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| RCJA 2025 Rescue Line, Rescue Maze and Soccer Technical Description Paper |
| Team Information: |
| Challenge/Division: Lightweight Soccer |
| Team Name: Hyperion |
| School: Brisbane Boys’ College |
| State/Territory: Queensland |
| Team Member Names:  If any team member had a specific role, please include this below. |
| Member 1: Matthew Adams (Hardware, Electrical) |
| Member 2: Sam Garg (Software, Movement & Avoidance) |
| Member 3: Luke Atherton (Hardware, Structural) |
| Member 4: Thomas McCabe (Software, Camera Vision) |
| **Robot Properties (200 words recommended maximum, plus components list (if applicable))** Please describe the software (e.g. EV3 Block Code, Python) and hardware (e.g. Spike Prime, EV3, Raspberry Pi) you have used for your robot.  For each piece of software/hardware used, please give it a star rating out of 5 (1=very bad, would not recommend to other teams, 5=very good, would strongly recommend to other teams).  If you have used custom electronics for your robot, please include specific model/part numbers or web links, and a star rating for each. |
| Hardware:  Our robots are custom-made with PCBs, PLA Printed Parts, and CNC-machined Aluminium  plates. We use the CAD program Autodesk Fusion 360 to create 3D models of parts to  test, then decide if they are applicable to implement into our final design. The main things  considered when making the design were Size, weight, and easy access to important  components, e.g., microcontroller, camera, fuses, battery.  Our robot uses 4 (DCX19 9v Maxon motors) motors for increased power and speed, and  to improve balance and control for full 360-degree movement of the robot. For this 360-  degree movement to occur, we made omnidirectional wheels, so the robot rolls flawlessly  around the field. The wheel frame is made from ABS filament, while the rollers are made  from silicone with a metal core. These wheels are positioned around a metal wire to keep  them in place.  The vision system for our robot consists of adjustable 3d-printed PLA plates (allowing for  image centring), an acrylic tube (ensuring no blind spots), a conical mirror (for long range,  reliable, 360 goal vision), and the camera itself (OpenMV Cam H7 Plus).  Electrical:  We have 2 custom-made PCBs these are an Integrated main board and a Light sensor  board.  The Main Board:  Our main board holds all our important components and the power supply circuit. Since  our robot uses a 12.6V 1300mA battery for our motors and motor controllers, we use 2  regulators, which are 5V and 3.3V to power the rest of the board. The main  microcontroller runs on 5V while all other components such as the (Camera) OpenMV-H7-  plus-R4, (IR Sensors) TSSP58038, (Bluetooth) HC-05, (Compass) BNO005, and the Light  sensor board via a FFC connector.  The Light Sensor Board:  This PCB contains 32 Red LEDs and 32 Photo transistors. Each LED and Photo transistor is  accompanied by resistors and 0.1uf caps. The signals are transferred to 2 16-bit  Multiplexers (MUX) 1 for the right side of the board and 1 for the left. These Multiplexers  are used for easy reading of many sensors. The outputs from the Multiplexers are  transferred through the FFC to the main board, then transferred to the Teensy.  Software:  In terms of software, we use Visual Studio Code as our primary code editor to write, maintain, and manage our projects. Alongside this, we utilise the PlatformIO extension, which provides powerful tools for compiling code, identifying errors efficiently, and uploading firmware seamlessly to our robot. This setup has proven to be both reliable and efficient. We highly recommend this combination (5/5) to other teams—provided they are using a PlatformIO-supported microcontroller, such as the Teensy 4.1, which we currently use in our system.  Component Ratings:  Maxon DCX 19 16:1 Motors x4 (Rating: 5/5) https://www.maxongroup.com/enau/drives-and-systems/brushed-dc-motors  OpenMV H7 plus R4 (Rating: 5/5) https://openmv.io/products/openmv-cam-h7-  plus?srsltid=AfmBOopUlx-O5g0kAdq29yPygN9NjdEHzttPajDnhGekYY7qRUs\_2A8N  Teensy 4.1 (Rating: 4.5/5) https://core-electronics.com.au/teensy-4-1.html  BNO005 (Rating: 4/5) https://www.amazon.com.au/Precision-Acceleration-GyroscopeGeomagnetic-Smartphones/dp/B0FD8P7FWX  HC-05 (Rating: 4/5) https://www.amazon.com.au/Bluetooth-Pass-Through-WirelessCommunication-Arduino/dp/B01G9KSAF6  TSSP58038 (Rating: 4/5) https://www.digikey.com.au/en/products/detail/vishaysemiconductor-optodivision/TSSP58038/4695717?srsltid=AfmBOopEVuwf\_liw91CwBaYATAahxA23xp6aBPaJavajmFHZMRfkdnSS |
| **Collaboration (100 words recommended maximum)** Please describe if your team has used any methodologies, software or systems to aid collaboration (working together). This could be related to the design, construction or programming of the robot(s).  It is the overall desire of RoboCup Junior events that any technological and curricular developments will be shared with other participants after the event. Any developments including new technology and software examples, may be published on the RoboCup Junior website after the event, furthering the mission of RoboCup Junior as an educational initiative. |
| To communicate, our team uses Microsoft Teams and WhatsApp. Furthermore, to ensure save backups, we use GitHub and email. This ensures that we have a backup should something go wrong locally on our computers at any time. |
| **Key Achievement & Area for Improvement (300 words recommended maximum)** Please describe one aspect of your robot your team is particularly proud of, and one aspect you would like to further improve. |
| From a hardware perspective, a key achievement would be the design of the vision  system. Utilising adjustable plates (ensuring the camera’s vision was centered in  OpenMV), an acrylic tube as opposed to standoffs (removing blind spots and allowing for  constant, reliable 360-degree goal vision), as well as a conical mirror shape with  specifically calculated dimensions (allowing for a theoretical 31m of goal vision with  seeing above perpendicular, in all directions), all allowed for a successful vision system  from a hardware perspective.  An area for improvement would include the addition of more complex components in  future competitions. While refining the basics was beneficial this year, without more  complex components such as a kicker, we often found our robot missing goal  opportunities, with the ball often getting stuck within the goal box. Furthermore, when  experiencing electrical issues, requiring changes to components on our main PCB we  often had to largely disassemble our robot, wasting large amounts of time. To improve  this in the future we aim to make our design in a way such that our main PCB is more  accessible, so changes can be made more efficiently.  Specific aspects that we are particularly proud of on the robot include our centring and defender logic. With both the attacker and defender, when the ball is not present, they are coded to “centre” on the field according to either the attacking or defending goal. However, despite these successes, there can be some improvements in other aspects of our robot. This can include implementing a more reliable and consistent method for our out-of-bounds avoidance, and also our line remembrance. Furthermore, we look forward to implementing a kicker and dribbler strategy on our robot in the near future.  The parts of our electronics that we are proud of are the design of the PCB. For example,  the routing for the motor controllers was difficult and time-consuming because we  needed to try and fit 100 mil width traces to reduce resistance in the circuit and have the  motor controllers be in an easy-to-access position for easy repair if the motors come  unplugged or damaged. Additionally, the motor controllers had to connect to the teensy  so space for all the traces had to be considered. |
| **Photos and Design Documentation (100 words recommended maximum, plus images)** If there is a design drawing of the robot or if you have photos or notes of the development process, please provide these as proof of your team’s learning. |
| All of our code developments can be seen in our previous commits inside our GitHub here: <https://github.com/SamGargRobotics/Hyperion-BBC-Robotics>. |