# PROJECT 1: EV3 ROBOT FOOTBALL GROUP TECHNICAL REPORT

# PROBLEM SOLUTIONS

A solution pertaining to the issue of what form of final drive to use was to use wheels instead of tracks. This is because, after extensive testing, it was found that, when building the robot using the supplied kit, wheels offered superior speed and maneuverability over tracks in this case. Coding changes were made to overcome the shortcomings of the wheels. When driving in a straight line, the motors were able to spin at 100% speed but when the robot was required to change direction, the motor speed was decreased and the motor on the side of which the robot was turning would rotate in the opposite direction. A bearing was also introduced at the rear of the vehicle to aid with turning, which allowed the robot to make more sudden, closer turns. This design negated the disadvantages of using wheels, whilst keeping the benefits.

With reference to the issue of the placement and orientation of the microprocessor, it was found that this should be placed horizontally and slightly to the front of the vehicle. This was discovered through testing, in which the position and orientation of the microprocessor was changed to analyze the most beneficial location. A horizontal orientation allows the weight of the microprocessor to be spread across the structure of the robot as opposed to a vertical position, as this forces the weight to be centralized around a smaller surface area. This caused the robot to become unstable when travelling at high speeds or when turning and could result in the robot falling over. The microprocessor was also placed slightly towards the front of the robot, to add a slight weight imbalance. The weight was slightly higher in the front than it was in the back, as this gave the front wheels added traction. This was necessary as the robot was front wheel drive. This allowed the robot to travel at higher speeds as it reduced the chance of the driven wheels spinning due to a lack of traction. A drawback to orientating the microprocessor in this position was that it was not ideal when the batteries inside required changing. It required a lot of the robot structure to be removed to complete this task. Although this was a factor, the group still decided to stick with the design as the positives outweighed the negatives in this case.

With reference to the issue of sensor placement, many different designs were tested in order to find the best result. The sound sensor was required to be facing away from the motors so that no sound would be detected from them, which could have caused the robot program to end prematurely. The ultrasonic and infrared sensors required locations that were near the front of the robot, but also had to be low enough on the frame to detect objects or an infrared beacon that were located at low heights. The touch sensor placement also had to be considered as it was required to be in front of all of the other sensors and had to be located far enough forward that, in case of a malfunction in which an object was hit, the sensor would be touched by the object instead of the robot. When the sensor was touched it would shut down the whole program, preventing any further damage to the robot or the object.

To overcome the sound sensor issue, it was placed with the microphone pointing vertically at the rear of the vehicle, away from the motors. Through testing it was found that this rectified the issue of excess noise detection from the motors. The ultrasonic and infrared sensors were both placed at the front of the vehicle, attached to the sides of the microprocessor. This allowed the sensors to be low enough that they were able to detect low objects, but high enough that their field if detection was not inhibited. When designing the robot, it was found that, by building a bracket out from the front of the robot frame, the touch sensor was able to be placed in a position that was in front of all the components of the robot. The frame also allowed the sensor to be placed at a low height, giving the sensor a more effective location. This was because the sensor was then able to touch lower objects than if it was located higher on the frame.

When faced with the problem of how to hold the ball whilst navigating to the goal and how to kick the ball at the goal, there were a few options. One option was to use a robotic claw at the front of the vehicle to grab the ball and release it at the goal. The other option was to use a motorized arm at the front of the vehicle to trap the ball whilst navigating to the goal before releasing the ball and acting as a surface to kick the ball with. When assembling the robot, it was found that, due to the design of the robot, the claw made the front of the vehicle too heavy which affected the traction of the rear bearing, lifting it away from the ground. A solution to this problem was to use a much lighter motorized arm, which when coded acted both as a retention tool and as a ‘leg’ to kick the ball with. The arm was designed to stay closed, holding the ball within until the robot reached 40cm away from the infrared beacon. Once the robot was within range, the arm would open, the robot would slowly reverse by 10cm and the arm would close again. Once the arm was closed, the robot would quickly accelerate, kicking the ball using the arm in the closed position to hit the ball. The motorized arm allowed for better weight distribution and the design was superior for the intended purpose.

With reference to the final issue stated in the problem analysis, trouble was found when attempting to code all the processes to work in unison. When coding, all the processes stated in the project specification were completed in separate programs, but trouble was found when attempting to put them together into one program. With research and testing the group discovered how to use loops and switches to enable processes to work simultaneously which allowed multiple processes to function in unison, but there were still processes that would not work together, namely the processes pertaining to the ultrasonic and infrared sensors. After more research and testing, the group concluded to focus on perfecting the processes individually before attempting to put them together in one program as this was more important within the specification. This was the superior idea, as this allowed the group to pass the robot performance testing stage.