# ROBOTS TO RESCUE - TEAM 2

UNSW SYDNEY

## ENGINEERING QUALITY

Through integrating sensors, DC motors, and reliable communication using Arduino technology, our robot is capable of **autonomous operation under human supervision.**

The rescue robot needed to meet the functionality objectives of;

- Manoeuvring through **a maze**
- Manoeuvring over **rough terrain**
- **Detect objects** in its path and **report distance** of an object
- Identify and **rescue a victim** (tennis ball)

The rescue robot's navigation and obstacle-avoidance capabilities relies on its **ultrasonic sensor**. This sensor scans the robot's surroundings by **moving left, right, and forward**, providing comprehensive vision. It can accurately measure distances between the robot and objects, and transmit this to the serial monitor. For **communication**, the rescue robot utilizes **Arduino Uno and motor drive modules.** The robot is **controlled using a keyboard keys,** allowing the robot to be controlled remotely with **precision**. These components were selected for their **affordability** and **user-friendly interface.** To ensure the **reliability** and **quality** of the **rescue robot,** measures are taken as shown in the **requirement table**, serving as a **guide for testing and verifying.**

| IDD | Description | Rationale | Verification method |
|---|---|---|---|
| 1 | No toxic, radioactive or dangerous materials shall be allowed | Constraint set by RDR design brief. | Conduct a thorough inspection and read through the materials on items such as batteries being used on the robot to ensure the robot adheres to guidlines. |
| 2 | Budget of $120 | Constraint set by RDR design brief. | Analysis: Create an online receipt/document of the prices of materials and resources required to construct the robot. |
| 3 | Robot must fit in a cylinder with a diameter and length of 250mm | Constraint set by RDR design brief. | Analysis: Utilise 3D modelling software to ensure the robot adheres to the restrictions and is smaller than 250mm in height at a fully extended position.<br>Test: Physically measure the robot using a tape measure and make sure the robot can fit in a cylinder of the same measurements. |
| 4 | The prototype robot must weigh less than 1000 gm, including its batteries | Constraint set by RDR design brief. | Analysis: Calculate the total weight of the materials and parts used to construct the robot to estimate the robots weight.<br>Test: Physically weigh the robot on a scale and get an accurate reading of its official weight. |
| 5 | The robot should be able to be operated offsite | Decision made by RDR team as the prototype is designed to mimic real disaster situations. | Test: Conduct a series of simulations and test to ensure the inputs from the operator are properly received by the robot. |
| 6 | The robot must be able to detect objects in its path and the gauge distance | Constraint set by RDR design brief. | Test: Conduct a series of tests using different items, obstacles and maze structures and compare the distances measured by the robot is equal to the actual distance measured using a tape measure. |
| 7 | The robot should be able to rescue the victim (tennis ball) | Constraint set by RDR design brief. | Test: Conduct a series of simulations to ensure the robot is able to safely capture and transport the victim. |
| 8 | The robot should be robust | Decision made by RDR team as the prototype is designed to mimic real disaster situations. | Test: Ensure the robot is built with robust material by placing the materials under stress and pressure tests and analyse if any of these tests left damage.<br>Inspection: Once the prototype robot is complete ensure that the frame is not fragile by pushing and abruptly manipulating the robots movements. |
| 9 | The robot design should be creative and innovative | Decision made by RDR team as assessed on innovation aspect. | Analysis: Research a multitude of robot designs from the past and see where these robots have failed and where they have been successful to brainstorm new ideas and potential solutions.<br>Test: Compare the prototype robot to other robots that have been designed by other teams, and brainstorm further about any more improvements that can be made. |
| 10 | The robot should be able to maneuver over rough terrain | Constraint set by RDR design brief. | Analysis: Use mathematical modelling to predict if the robot is able to overcome slopes of varying degrees and steps of varying height.<br>Test: Deploy the robot and conduct a series of simulations in different types of terrain. |

**Figure 1:** Requirements Table

## INNOVATION

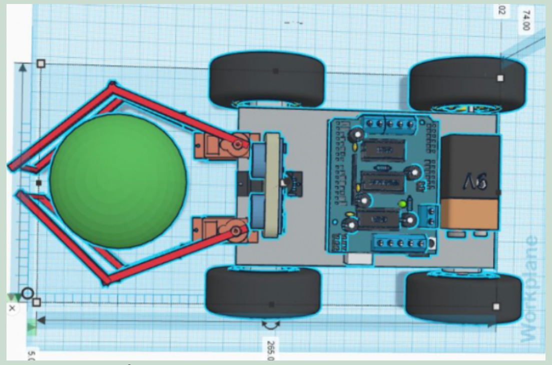

**Figure 2:** Prototype CAD

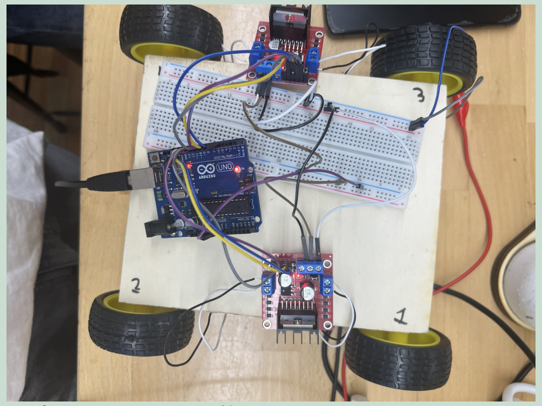

**Figure 3:** Compliance Test Prototype Without Claw

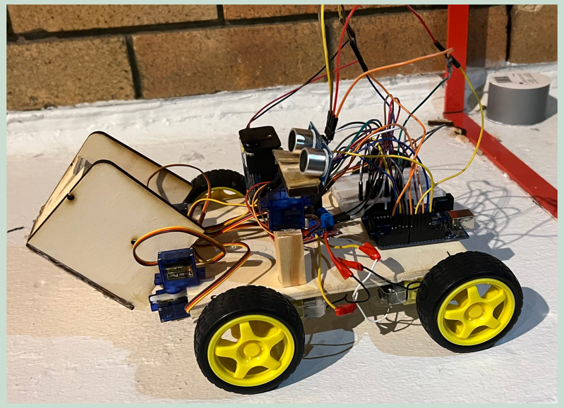

**Figure 4:** Final Robot

The design solution incorporated in our rescue robot for **movement** is **wheels with robust wooden chassis** which is simple yet effective. By utilising **wood** as the **primary chassis material**, the robot gains **durability**. The wheels provide **efficient mobility across various terrains**, enabling the robot to navigate through with ease. Both aspects ensure the **stability and resilience** of the robot. Whereas, we designed an **innovative solution for victim extraction**, **comprising two wood boards and servo motors**, offering an efficient means of retrieving survivors (tennis ball). The two side wood boards have **additional support on the bottom** which prevents the victim from falling off. The **integration** of **servo motors provides precise control** over the **movement** of the claw. The ability to pick and drop objects with controlled force enhances the robot's capability to extract victims safely. The addition of a servo motor for **vertical movement** expands the claw's functionality, allowing it to **adjust its position according to the victim's location and the surrounding conditions.** This feature enhances the robot's adaptability to diverse rescue scenarios, ensuring optimal performance in challenging environments. Along with innovation, we needed to ensure that the robot **meet the design objectives and budget limits** which **restricted** the ability to show **more innovation solutions.**

## AESTHETIC APPEAL

In a rescue context, our robot features **highly visible**, plastic yellow **wheels** positioned on **all four corners** of the robot's outer frame. These bright wheels are **designed to stand out**, aiding in **catching the attention of victims**, particularly in low-light conditions. Additionally, we've **painted** the robot **yellow** to further enhance its visibility during rescue operations. This deliberate choice of colour makes the robot **easily locatable and identifiable** amidst chaotic environments. By incorporating brighter colours into the robot's aesthetic appeal, our aim is to **encourage cooperation from victims** during unforeseen circumstances, ultimately **facilitating smoother and more effective rescue operations**.

**Figure 5**: Inspiration for high visibility

## ROBUSTNESS

For our rescue robot's robustness, we carefully selected the most **durable and lightweight** wood available for constructing its chassis, to ensure the robot possesses the **necessary strength** to withstand challenging environments whilst still **adhering to weight constraints**. By utilising this robust yet lightweight wood, our robot **benefits from enhanced manoeuvrability**, enabling it to navigate through rugged terrain - characteristic of rescue missions - with ease, while **maintaining optimal performance**.

To further ensure the robustness of the robot, we implemented a **modular design solution**, allowing for the **seamless replacement of damaged or malfunctioning components**, with each component of the robot designed to be easily detachable and replaceable. This not only improves robustness but **saves** the most important resource during rescue operations: **time.**

The components of the prototype are **reinforced with hot glue** as a durable adhesive allowing it to withstand vibrations whilst navigating the maze. Additionally the electrical components are **reinforced with solder** to bind the wires of the circuits together enabling it to stay secure so that the circuit, and by extension the prototype, operates as intended.