A REPORT BY

AKGEC TEAM ROBOCON

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We are also thankful to the faculty co-ordinator, **Mr. Gaurav Srivastava** for his valuable support and guidance throughout the project.

We would also pay our sincere gratitude to **the Review team** and the **concerned faculties** for their precious and enlightening words of wisdom which motivated us throughout the project work.

Finally, the perseverance and hard work of the whole team made the event happening for us. Their mention is inevitable.

PREFACE

The most important focus of this project report is the National Robocon, 2015. It provides you with an insight into the details of each robot, new technologies used and further improvements.
This was the second time Ajay Kumar Garg Engineering College participated in the National ROBOtics CONtest organised by ABU and MIT College of Engineering, Pune.
We learnt a lot, not only in the field of robotics but also about project management, time management and most importantly, about team work. The team recorded a first Robocon success this year. Apart from Robocon, the Robotics Club, AKGEC made its presence felt all across the campus and in technical festivals of various other Universities.
This was possible only with the sincere efforts of Prof. Ashiv Shah and help from the Robocon team.
We look forward to even more a jubilant and successful Robocon 2016

ROBOCON

The Asia-Pacific Robot Contest (ABU Robocon) is an Asian Oceanian College robot competition, founded in 2002 by Asia-Pacific Broadcasting Union. In the competition robots compete to complete a task within a set period of time. The contest aims to create friendship among young people with similar interests who will lead their countries in the 21st century, as well as help advance engineering and broadcasting technologies in the region. The event is broadcast in many countries through ABU member broadcasters.

Each year the competition has different topics, but generally speaking two or more robots must be used to complete the tasks. One of the robots would be manual control while the others are automatic. The best robots usually weight more than 10kg and span in one square

meter area. To build the robots, contestants, who are restricted to be undergraduate students, must possess rich knowledge in programming, mechanical design and electronic circuit design.

Robocon, short for Robotic Contest, is an interesting game - cum - intellectual exercise for budding engineers and their enthusiastic instructors, determined to innovate and create machines for producing desired results. Participation in this activity is an end - to - end competitive experience from concept design of a system of robots programmed to perform according to rules of the game played on a high precision technical Contest Area and to score a victory beating the competitors; all this according to a Theme declared by the Host Country.

Robotic Contests (Robocons) organized by Asia Pacific Broadcasting Union (ABU) and its member countries including Doordasrshan (Prasarbharati) of India offer young engineers a platform to innovate and excel in creative thinking. Here, they demonstrate their technical ideas in robotics, as well as establish cross cultural contacts in an environment. These events also offer great opportunity to broadcasting agencies for advancing their technological skills and international cooperation. The International and National Robocons have started from 2012.

The first year international host country is Tokyo, Japan with the theme "Reach for The Top of Mt. Fuji" and ABU Winner was Ho Chi Minh City University of Technology, Vietnam, and the Indian contest organized by IIT Kanpur with Institute of Technology, Nirma University as a National winner.

Last year international host country is MIT AOE Pune, India (Scheduled on 24thAugust 2014) with the theme "A Salute to the Parenthood" and ABU Winner was Lac Hong University, VIETNAM, and the Indian contest organized by MIT AOE, Pune with Institute of Technology, Nirma University as a National winner.

ROBOCON 2015

The ABU Robocon 2015 is going to be conducted on August at in YOGYAKARTA, INDONESIA. The contest theme is 'Robominton-Badmiton RoboGame'.The venue would be at the Sportorium of UMY (Universitas Muhammadiyah Yogyakarta).In this contest, the 2 teams(red and blue) will attempt to play badminton against each other. Each team will consist of 2 robots just like a normal doubles badminton game. Australian public broadcaster Television of the Republic of INDONESIA- TVRI will be the host broadcaster for the event.

In India, Robocon is presented in collaboration of MIT, Pune along with Doordarshan

Shiv Chattrapati Kreeda Sankul, Pune.

“ROBOMINTON: BADMINTON ROBO-GAME”

1. THEME AND RULES

The motif of this contest theme is badminton’s doubles game. The highlight of this game is how the two robots hit and hit back shuttle by collaborating each other. The longer the rally continues the more exciting the game becomes. The robot with unique way of hitting shuttle can be entertaining. The audience will be enthralled if the robot made an eye-opening jumping smash. We are looking forward to witnessing exciting matches of unique robots built by the young budding engineers in Jogjakarta, Indonesia.

2. ABOUT SAFETY

2.1. Please abide by the rules of the safety guidelines defined by the participant’s university or country.

2.2. Participants must pay adequate attention to safety when designing and building robots so that they don’t harm anyone (other teams, organizing committee, audience and so on) in the venue.

2.3. Team members must wear helmet and protective goggles and shoes during the game.

2.4. When using a laser beam, it must be less than class 2 laser.

2.5. Not only in the construction period of the robots but also all time in the test-run and practice phase, please take effective safety measures such as wearing gloves and clothes to protect limbs and that don’t get caught by robots easily.

2.6. Please attach emergency button on the robots.

2.7. Never practice/test robots alone so that members can immediately respond to an accident.

2.8. In order to avoid major accident by design mistake or reconstruction of the robot or over-current to a circuit or short circuit of the battery causing fire, please carry out following;

2.8.1. Use wiring with adequate volume and fuse.

2.8.2. Work apart from inflammables.

2.8.3. Don’t do unauthorized remodelling of the battery.

2.8.4. Use adequate batteries designated by the battery manufacturer.

2.9. In addition to above, various dangerous events could be triggered by the unique features of each robot. Please take effective safety measures according to the characteristics of an individual robot.

2.10. Please take safety measures so that a single malfunction or miss operation doesn’t cause a serious accident.

3. TEAM MEMBERS

3.1. Each team comprises of four members consisting of three students, one instructor and pit crews, all from the same university, polytechnic or college.

3.2. Team members and pit crews must be enrolled in their university, polytechnic, college at the time of the international contest. Postgraduate students are not eligible to participate in the contest.

3.3. All the robots that will participate in the contest must be designed and constructed by the team members and pit crews.

3.4. Only three student team members are permitted to participate in the contest.

3.5. The maximum of three pit crews are allowed to adjust robots in the pit area and carry robots to the contest field.

4. FLOW OF THE GAME

4.1. The first server will be decided by a lottery before the game.

4.2. Each team must preload six shuttles that will be provided by the referee. Teams can decide how many shuttles to preload to each robot.

4.3. Setting time

4.3.1. With the referee's sign, teams will be given a minute of setting time before the game.

4.3.2. The power source of the drive system of the robots must be switched off until the setting time begins.

4.3.3. Teams can set their robots anywhere in their side of the field.

4.3.4. During the setting time, maximum of three team members and three pit crews are allowed to prepare for the game.

4.3.5. The team will be given 6 shuttles. The shuttles must be loaded to the robots during the setting time, within 15 seconds from the previous points are confirmed to the next service is delivered. The team can decide how many shuttles to load to robot(s).

4.4. Service

4.4.1. Service will be delivered by both teams taking turns.

4.4.2. Service must be delivered within five seconds from the referee's whistle.

4.4.3. Service can be delivered by any of the two robots.

4.4.4. When delivering a service, a part of the robot must be in contact with the right side of the service area (including the border line) of its own zone. (Refer to Fig.1)

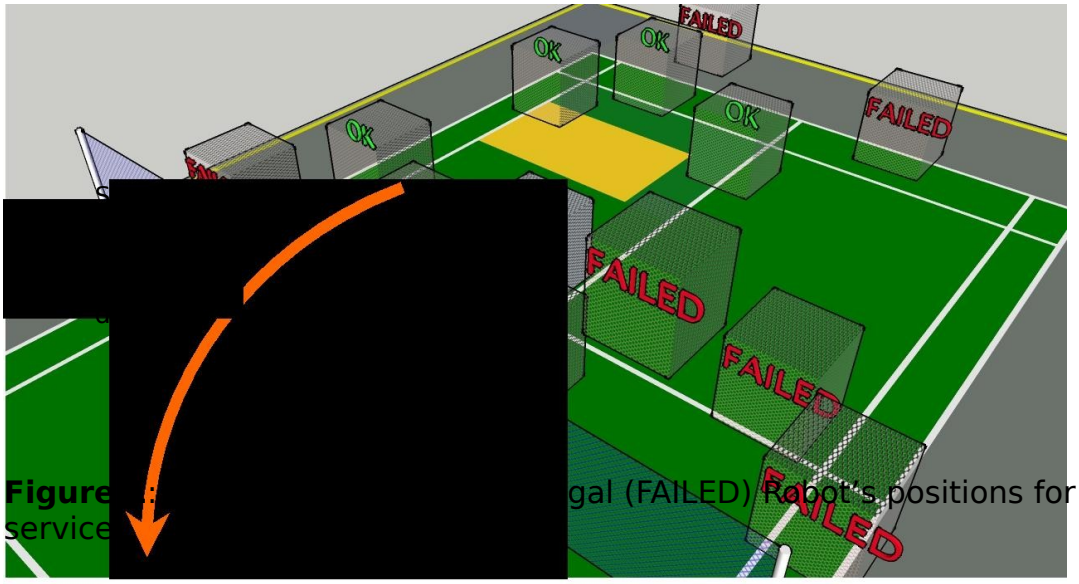


Figure ...gal (FAILED) Robot's positions for service

4.4.5. When delivering a service, the robot must drop the shuttle vertically using free-fall. The position to drop the shuttle must be in the space above of right side of the service area (including the border line) of its own zone. (Ref to Fig.2)

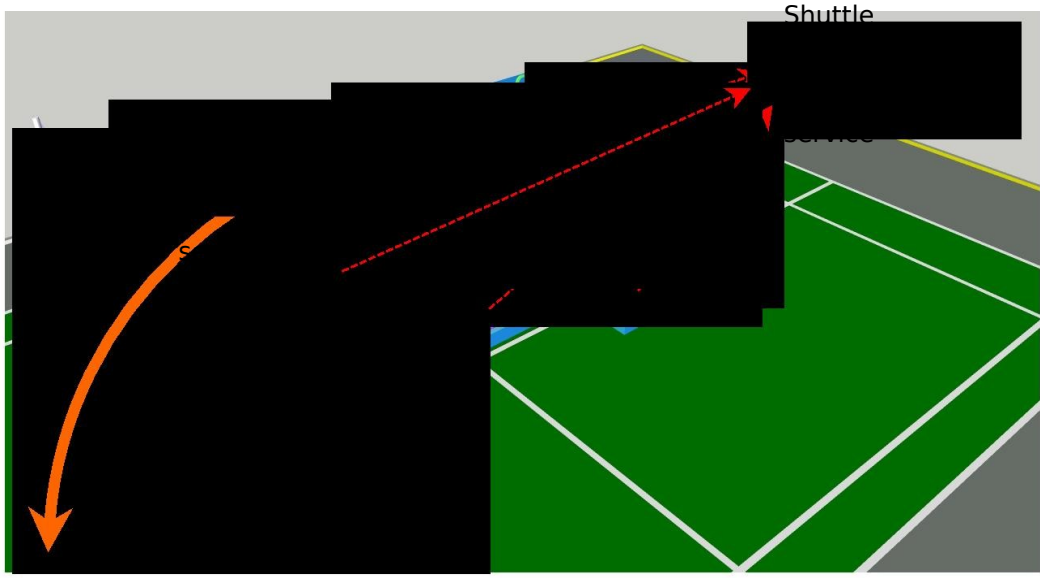


Figure 2: The legal (OK) and the illegal (FAILED) shuttle dropping for service.

4.4.6. The robot that delivers a service must hit the base of the dropped shuttle with a racket. (Refer to Fig.3)

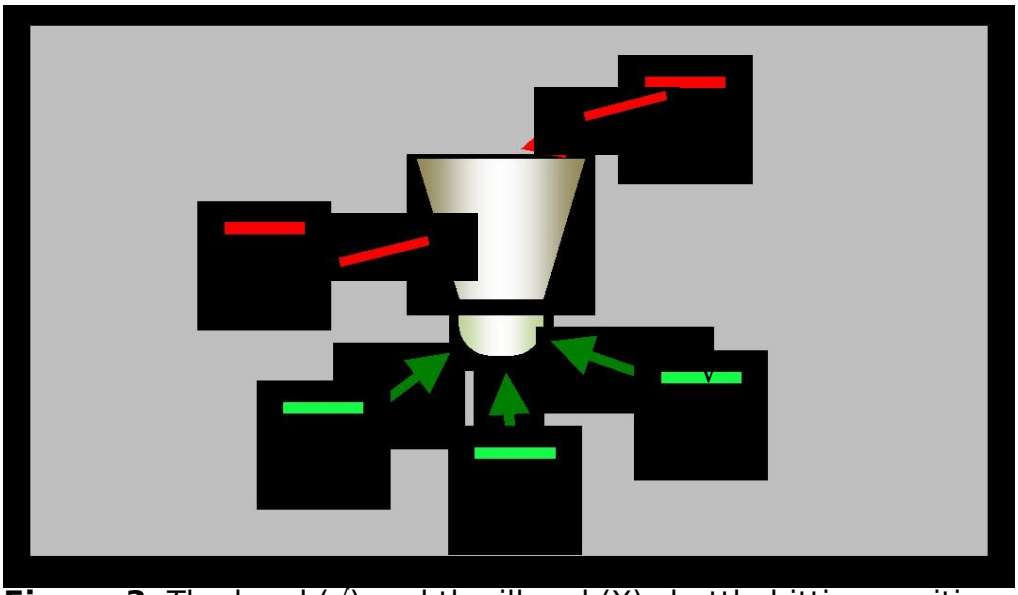


Figure 3: The legal (√) and the illegal (X) shuttle hitting positions for service.

4.4.7. At the moment when the robot delivers a service, the area from shaft to head of the racket must be facing downward lower than horizontal.

4.4.8. The racket and the shuttle can come in contact only once per service.

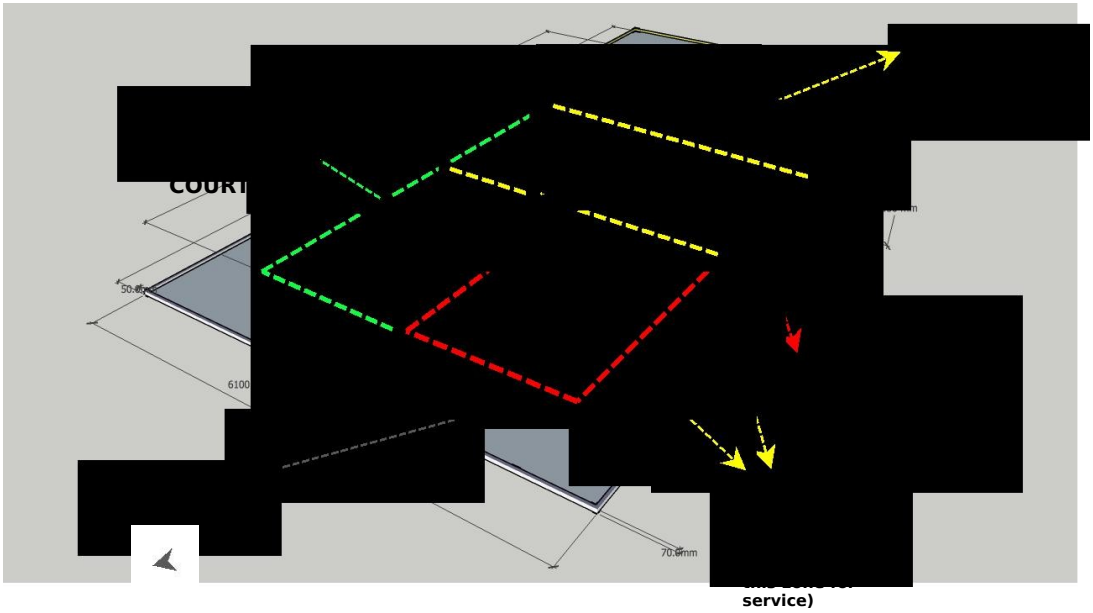


Figure 4: A perspective view of contest field (court).

4.4.9. The shuttle that has been hit must travel over the net (without touching the net) and land on the opponent team's serve drop zone (Refer to Fig.4). However it doesn't apply if the opponent team hits back the shuttle

or the shuttle should come into contact with the opponent’s robot (if operated by cables, including the cable and its operator).

4.4.10. The robot(s) that will receive service must stand behind the short service line until the robot receives the service.

4.4.11. The robot shouldn’t come in contact with the short service line.

4.4.12. The robot shouldn’t enter the space above the net side.

4.5. Scores

4.5.1. When the conditions mentioned under ‘4.4.1-4.4.12 Service’ are achieved and the shuttle lands on the serve drop zone (including border line) of the opponent team or if the shuttle should come into contact with the opponent’s robot (if operated by cable, including cable and its operator), the team will gain score.

4.5.2. If the team failed to achieve the conditions mentioned under ‘4.4.1-4.4.12 Service’, the service ends in failure and opponent team will gain score.

4.5.3. Excluding service, if the shuttle hit by the racket lands in the opponent’s court (including border line, refer to Fig.5) or comes into contact with the opponent’s robot (if operated by cable, including cable and its operator) the team will gain score.

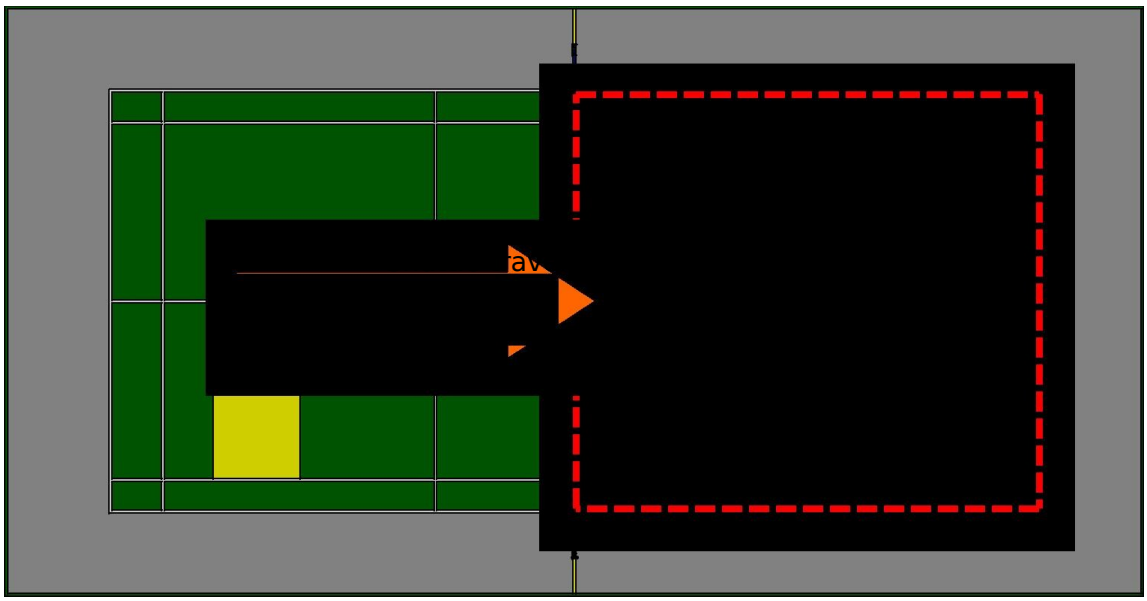


Figure 5: Legal landing area of shuttle hit (indicated by red dash-line)

4.5.4. If the shuttle hit by the racket doesn’t land on the opponent’s court, (including border line, refer to Fig.5) opponent team will gain score.

4.5.5. If the same robot hit the shuttle twice, opponent team will gain score.

4.5.6. If the A robot and B robot of the same team hit the shuttle consecutively, opponent team will gain score.

4.5.7. The opponent team will gain score if the team cannot set the robot

To deliver next service within 15 seconds from the referee blows the whistle after the previous score has been confirmed. In this 15 seconds, team members are allowed to enter the contest field and touch their robots including to maintain the preload shuttle(s) that should be loaded.

4.5.8. If the team should committed act of violations mentioned in the rulebook, opponent team will gain score.

4.6. Win and loss of the game

4.6.1. The team which gains 5 points first will win the game.

4.6.2. If the score reached draw of 4-4, the team which scores 2 points first will win the game.

4.6.3. If the score reached draw of 6-6, the winner will be decided by the following order;

4.6.3.1. The team which hit greater number of shuttle when the team gained score.

4.6.3.2. The team with higher successful rate of services.

4.6.3.3. The team with less number of warnings.

4.6.3.4. To be decided by the judge panel.

4.7. Timeout

4.7.1. Each team can take 1 timeout per game.

4.7.2. The duration of timeout is 30 seconds.

4.7.3. Teams cannot take timeout while the service is being delivered and point is yet to confirm.

4.7.4. Timeout can be taken only if the team said to referee ‘Timeout’ and the referee grants it.

4.7.5. During timeout, both teams are allowed to enter the field and touch their robots including maintaining the preload shuttle(s) that should be loaded.

4.7.6. After timeout is finished and referee blows whistle, the team must deliver a service within 5 seconds.

5. CONTEST FIELD

5.1. The contest×16,400mmfieldis rectangle and of 8,500mm it is surrounded by a wooden fence. Inside the field, badminton’s doubles court will be laid.

5.2. The height of the net from the surface of the court is 1,524mm in the middle, 1,550mm on the side-line of the doubles court.

5.3. The same net and support pole used in badminton game will be used.

5.4. As for details of the field and materials, please refer to attached

sheet.

6. ROBOT

6.1. Each team must make two robots.

6.2. Robots can be manual or automatic.

6.3. Robots cannot be separated.

6.4. Operation of the robots

6.4.1. Team must operate their robots from outside of the contest field.

6.4.2. The maximum number of robot operator is two.

6.4.3. The robots can be operated by wire or wireless. But only one robot can be operated via cable.

6.5. Wireless communication

6.5.1. The method of wireless communication is limited to following;

6.5.1.1. Bluetooth (IEEE802.15.1x After Ver2.0x No indication of class),

6.5.1.2. IR ray,

6.5.1.3. sound, sonic wave,

6.5.1.4. Visible radiation.

6.5.2. Basic rules for wireless communication

6.5.2.1. Please follow the guidelines of the Contest Committee

6.5.2.2. The use of wireless/radio wave device which will effect on other teams and run of the contest was prohibited.

6.5.2.3. The use of wireless communication systems other than under ‘6.5.1’ is prohibited.

6.5.2.4. Please use wireless devices that comply with the law of the participating country and host country.

6.5.3. The two robots of the team are allowed to communicate. However the method of communication must be mentioned under 6.5.1.

6.5.4. Wireless control could cause troubles in actual use. Please take necessary measures against interference to promote smooth run of the contest.

6.6. The maximum dimension of a robot when fully extended excluding the racket must fit in a cylindrical tube with diameter of 1,200mm and height of 1,500mm.

6.7. The weight of each robot must be under 25kgs. However, if the robot is controlled by cable, the weight of the cable and

controller will be included in the total weight.

6.8. There is no limit in the number of rackets that each robot can hold.

6.9. Robot must not jump using propellers.

6.10. The two robots must fit in the robot box with dimension of 1,600mmW X 1,000mmD X 1,400mmH for shipping.

6.11. The voltage source used in the robot must not exceed 24 volts.

6.12. It is allowed to operate robot using compressed air filled in PET bottle and so on. However it must be under 6 bar of compressed air.

6.13. It is strictly prohibited to use dangerous energy source such as high pressure gas and explosives.

6.14. When using a laser beam, it must be less than Class 2 laser and used in a way that will not harm anyone in the venue, equipments and contest field.

6.15. Robots must be designed in the way that the rubber (or similar) bumper surroundings come in contact first with the object in case of a crash.

7. STANDARD OF THE RACKET

7.1. Please use the commercial product racket that has been made based on the regulations set by the Badminton World Federation.

7.2. The purchased racket shouldn’t be transformed. However, the handle of the racket or shaft can be remodelled so that it won’t be detached from the robot during the game.

7.2.1. When remodelling, please take safety measures so that the racket doesn’t fly away or the shaft doesn’t come off.

7.2.2. Please attach the racket using plural methods in case one fixing should be broken the racket doesn’t fly away.

8. STANDARD OF SHUTTLE

8.1. Please use the class one official shuttle of the World Badminton Federation.

8.2. The shuttle used in the game must fall 530-990mm before the back boundary line when it is hit by underhand stroke with full strength from the back boundary line.

8.3. Because the flight characteristics differ according to the season and area, great variety of shuttles are available in the market. Please use shuttles that meet requirement under ‘8.2’ from the practice phase.

9. VIOLATIONS AND DISQUALIFICATION

9.1. The following actions will be regarded as violations and 1 point will be given to the opponent team.

9.1.1. Team member or robot (including racket) to enter opponent’s field (including its space above) after the service is delivered and before the point is fixed.

Team member and robot (including racket) to touch opponent's robot.

9.1.2. Robot (including racket) to touch net or its support pole.

9.2. The following action will lead to disqualification and the opponent team will win with score of 5-nil.

9.2.1. Repeating the act in 9.1.1 twice.

9.2.2. Racket is detached from the robot.

9.2.3. Damaging the contest field.

9.2.4. Team or someone related to the team to omitting interference radio wave.

9.2.5. Changing the shape of the shuttle intentionally.

9.2.6. An act against fair-play spirit

10. OTHERS

10.1. For any other behaviour not specified in the rules, please follow referee's decision.

10.2. Any amendments to the rules by the Contest Committee will be announced and updated as the FAQ on the official website.

10.3. All robots must pass dimension, weight and safety check in order to take part in the contest.

10.4. There will be extra lights in the field for recording the event for TV broadcasting.

10.5. On the previous day of the contest, all teams will be given a time slot by the Contest Committee for test run at the actual contest field. Teams must show all the function of the two robots.

10.6. When requested by the Contest Committee, participating teams must submit information on their robot (such as mechanism and function) in the form of video and so on. The Contest Committee will verify whether each robot is made in accordance with the rules through screening the videos in advance of the shipment of the robots.

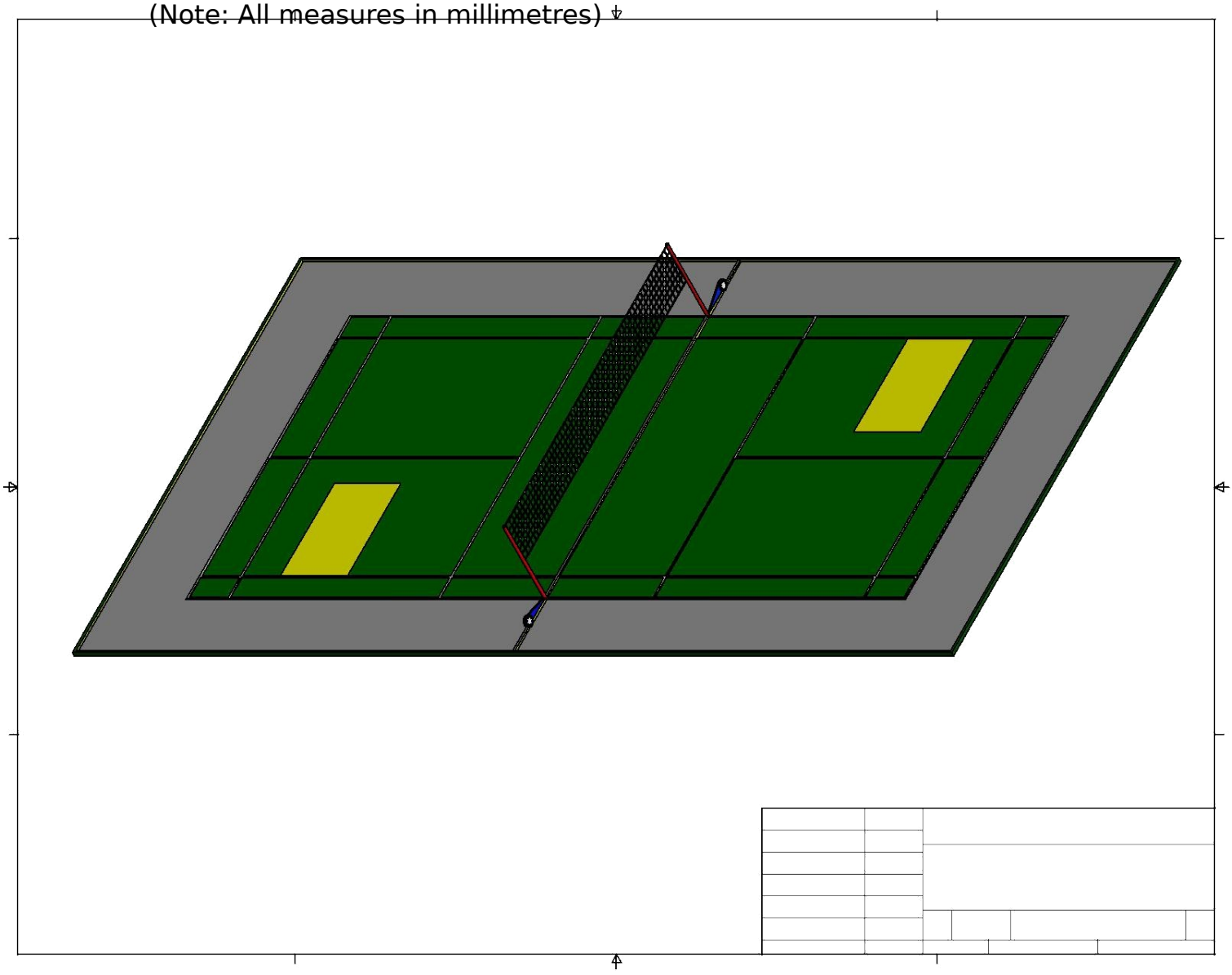
APPENDICES

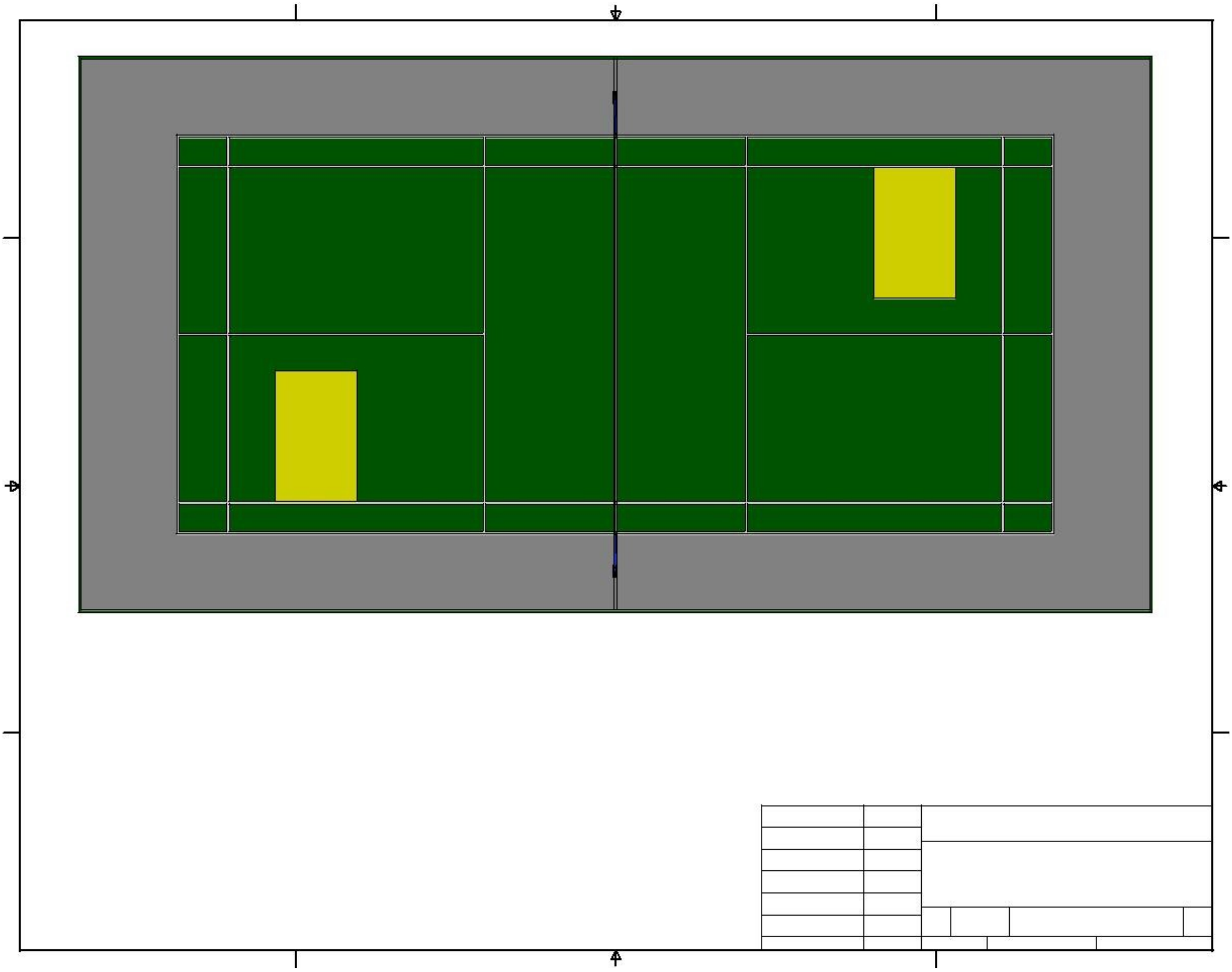
A. Materials and Colours of Contest field

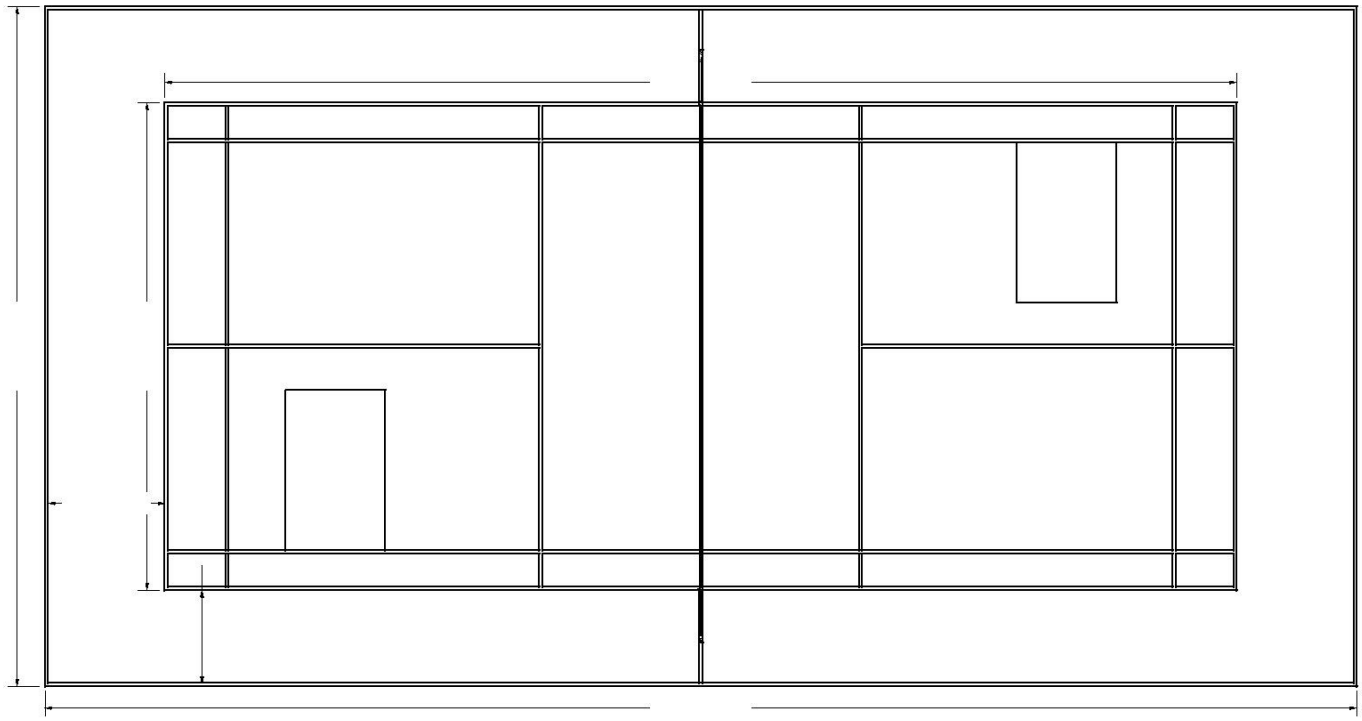
No	Description	Material	Colour		
1	Serve Drop Zone (yellow)	painted plywood	R=255	G=255	B=0
2	Main court (dark green)	painted plywood	R=0	G=102	B=0
3	Grey Area (grey)	painted plywood	R=160	G=160	B=160
4	Fence	painted plywood	R=160	G=160	B=160
5	White lines	painted plywood	R=255	G=255	B=255
6	Net & Pole	Standard badminton	Net & Pole		

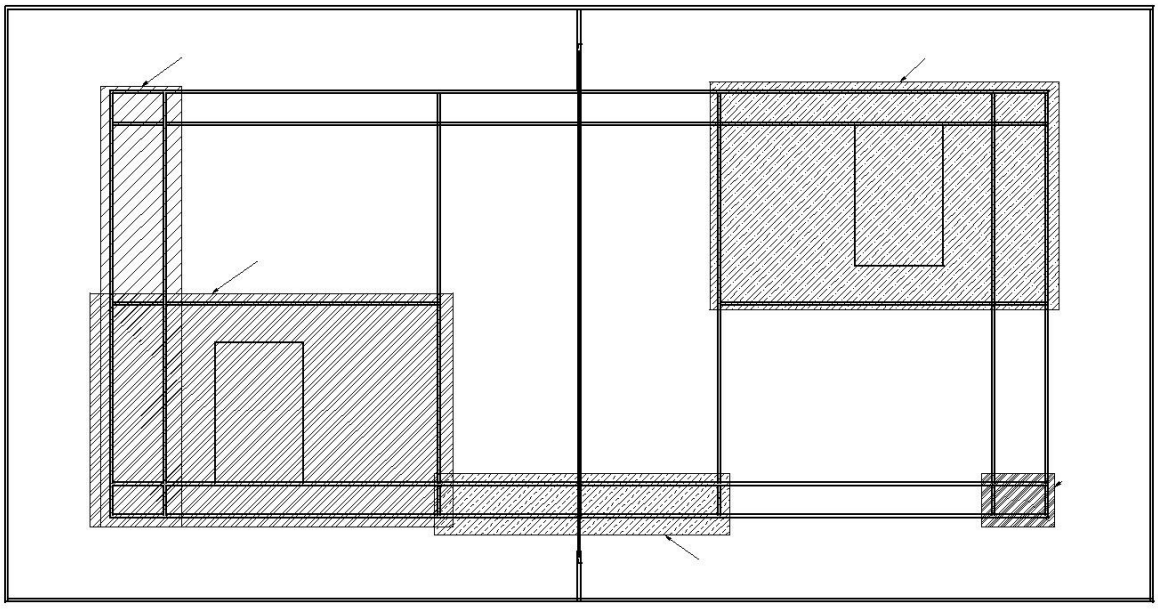
B. Contest field

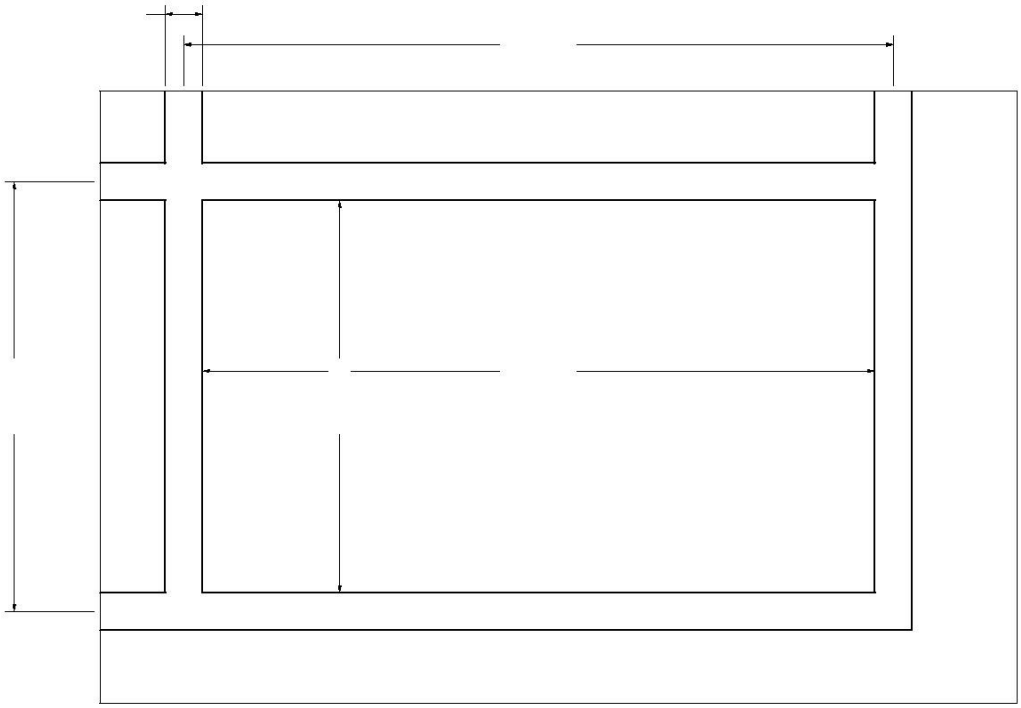
(Note: All measures in millimetres)

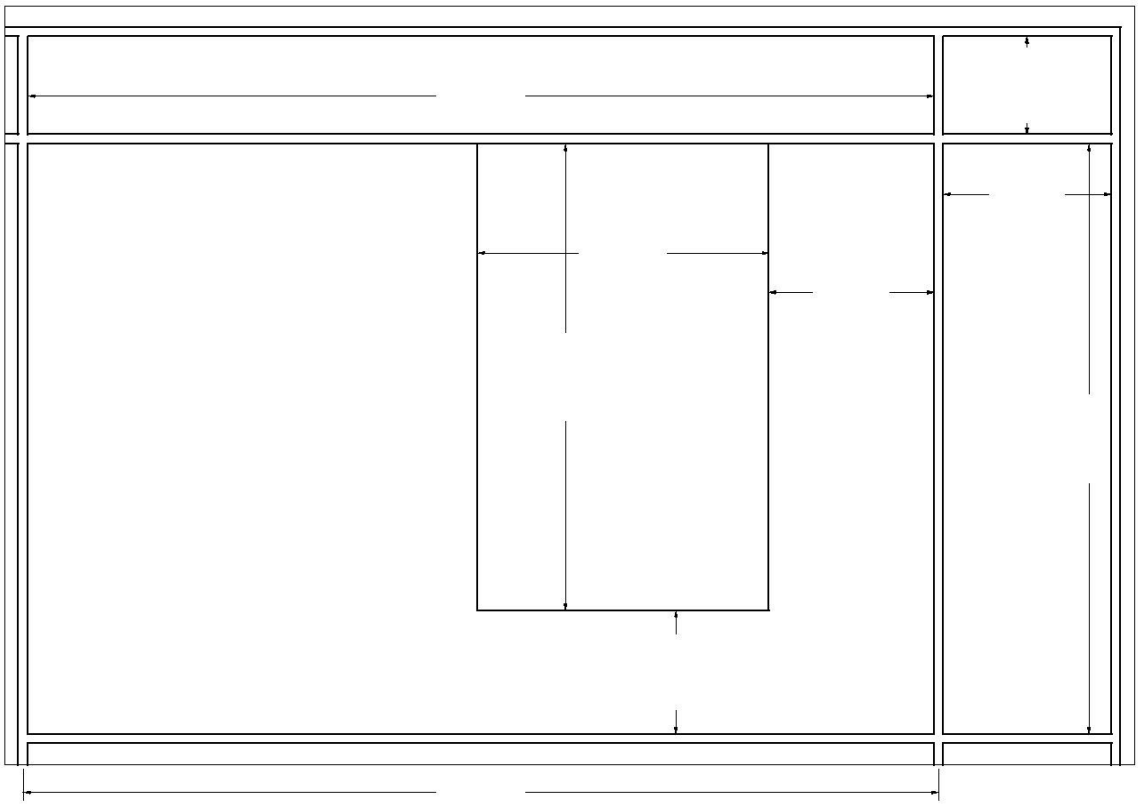


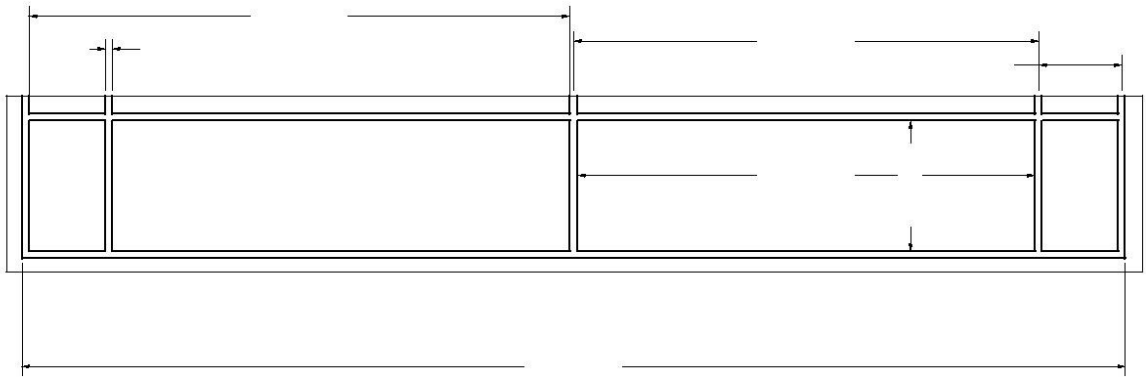


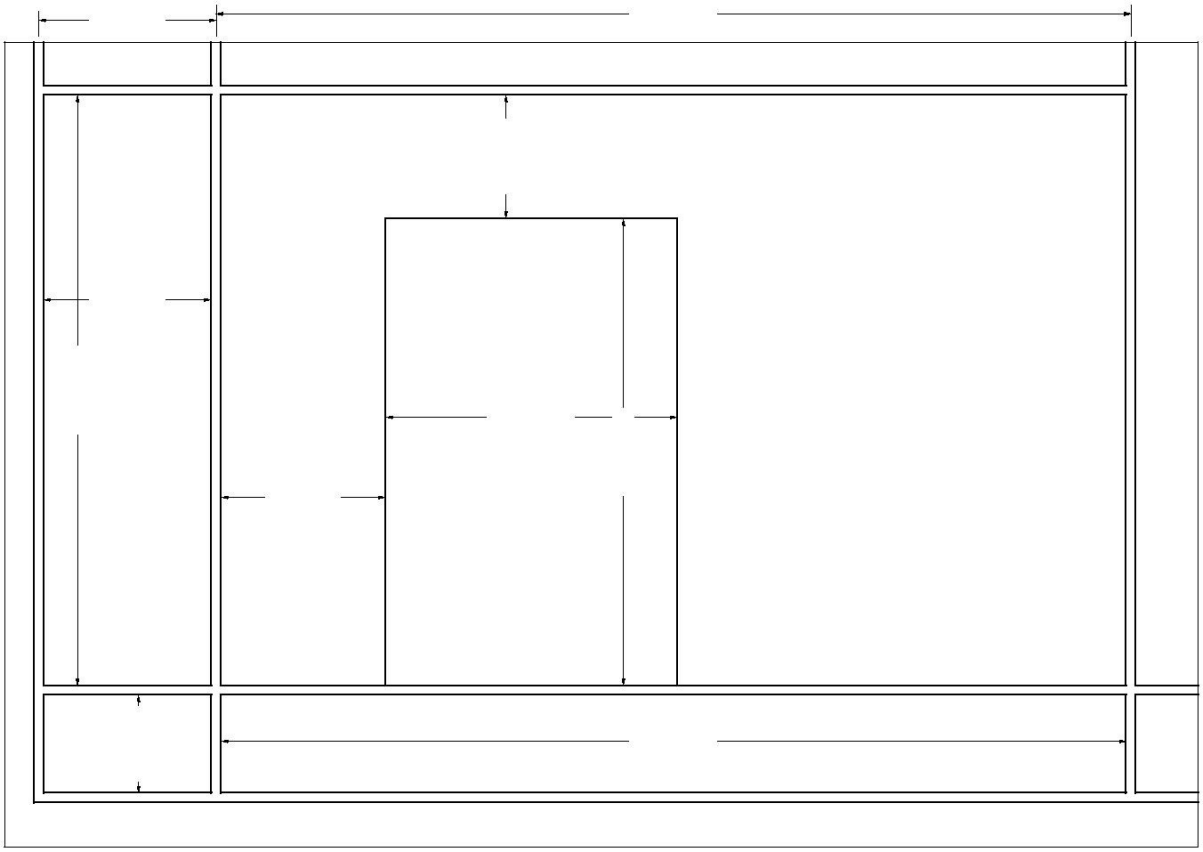


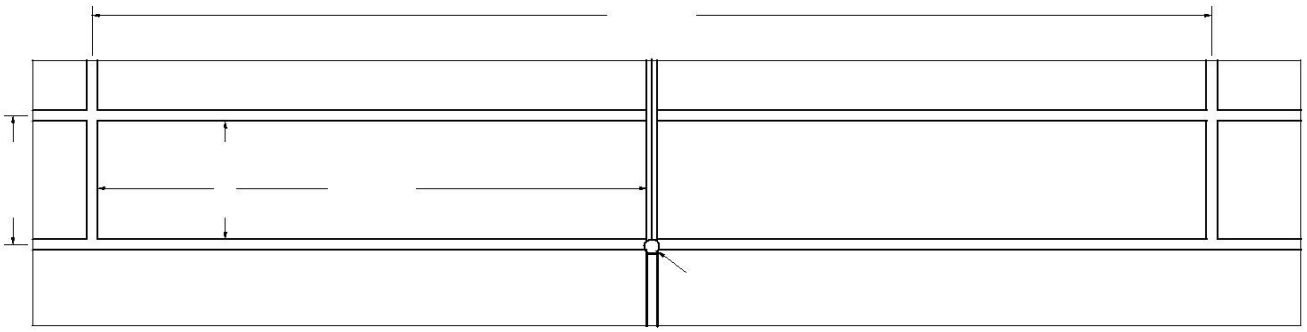


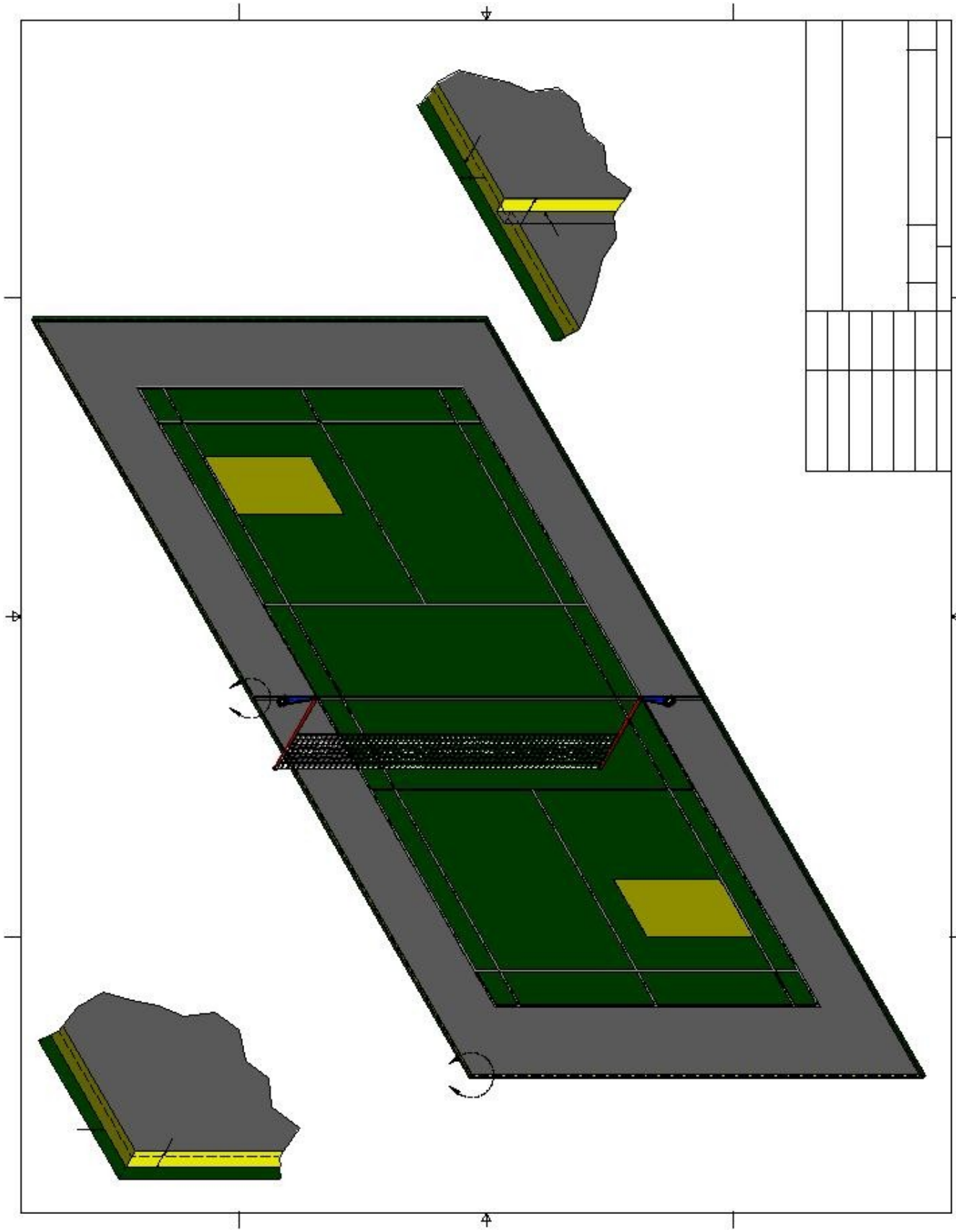


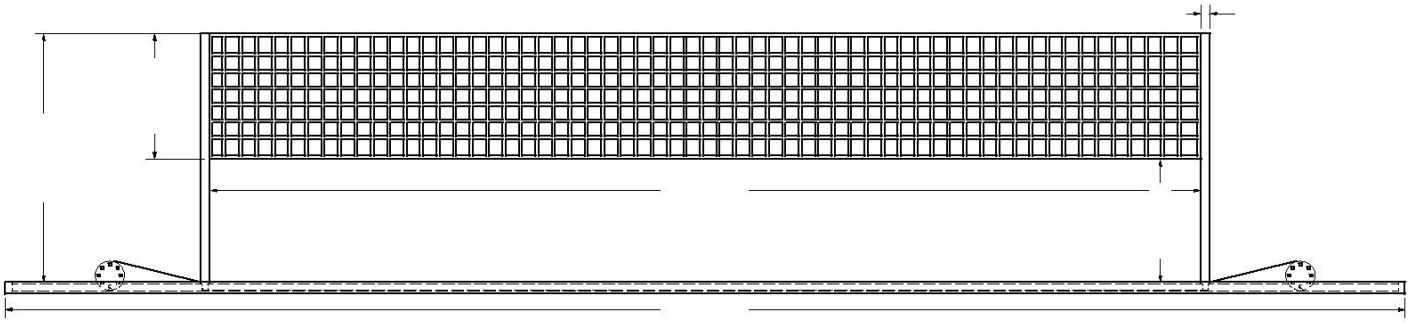












WORKFLOW

- Dateline was set for the team members to propose their designs to everyone.
- Everyone discussed their designs, flaws, and points renewed by seniors.
- Finally, best points were incorporated.
- The team was shown to have two influences:
  i. Jada
  ii. Pneumatics
- Considering this- Two teams: Alpha and Omega were made.
- A common meeting date was decided.
- Plans were discussed and two designs came up.
  i. Jada inspired: Hitting Mechanism mounted on a circular disc.
  ii. Pneumatics model: Google Glass Concept, Pneumatics
- It was then decided to proceed with both the designs.
- The teams were later named A and B.
- The work finally began.

THE JADA INSPIRED DESIGN

JADA was the first fully autonomous badminton robot ever built. For details on JADA visit *http://www.bitrebels.com/technology/this-is-jada-the-first-working-badminton-robot-in -the-world/*

Our design consisted of hitting mechanism mounted on a circular disc. The disc rotated to cover a hitting area and stepper motors were used for hitting.

For the moment, the design seemed viable and the team worked hard upon it.

Then, gradually, problems started emerging. The area covered by the bot was not viable and slow response hindered the progress. Slowly, few nice points were taken from the bot and rest was abandoned.

THE PNEUMATICS INSPIRED DESIGN

The second design drew inspiration from various sources, mainly Festo's pneumatic muscles, google glass, tele-manipulation, etc. The design involved a very innovative base upon which the mechanism was mounted. The mechanism included pneumatic muscle operated by tele-manipulation and ergonomic keypads and vision was provided by google glass.

The team worked very hard to implement these designs but due to time and technology constraints, the bot was grounded. Had it been build, the Robocon would have seen quite an innovation.

Later…

The final bot design (described in the next section); beautifully amalgamated the best features from both the bots and was finalised for development. The teams merged and geared up upon the design.

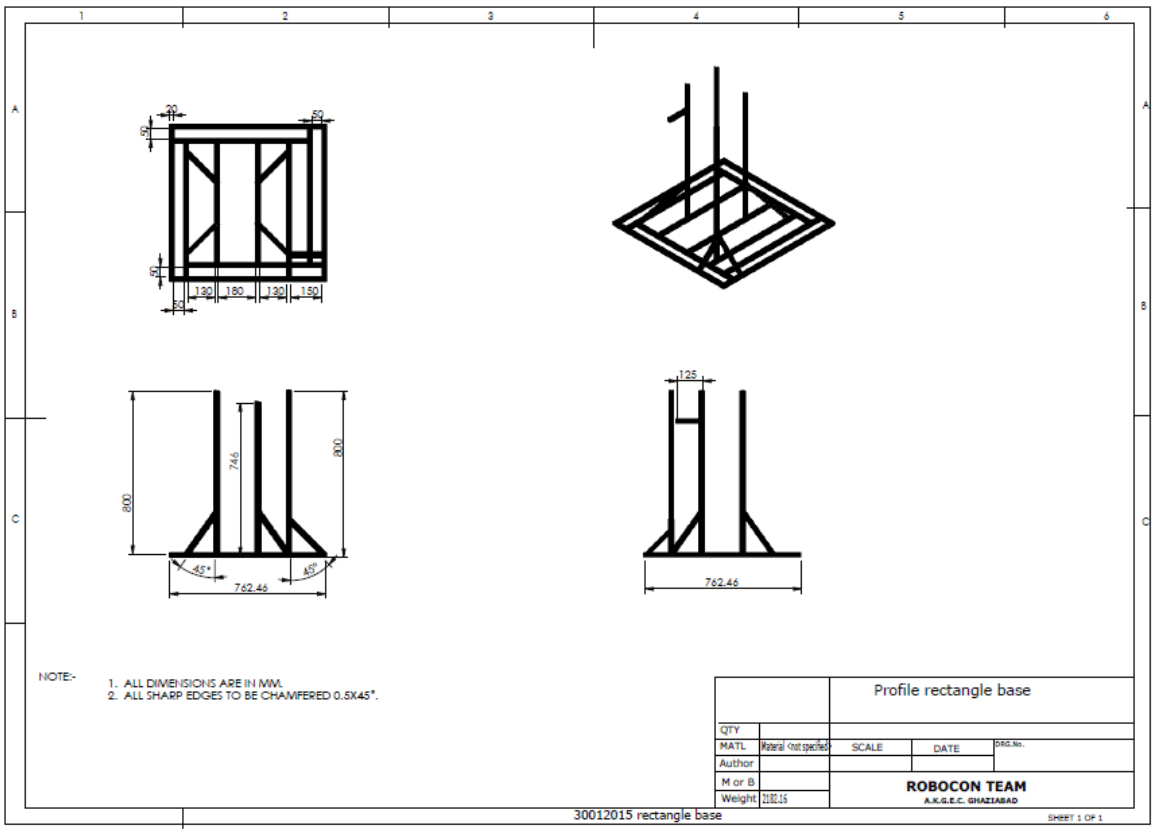
Robot Specifications

1 DESIGN

Guidelines

1. Each team was required to build two robots from which at least one must be wireless.
2. The maximum dimensions of a robot when fully extended excluding the racket must fit in a cylinder tube with a diameter of 1,200mm and height of 1,500mm.
3. The weight of each robot must be under 25 Kgs.
4. No limit on the number of rackets used.

The major aspect while building a robot is the design which dominantly depends upon the application of your robot or what it is going to perform. Our design goes from one to another and at last reached a stage where it fits best. (In our view of course)
In the beginning our robot was something like this:



Basically it consisted of aluminium section/profiles which are light weight and basically a prerequisite for the robot as weight considerations (less than 25 Kg) are to be taken care of in order to compensate the weight of the parts to be mounted. The profiles consisted of sections that can easily be used for mounting different parts. Beneath the structure motors are mounted for the locomotion of the robot. The motors are coupled with the Omni-wheels with the help of aluminium coupling. Basically the Omni-wheels are looks like this:

The main objective behind using this kind of wheels is that they are multi-directional i.e. they can transverse forward/backward and sideways. Resting on the base the base there was a pillar assembly to provide our robot with some height and for mounting the hitting and servicing mechanism.
After studying the rule book carefully we came to know that we can use the same robot for servicing again and again. Thereafter it was decided that we will mount serving mechanism only on one of our robots. For the first robot top of our priority is the serving mechanism (basic need to start the game). To serve the purpose many designs were thought of including piston assembly etc. but due to limited reach of the shuttle due to the piston (which we later realized could be attained) that idea was dropped out and dc motors came into action. These are controlled and positioned by encoders inbuilt in the motors but it took time and effort to design an algorithm for successful hitting of the shuttle to a proper distance and height. The same coupling with minor modification was used to couple the racket with the motor for the serve. In opposition to it the hitting mechanism was mounted similar to the serve mechanism but without any fearsome coding requirements (simply hit and return).
The second robot is comparatively easier to manufacture and implement as it pretty much resembles the first one. It only lacks the serving mechanism and had multiple (three) rackets for hitting

purpose. Again aluminium material is used to mount these rackets to the robot. To make the wiring less lousy and clean, the whole circuitry was design to assemble in between of the pillar assembly which includes the motor driver, microcontroller, batteries and connection host etc. and the whole wiring from the motors etc. were taken side by side from the aluminium profiles.

2 Technologies and Techniques proposed

As every project idea begins with some aspiration, ours begin with some overexcited state. As our brain came to know about the badminton game, it begins flushing itself with applicable but big ideas (you will come to know in just a few minutes).
As soon as hitting the shuttle cock comes into our mind we were eager to find the ways to track or know the path of the shuttle cock with the help of image processing using NI LabVIEW but it requires some specific background for detection (we don't know of), certain lightening conditions (we don't know of) and some high resolution and high fps cameras (we can buy, but that's not worth it as tracking at such a fast rate is not in our hand). The level of image processing required is quite high which can be attained but time doesn't allow us to go for that. The image processing is tried to achieve by NI LabVIEW and MATLAB. The microcontroller to be used is again from NI known as myRIO.

In the end, we are again in a dilemma of the positioning of our robot to where the shuttle would be coming. Then it is decided to virtually divide the field into sixteen equal boxes such as a matrix and corresponding to every box a button would be serve as a controller. This looks like as:

The main disadvantage of this is to design the algorithm for the motion and reduce the error. The algorithm requires to design a flexible coordinate system which again is pushing the time limit. It also requires a detailed study for PID (a closed loop feedback system) for the proper reduction of error in the locomotion of the robot. After a lot analysis that it is not possible for a human to determine the location of the dropping point and then position the racket and return the shuttle. Thereafter, this is also not found feasible and hence dropped. At last it was decided to use our old PS2 controller which is reliable, efficient and fun to play with. Another mechanism for hitting the shuttle was proposed by our seniors which consisted of “PNEUMATIC MUSCLES”. Yeah you heard it “Pneumatic Muscles”. This concept was far away from our imagination and till now yours also. This refers to replicate a human arm with one having tubes instead of muscles and air pressure to move them just like blood in our body. The main concept of this is to decrease the time response of the robot. But as it was a whole new concept for us and not reliable for the final stage so, it was not likely to be implemented but one of our team member is confident about it, so the idea was not literally dropped but R&D keeps on going on this technology.

3 Technologies and Techniques used

After all the technologies discussed, evaluated and worked upon some time at last we realized our potential which was not quite big enough but satisfactory to build a good and efficient robot (In our view of course).
The present robot has an Arduino as the brain of the robot for inputs and outputs for controlling the locomotion, servicing and hitting mechanism. The main breakthrough for our robots was that they were wireless i.e. can be controlled remotely for up to certain meters. The wireless communication was achieved by a configurable Bluetooth module (HC-05) which works on TTL logic and can receive or send data by its Tx/Rx lines. This Bluetooth module was configured through AT commands (through Arduino) and can receive and forward data to the Arduino for further actions according to this configuration.

Problems faced & Solutions

1. Due to the delay in official procedures of the college, we were equipped with all the material very late, about 20 days before Robocon’15. It was very difficult for all of us to build two robots within this short period, but with all efforts of our team we still managed to do so. To ensure that we do not have to face this problem again in upcoming Robocon’16, we have decided that the

BOM procedure will we started very early soon after the theme is available to us.

2. Delay in prototyping: Prototyping was delayed because we didn’t have the motors to test our design. However, care must have been taken so that prototypes for both designs were absolutely ready before the arrival of motors. Besides, since all our efforts were concentrated in making the first design work, by the time we realized that it was too late to test the second design, (especially when its prototyping had not even begun).

3. Overshooting of robot due to inertia: The base of the bot would overshoot while rotating because of inertia, i.e. it would keep rotating for some distance even after the supply to the motors was stopped. This problem could have been tackled easily by giving a velocity in the negative direction with the help of feedback from encoders. This would also improve braking of the motors.

4. We lacked expertise in using modern technologies and sensors. Initially we progressed by using image processing to detect the trajectory of the shuttle but when not more than a month was left we understood that we were just wasting our precious time, so we stopped any further research work in that field and concentrated on simpler and straight approach. The only sensor we tried to use was photoelectric sensor, but unfortunately we could not use it properly.

5. A major problem face by our team was the inability to use the BLDC motors. This led us to make a major change in our design, due to which bot could not have clockwise and counterclockwise motion round the bot’s torso. Tachometric solutions hadn't provided any Datasheet to know about the actual connections of different color of wires which were itself very confusing. At that time we were unaware of the concept of floating ground, which was to be used in the motor driver connections.

6. We had bought motors with inbuilt encoders. To have full automation in the hitting and servicing mechanism it was required to control the motor position very accurately, but it was not possible at that time due to motor inertia. It restricted us to have manual control over the racket position. This problem could have been easily solved by the implementation of feedback control system commonly known as PID.

7. Problems due to low battery: When the power supply to the motors start going below around 24 volts, its operation becomes unreliable and may lead to unexpected behavior of the bot. many a time this used to be the reason behind the malfunction of the robots.

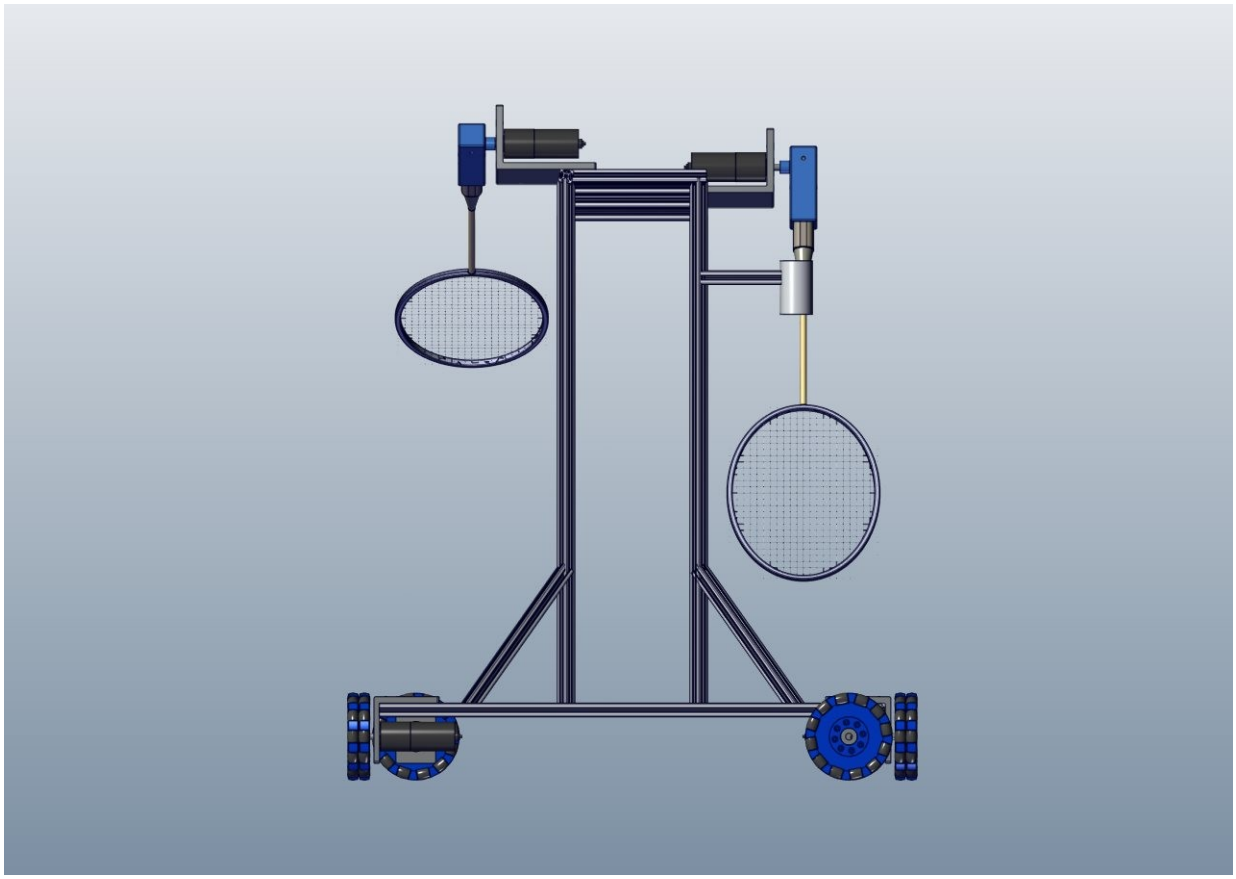
8. Rack and Pinion: A recurrent problem was the motion of the rack and pinion sometimes becoming too stiff. Also, at times there was slipping at the motor shaft.

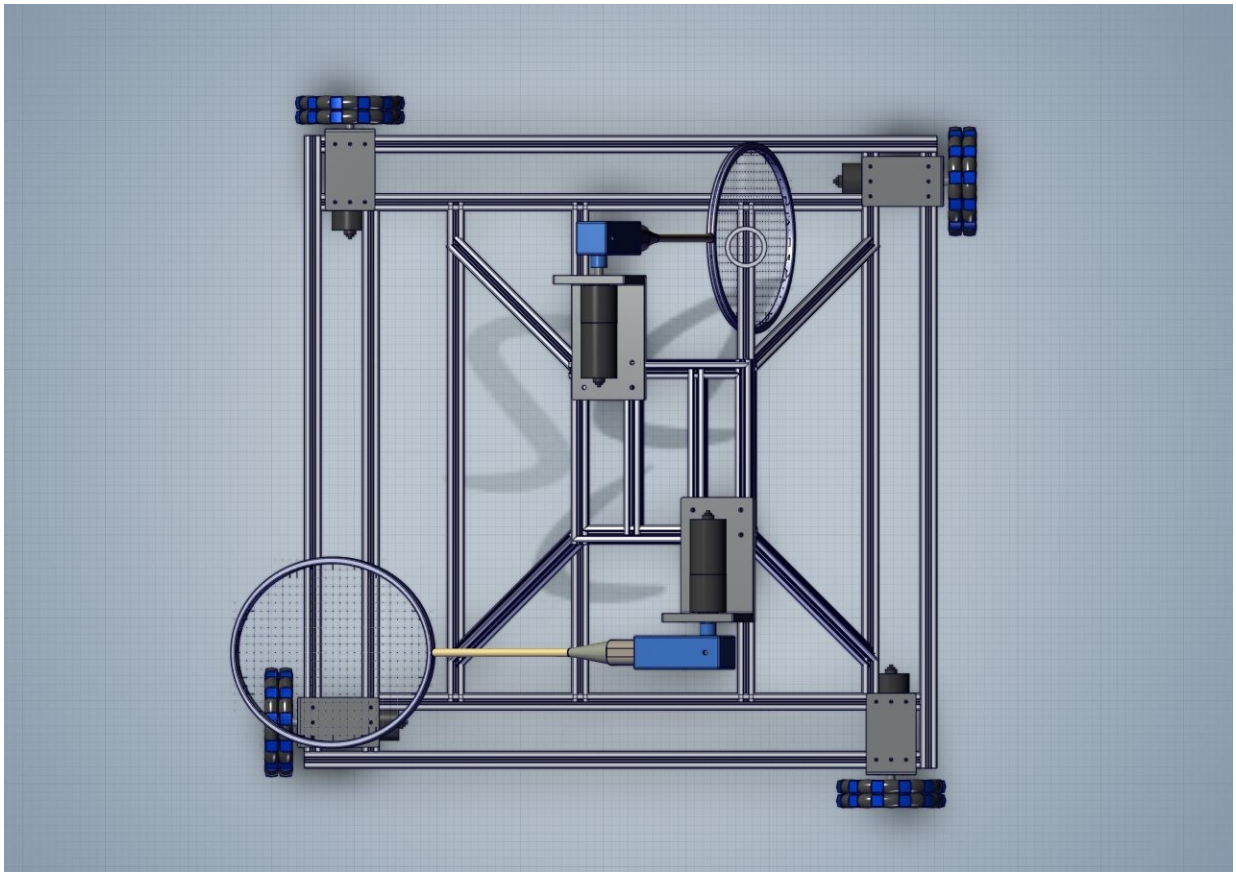
9. In our previous bot we faced problem in the mechanical structure due to its weight and self-made structures, but the problem was solved by the of aluminum profile.

10. Even though we didn’t win, our design of the lifting mechanism of the manual robot was admired by co-competitors and judges alike.

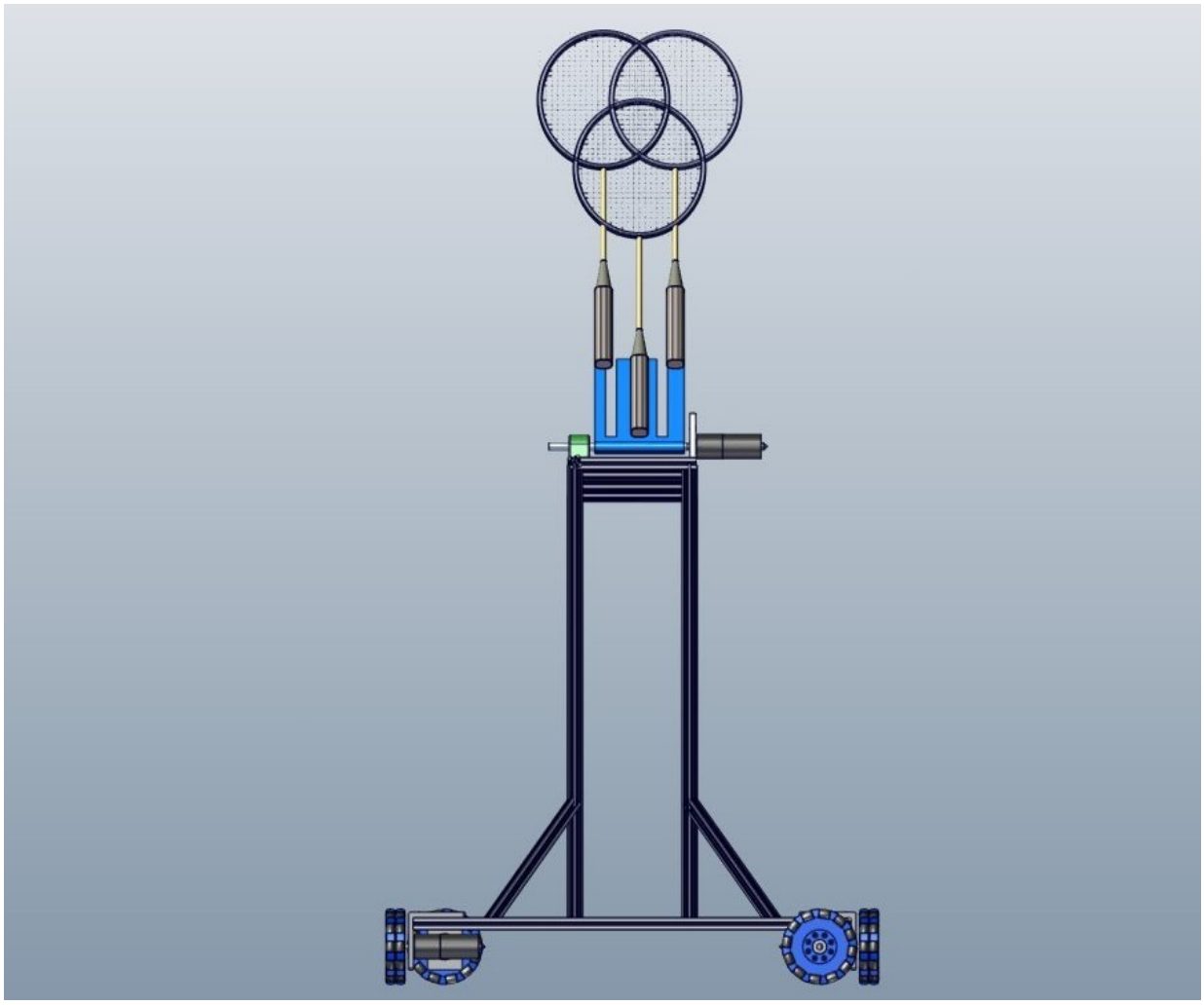
OUR FINAL CAD MODELS AND DESIGNS

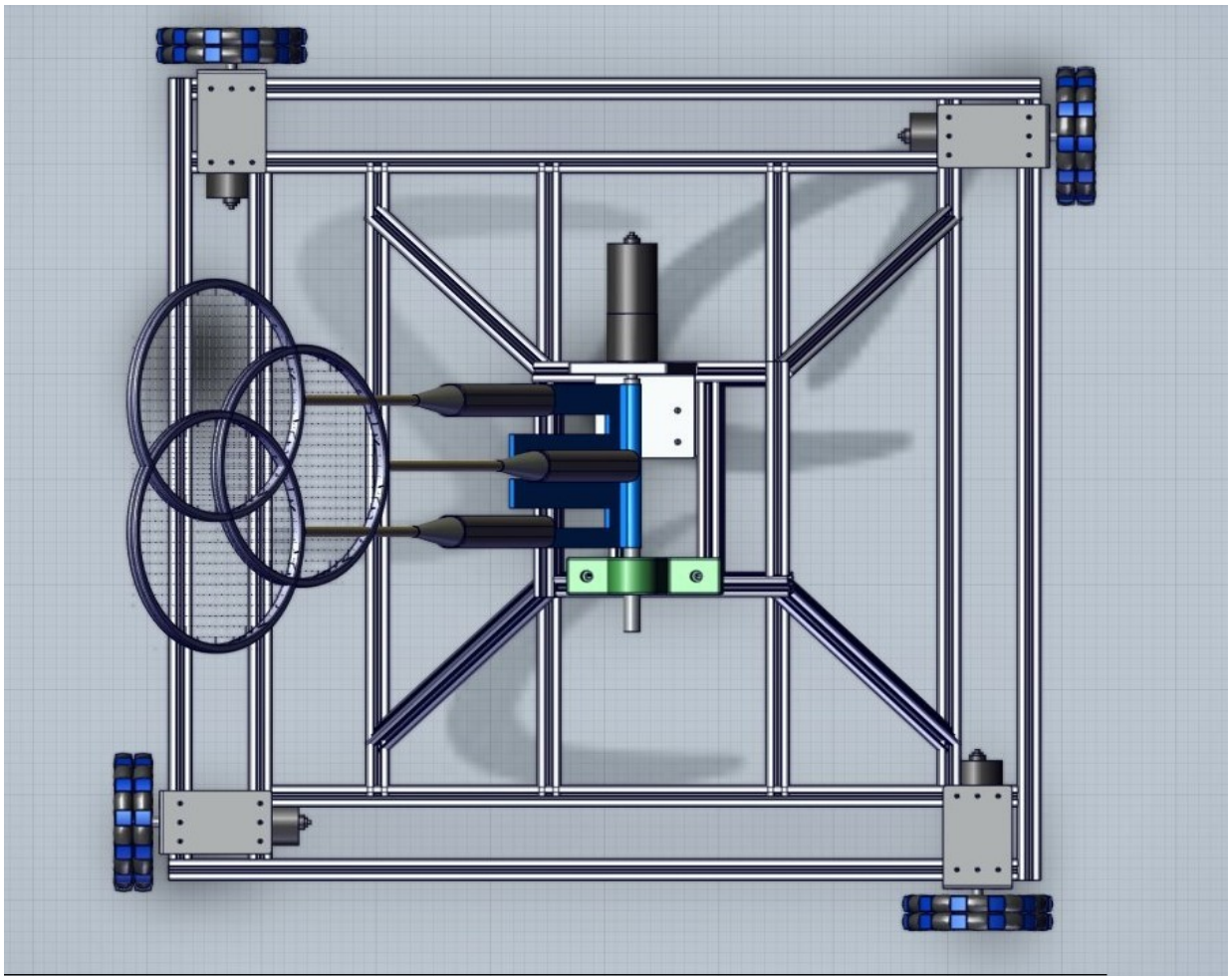
The Robot for Servicing as well as Hitting





The Robot for Hitting Only





CONDITION OF THE BOTS BEFORE LEAVING FOR PUNE

We started with three robot designs in our mind. Of them the two most feasible and perfectly designed robots were to perform at the arena of Robocon.
Our first bot which inherited its design idea from the first badminton playing robot (Jada Robot), was in the best condition before moving towards Pune. It was equipped with the two most important mechanisms required to play Badminton, shuttling mechanism and hitting mechanism. We had done a sufficient amount of practice on this bot.

THE BOTS A DAY BEFORE PUNE JOURNEY

Our second bot which comprised of only the hitting mechanism, lacked practise because the circuitry of that bot was made just the night before leaving to Pune. This bot was totally designed made to hit, so we had installed two rackets on it, to have greater probability of hitting the shuttle.
The third bot which was proposed to be employed with the latest advancements like google glass, tele manipulation, pneumatics and agronomic structure was cancelled because of time boundations.

EVENT DESCRIPTION

ROBOCON 2016 saw participation from 85 teams from all over India. Shiv Chatrapati Kreeda Sankul was bustling with crowd and the enthusiasm on the face of teams was clearly visible. Every team, was busy servicing their bots in the pits assigned to them. The crowd was a mix of first timers as well as multiple times champions.

Practice Area and the Stadium

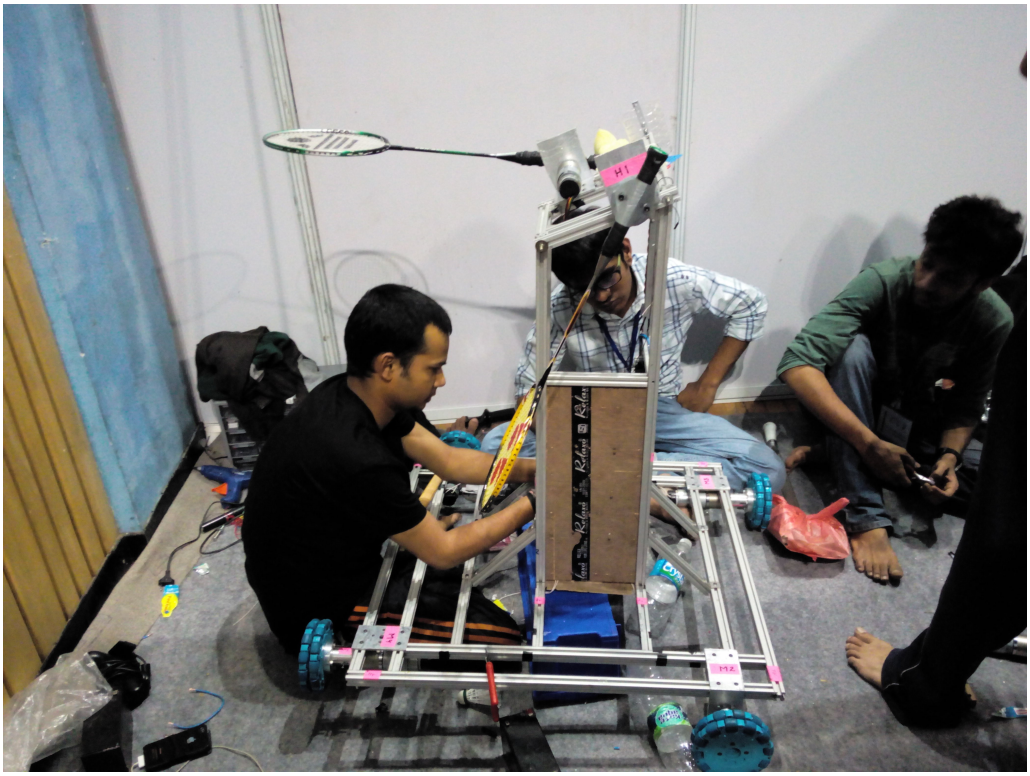
The event was designed in the following fashion-

1. League matches- Three teams in a league played against each other. The team with maximum points after the league matches qualified for the super league.
2. Super league matches- Again three winning tems competed and the one with max points reached the quarters.
3. Quarter final matches- Eight teams from all league matches competed to be the top four.
4. Semi-finals – Four top teams' battles to be the ultimate duo.
5. Finals to decide the winner of National RoboCon 2015.

Our team was placed in the league 'J' along with MIT, Gondia and MIET, Manipal.

After reaching Pune

The highly motivated team with utmost zeal to participate in Robocon'15 reached Pune. It was nothing less than a dream come true.
Since the bots had to be disassembled to carry it during the journey, the first and foremost attention of the team was towards assembling the bots as soon as possible.
The bots were assembled soon within no time by the competent hands of our team members.



Assembly of the bots at Pune

After assembling the bots, the main focus of the team moved towards practicing with the bots in the practice arena.

The AKGEC Team Robocon during practice session

During the practice, all the little ups and downs in our hard work were reflected and the team pondered over ideas to overcome the flaws.

OUR PERFORMANCE

The night before our first match, everyone was thrilled and overjoyed. The bots functioned perfectly and the drivers were well versed with their bots. We were quite confident of a win and the team was high on confidence.
That moment came, our first match, with MIET, Gondia, and all were more than ready, the bots were measured and weighed and passed the test, and then on the outfield, something much unexpected happened. The Bluetooth of the bot and the controller could not communicate perfectly. Everyone panicked, several attempts were made to rectify the fault, only to go in vain. Every member's heart skipped a beat. It came like a shock to the team, our bots just moved around the field, unable to service or shoot and we left the arena with a crushing 1-5 defeat and a dozen teary eyes.

The first match with MIET, Gondia

Later, time acted as the healer and the loss had a rather inspiring effect on the team. The embedded team stood wide awake till the night to remove all the shortcomings of the circuits, only to find that controller wire was loose. Some other minor problems came and were rectified and the team, doubly confident this time, geared up for the second match.
In the next match, with MIT, Manipal, the bots functioned well (except of course, few handling problems, which the pit crew excellently managed) and we won our second match with a score of 5-3.

The second match with MIT, MANIPAL

The team was overjoyed. The tears of joy washed away the tears of sorrow. Cheers and jeers were heard aloud, the team became a bunch of happy maniacs. First victory for the AKGEC ROBOCON TEAM was no small-a-deal and we celebrated it accordingly.

The overjoyed team after the second match

Finally, we did not make it to the Super League due to points lost in the first match and the 2015 journey of the AKGEC ROBOCON TEAM ended thus.

PROBLEMS FACED AT PUNE

1. It is known that in the field of electronics disasters could happen by just one wrong connection, and the same happened in our case to. Just before the commencement of the match our Bluetooth stooped communicating. The problem recognized by us after the match was much smaller than its consequences, the RX TX lines in the Bluetooth module of the controller were loosen and connection was lost between the controller and the bot.

2. After a lot of debugging, some parts of the circuit did work but never reliably. One reason for this could be substandard quality of the PCB.

Leaders Comment

As the second Robocon, this experience was obviously merrier than the first one. The team was a mix of experienced guys and newbies but the past Robocon had taught us a lot, many mistakes were avoided. Simplicity in design and control over the bots were the key this year. Things worked out great and AKGEC registered its first ever win at Robocon. As the Robocon head, the experience was obviously very joyous. The team obviously deserved the win after so many sleepless nights. The first match however was lost due to a silly connection mistake. This obviously disheartened us but taught us to look even to the slightest technical faults if you wish to win. I hope the next team benefits from the experience and look forward to an award this year. My best wishes and unending support is always with the team.

Ravi Kumar Gupta

Robocon is my passion, and first successful event in such a passion is always thrilling. The first victory of AKGEC TEAM ROBOCON was huge. It was really wonderful to see the entire team, which started from scratch, finally achieving something commendable.
The team's efforts, were no doubt huge. All toiled hard till their capabilities. Very few are privileged to work with such a team. I think a little extra effort, knowledge from experience and team unity will win us the trophy next year. My hearty wishes to the whole team. No matter what comes, the team can always count on me for any worthy support.
All the best!!

Shubham Gupta

A SHORT LEARNING

Lot of mistakes was made during the planning and scheduling of the tasks to be completed. There were many tasks that were spent time on which weren’t required, which led us to ignore what was more important and waste time. The team gained experience on

how plan and proceed systematically, so that the work is completed within a comfortable frame of time.