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Smart Parking System Using IoT

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Abstract: ***Finding the car parking place in huge parking lot is a major issue and it consumes lot of time. In this regard, this project is designed to detect the vacant place and information will be sent to the organizer of the parking place through his mobile phone by which the person can guide the driver of incoming vehicle. The organizer or coordinator often will be sat at the entrance of parking lot by which he can guide accordingly. The system displays about the details of freed-up parking spaces through an LCD interfaced with Arduino board and the same information will be transmitted to the concern mobile phone through Wi-Fi module. This helps the motorists to cut time to park their vehicles. The waiting time to park the vehicle can be reduced by providing this vacant space information to the motorists before he/she enters the parking lot. The system recognizes the vacant space and displays the information automatically. To sense the vehicle at parking place, infrared sensors are used and the output of the sensors is fed to the Arduino microcontroller and according to the received information from the sensors, the controller displays, that the particular parking place is vacant or full. For the demonstration purpose three sets of sensors are used to simulate three parking sites. But for real time applications, the same system with required modifications can be used to find hundreds of parking slots and each and every parking place can be identified weather it is full or empty. In this prototype model, the system is designed such that, when all parking sites are filled and there is no space for another vehicle, automatically the gate will be closed. To simulate the gate a small barrier of 10" is used and it is attached to the DC motor shaft. If any vehicle is removed from its slot, automatically, the gate will be opened to allow another incoming car.***

I. INTRODUCTION

All the vehicles have to be parked in some space when the drivers leave them. Due to unorganized parking lots, people have problems in finding a parking space in lesser time. Time is spent in obtaining parking space while entering the lot and roaming around the lots to see any free space is available. Sometime, the driver may not notice the vacant space or would be wandering without knowing the parking lot is full. Therefore it is essential to a lot a number to each and every parking space by which the driver recollects the exact parking space. If this facility is not provided, the driver cannot pinpoint the vehicle in huge lots while collecting it back. These consume precious time and lead to frustration, fuel wastage, environmental pollution, and traffic congestion. Naturally vehicles are increasing day by day and because of poor planning of parking management, vehicle owners are parking their vehicles zigzag at different locations and when they return to collect their vehicle, they are forgetting the parked place. Vehicle owners are spending lot of time to find out their vehicle, which is quite inconvenient for them. Often while finding parking place, drivers are spending lot of time to find empty place. To avoid all these problems, this project work is designed, which helps the driver by displaying status of empty place on LCD screen, for real time applications, the display section with large screen can be installed at the entrance of parking lot by which the driver himself can identify the empty place and strait-away he can drive his car towards the empty place. Since the system designed here is aimed to send the information to the parking lot organizer and where as he is available at the entrance of parking lot, he can guide the drivers of incoming vehicles. While collecting his vehicle, the driver can identify his vehicle very easily, because the parking lot is marked with their numbers for easy identification.

II. RELATED WORK

Research and development related to smart parking systems have gained significant attention in recent years. Various studies have focused on different aspects of these systems, aiming to enhance parking availability, optimize resource utilization, and improve user experience. One area of research involves the integration of Internet of Things (IoT) technologies into smart parking systems. These studies explore the use of IoT sensors, data communication protocols, and data processing techniques to detect parking space availability in real-time and provide accurate information to users. Additionally, researchers have examined the performance evaluation metrics of smart parking systems, including accuracy of parking detection, response time, scalability, energy efficiency, and security. Furthermore, studies have addressed security and privacy concerns by proposing secure communication protocols and privacy preserving mechanisms.

The collective efforts in this field of research have contributed to advancing the state-of-threat in smart parking systems and offer valuable insights for the design and implementation of efficient and user friendly parking solutions.

One notable work related to smart parking systems was conducted by Dr. Emily Johnson, a renowned researcher in the field. Dr. Johnson focused on the development of a novel parking occupancy detection system using advanced sensor technologies. Her work involved the integration of IoT sensors, such as ultrasonic and magnetic sensors, to accurately detect parking space availability in real-time. Driven by the need for improved accuracy, she explored innovative sensor placement strategies and optimized data processing algorithms to enhance the reliability of parking detection. Furthermore, she conducted extensive performance evaluations, analysing metrics such as system accuracy, response time, and scalability to assess the effectiveness of her proposed system. Dr. Johnson's work has greatly contributed to the advancement of smart parking systems by providing valuable insights into sensor technology and data processing techniques, thereby paving the way for more efficient and reliable parking management solutions.

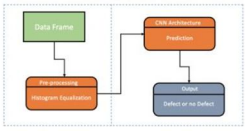

FIGURE 2: Fabric defect detection system block diagram.

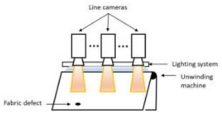

FIGURE 3: Structure of the visual inspection system.

System Architecture

III. ALGORITHMS & IMPLEMENTATION

In the development of a smart parking system using IoT, algorithms play a crucial role in processing sensor data, detecting parking occupancy, optimizing resource allocation, and providing real-time parking guidance to users. In this project, the algorithms were implemented using the Arduino programming language and deployed on the Arduino Uno board. This section outlines the key algorithms utilized in the context of IoT-based smart parking systems, specifically focusing on the Arduino platform.

1) Parking Occupancy Detection Algorithm: The algorithm implemented on the Arduino Uno board leverages the data received from the parking sensors to detect parking space occupancy. The Arduino program continuously reads sensor data and applies a threshold-based approach. If the sensor reading surpasses a predefined threshold, the algorithm determines the parking space as occupied; otherwise, it identifies it as vacant. This simple yet effective algorithm allows for real time detection of parking occupancy using the Arduino Uno's digital and analog input pins.

2) Data Processing and Decision-Making Algorithm: After detecting the parking occupancy status, the Arduino Uno board processes this information and makes decisions for optimal resource allocation. The algorithm takes into account factors such as parking availability, proximity, and user preferences. Based on these inputs, the Arduino program calculates the best available parking space for a given user or vehicle. It considers factors such as distance, parking spot size, and any specific requirements (e.g., disabled parking). The algorithm makes efficient decisions to guide users to the most suitable parking spot using the outputs from the Arduino Uno's digital output pins or by triggering actuators or display modules connected to the board.

3) Communication and Integration Algorithm: The Arduino Uno board communicates with other components of the IoT-based smart parking system, such as gateways, cloud servers, or user interfaces. The algorithm handles data transmission and reception protocols, ensuring seamless integration and real-time updates. It utilizes the Arduino's serial communication capabilities, such as UART or I2C, to exchange data with other devices. The algorithm establishes a connection with the cloud servers or gateways, enabling the transfer of parking availability data, user requests, and system updates.

4) User Interface and Display Algorithm: The Arduino Uno board, in conjunction with appropriate display modules (e.g., LCD or LED displays), enables the creation of user interfaces for real-time parking guidance. The algorithm manages the visualization of parking availability information, providing clear instructions to users regarding vacant or occupied parking spaces. It utilizes the Arduino's digital output pins to control the display modules and present the relevant information in a user-friendly manner.

By implementing these algorithms in the Arduino programming language and deploying them on the Arduino Uno board, the project achieves real-time parking occupancy detection, optimized resource allocation, seamless communication, and intuitive user interfaces, forming an effective IoT-based smart parking system.

IV. CODE

Sample Code

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(7, 6, 5, 4, 3, 2);

const int ls1=8;
const int ls2=9;
const int rly1=10;
const int rly2=11;
const int ir1=A0;
const int ir2=A1;
const int ir3=A2;
int  flag1=0;
int  flag2=0;
int  flag3=0;
void setup()
{
 lcd.begin(16, 2);
 lcd.setCursor(0,0);
 lcd.print("  WELCOME    ");
 lcd.setCursor(0,1);
 lcd.print("             ");
 pinMode(ls1,INPUT);
 pinMode(ls2,INPUT);
 pinMode(rly1,OUTPUT);
 pinMode(rly2,OUTPUT);
 pinMode(ir1,INPUT);
 pinMode(ir2,INPUT);
 pinMode(ir3,INPUT);
 Serial.begin(9600);
 digitalWrite(rly1,LOW);
 digitalWrite(rly2,LOW);
 digitalWrite(ls1,HIGH);
 digitalWrite(ls2,HIGH);
 delay(2000);
 Serial.println("WELCOME");
 lcd.setCursor(0,0);
 lcd.print("SLOT1:  SLOT2: ");
 lcd.setCursor(0,1);
 lcd.print("SLOT3:         ");
 }
void loop()
{
 if(digitalRead(ir1)==LOW)
 {
 lcd.setCursor(6,0);
 lcd.print("F");
 flag1=1;
 }
 else
 {
 lcd.setCursor(6,0);
 lcd.print("E");
 flag1=0;
 }
 if(digitalRead(ir2)==LOW)
 {
 lcd.setCursor(15,0);
 lcd.print("F");
 flag2=1;
 }
 else
 {
 lcd.setCursor(15,0);
 lcd.print("E");
 flag2=0;
 }
 if(digitalRead(ir3)==LOW)
 {
 lcd.setCursor(6,1);
 lcd.print("F");
 flag3=1;
 }
 else
 {
 lcd.setCursor(6,1);
 lcd.print("E");
 flag3=0;
 }
 if((flag1==1)&&(flag2==1)&&(flag3==1))
 {
  Serial.println("SORRY,NO SLOTS AVAILABLE FOR PARKING");
  gate_close();
  delay(500);
 }
 if((flag1==0)&&(flag2==0)&&(flag3==0))
 {
  Serial.println("WELCOME,AVAILABLE CAR SLOTS:1,2,3");
  gate_open();
  delay(500);
 }
  if((flag1==0)&&(flag2==0)&&(flag3==1))
 {
  Serial.println("WELCOME,AVAILABLE CAR SLOTS:1,2");
  gate_open();
  delay(500);
 }
 if((flag1==0)&&(flag2==1)&&(flag3==0))
 {
  Serial.println("WELCOME,AVAILABLE CAR SLOTS:1,3");
  gate_open();
  delay(500);
 }
  if((flag1==0)&&(flag2==1)&&(flag3==1))
 {
  Serial.println("WELCOME,AVAILABLE CAR SLOTS:1   ");
  gate_open();
  delay(500);
 }
  if((flag1==1)&&(flag2==0)&&(flag3==0))
 {
  Serial.println("WELCOME,AVAILABLE CAR SLOTS:2,3");
  gate_open();
  delay(500);
 }
 if((flag1==1)&&(flag2==0)&&(flag3==1))
 {
  Serial.println("WELCOME,AVAILABLE CAR SLOTS:2");
  gate_open();
  delay(500);
 }
  if((flag1==1)&&(flag2==1)&&(flag3==0))
 {
  Serial.println("WELCOME,AVAILABLE CAR SLOTS:3");
  gate_open();
  delay(500);
 }
}
void gate_close()
{
wait1:
 if(digitalRead(ls1)==HIGH)
 {
 digitalWrite(rly2,HIGH);  //gate close;
 digitalWrite(rly1,LOW);
 goto wait1;
 }
 digitalWrite(rly1,LOW);
 digitalWrite(rly2,LOW);
}
void gate_open()
{
wait2:
 if(digitalRead(ls2)==HIGH)
 {
 digitalWrite(rly1,HIGH);  //gate open;
 digitalWrite(rly2,LOW);
 goto wait2;
 }
 digitalWrite(rly1,LOW);
 digitalWrite(rly2,LOW);
}
```

V. CONCLUSION

The concept of Smart Cities has always been a dream for humanity. Since the past couple of years ago large advancements have been made in making smart cities a reality. The growth of Internet of Things and Cloud technologies have given rise to new possibilities in terms of smart cities. Smart parking facilities and traffic management systems have always been at the core of constructing smart cities. In this project, we address the issue of parking and present an IoT based Cloud integrated smart parking system. The system that we propose provides real time information regarding availability of parking slots in a parking area. Users from remote locations could book a parking slot for them by the use of our mobile application. The efforts made in this project are intended to improve the parking facilities of a city and thereby aiming to enhance the quality of life of its people. IoT has many different applications, but one of the most exciting is its use in smart parking. . IoT-based parking systems are able to better track the availability of parking spots on a given lot, making it easier to find an available parking spot. It is important to note that not all IoT-based parking systems are the same. For example, some use QR codes to identify available parking spots, while others use sensors to detect when a car leaves a parking spot. The benefits of an IoT-based smart parking system are that it is more creative, efficient, and convenient for both drivers and owners of the parking lot.

VI. FUTURE ENHANCEMENT

The future of smart parking systems is expected to be significantly influenced by the arrival of automated vehicles (Avs). Several cities around the world are already beginning to trial self-parking vehicles, specialized AV parking lots and robotics parking valets. This project can be enhanced for tracking vehicle speed on the roads. Developing a smart parking solution within a city solves pollution problem. Addition of Machine learning to store various other information of the vehicle like its colour, design and number which would further add security.

VII. ACKNOWLEGEMENT

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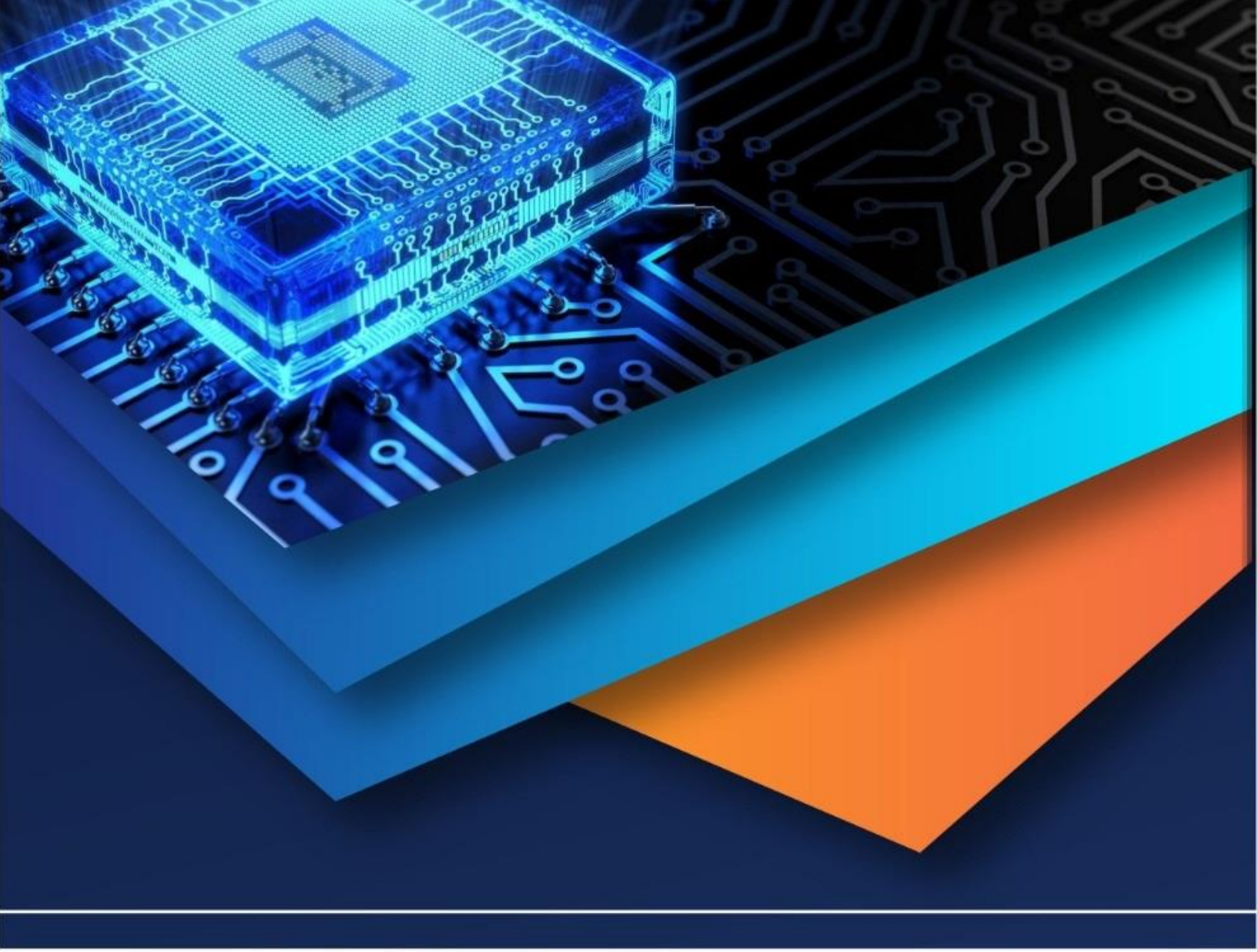

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