Hand Gesture Based Robotic Controlled Vehicle

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Outline

- Introduction
- Motivation and Need
- Project Scope
- Problem Analysis
- Proposed Solution
- Goals/ Objectives/ Deliverables
- Impact of the Project
- Project Management
- Project Design and Development
- Simulation Results/Discussion
- Conclusion
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Introduction

- A robotic vehicle capable to move based on hand gestures.
- Can be controlled wirelessly without remote or joysticks etc.
- Allow a human to interact with a device without any touch or audio.
- A car, under the control of user's hand gestures.
- **Gestures:**
  - Non-vocal or non-verbal communication in which visible bodily actions communicate particular messages.
  - Gestures include movement of the hands, face, or other parts of the body.

Motivation and Need

- Aim to provide at par services to disabled persons.
- Better living condition for people with disabilities.
- A single equipment that handles multiple applications.
- Low power consumption.
- Execute the vehicle tasks identified through the human hand gesture.

Project Scope

- According to WHO around 16% (1.3 billion) people of the global population are experiencing disability. These people are facing hardships in their daily life routine. [1]
- We are making a system that will help them to drive their vehicles by using hand gestures which will make their life much easier.
- A robotic car will be developed that will intelligent enough to analyze the hand gesture of the person and will take the appropriate action.

Project Scope (continued)

- The Features of the robotic car are:
  - Forward Movement
  - Backward Movement
  - Right Forward Movement
  - Left Forward Movement
  - Right Backward Movement
  - Left Backward Movement
  - Break
  - Object Detection
  - Rain Sensor/Turn On Wipers
  - Speed Increase/Decrease
  - LEDs

Problem Analysis.(CLO 2)

- Design a robotic car that is controlled by the hand gestures.
- A transmitting circuit is used which transmit the gesture of hand.
- At receiving end, the receiving circuit will allow the motors to move in the transmitted directions.
- The car will be able to follow the seven types of hand gestures.
- To develop Human-Machine interaction.

Proposed Solution (continued)

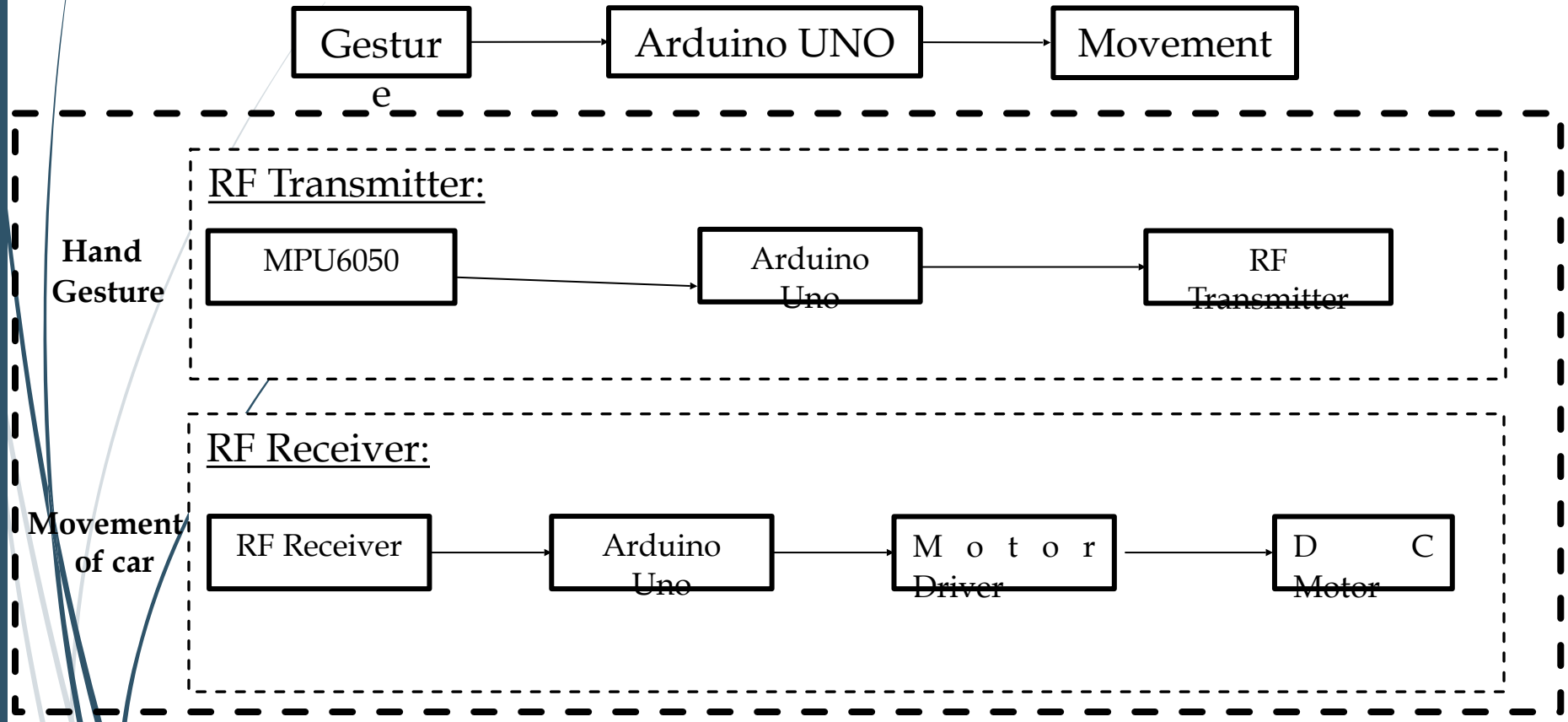
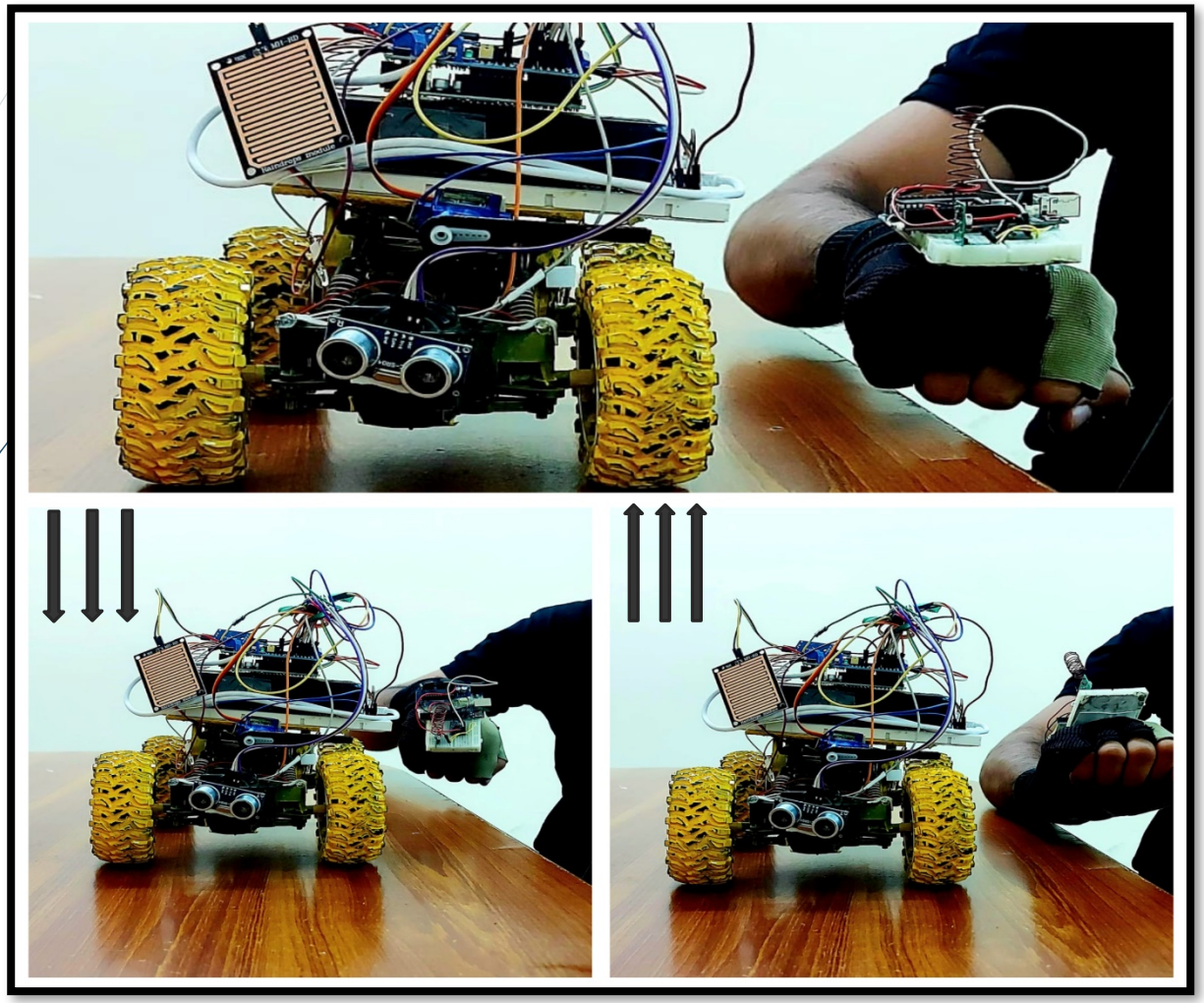


Fig 1: Overall block diagram of proposed project

Proposed Gestures

Part(a): Stop



Part(b):Forward

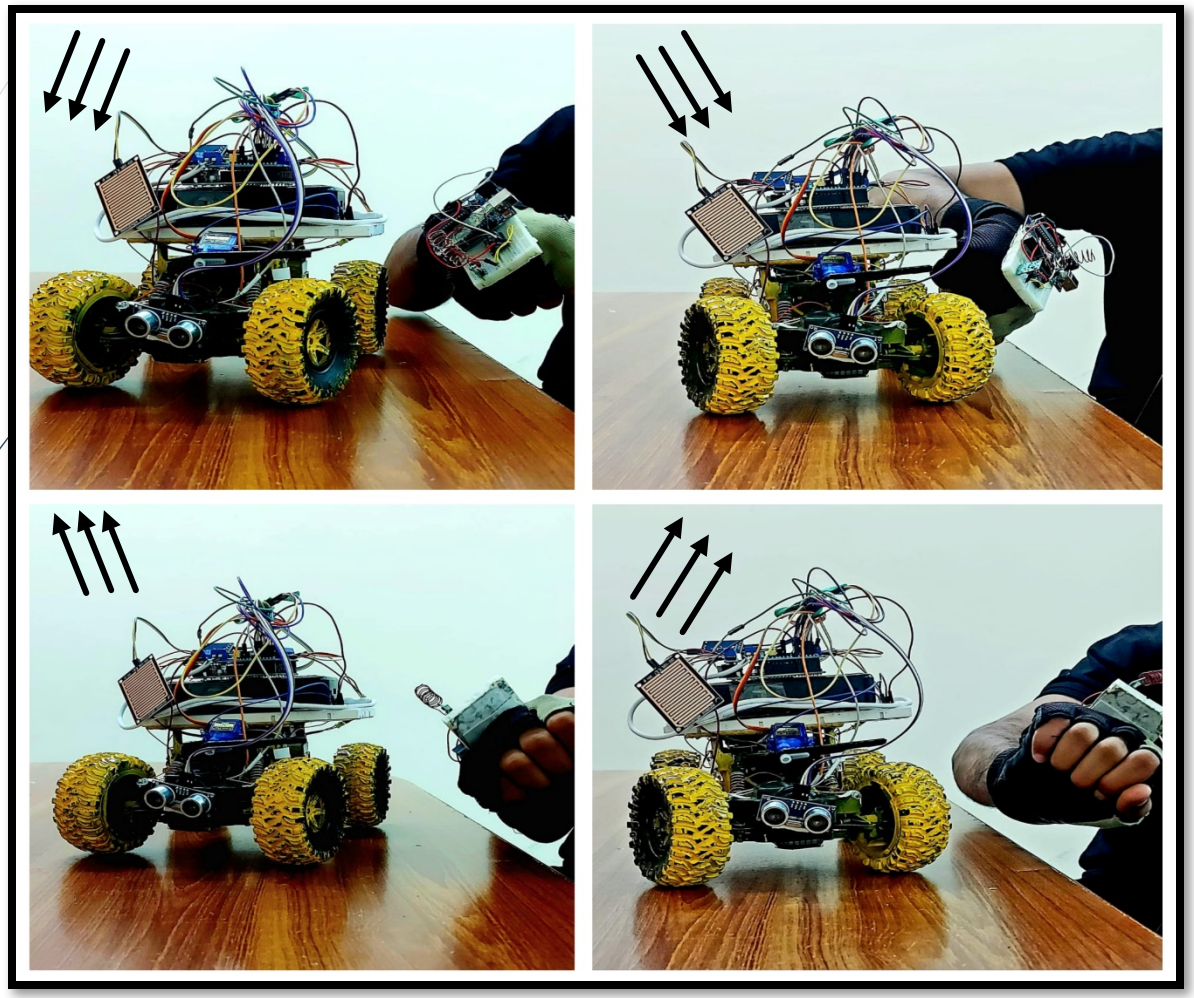
Part(c):Backward

Fig 2: Gestures For Vehicle Movement

Proposed Gestures (continued)

Part(d): Right Forward

Part(f): Right Backward



Part(e): Forward Left

Part(g): Backward Left

Fig 3: Gesture For Vehicle

Required Components

- Arduino Uno
- RF Module
- Motor Drivers L293D
- MPU6050
- Ultrasonic Sensor
- Rain Sensor
- Antennas(Copper wire)
- DC Motors
- Wipers
- Connecting Wires
- Power Source
- Breadboard
- Hand Glove
- LED

Components' Specifications

- **Arduino UNO:**
  - A microcontroller board based on the ATmega328P (datasheet).
  - Operating Voltage 5V.
  - DC Current per I/O Pin 20 mA.

- **Motor Driver Shield L293D:**
  - Wide Supply-Voltage Range: 4.5 V to 36 V.
  - Output Current 600 mA Per Channel.
  - Peak Output Current 1.2 A Per Channel.

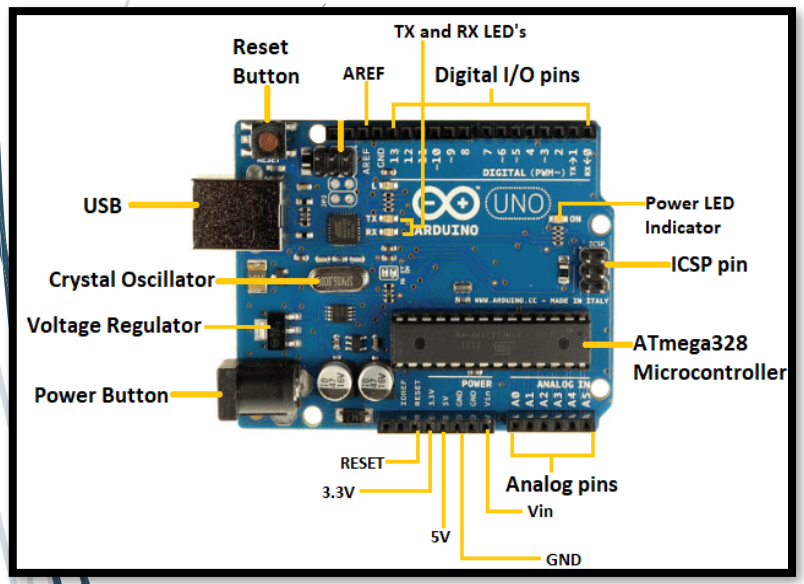


Fig 4.1: Arduino Uno

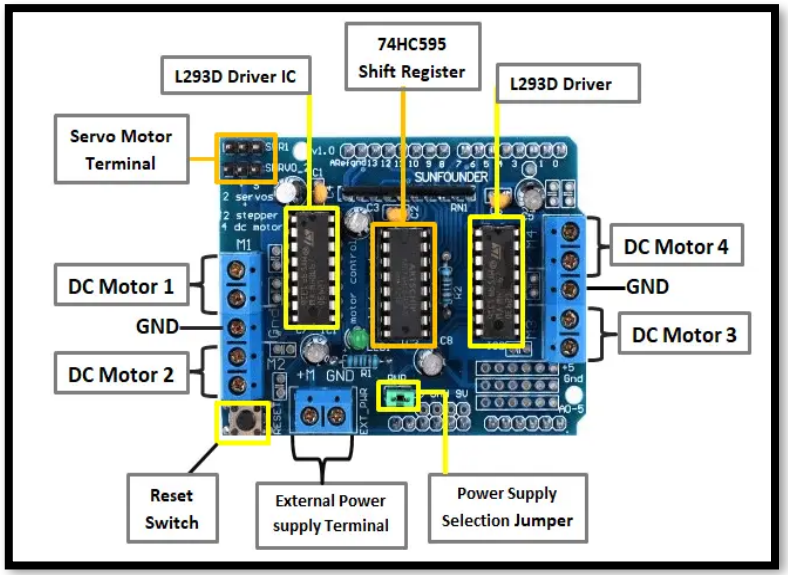


Fig 4.2: Motor Driver shield L293D

Components' Specifications(Continued)

RF Receiver:

- Receiver Model: **XY-MK-5V** (Range:433.92MHz)
- Current Consumption in Standby: 4mA
- Operating Voltage: 5V.

RF Transmitter:

Transmitter Model: **FS1000A** (Range:433.92MHz).

Current Consumption: 20 to 28mA.

Operating Voltage: 3V to 12V.

Transmitting Power: 10mW to 40mW 16dBm

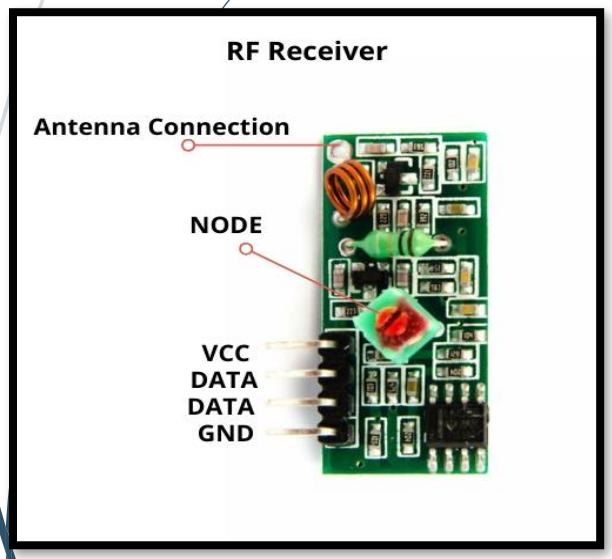


Fig 4.3: RF Receiver

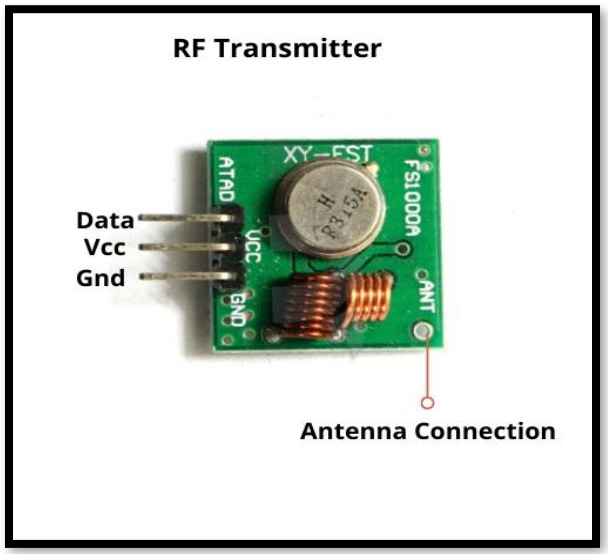


Fig 4.4: RF Transmitter

Components' Specifications(Continued)

- **DC Motor:**
  - An electrical machine that converts electrical energy into mechanical energy.

- **MPU6050 :**
  - Power Supply: 3-5V.
  - Communication : I2C protocol.
  - In Arduino the pins A4 and A5 are the SDA (data line) and SCL (clock line) pins.

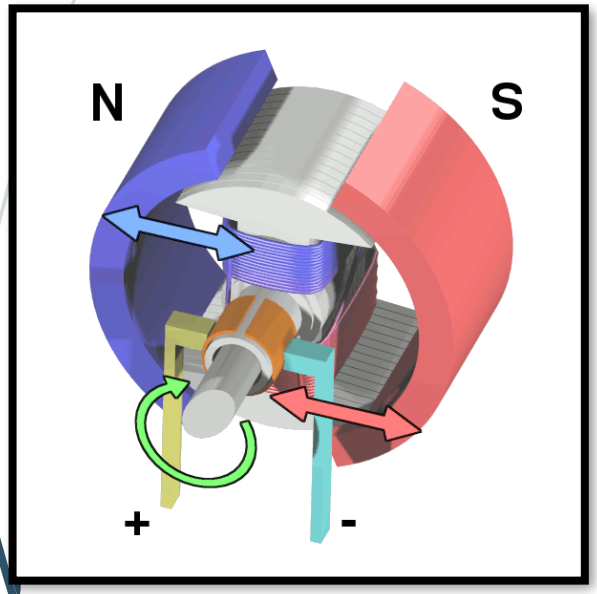


Fig 4.5: DC Motor

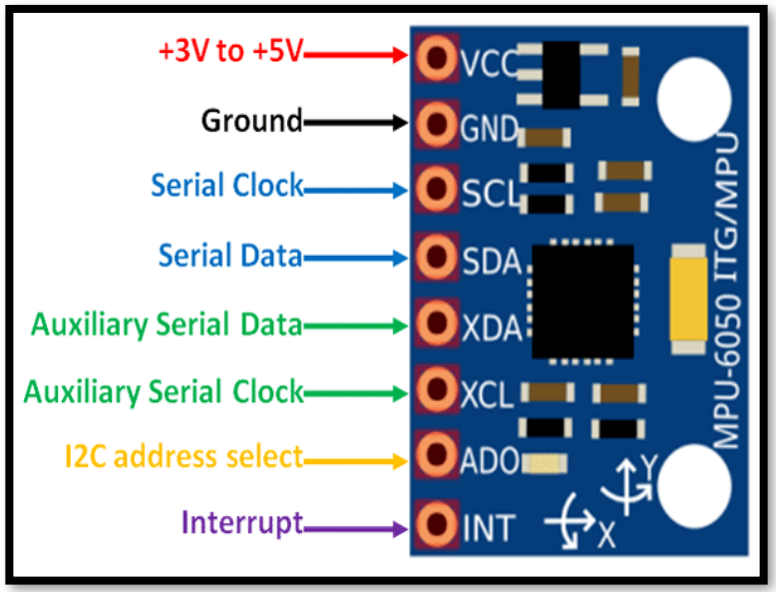


Fig 4.6: MPU6050

Components' Specifications(Continued)

- **Servo Motor:**
  - Operating Voltage is +5V typically
  - Operating speed is 0.1s/60°.

- **Ultrasonic Sensors(HC-SR04):**
  - Operating voltage: +5V
  - Operating Current: <15mA
  - Operating Frequency: 40Hz
  - Sensing range lies between 40 cm to 300 cm

$$L = 1/2 \times T \times C$$

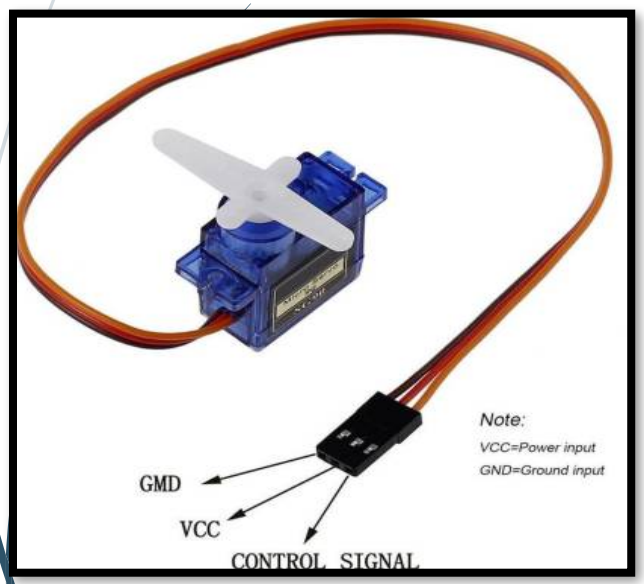


Fig 4.7: Servo Motor

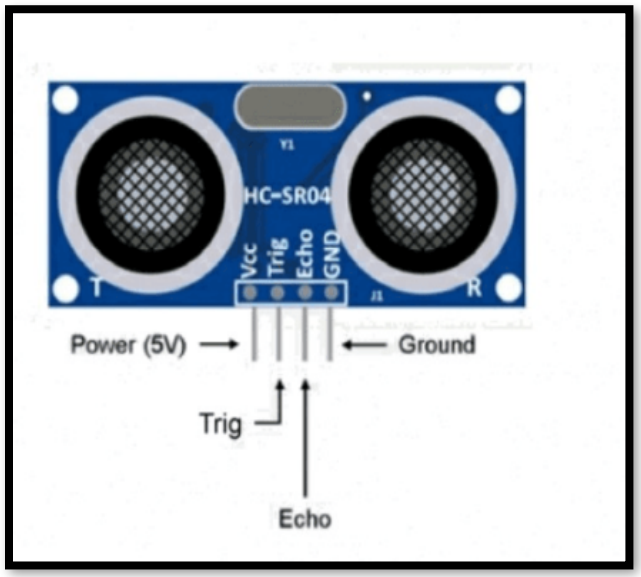


Fig 4.8: Ultrasonic Sensors

Components' Specifications(Continued)

- **Rain Sensor:**

- Operating Voltage 3.3V to 5V.
- Operating Current 15 mA.
- Output type: Analog output voltage and Digital switching voltage.
- LED lights indicators Power (red/green) and Output (red/green).

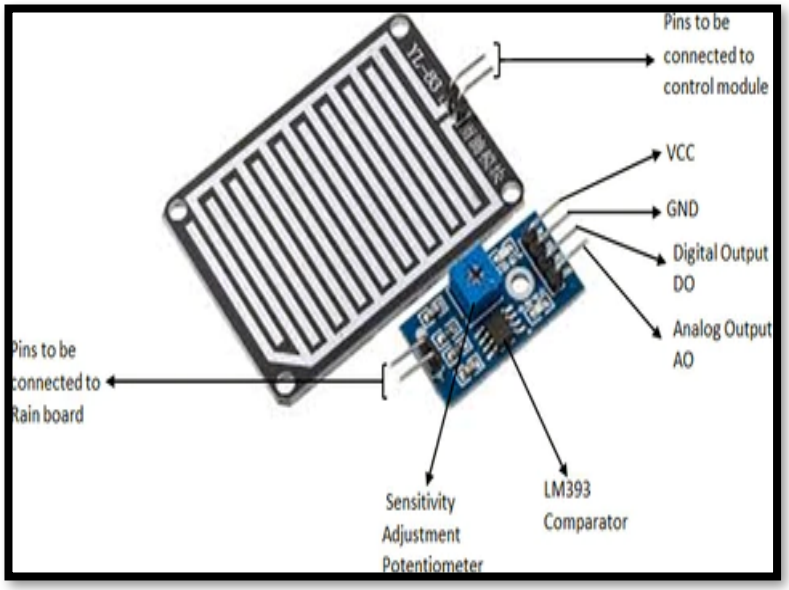


Fig 4.9: Rain Sensors

Deliverables

- Simulation
  - The programming language that we will use is C.
  - Algorithm will be embedded in the Arduino Uno.

- Hardware
  - Hardware that we would design are, a robotic car and a glove.
  - Components that we would use are MPU 6050,Arduino Uno, (**FS1000A**) RF transmitter and (**XY-MK-5V**) RF receiver, motor driver and two motors of robot-car.

MPU6050 Working

- The MPU6050 works by detecting changes in acceleration and rotation rates in three dimensions (X, Y and Z axis) using a combination of an accelerometer and gyroscope.

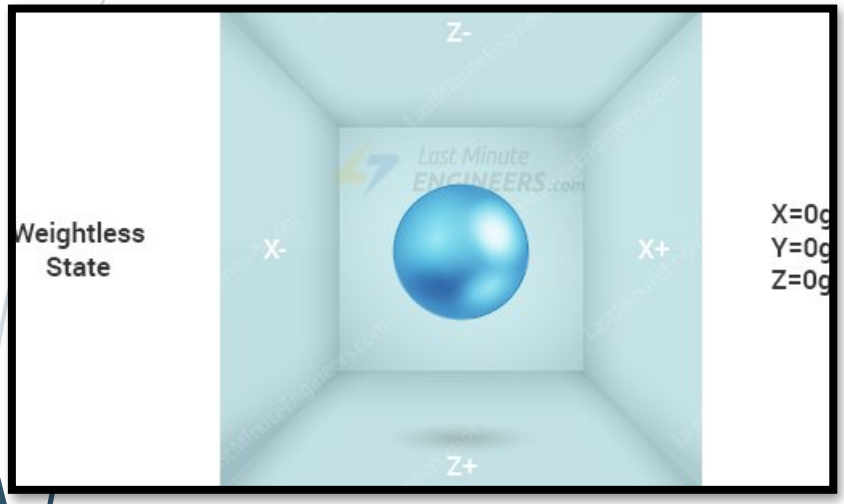


Fig 5 : Ball in a vacuum box

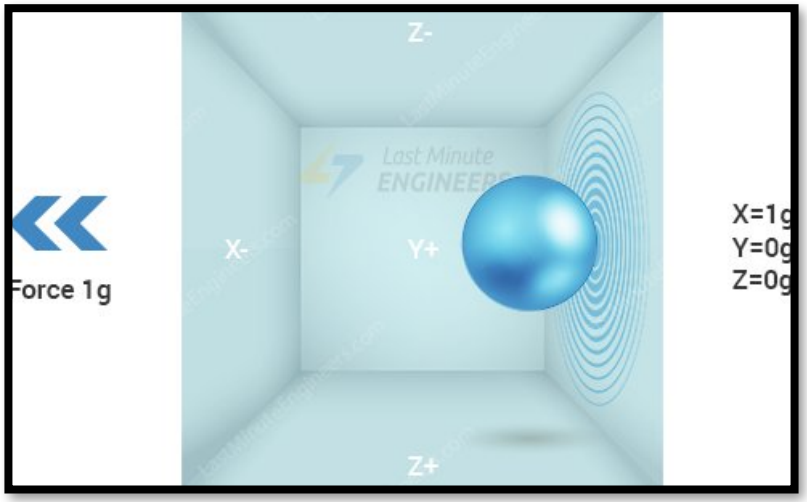


Fig 6: Tilting the box on left side with 1g.

MPU6050 Working(Continue)

- In case of not applying any force on any direction, the box isn't moving, but we still get a 1g reading on the Z axis. This is because gravity is pulling the ball downward with a force of 1g.

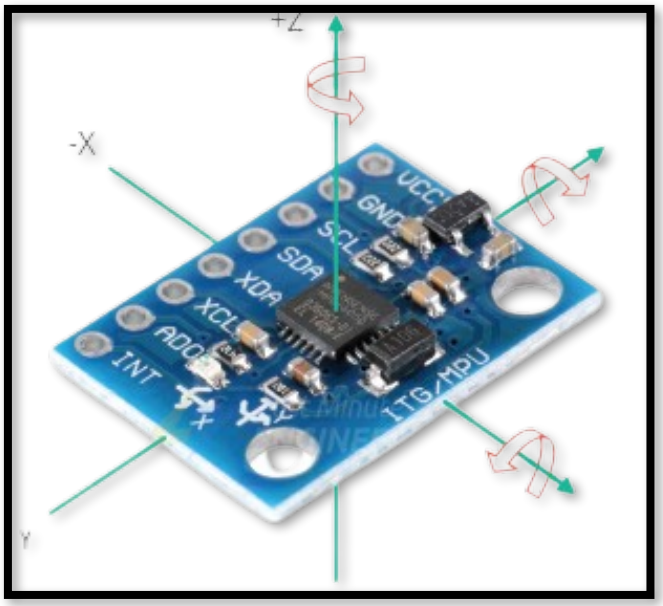


Fig 7 : MPU6050

Design Development

Transmitter Circuit

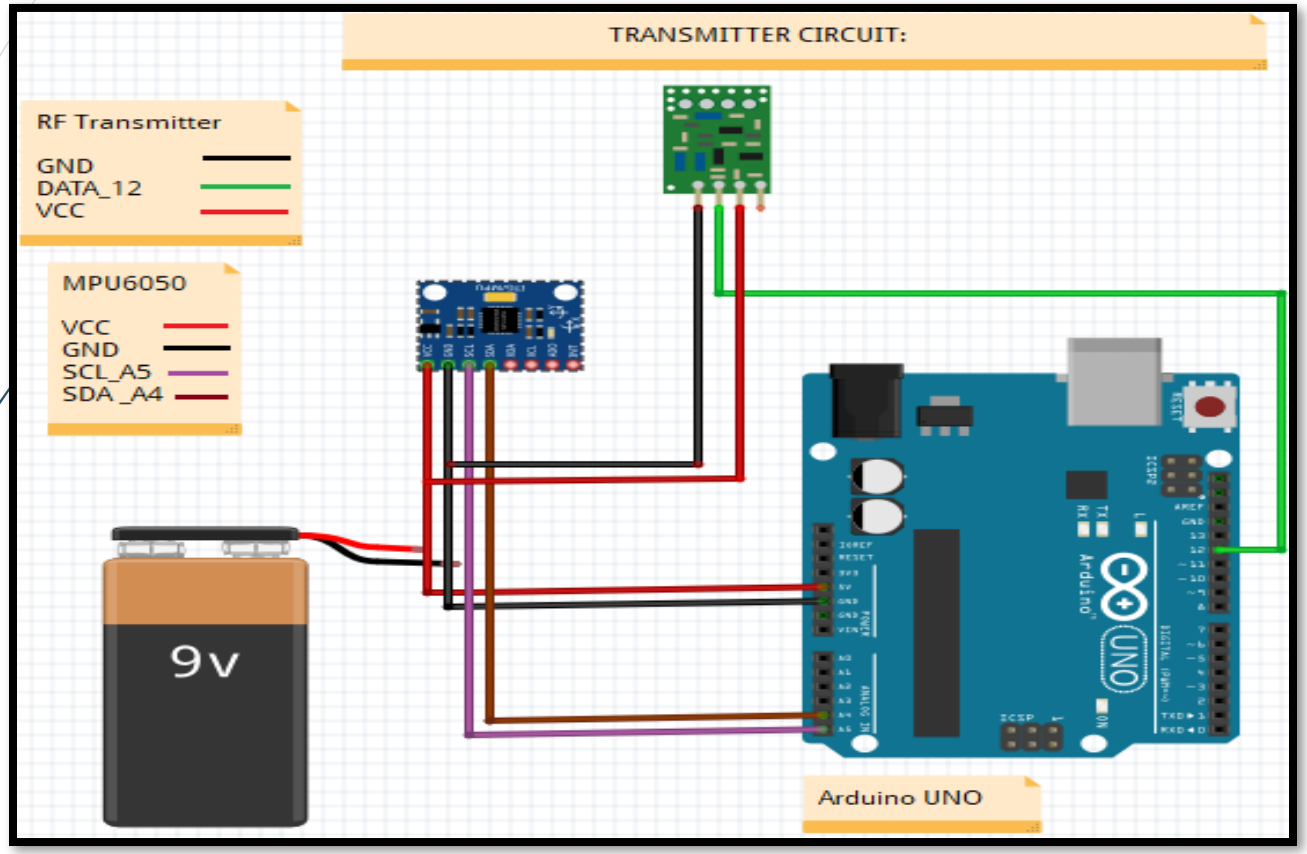


Fig 8: Transmitter Interfacing

Receiver Circuit

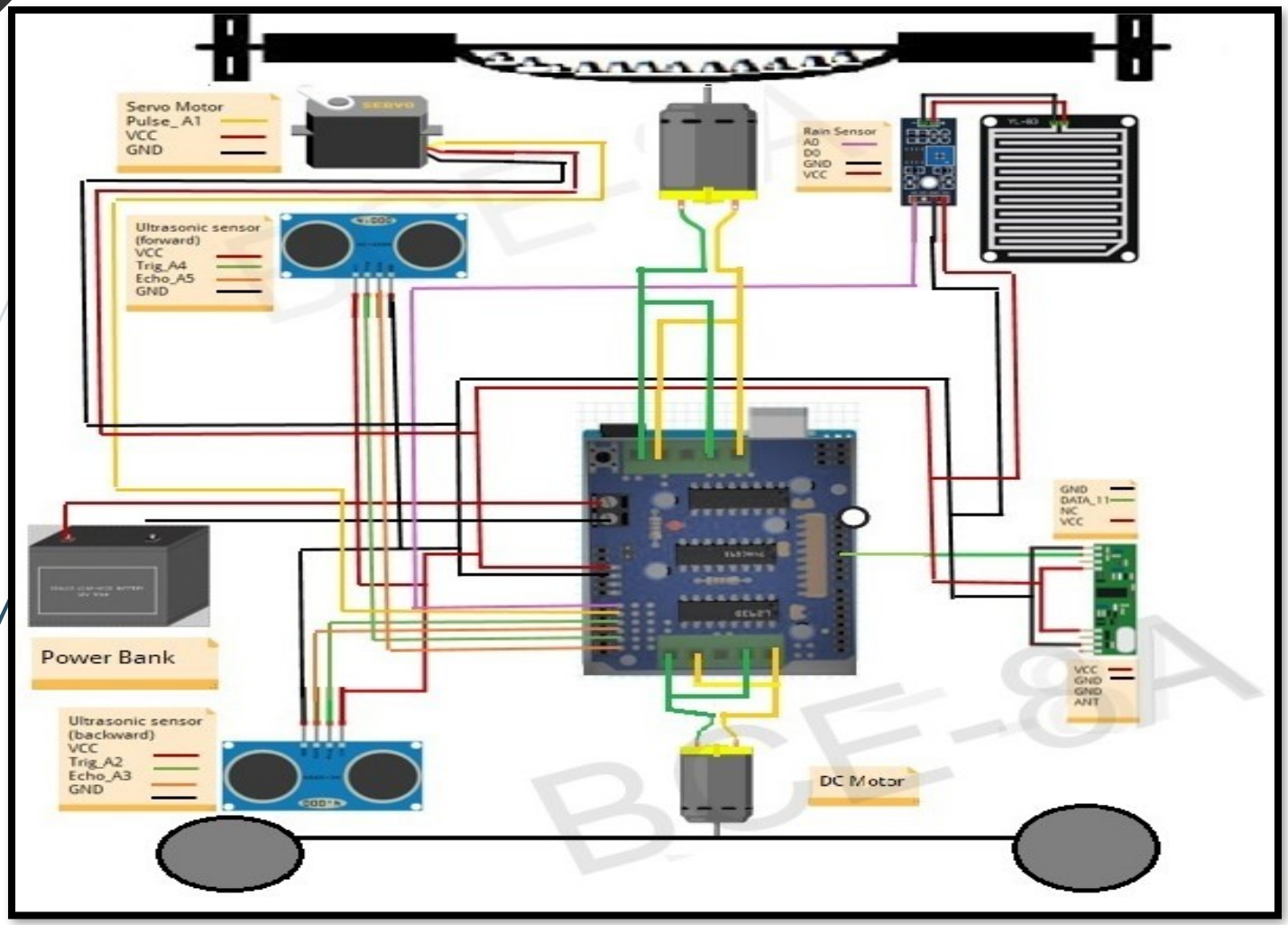


Fig 9: Receiver Circuit

Methodology

- In the transmitter end the MPU6050 Sensor will generate values on three axis.
- We will monitor those values and make a logic to get a physical value on each axis.
- We will apply 7 checks (conditions):
  - Four for x axis (right/left movement i.e. right or left forward/backward)
  - Two for y axis (forward/backward movement)
  - One for all other values on x and y axis, except these values (stop position).
- For each movement, 3 bit data will transmit through RF module to the receiver end.
- At the receiver end, we start monitoring the distance of the car from any other object coming in its way.

Methodology(Continued)

- Then we'll compare the receiving string length with the transmitted string length, if the length is equal the we'll compare the whole string (message).
- When whole string matches with one from all others, car will move in that direction.
- e.g. if 001 Is transmitted from transmitter and it received as it is 001, the car will move in forward direction, until the other signal is not received.
- If the distance of the object become less than the threshold value (which is 50 cm) the car will apply breaks.
- And if any water drop falls on the windshield the wipers will start moving and they will wipeout the water.

Transmission End Logic:

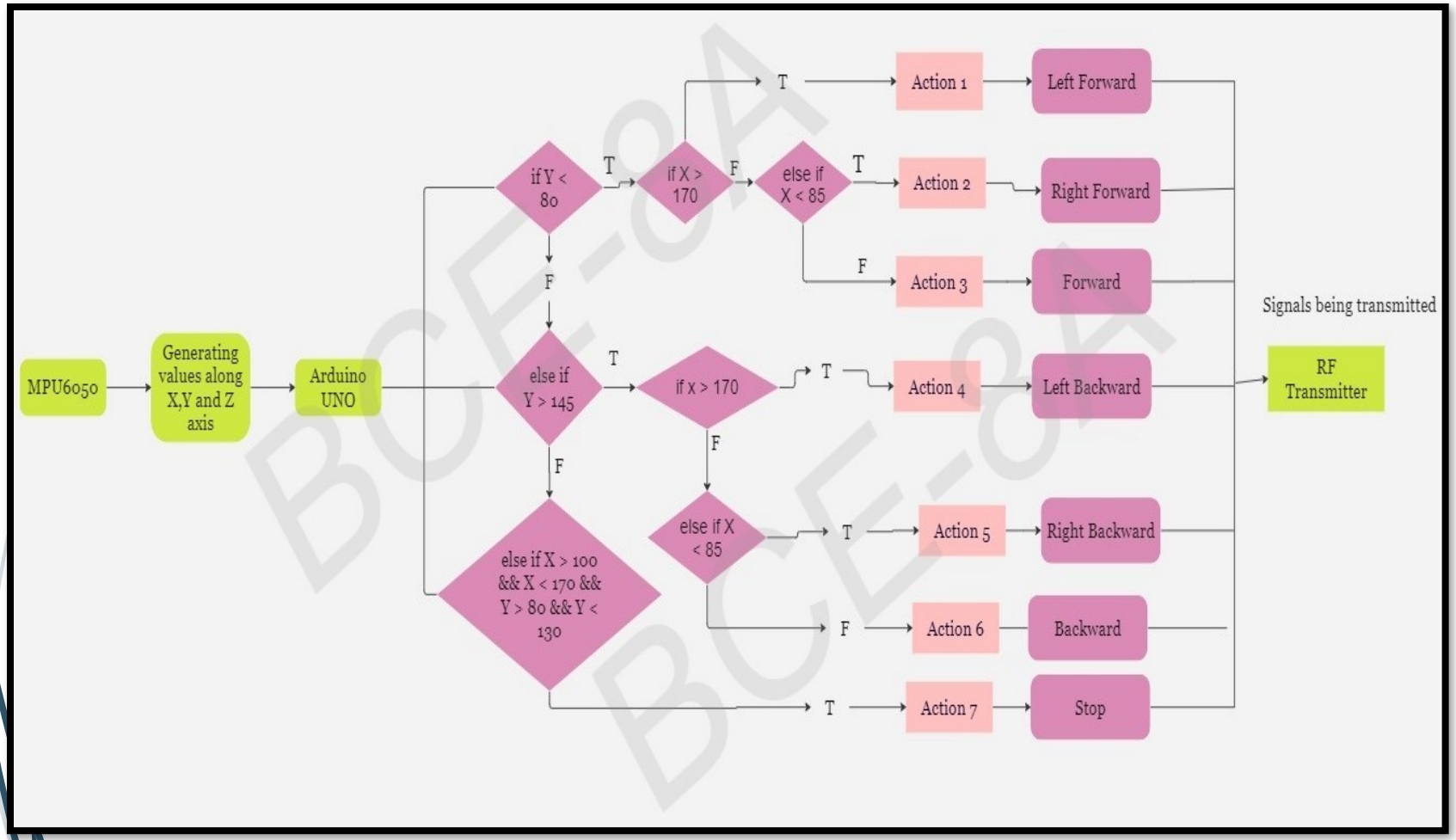


Fig 10: Transmission End Logic

Receiver End Logic:

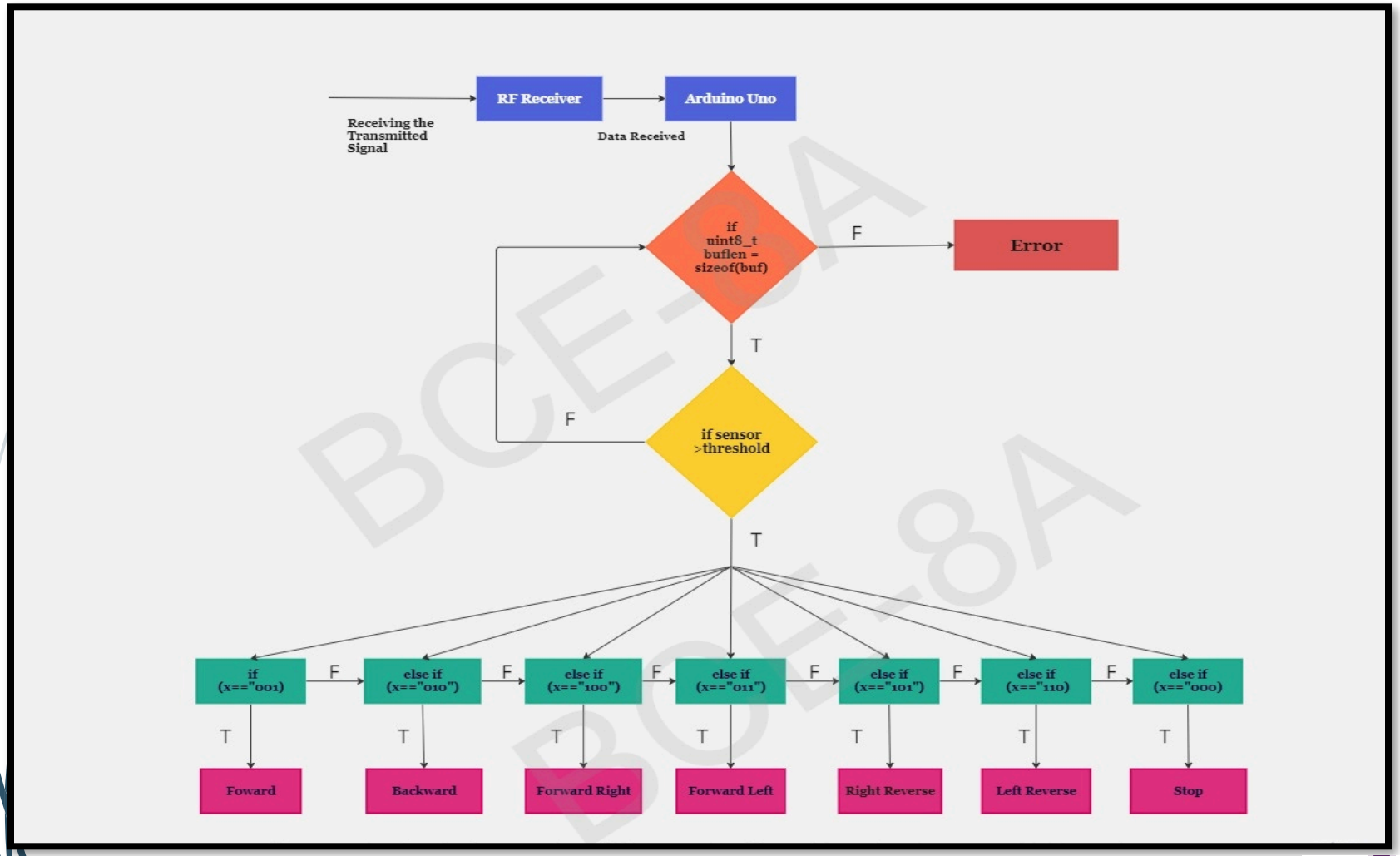
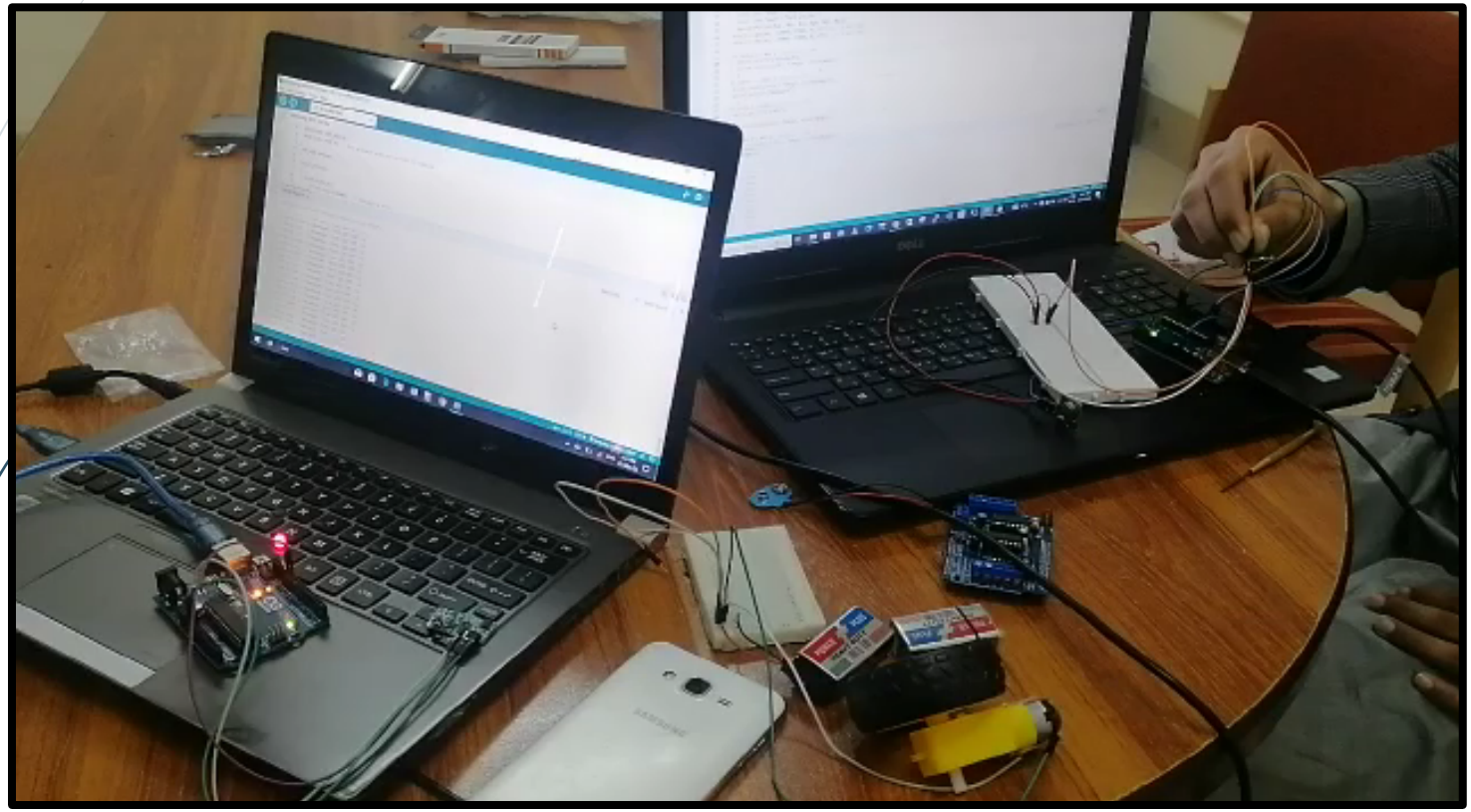


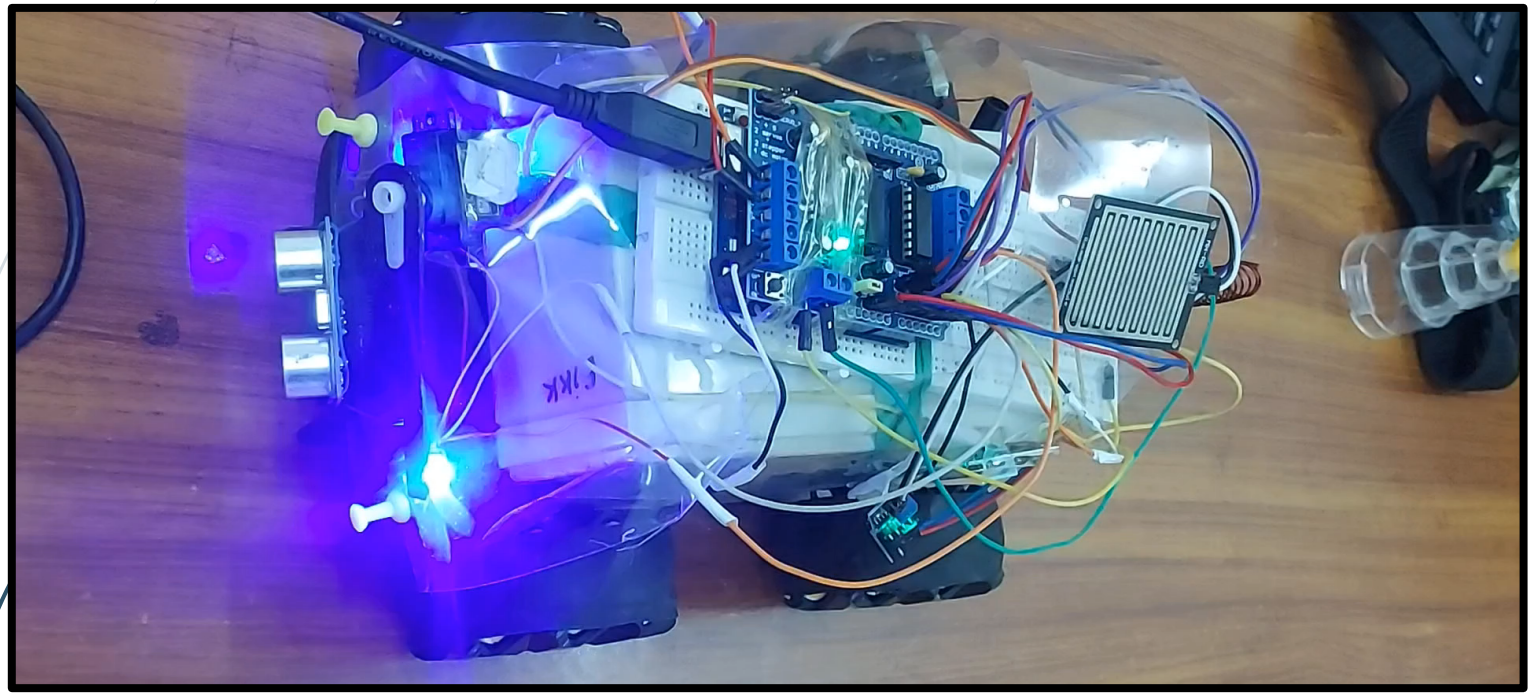
Fig 11: Receiver End Logic

Wireless Communication Testing Simulation



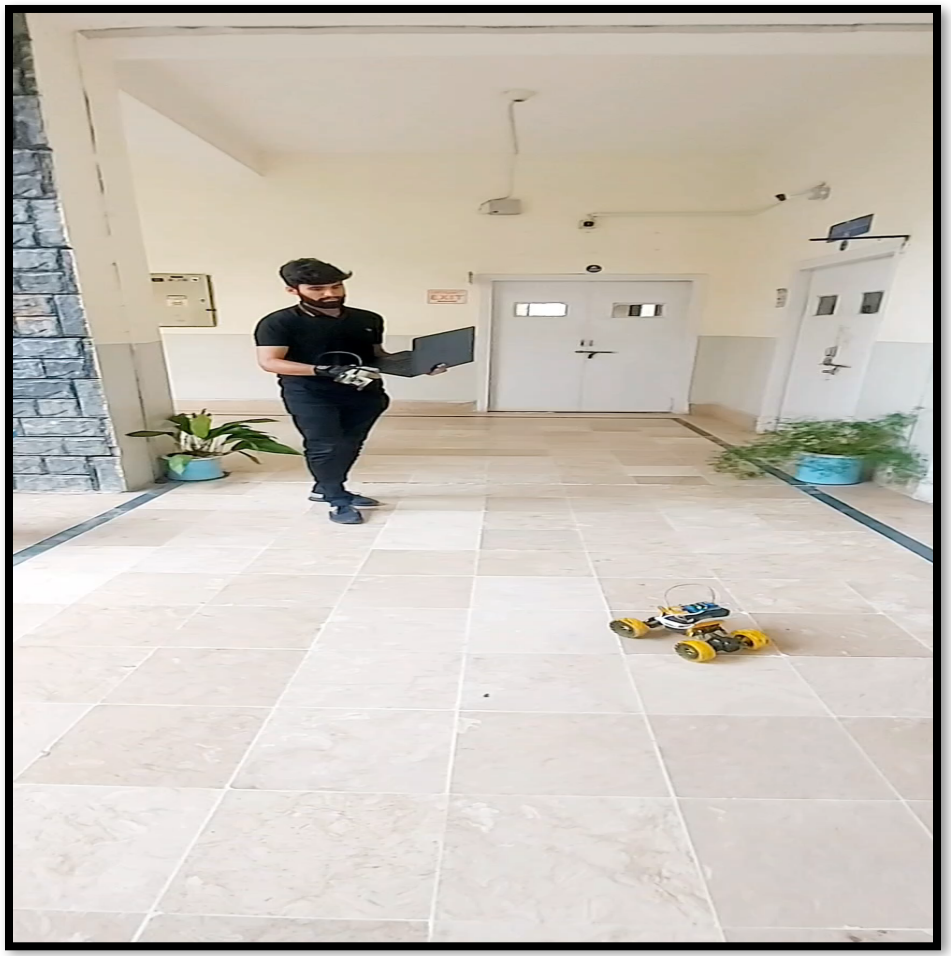
Simulation 1: Wireless Communication Testing

Wiper testing and Object Detection Simulation



Simulation 2: Wiper Testing and Object Detection Simulation

Hardware Simulation



Simulation 3: Hardware simulation

Impact of the Project

- **Societal Impact.**
- User friendly
- Reduce time
- Advancements in Human-Machine Interaction.
- Accessibility

- **Environmental Impact**.
- Low power consumption
- Prevent pollution
- Eco-friendly.

Impact of the Project (continued)

- **Lifelong learning**
  - To analyze problem.
  - Problem investigation skill.
  - Algorithm design and development solution.
  - Understanding Human-Machine Interaction.

Project Management

Months / Tasks Names:	Sep 2022	Oct 2022	Nov 2022	Dec 2022	Jan 2023	Feb 2023	Mar 2023	Apr 2023	May 2023	Jun 2023	Jul 2023
Literature Review											
Methodology Selection and Implementation											
Hardware Development											
Project Completion & Thesis Write up											

Project Management (continued)

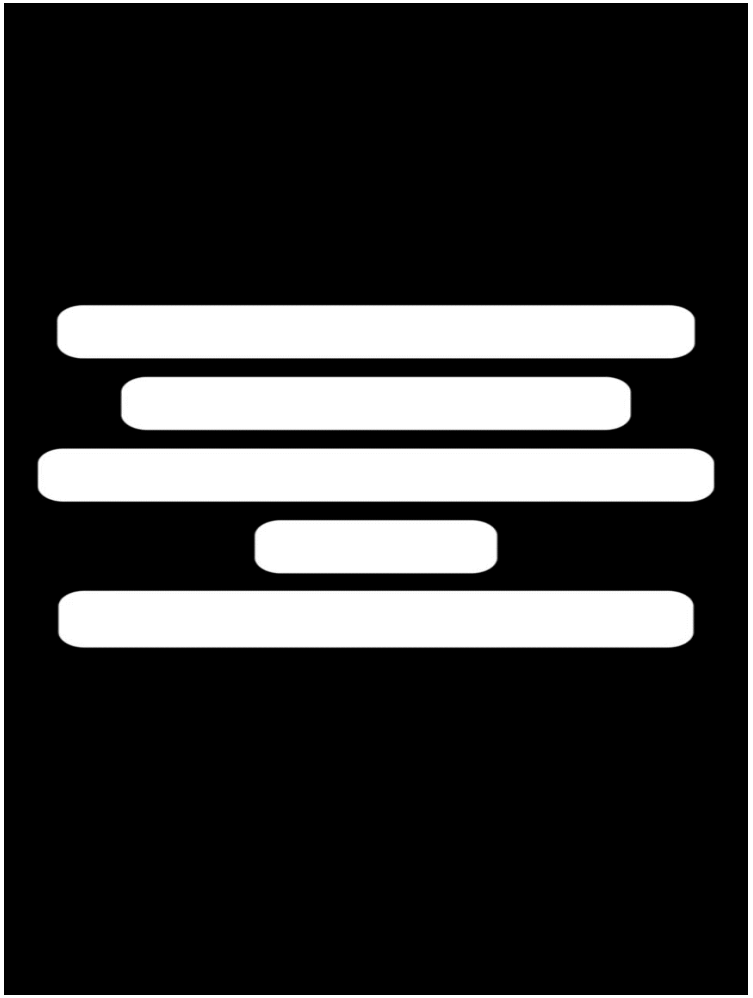
Teamwork

Group Members / Tasks Names	Mahin Asif	Ayesha Younas	Aiman Mateen	Muhammad Ahmed
Literature Review	✔	✔	✔	✔
Algorithm Implementation	✔	✔	✔	✔
Integration and Testing	✔	✔	✔	✔
Project Validation	✔	✔	✔	✔
Thesis Writing	✔	✔	✔	✔

Conclusion

- Making an automated system to make life easy.
- Sensors are intended to replace the remote control that is generally used to run the car.
- Control a car using hand gestures.
- Automated wipers.
- Detect object and apply breaks automatically.

Project Journey



References

1. Brennan, C.S., *Disability Rights During the Pandemic: A Global Report on Findings of the COVID-19 Disability Rights Monitor*. 2020, COVID-19 Disability Rights Monitor.