A Project Report
Submitted for
IoT Based Systems (UEC-715)

IPAS(Intelligent Park Assist System)

by

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CERTIFICATE

This is to certify that the project report entitled, IOT BASED IPAS(Intelligent Park Assist System) , submitted to Dr.Shireesh Kumar Rai of the Department of Electronics and Communications Engineering, Thapar Institute of Engineering and Technology, Patiala. It is a record of bonafide work carried out by Swayansu Baral(102015028), Devanshi Arora(102015029), Lakshay Ahuja (102015026), Ashmita Tandon (102015024) and Nripdev Saggu (102015026), students from the branch of Electronics and Communications Engineering, under the supervision and guidance of Dr. Shireesh Kumar Rai. All help received by them from various sources has been duly mentioned.

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ABSTRACT

The Urban parking management faces significant challenges due to rising vehicle populations and limited space availability. The Intelligent Park Assist System (IPAS) emerges as a pioneering solution designed to optimize parking space utilization in dense urban environments. This system harnesses the synergy of Infrared (IR) technology and the Internet of Things (IoT), promising to revolutionize the traditional parking landscape.

IPAS deploys IR lights across parking facilities as sophisticated sensors that detect the presence and vacancy of vehicles. These sensors are intricately networked to provide real-time data transmission to a centralized IoT platform, ensuring instantaneous updates on space availability. Drivers can access this information through a user-friendly interface, facilitating efficient navigation to available parking spots and enabling informed decision-making regarding parking choices.

Moreover, IPAS equips parking lot operators and urban planners with critical data insights. This information is instrumental for improving resource allocation, enhancing traffic flow, and refining urban planning measures. The integration of IR and IoT technologies within IPAS is aimed at mitigating congestion, elevating the user experience, and maximizing efficient parking space use. The deployment of IPAS represents a forward-thinking step toward sustainable urban development, reflecting a transformative approach to tackling the complexities of modern-day parking.

INTRODUCTION

In the panorama of contemporary urban development, one of the most pressing challenges is the efficient management of parking spaces amidst the escalating number of vehicles. The Intelligent Park Assist System (IPAS) is conceived as an innovative response to this challenge, leveraging the advancements in the Internet of Things (IoT) and infrared technology to streamline the parking experience in urban landscapes.

The essence of IPAS lies in its capacity to transform parking lots and garages into smart environments. By installing a network of IoT-enabled infrared sensors throughout these areas, the system dynamically monitors parking space occupancy. This data is processed and relayed in real-time to a centralized platform, which then disseminates the information to drivers via an intuitive interface. The implications of this technology extend beyond mere convenience; it is a tool that can significantly reduce the time spent in search of parking spots, which in turn can lead to a substantial decrease in traffic congestion and vehicle emissions. IPAS is not only a boon for drivers but also serves as a strategic asset for city planners and parking lot operators. The wealth of data generated by IPAS can be analysed to unearth patterns in parking behaviour, predict peak times, and make informed decisions about pricing and space allocation. By doing so, it promotes a more dynamic and flexible approach to urban space management, adapting in real-time to the changing needs of the city's inhabitants.

As urban areas continue to grow and evolve, the introduction of smart technologies such as IPAS is essential. This system represents a convergence of efficiency, sustainability, and innovation, setting the stage for a new era in urban mobility and planning. Through the deployment of IPAS, cities can look forward to an optimized parking system that not only enhances the driver experience but also contributes to the broader goals of urban sustainability and smart city initiatives..

MOTIVATION FOR THE PROJECT

1. **Convenience:** Projects aim to simplify tasks, processes, and access, prioritizing user ease and seamless experiences for enhanced usability and accessibility.
2. **Consistency:** Ensuring uniformity and reliability in operations, projects strive to deliver outcomes reliably, maintaining a standard quality across tasks and functions.
3. **Efficiency:** Projects focus on optimizing resources and processes, minimizing waste, and maximizing output, ultimately achieving goals in a timely and resource-effective manner.
4. **Precision:** Emphasizing accuracy and exactness, projects aim for meticulous execution and results, minimizing errors and achieving high-quality outcomes.
5. **Sustainability:** Projects incorporate eco-friendly practices, aiming to reduce environmental impact, promote renewable resources, and ensure long-term viability and ecological balance.

COMPONENTS USED

- **Arduino Uno:** The Arduino Uno, a widely used microcontroller board, integrates key components essential for diverse projects. Its central processing unit (CPU) powered by an ATmega328P chip, clocked at 16 MHz, drives its functionalities. Equipped with 32KB of flash memory for program storage and 2KB of SRAM for variable storage, it interfaces through digital and Analog input/output pins, enabling connectivity with various sensors, actuators, and peripherals. Its USB interface facilitates programming and communication. Additionally, the Uno incorporates voltage regulators ensuring stable power supply, making it an ideal platform for prototyping and realizing innovative projects in the realms of robotics, automation, IoT, and beyond. (Fig.1)

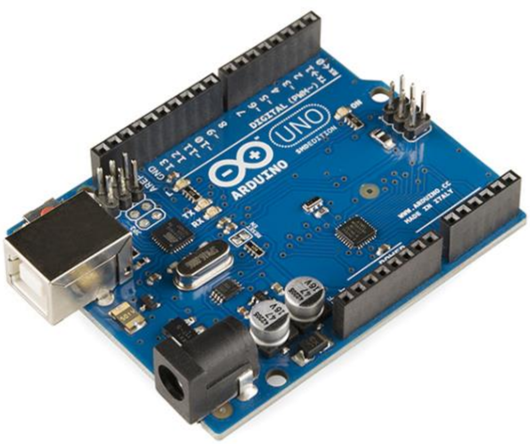


Fig.1 Arduino Uno

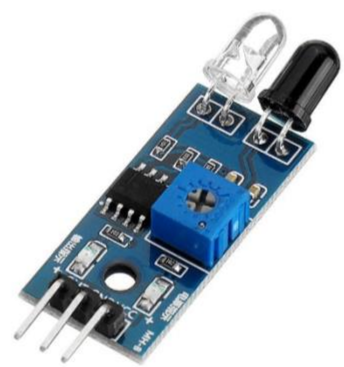


Fig. 2 IR Sensor Module

- **IR Sensor Module:** An IR (Infrared) sensor module comprises an IR transmitter and receiver, detecting infrared radiation variations. The transmitter emits infrared light, while the receiver senses reflections or interruptions in this emitted signal. These modules often include a photodiode, amplifier, and signal processing circuitry. When an object intersects the emitted infrared beam, the receiver detects changes in the received signal's intensity, triggering the module's output. Widely used in proximity sensing, obstacle detection, and automated systems, IR sensor modules offer versatility and reliability in diverse applications such as security systems, automated doors, and object detection in robotics. (Fig. 2)

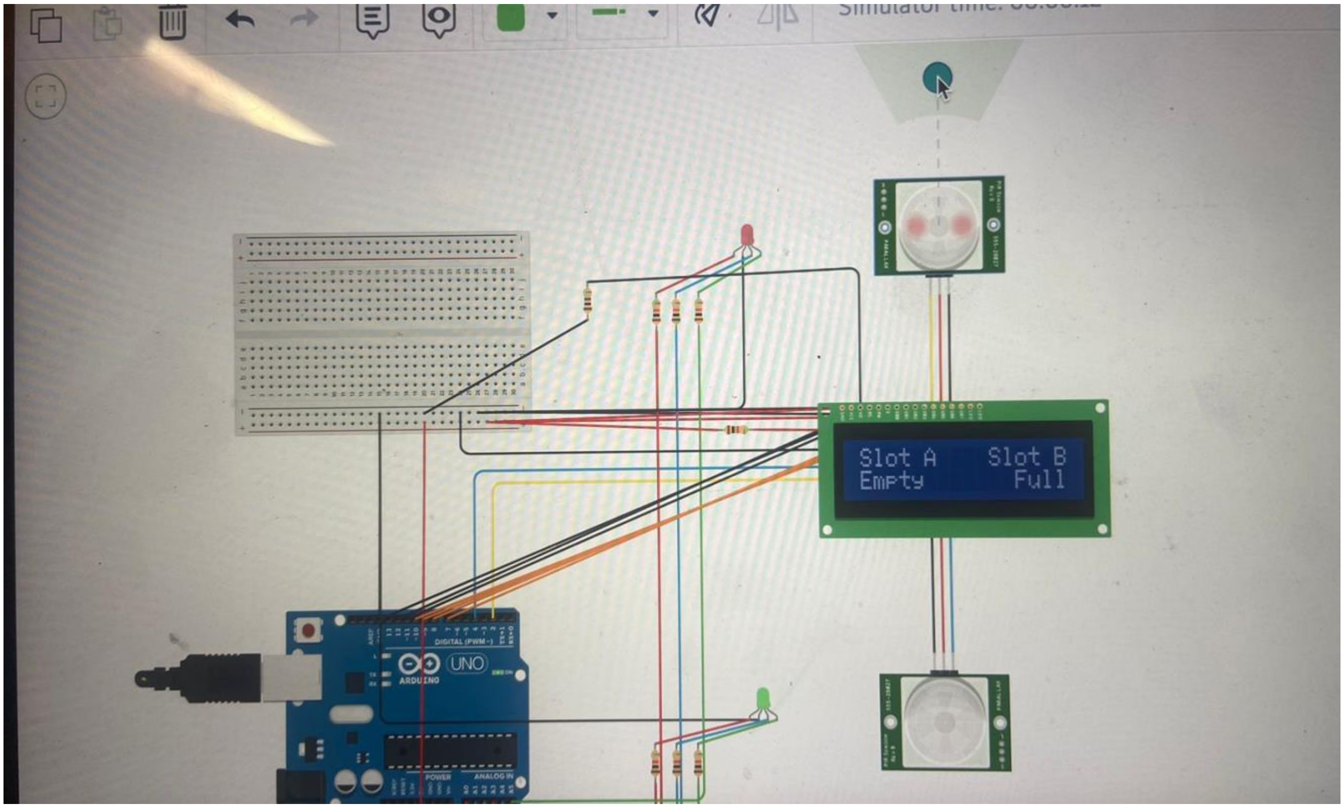
- **Jumper wires:** Jumper wires are indispensable components in electronic prototyping, facilitating seamless connections between various elements within circuits. These wires, typically made of flexible insulated conductive material, enable quick and reliable interconnections between components on breadboards, microcontrollers, sensors, and other electronic modules. Their versatility allows for easy experimentation, testing, and modification during project development, serving as essential conduits for transmitting signals, power, and data between different components. With their varied lengths, colors, and connection types, jumper wires offer a fundamental and flexible solution for establishing electrical pathways, fostering efficient and organized circuitry assembly in electronics projects. (Fig.3)

Fig.3 Jumper wires

METHODOLOGY

1. **Sensor Installation:**
    - **Dividing Parking Areas:** Segment the parking space into Parking 1 and Parking 2 sections.
    - **Sensor Placement:** Install infrared sensors in each parking slot to detect car presence. Calibrate sensors for accurate detection.
2. **Data Acquisition and Processing:**
    - **Sensor Data Collection:** Continuously monitor sensor outputs to detect car presence or absence in each slot.
    - **Real-time Data Processing:** Implement algorithms to interpret sensor data. If a sensor detects a car, mark the corresponding box as "checked."
3. **Interface Development:**
    - **User Interface Design:** Create an intuitive user interface displaying Parking 1 and Parking 2 layouts.
    - **Visual Representation:** Visualize parking slots with checkboxes or indicators reflecting the car occupancy status.
4. **System Operation:**
    - **Real-time Updates:** Ensure the interface reflects the real-time status of parking slots based on sensor inputs.
    - **Responsive System:** Design the system to immediately update the checkbox status upon car arrival or departure.
5. **Testing and Validation:**
    - **Simulation and Testing:** Simulate car arrivals and departures to validate the system's responsiveness.
    - **Accuracy Verification:** Validate the system's accuracy in reflecting car occupancy status through sensor activations.
6. **Deployment and Optimization:**
    - **Integration:** Integrate the system into the parking area, ensuring proper sensor functionality and data transmission.
    - **Optimization and Fine-tuning:** Refine algorithms and system responsiveness based on real-world testing feedback for enhanced accuracy and reliability.
7. **Maintenance and Scalability:**
    - **Monitoring and Maintenance:** Establish a protocol for regular system checks and maintenance to ensure continued functionality.

CIRCUIT DIAGRAM



SOURCE CODE

```
#include <LiquidCrystal.h>
int r1 = A0;
int g1 = A2;
int b1 = A1;
int r2 = A3;
int g2 = A5;
int b2 = A4;

LiquidCrystal lcd(12,11,10,9,8,7);
void setup() {
  // put your setup code here, to run once:
  pinMode(r1, OUTPUT);
  pinMode(g1, OUTPUT);
  pinMode(b1, OUTPUT);
  pinMode(r2, OUTPUT);
  pinMode(g2, OUTPUT);
  pinMode(b2, OUTPUT);

  lcd.begin(16,2);
  lcd.setCursor(5,0);
  lcd.print("Welcome");
  delay(2000);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("   Smart parking   ");
  lcd.setCursor(5,1);
  lcd.print("System");
  delay(2000);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Slot A ");
  lcd.setCursor(10,0);
  lcd.print("Slot B");
  pinMode(4,INPUT);
```

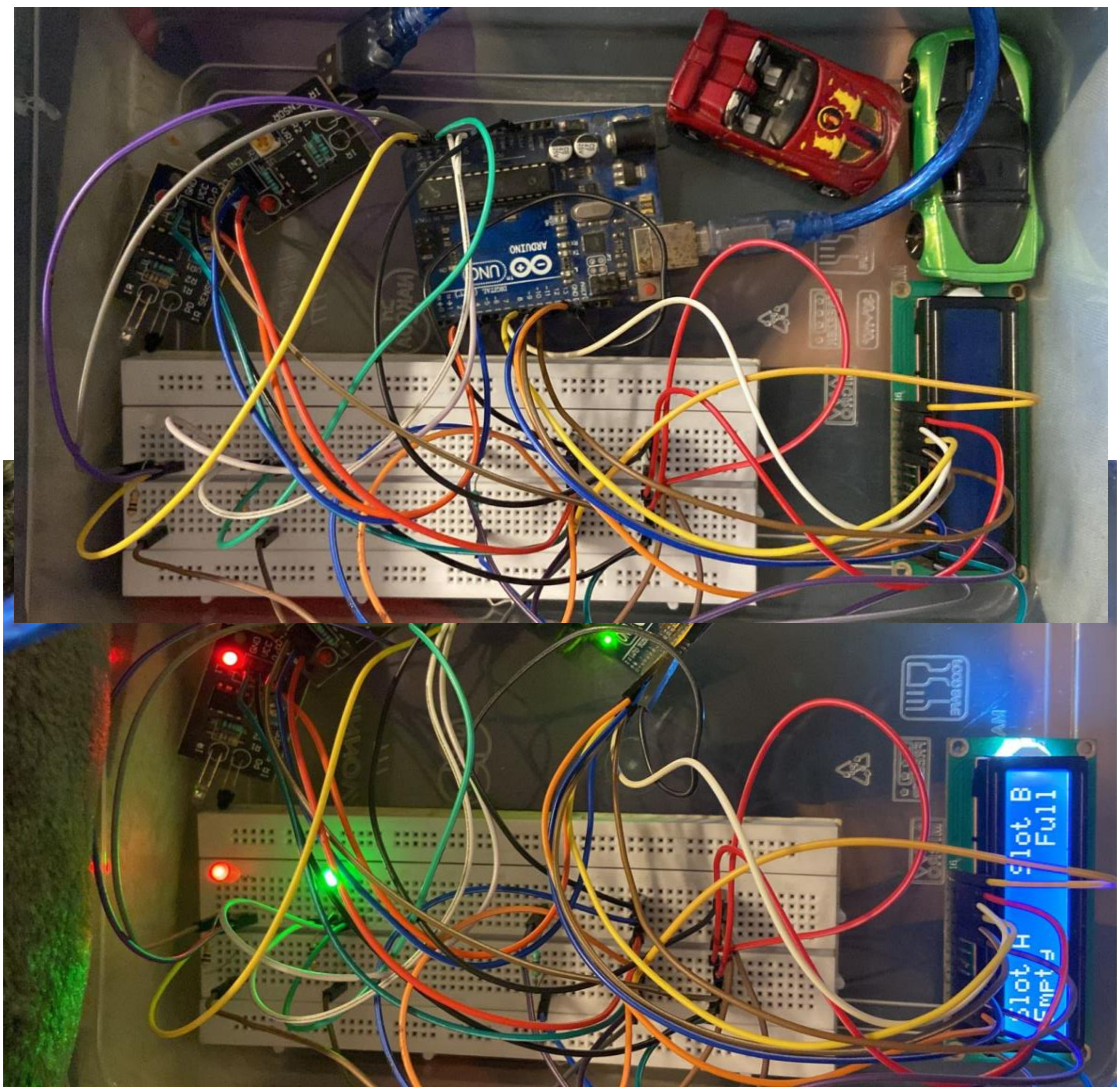
```
 pinMode(2,INPUT);
}

void loop() {
 // put your main code here, to run repeatedly:
 if (digitalRead(4)==HIGH)
 {
  lcd.setCursor(0,1);
  lcd.print(" Full");
  setColor(r1,g1,b1,0, 255, 255);
 }
 else
 {
  lcd.setCursor(0,1);
  lcd.print("Empty");
  setColor(r1,g1,b1,255, 0, 255);
 }
 if (digitalRead(2)==HIGH)
 {
  lcd.setCursor(11,1);
  lcd.print(" Full");
  setColor(r2,g2,b2,0, 255, 255);
 }
 else
 {
  lcd.setCursor(11,1);
  lcd.print("Empty");
  setColor(r2,g2,b2,255, 0, 255);
 }

}

void setColor(int redPin, int greenPin, int bluePin, int redValue, int greenValue, int blueValue) {
 analogWrite(redPin, redValue);
 analogWrite(greenPin, greenValue);
 analogWrite(bluePin, blueValue);
}
```

PROJECT HARDWARE



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