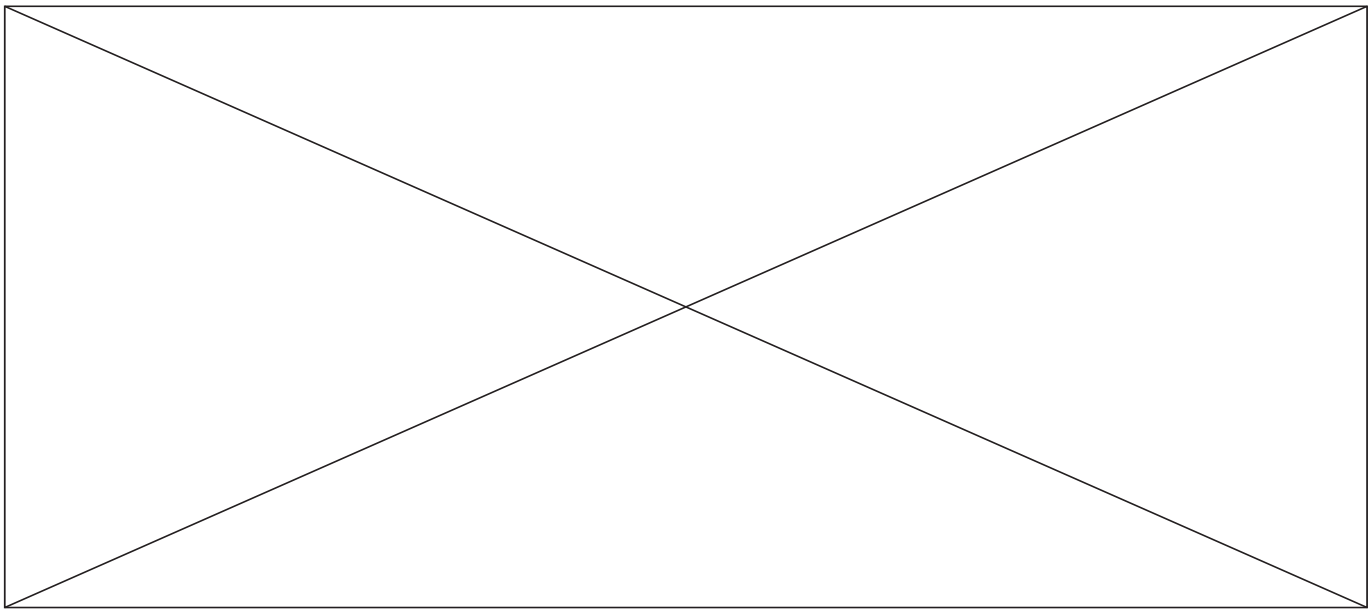


Figure 99: The new mount of crossbar

4. Results:
   4.1. Crossbar was moved higher but lift wasn't tested.
5. Tasks for the next meetings:
   5.1. To train on the control robot.
   5.2. To test the lift.



4.5.60 16.01.15

1. Time of beginning and ending of meeting: 16:30 - 21:30.
2. Purposes of meeting:
   2.1. To train on the control robot.
   2.2. To identify disadvantages of construction or programme.
3. Work that has been done:
   3.1. Today we trained on the control of robot. Programme worked well. The lift didn't shake. Gutter and guideway for balls allowed maximal accuracy of throwing balls into the basket. Now we need from 30 to 60 seconds in order to capture 3 big balls (we has only three) and put their into basket that fixed stationary. But in a game we'll pull the rolling goal behind the robot so we will not waste time on the entrance to the bucket. We plans to reduce the time of collecting one portion of balls to 30 or less seconds.
   3.2. It was found that some balls go sideways and doesn't get into the bucket. So it was decided to install additional slopes that directs balls into the bucket.

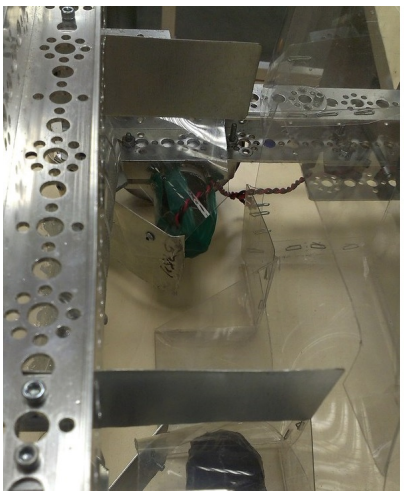


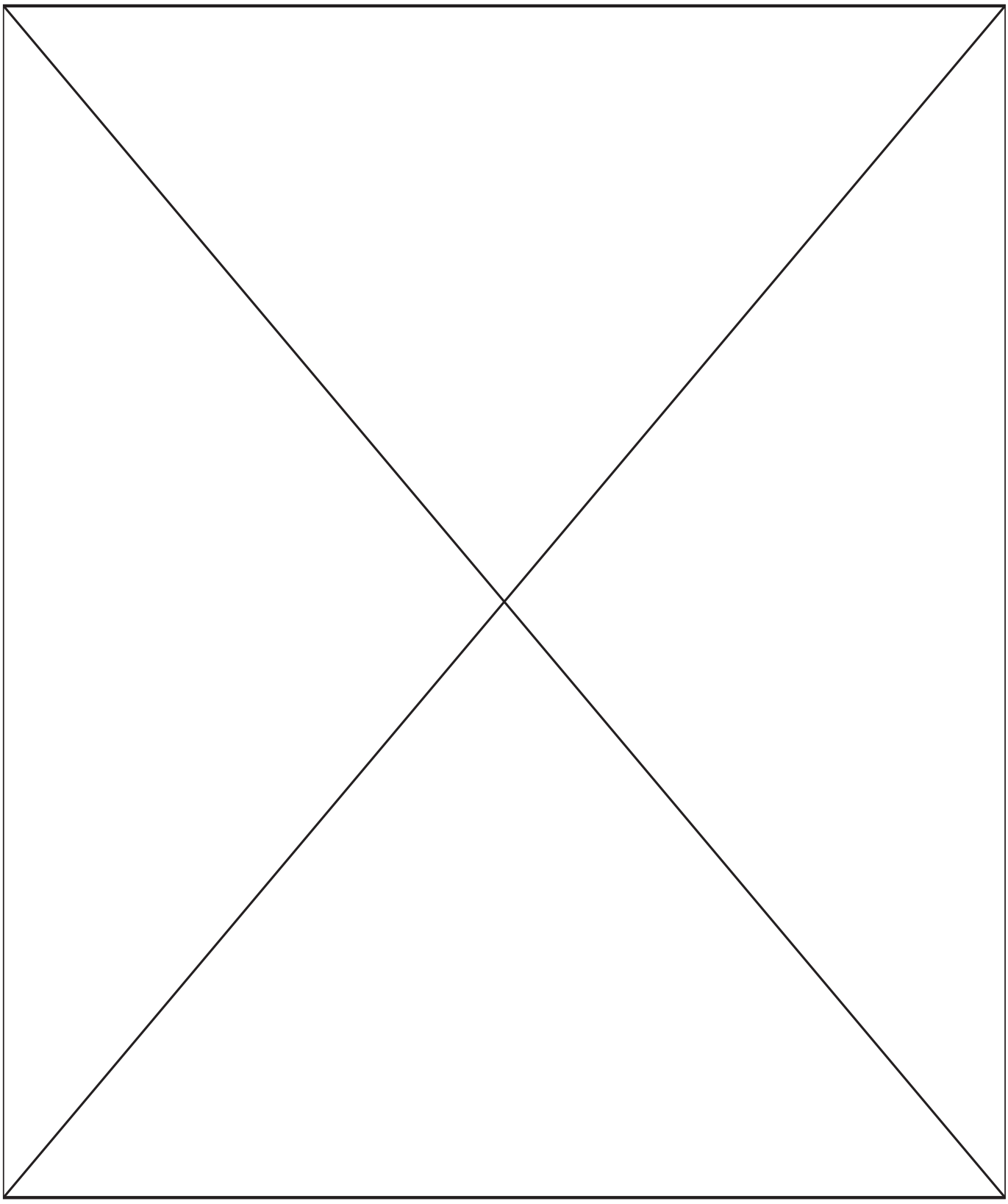
Figure 100: Additional slopes

   3.3. Today they was elaborated variants of autonomuos perid:
      3.3.1. Ride from the ramp put the ball into 60cm goal and into the center goal. Move the 60cm goal to the parking zone (maximum 130 points).
      3.3.2. Ride from the ramp put the ball into the 60cm goal and move it to the parking zone. Then return to 90cm goal put the ball into this goal and move it to the parking zone (maximum 120 points).
      3.3.3. Ride from the ramp put the ball into the 60cm goal capture 90cm goal by additional MCB, move their to the parking zone. Then release 60cm goal and put the ball into 90cm goal(maximum 120 points).
4. Results:
   4.1. We had trainings on the control robot.
   4.2. Gripper for balls was improved.
   4.3. They were elaborated strategies of autonomuos period.

5. Tasks for the next meetings:

   5.1. To train on the control robot.

   5.2. To choose the strategy of autonomuos period and implement it.



4.5.61 17.01.15

1. Time of beginning and ending of meeting: 16:00 - 21:00
2. Purposes of meeting:
   2.1. To make the programme of autonomuos period that include ride from the ramp, put autonomuos balls to 60cm goal and move 60cm goal and 90cm goal to the parking zone.
   2.2. To understand how works IR-sensor.
   2.3. To write a programme for throwing autonomuos balls to the center goal (start from the parking zone).
3. Work that has been done:
   3.1. It was decided to carry out moving of two rolling goals to the parking zone by the next algorithm: robot moves 60cm goal after the throwing balls into 60cm goal. Then it unfolds, rides to 90cm goal and moves it to the parking zone.
   3.2. Programme was wrote and tested. Result positive: robot can to complete it in 30 seconds.
   3.3. IR-sensor was installed on the robot.

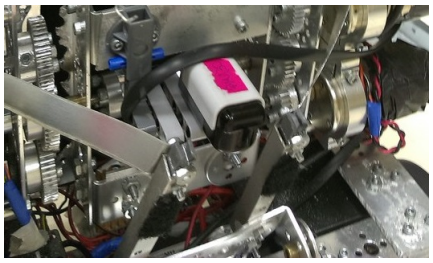


Figure 101: IR sensor

   3.4. They were wrote two programmes: one programme prints value of IR sensor and the second - rotate while IR emitter isn't in certain position relative to the robot.
   3.5. Programme of throwing autonomuos balls into the center goal was wrote by the next algorithm: firstly robot determines the position of the center goal. If the goal is front the robot it moves on a straight line and put the balls into the goal. If the goal is sideways to the robot it turns to the goal so that robot can ride between the ramp and goal. Then robot moves on a straight line while the goal not perpendicularly to the robot. Then robot rides to the goal and puts the balls .
   3.6. Programme was wrote and tested. Result negative. If IR emmiter is sideways to the robot it turns then rides and doesn't stop.
4. Results:
   4.1. Programme that include moving two rolling goals was wrote.
   4.2. The IR sensor mastered.
   4.3. Programme of throwing autonomous balls into the center goal wasn't wrote.
5. Tasks for the next meetings:
   5.1. To finish the programme of throwing autonomous balls into the center goal.
   5.2. To train on the control robot.

4.5.62 19.01.15

1. Time of beginning and ending of meeting: 17:30 - 21:00.
2. Purposes of meeting:
   2.1. To continue the working on the programme of autonomuos period.
3. Work that has been done:
   3.1. The front right motor was removed and it was installed motor with encoder. Now our robot has encoder from each side.
   3.2. Idea of programme of autonomuos period from the ramp was changed: ride from the ramp, put the small ball into 60cm goal and capture it. Then turn and release 60cm on the line that connect 90cm goal and the parking zone. Then put the ball into 90cm goal and capture it. To move the 90cm goal to the parking zone and push the 60cm goal. The programme of moving was wrote. The throwing balls into the goals will add when we'll have original goals.
   3.3. It was elaborated special hook for throwing the first autonomous ball into the goal. The ball doesn't fall from it during the moving but when robot rides to the goal, rise the lift and starts lower it the ball touch the edge of the basket and falls to the goal.

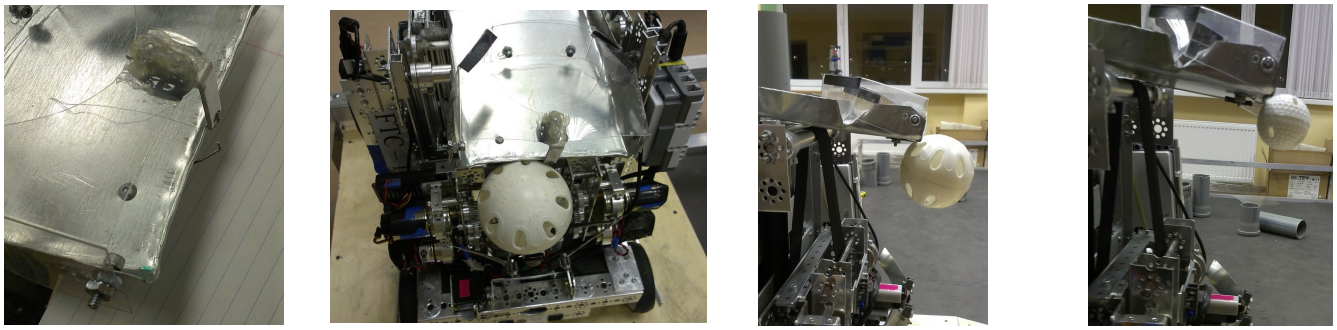


Figure 102: Hook for autonomous ball

   3.4. It was found that the middle pair of slats falls when the lift is lowered. So they were installed additional limiters.

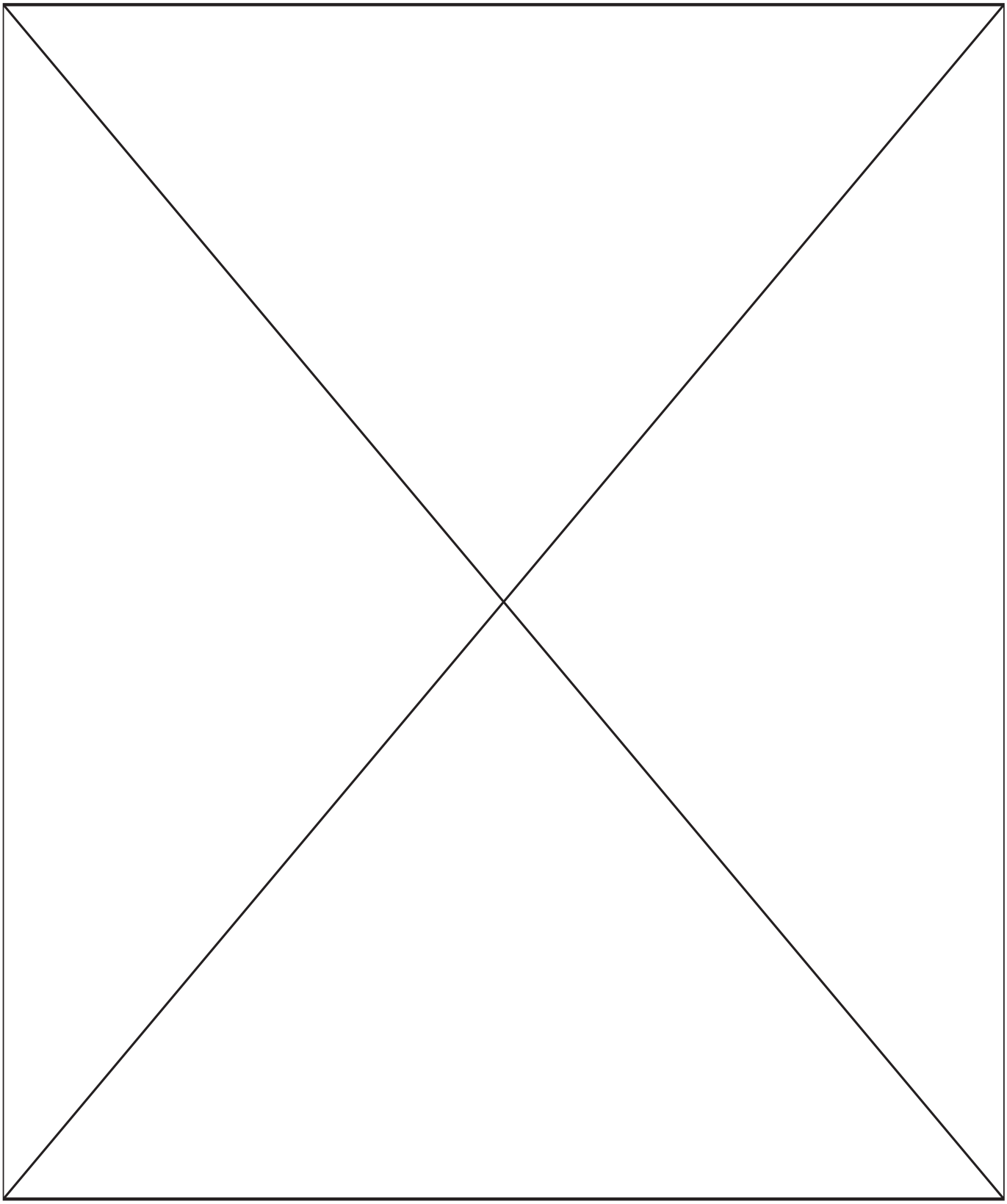
Figure 103: Limiters for slats

4. Results:
   4.1. Changed programme of autonomous period was wrote.
   4.2. It was installed front right motor with encoder.
   4.3. They were installed limiters for slats.

5. Tasks for the next meetings:

   5.1. To write the programme of autonomuos period for start from the parking zone.

   5.2. To train on the control robot.



4.5.63 20.01.15

1. Time of beginning and ending of meeting: 16:20 - 20:40.
2. Purposes of meeting:
   2.1. To write the programme of autonomuos period for start from the parking zone.
   2.2. To train on the control robot.
3. Work that has been done:
   3.1. We reach better results on the control robot. We can to put 10 balls into the goal on 90 seconds. Our task is to put 15 balls on 60 seconds.
   3.2. It was found that the third blade on the gripper for balls sometimes prevents to it's working. So this blade was removed.

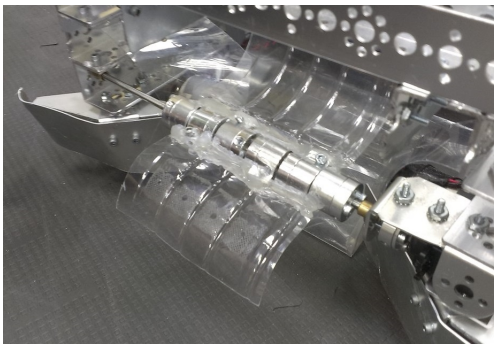
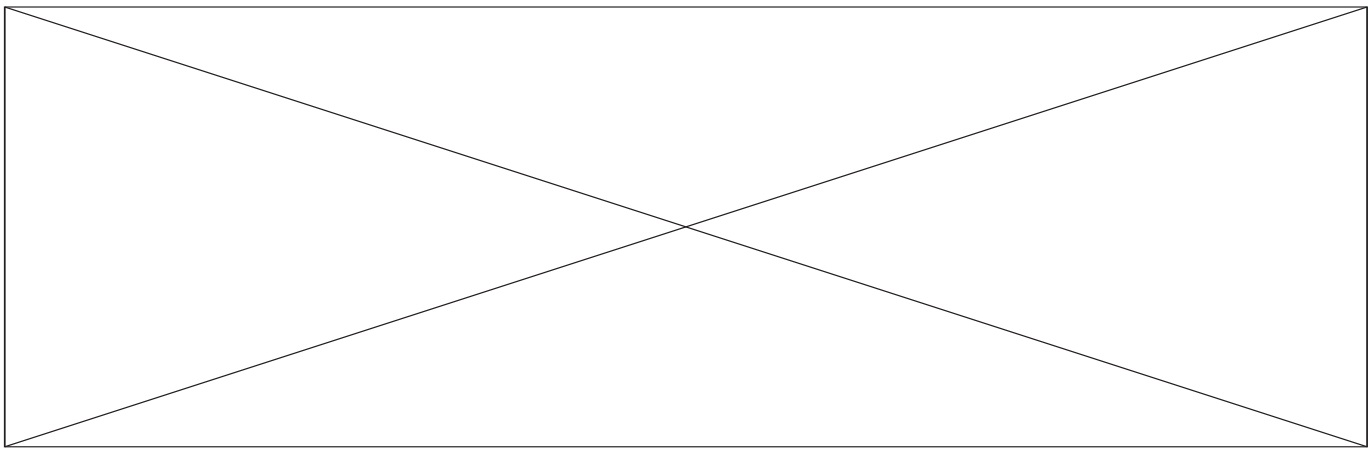


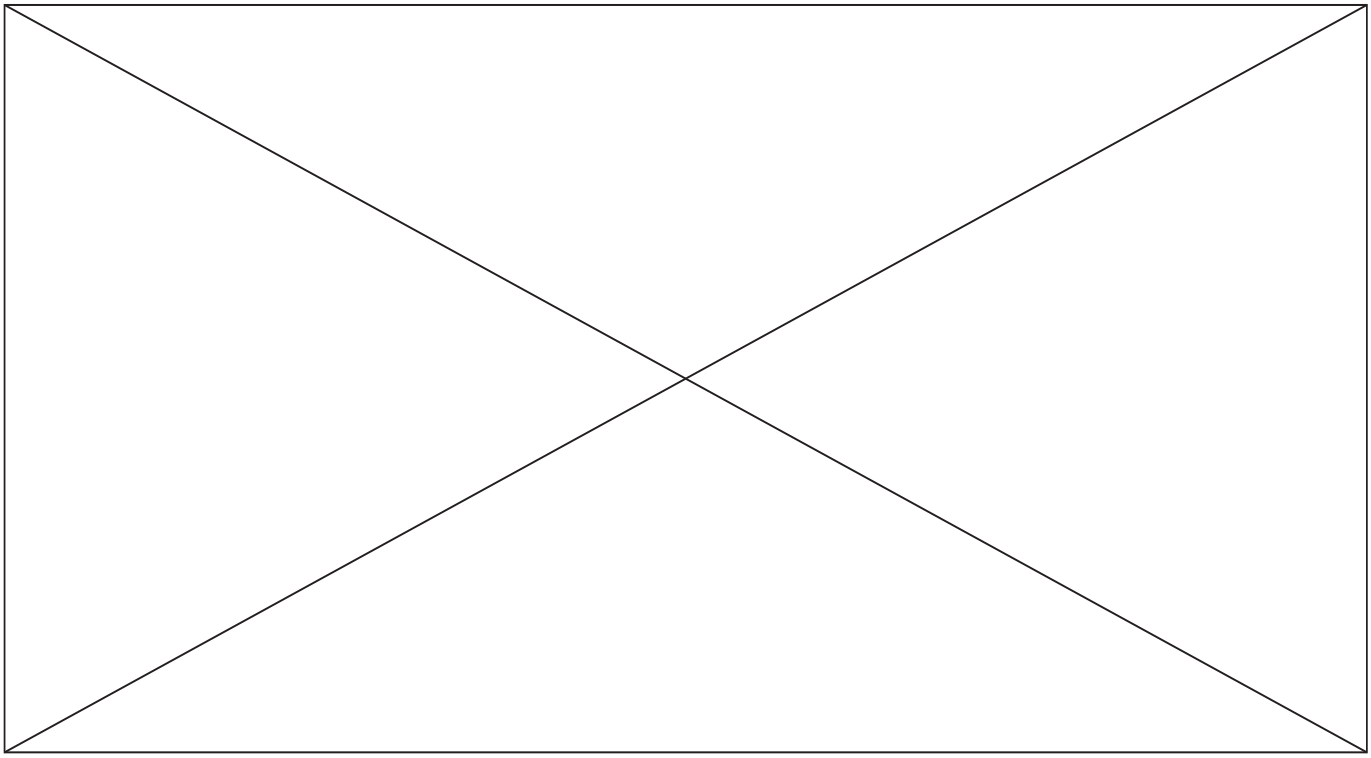
Figure 104: Gripper with 2 blades

4. Results:
   4.1. Programme of autonomuos period for start from the parking zone wasn't wrote.
   4.2. Operators improved on the control robot.
   4.3. Gripper for balls was improved.
5. Tasks for the next meetings:
   5.1. To train on the control robot.
   5.2. To write the programme of autonomuos period for start from the parking zone.



4.5.64 21.01.15

1. Time of beginning and ending of meeting: 18:10 - 20:40.
2. Purposes of meeting:
   2.1. To write the programme of autonomuos period for start from the parking zone.
   2.2. To train on the control robot.
3. Work that has been done:
   3.1. Today operator that responsible for control lift and MCB wasn't on the meeting. So there weren't trainings.
   3.2. Strategy of autonomuos period for start from the parking zone is: ride to 30cm goal and put the ball into it (from the hook). Then turn and ride to 90cm goal and put the second autonomuos ball into it (from the bucket). Then move this goals to the parking zone ().
   3.3. It was decided to make an additional hook for the autonomous ball because the first hook is higher than the edge of 30cm goal. In addition it will need to install additional gripper for rolling goal because we will can't to push it (it will too complex to put this goal on the line that connects 90cm goal with the parking zone).
4. Results:
   4.1. Programme of autonomous period for start from the parking zone was wrote.
   4.2. There were no trainings.
5. Tasks for the next meetings:
   5.1. To train on the control robot.
   5.2. To make an additional hook for autonomuos ball and additional gripper for rolling goal.



4.5.65 23.01.15

1. Time of beginning and ending of meeting: 16:30 - 20:30.
2. Purposes of meeting:
   2.1. To train on the control robot.
   2.2. To make an additional hook for autonomuos ball and additional gripper for rolling goal.
3. Work that has been done:
   3.1. During the training it was found that some big balls don't leave the blade and start moving back but stuck between the axis of the gripper and transverse beam. So the beam was fixed higher. But the balls still slightly stuck. It will need to move the beam more high.
   3.2. It was installed mount for servo that will move an additional gripper for rolling goals.

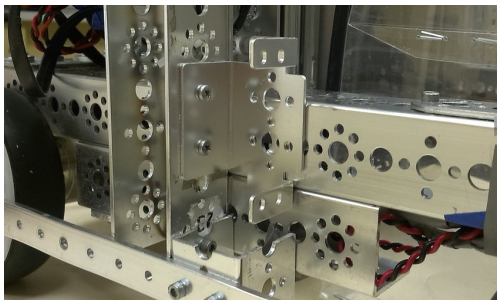
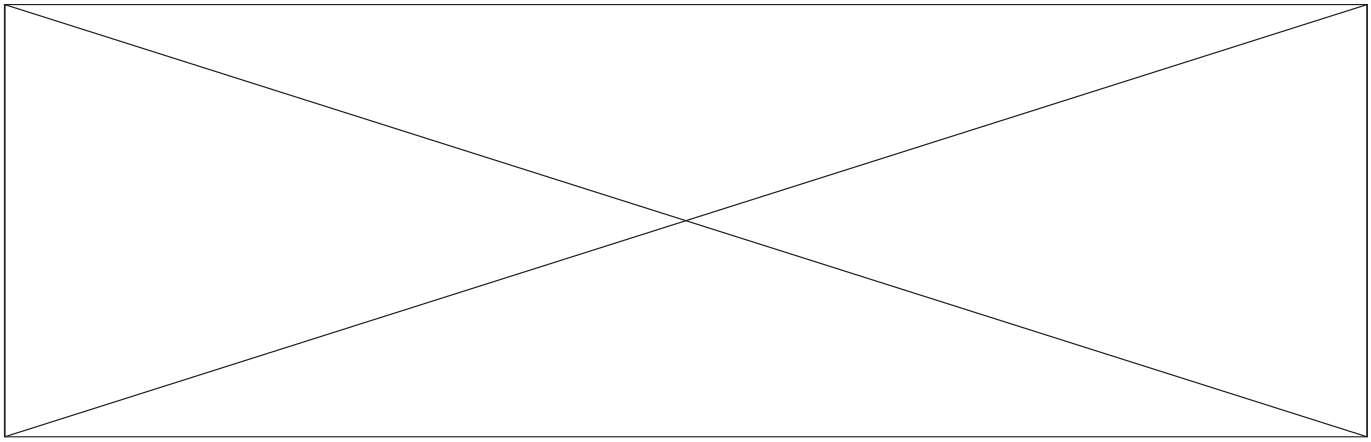


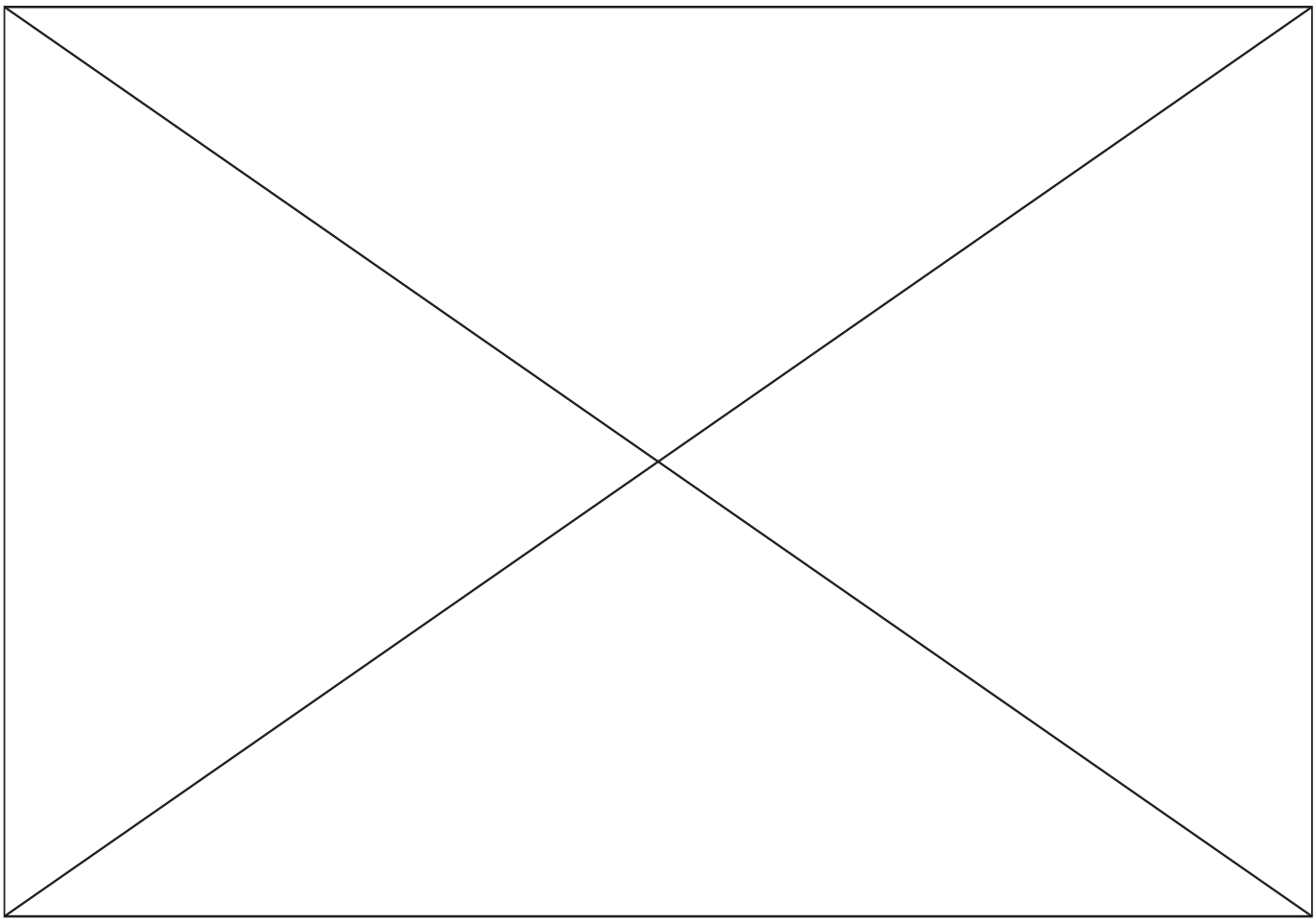
Figure 105: Mount for servo

4. Results:
   4.1. Gripper for balls was impoved.
   4.2. It was installed mount for servo for additional gripper for rolling goals but servo wasn't installed.
   4.3. Additional hook for autonomuos ball wasn't made.
5. Tasks for the next meetings:
   5.1. To make an additional hook for autonomuos ball.
   5.2. To finish additional gripper for rolling goal.
   5.3. To train on the control robot and reduce time of collecting 5 balls.



4.5.66 24.01.15

1. Time of beginning and ending of meeting: 19:00 - 21:40.
2. Purposes of meeting:
   2.1. To train and reduce the time for collecting 5 balls.
3. Work that has been done:
   3.1. It was achieved that our robot can to collect 3 balls on 15 second. Also it was found that we use slow moving more than fast. So it was decided to make slow moving is by default and fast moving turn on by pressing the button. The programme was corrected. Trainings showed that it was true decidion. Control robot became more comfortable.
4. Results:
   4.1. Our robot can to collect 3 balls on 15second.
   4.2. The programme of control robot was improved.
5. Tasks for the next meetings:
   5.1. To train on the control robot.
   5.2. To make an additional hook for autonomuos ball.
   5.3. To finish additional gripper for rolling goal.



4.5.67 25.01.15

1. Time of beginning and ending of meeting: 18:30 - 20:30.
2. Purposes of meeting:
   2.1. To make an additional hook for autonomuos ball..
   2.2. To finish additional gripper for rolling goal.
3. Work that has been done:
   3.1. Today there was no one operator. So it was decided to do construction of robot.
   3.2. Additional hook for autonomous ball was made and tested. Result positive.

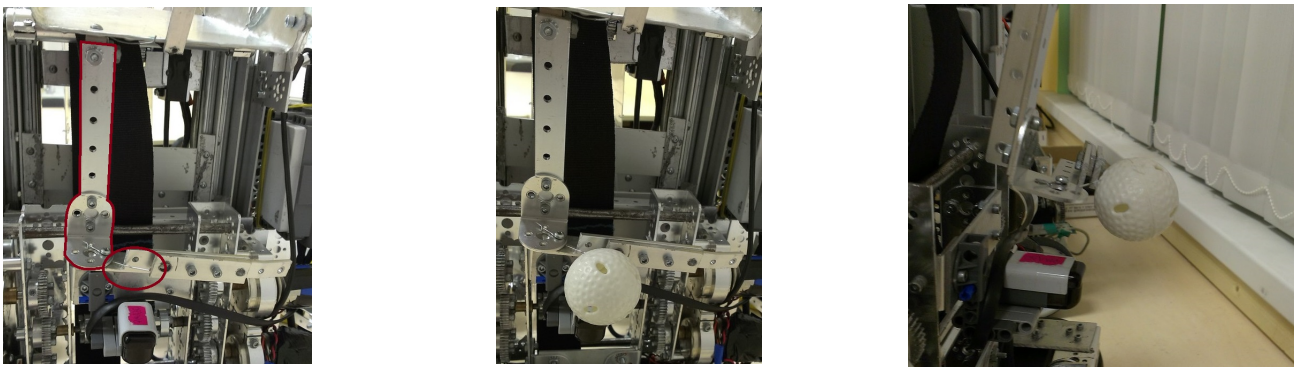


Figure 106: Additional hook for autonomous ball

   3.3. Servo that moves additional gripper for rolling goal was installed but wasn't connected with servocontroller.

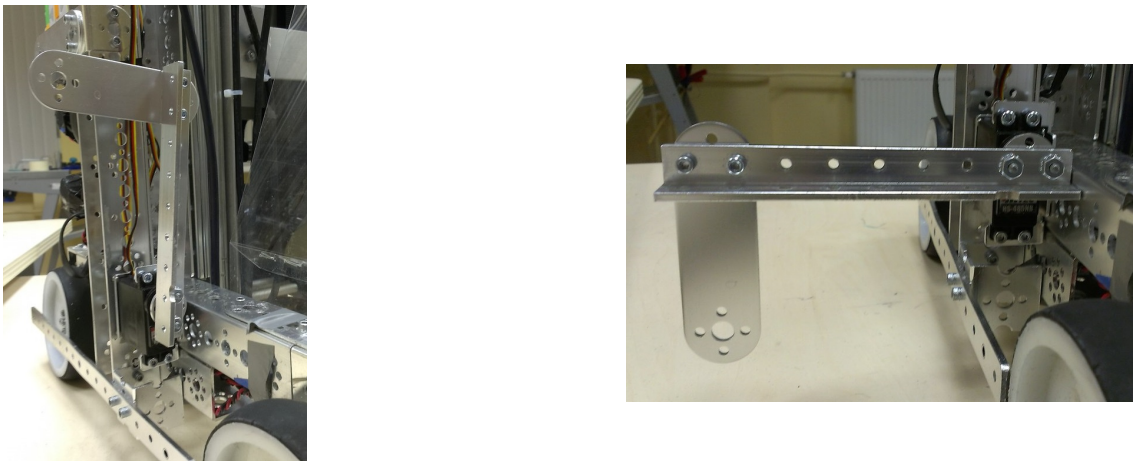
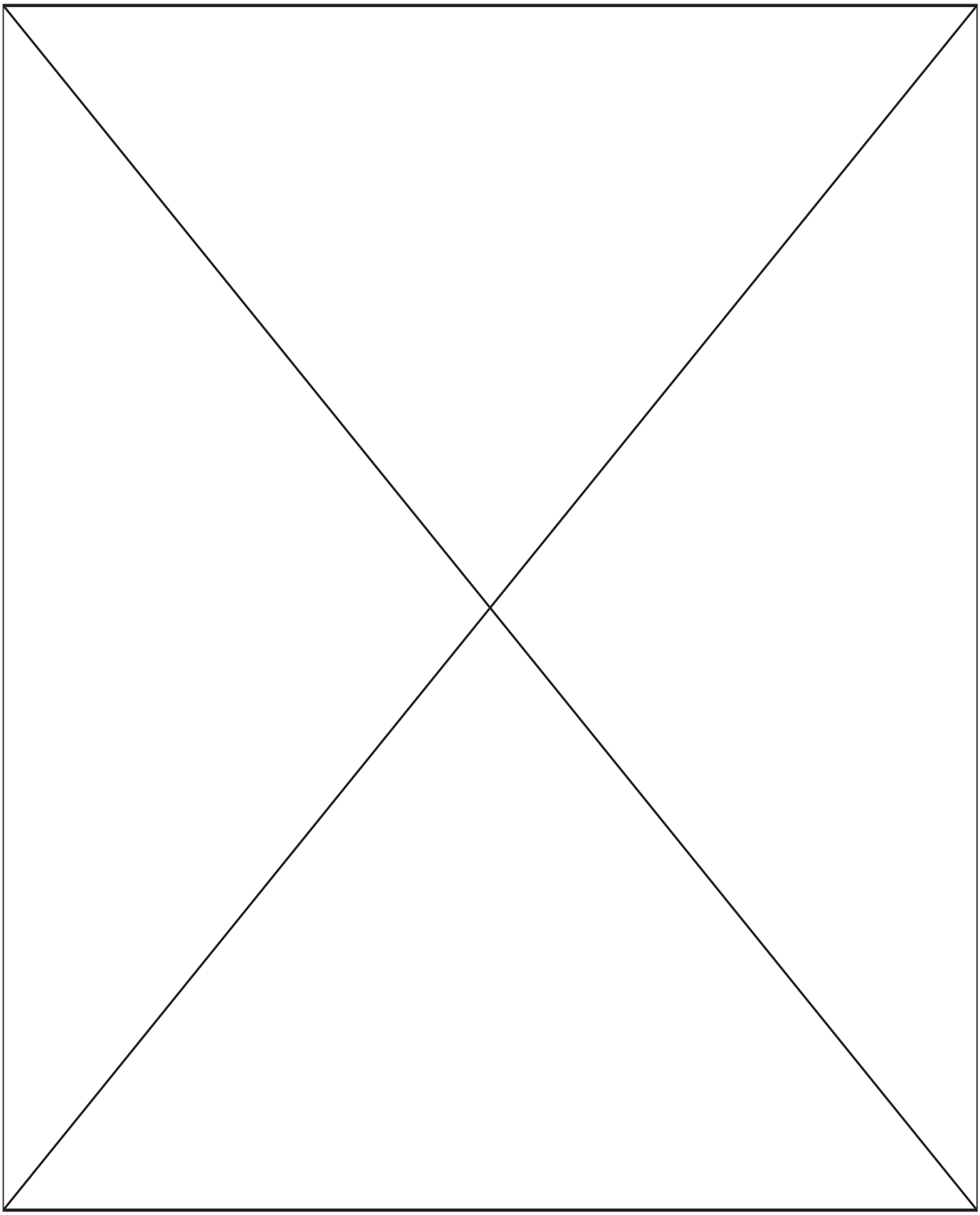


Figure 107: Servo that moves additional gripper for rolling goal

4. Results:
   4.1. There were no trainings.
   4.2. The second hook for autonomous ball was installed and tested.
   4.3. The additional gripper for rolling goal was installed but wasn't connected.
5. Tasks for the next meetings:

5.1. To connect the servo that moves additional gripper for rolling goal.

5.2. To train on the control robot.



4.5.68 26.01.15

1. Time of beginning and ending of meeting: 17:15 - 22:00.
2. Purposes of meeting:
   2.1. To connect the servo that moves additional gripper for rolling goal.
   2.2. To train on the control robot.
   2.3. To install protection for NXT-brick and Samantha-module.
3. Work that has been done:
   3.1. Servo that moves additional gripper for rolling goal was connected with servocontroller and it was added control of it in programmes of autonomous and tele op period.
   3.2. Protection for NXT and Samantha-module was installed.

Figure 108: Protection for Samantha-module

   3.3. It was invented the idea for improvement gripper for balls. Servo of continous rotation that moves gripper rotates too slow. So it was decided to replace it on two Lego-motors that arranged on both sides of the axis. Motors were installed and it was made metalic protection for their..

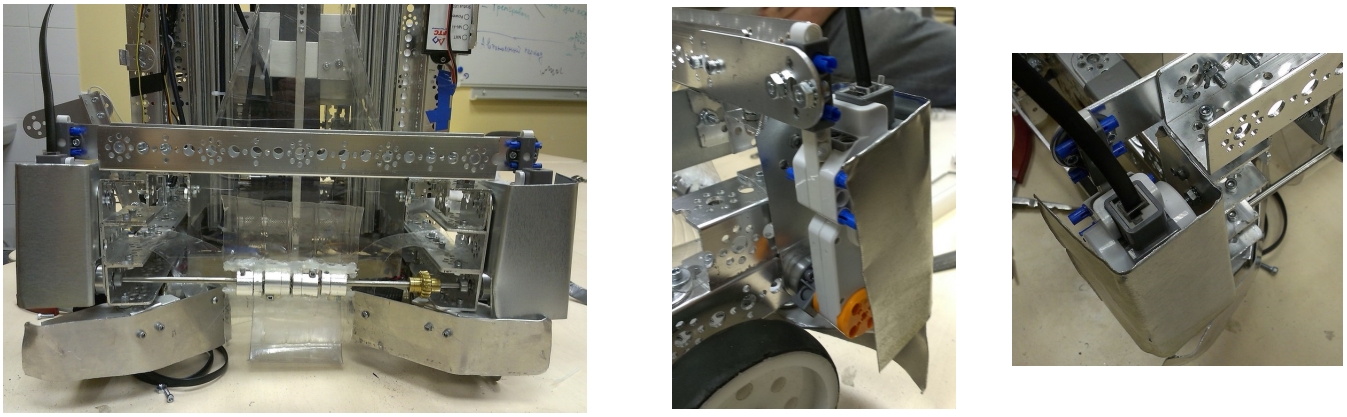


Figure 109: Improved gripper for balls

   3.4. The new gripper was tested. Result positive. Speed of rotation of gripper increased threefold. Balls are captured very fast and dispersed so that they fly into the bucket. So they don't stuck between the axis and beam. The new gripper will allow us to reduse the time of collecting balls.

3.5. 28th - 29th of January we'll come to competition that will be in Perm. So today we need to train and package the robot for transportation.

4. Results:

4.1. Servo that moves additional gripper for rolling goal was connected with servocontroller.

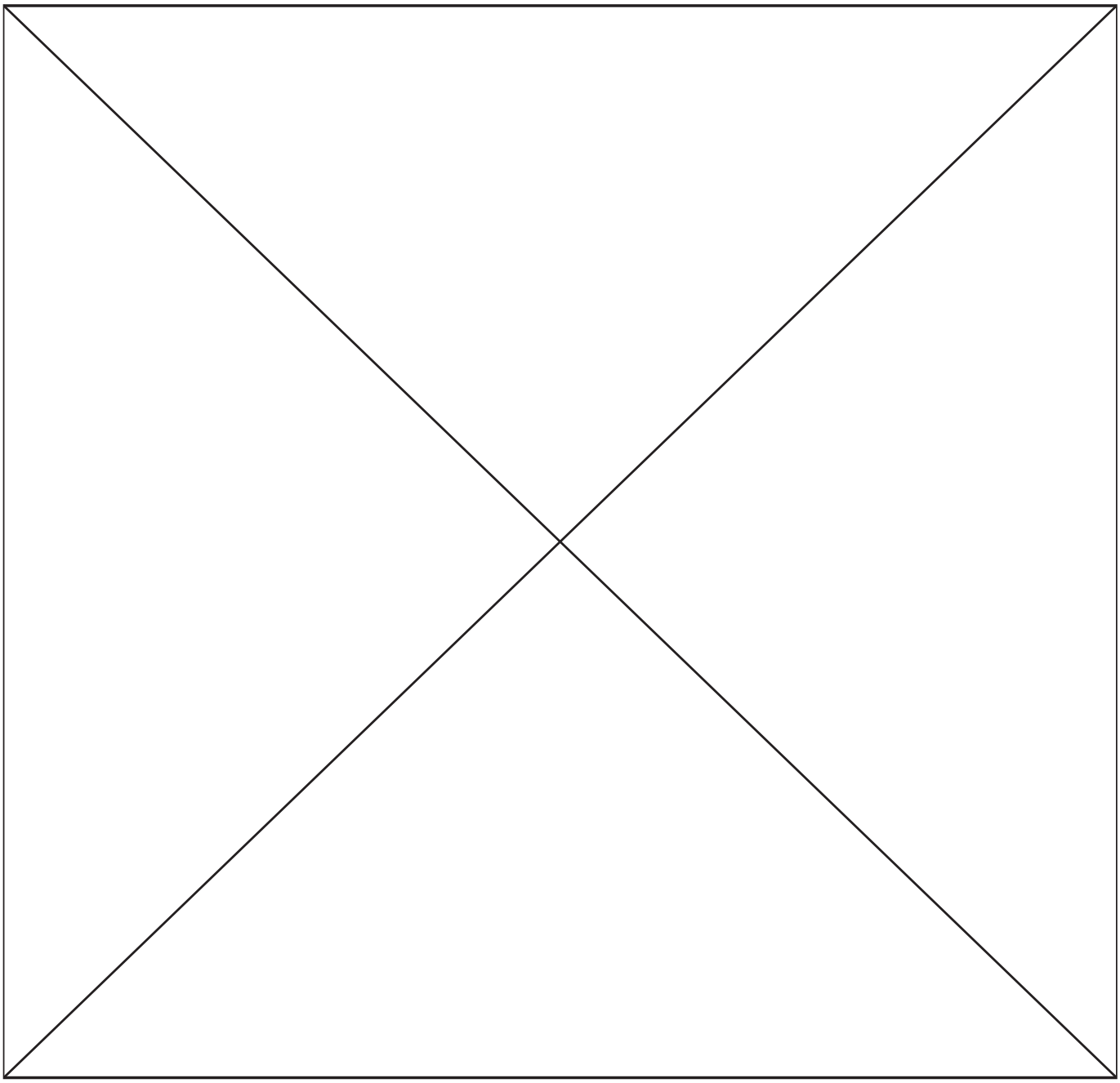
4.2. Protection for NXT and Samantha was installed.

4.3. Gripper for balls was improved. Result positive

5. Tasks for the next meetings:

5.1. To train on the control robot.

5.2. To package the robot for transportation it to Perm.



4.5.69 28.01.15 (Competition)

1-st day of competition "Robofest-Ural"

Today there was protection of engineering book. Also we trained on the control robot and corrected programme of autonomous period. During the protection of engineering book judges asked us tell about our robot in English. We did it not very well. We need to prepare the protection of engineering book in English. Improvements that were done:

1. Robot lost the rolling goal during the fast moving because servo on MCB had not enough power. So it was decided to replace it to more powerful. Also the slopes for alignment rolling goal were moved higher because they hooked the base of rolling goal.

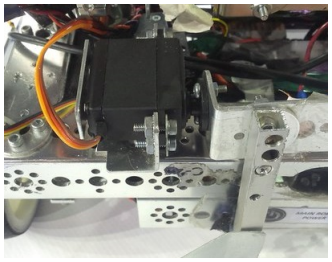


Figure 110: Replaced servo

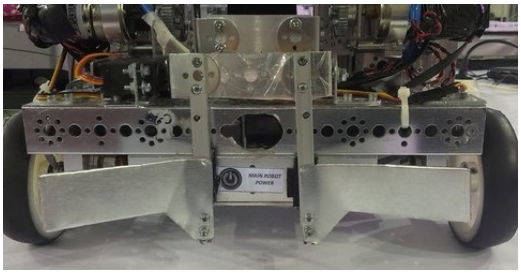
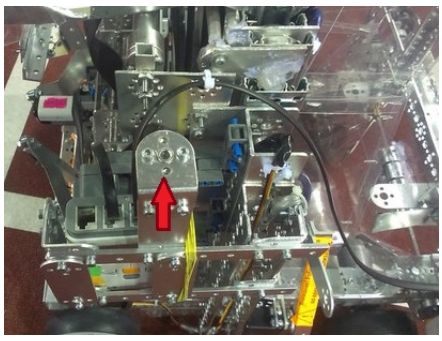


Figure 111: The new slopes

2. It was made the mount for a flag.



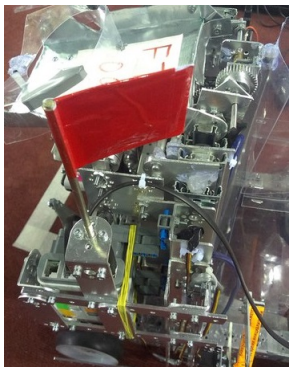


Figure 112: Mount for a flag

3. Some balls hit the top edge of the bucket because new gripper launched balls too highly. The balls didn't get to the bucket fell to the blades and stopped them. So it was decided to expand the hole in the front partof the bucket. Also they were installed plates that will prevent to loss balls if they will fly too hughly

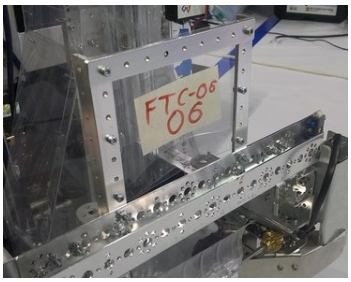


Figure 113: Addinational plates

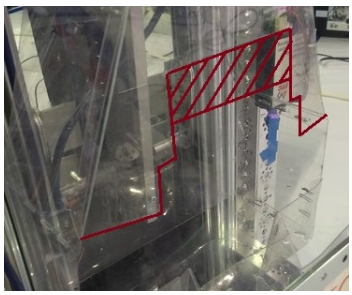
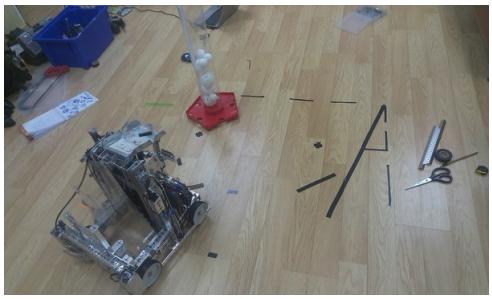


Figure 114: Bucket was cut

4. Programme of autonomous period from the parking zone was debugged in accordance with the characteristics of the field. Programme of autonomous period from the ramp wasn't corrected because all teams had programme for start from the ramp.



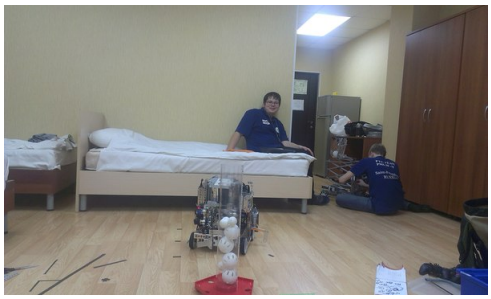
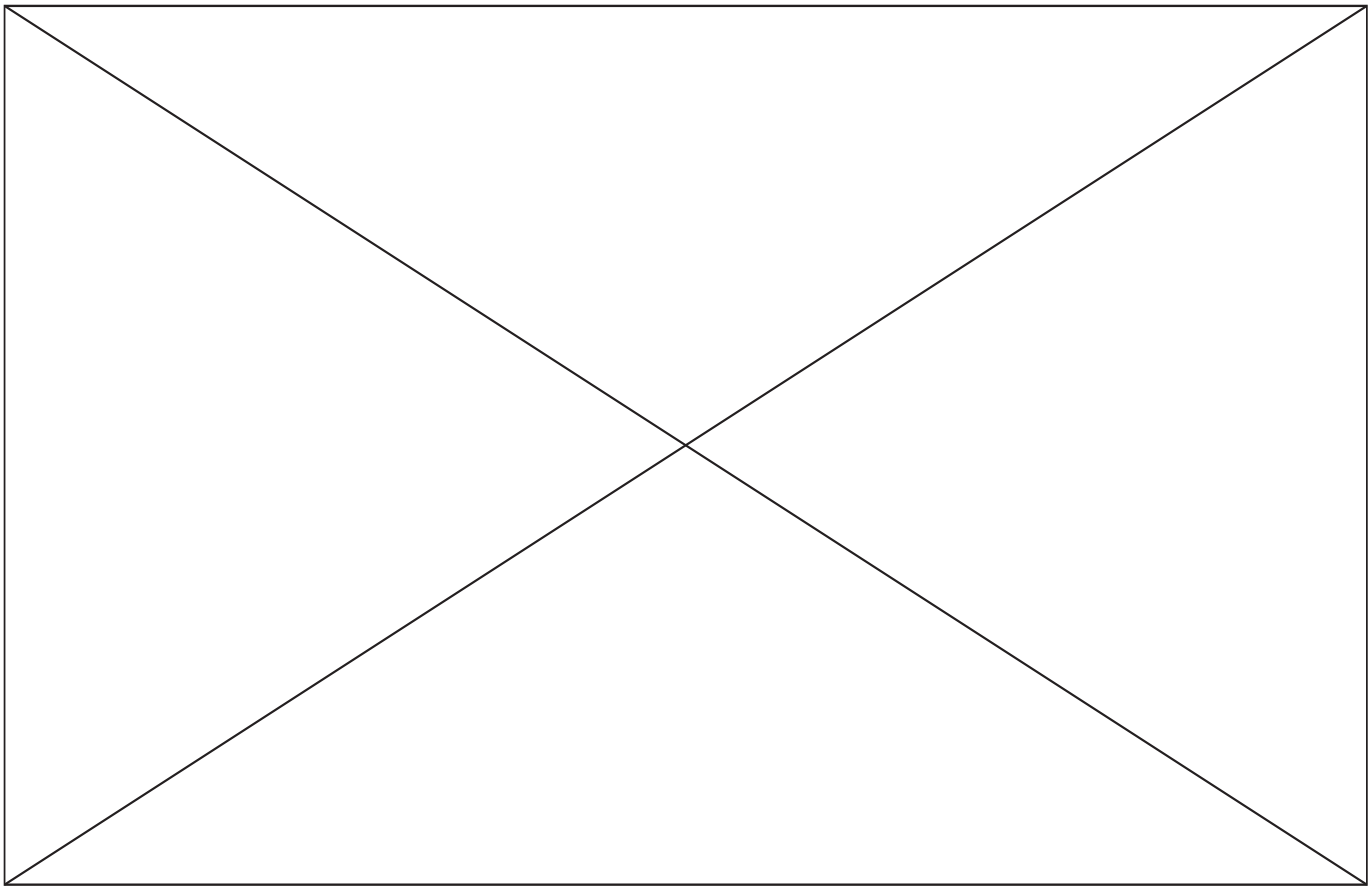


Figure 115: Debugging of programme of autonomous period in a hotel



4.5.70 29.01.15 ()

2-nd day of competition "Robofest-Ural"

Today there were qualification mathces.

Improvements that were done:

1. It was installed the screw as the hook for autonomous ball because a wire hook bended and didn't provided a guaranteed hit ball to the goal.
2. The second team from our circle "PML 30 ψ" needed a powerful servo because they had failure of servo that overturns bucket for balls. So we were forced to remove powerful servo from MCB.

Results of competition:

1. We took the 3-rd place by the results of qualification matches.
2. We made it to the final match because team "λ" that took the first place by the results of qualification matches chose us.
3. Our alliance won the final match.
4. We took the first place in nomination "Engineering book".
5. We took the 1-st place on team standings.

Summing up:

1. Success in competition:
   1.1. We took the prize in nomination "Alliance-winner".
   1.2. We took the first place in nomination "Engineering book".
   1.3. We didn't implemented all advantages of our robot: autonomous period worked in only one qualification match. In the final match opponent that left his zone and blocked the road for our robot prevented to perform autonomous period. Collecting the balls to 90cm goal in driver-control periodit was complicated by the fact that the small balls got under the bottom of our robot. It deteriorated of controllability of the robot. Also the wheels got on the stick-stopper. So the robot lost the 90cm goal.
   1.4. We performed our main task - to train on the original field before "Robofest-2015" that will be 11th - 13th of February in Moscow.
2. Our mistakes and disadvantages of construction:
   2.1. The main problem was that the robot ran over the small balls and the stick.
   2.2. We prepared the programme of autonomous period badly. So it was debugged only at the end of competition.
   2.3. Sometimes balls stuck in the bucket because it has a narrowing in a top part. So we were must to retutn the bucket to the start position and overturn it again. So some balls fell outside the bucket. It will need to add an intermediate position of the bucket in order to the congestion dissapeare and balls don't fall from the bucket.
3. Tasks for the next meetings:
   3.1. To make programme of autonomous period from the ramp.

3.2. To make the gripper for balls that can to collect only big balls.

3.3. To imrove the protection from the small balls and the stick.

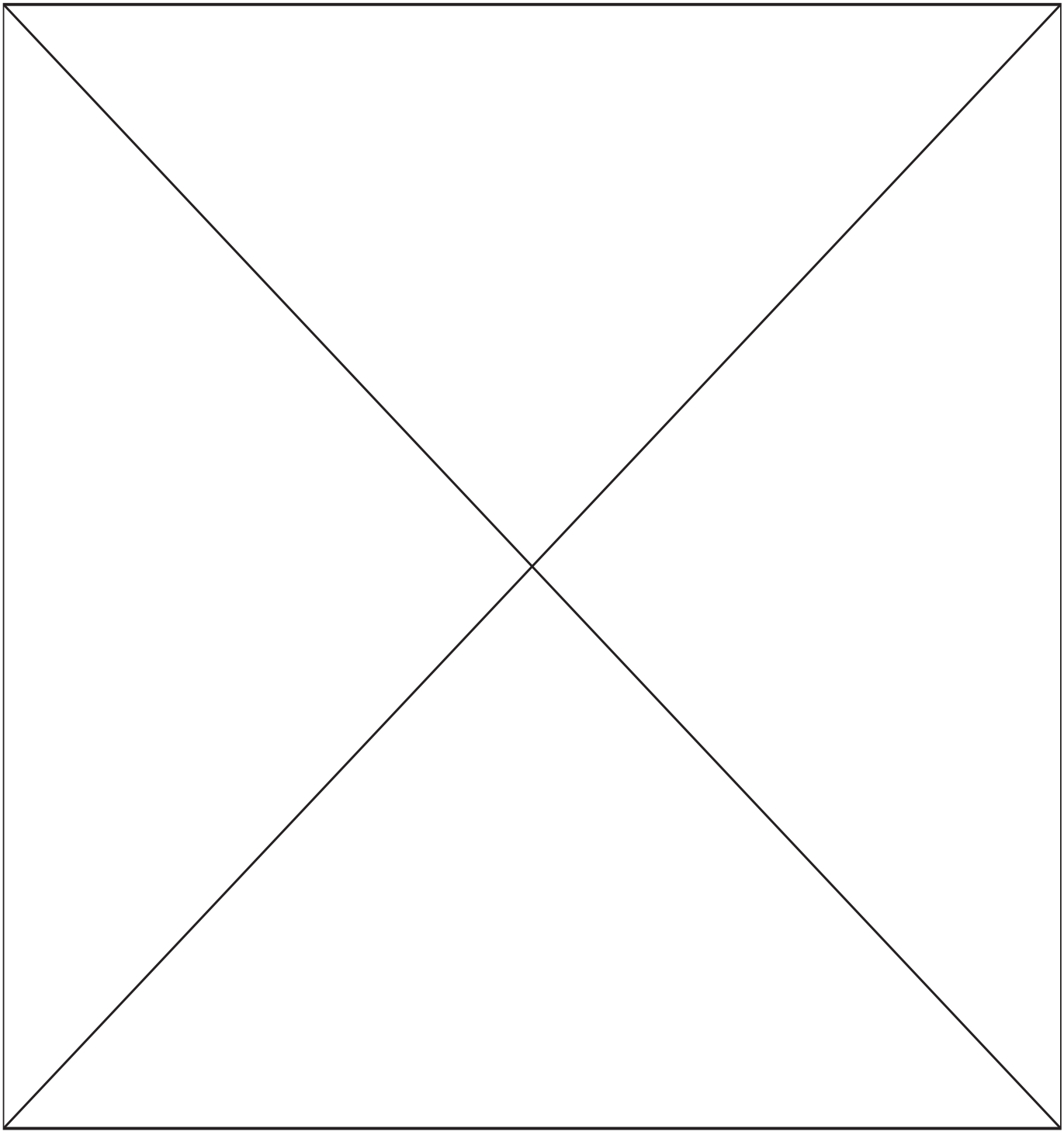
3.4. To improve MCB so that it don't lose the rolling goal during the fast moving.

3.5. To add to the programme of control robot an intermediate position of the bucket.

3.6. To prepare the protection of engineering book in English.

3.7. To install field control system for trainings in a most real conditions.

3.8. To install plexiglass protection of robot.



4.5.71 02.02.15

1. The time of beginning and ending of the meeting: 18:00 - 21:00.
2. Purposes of the meeting:
   2.1. To make the gripper for balls that can to collect only big balls.
   2.2. To install field control system for trainings in a most real conditions.
3. Work that has been done:
   3.1. Balades were cut to desired lengh. So the gripper captures only big balls but it can to capture small ball by accident because it can to get into the bucket behind the big ball. But this situations were rarely. So that result positive.
   3.2. It was installed the protection for wire that connect NXT with one Lego-motor.

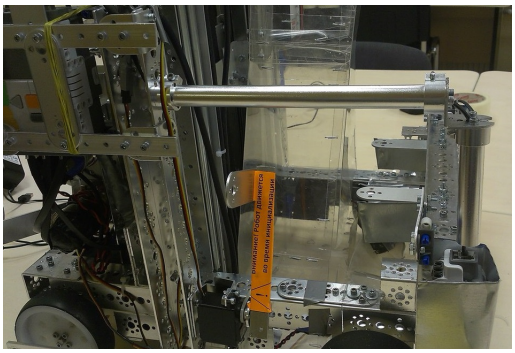
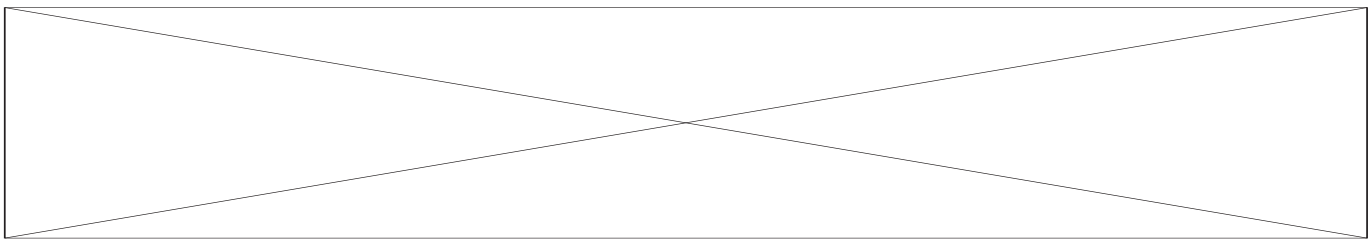


Figure 116: Protection for wire

   3.3. Field control system was installed but wasn't setup.
4. Results:
   4.1. The gripper for ball can to capture only big balls.
   4.2. The wire for NXT motor was protected.
   4.3. Field control system wasn't setup.
5. Tasks for the next meetings:
   5.1. To add to the programme of control robot an intermediate position of the bucket.
   5.2. To train on the control robot.
   5.3. To make programme of autonomous period from the ramp.
   5.4. To imrove the protection from the small balls and the stick.
   5.5. To setup field control system.



4.5.72 06.02.15

1. The time of beginning and ending of the meeting: 20:00 - 21:00.
2. Purposes of the meeting:
   2.1. To add to the programme of control robot an intermediate position of the bucket.
   2.2. To train on the control robot.
3. Work that has been done:
   3.1. Today there were bought balls that has sizes of big balls. They are lighter than original but we can to train with them.
   3.2. It was estimated that for filling of 90cm goal we need 13-14 big balls. It was decided to train with 14 big balls and 20 small balls (3 original and 17 tennis balls). We can fill the 90cm goal in 2 minutes and 40 seconds. It is not bad bud not enough.

Figure 117: Our game field

   3.3. Programme of control bucket was improved and tested.Result positive.

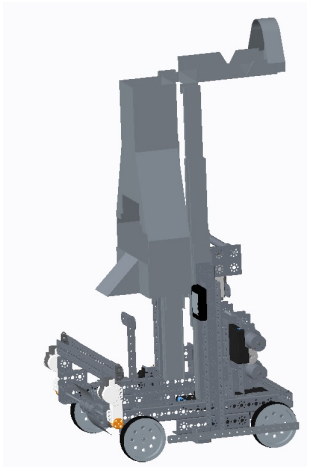


Figure 118: Start position

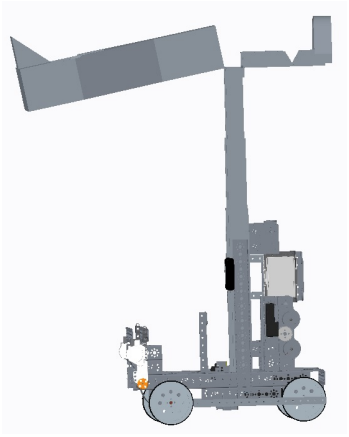


Figure 119: Intermediate position

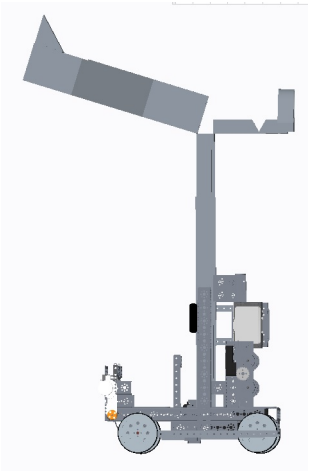


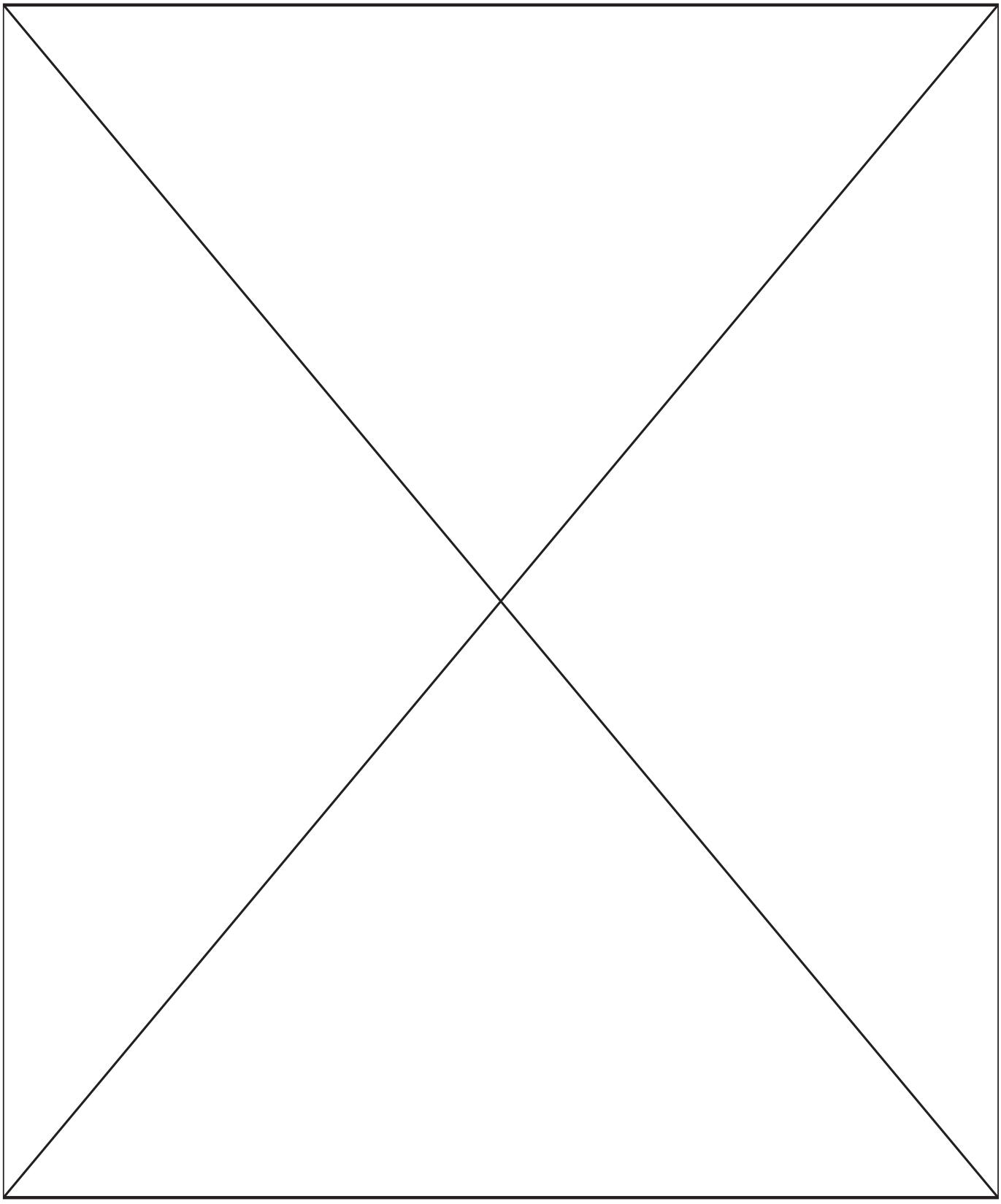
Figure 120: Overturned position

4. Results:
   4.1. We can fill 90cm goal in 2min and 40sec.
   4.2. It was added intermediate position of the bucket.
5. Tasks for the next meetings:

5.1. To train on the control robot.

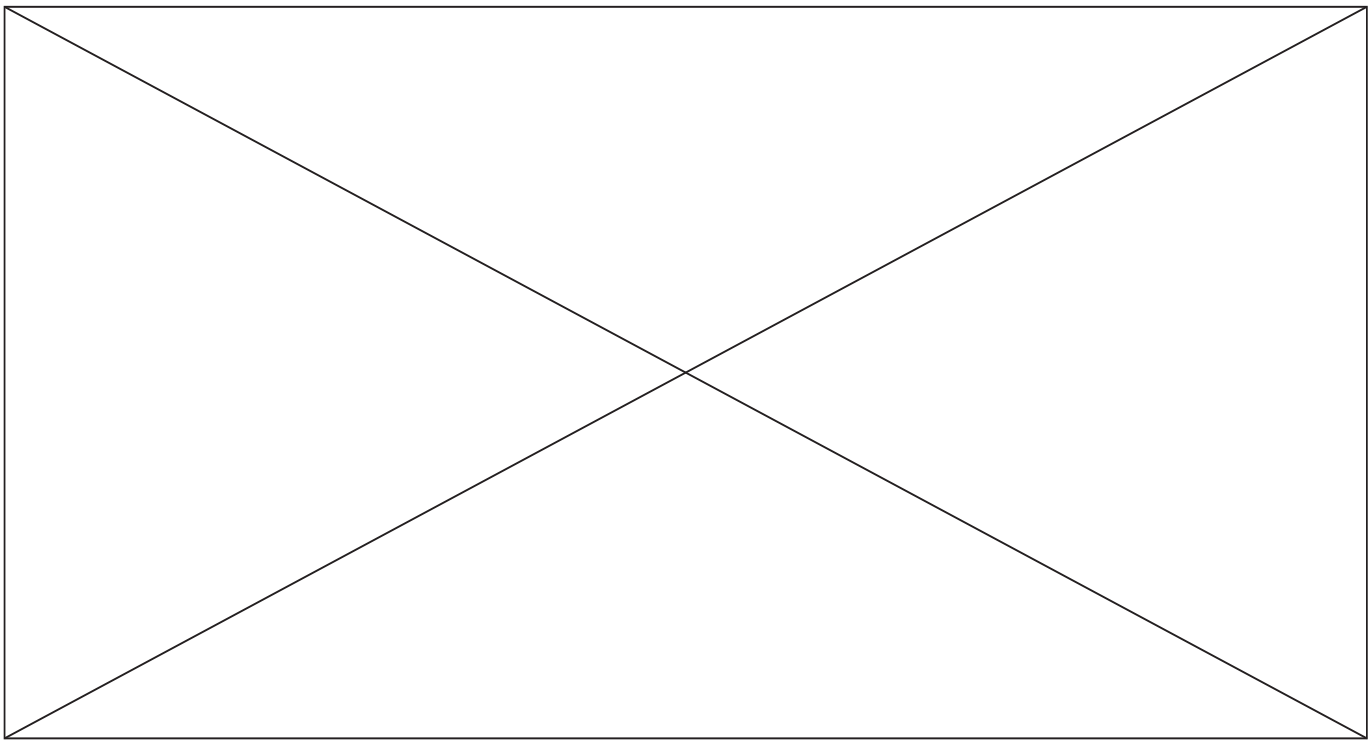
5.2. To make programme of autonomous period from the ramp.

5.3. To imrove the protection from the small balls and the stick.



4.5.73 07.02.15

1. The time of beginning and ending of the meeting: 16:30 - 20:00.
2. Purposes of the meeting:
   2.1. To train on the throwing balls to 90cm goal. To reduse the time of filling it.
3. Work that has been done:
   3.1. Today we trained but the middle time of filling 90cm goal stayed 2.5min.
   3.2. It was discussed the strategy of tele op period. We decided that the best strategy is
      3.2.1. Capture 90cm goal (usually we do it in autonomous period).
      3.2.2. Put the maximal count of balls to 90cm goal.
      3.2.3. Move 90cm goal to the parking zone (it is more safely than move it to the ramp because we can to turn over it).
      3.2.4. When there is left 45sec to end of the match start to collect balls for the center goal. Then ride to the center goal and wait for end game.
      3.2.5. Put the balls to the center goal when the end game starts.
      3.2.6. Ride to the ramp if 15sec or more lefts to end of the match. Else ride to the parking zone.
4. Results:
   4.1. It was elaborated the strategy of tele op period.
5. Tasks for the next meetings:
   5.1. To train on the control robot .
   5.2. To make programme of autonomous period from the ramp.
   5.3. To imrove the protection from the small balls and the stick.



4.5.74 08.02.15

1. The time of beginning and ending of the meeting: 12:30 - 18:00.
2. Purposes of the meeting:
   2.1. To improve MCB so that it doesn't lose the rolling goal during the fast moving.
   2.2. To make programme of autonomous period from the ramp.
3. Work that has been done:
   3.1. It was decide to install on MCB two servo instead of one. The second was installed. The control of second servo was added to the programmes.

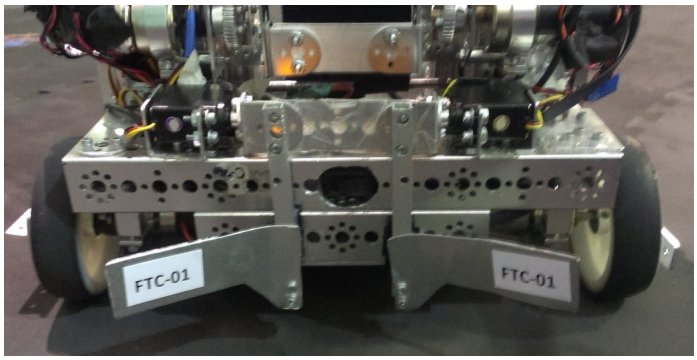
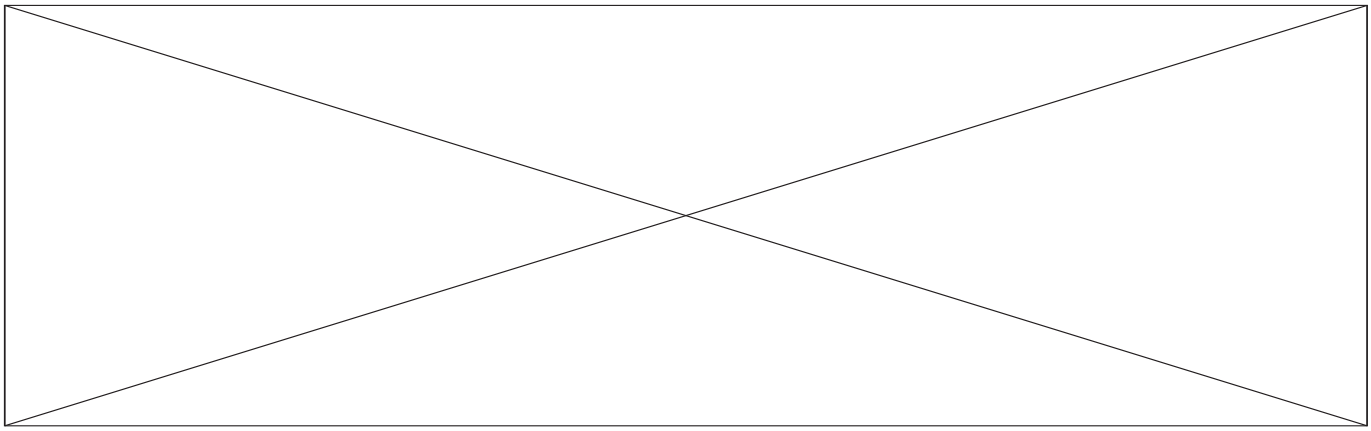


Figure 121: MCB with two servos

   3.2. Programme of autonomous period from the ramp was wrote. Strategy of autonomous period wasn't changed. It will need to correct the programme in accordance with the characteristics of the competition field.
4. Results:
   4.1. MCB was improved.
   4.2. Programme of autonomous period from the ramp was wrote.
5. Tasks for the next meetings:
   5.1. To train on the control robot.
   5.2. To imrove the protection from the small balls and the stick.



4.5.75 09.02.15

1. The time of beginning and ending of the meeting: 16:10 - 22:00.
2. Purposes of the meeting:
   2.1. To imrove the protection from the small balls and the stick.
   2.2. To train on the control robot.
   2.3. To package robot for transportation it to Moscow to competition "Robofest-2015".
3. Work that has been done:
   3.1. It was decided to install additional protection only on the front part of robot because the polling goal will protect back part. They were instaled corners that protects robot from running over the stick.

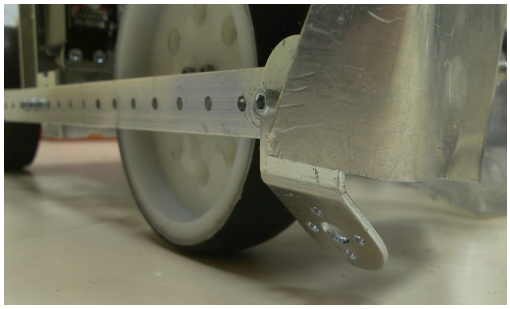
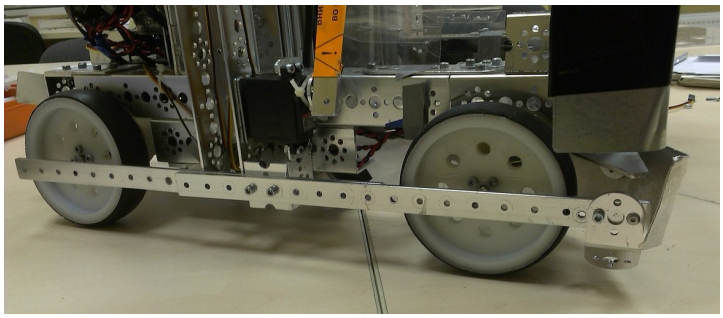
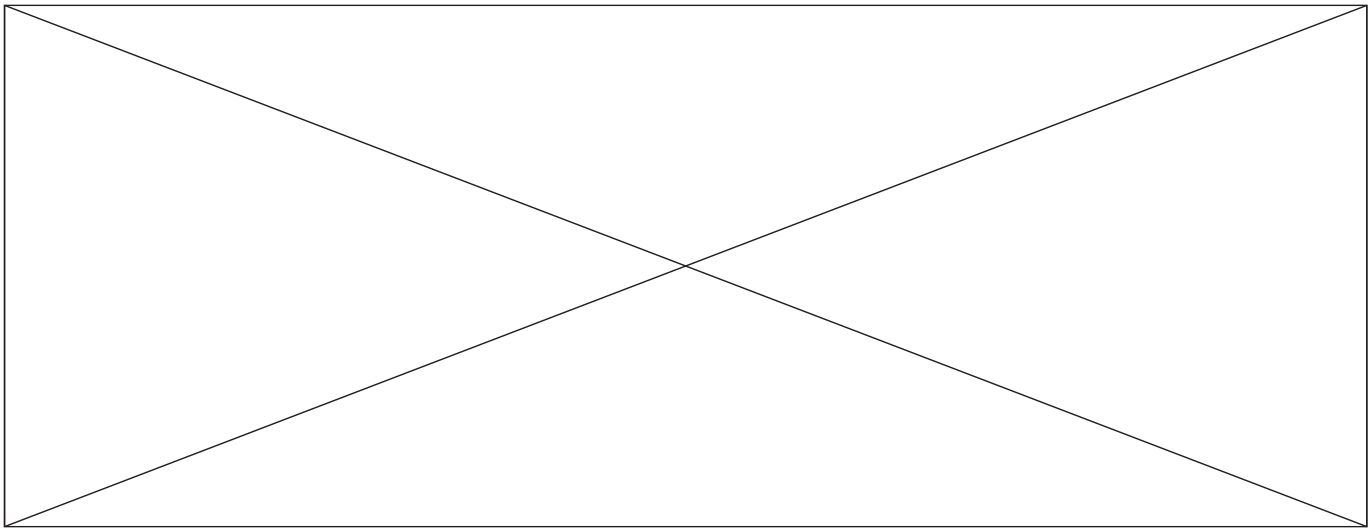



Figure 122: Protection from the stick

   3.2. Robot was packaged into the box.
4. Results:
   4.1. Protection for wheels was installed.
   4.2. Robot was packaged into the box.
5. Tasks for the next meetings:
   5.1. To do our best in Moscow.



4.5.76 11.02.15 (Competition)

1-st day of competition "Robofest-2015"

Today there was technical day. We trained debugged autonomous period and communicated with another teams.

Firstly we talked with all FTC teams. There were 33 teams.We learnt about opportunities and strategy of every team. We got a dates about all robots. Also we gave to all teams the lists with short information about our strategy and opportunities. So we drew attention to our team and we has more chances that another team will choose us for the final matches.

In addition we gave our engineering book to the judges.

Improvements that were done:

1. It was found that the right corner of the bucket hooks the wire that connect servo that overturns bucket with servocontroller. So the corner was cut and it was glued the patch. The bucket stopped hook the wire.

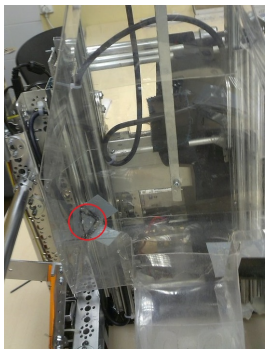


Figure 123: The cut corner

Figure 124: Larger image

2. We decided to concentrate on the programme of autonomous period from the parking zone because the most part of teams did autonomous period from the ramp better than from the parking zone.
3. The guideway for balls was fixed only on the slats. So it staggered. To prevent this it was decided to install the stopper that that limits backlash of the guiedeway. So the problem was fixed.

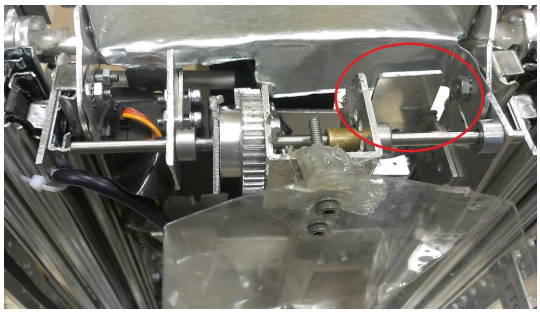


Figure 125: Stopper

4.5.77 12.02.15 (Competition)

2-nd day of competition "Robofest-2015"

Today there were qualification matches.

After qualification marches we conducted technical inspection of our robot and twirled all screws. The construction of robot wasn't changed.

First organizators planned to spend 40 matches (every team plays 5 matches) but due to problems with field control system they spent only 32 matches (4 for every team)

Results of matches: 3 wins from 4.

Matches where we won finished with good score. In every matches we got an average of 50 points for autonomous (robot did 2 or 3 actions from 4). It talk about low accuracy of moving by encoders. In tele op we captured 90cm goal and put into it 8 - 10 big balls (about 60cm - 180 points) then release it in the parking zone (10 points) and put 2 - 3 big balls to the center goal (about 90 - 140 points). That is we followed a planned strategy.

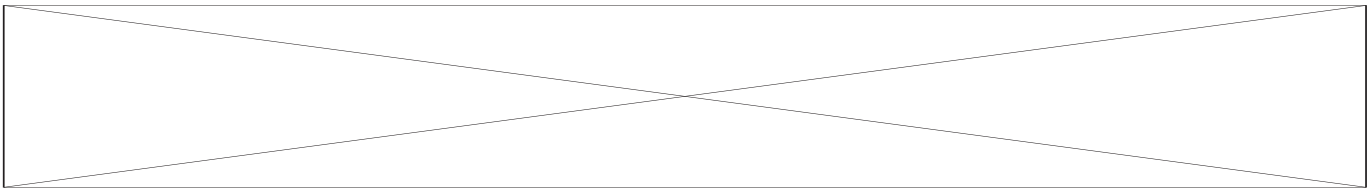
In the second game we got a big count of points - 495. We made it because we reach effective teamplay with our ally (team "Sirius" from Ryazan). Our teammate had low accuracy of throwing balls into rolling goals. So we rised our lift, overturned the bucket and they put their balls on our gutter and balls got into rolling goal. So we filled the 90cm goal then we put 3 big balls into center goal and went to parking zone. Our ally went to the ramp and moved one rolling goal to it.

We lost third game because we forgot to put autonomous balls and didn't get points for them. In addition our robot for unknown reasons didn't turn to the parking zone and knock the stick of opponents. Also we made a lot of mistakes in tele op period and filled 90cm goal on only 30cm and didn't put the balls into center goal.

Format of protection engineering book changed. Now judges went to us during the brake between qualification matches. The plus of this format is that we can to demonstrate at the field opportunities of our robot. We talked with judges well. Results are unknown.

Main problems identified during matches:

1. Our gripper was narrow. So we had problems with capturing balls.
2. Some team blocked way to rolling goal during autnomous period. So it impossible to put autonomous balls into rolling goals and move rolling goals to the parking zone. We didn't play with team with this strategy but we understood vulnerability of our autonom.
3. Before the last match it found that our MOB can't overturn bucket with five balls. This was because servo partically spoiled. We didn't have new powerful servo so we should to capture only 4 balls.



4.5.78 13.02.15 (Competition)

3-rd day of competition "Robofest-2015"

Today there were final matches.

Before ad of results qualification matches we talked with all teams again and tell them about advantages that they will get if they will choose our team. So we increased our chanse to take part in a final matches if we will not get to the "top-4".

When were announced results of qualification matches it turned out that our team got 4 place by the results of qualification matches. There were 3 teams in the each alliance that take part in filal matches. We refused to join to alliance of team "Pinck goose" that took 3-rd place in rating. We choose the team "Sirius"(we played very resultative match with this team) and team "Brontozabry-2007" (they could to fill 70cm of 90cm goal alone).

Strategy of our alliance:

1. When we play with team "Sirius" we do autonomous period from the parking zone and they ride from the ramp. In tele op period we fill the 90cm goal together. They put their balls on our gutter. In the end game they put balls into center goal and we continue filling of 90cm goal and ride to the parking zone and move 90cm goal to it.
2. When we play with team "Brontozabry-2007" we do autonomous period from the parking zone and they ride from the ramp and put autonomous balls to 60cm goal. In tele op period "Brontozabry" fill 90cm goal and we fill 60cm goal. In the end game we put the balls into center goal and they move two goals and they robot to the ramp.
3. When play team "Brontozabry-2007" and "Sirius" the first team do they autonomous from the ramp and "Sirius" put the balls to the center goal if the central structure is in the one position and knock the stick when it in the other two positions. In tele op they fill the 90cm goal together. Robot of the team "Brontozabry-2007" had a gutter for balls too. So "Sirius" put the balls to their gutter. In the end game "Sirius" put the balls into center goal and "Brontozabry-2007" move rolling goals to the ramp.

We won both rounds of the semi-final. The first round played our team and "Sirius" the second - we and "Brontozabry-2007"
Actions that we did in semi-final:

1. 1-st round:
   - In autonomous period we put the balls into 30cm goal and 90cm goal (60 points). Team "Sirius" didn't ride from the ramp.
   - In tele op period we and "Sirius" filled 90cm completely (261 point).
   - In the end game "Sirius" coundn't put balls into center goal and they ride to the parking zone. We moved 90cm goal and our robot to the parking zone (30 points).
   - Total: 351 point
2. 2-nd round:
   - In autonomous period we put the balls into 30cm goal and 90cm goal (60 points). Team "Brontozabry-2007" moved out from the ramp and put autonomous balls into 60cm goal (50 points).
   - In tele op period "Brontozabry-2007" filled 70cm of 90cm goal (210 points) and we filled 30cm of 60cm goal (60 points).

- In the end game we put 3 big balls and 1 small to the center goal (about 140 points). The second team moved 60cm and 90cm goal and their robot to the ramp (90 points). Also we moved our robot to the parking zone (10 points).
- Total: 620 points

One team from the second alliance-finalist blocked the way to rolling goals in autonomous period. So it was decided that our team will not take a part in the match against this team. We won both round of the final match. The first round played our team and team "Brontozabry-2007". The second round played "Sirius" and "Brontozabry".
Actions that we did in final:

1. 1-st round:

   - In autonomous period we put balls into 60cm goal and 90 cm goal and moved 90cm goal to the parking zone (80 points). The 30 cm goal we lost because it hit central structure due to low accuracy of turning. The second team moved out frome the ramp and put autonomous balls to 60cm goal (50 points).
   - In tele op period we filled 60cm goal completely (114 points). "Brontozabry-2007" filled 70cm of 90cm goal (210 points).
   - In the end game we put 4 big balls into center goal (162 points). The second team moved 60cm and 90cm goals and their robot to the ramp (90 points). Also we moved our robot to the parking zone (10 points).
   - Total: 716 points.

2. 2-nd round:

   - In autonomous period "Sirius" knocked the stick (30 points). "Brontozabry" moved out from the ramp(20 points). They didn't put autonomous balls to rolling goal because one opponent blocked the way to rolling goal.
   - In tele op period they filled 75cm of 90cm goal (225 points).
   - In the end game "Brontozabry-2007" moved 60cm and 90cm goals and their robot to the ramp (90 points). "Sirius" couldn't put 4 big balls to center goal because opponent pushed them and balls fell to floor. But they still managed capture one big and one small balls and put them to cener goal (60 points).
   - Total: 425 points.

So our alliance won in categotry FIRST FTC.

:

1. The traectory of moving to the parking zone in autonomous period was changed so that our robot doesn't hit our ally that moved out from the ramp.

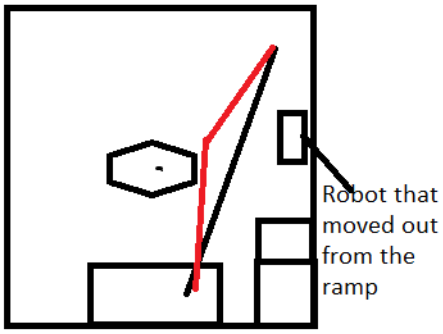


Figure 126: Black line - old traectory, red line - new

Results of competition:

1. We took 4 place by the results of qualification matches.
2. Our alliance won semi-final and final.
3. Our team took the first place in team standings.
4. We didn't tale prize places in nomination "Engineering book".
5. We didn't tale prize places in other nomination.

Summing up:

1. Success in competition:
   - 1.1. We took the 1-st place in team standings and made it to FIRST World Championship that will be in Saint-Louis, USA.
   - 1.2. We won 6 matches from 7 (4 qualification and 3 final matches).
   - 1.3. Due to trainings our operators control the robot successfuly worked competently and coordinated their actions with each other and with operators of ally.
   - 1.4. Mechanisms worked stability and didn't brake except partially failure of MOB (unlike the previous competition).
   - 1.5. Programme of autonomous period worked not very stable and we got only half from planned points on average.
   - 1.6. Programme of tele op worked stabil.
2. Our mistakes and disadvantages of construction:
   - 2.1. Although we made intermediate position of the bucket jam of balls was a problem and we wasted time due to it.
   - 2.2. We couldn't move when lift rised because small balls can get under the robot and prevent to lowering bucket. If we'll make stationary ramp this problem will solved.
3. Useful ideas that we took from another teams:

3.1. Robot of the team from Moscow "Indigo" had a mechanism that can rise rolling goal in allows to get 30 points and don't move rolling goal to the ramp.

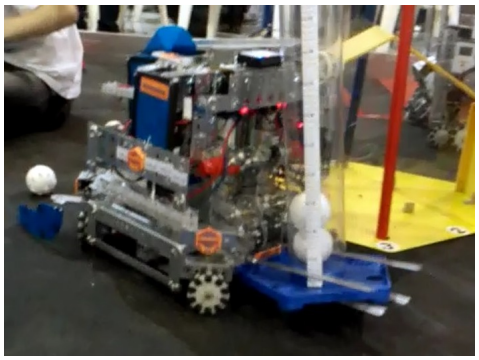


Figure 127: Mechanism that rises the rolling goal

3.2. Robot of the Romanian team "AutoVortex Black Edition" had a wheel base that consist of 6 standard wheels that can rotates around vertical axis. It allows to robot move in all directions and prevent to problems that has robot with omni-wheels: sliping of wheels and low accuracy of moving by encoders and problem with riding to the ramp.

Figure 128: Robot of Romanian team (wheel base is not showed)

3.3. Robot of the team "Indigo" had a additional grippers that was fixed on the sides. This grippers moved balls to the main gripper. It effective when balls are near the wall and main gripper can't get them. In addition operators doesn't need to aim to the ball and if robot push ball it not away from it.

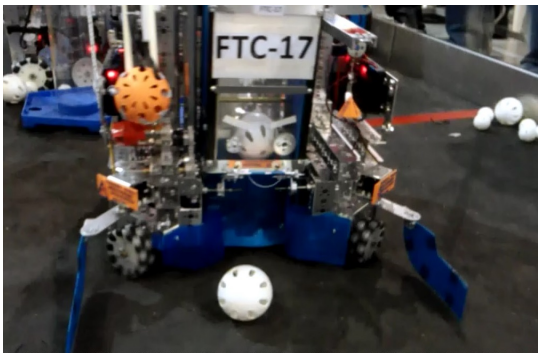
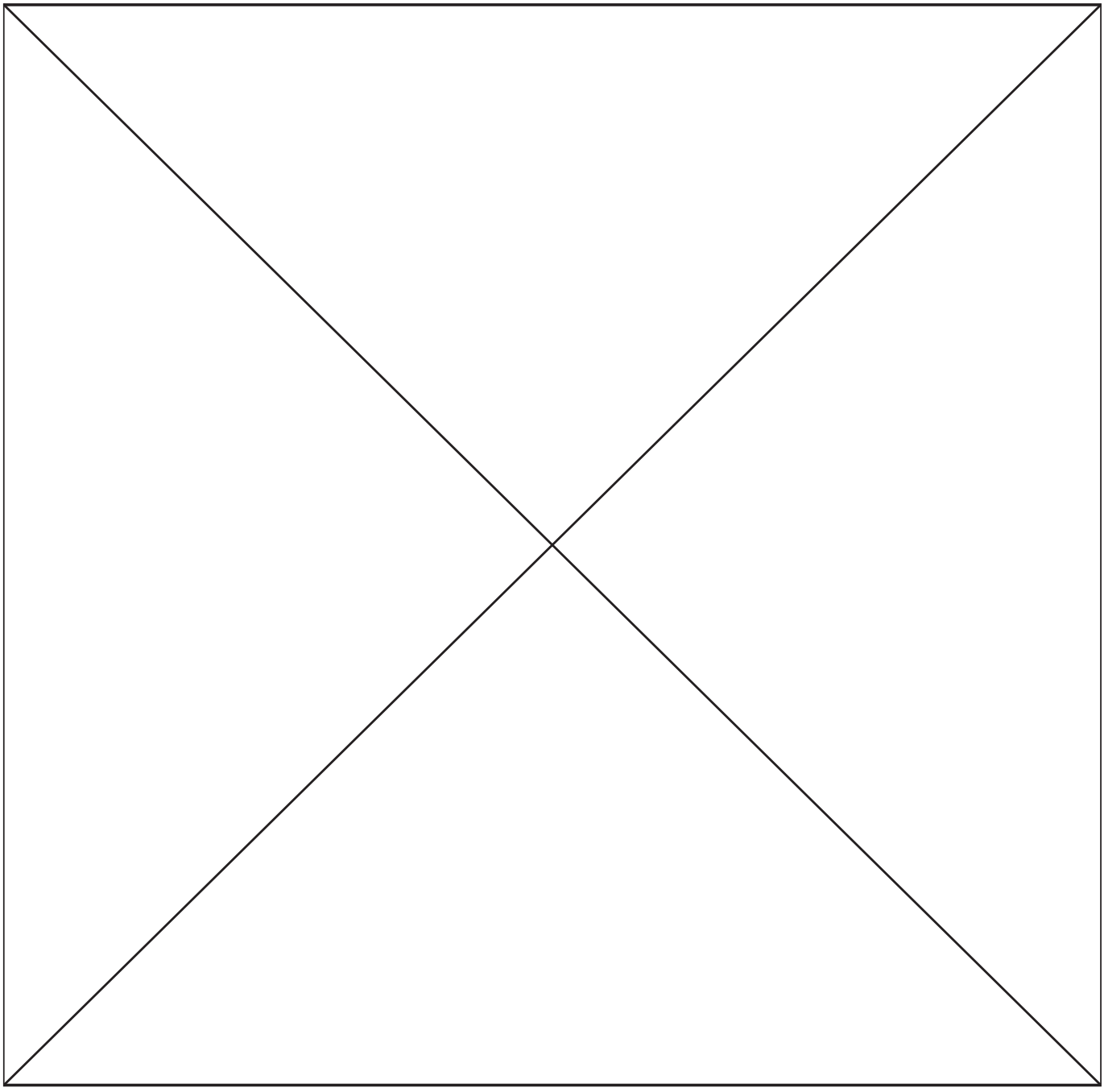


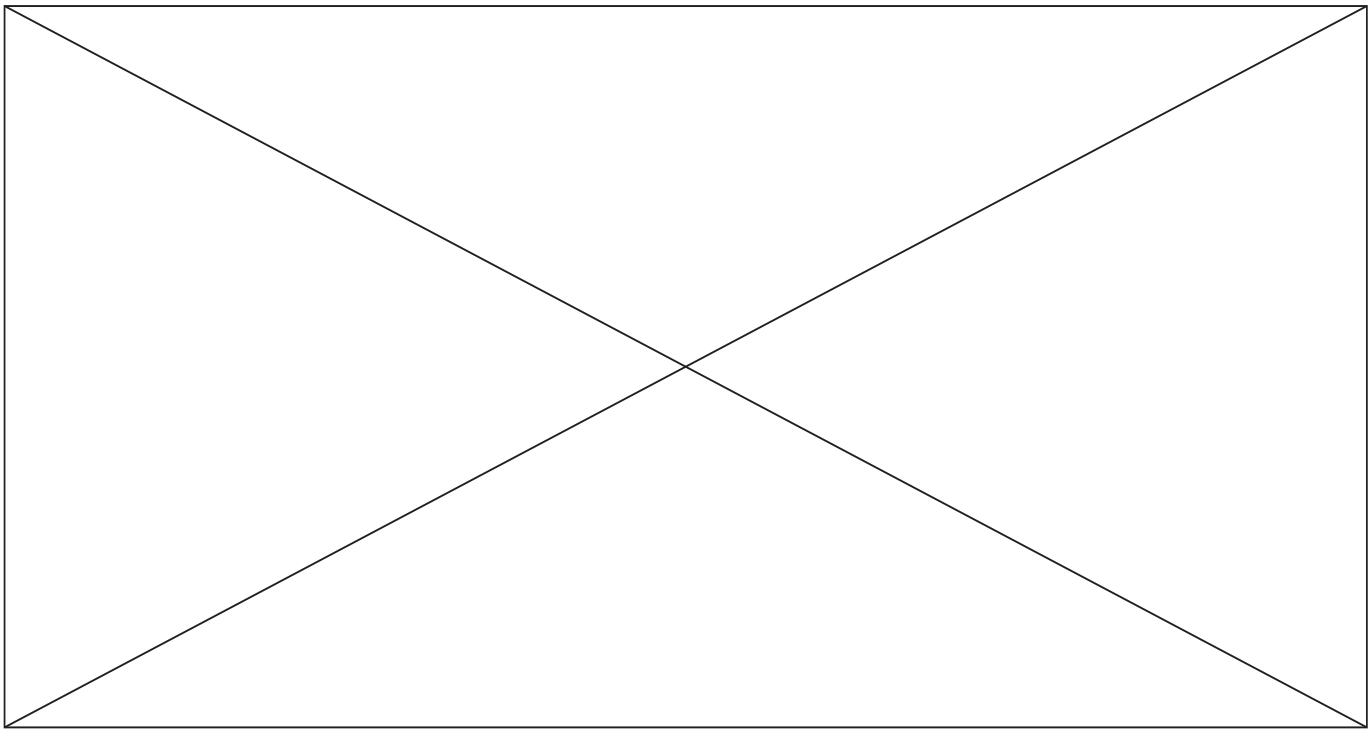
Figure 129: Side grippers

4. Tasks for the next meeting:
   4.1. To make the mechanism that rise the rolling goal.
   4.2. To make the autonomous period so that robot put the balls to center goal and knock the stick.
   4.3. To make turning in autonomous period by giro. It more accurate than encoders
   4.4. To make side grippers for balls.
   4.5. To make 3-d model of robot more accurate and detalied.
   4.6. To make the bucket where balls will not stuck.
   4.7. To make stationary ramp for balls.
   4.8. To increase power of MOB so that it can overturn bucket with 5 balls.



4.5.79 21.02.15

1. Time of beginning and ending of meeting: 16:00 - 20:00.
2. Purposes of meeting:
   2.1. To held the wires that connect servocontroller with servos that moves additional grippers for balls.
   2.2. To correct blades on the additional grippers for balls.
   2.3. To make a new blades on the central grippers for balls.
3. Work that has been done:
   3.1. The wires on servos that moves grippers for balls were held so that they can't hook elements of field or another robot.
   3.2. Blades on additional grippers for balls were cut so that the doesn't hook the body of robot.
   3.3. The new blades for central were made by two plastic plates. Each plate was made by two pieces of PET bound to each other.
   3.4. New gripper was tested. Result negative: balls often stuck between the bucket and blades because they too rigidly. So the bucket cracks. It was decided to try install the screeds on the gripper.
4. Results:
   4.1. The blades on additional gripper for balls were cut.
   4.2. The wires were held.
   4.3. The new blades were made and tested. Result negative
5. Tasks for the next meetings:
   5.1. To make new blades by screeds.
   5.2. To make the mount for the second servo on MOB.



4.5.80 23.02.15

1. Time of beginning and ending of meeting: 16:00 - 20:00.
2. Purposes of meeting:
   2.1. To make the mount for the second servo for MOB.
3. Work that has been done:
   3.1. It was decided to install the second gear on the axis around which turns the bucket. The second servo will rotate this gear. It was decided not connect the shafts of servos because they will not coaxial. So servos will tremble. But if we'll connect the second servo with the axis through the gear the backlash between the gears will compensate not coaxial arrangement of servos.
   3.2. The second gear was installed.

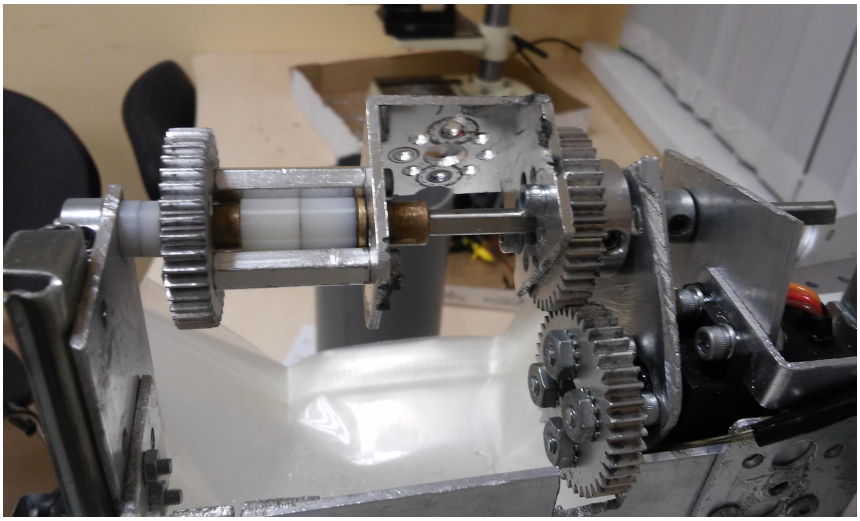
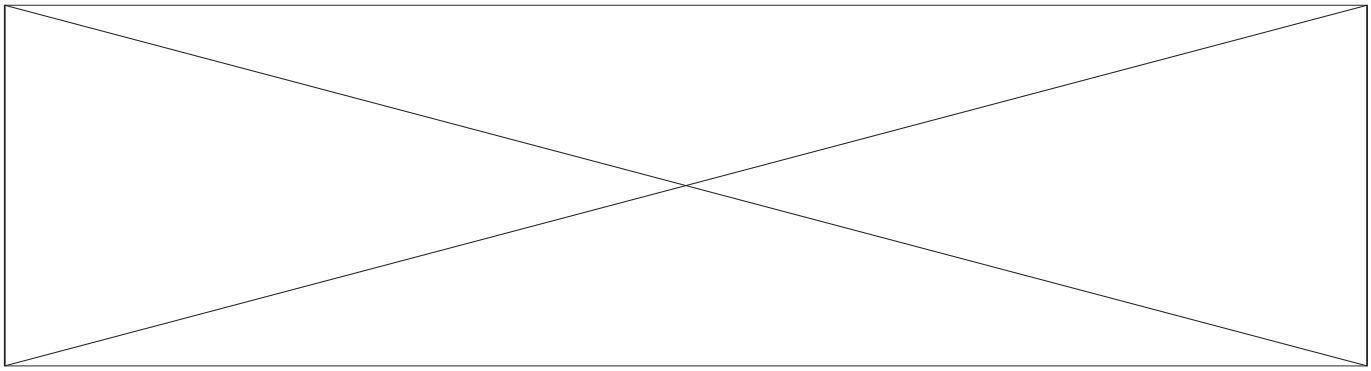


Figure 130: The second gear)

4. Results:
   4.1. It was elaborated the way of fixing the second servo.
5. Tasks for the next meetings:
   5.1. To fix the second servo.
   5.2. To make the new blades for central gripper for balls by screeds.



4.5.81 26.02.15

1. Time of beginning and ending of meeting: 16:00 - 22:30
2. Purposes of meeting:
   2.1. To replace blades on the gripper for balls.
   2.2. To make the ramp for balls that fixed stationary.
3. Work that has been done:
   3.1. It was decided to make blades by pieces of plastic bottle.
   3.2. It was found that when robot moves with raised lift small balls gets under the bucket. It prevents to lowering of the bucket. This was because the ramp for balls was fixed on the bucket. So it was decided to install the ramp stationary.
   3.3. It was made cardboard layout of the ramp. It was decided to fix the ramp on the slopes.

Figure 131: Cardboard layout of the ramp

   3.4. It was made the ramp of galvanized steel.

Figure 132: Steel ramp

   3.5. The ramp was tested and it was estimated optimal distance between the gripper for balls and ramp.
   3.6. It was found that when two balls gets into the gripper they stuck because they can't to pass between the slopes. So it was decided to cut one side of the blades of gripper. So the gripper capture one ball stronger than the second. Firstly the ball that captures by longer side of the blade

gets into the bucket. When there is only one ball in the gripper it can to capture ball without problems.

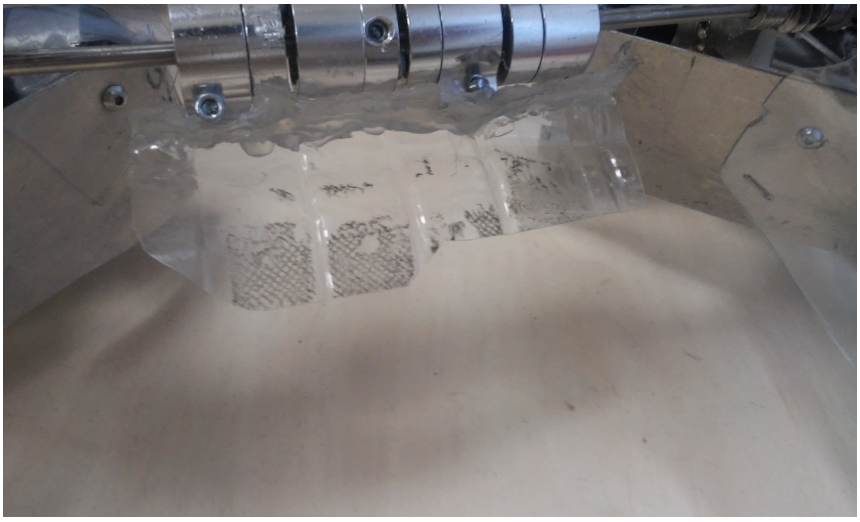


Figure 133: Blades were cut

3.7. It was carried out training. During the training there was a problem that motors didn't work but servos and Lego motors worked. When we turned off the power and then turned on it this problem was solved. But if it will happen during the match we'll can't to do it. So it was elaborated mechanism that turns by Lego motor and press the button of power. It will need to connect two buttons one - for Samantha-module and the second - for controllers. This mechanism will press the second button. So the robot will not disconnect from the field control system. Also it will be more comfortable turn off the power from joystick. In addition we'll can turn off the power between autonomous and tele op period. So our battery will not discharge.

3.8. The problem was that the balls can stuck in the bucket when it overturned. So it was decided to make asymmetrical bucket.

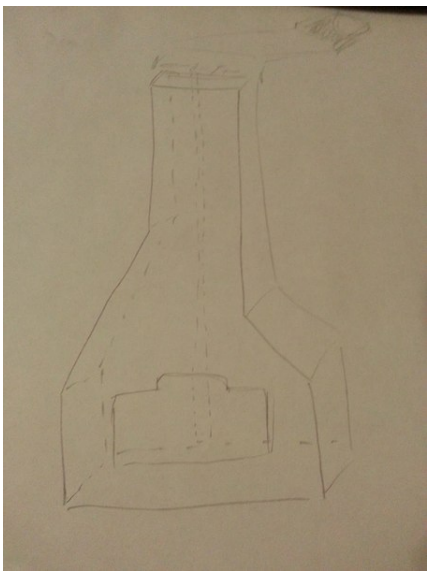


Figure 134: The idea of the new bucket

3.9. The blades of additional gripper were cut so that they doesn't hook the slopes when they under the load.

4. Result:

4.1. They were made new blades for gripper.

4.2. It was projected new ramp for balls.

4.3. The gripper for balls was improved.

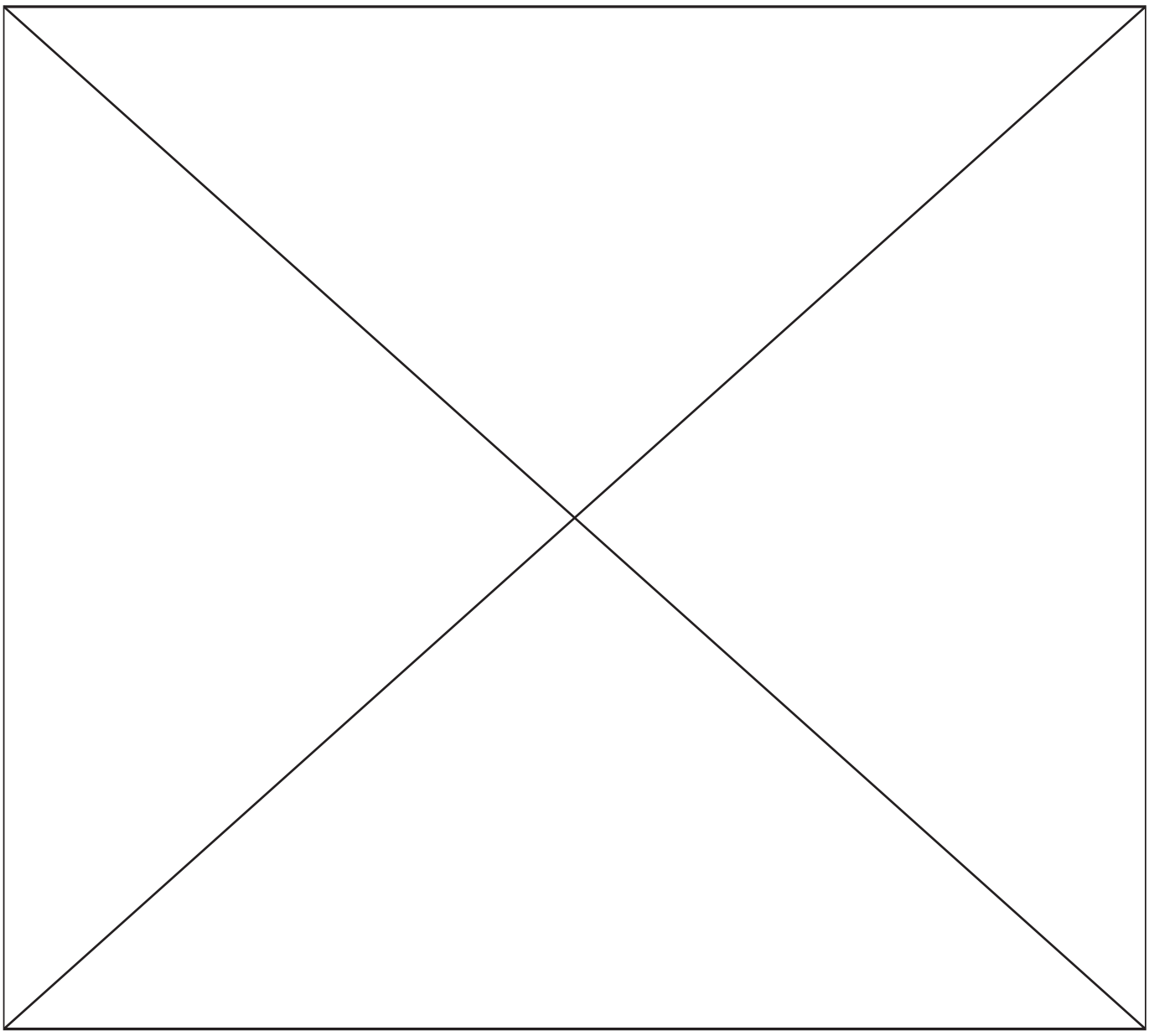
4.4. It was invented the idea of the automatical button of power.

4.5. The blades on additional grippers for balls were cut so that they doesn't hook the slopes.

5. Tasks for the next meetings:

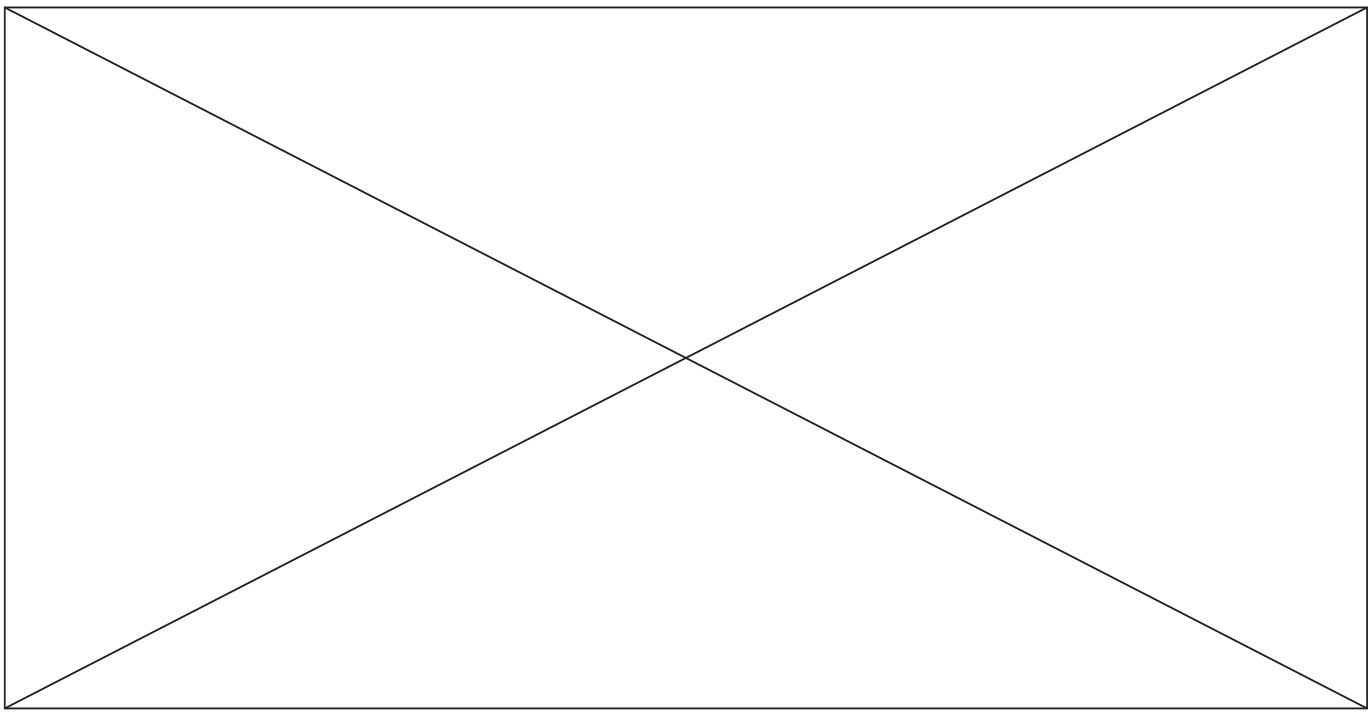
5.1. To make a new bucket.

5.2. To fix the ramp.



4.5.82 28.02.15

1. Time of beginning and ending of meeting: 16:00 - 22:00
2. Purposes of meeting:
   2.1. To make the new bucket.
   2.2. To fix the ramp.
3. Work that has been done:
   3.1. The ramp was fixed to the slopes with help of 4 corners from the Tetrix set.
   3.2. Today we projected a new bucket. We took the old bucket and modeled various scenarios. We try to reduce the angle of the bucket. So the balls should roll slower and straight. But it was wrong: balls continued stuck in the bucket.
   3.3. Also we discussed different buckets complex form. For example bucket with zigzag tube. But it was decided to fefuse from this variants because this bucket has more places where balls can stuck.
   3.4. It was found that if we install the plates that will smooth corners of the bucket balls will pass throught the bucket without problems. But this bucket will take more the place because due to the plates 5 balls will not fit in the bucket with the dimensions of previous bucket. So it will need to reduce the length of the ramp.
4. Result:
   4.1. The ramp was fixed.
   4.2. The new bucket was elaborated
5. Tasks for the next meetings:
   5.1. To make the new bucket.
   5.2. To reduce the length of the ramp.



4.5.83 02.03.15

1. Time of beginning and ending of meeting: 20:00 - 22:30.

2. Purposes of meeting:

   2.1. To test the ramp for ball with the slope angle 60 degrees and estimate optimal distance between the axis of the gripper and ramp.

3. Work that has been done:

   3.1. It was made cardboard layout of the ramp with slope angle 60 degrees.

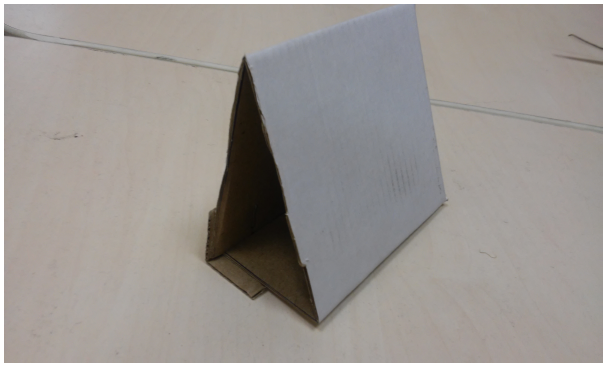


Figure 135: Cardboard layout of the ramp

   3.2. It was estimated that optimal distance between the ramp and axis is 5.5cm.

   3.3. During the tests of the ramp it was found that balls can stuck between the slopes when the ball that captures by more short side of blade is closer to the ramp than the second ball. This was because the blade bended when it touch the ball that captures by long side and didn't touch the ball that was closer to the ramp. So it was decided to cut the blades on 2 part because in this case blades touchs both balls. Also we planned to turn halfs of the blades relative to each other. It will increase the quality of capturing balls because one ball will captured before the second so they will not prevent to each other.

Figure 136: Cut blade

3.4. It was decided to make the bucket and then make ramp for it. If it will need we'll can to increase the slope angle.

4. Results:

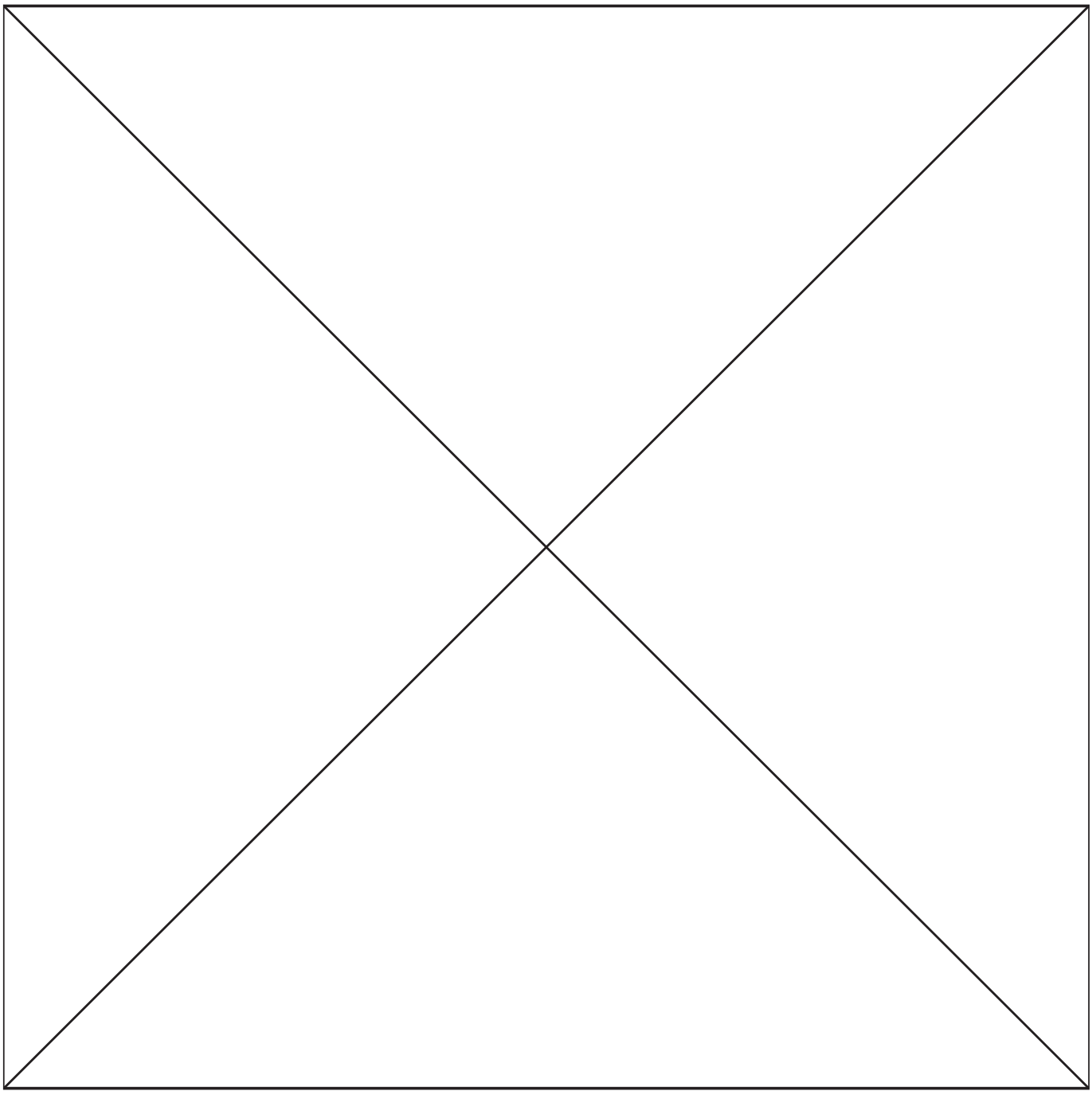
4.1. The ramp with slope angle 60 degrees was tested.

4.2. Gripper for balls was improved.

5. Tasks for the next meetings:

5.1. To make the bucket where balls will not stuck.

5.2. To make the ramp for bucket.



4.5.84 04.03.15

1. Time of beginning and ending of meeting: 17:00 - 22:30
2. Purposes of meeting:
   2.1. To make the new bucket.
   2.2. To add to the programme of control robot control of button.
3. Work that has been done:
   3.1. It was decided to increase the straight section of the bucket and install inside it piece of plastic that will smooth corners of the bucket. The balls will line up in one line by this plate and so they will not stuck.
   3.2. It was made the drawing of new bucket.

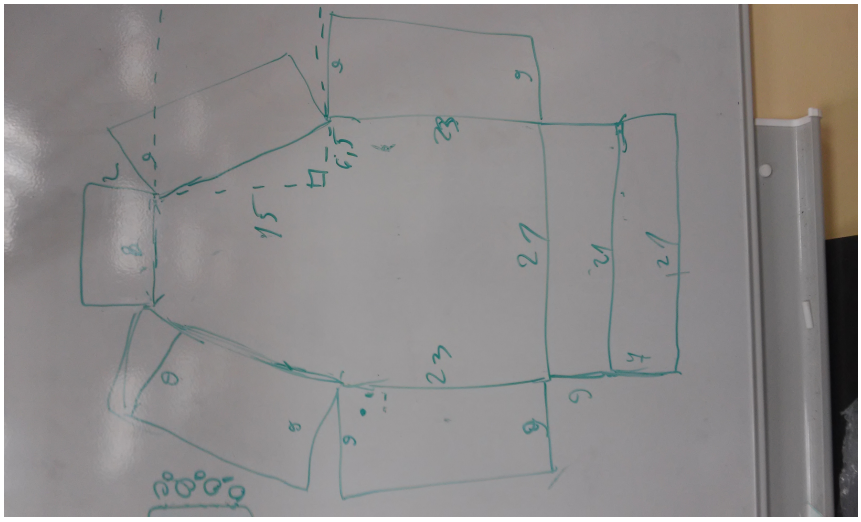


Figure 137: The drawing of the new bucket

   3.3. We couldn't make bucket because we didn't have enough PET.
   3.4. It was installed interned camera. If someone from members of the team can't go to the meeting he can take part in discussions by Intrnet.

Figure 138: Camera

   3.5. The control of the power was added to programmes of autonomous and tele op period. Programmes were optimized: initialization of motors and servos was made in separative file. Also values of joystick buttons were assigned to the special variables. So we doesn't need to remember them.

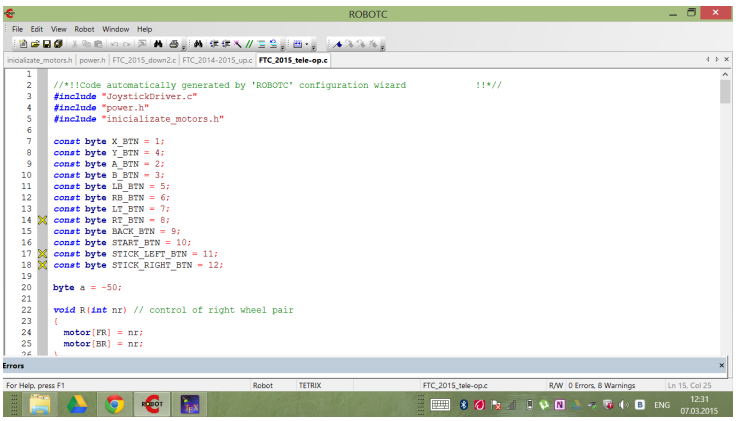


Figure 139: Values of joystick buttons

4. Result:

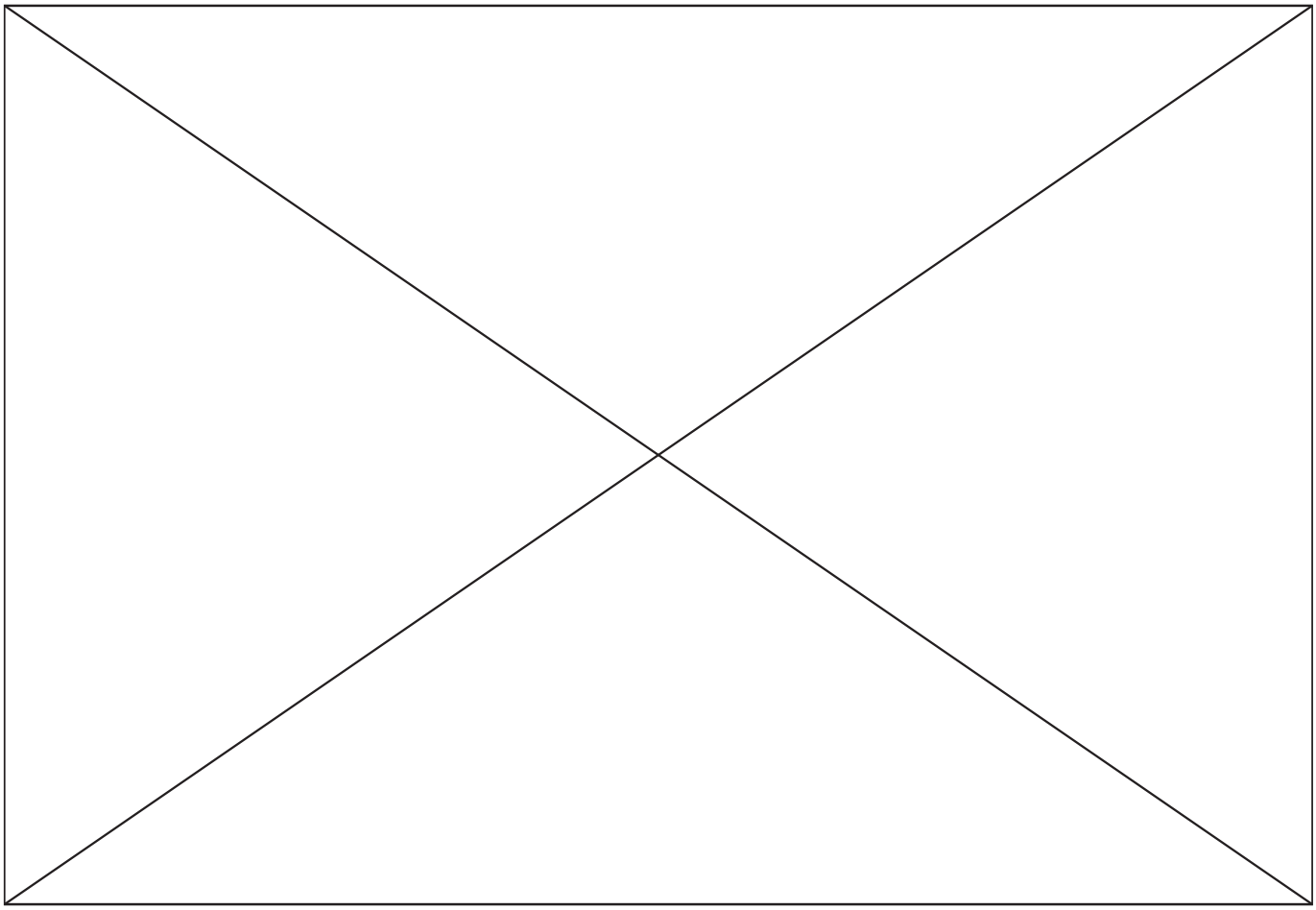
   4.1. It was installed Internet-camera.

   4.2. Control of power was added to programmes.

   4.3. Programmes were optimized.

5. Tasks for the next meetings:

   5.1. To buy the list of PET and make new bucket.



4.5.85 05.03.15

1. Time of beginning and ending of meeting: 18:00 - 22:30

2. Purposes of meeting:

   2.1. To make the new bucket.

3. Work that has been done:

   3.1. Today it was bought the list of PET.

   3.2. The drawing of bucket was drew at the list of plastic.

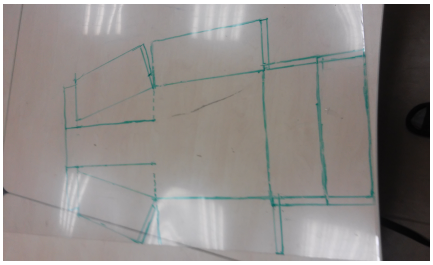


Figure 140: Drawing of the bucket on the list of plastic

   3.3. The bucket was cut and fastened by stapler.

Figure 141: Bucket

   3.4. The piece of plastic that smooth corners was installed inside the bucket.

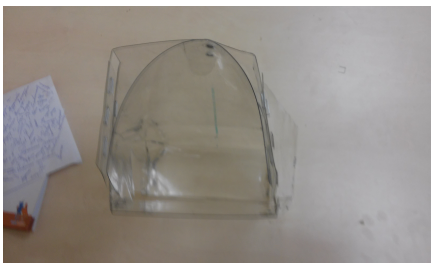


Figure 142: The piece of plastic that smooth corners

3.5. The bucket was tested. Result is positive: balls doesn't stuck inside it when there is 8 big balls in the bucket.

3.6. The corner that can hook the wire that connect MOB with servocontroller was cut. The patch was fixed on the cut part.

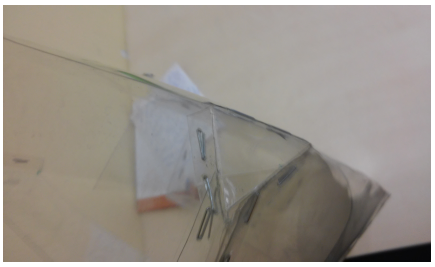


Figure 143: The patch

3.7. It was found that the left edge of bucket can hook the beam that limits the body of robot. So it was decided to cut this edge and install the inclined patch as on the right corner.

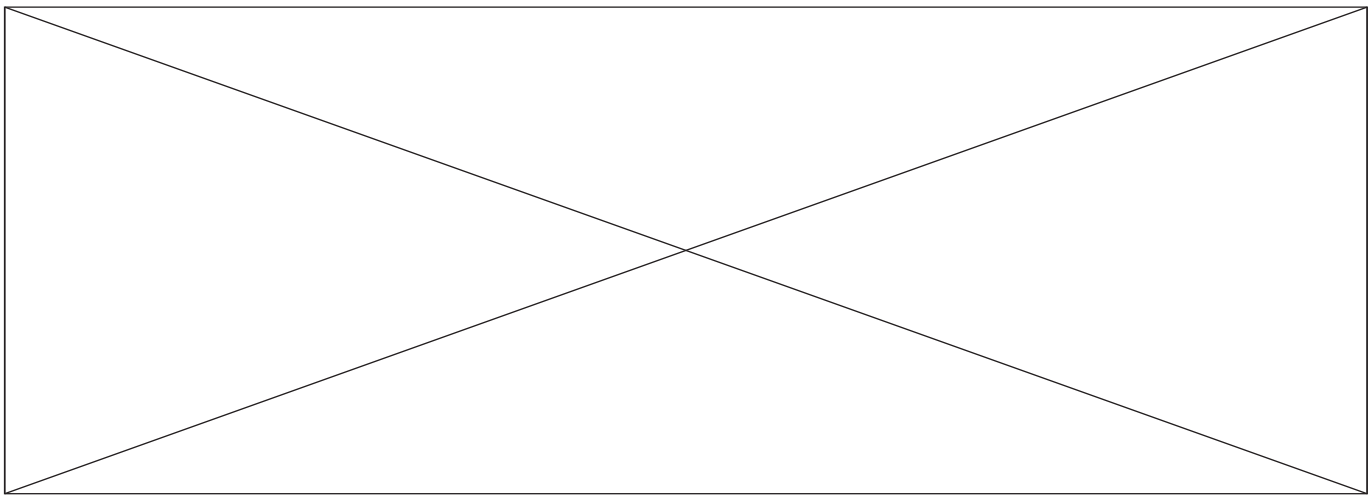
4. Result:

4.1. Bucket was made.

5. Tasks for the next meetings:

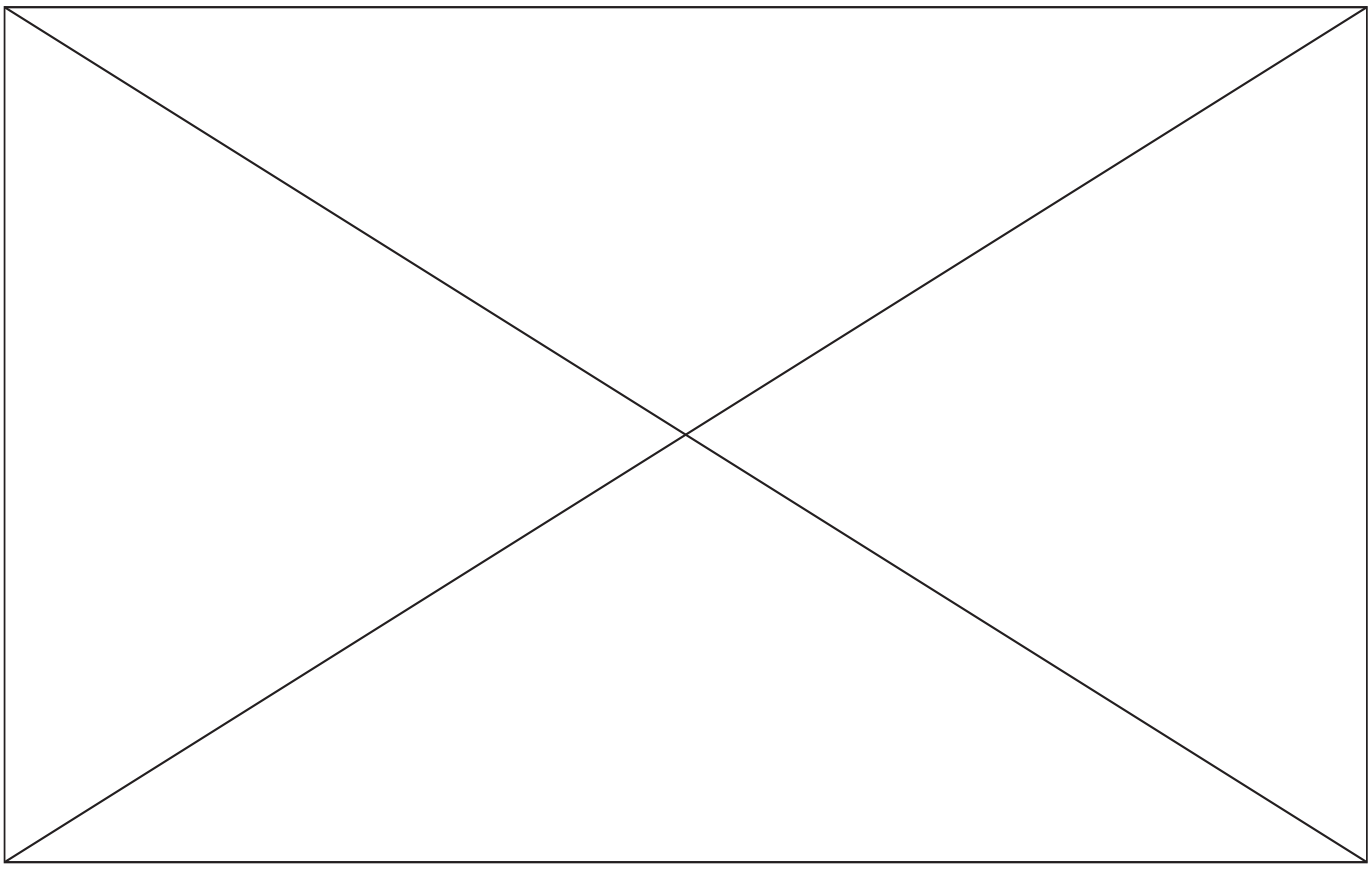
5.1. To cut the left edge of bucket.

5.2. To make the ramp for bucket.



4.5.86 07.03.15

1. Time of beginning and ending of meeting: 16:00 - 20:00
2. Purposes of meeting:
   2.1. To cut the left edge of bucket.
   2.2. To make the ramp for bucket.
3. Work that has been done:
   3.1. The left edge of bucket was cut and the patch was fixed.
   3.2. The bucket was tested. Result is positive: bucket doesn't hook the beam.
   3.3. It was decided to change the position of servo that overturns bucket. Later the extreme position is overturned and the start position we set up. But it was decided to make the start position extreme and set up the overturned position for redusing of the load on servo.
   3.4. We tryed to test the programme of control power but our NXT showed the error. The last part of the meeting we tryed to solve this problem.
4. Result:
   4.1. Bucket was finished.
5. Tasks for the next meetings:
   5.1. To solve the problem with NXT.
   5.2. To make new ramp for balls.



4.5.87 09.03.15

1. Time of beginning and ending of meeting: 16:00 - 23:00

2. Purposes of meeting:

   2.1. To solve the problem with NXT.

   2.2. To make the ramp for bucket.

3. Work that has been done:

   3.1. The problem with NXT was solwed.

   3.2. Programme of control robot was tested. Result is positive: button works without problems.

   3.3. It was found that when we turn on power robot doesn't work during the 1 second. So it was decided that we will not off power before autonomous period.

   3.4. It was decided to change wheel base. We looked next variants.

      3.4.1. To move the front motors with standard wheels to back part and install instead of them omni-wheels. Our robot will turn faster and we'll can increase width of gripper for balls.

      3.4.2. To move front motors to the top of beam and connect the wheel by gears. We'll can increase width of gripper but we'll need disassemble less elements.

      3.4.3. The same variant as the first but motors will fixed in the central part. They will connected with wheels by gears. We'll can to increase width of gripper, robot will turn faster and load on motor's shaft will reduced and reducers of motors will not break.

      3.4.4. Motors are installed on the central part and all wheels connected with them by gears. In this case we'll lose less traction than with the 3-nd variant.

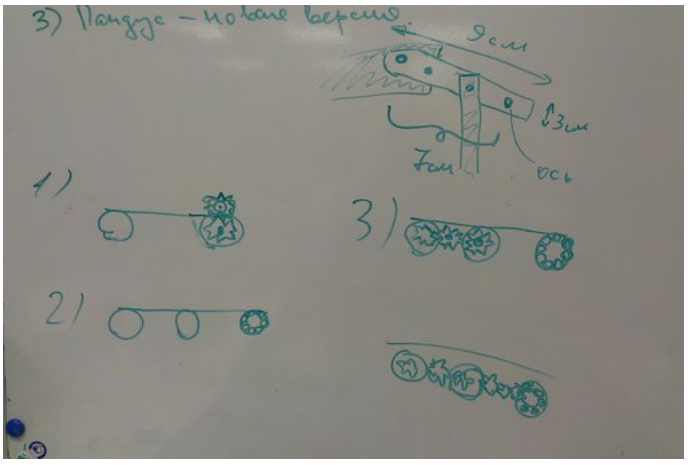


Figure 144: Ideas for improvement wheels base

   3.5. It was found that motor controllers that fixed on the bottom doesn't allow to fix motors on the central part. So it was decided to move them on the another place.

   3.6. It was decided to fix the beam on MEL and install controllers on it.

   3.7. The beam was fixed and controllers were removed from the old place.

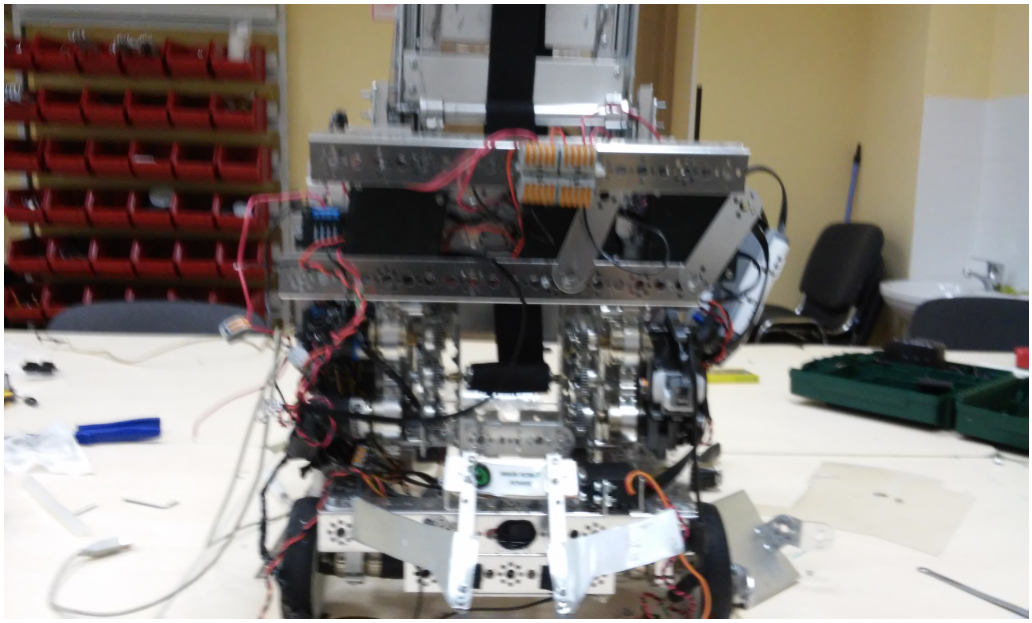


Figure 145: Mount for controllers (controllers wasn't fixed)

3.8. In addition MEL was strengthened by additional plate. Also this plate doesn't allow to wire get under the lift.

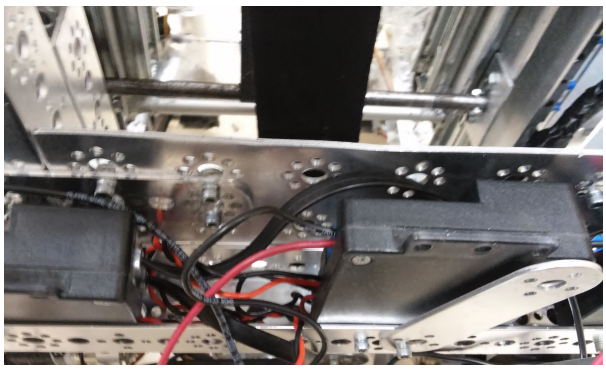


Figure 146: Plate on MEL

3.9. Today we got two powerful servos. One servo was installed on the MCB the second - on MOB.

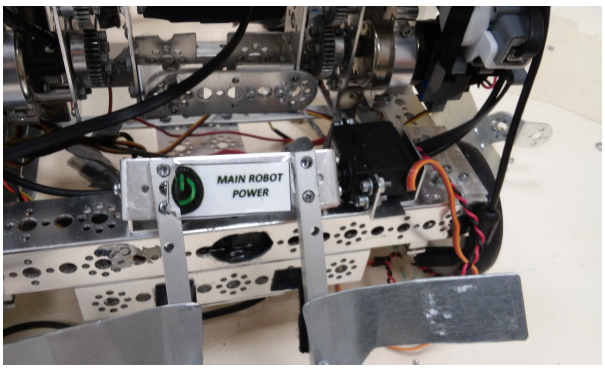


Figure 147: Servo on MCB

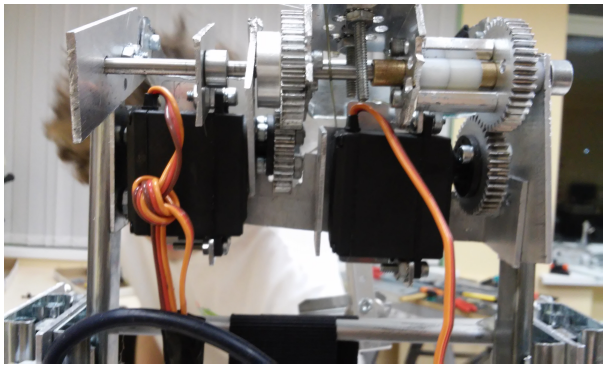


Figure 148: Servo on MOB

3.10. Also the gutter was fixed better so that it doesn't stagger.

Figure 149: Strenghtening plate

3.11. It was decided that driving wheels must be fixed on the same distance from center of gravity. Omni wheel must be fixed on the maximal distance from it because in this case we'll lose less traction. We should to estimate arrangement of center of grvity in Creo.

3.12. It was estimated center of gravity of robot that we has now but didn't set up weight of handmade elements. It is under the slats. So we can not install omni wheels to the front part.

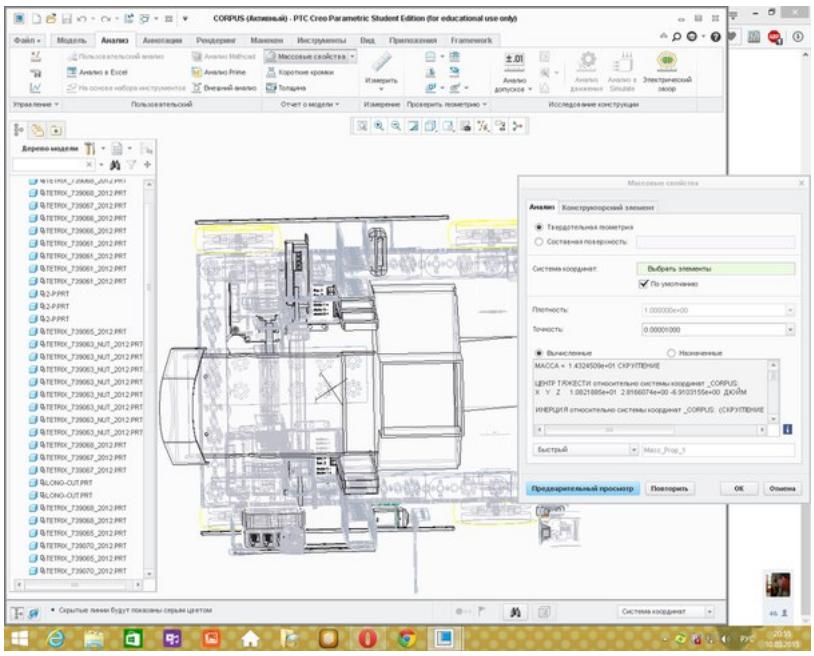


Figure 150: Center of gravity

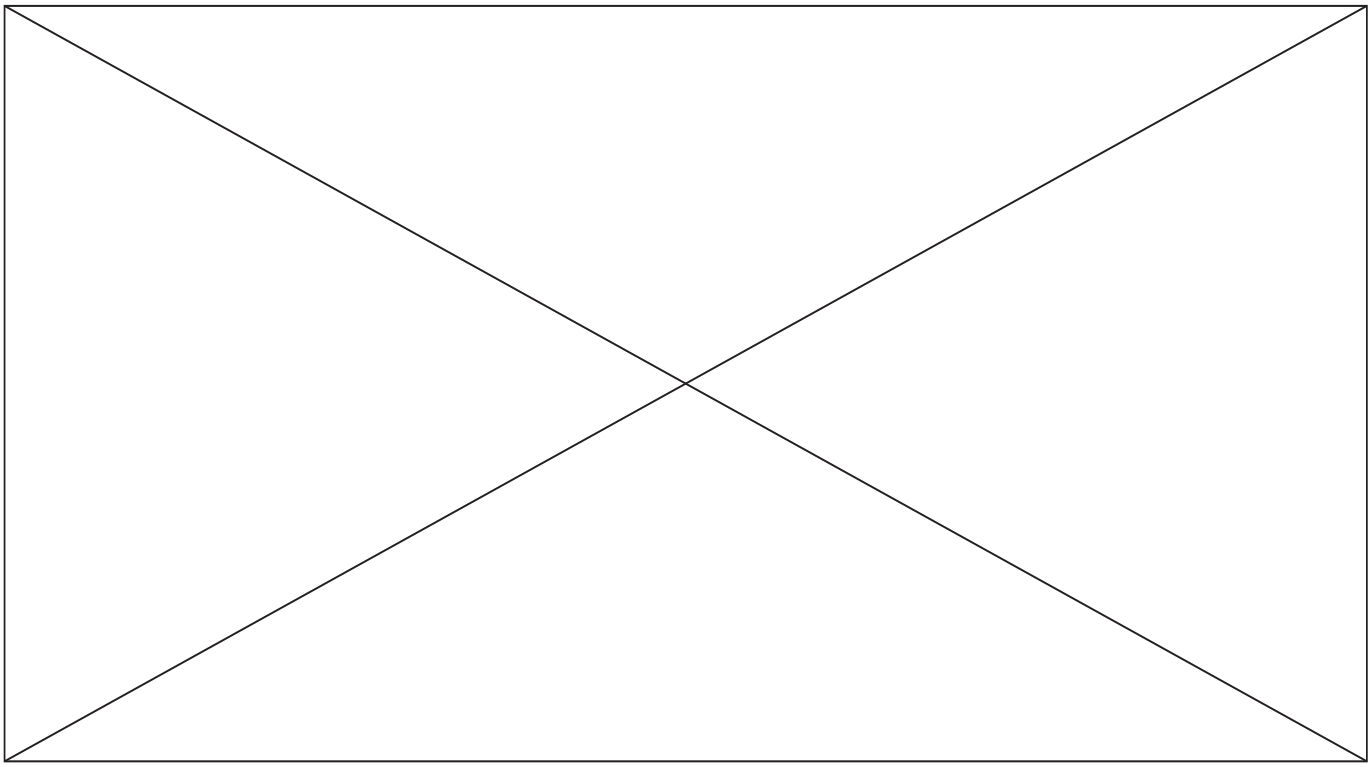
4. Result:

   4.1. It was elaborated new wheel base.

5. Tasks for the next meetings:

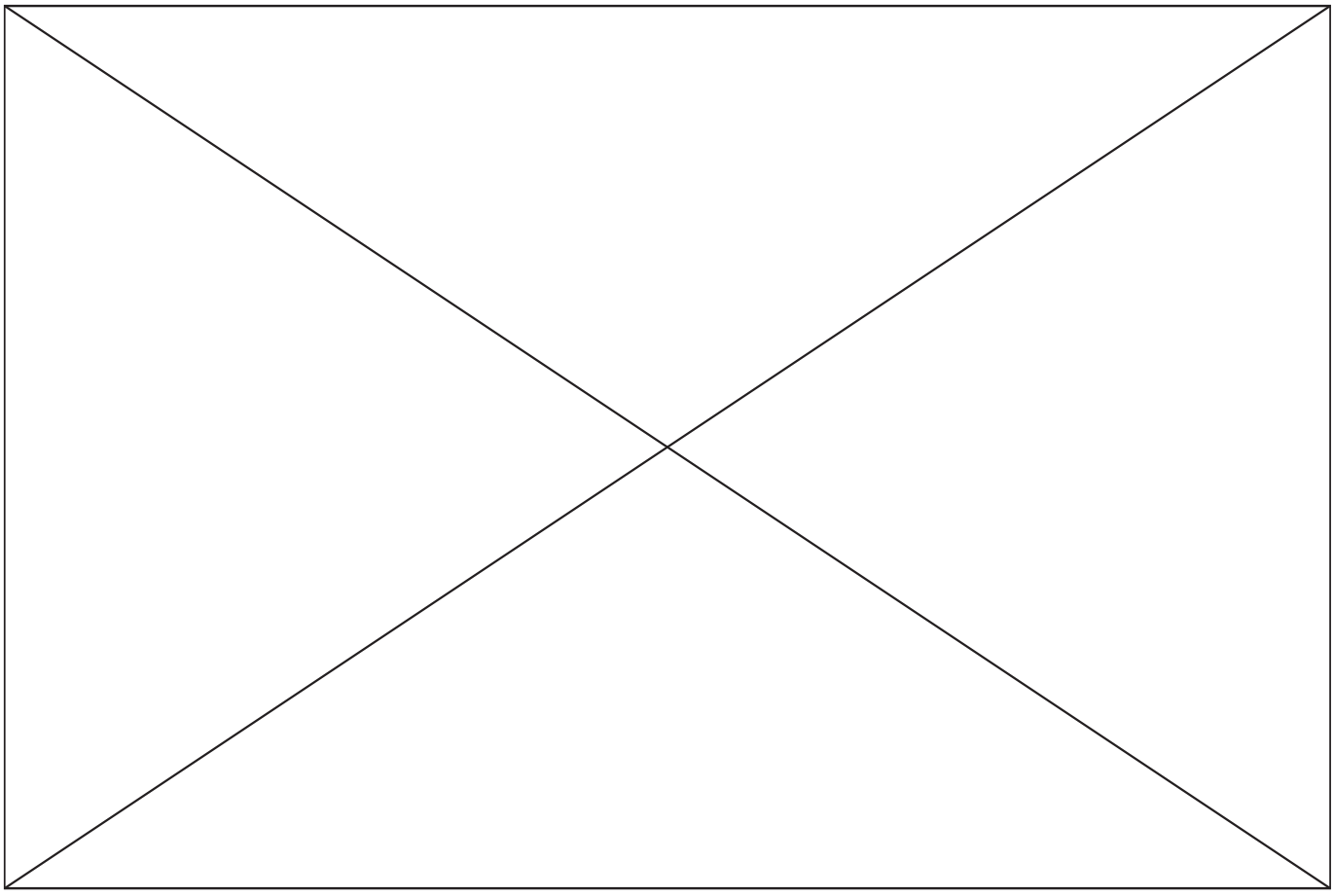
   5.1. To fix controllers.

   5.2. To make Creo model of the new wheel base.



4.5.88 11.03.15

1. Time of beginning and ending of meeting: 16:00 - 23:00
2. Purposes of meeting:
   2.1. To fix controllers.
   2.2. To make Creo model of the new wheel base.
3. Work that has been done:
   3.1. Controllers were fixed.
   3.2. It was decided to disassemle our robot into individual modules (MEL, lift, gripper for balls and base) for more comfortable imrovement and make Creo model of the new robot and after that star to assemble it.
   3.3. It was found that disadvantage of the mount for controllers: it will be difficuld to replace them. So we should to elaborate new mounts for them.
   3.4. Robot was disassembled.
4. Result:
   4.1. Robot was disassembled into individual modules.
5. Tasks for the next meetings:
   5.1. To make Creo model of the new robot.



4.5.89 12.03.15

1. Time of beginning and ending of meeting: 16:00 - 21:30
2. Purposes of meeting:
   2.1. To make Creo model of the MEL.
3. Work that has been done:
   3.1. Creo model of the MEL was made.

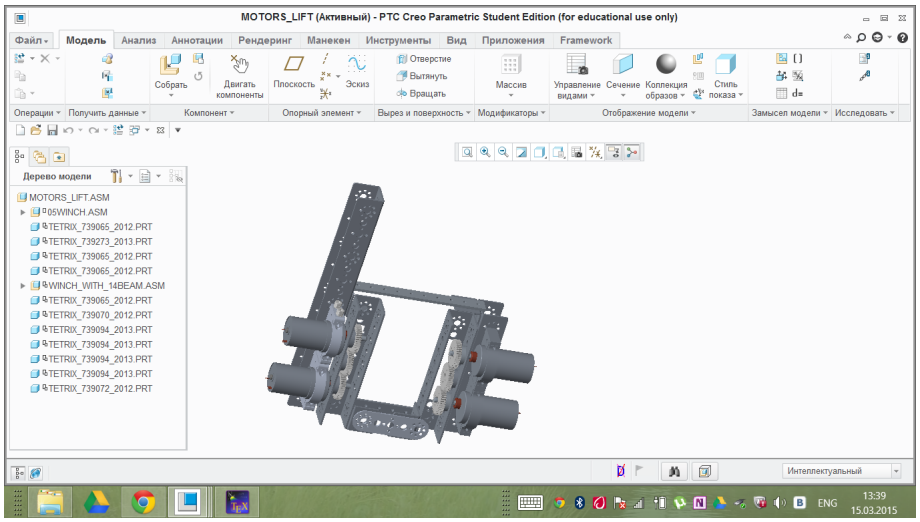


Figure 151: Creo model of the MEL

   3.2. MEL was fixed on the base of robot

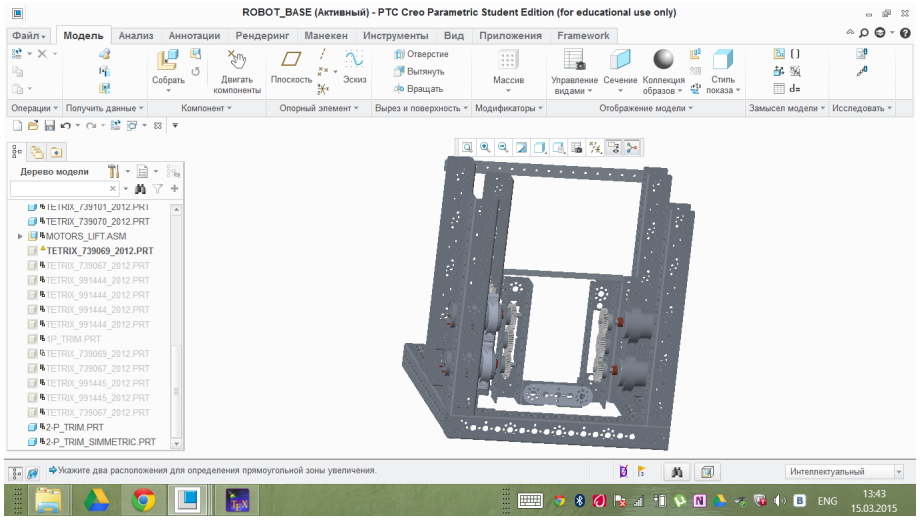
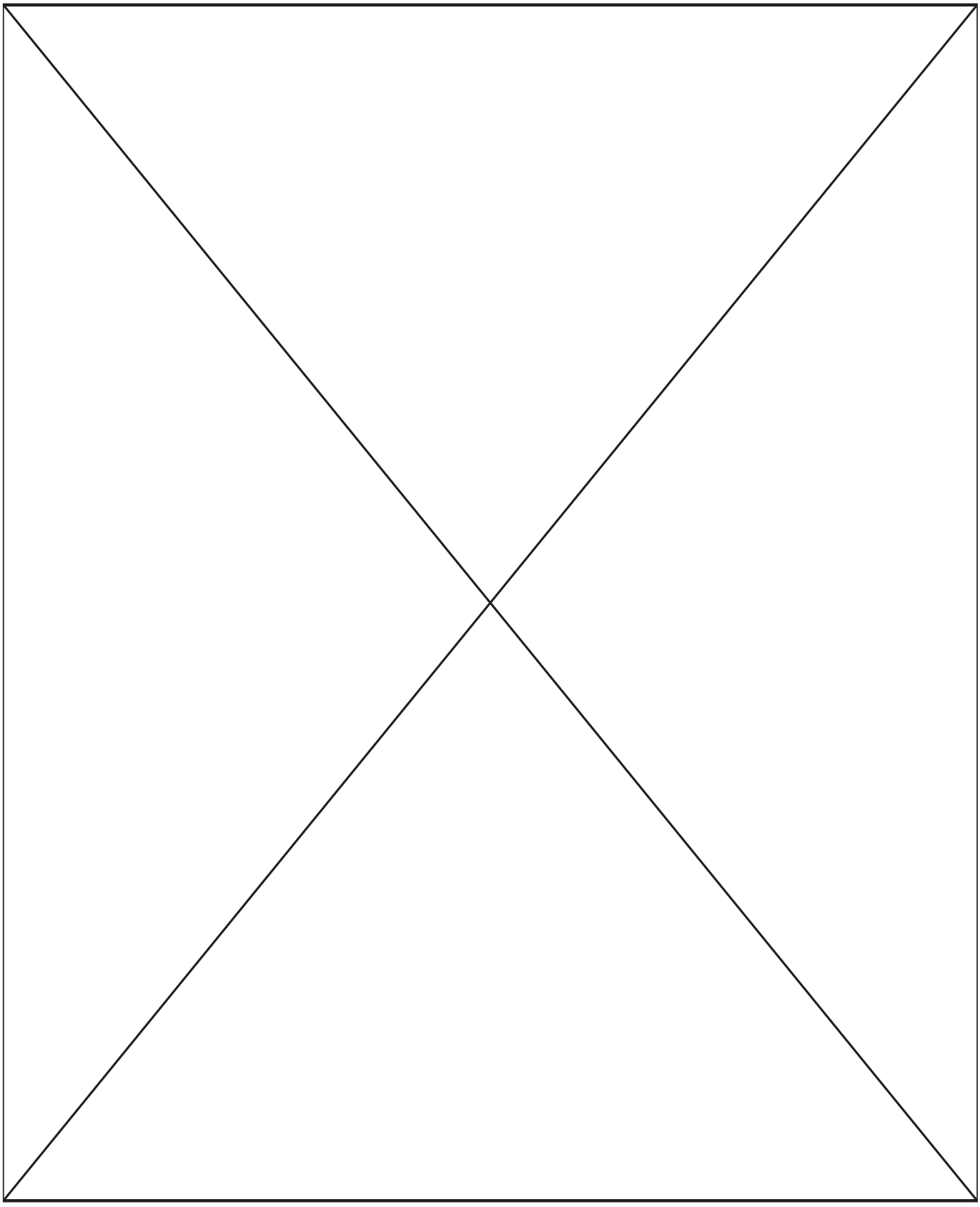


Figure 152: MEL on the base of robot

   3.3. It was made new wire for servos that moves MOB.
4. Result:
   4.1. MEL was assembled and fixed on the base of robot (in Creo).

5. Tasks for the next meetings:

   5.1. To elaborate new mount for controllers.



4.5.90 14.03.15

1. Time of beginning and ending of meeting: 16:00 - 21:30
2. Purposes of meeting:
   2.1. To elaborate new mount for controllers.
3. Work that has been done:
   3.1. It was decided to install the plate on the MEL (instead of -shaped beam) and fix controller s on it. This mount was assemled in Creo.
   3.2. It was found that the hook for autonomous balls hit controllers. So it was decided to fix them between the -shaped beam that fixed on the side of robot. Mount was assembled in Creo.

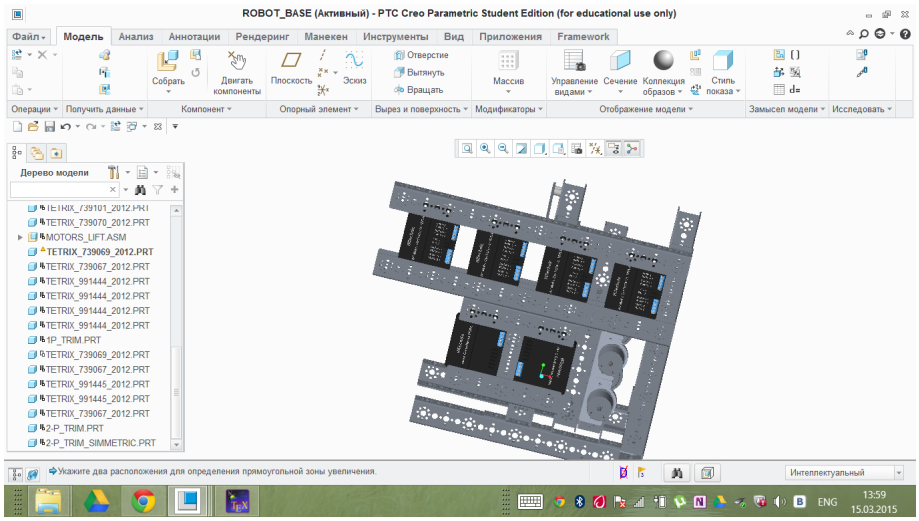
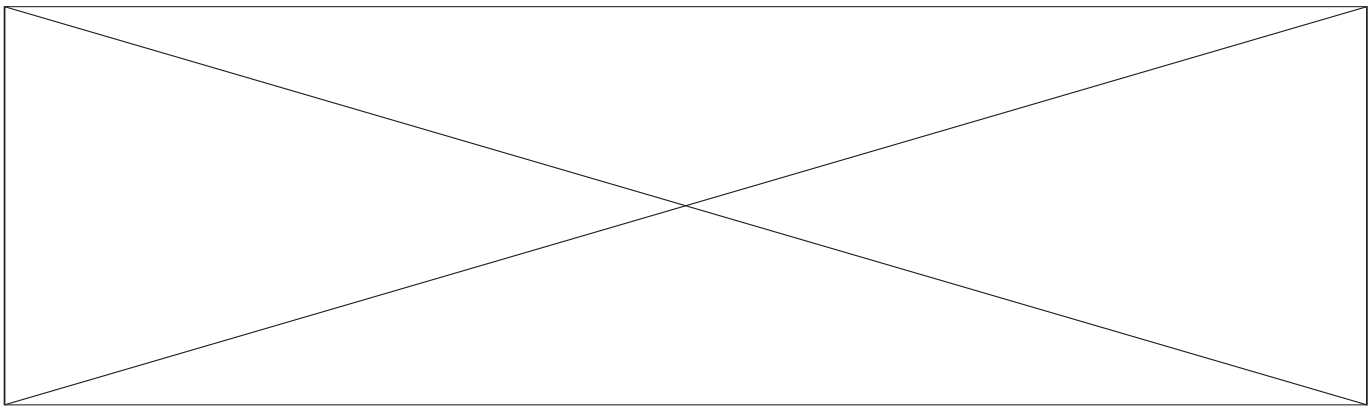


Figure 153: Mount for controllers

4. Result:
   4.1. Mount for controllers was elaborated and assembled in Creo.
5. Tasks for the next meetings:
   5.1. To elaborate mount for motors that will rotate wheels.
   5.2. To elaborate new gripper for balls



4.5.91 16.03.15

1. Time of beginning and ending of meeting: 16:00 - 21:00

2. Purposes of meeting:

   2.1. To elaborate mount for motors that rotates wheels.

   2.2. To elaborate new gripper for balls

3. Work that has been done:

   3.1. Motors were fixed on the plate and connected with each other by gears. Also they were fixed gear where will fixed wheels. It allowed us to imagine how we should to fix motors and gears.

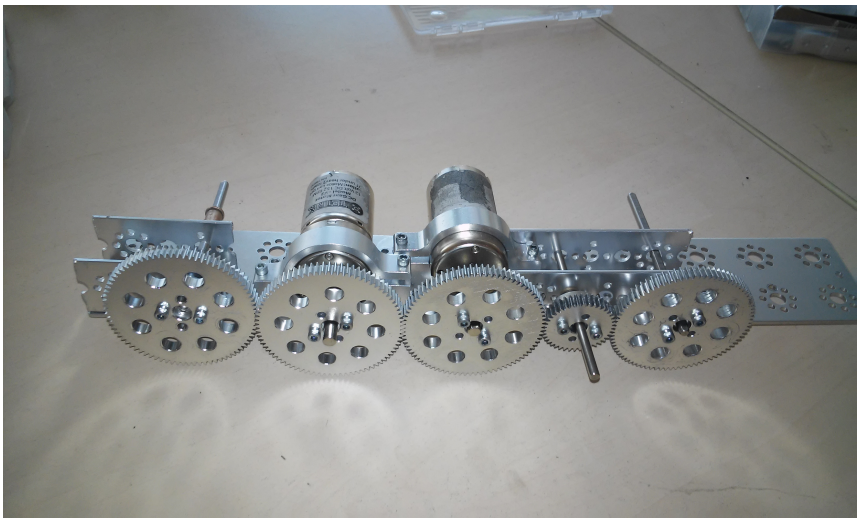


Figure 154: Layout of the mount for motors

   3.2. It was found that optimal clearence is when 3 beams from Tetrix set are fixed between motors and -shaped beam that limits body of robot. But in this case we need screws with more length.

   3.3. The mount for motors was assembled in Creo.

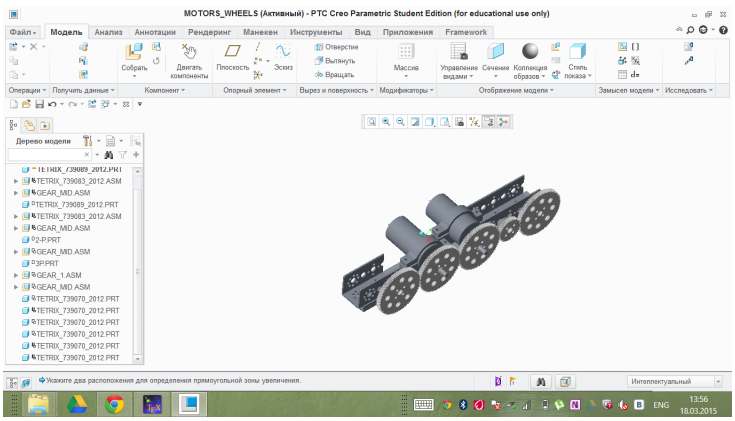


Figure 155: Location of gears

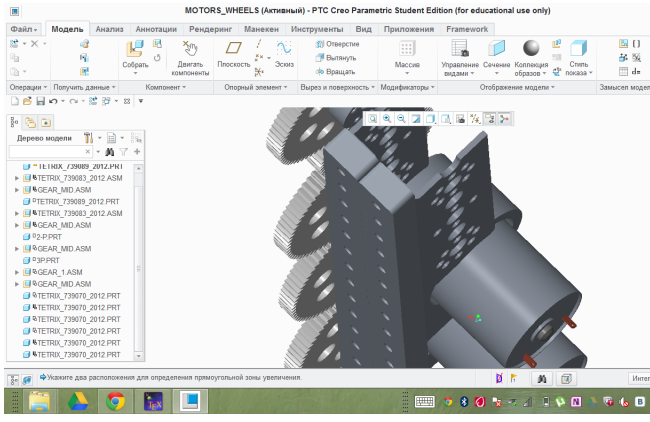


Figure 156: Beams that will fixed between motors an beam

3.4. It was elaborated and added to the model of the robot new gripper for balls. The new gripper has this advantages: width of blades was increased (it allows to expand slope of action of the gripper) and axis of gripper was located higher (so it will be easer to push balls on the ramp).

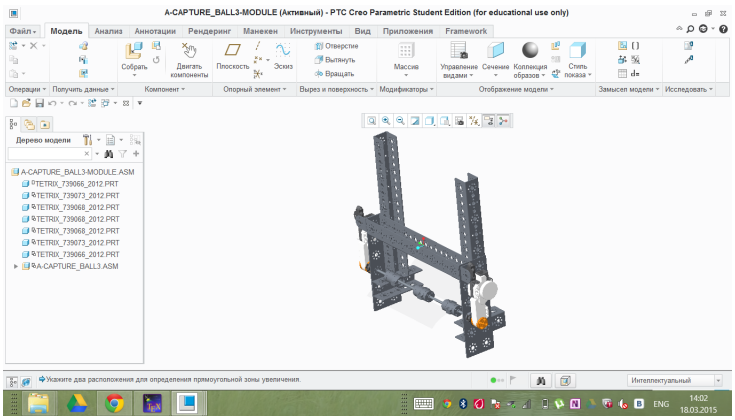


Figure 157: Module of gripper

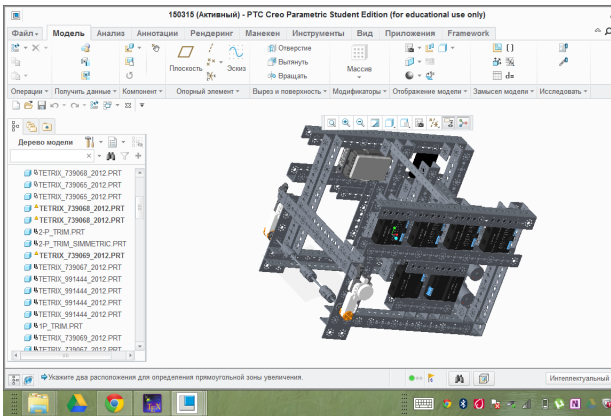


Figure 158: Gripper on the body of robo

4. Result:

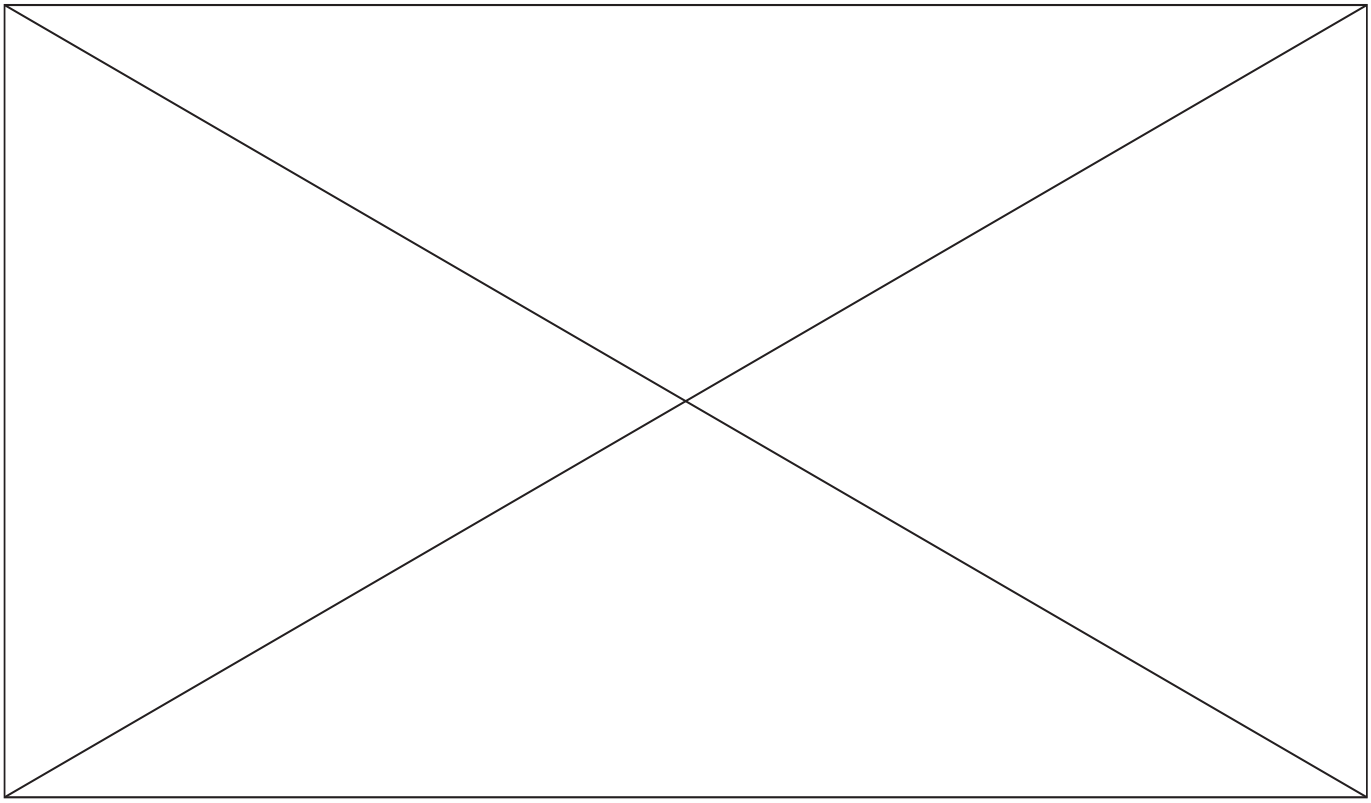
4.1. Mount for motors that rotates wheels and new gripper for balls were elaborated.

5. Tasks for the next meetings:

5.1. To add the lift to Creo model of the robot.

5.2. To estimate location of center of gravity.

5.3. To install wheels (in Creo).



4.5.92 18.03.15

1. Time of beginning and ending of meeting: 19:00 - 21:00
2. Purposes of meeting:
   2.1. To make model of the lift.
3. Work that has been done:
   3.1. It was found that we has only 7 beams. But for mount for motors that rotates wheels we need 12 (6 for each wheels pair). So it was decided to use 4 beams (2 for each pair) and fix short beams between the beam that limits base of robot and mount for wheel. So we need only 4 long beams and 16 short (4 for each wheel).

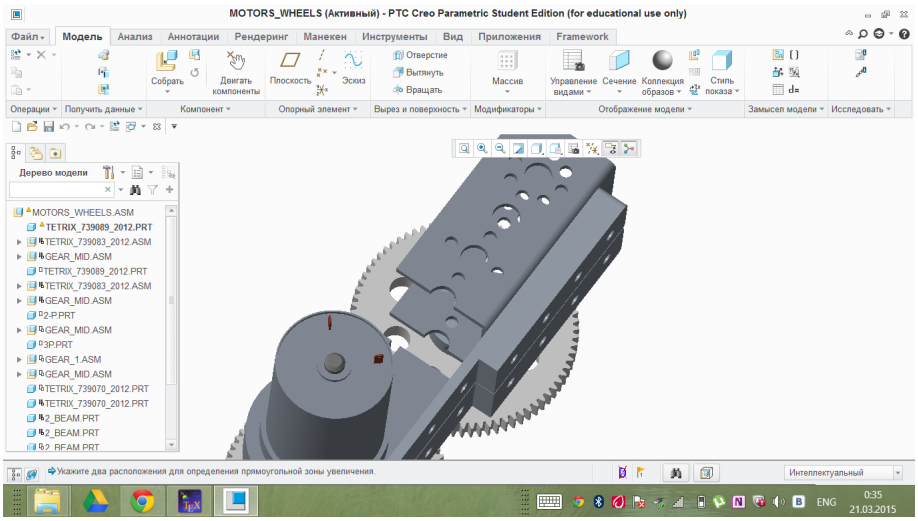


Figure 159: New mount for motors

   3.2. They were made models of the slats. It was starting assembling model of the lift.

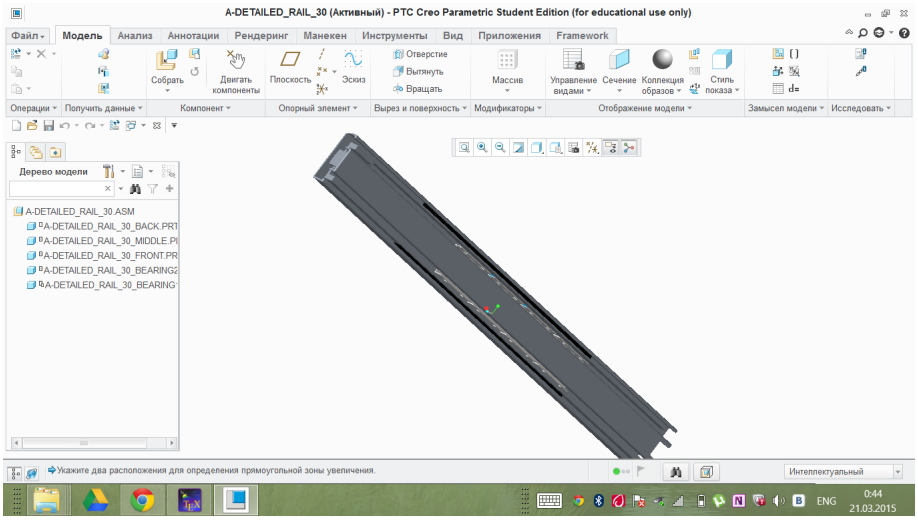


Figure 160: Model of the slats

4. Result:

4.1. Mount for motors that rotates wheels was improved.

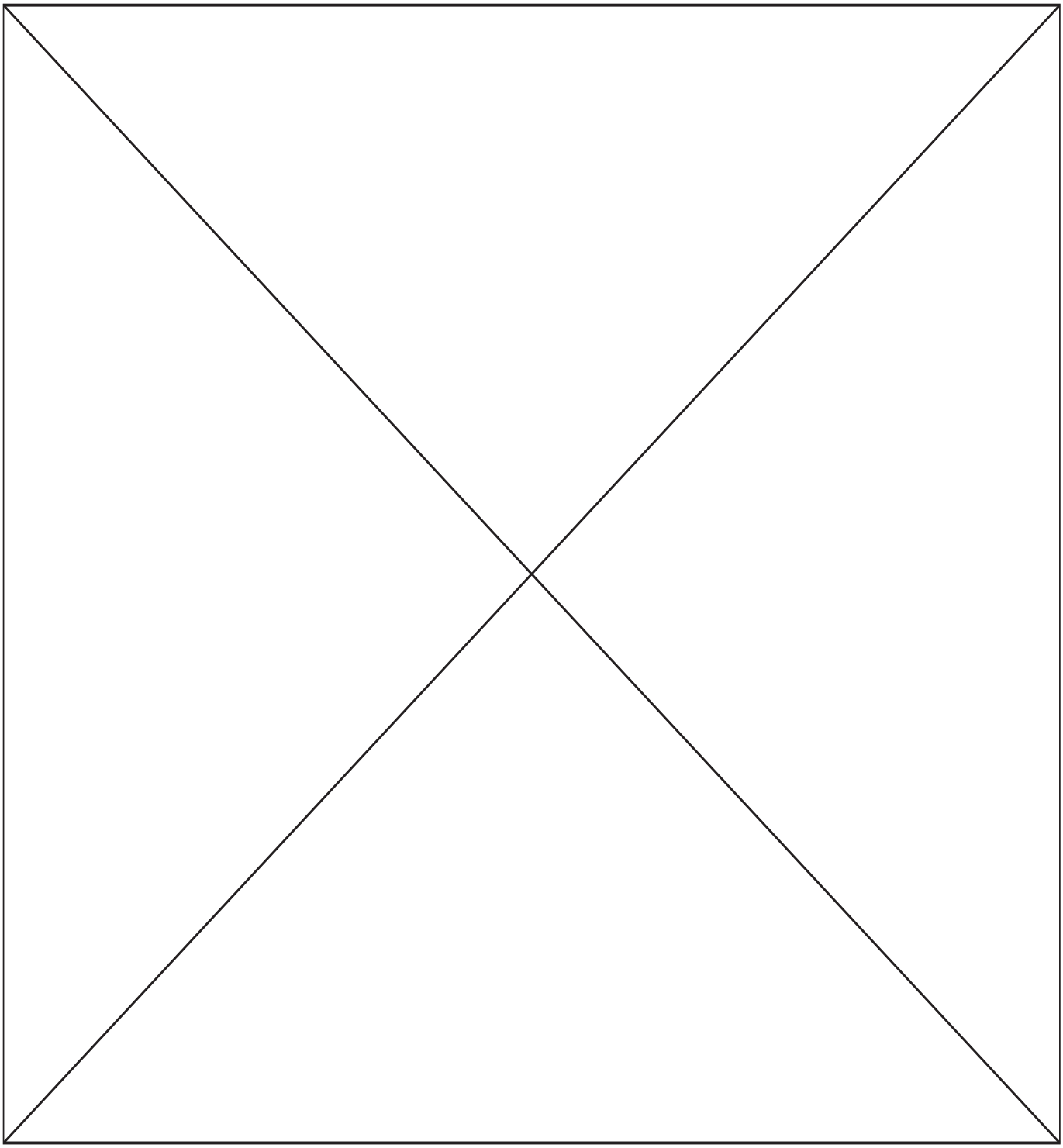
4.2. Model of the slat was created

5. Tasks for the next meetings:

5.1. To make model of the lift.

5.2. To estimate location of center of gravity.

5.3. To estimate optimal location for wheels.



4.5.93 19.03.15

1. Time of beginning and ending of meeting: 16:00 - 00:00
2. Purposes of meeting:
   2.1. To make model of the lift.
   2.2. To start assemble robot.
3. Work that has been done:
   3.1. Today we decided to start assembling of the robot. It was assembled the base and mount for MEL.
   3.2. It was found that mount for second servo that moves MOB bends. So the gears sometimes doesn't touch each other. It was decided to install plate as on the first servo and strengthen corner of the mount by additional plate. The plate that connect shaft of the servo with axis was installed. The second plate was made but wasn't installed.

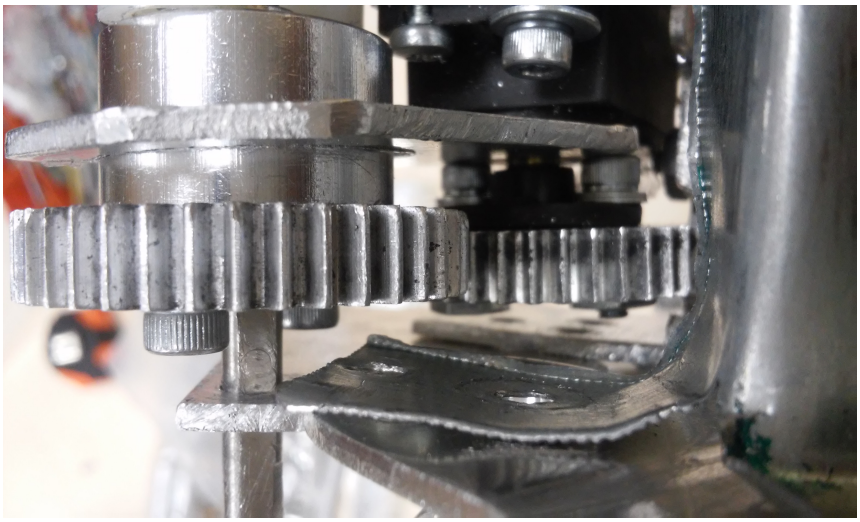


Figure 161: Plate that connect shaft of the servo with axis

   3.3. Model of the lift was made.
4. Result:
   4.1. MOB was strengthened.
   4.2. Model of the lift was made.
   4.3. Base of the robot was assembled.
5. Tasks for the next meetings:
   5.1. To install the second plate on the mount for servo that moves MOB.
   5.2. To fix the lift on the robot's base.
   5.3. To fix MEL.
   5.4. To estimate location of center of gravity.
   5.5. To estimate optimal location for wheels.

4.5.94 20.03.15

1. Time of beginning and ending of meeting: 16:00 - 22:00
2. Purposes of meeting:
   2.1. To install the second plate on the mount for servo that moves MOB.
   2.2. To fix the lift on the robot's base.
   2.3. To fix MEL.
3. Work that has been done:
   3.1. MEl was fixed on the robot's base.
   3.2. Elements of robot's base were connected with each other by additional beams. So it became more rigidly.
   3.3. It was started fixing of the lift. Also it was decided to fix crossbars of the lift more reliable.
   3.4. The second plate was installed on the mount for servo. So the corner with holes was connected with the back part of the mount and it stopped bend.

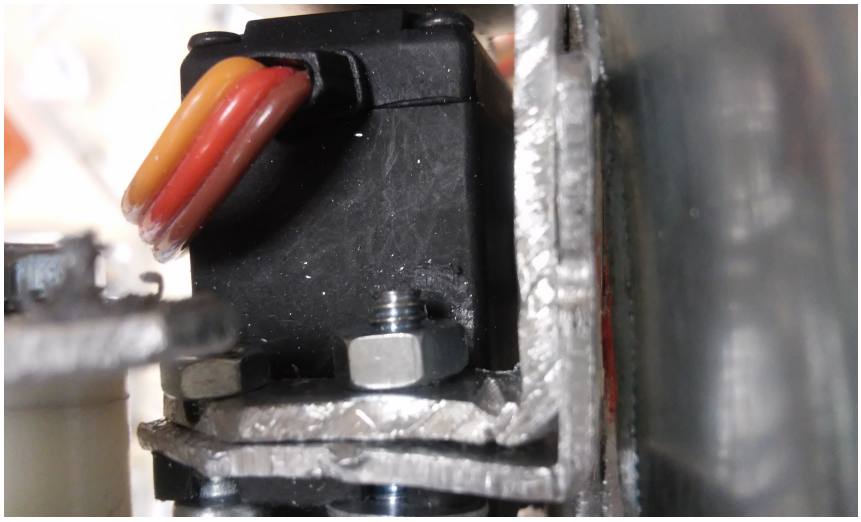


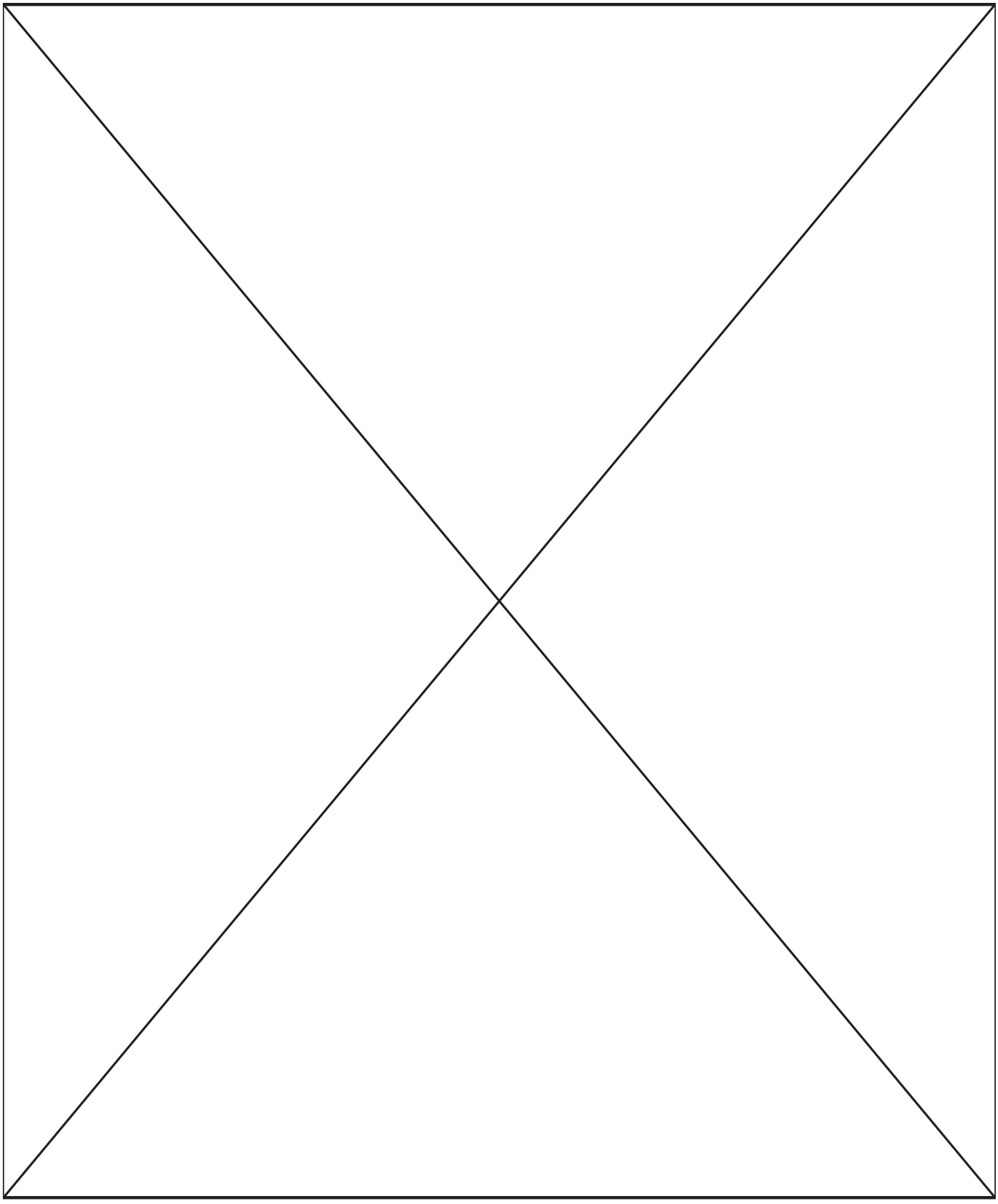
Figure 162: The second strengthening plate

   3.5. It was found that bucket can hook edges of axles around which rotates wheels. So it was decided to make new bucket that will more narrow and longer.
4. Result:
   4.1. MEL was fixed.
   4.2. MOB was strenthened.
   4.3. Base of the robot was strengthened.
   4.4. Lift partially fixed.
5. Tasks for the next meetings:
   5.1. To fix the lift and make mounts for crossbars more reliable.
   5.2. To estimate location of center of gravity.

5.3. To estimate optimal location for wheels.

5.4. To fix wheels.

5.5. To make new bucket.



4.5.95 21.03.15

1. Time of beginning and ending of meeting: 16:00 - 00:00
2. Purposes of meeting:
   - 2.1. To fix the lift and make mounts for crossbars more reliable.
   - 2.2. To estimate location of center of gravity.
   - 2.3. To estimate optimal location for wheels.
   - 2.4. To fix wheels.
3. Work that has been done:
   - 3.1. Lift was fixed. It was decided that the top pair of slats slats shrinks by beam too much. So it lowers badly. It was decided to increase distanse between the slat and beam.
   - 3.2. Crossbars were fixed more reliable. One of the mount was equpped by additional plates. The ends of the other axes were flattened so that they can't pass throught the hole.

Figure 163: Additional plates

Figure 164: Flattened crossbar

   - 3.3. It was installed gripper for balls. Blades weren't installed on it because we decided to use pieces of 6 liter bottle for this purpose. Today we didn't have a bottle.
   - 3.4. It was estimated the center of gravity and location of wheels.

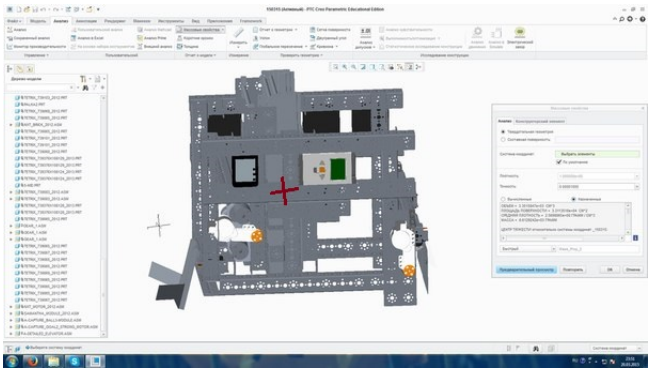


Figure 165: Center of gravity

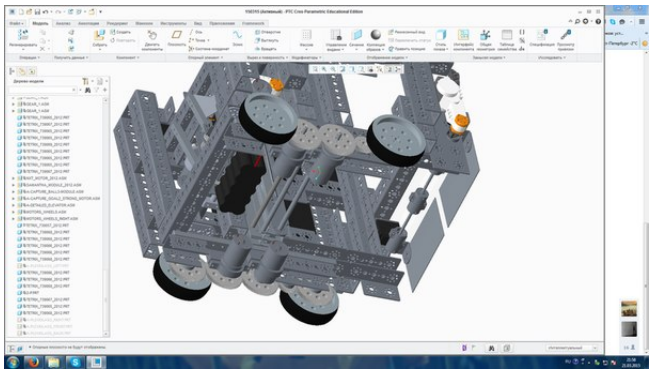


Figure 166: Wheels

   - 3.5. It was started assembling of module of motors that rotates wheels.
   - 3.6. Controllers for motors were fixed on the robot but weren't connected with battery and NXT.

3.7. It was found that hook for autonomous ball get on the transverse beam that fixed on the top part of the MEL. So it was changes: corner that fixed on the gutter was bended and so the beam where fixed hook moved to back part. Also the beam where was fixed the screw was replaced by the plate from TETRIX set.

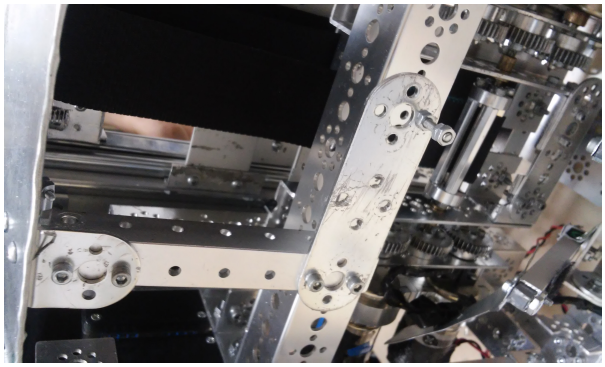
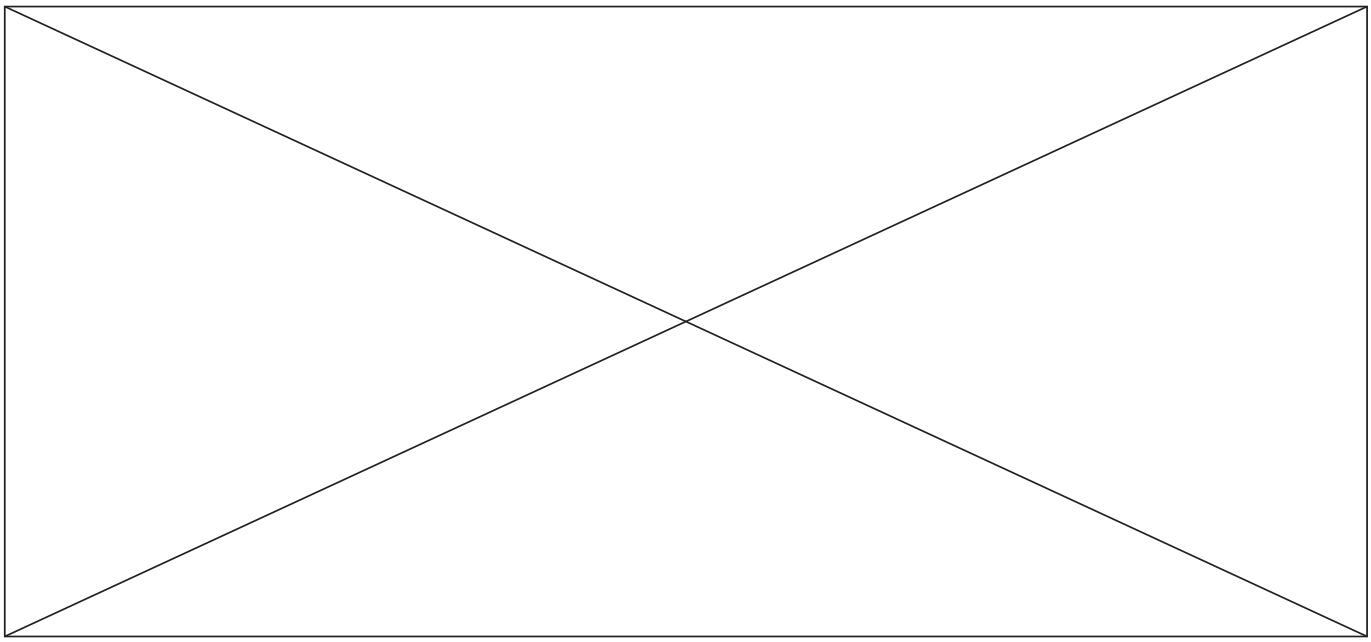


Figure 167: New mount for hook

4. Result:
   - 4.1. Lift was fixed.
   - 4.2. Crossbars were fixed more reliable.
   - 4.3. Gripper for balls was fixed.
   - 4.4. Controllers were fixed.
   - 4.5. Hook for autonomous ball was changed.
5. Tasks for the next meetings:
   - 5.1. To make new bucket.
   - 5.2. To make ramp for it.
     To install blades on the gripper for balls.



4.5.96 23.03.15

1. The time of beginning and ending of the meeting: 8:00 - 18:20.

2. Purposes of the meeting:

   2.1. To change the bottom part of bucket.

   2.2. To fix wheels.

   2.3. To install blades on gripper for balls.

   2.4. To package robot for transportation it to Moscow to PTC Live Tech Forum.

3. Work that has been done:

   3.1. When we projected robot we noticed that bucket hook couplers which fixed on the axles with gears that rotate wheels. So we decided to remove it's bottom part and make new one. The new part should be norrower and longer (else 5 balls will not fit in the bucket).

   3.2. We drew the projection of bottom part of bucket on the list of PET.

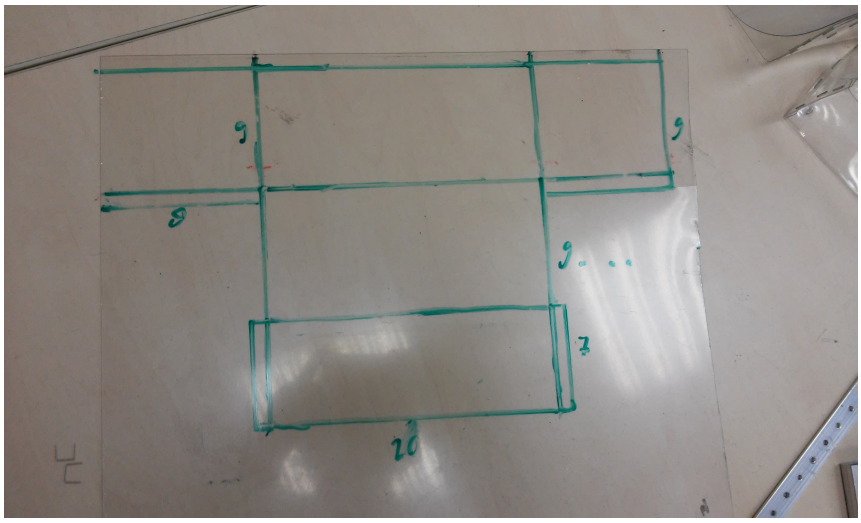


Figure 168: The drawing of the new bottom part of bucket

   3.3. The new bottom part of bucket was made and fixed on the top part. Also it was decided to increace hight of the front wall from 7cm to 9cm. So balls never fall from the bucket.

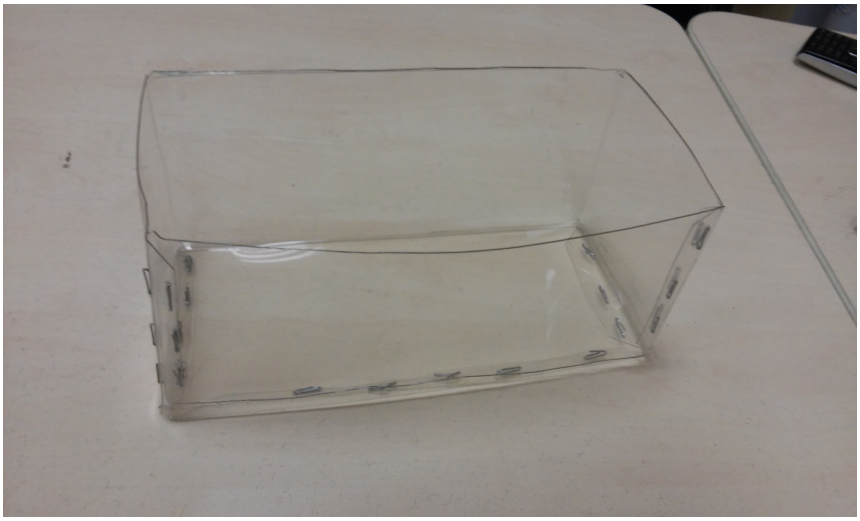


Figure 169: The new bottom part of bucket

3.4. Wheel base was fixed on the robot. In addition we decided to replace Tetrix motors with Andy Mark when we'll get them in PTC forum in Moscow. Andy Mark motors are slightly more powerful and more durable.

3.5. One blade was installed on gripper for balls.

4. Results:

4.1. Bucket was finished.

4.2. Wheel base was installed.

4.3. One blade was installed on gripper for balls.

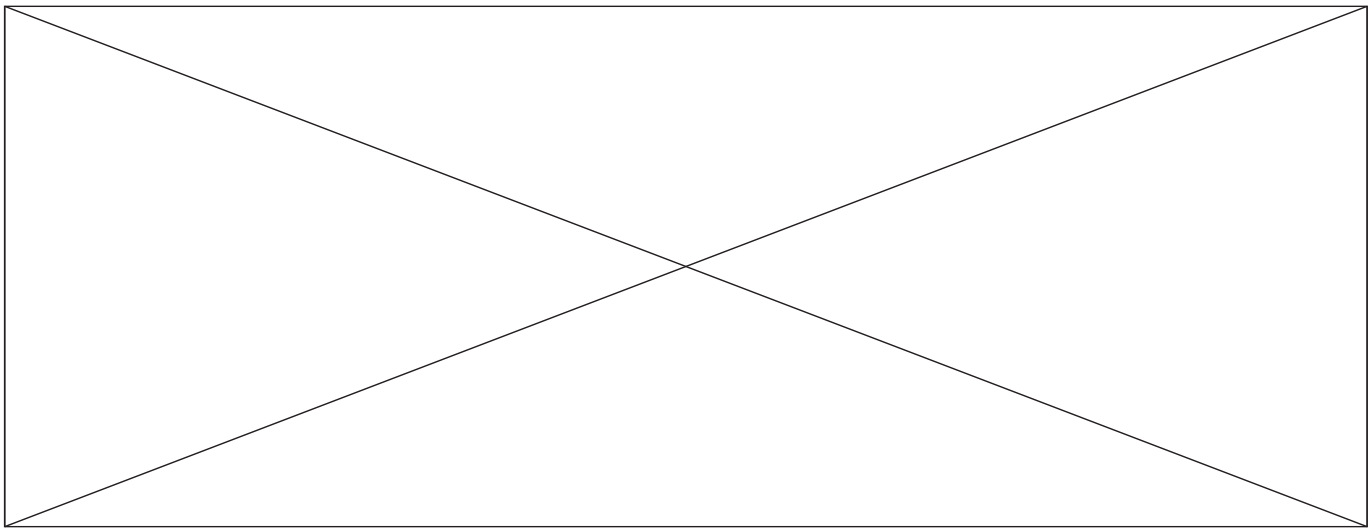
5. Tasks for the next meetings:

5.1. To replace Tetrix motors with Andy Mark.

5.2. To hold all wires.

5.3. To install second blade on the gripper for balls.

5.4. To test the wheel base.



4.5.97 24.03.15

Today we had a one-day trip to Moscow. In Moscow we had been at the event "PTC Live Tech Forum" organised by our sponsors, company PTC. We were invited there by PTC to show how we use their software. There we presented our model of robot assembled in Creo Parametric 3.0.
The second reason to visit Moscow was a number of special TETRIX detailes, which we ordered before. To take them we needed to meet the representative of PTC, Dmitriy Orlov.
Also the forum was a good chance for us to meet new people who could cooperate with us or become our sponsors.
During the forum, we continued working on our robot (we took it to moscow with us).

1. The time of beginning and ending of the meeting: 8:00 - 18:20.

2. Purposes of the meeting:

   2.1. Install to the wheel base AndyMark motors.

   2.2. Hold the wiring.

   2.3. Install new longer beams to the mount for controllers.

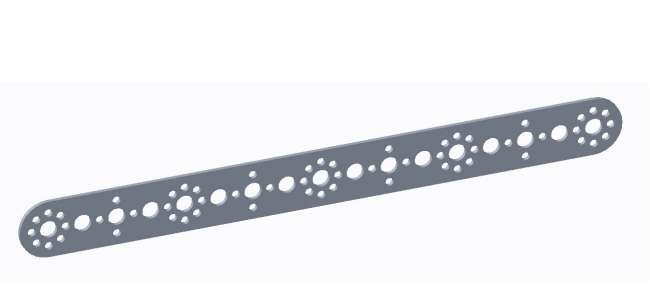
   2.4. Stregthen the wheel base with new plates.

   2.5. Change the program and test robot's motion.

3. Work that has been done:

   3.1. We installed to the wheel base Andymark motors (which were in our order) instead of DC. Next we connected all the motors and encoders to the Hi-technic controllers.

   3.2. Unfortunately, in the order were no special beams which we wanted to install on wheelbase to make it more reliable.



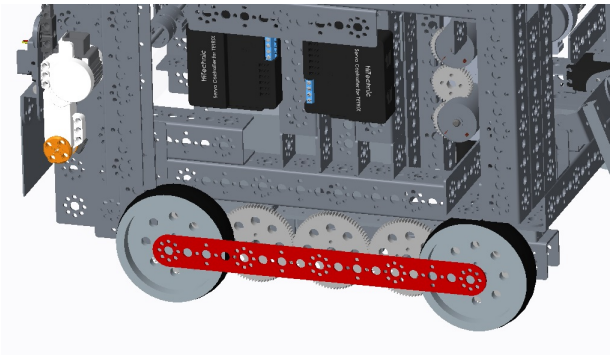


Figure 170: Missing beams

   3.3. However, we got other long beams which we needed. So we installed them on the mount for controllers. Since then the construction became more straight because there is only one long beam and not the several short ones.

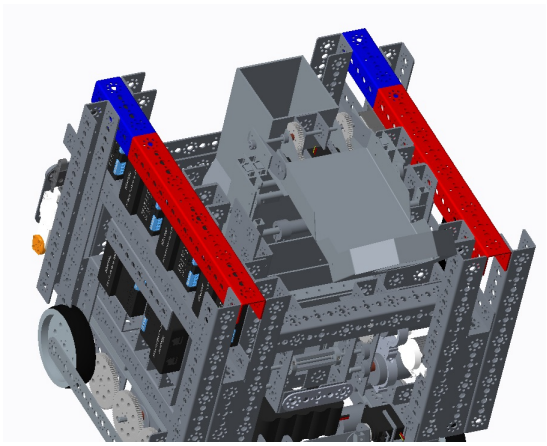


Figure 171: Previous construction

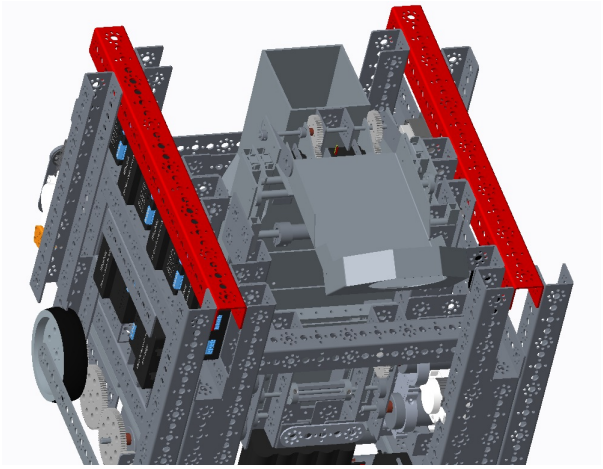


Figure 172: With new beams beams

3.4. After we finished working on construction, we decided to make a trial run of the robot. To do this, we changed our program a bit: inversed the direction of rotating of two motors (one from each side), because the motors linked with gears and need to rotate in opposite directions. During the testing we noticed, that robot's movement became easier to control: as the center of gravity is now at the same distance from each wheel, it turns around one point. As a result, it moves more predictable.

3.5. We decided to remake the mechanism of overturning of the bucket because of weakness and unreliability of present construction. Firstly, we discussed the general aspects of new construction. The material will be the aluminium L-shaped profile 5x5 cm. After the conversation we created an assembly of new module in Creo Parametric.

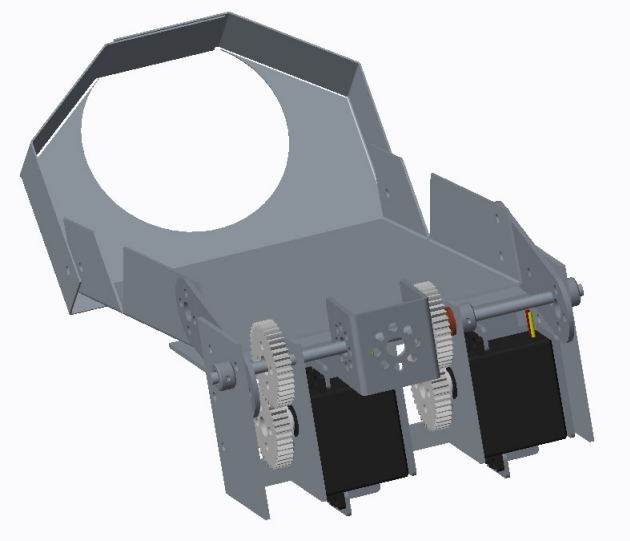


Figure 173:

4. Results:

4.1. AndyMark motors are installed to the wheel base.

4.2. All the wiring is held.

4.3. New longer beams were installed to the mount for controllers.

4.4. The flats weren't fixed on the wheel base.

4.5. We tested how the robot moves. Results are positive.

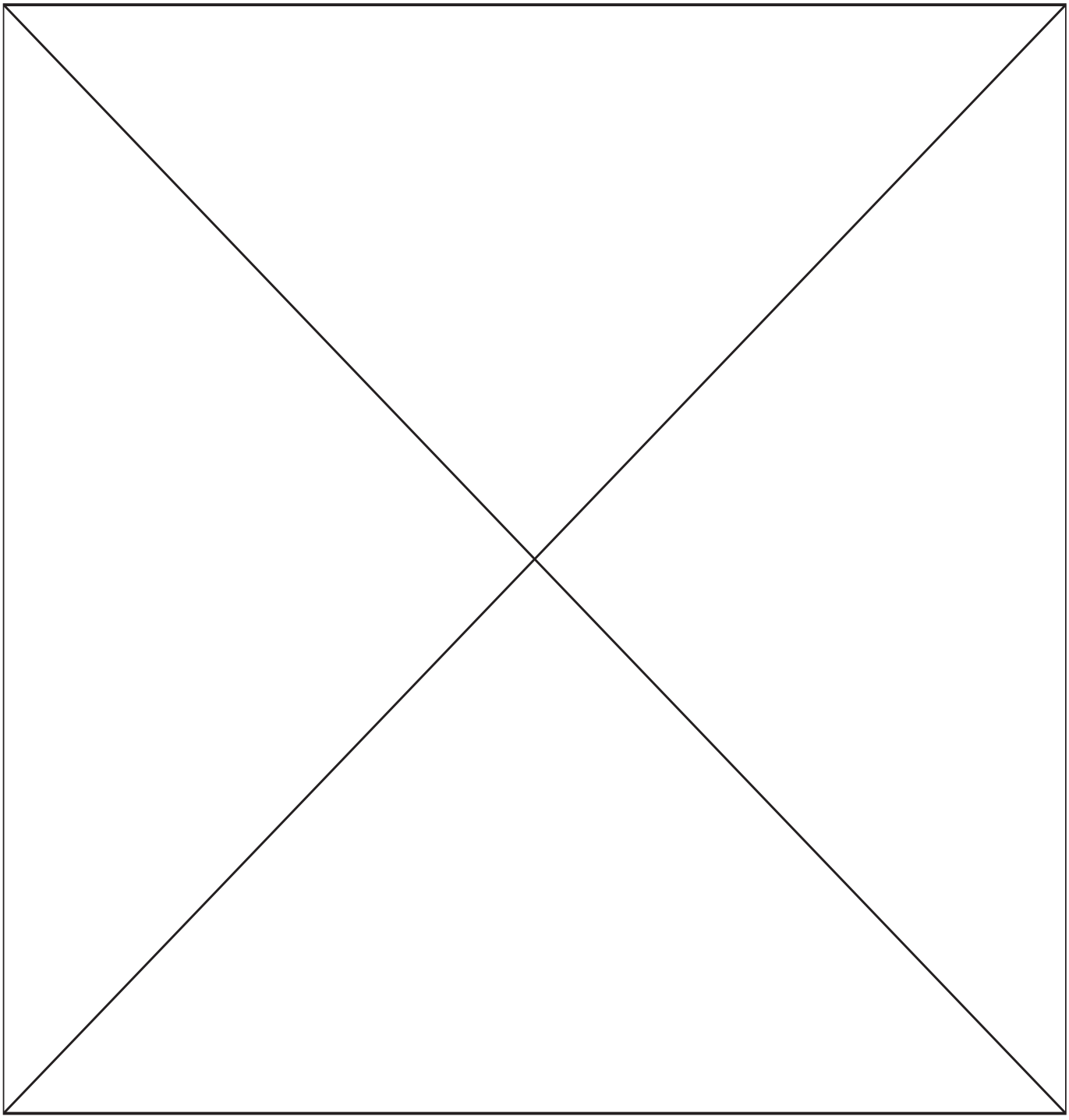
4.6. We created a model of new MOB.

5. Tasks for the next meetings:

5.1. Make new MOB.

5.2. Make blades for gripper for balls and the ramp for guiding balls into the bucket.

5.3. Finish working on plexiglass protection.



4.5.98 25.03.15

1. The time of beginning and ending of the meeting: 10:00 - 23:59.
2. Purposes of the meeting:
   2.1. Make new strong mechanism of overturning of the bucket.
   2.2. Make blades for gripper for balls.
   2.3. Make ramp for guiding balls into the bucket.
   2.4. Finish working on plexiglass protection.
   2.5. Create a poster for the nomination "Compass Award".
   2.6. Prepare the robot for the flight to the competition.
3. Work that has been done:
   3.1. Today we bought the L-profile and started creating the mechanism of overturning of the bucket.
   3.2. We created new blades for the gripper for balls. As now it became wider, as the material for blades we used a 5-loter plastic bottle. To make blades stronger we infixed them in attaching to the axis with sheets of steel.

Figure 174:

   3.3. After we finished working on gripper for balls, we installed ramp, which guids balls into the bucket. The angle between the floor and the ramp amounted to 77.5°, so balls fly from the gripper straight up and can be scored into the bucket even though it slightly raised. We were satisfied with these results.

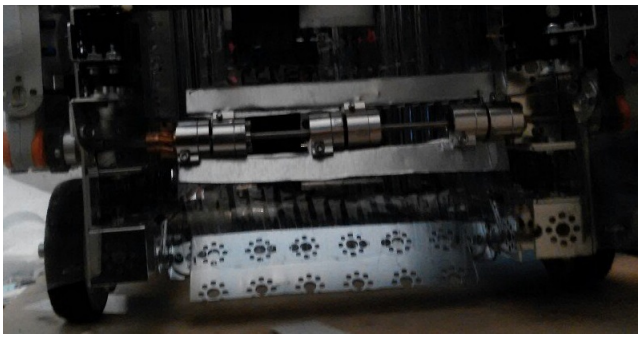


Figure 175:

   3.4. We made the second sheet of plexiglass protection - for the right side of the robot. We also made holes for screws in both sheets of plexiglass.

3.5. Next we installed extra catch for rolling goals to its previous position. To remove extra load from servo we decided to connect it to catching beam with gears. After that we made in the plexiglass protection hole for this gripper.

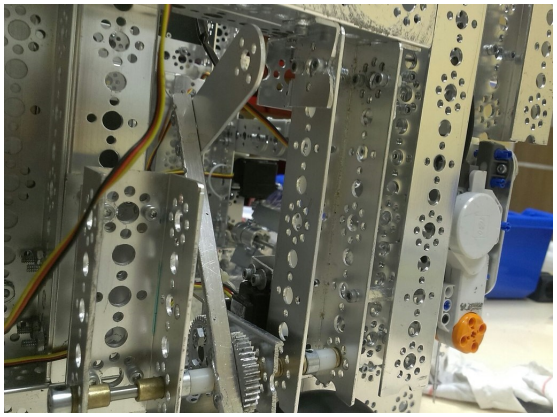


Figure 176:

3.6. Tomorrow we had a flight to Nederlands to the "FTC Dutch Open" competition, so we had to prepare our robot for the transportation. Our robot weighs 18 kg and the box for it - 11 kg. So, in order not to pay for extra weight of the luggage we disassembled robot into modules and put them to different bags.

3.7. Today we created a poster for the nomination "Compass Award" for the competition in Nederlands. For the championship in USA we will make a video for this nomination, but now we don't have any time to do it.

3.8. At the end of the day we printed out our engineering book, stickers for the plexiglass lists, a poster for the "Compass Award" and 150 copies of leaflet with information about our robot (for other teams, judges and guests).

4. Results:

4.1. Mechanism of overturning of the bucket is not ready yet.

4.2. Blades for gripper for balls were installed.

4.3. The ramp for balls was installed.

4.4. The plexiglass protection is ready.

4.5. A poster for the nomination "Compass Award" was created.

4.6. The robot was prepared for the transportation.

5. Tasks for the next meetings:

5.1. Reassemble robot after a flight.

5.2. Install the plexiglass protection to the robot and put the stickers onto the plexiglass.

5.3. Connect servos from the bucket overturner to the controllers.

4.5.99 26.03.15

Today we had a flight to Amsterdam trough Frankfurt. Next we went to Eindhoven (the town where the competition takes place) by train. Then we settled into the hoteland started working on robot.

1. The time of beginning and ending of the meeting: 12:00 - 23:59.
2. Purposes of the meeting:
   2.1. Reassemble robot after transportation.
   2.2. Finish the mechanism of overturning of the bucket and fix it on the robot.
   2.3. Install the plexiglass protection onto the robot.
   2.4. Connect servos from the bucket overturner to the controllers.
   2.5. Prepare for the presentation of the engineering book to the judges at the competition.
3. Work that has been done:
   3.1. At first, we reassembled robot from parts.
   3.2. Next we pasted stickers to the plexiglass protection and then fixed it on the robot.

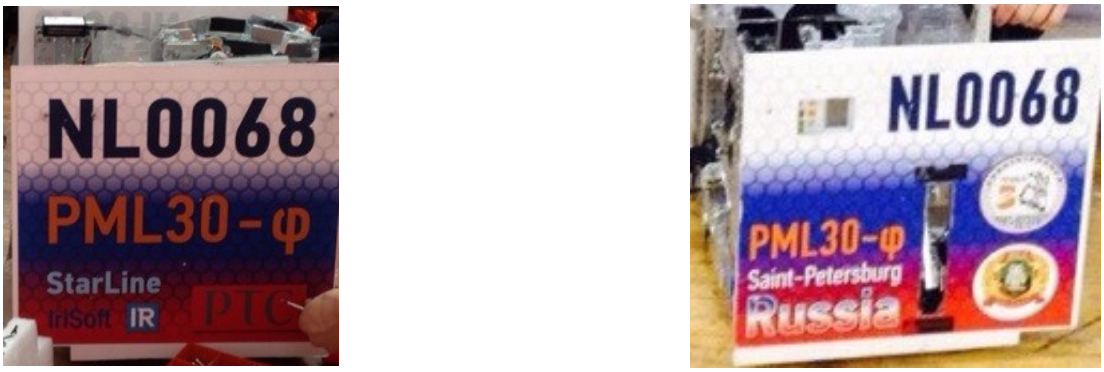


Figure 177: Stickers for the plexiglass

   3.3. We finished working on mechanism of overturning of the bucket. Next it was installed to the last pair of slats. The gutter for balls and the bucket were fixed on this module. Now the bucket overturner is working stable and looks more reliable than it was before.

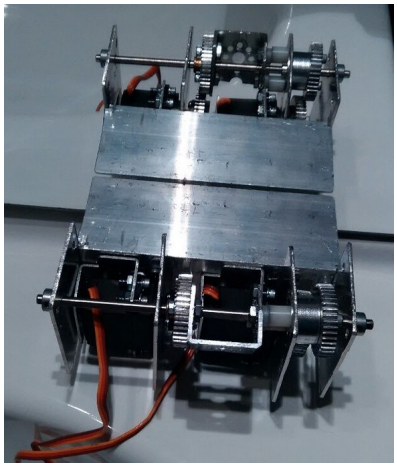


Figure 178: New MOB module

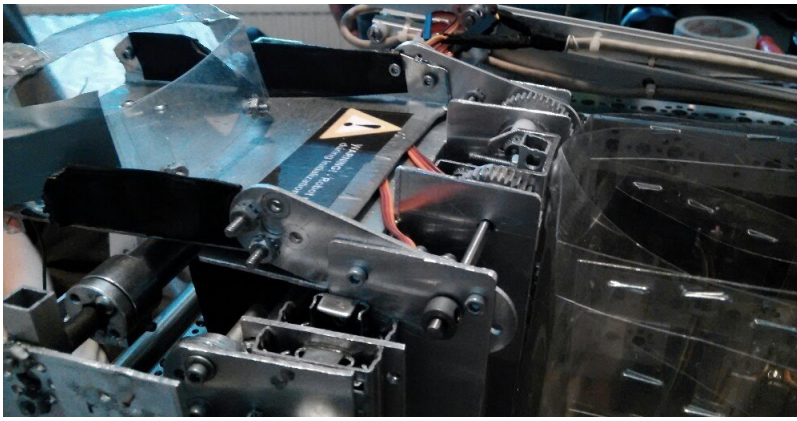


Figure 179: MOB on the robot

3.4. The mount of axis on the last pair of slats on elevator was moved 16 mm up because it beated the motor at the bottom position.

3.5. To connect the servos from the bucket overturner to the controllers we decided to create a system that we had seen in Moscow on some robots. We made the additional lift - a number of beams, connected to each other with hinges like a chain. The first beam was connected to the carcase of the robot and the last one - to the top of the main lift. The wire was fixed on these beams, so there was no risk of entanglement. We refused our previous solution with fixing the wire on the main lift because there were problems. The bucket was always clinging the wire and bicket couldn't go to the bottom, so it disturbed scoring balls into the bucket.

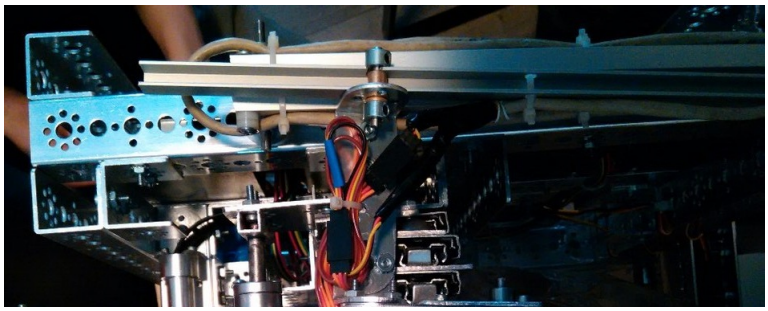


Figure 180:

3.6. After we finished all works with construction, we rehearsed the presentation of our engineering documentation.

4. Results:

4.1. Robot was reassembled after transportation.

4.2. The mechanism of overturning of the bucket was finished and installed on the robot.

4.3. The plexiglass protection was fixed on the robot.

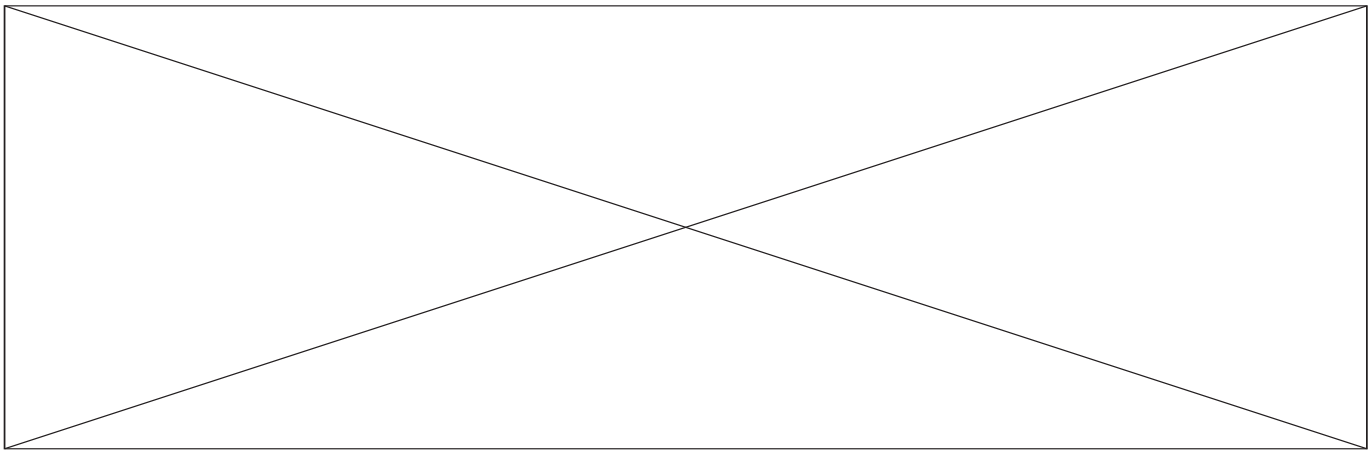
4.4. Servos from the bucket overturner were connected to the controllers with additional lift.

4.5. Prepare for the presentation of the engineering book to the judges at the competition.

5. Tasks for the next meetings:

5.1. Realise opening of the mechanism for directing balls vertically.

5.2. Prepare autonomus programs.



4.5.100 27.03.15 (Competition)

1-st day of competition "FTC Dutch Open" in Eindhoven.

Today there was technical day. Also today we presented our engineering book to judges.

As soon as we arrived at competition area, two of us started talking with other FTC teams. There were 48 teams on competition. We learned about opportunities and strategy of every team. We got data about all robots except two robots of teams from Saudi Arabia because their robots didn't arrived at Nederlands yet (they we transported as a luggage on another plane).
All the teams received from our team lists with short information about our strategy and opportunities. The background of our information list was the same to the background of the print on plexiglass protection of our robot which made our robot more noticable. So we did everything to attract others' teams attention and increase our chanses to be chosen by other teams for final matches.
Between the teams we found two our friends (we kept in touch woth them since the central robofest in Moscow): team "Auto Vortex" from Romania and team "Trex" from Rissia.

At the beginning of the day we presented engineering book. At first one of us told the judges about:

1. Our team.
2. Our strategy in game.
3. Construction of the robot.
4. Resourses we used in our work (LaTex, Creo Parametric 3.0, etc).
5. Our coaches and sponsors.

After that we all answered the judges' questions. After the presentation we realised, that our new way of telling it is more effective and we decided to follow this way in further presentations.

When we were on hardware control, the judge criticized us for using for connecting the servos on the lift self-made wire. He permitted us to participate in this competition, but adviced us to change this wire to standard before the competition in USA because rules there are more strict.
Improvements that were done:

1. For opening ball direct on the gutter during the game we linked it with the bucket by the thin wire instead of previous fishing line because it's easier to tie the wire than the line.

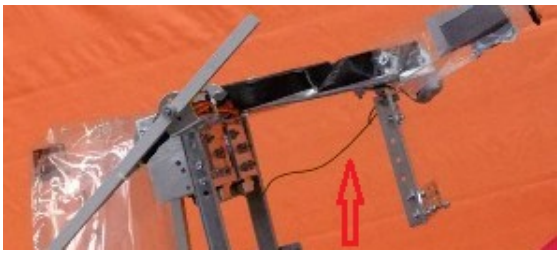


Figure 181: Linking with wire

2. After a few trainings 2 servos on mechanism of overturning of the bucket broke down. The reason was that because of problems in mechanism of opening of the mechanism for directing balls vertically servos got extreme charge. Likely, we had an extra high-powered servo at the mechanism for capturing rolling goals. We installed this servo to the bucket overturner.

3. After that, we insalled two standard servomotors that we borrowed in teams "Trex" and "Auto Vortex" to the mechanism for capturing rolling goals.

4. Then we solved the problem with opening the mechanism for directing balls vertically. Now the servo is able to overturn the bucket with five balls, but after we return to Russia we should install there the second one - in order to prolong servos' lifes.

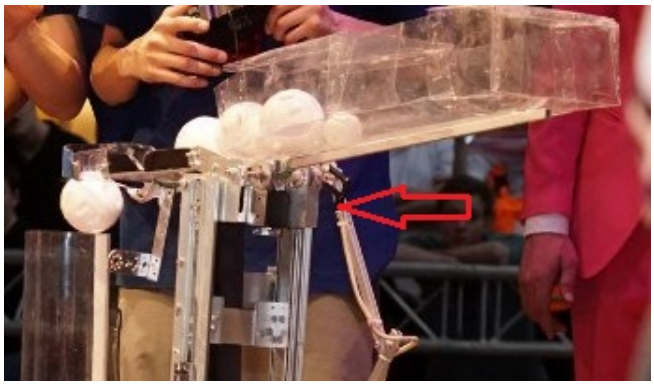


Figure 182: Strong servo on MOB

5. We made special latches for the battery to prevent from falling out of the robot.

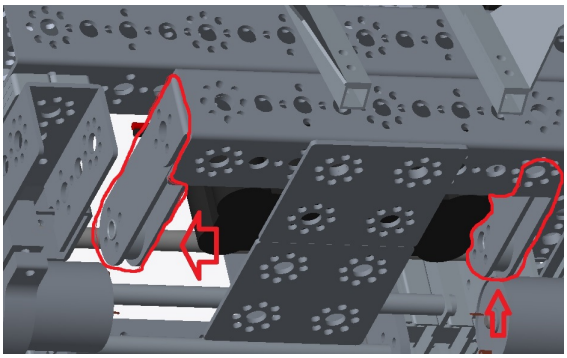


Figure 183: Latches for battery

6. We installed protection from small balls and the stick in front of forward wheels.

7. We made 2 framework programs for autonomus period (from the ramp and from the parking zone). To make code easier, we left only tank rotations (eg. left forward, right backward). It became possible because with optimized wheel base robot rotates more accurately.

8. When we started testing automomus period, we noticed that Andymark motors' encoders didn't work. We realised, that they had been connected in a wrong way. We reconnected encoders right, but, unfortunately, it was time to go out from the competition area, so we didn't manage to make autonomus programs today.

4.5.101 28.03.15 (Competition)

2-nd day of competition "FTC Dutch Open"

Today there were qualification and final matches.

Firstly, we talked with all teams again about the possibility of organising the alliance in final matches. After the shedule of qualification matches was announced, we discussed with teams, with whom we would play, our common strategy for a match.

Figure 184: "Team Tulip" - team, which got the "Inspire Award" at this competition

In parallel with communicating, we made program for the autonomus period from the parking zone. We couldn't make a program of autonomus from the ramp because of lack of time.

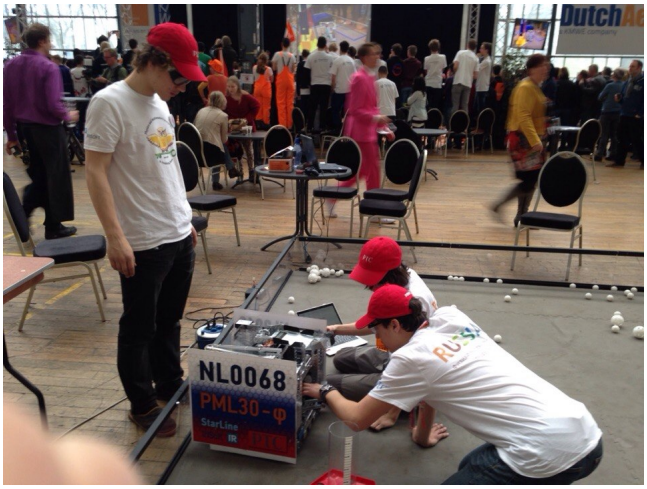


Figure 185: We're coding autonomus period

All the teams in qualifications we divided into 2 divisions: Huygens and Laurence. In our division, Laurence, all teams had only three qualification matches because of troubles with wifi.

Actions that we did in qualification matches:

1. 1-st match:
   - In autonomous period we put the balls into 30cm goal and 90cm goal (60 points).
   - In tele op period all teams except our lost connection with the field. Unfortunately, we gave 90 cm rolling goal to our teammate, so we only filled with balls the 60 cm goal. (114 point).
   - In the end game we moved 60 cm goal to the ramp, but our robot moved downwards from the ramp after the power was turned off. (30 points).
   - Total: 204 points, we won.
2. 2-nd match (In that match we had different finware on our samantha, so we couldn't connect to the field. However, the judges didn't help us and we had to stay at the parking zone for the whole game):
   - In autonomous period our teammate fell down from the ramp (20 points).
   - In tele op period our team did nothing (0 points).
   - In the end game our teammate moved the 30 cm goal to the parking zone. Also our robot stayed in the parking zone since the beginning of the match (20 points).
   - Total: 40 points, it's hard to believe, but we won!
3. 3-rd match:
   - In autonomous period we put balls into 30cm goal. Our teammate went off the ramp and put balls into 60cm goal. (80 points)
   - In tele op period we put only 3 big balls into 90cm goal because we had problems with overturning bucket. Our teammate filled 60cm goal.(180 points)
   - In the end game we didn't put balls into center goal due to problems with the bucket but we moved to the parking zone. Our teammate moved to the ramp and took one rolling goal on it. (70 points)
   - Total: 330 points

   After the match, one of judges said us, that our mechaism for capturing rolling goals align goals in a restricted way - it touchs the tube when riles allow only to touch the base. If we continue using this construction, we will get 1 minor for each game, so after we return from competition, we should remake the mechanism of centering goals.

When were announced results of qualification matches it turned out that our team didn't reach the position in top-4 because of low rating points (although we won all matches). Likely, we were chosen to the final alliance by the "Auto Vortex" team. The final alliances consisted of 2 teams, so we played in all the matches.

Strategy of our alliance:

1. In the semi-final we fill 60 cm goal and lead goals to the ramp and "Auto Vortex" fills 90 cm goal and 120 cm goal.
2. In the final game we decided to lose. The thing was that our opponents (the motherteam) were friends of the "Auto Vortex" team and they didn't have a quota for the world championship in St. Louis, when in our alliance we both already had. So, we decided to let them win, as it will be useful for us to have a one more friendly team on St. Louis Championship.

Actions that we did in semi-final:

1. 1-st round:
    - In autonomous period we put ball into 90cm goal. "AutoVortex" didn't have programme for autonom. (30 points)
    - In tele op period we filled 60cm goal. Our teammate filled 90cm goal. (375 points)
    - In the end game we moved 60cm goal and robot to the ramp. When we ride up we overturned the rolling goal but rised it back and so only 3 big balls fell from it. Our teammate filled center goal (221 points).
    - Total: 626 points
2. 2-nd round:
    - In autonomous period we put ball into 30cm and 90cm goal. (60 points)
    - In tele op period we filled 60cm goal. Our teammate filled 90cm goal. (375 points)
    - In the end game we moved 60cm goal and robot to the ramp. Our teammate filled center goal (221 points).
    - Total: 656 points

As we planned we lost final.

Figure 186: Playing process

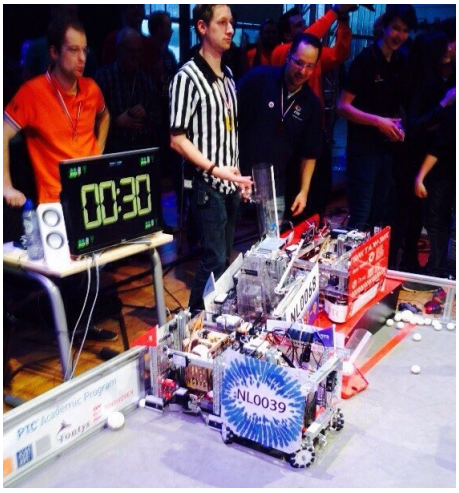


Figure 187: The result of the last round

So our alliance won in category "Alliance-finalist".

Figure 188: We got a five-kilogram metal tulip as a cup

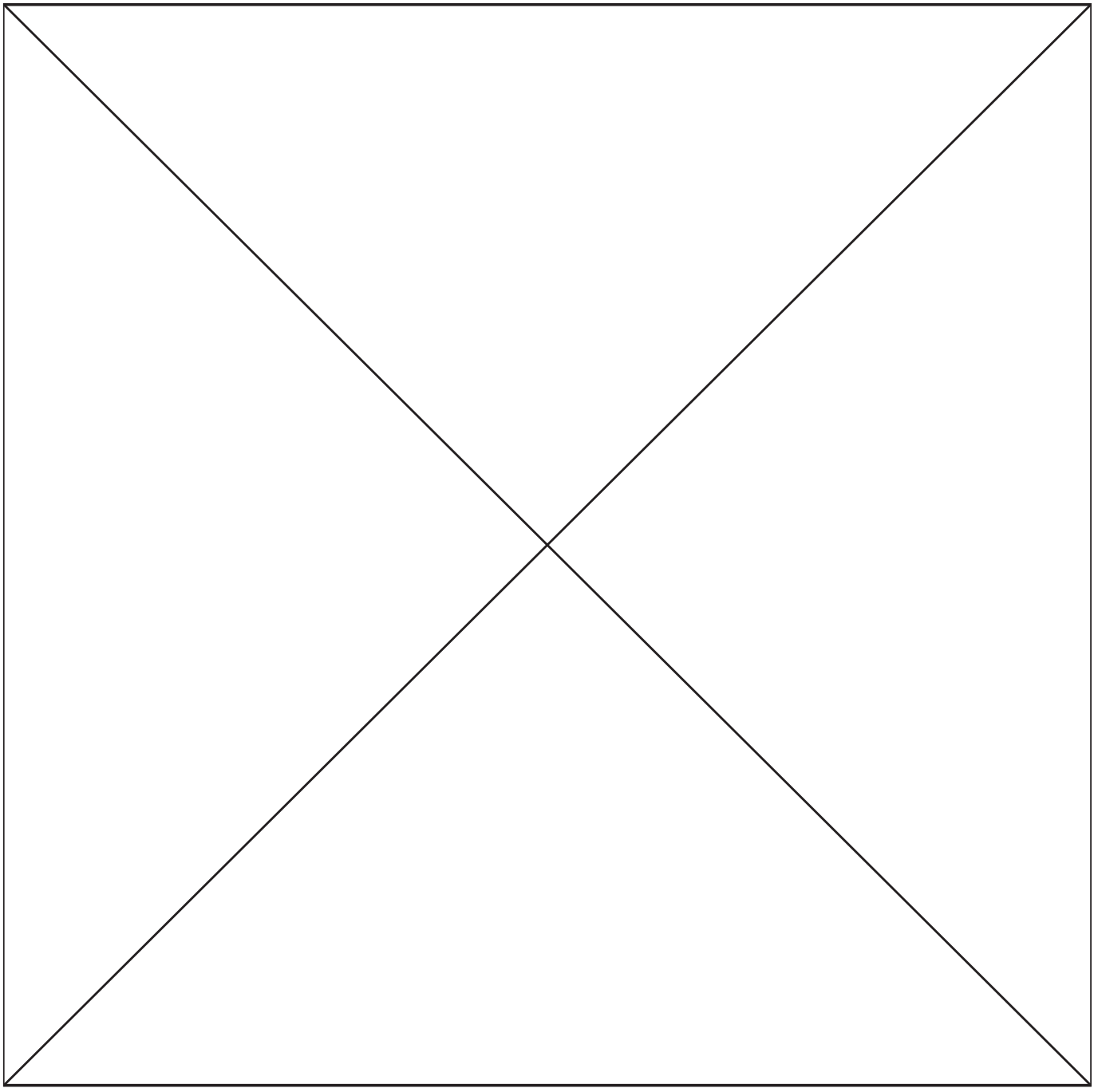
After the competition ended, we returned to the hotel and disassembled our robot for transportation.
Results of competition:

1. We didn't take top places by the results of qualification matches.
2. Our alliance won semi-final and lost final.
3. We didn't gain prize in nomination "Engineering book".
4. We didn't receive prize places in other nominations.

Summing up:

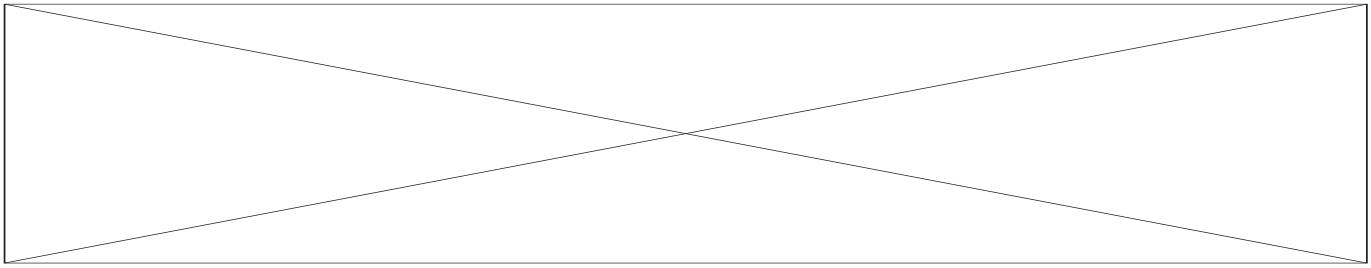
1. Success in competition:
   - 1.1. We won 5 matches from 8 (3 qualification and 5 final matches).
   - 1.2. Our operators controlled the robot successfuly, worked competently and coordinated their actions with each other and with operators of ally, like at the previous competition in Moscow.
   - 1.3. Programme of autonomous period worked more stable, than at previous competition. However, we had problems with moving 30 cm goal to the parking zone because of weakness of additional capture for goal.
   - 1.4. Programme of tele op worked ok, but in 2 games game we had to use emergency power button to restart the servos, which didn't work.
2. Our mistakes and disadvantages of construction:
   - 2.1. Because of lags with translation of data, we wasted too much time trying to rise the bucket up to the needed height. We can solve this problem by automatization the moving of the lift. We can insert 4 positions: ground, 60 cm, 90 cm and 120 cm and use each of them by pressing one button.
   - 2.2. We also wasted some time on turning on the gripper for balls. During the game, we needed to stop it while the bucket is rised and then run it again. In our program the gripper automatically stops when the winch starts working, but to launch it we need to press the button on the joystick. That is the problem that when the wifi lags, we it's hard to check if it started working or not. So, to solve this problem, we need to automize working of gripper for balls and leave for operator only control of thew reverse for emergency situations.
   - 2.3. We scored 1 minor point in every final match because of forbidden construction of capture for rolling goals.
   - 2.4. After a few games we noticed, that one of the wheels is near to fall off besause the fixators were unable to withstand the load. So, we decided to install more fixators to the axles after the competition.
   - 2.5. Many robots on this competition were faster, than our and we know, that in USA robots are even faster than here, so we need to increase speed of our robot to be on equal footing with them. We can install gear for speed and try to take 2 motors from lift to wheel base because we use wheels constantly and the lift - only a few times per game.
3. Tasks for the next meeting:
   - 3.1. To make the mechanism that rise the rolling goal (the task that we hadn't realised from the previous competition).
   - 3.2. To make turning in autonomous period by giro (the task that we hadn't realised from the previous competition).

3.3. Automise working of the lift and the gripper for balls.
3.4. Remove slopes for centering goals from the mechanism for capturing rolling goals.
3.5. Replace the self-made wire on the lift with a standard one.
3.6. Make robot faster.
3.7. Use 6 motors for motion and 2 for rising the lift.
3.8. Remove the majority of friction between slats from the lift to make it move easier.
3.9. Buy new strong servos and fix them on MOB (2 servos) and on the capture for goals (1 servo).
3.10. To make the video for nomination "Compass Award".
3.11. Fix the wheels more reliably.



4.5.102 01.04.15

1. The time of beginning and ending of the meeting: 19:00 - 21:30.
2. Purposes of the meeting:
   2.1. Make a plan of tasks for the next 2,5 weeks before the championship in St. Louis.
3. Work that has been done:
   3.1. Today we discussed what changes and improvements with robot we'll do and in what order. Here is the final list of tasks:
      3.1.1. 1-st priority:
         3.1.1.1. Remove the majority of friction between slats from the lift to make it move easier.
         3.1.1.2. Install AndyMark motors instead of all DC motors.
         3.1.1.3. Use 6 motors for motion and make robot faster.
         3.1.1.4. Fix the wheels more reliably.
         3.1.1.5. Change the MEL for using 2 motors.
         3.1.1.6. Remove slopes for centering goals from the mechanism for capturing rolling goals.
         3.1.1.7. Buy new strong servos and fix them on MOB (2 servos) and on the capture for goals (1 servo).
         3.1.1.8. Replace the self-made wire on the lift with a standard one.
      3.1.2. 2-nd priority:
         3.1.2.1. To make turning in autonomous period by giro.
         3.1.2.2. Automise working of the lift (4 positions: 0, 60, 90, 120 cm) and the gripper for balls.
         3.1.2.3. To make the video for nomination "Compass Award".
         3.1.2.4. Try to use in elevator the idea we got from Romanian team - mechanism with simultaneous lifting of the pairs of slats.
         3.1.2.5. Install the flexiglass protection to the front and back.
         3.1.2.6. Think about design of the pit at the competition and souvenirs for other teams.
      3.1.3. Low priority:
         3.1.3.1. To make the mechanism that rise the rolling goal.
         3.1.3.2. Create a mechanism for pulling down the stick in autonomus period.
         3.1.3.3. Make autonomus program with IR for taking balls into the central goal.
4. Results:
   4.1. We made a detailed plan of tasks for the time before the competition in St. Louis.
5. Tasks for the next meetings:
   5.1. Follow the plan we made today.



4.5.103 02.04.15

1. The time of beginning and ending of the meeting: 16:00 - 21:30.
2. Purposes of the meeting:
   2.1. Sort out details in the boxes.
   2.2. To install AndyMark motors on the MEL.
3. Work that has been done:
   3.1. Today we sorted out all details in boxes. It will make our working more comfortable and effective because we don't need waste time for seek details.
   3.2. We decided to fix gears on the MEL with help of two couplers. It will more reliable. Also we plan to fix gears that rotate wheels by two couplers.

Figure 189: The photo was made after we realised this idea, 03.04.15

   3.3. AndyMark motors were installed on the MEL.
4. Results:
   4.1. Details were sorted.
   4.2. AndyMark motors were installed.
5. Tasks for the next meetings:
   5.1. To finish MEL.
   5.2. To install blocks on the lift.
   5.3. To try a system with simultaneous lifting slats.

4.5.104 03.04.15

1. The time of beginning and ending of the meeting: 16:00 - 21:30.
2. Purposes of the meeting:
   2.1. Investigate about causes of extra friction in the lift and eliminate them.
3. Work that has been done:
   3.1. Today we did a research to find out about obstacles for moving of the slats. There was one problem: the distance between inside pairs of slats was too wide and caused a lot of friction. To solve this problem, we shortened the ribs and axles, which fixed pairs of rails and adjusted the width of both three elements of the lift. The movement of all the pairs of slats became easier, so now we won't waste power of motor on friction. Now, when the lift is improved, we can try to use blocks with cable instead of belt for lifting.

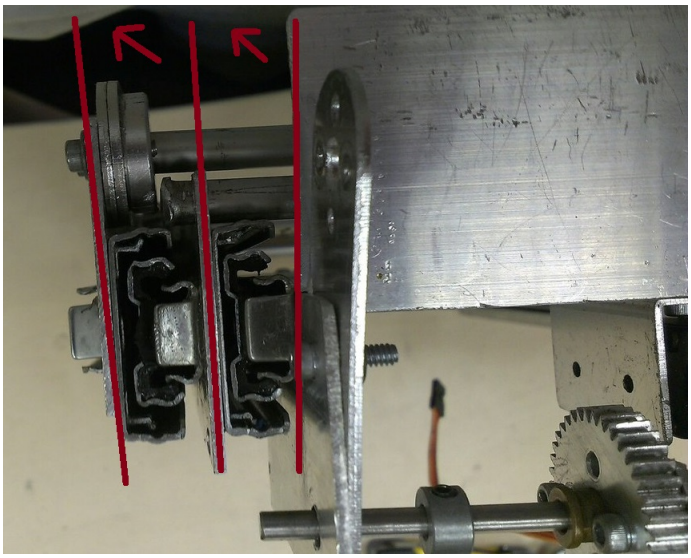


Figure 190: Bursting slats before the improvement

   3.2. In addition, today we held new wire for servos on the lift. This wire was made of standard ones and stregthened by the insulating tape.

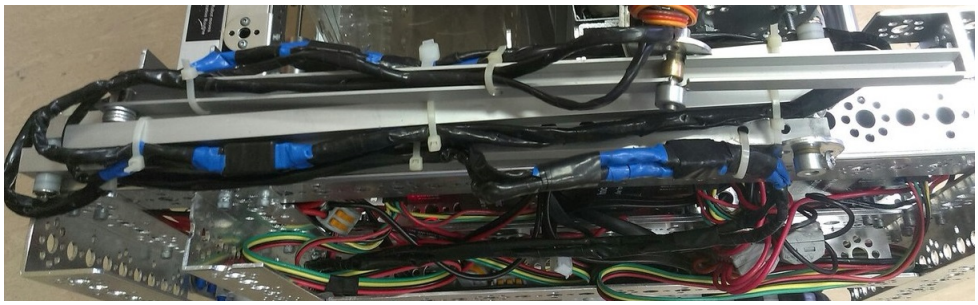


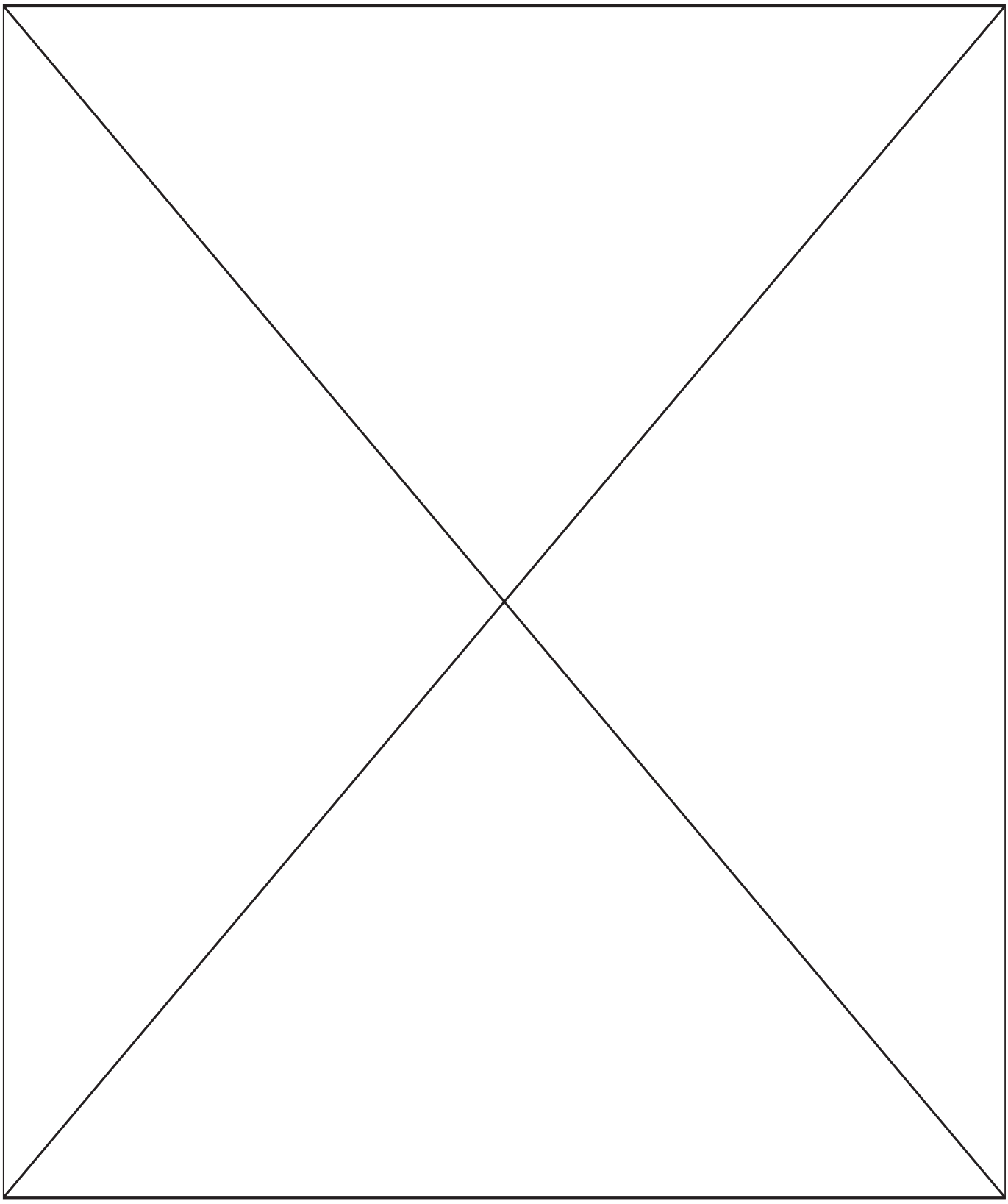
Figure 191: New wire

4. Results:
   4.1. All problems with extra friction in the lift are solved.

5. Tasks for the next meetings:

   5.1. Install blocks to the lift and compare its efficiency with the belt.

   5.2. Install AndyMark motors to the lift.



4.5.105 04.04.15

1. The time of beginning and ending of the meeting: 12:00 - 22:00.

2. Purposes of the meeting:

   2.1. To install blocks on the lift.

   2.2. To compare the efficiency of systems with the belt and with the cable with blocks.

   2.3. To try a system with simultaneous lifting of the slats.

   2.4. To install AndyMark motors on the MEL.

3. Work that has been done:

   3.1. Blocks were installed with help of screeds. Unfortunately, the latches of the screeds were too big and clung other crossbars of the lift, so it always got stuck. So, we decided to use threads for fixing blocks. As the cable we used thin but extremly strong rope for mountain climbing. Lift was tested. Result is positive. The force that we need for lifting much reduced. Also we compared onstruction with the belt and construction with blocks with help of steelyard. Blocks give us the gain in force by a factor of 3-4 (at the top of power the belt needed 12 kg force when blocks - only 3 kg force).

Figure 192: Belt, power $>$ 12 kg

Figure 193: Blocks, power $<$ 3 kg

   3.2. It was decided to make MEL with 2 motors and transmission with gear ratio 1:2 and system with simultaneous lifting. It will give us the gain in speed by a factor of 1.5.

   3.3. MEL with gear ratio and Andy mark motors 1:2 was made.

   3.4. It was found that if we want to make a system with simultaneous lifting we need to make an individual mounts for rope that connect slats with each other. But it is too complicatedly and we haven't enough time for it.

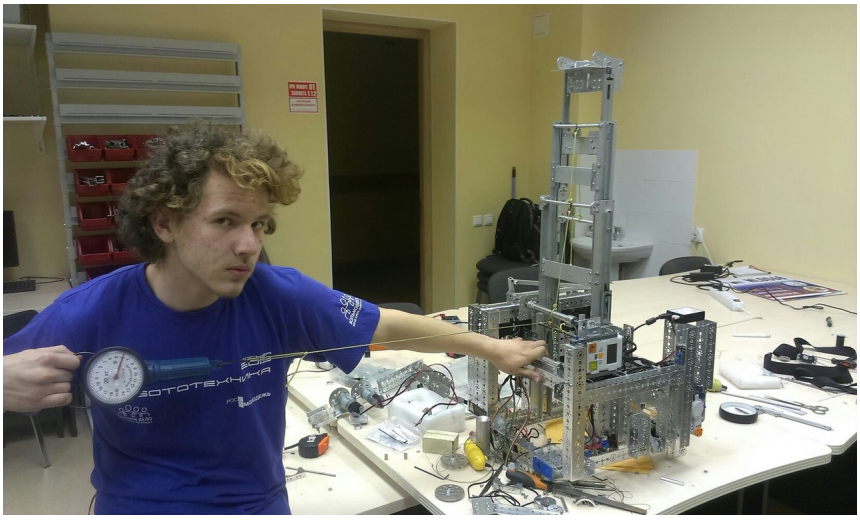


Figure 194: Testing mechanism with simultaneous lifting of the slats

3.5. So it was decided to make MEL with 2 motors and gear ratio 2:1 without simultaneous lifting. It is less complicadly and give gain in speed by a factor 2.

4. Results:

4.1. Andy mark motors were installed on the MEL.

4.2. Blocks were installed and tested.

4.3. We found that blocks give gain in force by a factor 3-4.

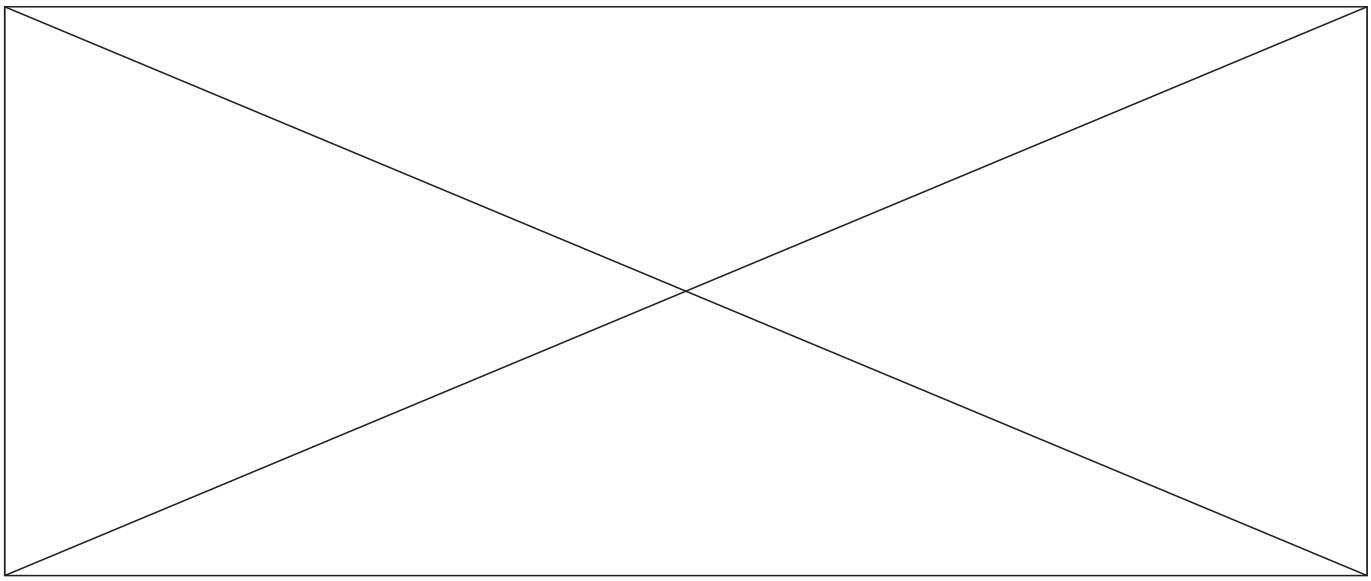
4.4. New construction of the lift and MEL was prokected.

5. Tasks for the next meetings:

5.1. To make MEL with gear ratio 2:1.

5.2. To install 2 additional motors for moving.

5.3. To install transmission with gear ratio 2:1 on the motors that rotates wheels for more fast moving.



4.5.106 06.04.15

1. The time of beginning and ending of the meeting: 16:10 - 21:50.
2. Purposes of the meeting:
   2.1. To make MEL with transmission with gear ratio 2:1.
   2.2. To test new MEL.
   2.3. To fix MEL on the body of robot.
3. Work that has been done:
   3.1. New MEL was created and tested. Result is positive. Speed of lifting increased twice. But during the test threads that keep blocks torned. So it was decided to fix it by strong fishing cord. Today we didn't have time to fix The MEL on robot.

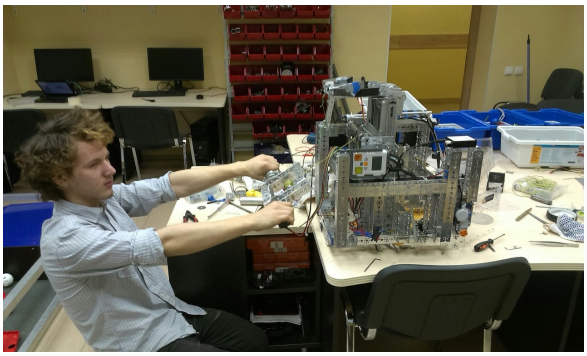


Figure 195: Testing new MEL

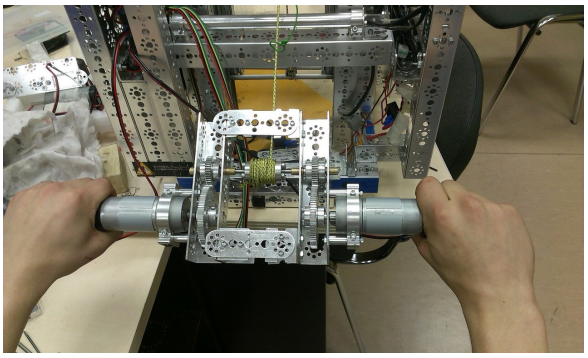
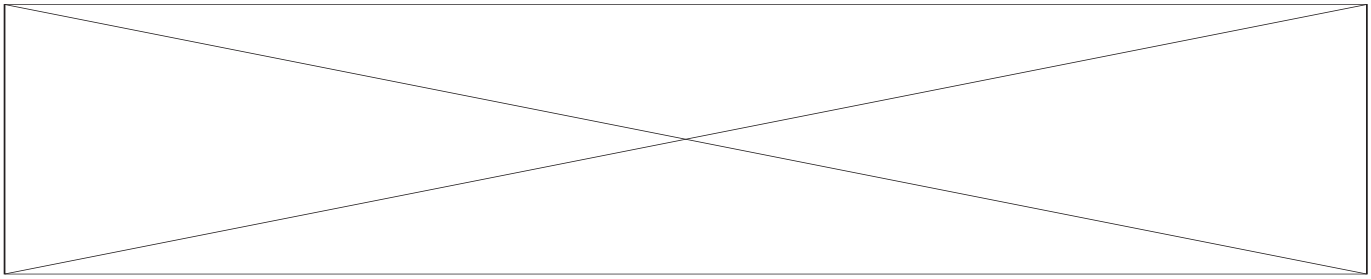


Figure 196: MEL's construction

   3.2. Also during the test we found that lift shakes when we rise it. It happend because rails extract not to maximal high. But we knew, how to solve this problem: install limiters which will not allow to rails rise too highly. Due to this limiters the slat will stop and so can't shake.
4. Results:
   4.1. MEL was made and tested.
   4.2. MEL was not fixed on the robot.
   4.3. We installed two servos onto the MOB.
5. Tasks for the next meetings:
   5.1. To buy fishing cord and use it for mount for blocks.
   5.2. To project and make new wheel base with increased speed of moving.



4.5.107 07.04.15

1. The time of beginning and ending of the meeting: 16:30 - 22:10.
2. Purposes of the meeting:
   2.1. Prevent the cable from leaving the reel.
   2.2. Install new servos to the MOB.
3. Work that has been done:
   3.1. We noticed the problem, that when the winch works, sometimes the cable slips over the wide reel and wraps around the axis, which slows the rising of the lift. To improve this, we installed limiters from the sides of the reel to prevent the cable from leaving it.

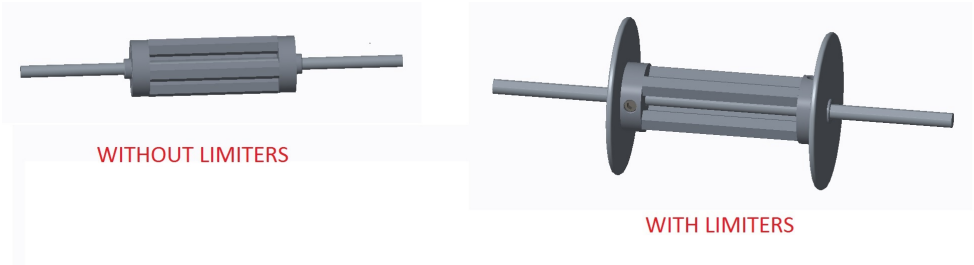
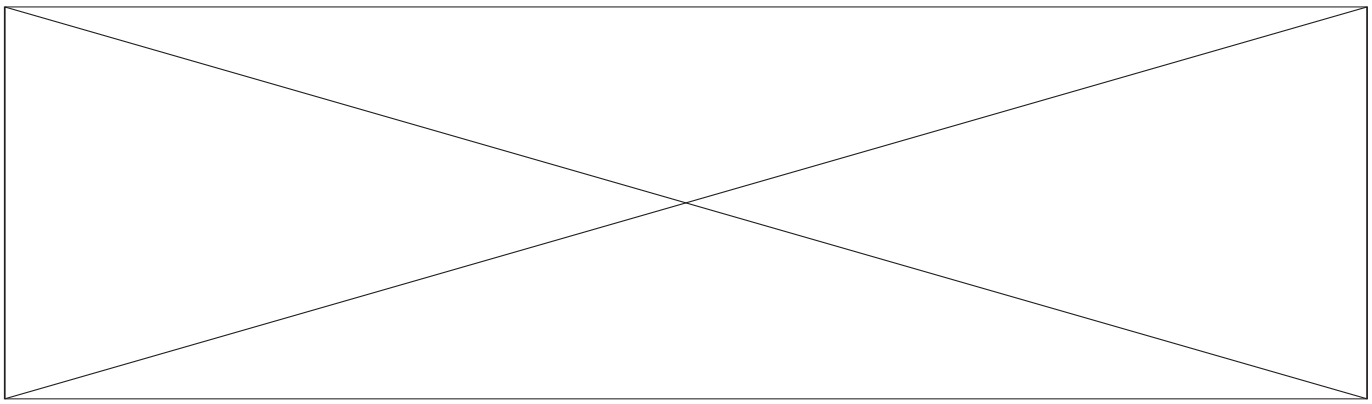


Figure 197: Improvement of the reel

   3.2. Also today we got 2 new strong servos and installed them to the MOB. The strong servo we used for overturning the bucket in Nederlands was left for the MCB, because this module requires less loads than the MOB, where we needed to install fresh servos. We didn't fix the servo on MCB today, because before we need to fix the MEL on the robot and next place servo in the free space.
4. Results:
   4.1. Limiters for the reel were installed.
   4.2. Strong servodrivers were installed.
5. Tasks for the next meetings:
   5.1.
   5.2.
   5.3.



4.5.108 09.04.15

1. The time of beginning and ending of the meeting: 1:00 - 2:00.

2. Purposes of the meeting:

   2.1. To understand how to work with the chain.

   2.2. To start assemble new wheel base.

3. Work that has been done:

   3.1. Today we understood how to use the instrument for unlocking the chain and how to connect it by this instrument.

   3.2. There were installed 4 motors with gears and sprockets for chain which were fixed by two couplers. So there is a very small probability that they will get off during the match.

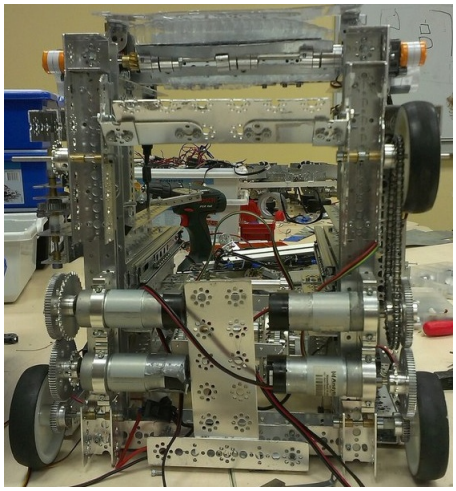


Figure 198: We began assembling the wheelbase

   3.3. From the left side we held the chain between the motors and axis with front wheel. Firstly we located it so that it hooked the floor. But when we found it we turned motors in their mounts and this problem disappeared.

   3.4. We installed one mount for additional motor that will rotate wheel.

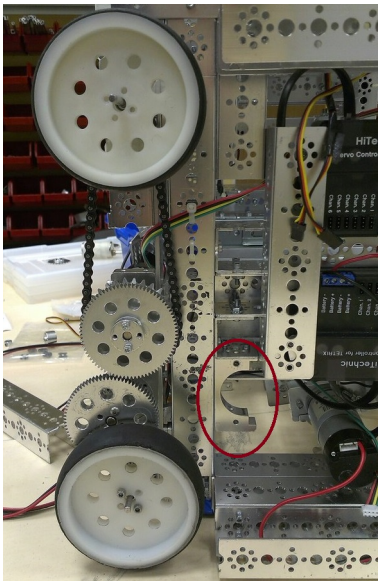
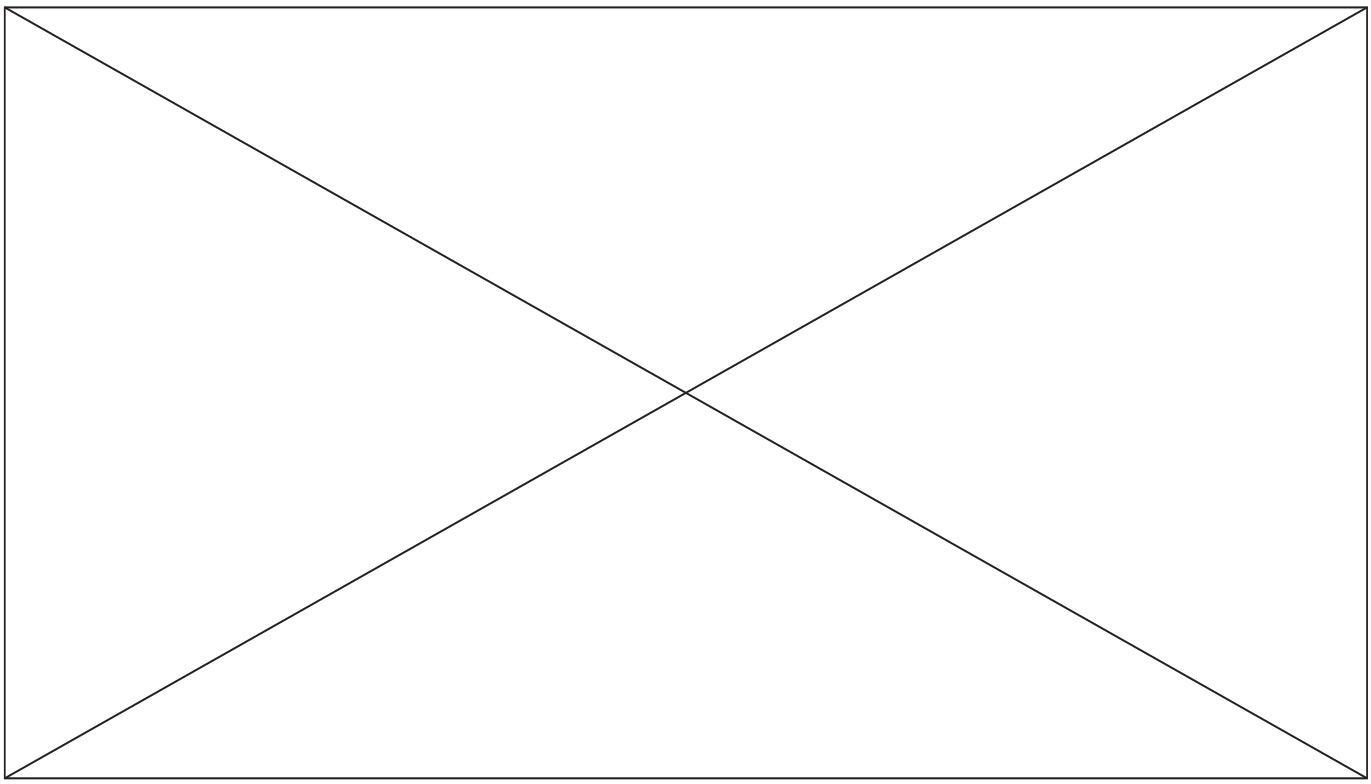


Figure 199: Mount for the 3-rd motor

4. Results:
   - 4.1. We understood how to work with the chain.
   - 4.2. Wheel base partially assembled.
5. Tasks for the next meetings:
   - 5.1. To finish wheel base.
   - 5.2. To buy fishing cord and use it for mount for blocks.

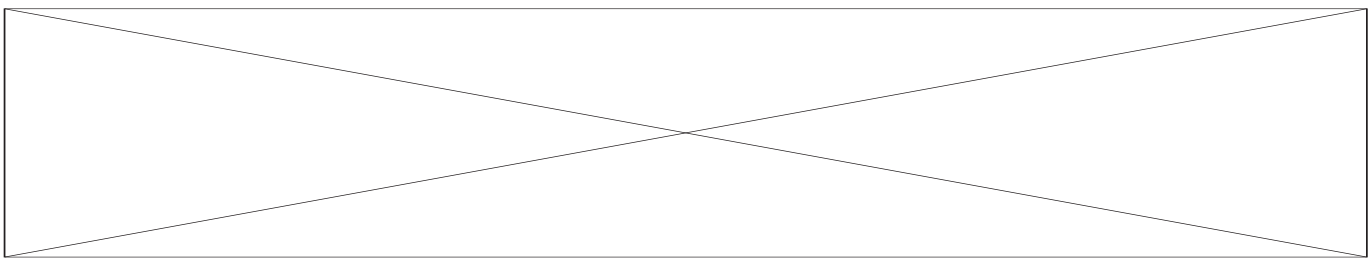


4.5.109 11.04.15

1. The time of beginning and ending of the meeting: 17:00 - 21:00.
2. Purposes of the meeting:
   2.1. To make a video for the nomination "Compass Award"
3. Work that has been done:
   3.1. Today we were making a 1-minute video for the nomination "Compass Award". Thye deadline for sending video ot jidges was the following day, so we needed to shoot all the material today. That's why we didn't do anything with construction of our robot.
   3.2. Unfortunately, There were only three of us who managed to come. Our coach Dmitry Luzin and our captain Georgiy Kryliv were on "Robochallenge" competiotion in Austria (they achieved there the 2-nd place in nomination "Puck Collect"). Maksim Radionov couldn't come too. So, we made a video witout them. Although it was difficult to make a video about our coach withiut him and a half of the team, but we did our best to do it wuth a high quality.

Figure 200: The frame from our video

4. Results:
   4.1. The material was shot.
   4.2. Ivan Fokin will do the video editing at home.
5. Tasks for the next meetings:
   5.1. Send the video to judjes.



4.5.110 12.04.15

1. The time of beginning and ending of the meeting: 12:00 - 21:30.

2. Purposes of the meeting:

   2.1. To install blocks by the fishing cord.

   2.2. To install 5th and 6th motors to the wheel base.

3. Work that has been done:

   3.1. Today we bought a fishing cord and fixed blocks with help of it. We tested strength of this mount. Result is positive. The cord is strong enough.

Figure 201: Fishing cord

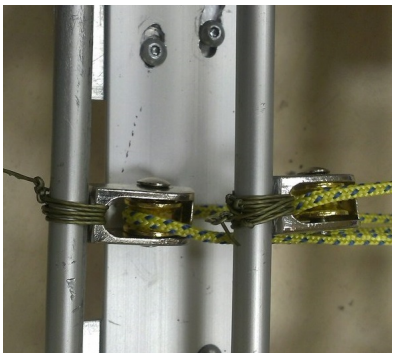


Figure 202: Blocks fixed to the axles

   3.2. It was found that backlashes of the installed chains are too big. So we corrected chain tension. Now backlashes are optimal.

   3.3. 5th and 6th motors for wheel base were installed and connected with other motors by the chain.

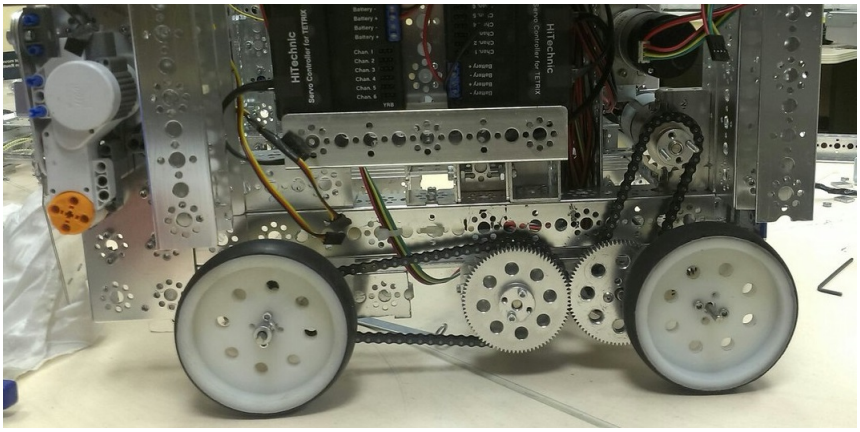


Figure 203: Wheel base with 3 linked motors

   3.4. In addition, today we made wiring for all motors.

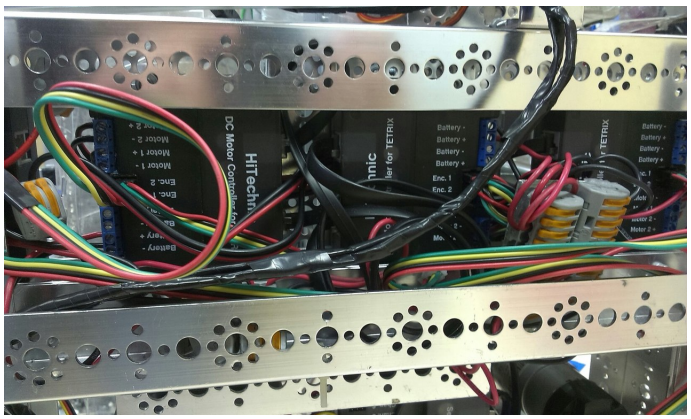
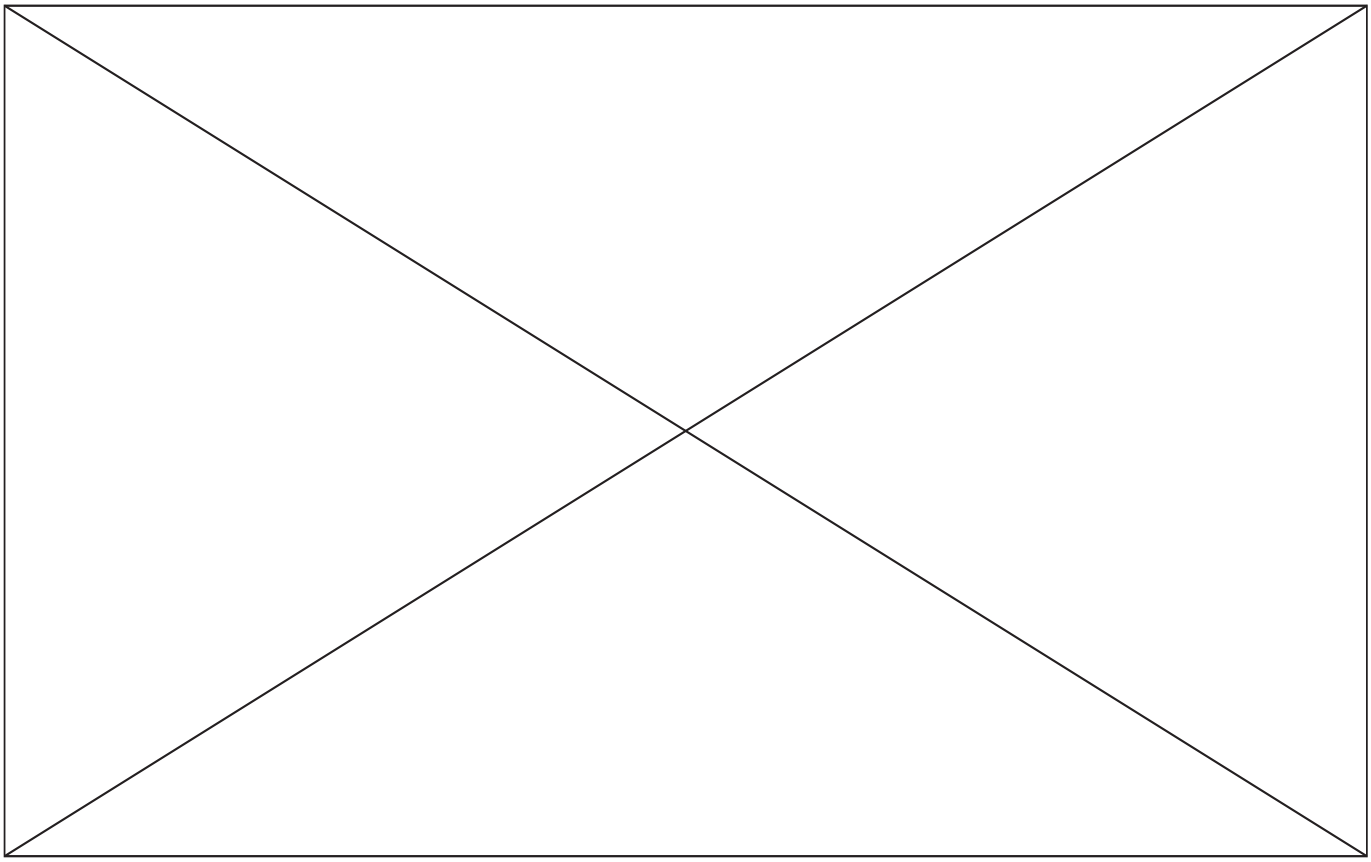


Figure 204: Wiring is held

4. Results:
   - 4.1. Additional motors for wheel base were fixed.
   - 4.2. Blocks were fixed.
   - 4.3. Wiring for motors was made.
5. Tasks for the next meetings:
   - 5.1. To fix MEL.
   - 5.2. To install limiters on the slats.
   - 5.3. To test the robot.



4.5.111 13.04.15

1. The time of beginning and ending of the meeting: 17:00 - 23:00.
2. Purposes of the meeting:
   2.1. To finish the wheel base.
   2.2. To fix MEL.
   2.3. To install stoppers on the rails.
   2.4. To test the robot.
3. Work that has been done:
   3.1. MEL was fixed on the robot.
   3.2. It was decided to connect the top crossbars with each other by the rope. It will not allow the bottom crossbars lift too high.

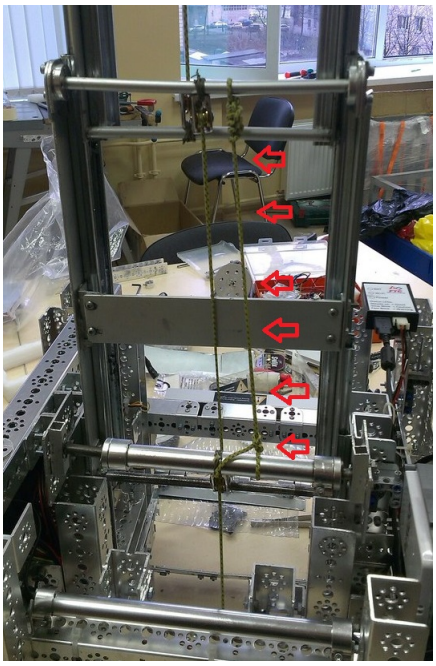


Figure 205: Limiting rope

   3.3. Wheel base was tested. It was turned out that robot can't turn on our field. Most likely it happened due to other arrangement of the wheels (compared with what we had on the "Robofest"). When we had old wheel base our robot turned on our field due to the back wheels and front wheels slip (In the original field robot turned normaly because there is lower friction on the original field). Now all wheel are not slip and due to high friction robot can't turn. It not allow us to train before competition. So we need to change wheel base.
   3.4. We tryed to wrap wheels with electrical tape. Tape is more slippery and so it can to help us. But robot still didn't turn.
   3.5. We looked the variant to install Lego tires on the wheels but they were too small.
   3.6. It was decided to install omni-wheels instead of standard. This variant was tested. Result is positive. Robot move and turn very fast. Also it ride to the ramp almost without problems. There was only one problem that when we ride to the ramp not directly but at an angle robot slip from it due to rollers. But we think that it not very big problem.

3.7. Also we looked a variant to install Lego caterpillars on the wheels but we decided that construction with omni-wheels is better because robot with omni-wheels can turn faster and more accurate.

3.8. It was decided to install beam that will connect axles of two wheels. It will not allow to gears move away from each other. So we need to move wheels closer to the beam of the base. The right wheels were moved on the desired distance.

4. Results:

4.1. MEL was fixed.

4.2. Limiters for lift were projected.

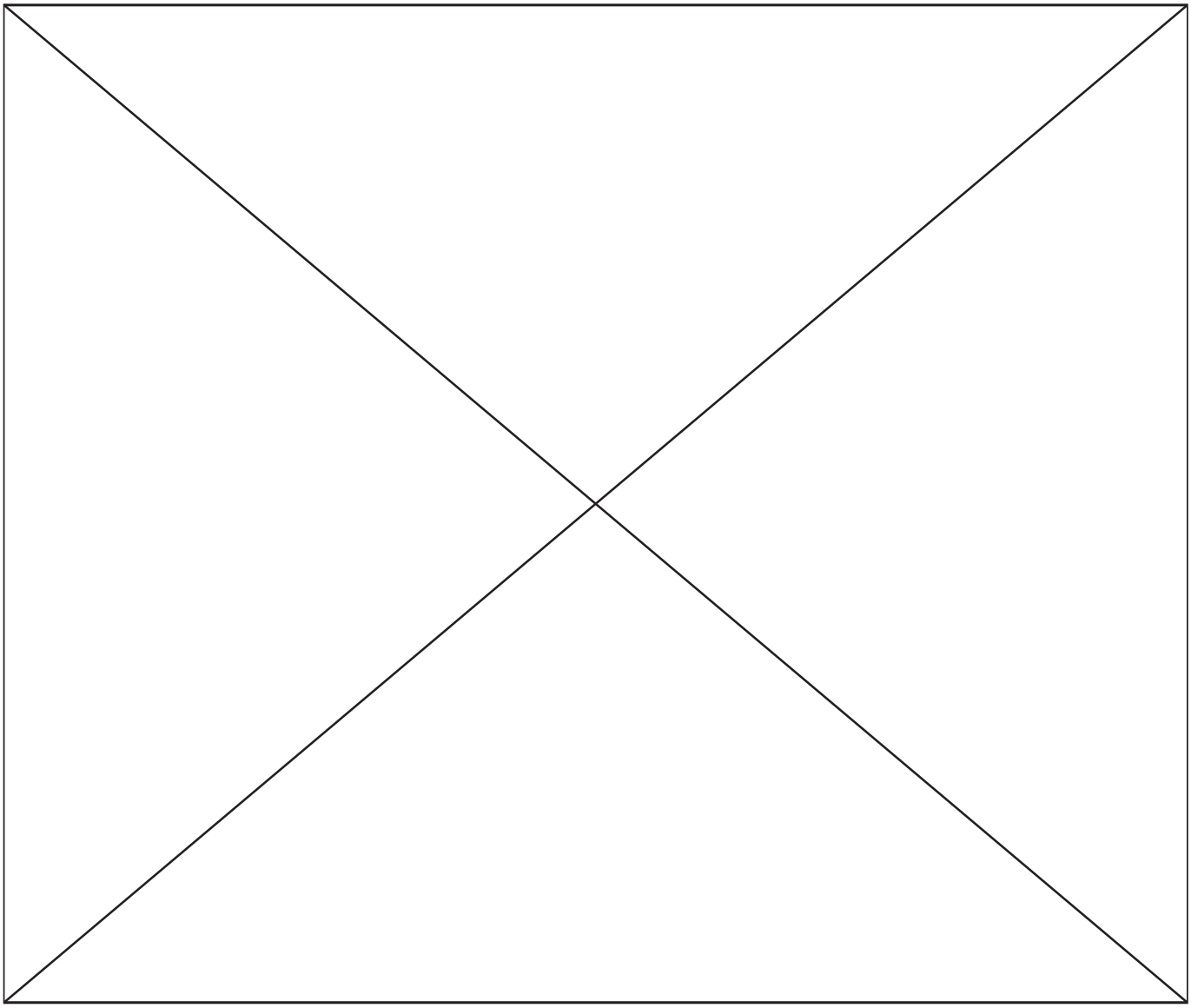
4.3. Wheel base was changed and tested.

5. Tasks for the next meetings:

5.1. To install beams thet connect two wheels with each other.

5.2. To install limiters on the lift.

5.3. To install button of power with Lego motor.



4.5.112 14.04.15

1. The time of beginning and ending of the meeting: 16:00 - 21:50.
2. Purposes of the meeting:
   2.1. Fix omniwheels permanently.
   2.2. To have a training in driving of the robot.
3. Work that has been done:
   3.1. Today we continued working on wheel base. Yesterday we installed omniwheels hestily, only to try this construction. However, after it showed itself more convenient than construction with basic wheels and we decided to use omniwheels permanently, we decided to fix wheels stronger.
   3.2. So, we fixed wheels to gears with screws and made the construction tighter in order to install stregthening plates from the sides. To fit plates between wheels and plexiglass protection, we had to shorten some details.

Figure 206: Shortened details

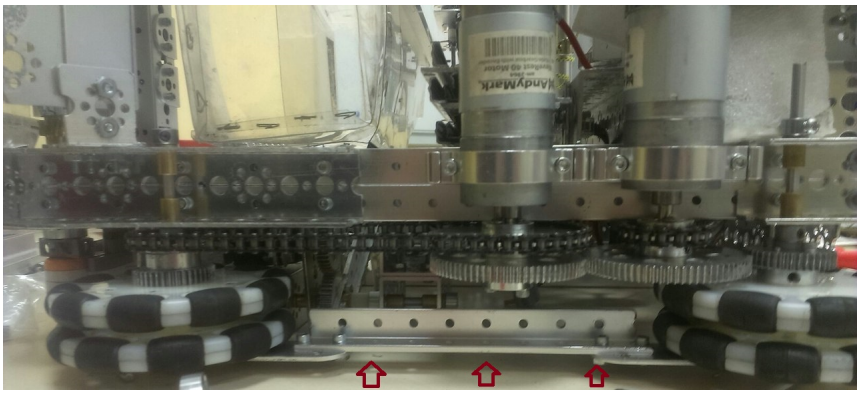


Figure 207: Stregthening plate

   3.3. After the plates were installed, we made a test run of the robot. Our robot moved and turned around extremly fast, but it was one difficulty that after the robot stops after a fast motion, it stands on forward wheels and in this moment apears the risk of overturning (for example, our robot overturned today once because of operator's mistake). At the end of training we investigated, that the robot stops fluently if we turn with one pair of wheels from the similar side. In that case we should practice doing this maneuver to avoid accidents.
4. Results:
   4.1. Wheels were fixed with quality.
   4.2. Strethening plates were installed.
   4.3. We investigated, how to stop robot fluently. This will help us to avoid accidents with overturning of the robot.
5. Tasks for the next meetings:
   5.1. Have more trainings.
   5.2. Set up servos on MOB and examine it.

4.5.113 15.04.15

1. The time of beginning and ending of the meeting: 18:00 - 23:00.
2. Purposes of the meeting:
   2.1. To set up servos on MOB.
   2.2. To install MCB with powerful servo and set up it.
3. Work that has been done:
   3.1. We chose the correct difference between values of servos that move MOB. So there is no high load on it.
   3.2. It was found that servos were installed wrong. It overturned to extreme position but balls still didn't roll from it. So the position of servos was changede and now MOB works normally.
   3.3. MCB was changed. Servo was installed vertically because we couldn't install it horisontally due to additional motors that rotate wheels. However, in this position it wasn't standing straight.

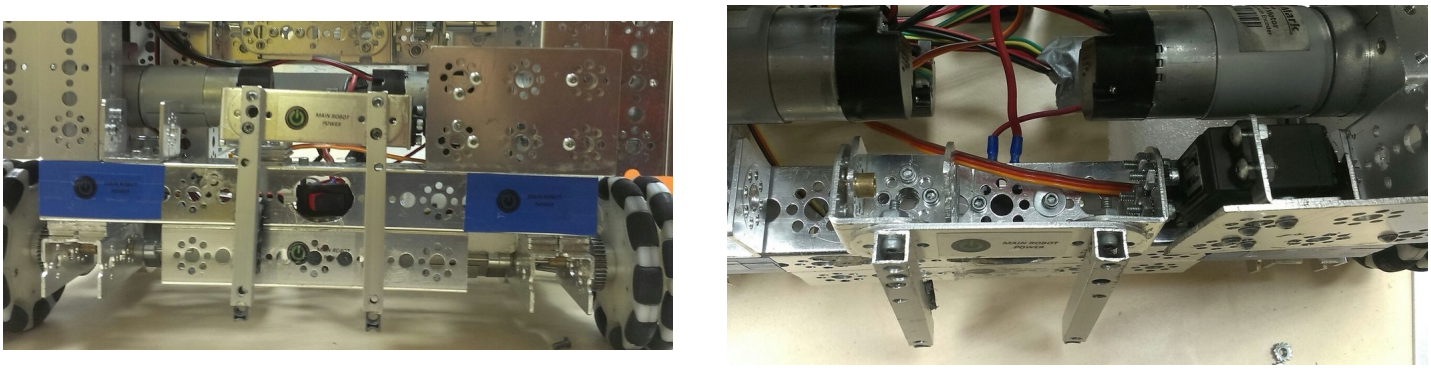


Figure 208: Servo installed vertically

   3.4. In addition, we fixed plates from the wheel base to the carcase.

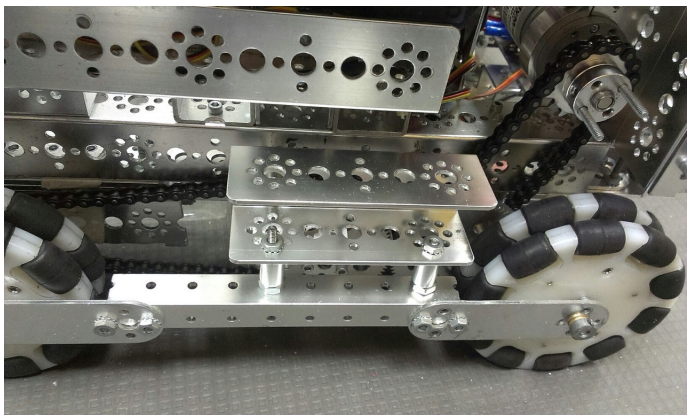


Figure 209: Plate fixed to carcase

4. Results:
   4.1. Servos on MOB were set up.
   4.2. MCB was installed.

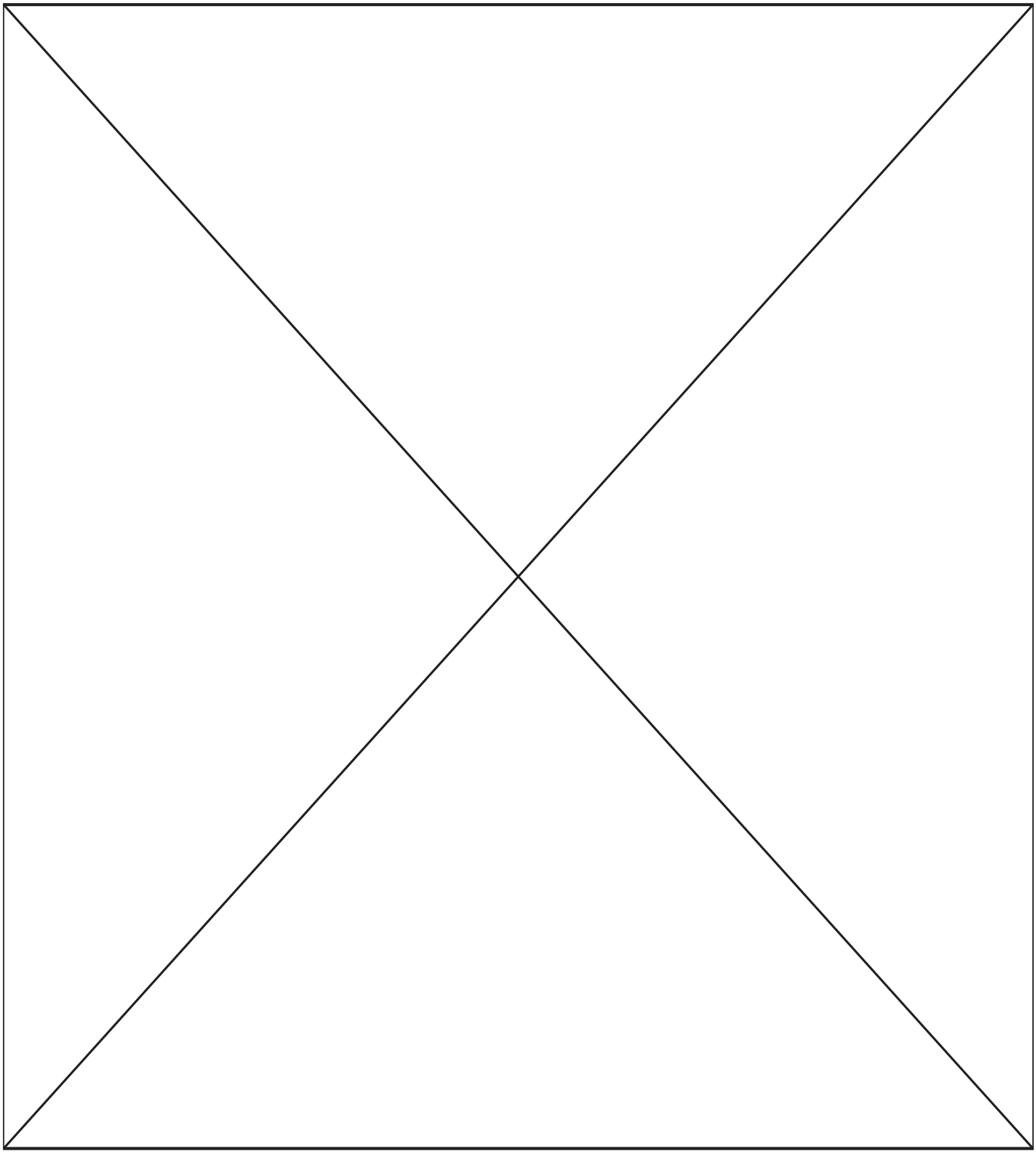
4.3. Plates for stregthening the carcase were fixed to the carcase.

5. Tasks for the next meetings:

5.1. To set up MCB.

5.2. To train in the control robot.

5.3. To make programme of autonomous period.



4.5.114 16.04.15

1. The time of beginning and ending of the meeting: 1:00 - 2:00.

2. Purposes of the meeting:

   2.1. Install plexiglass protection from the back.

   2.2. Connect the detail for directing balls vertically to the bucket.

   2.3. Change the construction of the MCB.

3. Work that has been done:

   3.1. We understood that the previous mechansm for capturing rolling goals can't be installed accurately, so we refused it. We decided to realise a project with servo fixed under the back carcase beam. We didn't do this project before as it unable to center goal, but now it centers by beams from wheel base, so it's ok.

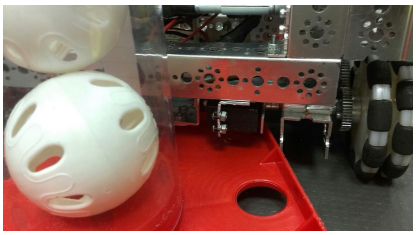


Figure 210: New capture with goal

Figure 211: MCB opened

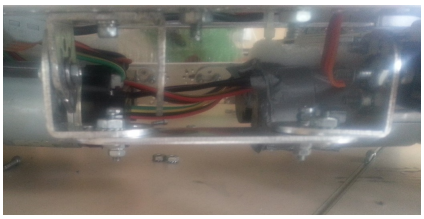


Figure 212: MCB closed

   3.2. Next, because of deinstalling the bottom plate (we installed new MCB instead if it), we needed to make new mount for the battery. We moved the battery closer to the lift, so it became easier to extract it.

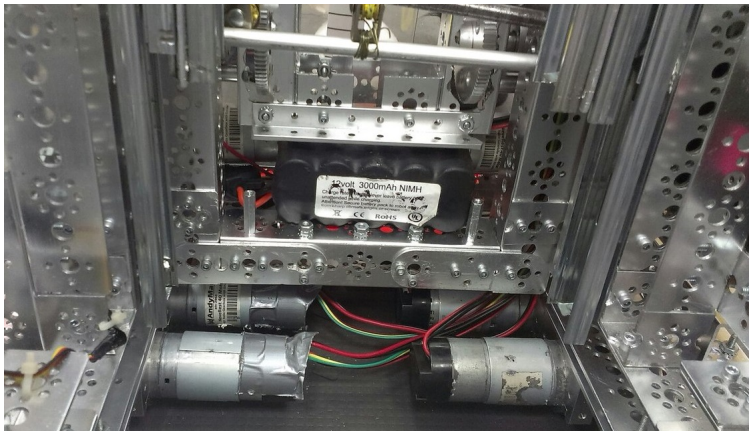


Figure 213: Battery in new mount

   3.3. We measured the sizes and cut out the back sheet of plexiglass. We left only 1,5 cm between the corner of of plexiglass and the ground (except hole for the rolling goal) to protect wheels from the small balls. Also we made holes for screws in the plexiglass.

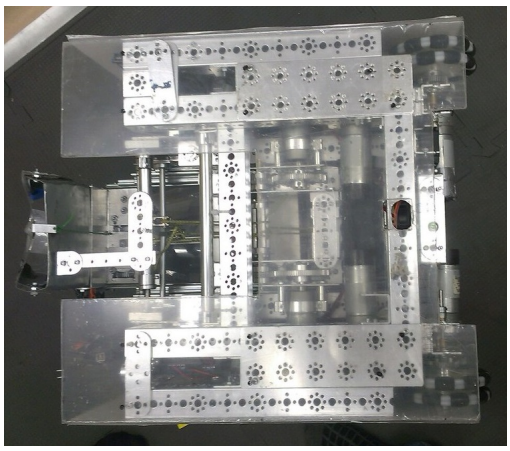


Figure 214: The back sheet of the plexiglass

3.4. After we cut the plexiglass out, we started working on a sticker for it.

3.5. We linked detail responsible for directing balls vertically with the bucket by the wire (as we detached it when we transported the robot by plane from Nederlands).

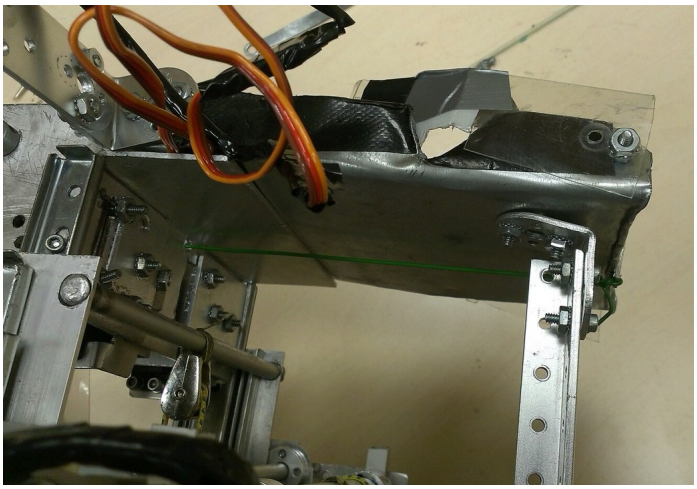


Figure 215: The wire for opening the direct for balls.

3.6. In addition, we changed frameworks for autonomus programs as now we use 6 motors for moving and 2 for rising the lift.

3.7. At the end of the day, during the training, robot lost 3 of it's wheels. at the following congregation we should fix wheels more reliable.

4. Results:

4.1. The construction fo the MCB was changed to a more compact.

4.2. Battery was moved to another place.

4.3. We made the back sheet of plexiglass.

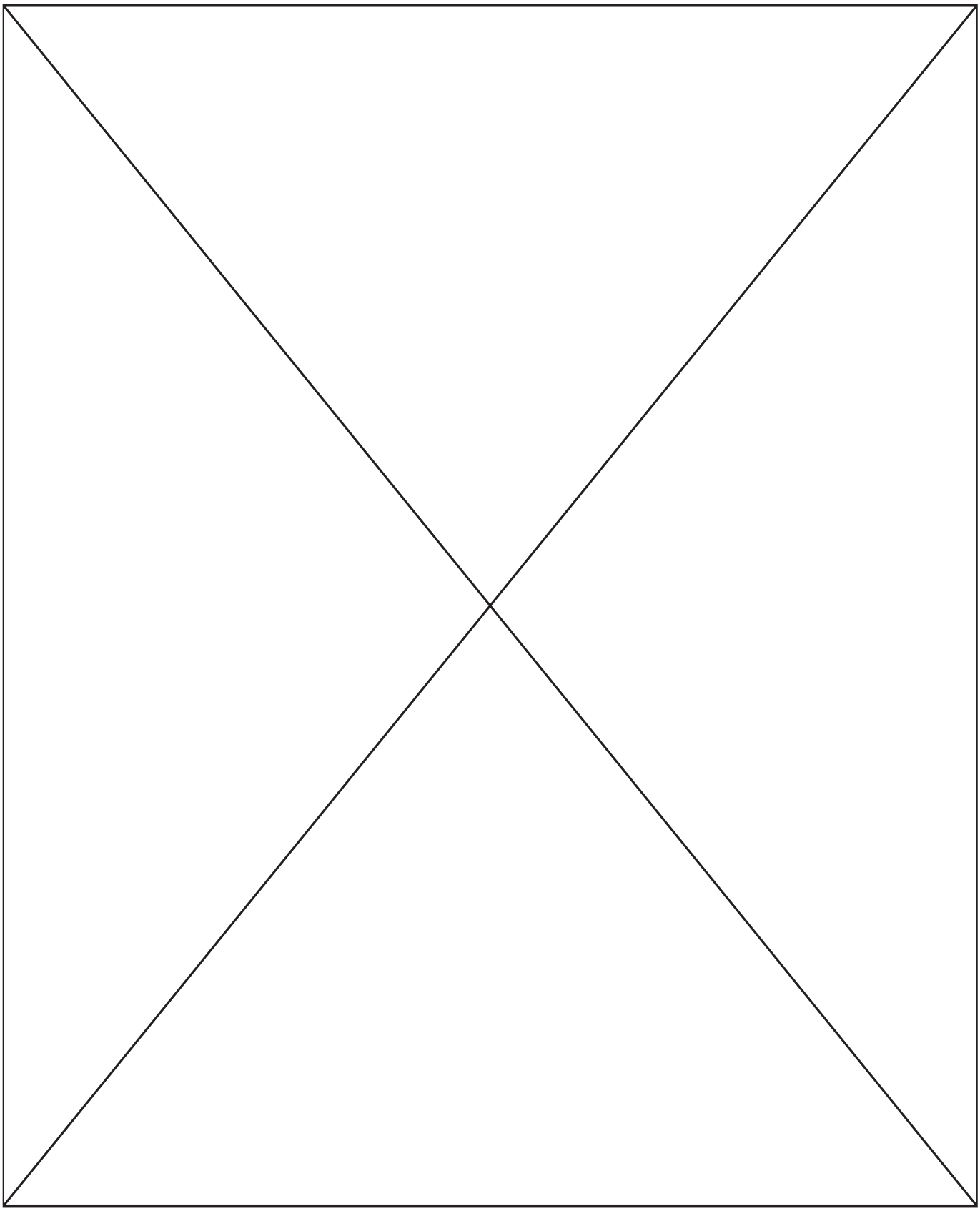
4.4. Detail for directing balls vertically was connected to the bucket.

4.5. Autonomus programs were corrected.

5. Tasks for the next meetings:

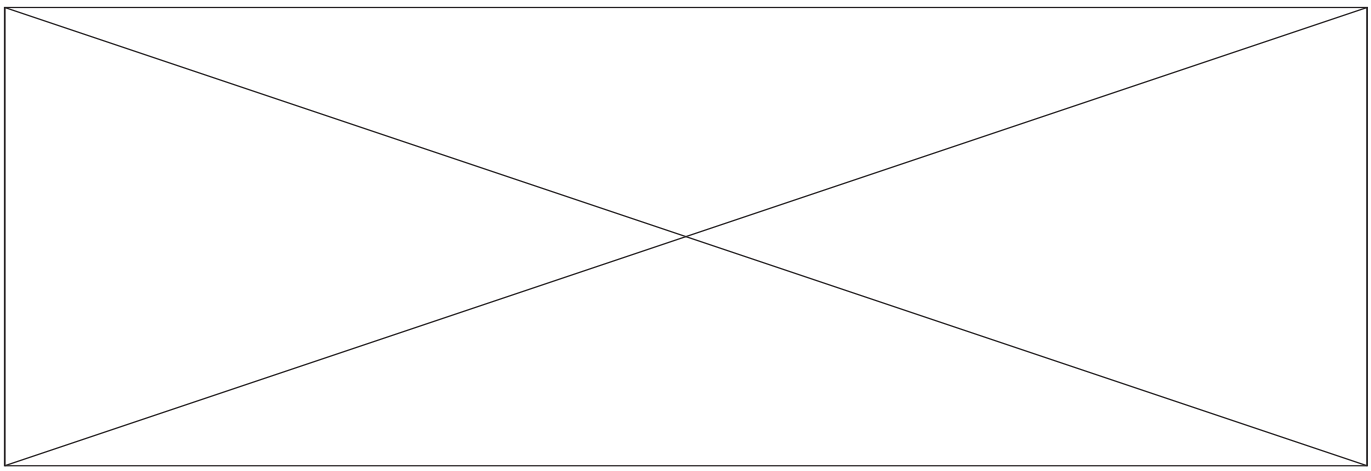
5.1. Fix wheels more reliable.

5.2. Create autonomus programs.



4.5.115 17.04.15

1. The time of beginning and ending of the meeting: 16:00 - 00:00.
2. Purposes of the meeting:
   2.1. To fix the wheels.
   2.2. To train on the control robot.
   2.3. To write programme for autonomous period.
   2.4. To make a video about our robot.
3. Work that has been done:
   3.1. Wheels were fixed more reliable.
   3.2. The programme of control moving was changed. When operator press button-trigger robot move on a straight direction. When operator press right or left arrow on "TopHat" robot turn by both wheel pairs. And when operator press trigger and arrow on "TopHat" robot turn by one wheel pair. This programme is more comfortable for operator.
   3.3. We made a material for video about our robot.
   3.4. It was decided to install plexiglass for trainings because without it robot often run over small balls and it make control robot too hard.
   3.5. During the training screws that fix wheels and gears unwound again. So we fixed it by super glue. It will not allow them get off.
4. Results:
   4.1. Wheels and gears that rotate them were fixed more reliable.
   4.2. We made more comfortable programme of control moving.
   4.3. We made material for video about our robot.
   4.4. We trained on the control robot.
   4.5. We didn't write programme of autonomous period.
5. Tasks for the next meetings:
   5.1. To train on the control robot.
   5.2. To write programme for autonomous period.



4.5.116 18.04.15

Today was our last day of preparing for the competition in St. Louis. Tomorrow at 17:00 we'll go to Moscow by train and then fly from Moscow to the St. Louis through the New York City.
Also today was an open door day in our lyceum and we participated there with our robot to involve new people into our robotics program. During the open day, we continued writing the program for automatization of the elevator.

1. The time of beginning and ending of the meeting: 15:20 - 00:00.
2. Purposes of the meeting:
   - 2.1. Make a code for automatically extracting of the lift in tele-op.
   - 2.2. Disassemble the robot for transportation.
3. Work that has been done:
   - 3.1. During the trainings, 2 servos from the MOB suddenly broke down. It was a problem, because we had only 1 extra strong servo and no time to buy more. So, we decided to remake the MOB with another strong servo we had, but install the gear 1:3 for safety (although the bucket now overturns slower, it's less risk that it will break down).

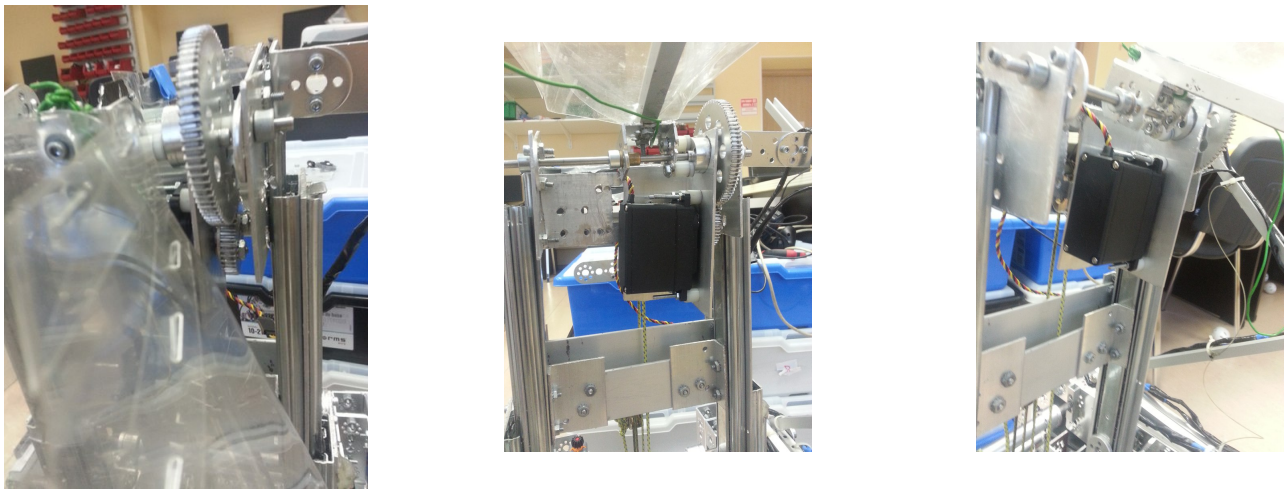


Figure 216: Strong servo for overturning the bucket

   - 3.2. We installed a button, that the gutter presses when the lift is fully closed. It allows us to use the automatically lift extracting, because we can reset the value of MEL's encoder every time the bucket reaches the floor.

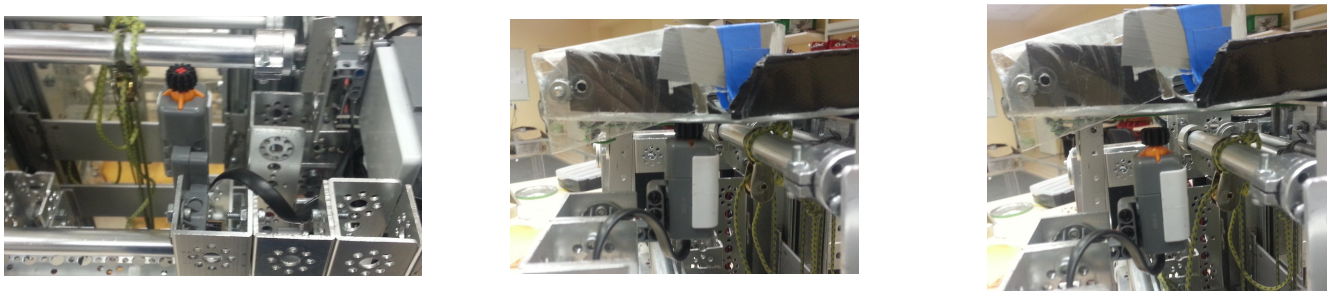


Figure 217: Checking button

3.3. We disassembled robot into parts to prepare it for transportation.

4. Results:

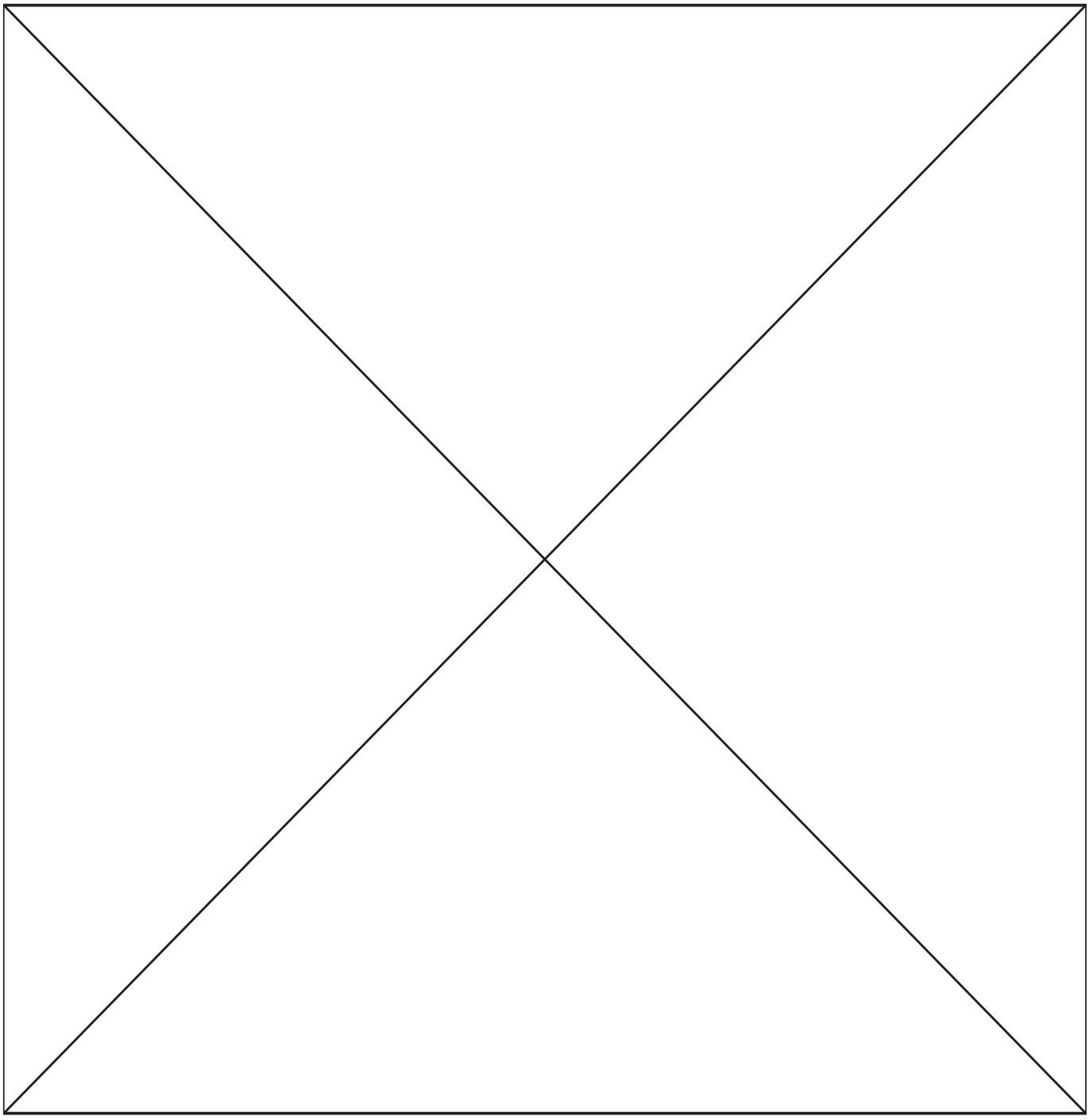
4.1. We installed button for checking the bottom point of the motion of the lift.

4.2. 2 servos from MOB broke down.

4.3. Robot was disassembled for transportation.

5. Tasks for the next meetings:

5.1. To show ourselves worthy at the competition in St. Louis.



5 Thanks and prospects

We enjoyed working on a custom and non-standard project, which, besides its technical aspect, included working with new people who shared our values of friendship and mutual understanding.

Our team is planning to continue doing robotics, setting new goals for ourselves in order to improve. This is our first year taking part in FTC and we will participate next year as well. If we don't realize ourselves this year, we'll look at all our mistakes, correct them, and preform a lot better next year.

In any case, we are ready to learn new things, improve ourselves and expand our skills.

None of us know for sure what we want to do in the future, but we are certain that our experience will be very valuable to us.

Our thanks go to the company FIRST for organizing this competition, which we are very happy to be participating in. We appreciate this wonderful opportunity to test ourselves and learn something new and wish them success and growth in their future endeavors.

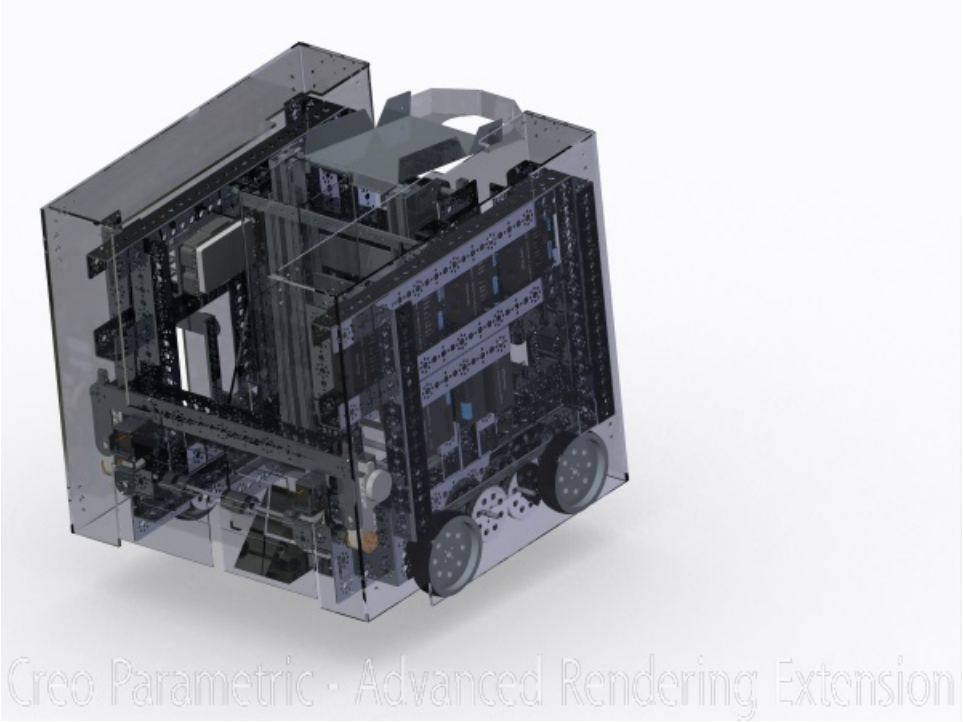
Also we thank our sponsors: company PTC and it's Russian representative "Irisoft" and charitable foundation "Finist" for their support. Also we thank Physics-Mathematics Lyceum 30 and it's director Alexey Tretyakov for providing comfortable conditions for preparation to competition.

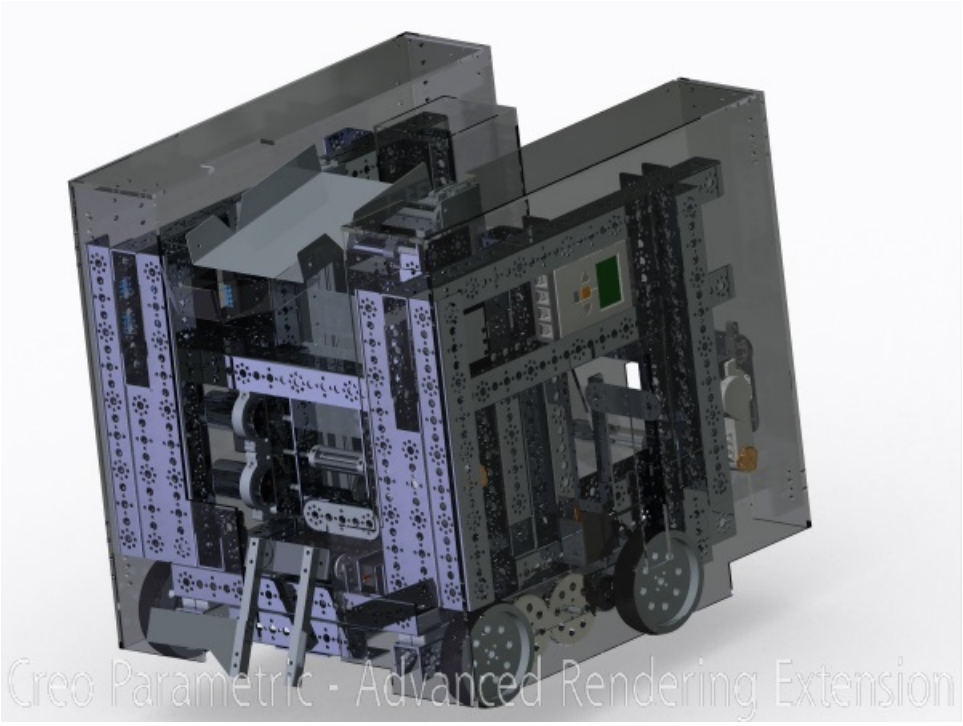
Team PML 30 φ

6 Key summary

6.1 Model

The final version of the model of the robot made in Creo Parametric 3.0:



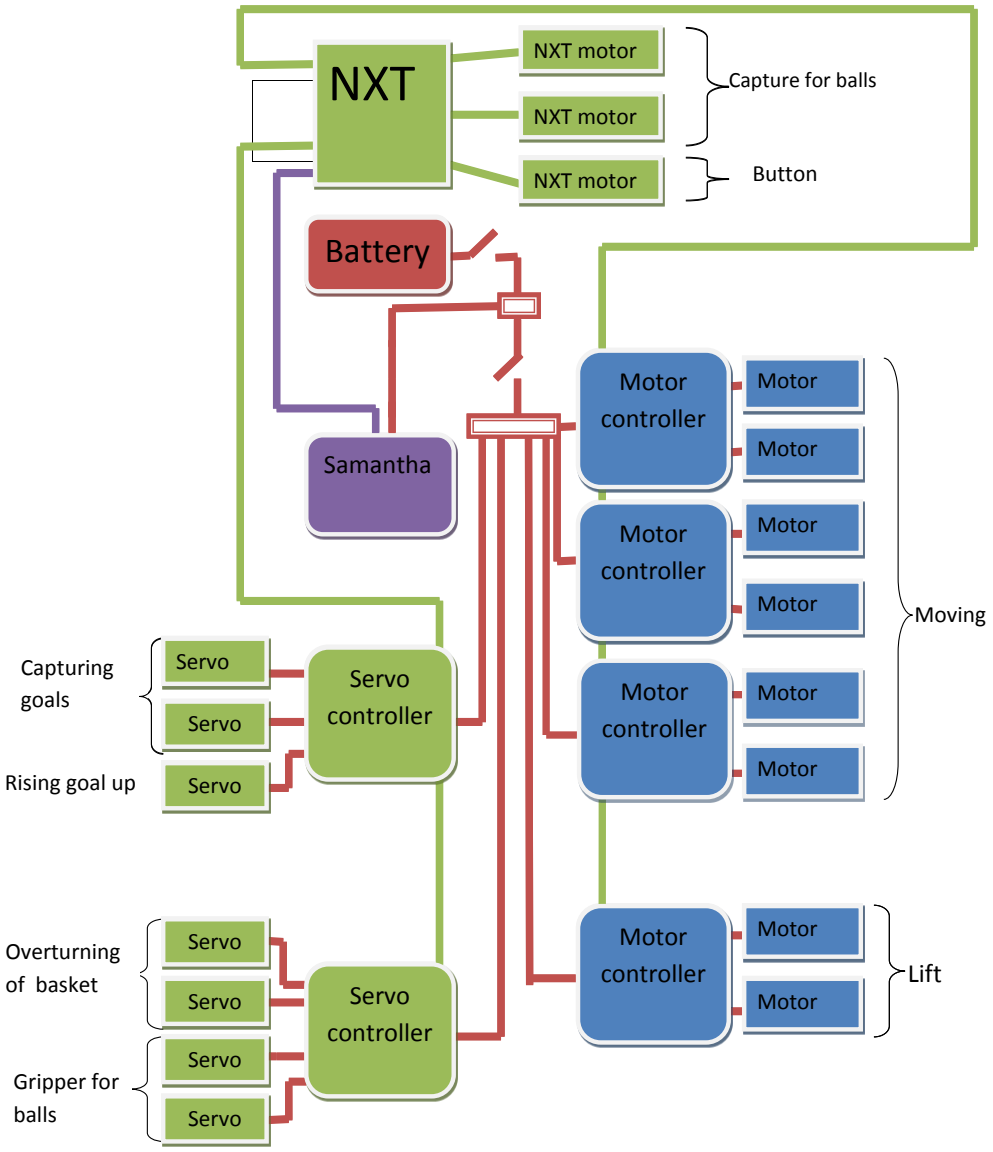


6.2 Strategy

Our strategy is very flexible, so we can adjust to any ally.

6.3 Electical scheme

The final version of the scheme of electrical components of our robot:



7 Appendix

7.1 Programm

Program of driver control period and two versions of autonomus period with brief explanations.

7.1.1 Driver control period

FTC_2015_tele-op.c*

```
#pragma config(Hubs,  S1, HTMotor,  HTMotor,  HTMotor,  HTMotor)
#pragma config(Hubs,  S2, HTServo,  none,     none,     none)
#pragma config(Motor,  mtr_S1_C1_1,     FR,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C1_2,     BR,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C2_1,     FL,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C2_2,     BL,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C3_1,     UL,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C3_2,     ULT,           tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C4_1,     UR,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C4_2,     URT,           tmotorTetrix, openLoop, encoder)
#pragma config(Servo,  srvo_S2_C1_1,    servoBall,           tServoContinuousRotation)
#pragma config(Servo,  srvo_S2_C1_2,    servoTube,           tServoStandard)
#pragma config(Servo,  srvo_S2_C1_3,    servoMvClaws,        tServoStandard)
#pragma config(Servo,  srvo_S2_C1_4,    servoMvClaws2,       tServoStandard)
#pragma config(Servo,  srvo_S2_C1_5,    servoMvClaws3,       tServoStandard)
#pragma config(Servo,  srvo_S2_C1_6,    servo6,              tServoNone)
//*!!Code automatically generated by 'ROBOTC' configuration wizard               !!*//
#include "JoystickDriver.c"
int a = -50;

void R(int nr) // control of right wheel pair
{
  motor[FR] = nr;
  motor[BR] = nr;
}

void L(int nl)// control of left wheel pair
{
  motor[FL] = nl;
  motor[BL] = nl;
}

void Servosetup() // initialization of servos and motors
{
  motor[FR] = 0;
  motor[BR] = 0;
  motor[FL] = 0;
  motor[BL] = 0;
  motor[UR] = 0;
  motor[UL] = 0;
  motor[URT] = 0;
  motor[ULT] = 0;
  servo[servoBall] = 127;
  servo[servoTube] = 70;
  servo[servoMvClaws] = 70;
  servo[servoMvClaws2] = 140;
  servo[servoMvClaws3] = 263 - ServoValue[servoMvClaws];
  nMotorEncoder[FR] = 0;
  nMotorEncoder[FL] = 0;
  nMotorEncoder[BR] = 0;
  nMotorEncoder[BL] = 0;
  nMotorEncoder[UR] = 0;
  motor[motorB]= 0;
  motor[motorC] = 0;
  nMotorEncoder[UL] = 0;
```

```
56    nMotorEncoder[URT] = 0;
57    nMotorEncoder[ULT] = 0;
58  }
59
60  task Ball() // control of gripper for balls
61  {
62    float b = 50;
63
64    while (true)
65    {
66     if(joy2Btn(2) > 0)
67     {
68       a = -a;
69       motor[motorB] = 50 + a;
70       motor[motorC] = 50 + a;
71       while (joy2Btn(2) > 0)
72         wait1Msec(1);
73     }
74     if (joy2Btn(4) > 0)
75     {
76       b = -b;
77       motor[motorB] = -50 + b;
78       motor[motorC] = -50 + b;
79       while (joy2Btn(4) > 0)
80         wait1Msec(1);
81     }
82   }
83  }
84
85  task MvClaw() // control of mechanism that capture rolling goals
86  {
87    int clse = 17,opn = 50;
88    while (true)
89    {
90      servo[servoMvClaws3] = 261 - ServoValue[servoMvClaws];
91      if(joy1Btn(5) == 1)
92      {
93        servo[servoMvClaws] = clse;
94      }
95      if(joy1Btn(7) == 1)
96      {
97        servo[servoMvClaws] = opn;
98      }
99    }
100 }
101
102 task MvClaw2() // control of additional gripper for rolling goals
103 {
104   int clse = 0,opn = 140;
105   while (true)
106   {
107     if(joy1Btn(4) == 1)
108     servo[servoMvClaws2] = clse;
109     if(joy1Btn(6) == 1)
110     servo[servoMvClaws2] = opn;
111   }
112 }
113
114 task tube () // control of mechanism overturning the bucket
115 {
116   const unsigned char  r2 = 245, start_val = 80;
117   int state = 23;
118
119   while(true)
120   {
```

```
  {
    if(joystick.joy1_y1 < -90)
    {
      servo[servoTube] = start_val;
    }
    if(joystick.joy1_y1 > 90)
    {
      servo[servoTube] = r2;
    }
    if (joy1Btn(2) > 0)
    {
      state = -state;
      servo[servoTube] = 222 + state;
      while (joy1Btn(2) > 0)
        wait1Msec(1);
    }
  }
}

task elevator() // control of lift
{
  while(true)
  {

      if(abs(joystick.joy1_y2) > 90 )
      {
        a = -50;
        motor[motorB] = 50 + a;
        motor[motorC] = 50 + a;
        motor[UR] = 100 * joystick.joy1_y2 / abs(joystick.joy1_y2);
        motor[UL] = -100 * joystick.joy1_y2 / abs(joystick.joy1_y2);
        motor[URT] = 100 * joystick.joy1_y2 / abs(joystick.joy1_y2);
        motor[ULT] = -100 * joystick.joy1_y2 / abs(joystick.joy1_y2);
      }
      else
      {
        motor[UR] = 0;
        motor[UL] = 0;
        motor[URT] = 0;
        motor[ULT] = 0;
      }
    //}
  }
}


task  motion() // control of robot's moving
{
  float k = 0;
while(true)
{
     motor[FR] = 0;
     motor[BR] = 0;
     motor[FL] = 0;
     motor[BL] = 0;

  if((joy2Btn(6) == 1) || (joy2Btn(7) == 1))
  {
    k = 1;
  }
  else
  {
    k = 0;
  }

  while(joystick.joy2_TopHat == 0)
```

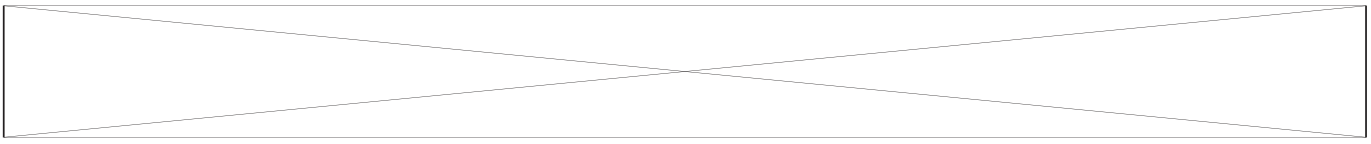
```
    {
      R(-100 + 80 * k);
      L(-100 + 80 * k);
    }
    while(joystick.joy2_TopHat == 1)
    {
      R(0);
      L(-100);
    }
    while(joystick.joy2_TopHat == 2)
    {
      R(100 - 30 * k);
      L(-100 + 30 * k);
    }
    while(joystick.joy2_TopHat == 3)
    {
      R(100);
      L(0);
    }
    while(joystick.joy2_TopHat == 4)
    {
      R(100 - 80 * k);
      L(100 - 80 * k);
    }
    while(joystick.joy2_TopHat == 5)
    {
      R(0);
      L(100);
    }
    while(joystick.joy2_TopHat == 6)
    {
      R(-100 + 30 * k);
      L(100 - 30 * k);
    }
    while(joystick.joy2_TopHat == 7)
    {
      R(-100);
      L(0);
    }
    while(joystick.joy2_TopHat == -1)
    {
      R(0);
      L(0);
    }

  }
  }

  task main()
  {
    Servosetup();
    waitForStart();
    StartTask(MvClaw);
    StartTask(MvClaw2);
    StartTask(Ball);
    StartTask(tube);
    StartTask(motion);

    StartTask(elevator);
    while(true)
    {
      getJoystickSettings(joystick);
    }
  }
```

7.1.2 Autonomus period from the parking zone

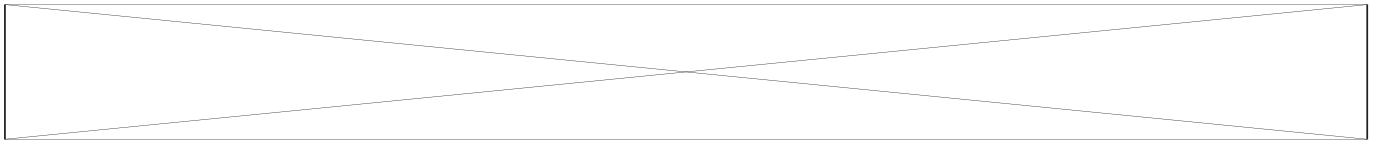
FTC_2015_down2.c

```
#pragma config(Hubs,  S1, HTMotor,  HTMotor,  HTMotor,  HTMotor)
#pragma config(Hubs,  S2, HTServo,  none,     none,     none)
#pragma config(Sensor, S3,     color,          sensorCOLORRED)
#pragma config(Motor,  mtr_S1_C1_1,     BR,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C1_2,     FR,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C2_1,     FL,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C2_2,     BL,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C3_1,     UL,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C3_2,     ULT,           tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C4_1,     UR,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C4_2,     URT,           tmotorTetrix, openLoop, encoder)
#pragma config(Servo,  srvo_S2_C1_1,    servoBall,            tServoContinuousRotation)
#pragma config(Servo,  srvo_S2_C1_2,    servoTube,            tServoStandard)
#pragma config(Servo,  srvo_S2_C1_3,    servoMvClaws,         tServoStandard)
#pragma config(Servo,  srvo_S2_C1_4,    servoMvClaws2,        tServoStandard)
#pragma config(Servo,  srvo_S2_C1_5,    servoMvClaws3,        tServoStandard)
#pragma config(Servo,  srvo_S2_C1_6,    servo6,               tServoNone)
//*!!Code automatically generated by 'ROBOTC' configuration wizard               !!*//

#include "JoystickDriver.c"

int a = 64;

void L_R (int ii, int jj, int tt) // + forward; - backward
{
  motor[FR] = -jj;
  motor[FL] = -ii;
  motor[BR] = -jj;
  motor[BL] = -ii;
  wait1Msec(tt);
}

void L_R2 (int ii, int jj, int tt) // + forward; - backward
{
  motor[FR] = -jj;
  motor[FL] = -ii;
  motor[BR] = -jj;
  motor[BL] = -ii;
  wait1Msec(tt);
  servo[servoMvClaws] = 17;
  servo[servoMvClaws3] = 263 - ServoValue[servoMvClaws];
  motor[FR] = -jj;
  motor[FL] = -ii;
  motor[BR] = -jj;
  motor[BL] = -ii;
  wait1Msec(tt);
}

void UP (int iii, int ttt) // control of lift by "wait"
{
  motor[UR] = iii;
  motor[UL] = -iii;
  motor[URT] = iii;
  motor[ULT] = -iii;
  wait1Msec(ttt);
```

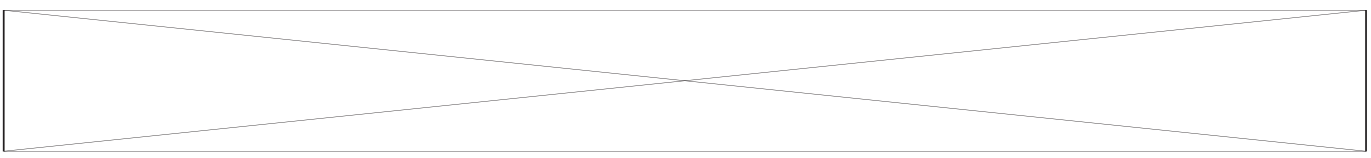
```
56
57  }
58
59  void lift (int pow, int high) // control of lift by encoder
60  {
61    nMotorEncoder[UL] = 0;
62    int sign = -abs(pow) / pow;
63    while (sign * nMotorEncoder[UL] < high)
64    {
65      UP(pow, 1);
66    }
67    motor[UR] = 0;
68    motor[UL] = 0;
69    motor[URT] = 0;
70    motor[ULT] = 0;
71  }
72
73  void L_R_UP (int i, int j, int k, int t)
74  {
75    motor[FR] = -j;
76    motor[FL] = -i;
77    motor[BR] = -j;
78    motor[BL] = -i;
79    motor[UR] = k;
80    motor[UL] = -k;
81    motor[URT] = k;
82    motor[ULT] = -k;
83    wait1Msec(t);
84  }
85
86  void Servosetup() // initialization
87   {
88    motor[FR] = 0;
89    motor[BR] = 0;
90    motor[FL] = 0;
91    motor[BL] = 0;
92    motor[UR] = 0;
93    motor[UL] = 0;
94    motor[URT] = 0;
95    motor[ULT] = 0;
96    servo[servoBall] = 127;
97    servo[servoTube] = 70;
98    servo[servoMvClaws] = 70;
99    servo[servoMvClaws2] = 140;
100   servo[servoMvClaws3] = 263 - ServoValue[servoMvClaws];
101   nMotorEncoder[FR] = 0;
102   nMotorEncoder[FL] = 0;
103   nMotorEncoder[BR] = 0;
104   nMotorEncoder[BL] = 0;
105   nMotorEncoder[UR] = 0;
106   motor[motorB]= 0;
107   motor[motorC] = 0;
108   nMotorEncoder[UL] = 0;
109   nMotorEncoder[URT] = 0;
110   nMotorEncoder[ULT] = 0;
111 }
112
113 void zero()
114 {
115   L_R_UP(0, 0, 0, 1);
```



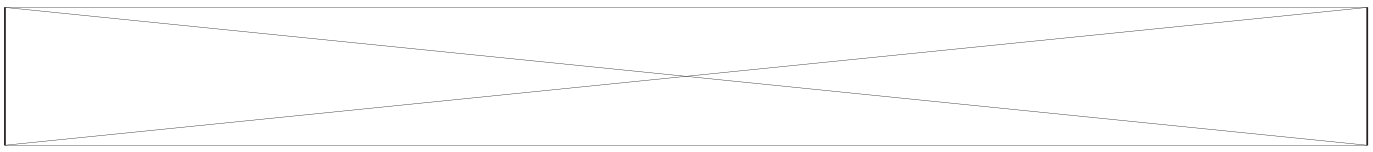
```
116  }
117
118  void motion_elevator(int l, int h)
119  {
120    nMotorEncoder[BL] = 0;
121    nMotorEncoder[UL] = 0;
122    while (-nMotorEncoder[BL] < l && -nMotorEncoder[UL] < h)
123    {
124        L_R_UP(20, 20, 100, 1);
125    }
126    zero();
127    while (-nMotorEncoder[BL] < l)
128    {
129        L_R(20, 20, 1);
130    }
131    zero();
132  }
133
134  void motion(int l_ramp_goal, int a) // moving to rolling goal and capture it
135  {
136    int enc;
137    int pow = 100;
138    nMotorEncoder[FR] = 0;
139    nMotorEncoder[BL] = 0;
140    //L_R(a * -100, a * -100, 1500);
141    enc = nMotorEncoder[BL];
142    nxtDisplayBigTextLine(1, "%i", enc);
143    /*if(a * nMotorEncoder[BL] < 10)
144    {
145      while(true)
146      {
147        for (; pow >= 0; pow--)
148        {
149          L_R(-pow, -pow, 5);
150          enc = nMotorEncoder[BL];
151          nxtDisplayBigTextLine(2, "%i", enc);
152        }
153      }
154    }
155   /* if (SensorValue[S3] == color)
156    {
157        nMotorEncoder[BR] = 0;
158        nMotorEncoder[BL] = 0;*/
159    while(a * nMotorEncoder[BL] < l_ramp_goal - 4096)// * 1024 /(3.1415 * 10 ))// - 50)
160    {
161      L_R(a * -100, a * -100, 1);
162      enc = nMotorEncoder[BL];
163      nxtDisplayBigTextLine(2, "%i", enc);
164    }
165    /*for (int pow = a * 100; pow >= a * 20; pow--)
166    {
167      L_R(-pow, -pow, 5);
168    }*/
169    while(a * nMotorEncoder[BL] < l_ramp_goal)
170    {
171      L_R(a * -20, a * -20, 1);
172    }
173    servo[servoMvClaws] = 17;
174    servo[servoMvClaws3] = 263 - ServoValue[servoMvClaws];
175    while(a * nMotorEncoder[BL] < l_ramp_goal + 500)
```



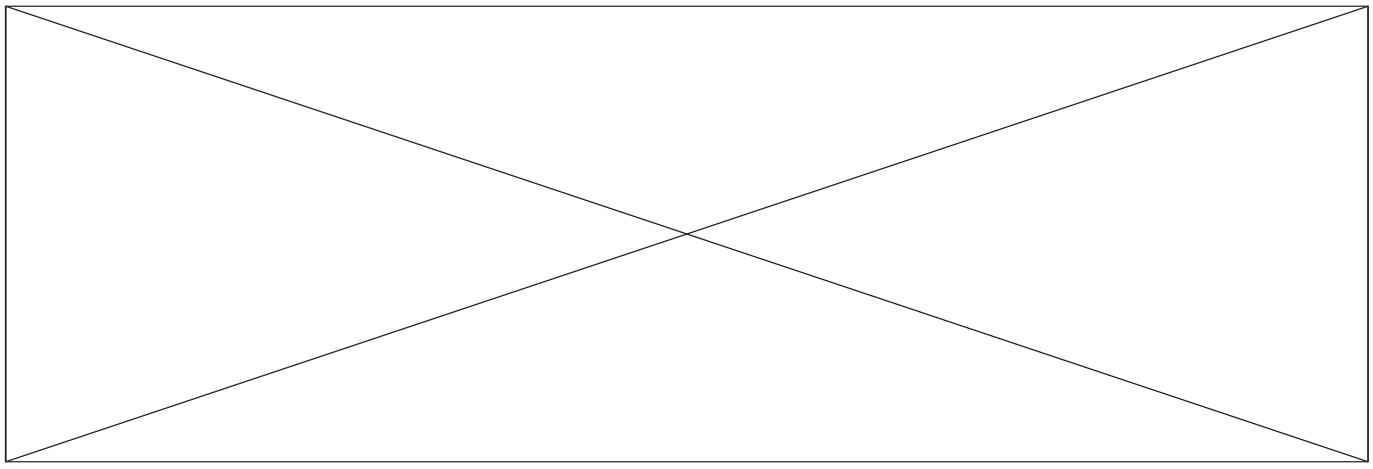
```
176     {
177       L_R(a * -20, a * -20, 1);
178     }
179
180     zero();
181   }
182
183   void elevator(int h) // raise the bucket and overturn it
184   {
185     int enc;
186     nMotorEncoder[UL] = 0;
187     UP(100, 500);
188     if(-nMotorEncoder[UL] < 10)
189     {
190       while(true)
191       {
192         UP(0, 1);
193       }
194     }
195
196     while(-nMotorEncoder[UL] < h)
197     {
198       UP(100, 1);
199     }
200
201     UP(0, 1);
202
203     servo[servoTube] = 245;
204     wait1Msec(2500);
205
206     servo[servoTube] = 70;
207
208     while(nMotorEncoder[UL] < -10)
209     {
210       UP(-100, 1);
211     }
212
213     UP(0, 1);
214   }
215
216   void R(float l_ramp_goal, int pow) // turn by right wheel pair
217   {
218     nMotorEncoder[FR] = 0;
219     int sign = abs(pow) / pow;
220     while(sign * nMotorEncoder[FR] /*/ 1000) * 3.14159265 * 10*/ < l_ramp_goal)
221     {
222       L_R(0, pow, 1);
223     }
224
225     motor[FR] = pow;
226     motor[BR] = pow;
227
228     zero();
229   }
230
231   void L(float l_ramp_goal, int pow) // turn by left wheel pair
232   {
233     nMotorEncoder[BL] = 0;
234     int sign = abs(pow) / -pow;
235     while(sign * nMotorEncoder[BL] /*/ 1000) * 3.14159265 * 10*/ < l_ramp_goal)
```



```
236     {
237       L_R(pow, 0, 1);
238       nxtDisplayBigTextLine(2, "%i", nMotorEncoder[FR]);
239     }
240
241     motor[FL] = pow;
242     motor[BL] = pow;
243
244     zero();
245   }
246
247   void rotate(float l_ramp_goal)
248   {
249     wait1Msec(500);
250     nMotorEncoder[BL] = 0;
251     nMotorEncoder[FR] = 0;
252     while(nMotorEncoder[FR] /*/ 1000) * 3.14159265 * 10*/ < l_ramp_goal)
253     {
254       L_R(-100, 50, 1);
255     }
256
257     L_R(100, 100, 1);
258
259     zero();
260   }
261
262   void rotate2(float l_ramp_goal)
263   {
264     wait1Msec(500);
265     nMotorEncoder[BL] = 0;
266     nMotorEncoder[FR] = 0;
267     while(-nMotorEncoder[FR] /*/ 1000) * 3.14159265 * 10*/ < l_ramp_goal)
268     {
269       L_R(50, -100, 1);
270     }
271
272     L_R(100, 100, 1);
273
274     zero();
275   }
276
277   void LR(int pow, float l_ramp_goal) // moving
278   {
279     nMotorEncoder[BL] = 0;
280     int sign = abs(pow) / -pow;
281     while(sign * nMotorEncoder[BL] /*/ 1000) * 3.14159265 * 10*/ < l_ramp_goal)
282     {
283       motor[FR] = -pow;
284       motor[BR] = -pow;
285       motor[FL] = -pow;
286       motor[BL] = -pow;
287     }
288
289     motor[FR] = 0;
290     motor[BR] = 0;
291     motor[FL] = 0;
292     motor[BL] = 0;
293   }
294
295
```



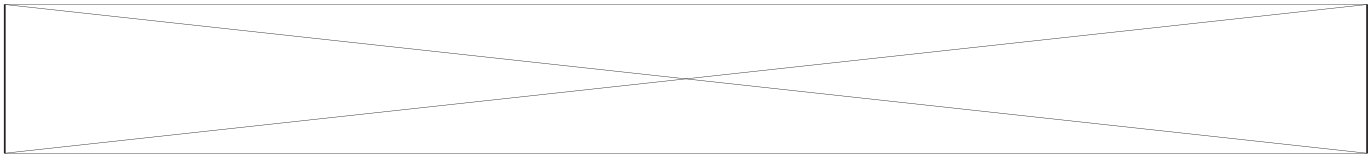
```
task main()
{
   Servosetup();
   //waitForStart();
   servo[servoMvClaws] = 55;
   servo[servoMvClaws3] = 261 - ServoValue[servoMvClaws];
   LR(-100, 2500); // go to space near the ramp
   //rotate(1200); // rotate to 30cm goal
   LR(-100, 9600);//go to 30cm goal
   //lift(100, 2000); //{ put
   //L_R2(-100,-100, 500); // the ball
   //lift(-50, 2000); //  to 30cm goal}
   servo[servoMvClaws] = 17;
   servo[servoMvClaws3] = 261 - ServoValue[servoMvClaws];
   LR(50, 1024); // go back with the 30cm goal
   servo[servoMvClaws] = 55;// release the 30cm goal
   servo[servoMvClaws3] = 261 - ServoValue[servoMvClaws];
   wait1Msec(500);
   LR(50, 1320); // go back from the 30cm goal
   R(2195, -50); // rotate to 90cm goal
   LR(-50, 900); // ride to 90cm goal and stop near the 30cm goal
   servo[servoMvClaws2] = 0; //capture to 30cm goal
   motion(1400, 1); // ride and capture to 90cm goal
   //elevator(8800); // put the ball to 90cm goal
   R(3500, 50); // rotate to parking zone
  // wait1Msec(5000);
   motion(11700,-1); // go to the parking zone
   R(8000, 50); // rotate in the parking zone

   //elevator();
   //rotate(1000);
   //L(2000, -100);
   //wait1Msec(1000);
   //motion(800, 1);
   //L(1000, 100);
   //motion(8000,-1);*/
  while(true)
  {
    motor[FR] = 0;
    motor[BR] = 0;
    motor[FL] = 0;
    motor[BL] = 0;
    motor[UR] = 0;
    motor[UL] = 0;
    motor[URT] = 0;
    motor[ULT] = 0;
  }
}
```



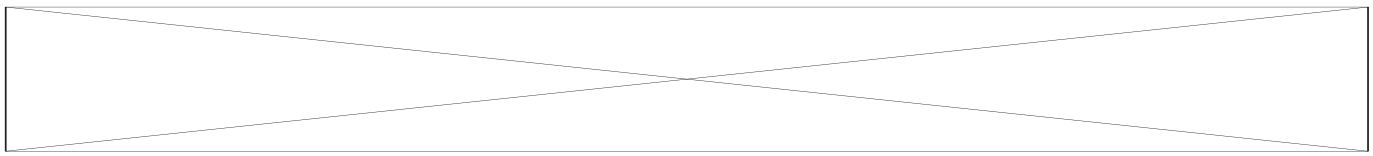
7.1.3 Autonomus period from the ramp

FTC_2014-2015_up-1.c*

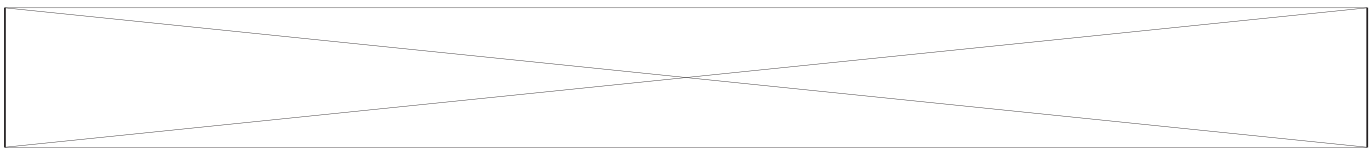
```
#pragma config(Hubs,  S1, HTMotor,  HTMotor,  HTMotor,  HTMotor)
#pragma config(Hubs,  S2, HTServo,  none,     none,     none)
#pragma config(Sensor, S3,     color,          sensorCOLORRED)
#pragma config(Motor,  mtr_S1_C1_1,     BR,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C1_2,     FR,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C2_1,     FL,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C2_2,     BL,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C3_1,     UL,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C3_2,     ULT,           tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C4_1,     UR,            tmotorTetrix, openLoop, encoder)
#pragma config(Motor,  mtr_S1_C4_2,     URT,           tmotorTetrix, openLoop, encoder)
#pragma config(Servo,  srvo_S2_C1_1,    servoBall,            tServoContinuousRotation)
#pragma config(Servo,  srvo_S2_C1_2,    servoTube,            tServoStandard)
#pragma config(Servo,  srvo_S2_C1_3,    servoMvClaws,         tServoStandard)
#pragma config(Servo,  srvo_S2_C1_4,    servoMvClaws2,        tServoStandard)
#pragma config(Servo,  srvo_S2_C1_5,    servoMvClaws3,        tServoStandard)
#pragma config(Servo,  srvo_S2_C1_6,    servo6,               tServoNone)
//*!!Code automatically generated by 'ROBOTC' configuration wizard               !!*//

#include "JoystickDriver.c"

int a = 64;

void L_R (int ii, int jj, int tt) // + forward; - backward
{
  motor[FR] = -jj;
  motor[FL] = -ii;
  motor[BR] = -jj;
  motor[BL] = -ii;
  wait1Msec(tt);
}

void UP (int iii, int ttt) // control of lift by "wait"
{
  motor[UR] = iii;
  motor[UL] = -iii;
  motor[URT] = iii;
  motor[ULT] = -iii;
  wait1Msec(ttt);
}

void L_R_UP (int i, int j, int k, int t)
{
  motor[FR] = -j;
  motor[FL] = -i;
  motor[BR] = -j;
  motor[BL] = -i;
  motor[UR] = k;
  motor[UL] = -k;
  motor[URT] = k;
  motor[ULT] = -k;
  wait1Msec(t);
}

void Servosetup() // initialization
```



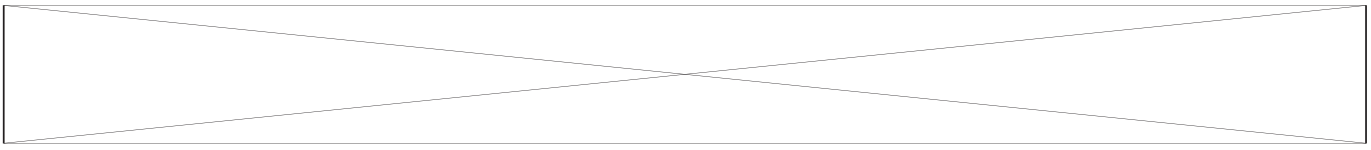
```
56  {
57    motor[FR] = 0;
58    motor[BR] = 0;
59    motor[FL] = 0;
60    motor[BL] = 0;
61    motor[UR] = 0;
62    motor[UL] = 0;
63    motor[URT] = 0;
64    motor[ULT] = 0;
65    servo[servoBall] = 127;
66    servo[servoTube] = 70;
67    servo[servoMvClaws] = 70;
68    servo[servoMvClaws2] = 140;
69    servo[servoMvClaws3] = 261 - ServoValue[servoMvClaws];
70    nMotorEncoder[FR] = 0;
71    nMotorEncoder[FL] = 0;
72    nMotorEncoder[BR] = 0;
73    nMotorEncoder[BL] = 0;
74    nMotorEncoder[UR] = 0;
75    motor[motorB]= 0;
76    motor[motorC] = 0;
77    nMotorEncoder[UL] = 0;
78    nMotorEncoder[URT] = 0;
79    nMotorEncoder[ULT] = 0;
80  }
81
82
83  void zero()
84  {
85    L_R_UP(0, 0, 0, 1);
86  }
87
88  void motion_elevator(int l, int h)
89  {
90    nMotorEncoder[BL] = 0;
91    nMotorEncoder[UL] = 0;
92    while (-nMotorEncoder[BL] < l && -nMotorEncoder[UL] < h)
93    {
94        L_R_UP(20, 20, 100, 1);
95    }
96    zero();
97    while (-nMotorEncoder[BL] < l)
98    {
99        L_R(20, 20, 1);
100   }
101   zero();
102 }
103
104 void motion(int l_ramp_goal, int a) // moving to rolling goal and capture it
105 {
106   int enc;
107   int pow = 100;
108   nMotorEncoder[FR] = 0;
109   nMotorEncoder[BL] = 0;
110
111   while(a * nMotorEncoder[BL] < l_ramp_goal)
112   {
113     L_R(a * -20, a * -20, 1);
114   }
115   servo[servoMvClaws] = 17;
```



```
116     servo[servoMvClaws3] = 261 - ServoValue[servoMvClaws];
117     while(a * nMotorEncoder[BL] < l_ramp_goal + 200)
118     {
119       L_R(a * -20, a * -20, 1);
120     }
121
122     zero();
123   }
124
125   void elevator(int h) // raise the bucket and overturn it
126   {
127     int enc;
128     nMotorEncoder[UL] = 0;
129     UP(100, 1000);
130     if(-nMotorEncoder[UL] < 10)
131     {
132       while(true)
133       {
134         UP(0, 1);
135       }
136     }
137
138     while(-nMotorEncoder[UL] < h)
139     {
140       UP(100, 1);
141     }
142
143     UP(0, 1);
144
145     servo[servoTube] = 245;
146     wait1Msec(3500);
147
148     servo[servoTube] = 70;
149
150     while(nMotorEncoder[UL] < -10)
151     {
152       UP(-100, 1);
153     }
154
155     UP(0, 1);
156   }
157
158   void R(float l_ramp_goal, int pow) // turn by right wheel pair
159   {
160     nMotorEncoder[FR] = 0;
161     int sign = abs(pow) / pow;
162     while(sign * nMotorEncoder[FR] /*/ 1000) * 3.14159265 * 10*/ < l_ramp_goal)
163     {
164       L_R(0, pow, 1);
165     }
166
167     motor[FR] = pow;
168     motor[BR] = pow;
169
170     zero();
171   }
172
173   void L(float l_ramp_goal, int pow) // turn by left wheel pair
174   {
175     nMotorEncoder[BL] = 0;
```



```
176     int sign = abs(pow) / -pow;
177     while(sign * nMotorEncoder[BL] /*/ 1000) * 3.14159265 * 10*/ < l_ramp_goal)
178     {
179       L_R(pow, 0, 1);
180       nxtDisplayBigTextLine(2, "%i", nMotorEncoder[FR]);
181     }
182
183     motor[FL] = pow;
184     motor[BL] = pow;
185
186     zero();
187   }
188
189   void rotate(float l_ramp_goal) // moving on circle
190   {
191     wait1Msec(500);
192     nMotorEncoder[BL] = 0;
193     nMotorEncoder[FR] = 0;
194     while(nMotorEncoder[FR] /*/ 1000) * 3.14159265 * 10*/ < l_ramp_goal)
195     {
196       L_R(-60, 100, 1);
197     }
198
199     L_R(100, 100, 1);
200
201     zero();
202   }
203
204   void rotate2(float l_ramp_goal) // "tank turning"
205   {
206     wait1Msec(500);
207     nMotorEncoder[BL] = 0;
208     nMotorEncoder[FR] = 0;
209     while(-nMotorEncoder[FR] /*/ 1000) * 3.14159265 * 10*/ < l_ramp_goal)
210     {
211       L_R(50, -100, 1);
212     }
213     L_R(100, 100, 1);
214
215     zero();
216   }
217
218   void LR(int pow, float l_ramp_goal) // moving
219   {
220     nMotorEncoder[BL] = 0;
221     int sign = abs(pow) / -pow;
222     while(sign * nMotorEncoder[BL] /*/ 1000) * 3.14159265 * 10*/ < l_ramp_goal)
223     {
224       motor[FR] = -pow;
225       motor[BR] = -pow;
226       motor[FL] = -pow;
227       motor[BL] = -pow;
228     }
229
230     motor[FR] = 0;
231     motor[BR] = 0;
232     motor[FL] = 0;
233     motor[BL] = 0;
234   }
235
```



```
task main()
{
   Servosetup();
   waitForStart()
   servo[servoMvClaws] = 55;
   servo[servoMvClaws3] = 261 - ServoValue[servoMvClaws];
   motion(9500, 1); // ride to the 60cm goal
   elevator(7300); // put the ball to 60cm goal
   rotate(3000);// { rotate with
   L(1500, -100);// 60cm goal }
   LR(-20, 1500); // go back with 60cm goal
   servo[servoMvClaws] = 55; // { release
   servo[servoMvClaws3] = 261 - ServoValue[servoMvClaws]; // 60cm goal}
   LR(20, 1500); // return
   rotate2(3000); // rotate to 90cm goal and stop near the 60cm goal
   servo[servoMvClaws2] = 0; // capture to 30cm goal
   rotate2(1000); // rotate to 90cm goal
   motion(1500, 1); // ride to the 90cm goal and capture it
   elevator(10000); // put the ball to 90cm goal
   R(1500, 100); // rotate to the parking zone
   LR(50, 10000); // move rolling goals to the parking zone
   L(2000, 100); // rotate in the parking zone
   LR(50, 1000); // moving in parking zone
  while(true)
  {
    zero();
  }
}
```