Implementation of Parking Assist System

Report for Mini Project/Electronic Design Workshop (EC-681)

B. Tech in Electronics and Communication Engineering

B. P. Poddar Institute of Management & Technology

Under

Maulana Abul Kalam Azad University of Technology

Submitted by:

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CERTIFICATE

This is to certify that the project work, entitled "*Implementation of Smart Parking System*" submitted by *Subhankar Kolay*, has been prepared according to the regulation of the degree B. Tech in Electronics & Communication Engineering of the Maulana Abul Kalam Azad University of Technology, West Bengal. The candidate(s) have partially fulfilled the requirements for the submission of the project work.

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(Name of HOD)	**(Name of the Supervisor)**
Dept. of Electronics & Comm. Engr.	**Dept. of Electronics & Comm. Engr**

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ABSTRACT:

A Smart (car) parking system is a mechanical system designed to minimize the area and/or volume required for parking cars. Like a multi-story parking garage, an APS provides parking for cars on multiple levels stacked vertically to maximize the number of parking spaces while minimizing land usage. The APS, however, utilizes a mechanical system to transport cars to and from parking spaces (rather than the driver) in order to eliminate much of the space wasted in a multi-story parking garage [1]. While a multi-story parking garage is similar to multiple parking lots stacked vertically, an APS is more similar to an automated storage and retrieval system for cars[1]. Parking systems are generally powered by electric motors or hydraulic pumps that move vehicles into a storage position. The paternoster (shown animated at the right) is an example of one of the earliest and most common types of APS [2].

The increasing urbanization and growing number of vehicles have intensified the challenges associated with parking in urban environments [4]. To address this issue, our project introduces "Smart Parking System" a novel parking assist system that leverages the Internet of Things (IoT) and Embedded Systems technologies. The system aims to enhance the efficiency and convenience of parking, ultimately contributing to reduced traffic congestion and improved urban mobility [4-5].

The system employs a network of IoT-enabled sensors strategically placed within a parking area to monitor and relay real-time data regarding parking space occupancy [3]. These sensors communicate with an embedded system, which processes the information and generates insights that are then made accessible to users through a user-friendly interface [3].

Key features of this system include real-time parking space availability updates, along with safe rear parking facilities that include audio as well as visual alerts [6]. The system incorporates algorithms to analyse parking data, providing predictive insights to optimize parking space utilization as well as safety alerts in both visual and audio modes, so as to prevent any nearby accidents [5].

The project utilizes a cost-effective and scalable approach to implement the Smart Parking system, making it adaptable to various parking environments [4]. The integration of IoT and Embedded Systems not only facilitates efficient data collection but also ensures a responsive and reliable parking management solution [2].

The implementation of Parking Assist, addresses the pressing challenges associated with urban parking, offering a sustainable and technologically advanced solution to enhance the overall urban mobility experience [1]. The project aligns with the broader goal of building smart cities by harnessing the power of IoT and Embedded Systems to create innovative solutions that contribute to a more connected and efficient urban infrastructure [6].

ACKNOWLEDGEMENTS

It is a great pleasure for me/us to express our earnest and great appreciation to Ms. Ankita Indu and Mr. Mostafa Sheikh, my project guide. We are very much grateful to her and him for her and him kind guidance, encouragement, valuable suggestions, innovative ideas, and supervision throughout this project work, without which the completion of the project work would have been difficult one.

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We also express our sincere thanks to all the teachers of the department for their precious help, encouragement, kind cooperation and suggestions throughout the development of the project work.

We would like to express our gratitude to the library staff and laboratory staff for providing us with a congenial working environment.

1.

2.

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4.

Date: _______________ _____________________________

(Full Signature of the Student(s)

B. Tech in Electronics & Comm. Engr.

Department of Electronics & Comm. Engr.

B P Poddar Institute of Management and Technology

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TITLE: Implementation of Smart Parking System

OBJECTIVE:

The purpose of this project is to:

1. Familiarize students with an in-depth knowledge of IOT and Embedded Systems

2. Discussing the working of the Ultrasonic Distance Sensor and the principles of Arduino UNO.

3. Proper utilization of parking space.

4. Help the learners to learn to work in groups.

DEPARTMENTAL MISSION & VISION:

Program Outcomes (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply to reason informed by the contextual knowledge to health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

1. Students will acquire knowledge in Advance Communication Engineering, Signal and Image Processing, Embedded and VLSI System Design.

2. Students will qualify in various competitive examinations for successful employment, higher studies and research.

PO& PSO MAPPING:

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2
2	3	2	3	2	2	2	2	3	3	2	1	2	1

JUSTIFICATIONS OF MAPPING:

PO/PSO MAPPED	LEVEL OF MAPPING	JUSTIFICATION
PO1	2	Apply knowledge of engineering fundamentals, mathematics, science, and an engineering specialization.
PO2	3	Analysing some complex engineering problems like how sensors work by detecting obstacles, how buzzer works and implementation of the whole system along with indicator LED lights.
PO3	2	The design solution for complex engineering problems that meet the specific needs with appropriate consideration for public safety.
PO4	3	Use research-based knowledge and research methods to analyse, interpret and synthesis of the information to provide valid conclusion.
PO5	2	Create, select and apply appropriate techniques, resources and modern engineering and IT tools to predict and model complex engineering activities with an understanding of the limitations.
PO6	2	Apply to reason informed by the contextual knowledge to safety issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	2	Understand the impact of professional engineering solutions and demonstrate the knowledge of, and need for sustainable development.
PO8	2	Apply ethical principles and commit to professional ethics and responsibilities.
PO9	3	Function effectively as an individual, and as a member or leader.
PO10	3	Comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	2	Apply knowledge to one’s own work, as a member or leader in a team, to manage projects.
PO12	1	Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning.
PSO1	2	Acquire knowledge in IOT and Embedded System along with other electronic components.
PSO2	1	Qualify in higher studies and research

ACTIVITY CHART:

JOB	15th -30th January	1st -30th February	1st -30th March	1st-15th April	16th-30st April	1st-15th May	16th-25th May
Literature Review	↔						
0th Review		↔					
Problem definition and requirement analysis			↔				
Midterm report and presentation				↔			
Design and Implementation					↔		
Optimization and Results						↔	
Report writing and project presentation							↔

Chapter 1

INTRODUCTION:

As urbanization continues to intensify, efficient management of parking spaces has become a critical challenge for cities worldwide [7]. Traditional parking systems often result in wasted time, increased fuel consumption, and heightened emissions as drivers circle in search of available spots [2]. To address these issues, smart parking systems have emerged as a technological innovation designed to optimize parking efficiency and enhance user convenience. Among the various technologies employed in smart parking solutions, ultrasonic distance sensors play a pivotal role due to their reliability, cost-effectiveness, and ease of integration [3].

Smart parking systems are advanced frameworks that use a combination of sensors, connectivity, and software to provide real-time information about parking availability [5]. These systems aim to streamline the process of finding and managing parking spaces, reducing congestion, and improving the overall urban mobility experience. Key components typically include:

1. **Sensors**: To detect the presence or absence of vehicles in parking spaces.
2. **Connectivity**: To transmit data to a central system or user interface.
3. **User Interfaces**: Such as mobile apps or digital displays to inform drivers of available spots.
4. **Management Software**: To analyse data and optimize parking allocation [2-6].

Chapter 2

THEORY:

A smart parking system using an ultrasonic distance sensor provides a straightforward yet effective approach to enhancing parking safety. This system operates by measuring the distance between a vehicle and nearby objects, and then alerting the driver through auditory and visual signals if the car gets too close to an obstacle. The core components of this system include an ultrasonic distance sensor, a microcontroller, a buzzer, and red LED lights [1-3].

The ultrasonic distance sensor is crucial for detecting obstacles. It functions by emitting ultrasonic waves, which travel through the air until they encounter an object [7]. These waves then bounce back to the sensor, which measures the time taken for this round trip. By knowing the speed of sound, the sensor can calculate the distance to the object based on the time delay of the returning waves. This distance measurement process is continuous, providing real-time data about the proximity of objects [2].

The microcontroller acts as the brain of the system. It processes the distance data received from the ultrasonic sensor and compares it against predefined safety thresholds. For example, if the system is set to alert the driver when an object is closer than 30 cm, the microcontroller will monitor the distance measurements for any value below this threshold [4-5].

When the microcontroller detects that the distance to an object is less than the critical threshold, it triggers the alert mechanism. The buzzer is activated to produce an audible warning, while the red LED lights are turned on to provide a visual signal. This dual alert system ensures that the driver receives clear and immediate warnings about potential obstacles, thus helping to prevent collisions and ensuring safer parking [7].

In essence, the smart parking system utilizing ultrasonic distance sensors offers a practical solution to common parking challenges [1]. It enhances driver awareness and safety by providing reliable, real-time information about nearby obstacles, coupled with intuitive alerts. This technology not only makes parking easier but also reduces the risk of accidents, making it a valuable addition to modern vehicle systems [6].

Components:

1. ***Arduino UNO:*** Arduino UNO is a microcontroller board based on the **ATmega328P**. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. [4]

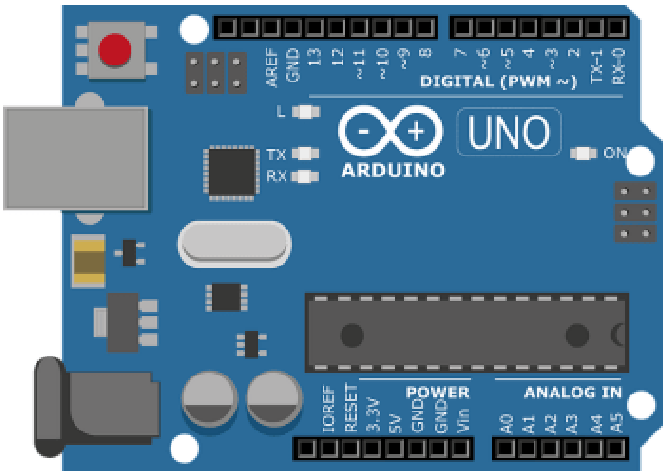


Fig 1.

2. ***Ultrasonic Distance Sensor (HC-SR04):*** This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit. There are only four pins that you need to worry about on the HC-SR04: VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground). [4]
   An HC-SR04 ultrasonic distance sensor actually consists of two ultrasonic transducers. One acts as a transmitter that converts the electrical signal into 40 KHz ultrasonic sound pulses. The other acts as a receiver and listens for the transmitted pulses. When the receiver receives these pulses, it produces an output pulse whose width is proportional to the distance of the object in front. [6]

Fig 2.

3. ***Passive Buzzer:*** A passive buzzer is a device that generates sound when an electrical signal is applied to it. It is called passive because it does not have an internal oscillator to generate sound on its own. Instead, it relies on an external signal from a microcontroller like Arduino to produce sound. [4]

Fig 3.

4. ***LEDs:*** It is the simple basic project created using Arduino. LED (Light Emitting Diode) is an electronic device, which emits light when the current passes through its terminals. LED's are used in various applications. It is also used as an ON/OFF indicator in different electronic devices. [4]

Chapter 3

PROPOSED SYSTEM:

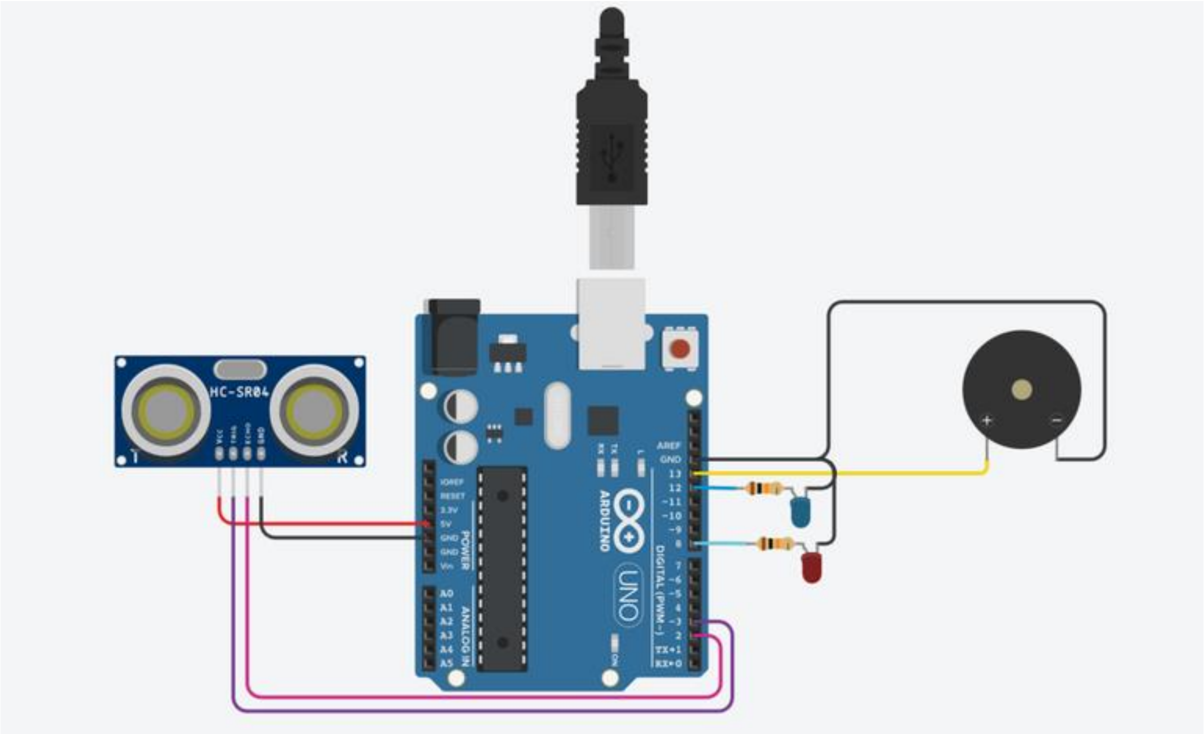


Fig.4. Circuit Diagram of proposed system

Chapter 4

MATHAMATICAL FORMULATION:

d=s*t

where, **t** is the pingtraveltime and **d** is the pingtraveldistance.

Therefore, s=765 miles/hr

d = 765 (miles/hr) * t (micro-sec)

d = 765 (miles/hr) * 5280 (ft/mile) * 12 (inches/ft) * (1/3600) (hr/sec) * (1/10^6)

(sec/micro-sec) * t (micro-sec)

Therefore, d = [{(765*5280*12)/(3600*10^6)}*t] inches

Hence, distance = d/2

CODE:

```
int trigpin=12;           //Variable declaration
int echopin=11;
int buzzpin=10;
int ledpin = 9;

float pingtraveltime;
float pingtraveldistance;
float distance;

void setup()
{
  Serial.begin(9600);


  pinMode(trigpin,OUTPUT);          //Declaring PinModes
  pinMode(echopin,INPUT);
  pinMode(buzzpin,OUTPUT);
```

```
  pinMode(ledpin,OUTPUT);

}

void loop()
{
  //Calculation of distance
  digitalWrite(trigpin,LOW);
  delay(10);
  digitalWrite(trigpin,HIGH);
  delay(10);
  digitalWrite(trigpin,LOW);

  pingtraveltime=pulseIn(echopin,HIGH);
  delay(25);

//Distance into inches
  pingtraveldistance=pingtraveltime*((765.0*5280.0*12.0)/(3600.0*1000000.0));
  distance=pingtraveldistance/2.0;
  Serial.println(distance);
  delay(100);




if(distance<=8 && distance>=5)
 {
    digitalWrite(buzzpin,HIGH);
    delay(200);
    digitalWrite(buzzpin,LOW);
    delay(200);
 }


 if(distance<=5 && distance>=3)
 {
    digitalWrite(buzzpin,HIGH);
    delay(50);
    digitalWrite(buzzpin,LOW);
    delay(50);
    digitalWrite(ledpin,HIGH);
    delay(70);
    digitalWrite(ledpin,LOW);
    delay(70);

 }
```

```
if(distance<=3)
{
   digitalWrite(buzzpin,HIGH);
   delay(50);
   digitalWrite(buzzpin,LOW);
   delay(20);
   digitalWrite(ledpin,HIGH);

}

else
{
digitalWrite(buzzpin,LOW);
digitalWrite(ledpin,LOW);
}

}
```

Chapter 5

RESULTS & DISCUSSIONS:

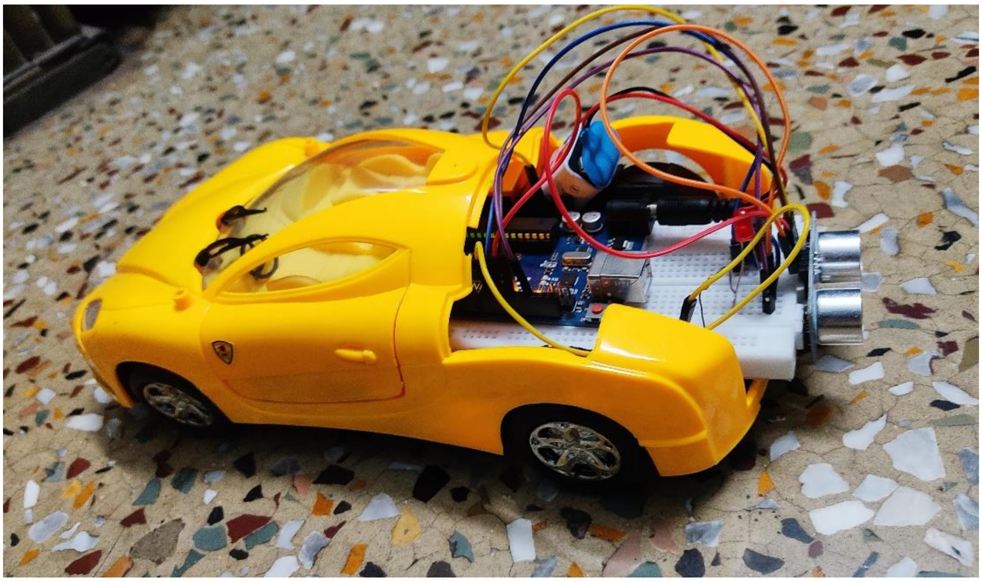
The implementation of a smart parking system using Arduino offers a practical and cost-effective solution to modern urban parking challenges. Through the integration of sensors, microcontrollers, and real-time data processing, this system can significantly alleviate issues related to parking congestion, inefficient space utilization, and time wasted searching for available spots [7].

One of the primary advantages of using Arduino for such a system is its accessibility and flexibility. Arduino platforms are relatively inexpensive, user-friendly, and highly customizable, making them an ideal choice for developing and prototyping smart parking solutions [4]. By employing ultrasonic sensors to detect the presence of vehicles and using wireless communication modules to relay information, the system can provide real-time updates on parking availability to drivers via a mobile application or display boards [2].

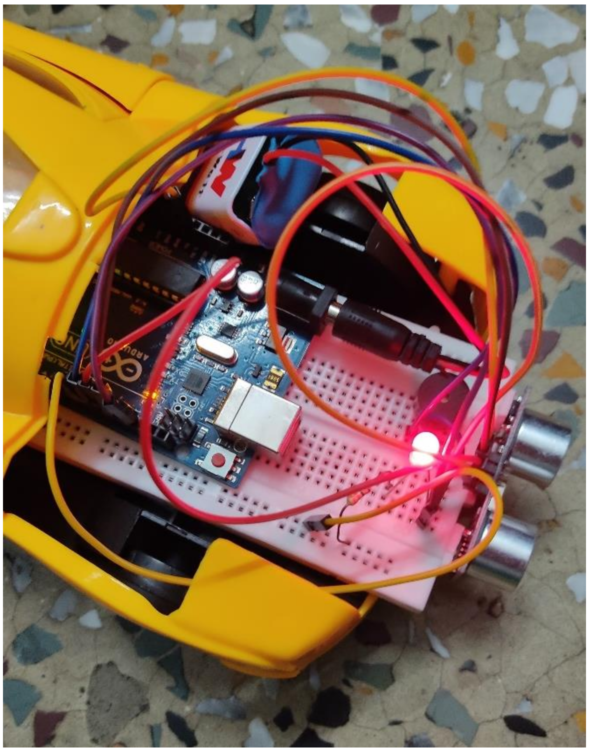
The successful implementation of this system can lead to several benefits. It can reduce traffic congestion by directing drivers to available parking spaces more efficiently, thereby decreasing the time spent searching for parking. This, in turn, can lead to lower emissions and a more environmentally friendly urban environment [3]. Additionally, the data collected by the smart parking system can be analysed to identify patterns in parking usage, enabling better urban planning and management of parking resources.

Despite its many advantages, the system also faces challenges such as ensuring reliable sensor performance in various environmental conditions, maintaining the security of transmitted data, and scaling the system to cover larger areas. Addressing these challenges will require ongoing research and development, as well as collaboration between technologists, city planners, and policymakers [2-5].

In conclusion, the smart parking system using Arduino represents a promising advancement in the field of urban infrastructure [5]. It showcases how leveraging modern technology can create smarter, more efficient cities. As these systems continue to evolve, they hold the potential to transform the parking experience, making it more convenient and sustainable for drivers and cities alike [6].



(a)



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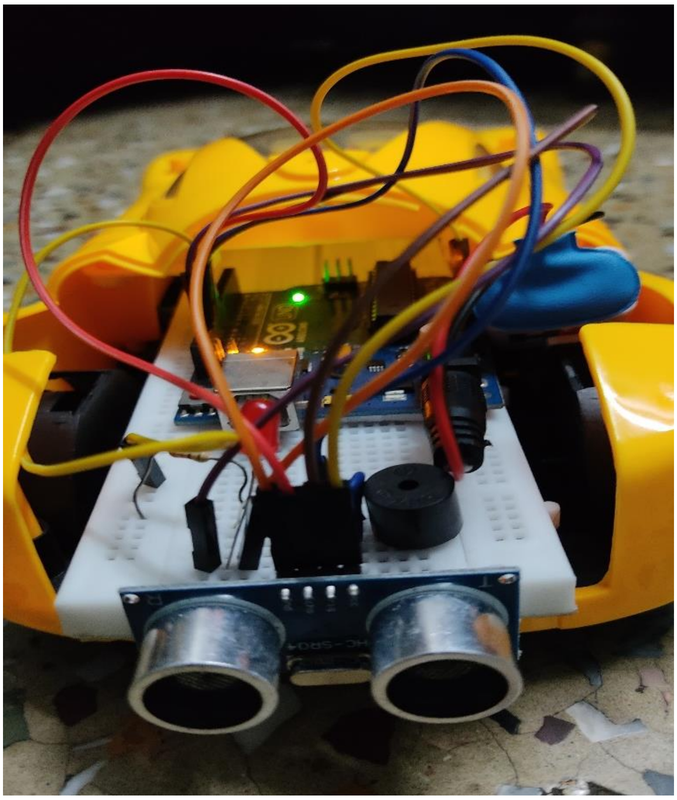

(c)

(d)

Fig.5.(a-d) Hardware Implementation

FUTURE PLAN:

1. Designing a Smart parking system along with visual view of the system, by implementing rear cameras.
2. Improving the overall efficiency of the system.
3. Advanced security features including AI-driven surveillance cameras, automatic number plate recognition (ANPR), and real-time alerts to enhance safety and prevent theft or vandalism.
4. Incorporation of Augmented Reality (AR) in mobile applications to guide drivers to available parking spots, highlight the nearest facilities, and provide real-time information overlay.
5. Development of more intuitive and interactive guidance systems within parking facilities to direct drivers to the nearest available spot using LED indicators, digital signage, and mobile notifications.
6. Improvements to accessibility, including better allocation and monitoring of handicap spaces, and features that assist users with disabilities in finding and using parking facilities.

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