UCD School of Electrical, Electronic and Communications Engineering

EEEN10020 Robotics Design Project

RoboRugby Interim Report

Team Number: 10 **Team Name:** **Bot The Builder**

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Declaration

I declare that the work described in this report was done by the people named above, and that the description and comments in this report are my own work, except where otherwise acknowledged. I have read and understand the consequences of plagiarism as discussed in the EECE School Policy on Plagiarism, the UCD Plagiarism Policy and the UCD Briefing Document on Academic Integrity and Plagiarism. I also understand the definition of plagiarism.

Signed: . . . . Date: . . . .

Introduction

Since the 30th of January my team has been learning how to both build and program a robot which is composed of common "Lego" parts and a handyboard. We are using interactive C to program the robot and we have completed seven weeks of the 12 week module, which will conclude on Tuesday the 22nd of April in a competition between all the teams and sponsored by Siemens. At the start of this module (For the first four weeks) we initally built a standard robot for which we were provided instructions. We have since dismantled that robot and moved on to our actual competition robot. To date we have decided on what we believe to be a winning strategy, we have completed the vast majority of the hardware and we have begun work on the software for our competition robot. We have also completed a timetable and "To-do" list for the coming weeks, to ensure we know whether we are on track or not and to give us the best chance of winning this competition given the little time we have left.

Strategy

Numerous strategies were considered by us, as a team, and each presented us with various pros and cons, which we diliberated over in turn. Each strategy presented it's own difficulties and we also discussed what type of robot we felt would do best given that particular strategy, which I will discuss further in this report under "Robot Design". We also felt that an excellent strategy and robot build would be absolutely crucial to our success, as we knew that numerous other people were very experienced programmers who possessed such a vast programming knowledge that we would have been foolish to think we could rival it within twelve weeks. As such, we spent a large amount of time mulling over each option, inspecting videos from previous years and discussing what route we felt most people would choose this year.

From this, we decided on two strategies, both being very similar to each other, however varying slightly when we know the other team will initially deploy a wall or if they decide to drop a wall blocking us from their scoring zone (or opt not to employ a wall at all) We felt the use of a wall would be crucial to a lot of teams and would be something that they spend a lot of time working on. We did initially give some thought to building a wall but given that previous years winners have won through primarily attacking and scoring points (and not utilising a deployable attachment) we felt that we would do better by trying to neutralise a walls effect rather than replicating it.

We also elected not to bother with the cube, as we felt that a lot of teams would try to secure those points initially, whereas we could secure a lot more than 2 points initially when we know where each ball still is, as hopefully the balls on our own side of the table will be untouched for the first 5 seconds of each round.

We decided finally on these variations of the same strategy which incorporates the best aspects of all the strategies we considered:

In the event we believe the opposition will deploy a wall or barrier stopping us from accessing their scoring zone, or we do not believe they are deploying any wall or barrier:
-Begin facing our defensive beacon.
-We plan to firstly go back to our own scoring zone and clear out the balls on our side of the table, avoiding the balls around the cube and the cube itself. We have chosen to ignore the cube and surrounding balls as we hope to have a fool-proof primary movement that works the same every single time and we feel that by engaging with variables such as the other robot early on (As they are likely to go for the cube, etc. early on) we could ruin this primary objective.
-We plan to collect the initial five balls on our side of the table in a harvester-like contraption and store them beneath the under carriage of our robot. The under carriage will hold up to eight balls, with a counter to tell the robot when it is full.
-Once the five initial balls are collected we plan to look around the table for three more balls, initially down the side of the table, hoping they have been left untouched in the opening sequences.
-The robot will find the grey zone and stay there once it either: Has collected eight balls, or the timer has gone off for it to find the scoring zone.

-At ten seconds to go (Or however long our actual robot takes to traverse the length of the table plus a few extra seconds) we intend for the robot to search for the beacon for the scoring zone and head towards it, this is part of our failsafe strategy.
-Should the robot be impeded on his way to scoring he will initially try to reverse and move around the obstacle by turning and then finding the beacon again. If that fails and the timer is less than four seconds we plan to use a device on the back of the robot, using the servo, to lift our collected balls up and tip them over the obstacle, like a dumper. We think this is a good idea because, as you have remarked in lectures, the use of a wall or barricade over the scoring zone has become quite popular, so this would be a good way to counteract that.
-If the robot is not impeded on his way to scoring, then he will find the grey zone and stay there.

Should we believe the opposition is going to initially drop a wall:
-Begin facing our offensive beacon (The zone we are trying to get balls into)
-Head straight for the mid section of the table, aiming to get the ball closest to us and the yellow ball on their side of the table on their side of the table.
-Hence, even if they deploy the wall behind themselves (Leaving them in our defensive zone where they can score points) we will be left in their defensive zone with more points.
-we will then go into "Ball find" mode until we have 7 balls.
-When we have seven balls we will find the grey zone and stay there, ensuring at least a draw as it is highly unlikely that both robots will collect seven balls and place them all in the grey zone.
-Our robot has a significantly bigger space in which to collect balls in comparison to all other robots, especially those who are using parts and space to deploy a wall, so given this we think that they will not be able to carry 7 balls at once, and so the chances of them getting two or more laods of balls into the grey zone without knocking others out is pretty miniscule.
-If we do not manage collect 7 balls in the allotated time then the robot will find the grey zone and park there at 8 seconds to go until the end.

Through utilising both of these stratgies I feel that, if properly implemented, we can exploit the other teams' weaknesses while making the most of our own strengths.

Possible Weaknesses:
I am, however, aware that our strategies also provide room for exploitation. Through discussing these and being acutely aware of them we have adapted our strategy and our initial design of our robot.
One way in which we would be weak is if the oppositions robot was much, much faster and agile than ours. As this would allow them to clean out our defensive end before us and still get to their end first as well. However, speed is in close correlation with size and sturdiness in this competition we believe, so any robot which is considerably quicker than our will probably be a lot smaller and not be able to collect as many balls as ours anyway, given how we have built our robot.
Another possible weakness would be if both our robot and the opposition got all seven balls each in the grey zone and they had deployed a wall which blocks us from moving the cube onto our defensive end, which would result in a win for them in a tie-break situation. However, as previously discussed, I feel that the chances of both robots getting 7 balls each in the grey zone is miniscule.

Ranking Round:
-We would implement some changes to our code for use in the ranking round however:

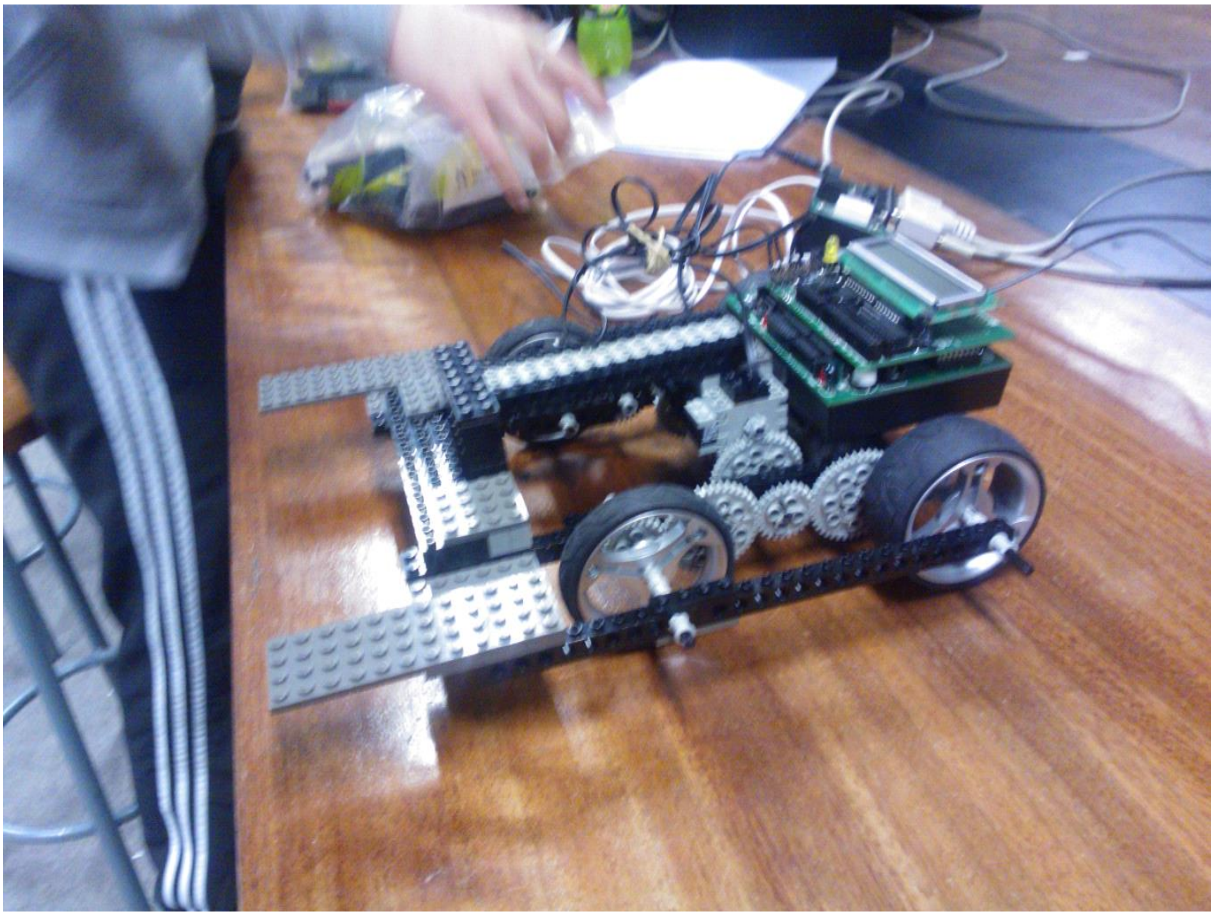
1) We would aim to collect all balls around the cube.
2) We would increase the holding capacity of the robot so that it could accommodate one more ball, so that it could collect all balls on our side of the table and in the centre in one swoop before going to the opponent’s side.
3) We would modify the counter accordingly.
4) We would not utilize the device to tip the balls over.
We feel that getting a good score in the ranking round will be crucial to doing well in the competition, as it will allow us to avoid the "Better" robots until later rounds.
5) We will try to collect all the balls in the ranking round in two sweeps of the board.

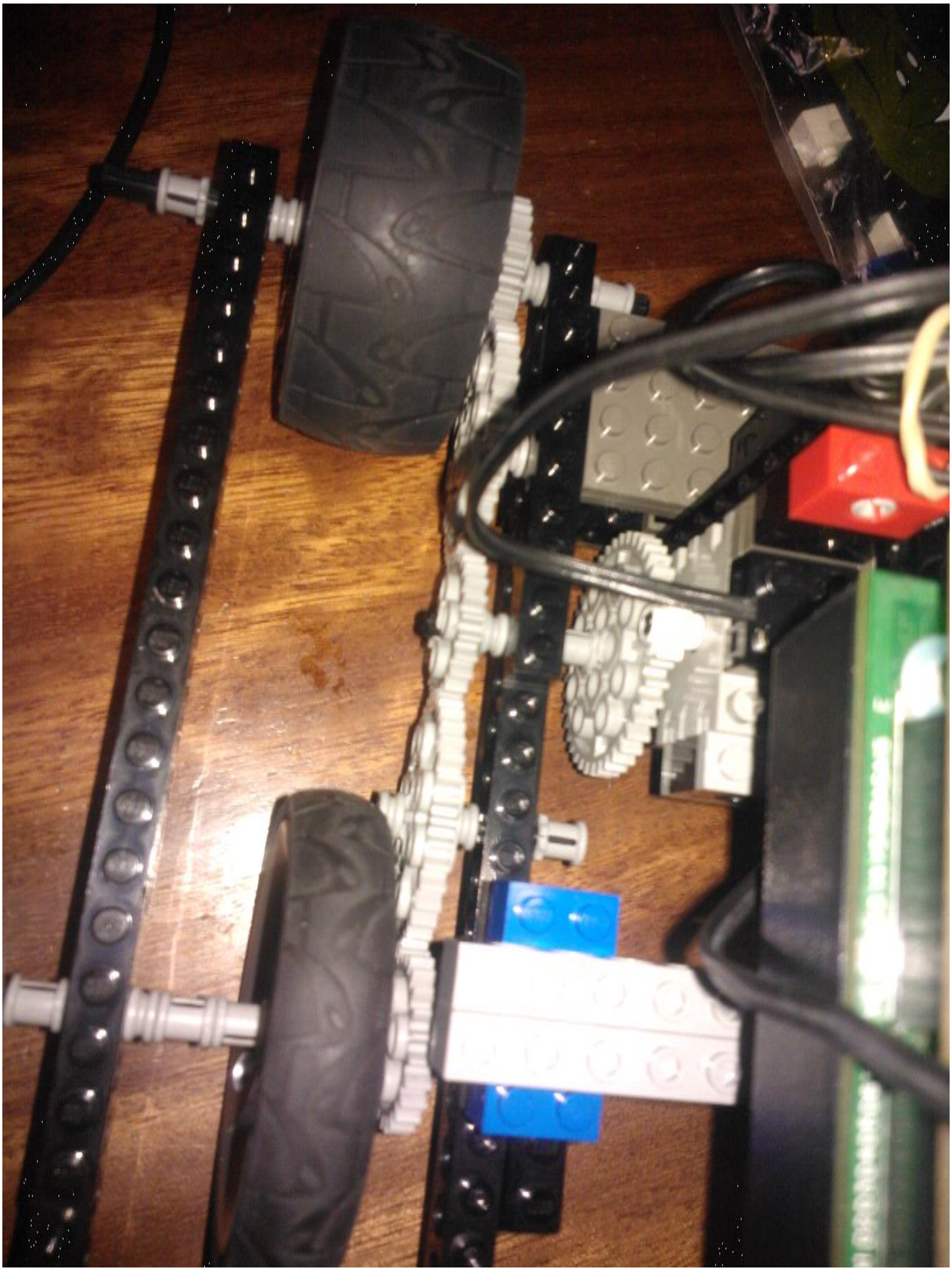
*I sent Brian Mulkeen an email regarding plagarism as I used a small portion of work which appears here in my team's strategy report. I, however, was the sole author of any body of work which appears in both documents. He said that I did not need to paraphrase myself and to leave a small footnote instead.

Robot Design

To make the most of the strategy which we have invested a lot of time in, we needed an excellent robot desig to support it. The robot had to be a quality build with structural integrity (so we know it won't fall apart), considerable agility, speed and a large under-carraige capable of holding a lot of balls at a time.

We decided to use a 5:1 gear ratio and four wheel drive. Four wheel drive was essential to our robot, as the wheel base is very long and the chassis very wide in comparison to other robots, so without it our robot would have been very unmaneouverable. We are using two lego motors, one of each side, to power our wheels. We also chose to use thicker wheels at the back to give more traction with the surface, giving us an advantage should we collide with another robot.





The wide base is also optimal for collecting balls in the undercarraige, as it will fit 8 balls.

We have the vast majority of the hardware put in already but we still have to make and install our "tipper". We are using the servo motor to power the tipper, which we are going to use to tip balls we have collected over a wall or barrier, thus neutralising the opponents wall, as discussed prior to this in the strategy section. This, we feel, will give us a distinct advantage over our opponents.

We have placed two microsensors with long hinges at the left and right front corners of the robot, with two lift arms placed infront of them as we found that they were overly sensitive and were being pressed twice when in reality they had only collided once without the lift arms in front of them.

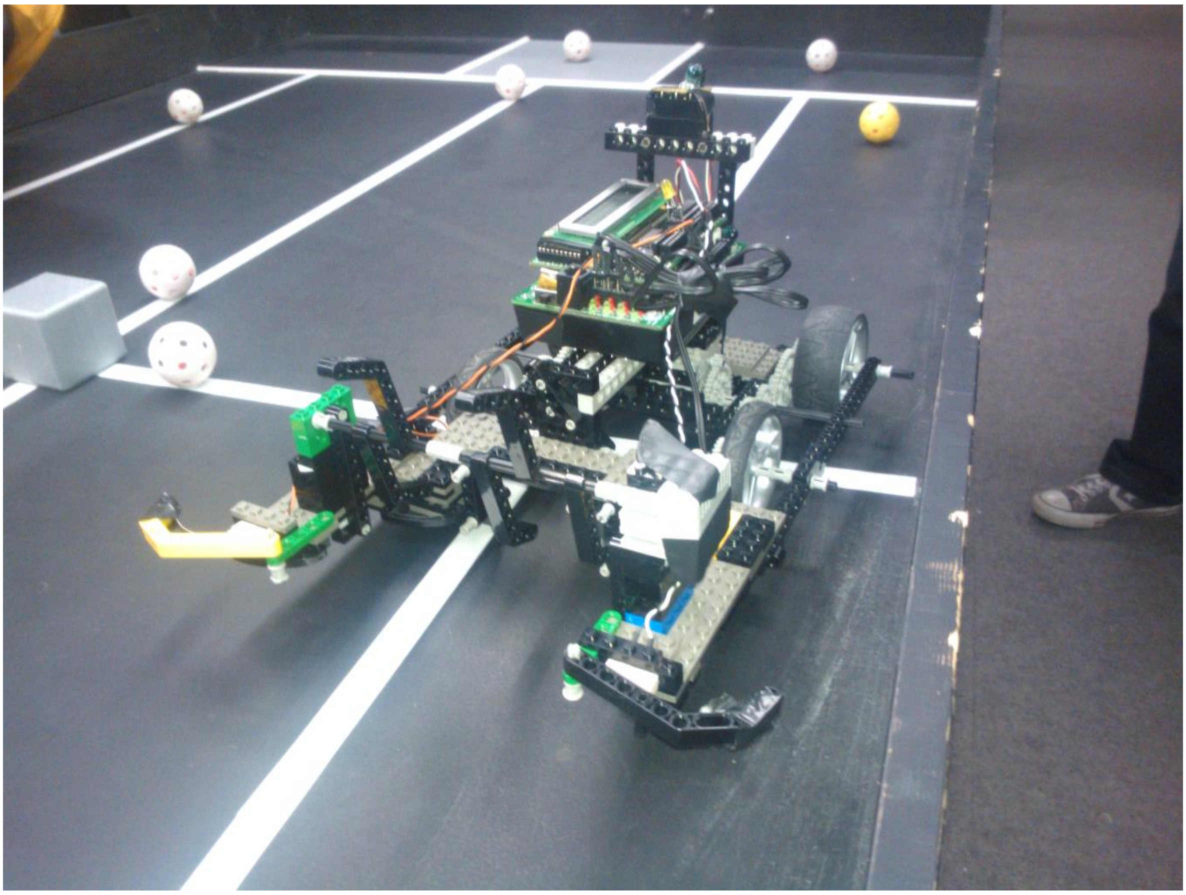
We have got a reflective optical sensor circuit on the inside undercarraige of the robot, in order to be able to differentiate between the grey zone and other areas of the table. This sensor simply must work well, as getting into the grey zone and being able to differentiate when we are in it, will be key in the points difference. However, we may need to rethink the placement of the optical sensor as currently it is in a space where it is covered, blocking all light, which I would imagine will make it more inccurate. Another option would be to position it at the very back of the robot. However, it has worked to date but it will definitely be a consideration moving forward. This sensor will only be used to differentiate between the grey zone and the other areas as we are not using the lines on the table for navigational purposes.

We also have placed a microsensor with a short hinge on the top of the undercarraige that is pressed each time a ball is collected and hence we will be able to know when we have 8 balls and hence head straight for the opponents grey zone. This will obviously incorporate a count function in the programming.

As per RoboRugby Rules, we also have a yellow LED for the handyboard to indicate the start sequence and we do, of course have a beacon receiver with cone shaped shield as well.

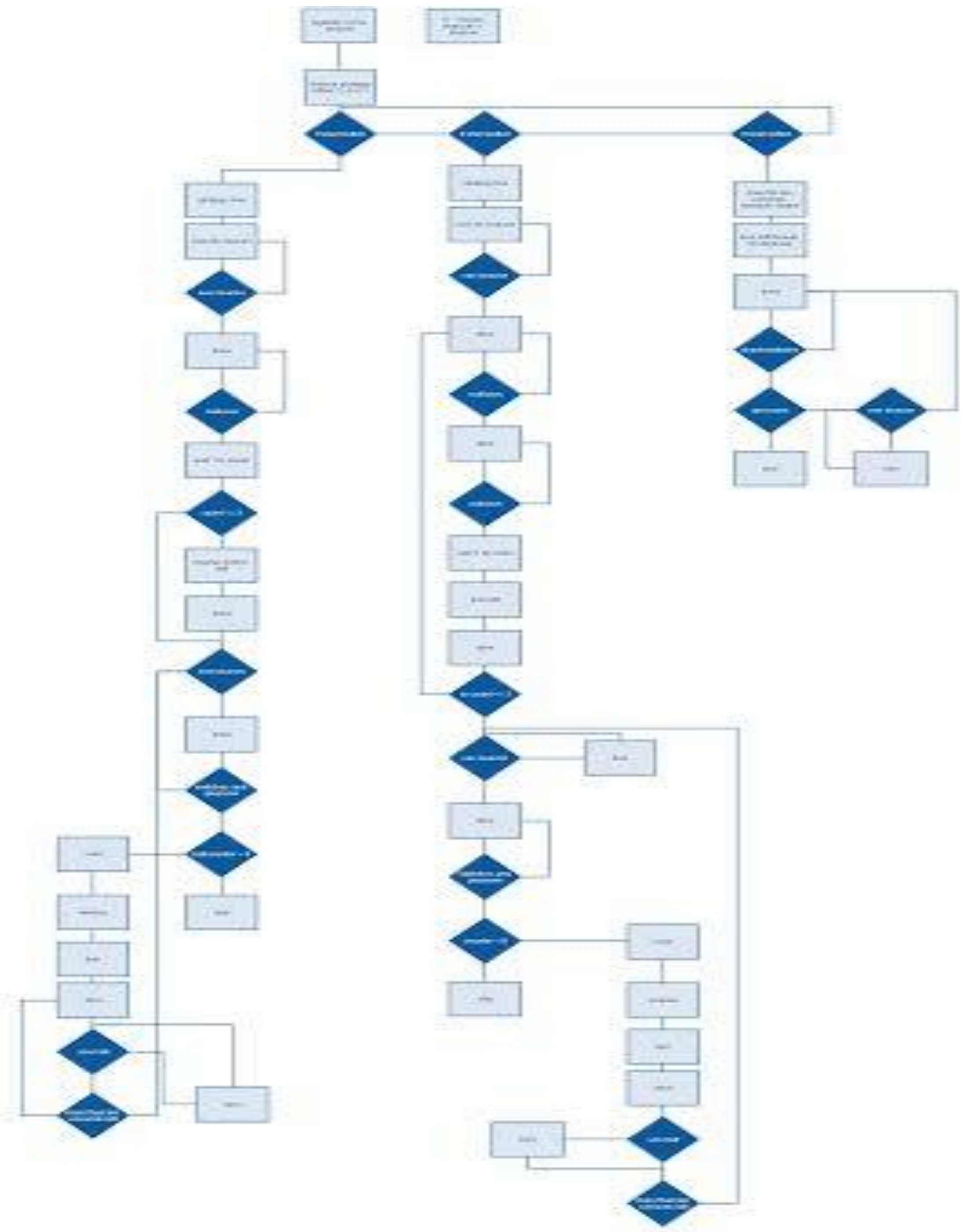
We have spent a considerable amount of time now ensuring that our robot is structurally sound, reinforcing the chassis and framework with more lego, as the considerable weight of the handyboard was causing our 24 and 40 bit gears to bend slightly inwards, even though the weight is distributed over a large surface area, which we initially thought would counteract this problem. We were afraid that this would eventually cause wear and tear and negatively affect our robot's performance, and so we are currently incorporating a matrix of criss-crossing beams across the chassis in order to strengthen the robot as a whole. We have also added two long beams vertically on the back of the robot, with the dual purpose of both supporting the handyboard and serving as a very good base for our beacon sensor.

The overall length of the robot is 325mm and the width is 315mm. The height is 235mm. This is extremely close to the limit for the robot's dimensions in width and length. We didn't initially plan to have a gargantuan robot in comparison to other teams, however once we finally found a gear mechanism that allowed for four wheel drive that we were happy with, it just happened to be quite big. This worked to our advantage I feel, as we had initially planned to be able to store a large amount of balls but we decided to figure out how exactly we would incorporate that into our robot after we had sorted our gears out. This was a lesson learned from our initial starter robot, which was absolutely plagued by gears slipping and grinding, which resulted in a horrible loud grinding sound and a lesson in peer humilation! Other teams however have ended up having quite a front or back heavy robot as well through having a smaller robot and trying to fit all the technology on, something which our larger chassis has really helped us to avoid!



Software

We have not written much of our competition strategy as of yet, however we do have it all planned out. I believe that it is simplistic enough that we should not run into any major difficulty programming it. Myself and Aaron have agreed to do most of the programming while Fergal works on the tipper.



**Credit to Fergal Lonergan for the flowchart*

Performance

The video for our demonstration starts at 5:53.

In the demonstration event, at the end of week seven, our team was pitted against team 20's robot. At the beginning of the lab we knew that we had a lot of work to do, however we elected to continue on with our project plan (Which will be discussed further in this report) and not to concentrate on the software programming. We weren't really concentrating on the demostration event, as it didn't count for anything towards our grade directly and we all felt confident that we were relatively far ahead of most other teams, time-wise. In hindsight, had we really wanted to do well in the ranking round we would have had one person continue on adapting the hardware and had two people work on the software. However, I felt that our robot showed some pretty good capabilities in the round, as it did manage to collect 6 points worth of balls. It did not make it to the scoring zone though, as we had about half an hour to work on the program and decided to go with dead-reckoning, knowing full well that that strategy might well backfire on us (Which it unfortunately did) We also assumed that the other team would head towards their scoring zone initially too, which they did not. However, this will be counteracted when we have our full competition programming done.

The end result was that we drew in points with team 20, however, watching the video, its pretty evident that our robot deserved the win. This however, was a great lesson for us. It showed us that dead reckoning will change everytime as there are always variables. It has redirected our attention towards the programming and it's importance, which was well needed.

A few other changes that needed to be made were also made evident by the practice round:

-The need for two pillars to be placed beneath the collision sensors to push balls towards the harvester instead of letting them rest against the collision sensors, as when we stop or turn the balls are lost. Three potential points were lost by our robot in this way in the demonstration round. I had previously listed the potential advantages of these, but I believe now that they will be added.

- We have to place bars infront of our harvester to stop it getting damaged, similarly to what team 19 have done.

-The importance of actually getting to the scoring zone was emphasised. I know that may seem like a ridiculously obvious point, yet many teams collected balls and never made it to the scoring zone. This also emphasised the possible importance of the tipper.

-I think we should experiment with slowing the motors slightly before turning or stopping as stopping abruptly is jolting the robot forward and when the robot is at full capacity it may cause a ball to come free or block the harvester. Its definitely a consideration and is just something that is noticable in the video.

I did think that we had some positives to take from the demonstration round, such as:

-Most teams had very what seemed like very basic and/ or very little programming done. However, it was blatently obvious who had given it any attention at all, such as team 19 who had a ball finding program in theirs obviously, however they didn't manage to make it to the scoring zone either.

-Our robot moved quickly and maneouvred itself around the table well. The other robot was noticably quicker, but I don't think that given the length of the board and the fact the match lasts sixty seconds and we only have to go around the board once that it's a worry.

-Our collision sensors worked well and weren't hyper-sensitive due to the addition of the arms over them.

Project Plan

Week 8	1) Add Tipper 2)Get all sensors programmes together 3) Ensure all previous operations are working 4)Add bricks beneath collision sensors to guide balls
Week 9	1)Get tipper working 2)Test all sensors and mechancal parts code 3)Write match program 4)Test against another robot
Week 10	1)Spend lab getting ready for seeding test.Write specific program and strip out unnecessary weight. i.e Tipper
Week 11	1) Tweaks to robot and strategy based on observation 2)Add additional strategy option in menu (Just a different order than primary strategy-See under strategy section) 3) Identify which teams we will play and decide which strategy to use for each-Write list. 4) Test matches against different types of robots
Week 12	1) Review performance 2)Write final reports 3) Celebrate (Hopefully!)

We do not need the tipper in the ranking round, in fact we plan to strip the robot of all non essential parts to increase it's speed for the round. So should we run into difficulty and become delayed, we can afford to wait to do the tipper.

Conclusion

I have completed an outline of all our proposals and plans for the design, programming and timescale of our project. I believe us to be well on track with being very competitive in the Siemens RoboRugby Competition and hope to compete for the title! We have picked out areas in which we need to improve, the programming predominantly, yet the timescale for the project is definitely achievable should we continue to focus our efforts and work as a team.

Clodagh Dunne