End-Sem Evaluation of B.Tech. Projects 2024

Sound based path planning for Next-Gen Smart Vehicular Navigation

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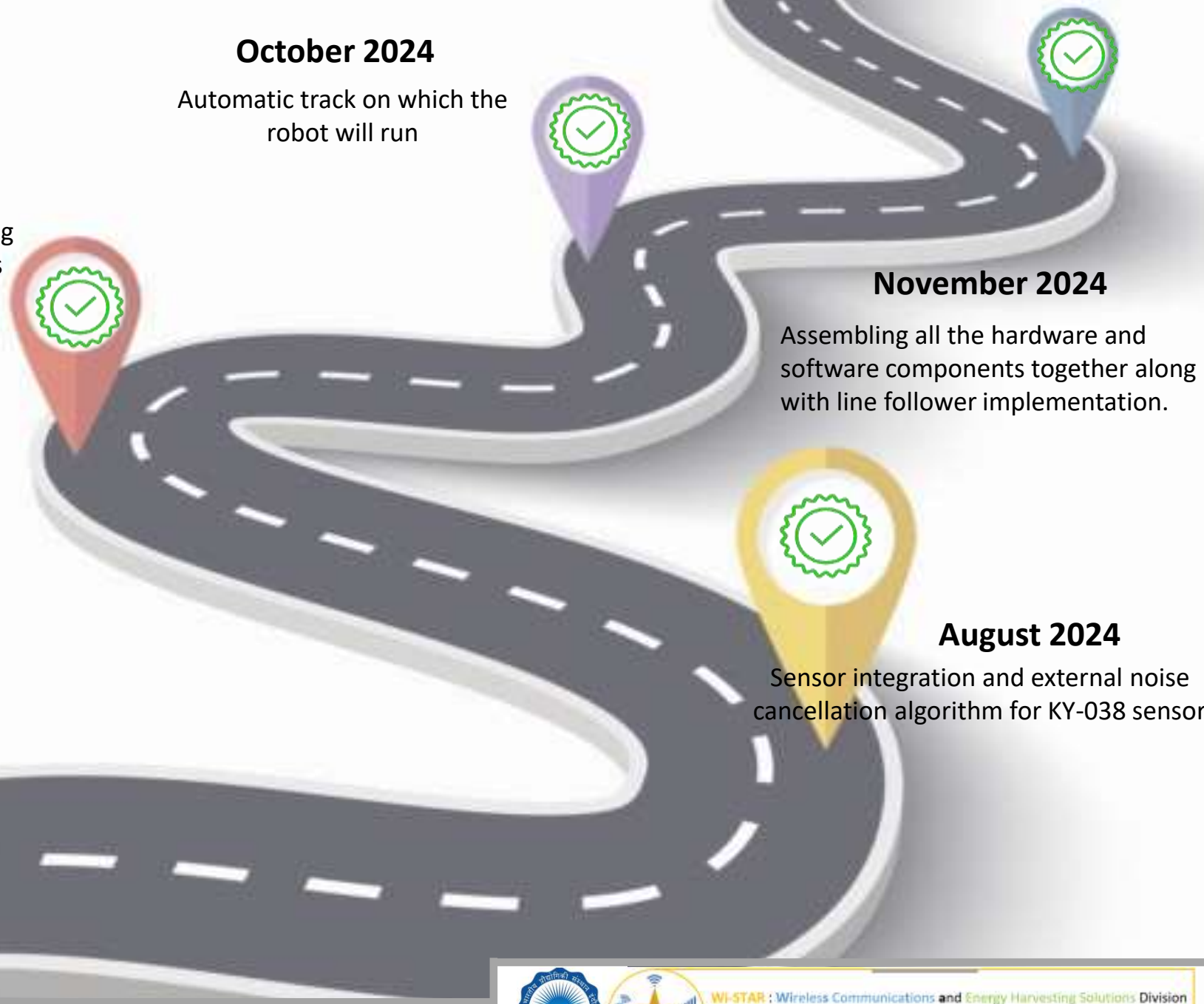
TIMELINE/ROADMAP



July 2024

Outline project goals, deliverables and selections of components to be used.

September 2024

Development of all the hardware parts(using 3D printing),assembling them along with electronics parts

October 2024

Automatic track on which the robot will run

November 2024

Assembling all the hardware and software components together along with line follower implementation.

August 2024

Sensor integration and external noise cancellation algorithm for KY-038 sensor

INTRODUCTION

- **Project Title**: *Sound-Based Path Planning for Next-Gen Smart Vehicular Navigation*.
- **Objective**: To design a vehicle navigation system that uses auditory signals, such as beeps, for controlling movement and direction.
- **Key Components**: KY-038 sound sensor, motor drivers (L293D), passive buzzers, and Arduino microcontroller.
- **Implementation**: Developing a prototype that judges the sound patterns to control it's movements, including forward, reverse, and turning actions. Development of an automatic track is also done.
- **Potential Applications**: Autonomous vehicles, disaster response robotics, agricultural practices and smart indoor navigation systems.

KY-038 SENSOR(₹200)

IR SENSOR(₹60)

L293D MOTOR DRIVER(₹300)

ARDUINO UNO(₹400)

PASSIVE BUZZER(₹20)

MOTIVATION

The rapid advancement in autonomous vehicles and intelligent transportation systems calls for innovative methods to navigation and decision-making. GPS, cameras and Lidar are proven technologies but work only under certain conditions. The primary goal of this project is to work towards abolishing all the existing problems in order to make vehicular navigation more versatile and adaptable.

- ❑ **Difficult Environments**
- ❑ **Safety and Communication**
- ❑ **Cost Efficiency**
- ❑ **Integration with Smart City Infrastructure**

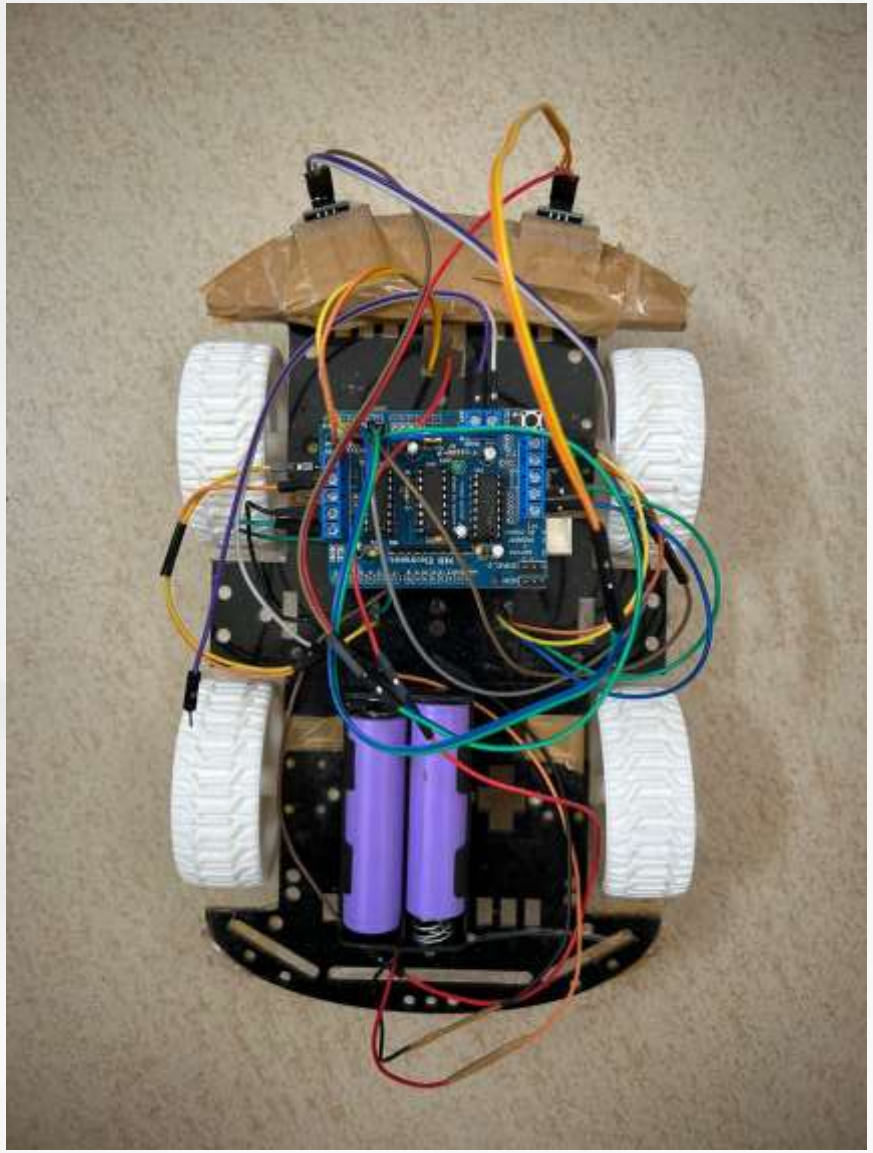
SYSTEM MODEL

1) ROVER DESIGN :

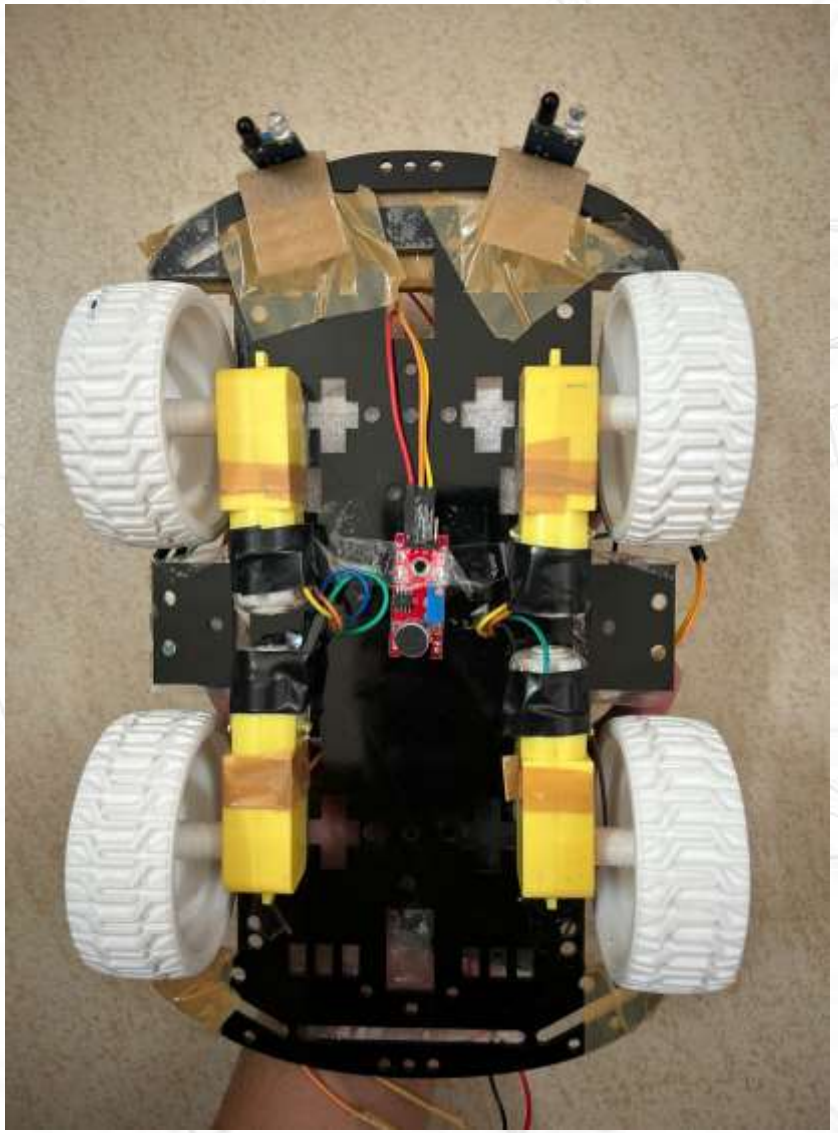
- **Chassis Construction**:
  We first used a sturdy piece of plywood as the base for the rover, ensuring it was lightweight yet durable to support all components.

- **Mounting Motors and Wheels**:
  Next, we attached the DC motors to the chassis and secured the 3D-printed tires onto the motor shafts, ensuring proper alignment for smooth movement.

- **Adding Sensors**:
  - A **KY-038 sound sensor** was mounted below the chassis to detect sound signals for navigation.
  - Two **IR sensors** were positioned underneath the chassis for obstacle detection or line-following functionality.



- **Installing the Control System**:
  (i)An **Arduino UNO** was placed at the center of the chassis to act as the main control unit.
  (ii.) The **L293D motor driver** was mounted on the Arduino and connected to the motors for efficient control of speed and direction.
- **Connecting the Power Supply**:
  A set of AA batteries was attached to the chassis and connected to the motor driver and Arduino to power the system.
- **Wiring and Integration**:
  All components, including the sensors, motors, and power supply, were wired to the Arduino and motor driver, ensuring secure and functional connections.
- **Testing and Calibration**:
  After assembly, the rover was tested to ensure proper response to sound and IR inputs, with adjustments made as needed for smooth operation.



WORKING :

- Sound Detection
- Command Processing:
  - Predefined commands are mapped to specific beep patterns:

Number of beeps	Movement
1 Beep	Move forward
2 Beeps	Turn left and Move
3 Beeps	Turn right and Move
4 Beeps	Stop

- Motor Control
- Path Detection
- Power Supply
- Movement Execution

Noise filtration process:

The process of noise filtration is done in the following ways:

- **Threshold-Based Filtering**:
  - A predefined intensity threshold is set in the Arduino code.
  - Only sounds above this threshold are considered for further processing, filtering out weak or irrelevant sounds like whispers or distant noises.

```
#define THRESHOLD 500
void filterByThreshold(int soundValue) {
  if (soundValue > THRESHOLD) {
  }
}
```

- **Frequency Matching**:
  - The Arduino checks whether the frequency of the detected sound matches the typical range of a beep produced by the buzzer.
  - Sounds that deviate significantly from this frequency range are ignored as noise.

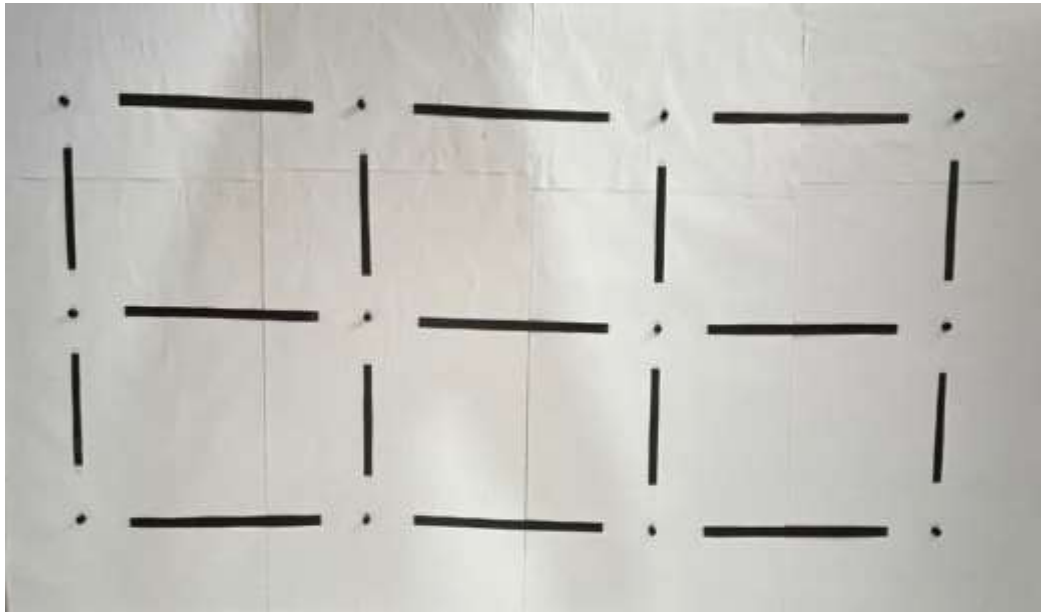
```
#define MIN_FREQ 1000
#define MAX_FREQ 1500
void matchFrequency(int frequency) {
  if (frequency >= MIN_FREQ && frequency <= MAX_FREQ) {
  }
}
```

- **Debouncing**:
  - Rapid successive detections of the same sound (caused by echoes or slight sensor fluctuations) are suppressed using a debounce mechanism.
  - The Arduino ensures that only distinct, intentional beeps are processed as valid inputs.

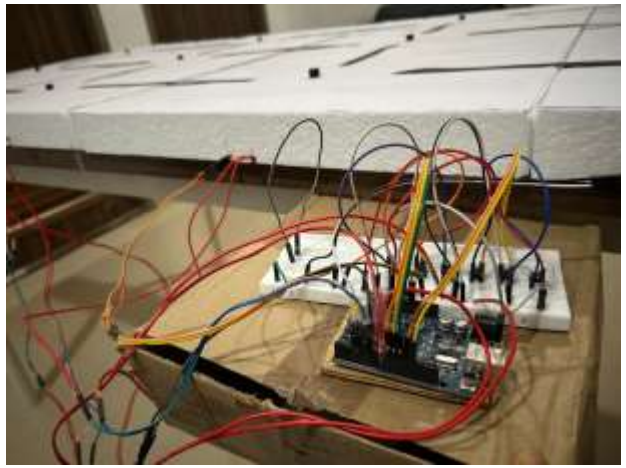
```
#define DEBOUNCE_TIME 200
unsigned long lastDetectionTime = 0;
void debounceSound() {
  unsigned long currentTime = millis();
  if (currentTime - lastDetectionTime > DEBOUNCE_TIME) {
    lastDetectionTime = currentTime;
  }
}
```

Track Design

- **Track Layout**:
  - •We have designed a 3*4 grid on which the rover would function.
  - •The track was designed with a black line on a white surface to provide clear contrast for the IR sensors.

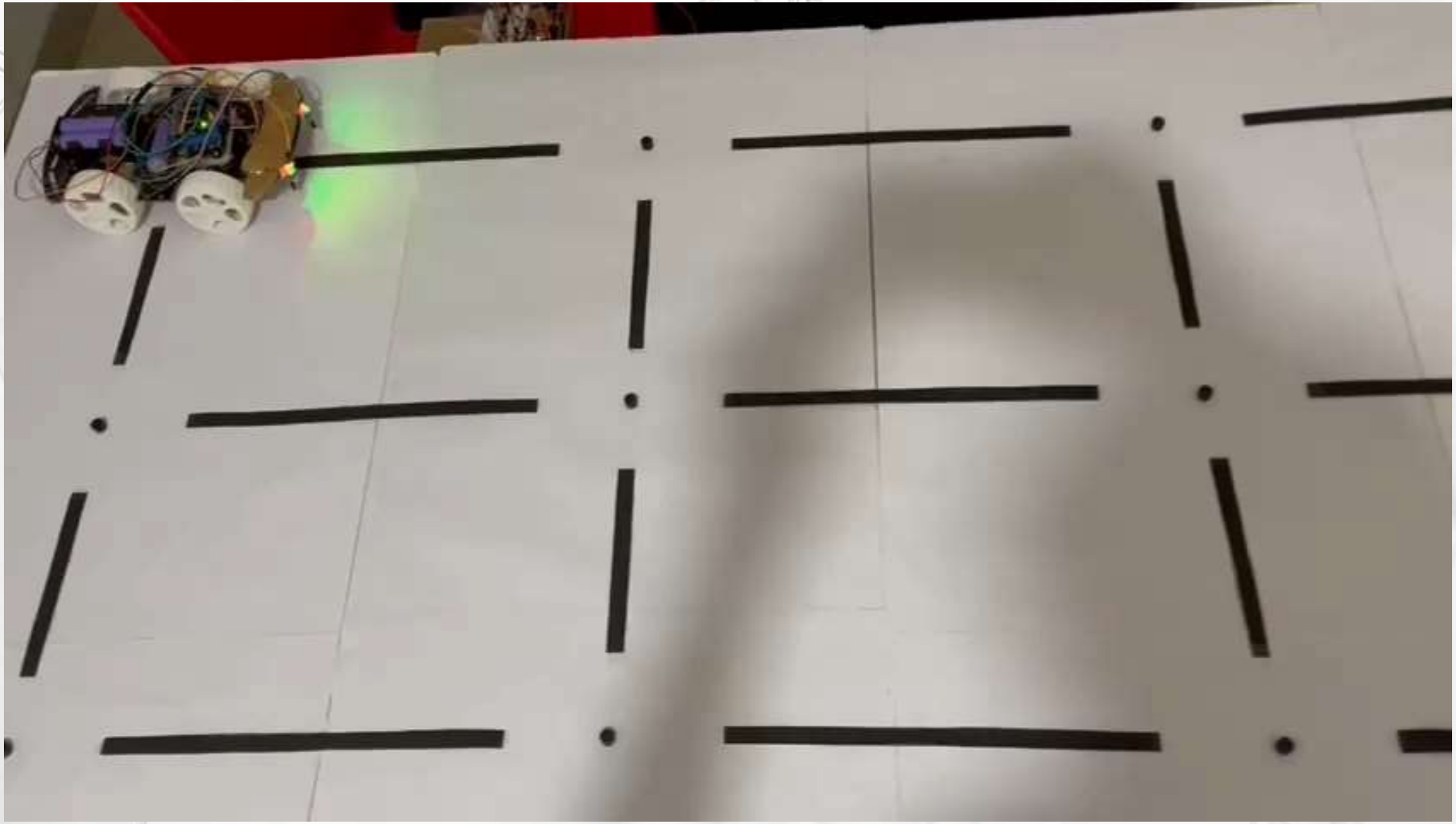


- **Material Selection**:
  - •The entire structure is made using thick thermocol sheets.
  - •The upper partis covered using white chart papers and the path lines were made using black sheet paper.
- **Buzzer control** :
  - •12 passive buzzers are connected in 3*4 grid format.
  - •The buzzers are controlled using an Arduino wherein a predefined path is given to the it.



- **Connection**:
  - •The connection of the buzzers to the microcontroller is done using jumper wires and copper wires.
  - •Grooves are made in the thermocol sheet and wires are being passed through them.

FINAL WORKING OF MODEL :



❑ Conclusion

- We have successfully designed autonomous rover using a SOUND-based path-planning system.
- We have successfully made sure that the beep detection is done with nearly 100% accuracy and external noise filtering is accurately done.
- Utilized KY-038 sound sensor for real-time detection of beeps made by passive buzzers.
- Verified the effectiveness of using simple, affordable components to develop scalable smart navigation solutions.

❑ Future Work

- Dynamic Path Adjustment
- Multi-Signal Input Handling
- Integration with IoT and Mobile Applications
- Scaling to Real-World Applications

REFERENCES

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Thank you