Project SuperNova

1. INTRODUCTION

SuperNova is a team of four students from various disciplines aimed at developing innovative robotic projects. The team comprises Adithya S.M. (Electronics and Communication Dept.), Femin Francis (Applied Electronics and Instrumentation Dept.), Karthik (Mechanical Dept.), and Riya Tony (Applied Electronics and Instrumentation Dept.) of Rajagiri School of Engineering and Technology, Kerala. We aim to build a rope climbing robot that can carry the given payload to a specified height in this competition. The work started with the conceptual design, scoring, and then selecting the most appropriate design. The bot has been designed to take commands through wireless communication using a mobile application. A detailed description of the robot design is included in the following sections.

2. PROBLEM STATEMENT

Design a manually controlled wired/wireless bot that can move on the ground, grip the given payload (wooden block) and climb the vertical rope to a specified height.

3. ROBOT COMPONENTS

- Arduino Mega 2560

- L298N motor drivers

- Metallic servo motors - MG995

- Operating voltage: 4.8V ~ 7.2V

- Power Supply - 18650 Li-On Battery Pack 12V
- Stepper Motors - 4.2 kg-cm, current: 1.5A/Phase, Step angle: 1.8 deg ● Stepper motor driver - A4988

- Max logic voltage: 5.5V, Max operating voltage: 35 V

- Max current per phase: 2 A

- Caster Wheel
- 3D printing filament (PLA)
- Switch
- Jumper Cables
- Battery
- HC-05 Bluetooth Module
- 12V DC Motors

4. LANGUAGES/PLATFORMS USED

- Arduino Compatible C
- MIT app inventor
- Fusion 360

5. DESIGN

The final design for the robot was selected by following a systematic approach based on

conceptual scoring and ranking. The essential characteristics considered for the conceptual selection were weight, manufacturability, portability, and ease of control. The CAD models for the various designs were done using the Autodesk Fusion 360 software. The Aluminium

Composite Panel was chosen as the base material to reduce weight and impart high strength to the robot. Similarly, few parts requiring custom shapes were made using the 3D printer.

The Arduino Mega is programmed using Arduino compatible C to complete the functions. The communication between the user and robot is established using a Bluetooth module. The mobile application interface is designed using the MIT app inventor. The essential parts of the robot are explained as follows,

A. GROUND MOVEMENT

12V DC motors were used for the ground motion of the robot.

B. GRIPPING

The gripping action is established using two rollers; namely, roller **A** and **B** assembled along with the gripping mechanism. Roller **A** is kept fixed above the other roller. The position of Roller **B** can be adjusted to the desired position using a spring-controlled trigger from a servo motor attached to the mechanism. Initially, if the space is insufficient between the rollers to feed the rope inside, we would adjust the roller **B** so that both the rollers conveniently grip the rope. This guides the rope from getting into the desired channel.

For the gripping mechanism of roller **B**, there are four pairs of **U**-shaped slots provided. Rods are placed in these slots. The rod comprises a spring that covers

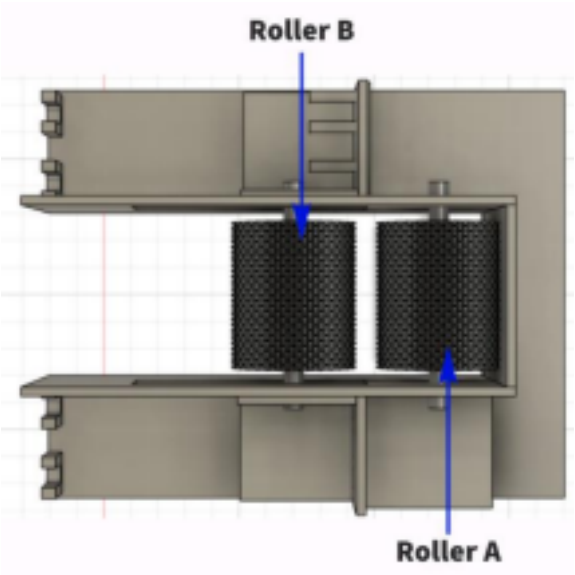
half of its length and the rest is covered by a moving slot (carrying the Stepper motor connected to the roller **B**). The movement of the slot is controlled by adjusting the length of the spring using the servo motor. A stepper motor was used for the rotational movement of the roller.

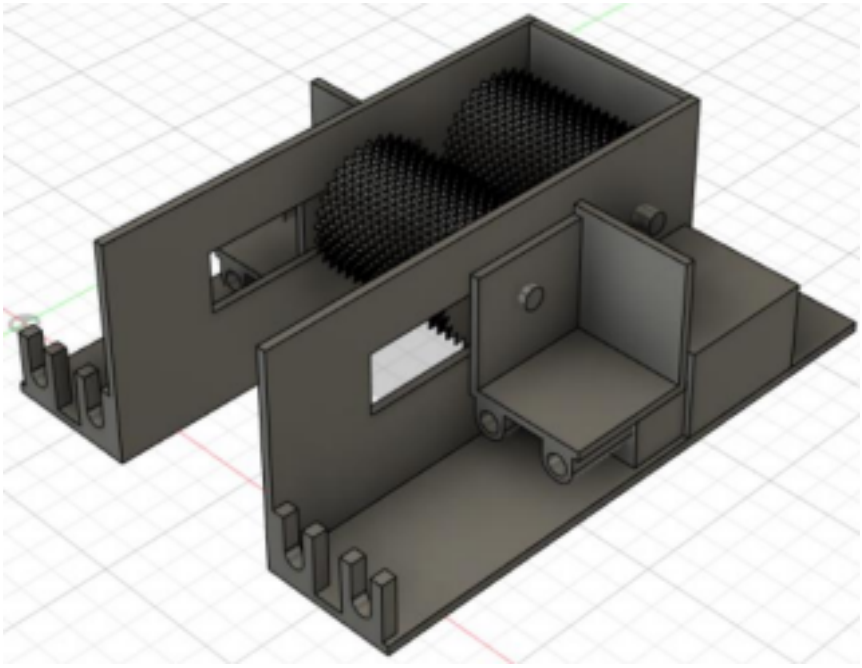
C. CLIMBING

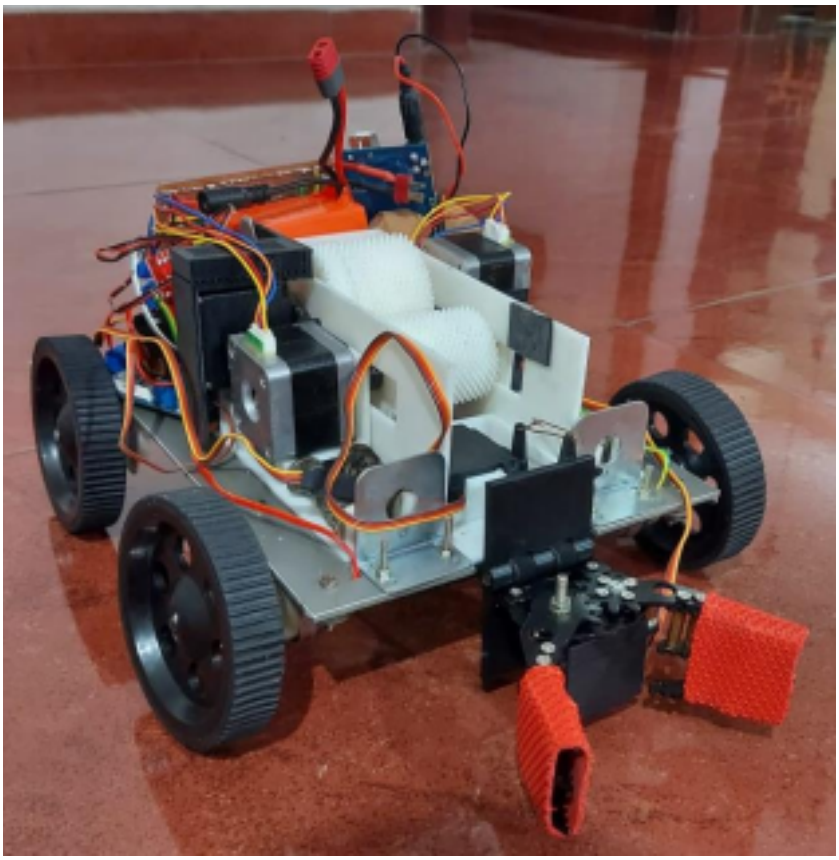
After the rope is gripped in position with the two rollers, the climbing mechanism can be initiated by controlling the speed of two rollers by the user through application.

D.ROBOTIC ARM

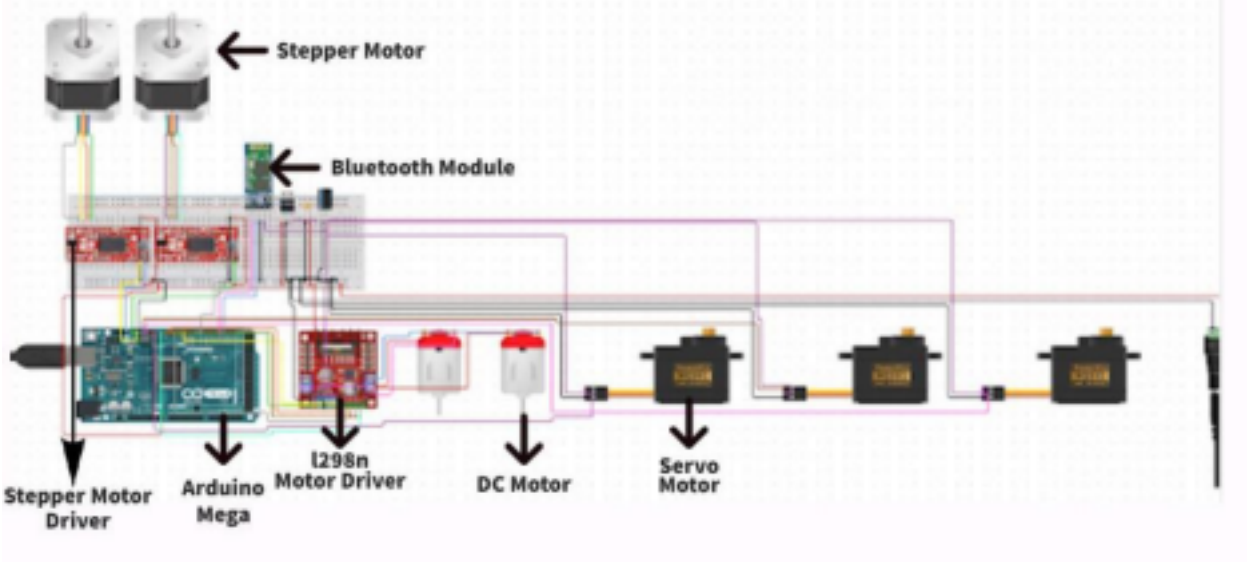
We found that to carry the load, a 3D printed robotic arm would do just fine. For the same, we printed a robotic arm and a high torque servo was used for the adjustments.

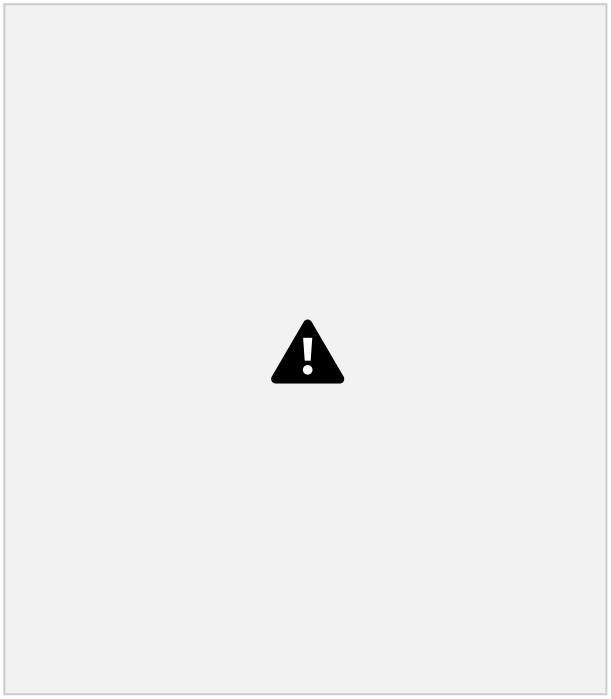

Roller B
Roller A





6. CIRCUIT DESIGN





The circuit mainly comprises of an Arduino Mega, driver, Stepper motor,12v motor, Bluetooth module and a voltage converter. Arduino which acts as the main control unit of the bot receives 8-bit data including a stop bit from the user via Bluetooth module. Each character received from the user, triggers an actuator associated with it. Dedicated drivers (L298N, a4988) are placed for stepper and 12V DC Motor, to prevent any sort of malfunctions. The main voltage source is converted to 6V using a voltage converter to power up the servos.

7. BOT SPECIFICATIONS

The dimension of the robot: 0.22m*0.20m*0.15m

Weight of the robot: 2.5kg

8. APPLICATION INTERFACE

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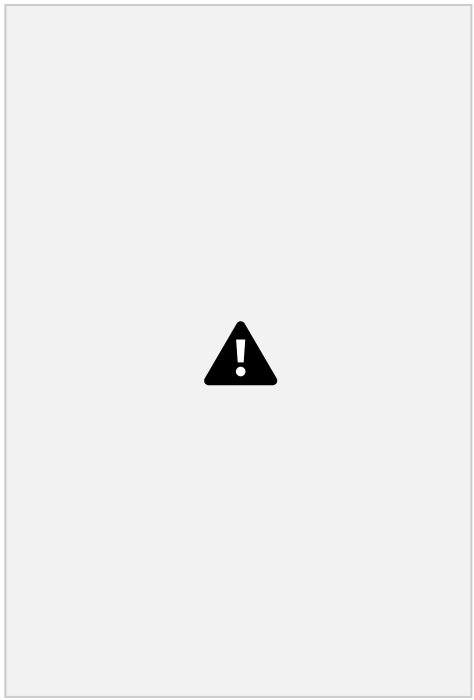
The application required for the robot was created using the MIT APP INVENTOR. Each button in the application interface provides necessary controls. **Show Devices** button is provided to show the devices, **Forward** and **Backward** button enables forward and backward movement of the robot, **Stop** button is used to pause or stop the robot, **Picker,** and **Unpicker** are used to clamp and release the box respectively, **Trigger** and **Reset** are used for gap adjustment of the rollers, **Uproller** and **Downroller** are used for upward and downward movement of the rollers. **Speed 1X** and **Speed 2X** are used for roller speed adjustment.



9. CONCLUSION

This project work helped us to learn different domains of engineering related to the development of a robot. We evolved into three various tasks: electronic, mechanical, and computer engineering. The difficulties in project management and those brought to light during experimentation provided an opportunity to work on our problem-solving abilities. Despite some problems encountered, we found this experience rewarding and educational. We acquired new technical skills while improving our analytical and reasoning abilities.

This project gave us a chance to culminate all our previous knowledge. With a sense of teamwork and commitment, we could complete the project on time. Finally, as technology improves, there will be new ways to use robots, bringing new hopes and potential to humankind.