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"To visualize and find free parking lots designed to alert the driver of obstacles while parking using software tool"

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Abstract: The economy has increased the number of cars on the road, resulting in illegal and unstructured parking in public places, private buildings, educational and corporate campuses, and other locations worldwide. As we progress with this project, we want to establish an intelligent parking system that can quickly handle disorganized parking. We must accomplish this most important goal.
For this study, the parking system will be viewed as a queue, and queueing theory will be used to determine consumer wait times. You must follow standard practices when searching for the next available parking spot.
These best practices include using a multi-server queuing system and improving user experience. When looking for the closest available parking spot, use these tips. These two rules should always be observed.

Keywords: Smart parking, Queue theory, Parking system, microcontroller, Control System

INTRODUCTION

Overview of Project

The escalating demand for parking spaces due to the growing number of car users in Malaysia has made smart parking systems essential. While some establishments have implemented intelligent parking systems using expensive sensors, a new research approach utilizes a modified 360-degree camera with a Raspberry Pi, a lens, and a Haar-Cascade classifier. OpenCV and Python process the images to detect available parking spaces, and Cloud Firebase updates data for users to check parking availability via Android phones. This upgraded system, replacing multiple sensors, achieved a remarkable 99.74% accuracy in determining parking space availability, presenting a cost-effective and reliable alternative to traditional smart parking systems. Numerous studies worldwide emphasize the need for enhanced parking systems, highlighting the limitations of costly and less accurate sensor-based solutions. Recent advancements, including magnetic and ultrasonic sensor systems, still pose challenges in terms of installation costs and effectiveness. Ongoing research focuses on improving precision, implementation costs, and system reliability for smarter parking solutions.

Related work

In recent years, global communities have increasingly demanded smart parking systems, evident in developed countries. Annual research on intelligent parking systems has led to significant advancements from the initial use of wired sensors to detect vehicle presence in every parking slot. Notable projects, such as Siemens Si Park, prompted the realization that improvements were needed in accuracy, reliability, installation cost, power consumption, and other aspects.

Researchers have explored sensor-based solutions for indoor parking, with challenges in wiring for LED and sensor interfaces. Another approach involves a vision-based system utilizing a 5-megapixel camera attached to a Raspberry Pi, achieving 98% real-time accuracy in identifying vacant parking spots. A study on Automatic Parking Space Detection System used

web cameras and image processing for a 99.5% accuracy rate.

A novel dual microwave Doppler Radar sensor achieved over 98% detection accuracy in recognizing vehicle movement for parking occupancy. However, system complexity is acknowledged. An embedded system design using Arduino, ultrasonic, and temperature sensors for real-time parking guidance faced challenges in installation costs and sensitivity to temperature changes and air turbulence.

Overall, ongoing research focuses on enhancing accuracy, reducing costs, and addressing challenges in implementing efficient and reliable smart parking systems.

LITERATURE SURVEY

Smart occupancy detection for road traffic parking using deep extreme learning machine, Shahan Yamin Siddiqui. et.al, Journal of King Saud University – Computer and Information Sciences, 2022

This article utilizes artificial neural networks to forecast parking locations, assisting vehicles in choosing a suitable area for stopping. This strategy improves traffic familiarity and reduces turbulence. The Deep Extreme Learning Machine (DELM) technique achieves reliability with minimal error rates, lowering skepticism. The suggested DELM has the greatest precision rate recorded at 91.25%. Simulation findings confirm the DELM strategy's prediction effectiveness.

Performance Analysis of Proximity and Light Sensors for Smart Parking, Mamta Bachania, Umair Mujtaba, International Conference on Ambient Systems, Networks and Technologies, 2018

This study examines smart parking system design variables such sensor selection and optimal deployment places for accurate detection. We start with two common sensors: LDR for shadow detection and IR for object detection. The study tests car and parking space detection accuracy in diverse settings. The study demonstrated that IR sensors identified vacant parking spaces and automobiles better than LDR sensors in varied environmental conditions.

Predicting truck parking occupancy using machine learning, Jean Paul Sebastian Piest, Et.al, International Conference on Ambient Systems, Networks and Technologies 2022

Improve truck parking utilization. Future study can increase truck parking utilization using machine learning and prediction model authorities. Future study can employ the machine learning prediction model for different truck parking areas.

An IoT assisted Intelligent Parking System (IPS) for Smart Cities, Shahina Anwarula, Et.al, International Conference of Machine Learning & Data Mining, 2023

This article explores various driver use-cases for discovering and parking in the correct location. The suggested system utilizes Raspberry Pi, NodeMCU, RFID, and IR sensors. The results in later sections demonstrate the usefulness of this IPS.

A low cost IoT-based Arabic license plate recognition model for smart parking systems, Mohammad M. Abdellatif, Et. Al, Ain Shams Engineering Journal, Science Direct 2023

The experiment in this research employed 200 photos to recognize Egyptian automobile plates. The model accurately identified Arabic license plates with 93% accuracy. A prototype is created utilizing ESP32 Cameras and Raspberry-Pi to evaluate system performance. Additionally, the RPi hosts a database and website allowing users to locate their car in the parking lot using their license plate, which is kept in the database upon detection.

Parking Information Guidance Systems and Smart Technologies Application Used in Urban Areas and Multi-storey Car Parks, Jiří HanzL, Horizons of Autonomous Mobility in Europe, 2020 Science Direct

The benefits that these technologies bring to both transport and logistics areas are summarized and the benefits that these technologies bring to both transport and logistics processes are evaluated.

Chiwhane, S.A., et al. (2017) IOT Based Fuel Monitoring for Future Vehicles. International

Journal of Advanced Research in Computer and Communication Engineering, 6, 295-297.
In the author proposed a system for overcoming fraud at petrol-pumps. In an instant, when agent starts filling fuel in vehicle tank the flow sensor gets activated and provides a series of pulses proportional to instantaneous flow rate. The ESP8266 sends the data to the cloud server. User application also locates the user throw GPS. The reviewed paper works with flow sensor for measuring fuel whereas the proposed system works with ultrasonic sensor which can measure fuel from various dimension fuel tanks.

Padmaja, B.V., et al. (2019) IoT Based Implementation of Vehicle Monitoring and Tracking System Using Node MCU. International Journal of Innovative Technology and Exploring Engineering, 8, 446-450
In the author proposed a system for vehicle monitoring and tracking systems using Blynk platform acting as a medium for data transfer and visualization. This system is implemented using Ultrasonic sensor, Gas sensor, IR sensor, Temperature sensor, GPS. The reviewed paper used Blynk for monitoring whereas the proposed system used mobile application for monitoring.

Dukare, S.S., Patil, D.A. and Rane, K.P. (2015) Vehicle Tracking, Monitoring and Alerting System: A Review. International Journal of Computer Applications, 119, 39-44.
https://doi.org/10.5120/21107-3835
In the author proposed a system to develop a method that provides vehicle tracking, monitoring and alerting System. Alerting system uses GSM or GPRS for sending information. GPS is used to inform the user about exact location of vehicle. The reviewed paper proposed to develop vehicle tracking, monitoring and alerting system whereas the proposed system develop vehicle activities such Advances in Internet of Things as fuel monitoring, vehicle location tracing, find nearest fuel pump and get alerting notification.

Gullipalli, S., Karri, Y. and Kota, S. (2018) GPS Live Tracking of Buses and Fuel Monitoring System Using Rasberry Pi. International Journal for Research in Applied Science & Engineering Technology, 6, 2278-2285.
In the author proposed a system to consist of Raspberry Pi, GPS, GSM, fuel sensor and speed sensor. It provides the outcomes from the interaction between the system devices, which are on the bus, web application and desktop application. The reviewed paper used GSM for sending data whereas the proposed system used NodeMCU (ESP8266) for sending data and it use web application to monitoring the system whereas the proposed system uses a mobile application to monitoring the system.

Vanmore, S.V., et al. (2017) Smart Vehicle Tracking Using GPS. International Research Journal of Engineering and Technology, 4,
In the author proposed a system for tracking and positioning of any vehicle by using Global positioning System (GPS) and (GSM) this system is continuously control and monitoring report the status of vehicle which is only possible by the reporting frequency of GPS tracking. It will monitor and track their vehicles for safety concerns with the help of android applications. The reviewed paper works with PIC18F4520 whereas the proposed system works with NodeMCU.

Alshamisi, H. and Këpuska, V. (2017) Real Time GPS Vehicle Tracking System. International Journal of Advanced Research in Electronics and Communication Engineering
In the author proposed a system to track the vehicle by using GPS and GSM technology. The GPS and a GSM modem with an Raspberry Pi MEGA2560 which is attached to the vehicle. The reviewed paper used GSM to send data whereas proposed system use NodeMCU (ESP8266) which has built in WiFi chip to send data in database.

Rohitaksha, K., Madhu, C.G., Nalini, B.G. and Nirupama, C.V. (2018) Android Application for Vehicle Theft Prevention and Tracking System. International Journal of Computer Science and Information Technologies, 5, 2018
In the author proposed a system which helps the user to exploit the working of multiple processors in parallel. In this system user interface is on another android mobile where

the user can track the vehicle on Google map. The reviewed paper works only for vehicle location track whereas the proposed system works for vehicle activities such as fuel monitoring and vehicle location tracking.

Gap Research

Parking issues in major cities pose common and hazardous challenges. The widespread adoption of Android devices, coupled with advancements in Wi-Fi technology, offers a potential solution through digital data integration. The increasing use of Android phones contributes to a growing problem of users spending significant time searching for available parking, leading to congestion and traffic issues. The inefficiency in finding parking spaces results in wasted time for individuals traveling from various locations. Moreover, the cumbersome payment process often leads to users leaving without completing the transaction, exacerbating the parking problem.

Aim

"To visualize and find free parking lots designed to alert the driver of obstacles while parking using software tool"

Problem Statement

"The proposed solution in this research utilises affordable, easy-to-install IoT devices. They use an algorithm that requires minimal computing resources. Additionally, the extracted text is stored locally, allowing users to search results from anywhere on the network. An experimental prototype is developed to evaluate system performance and feasibility in smart city applications. Smart cities demand fast, user-friendly, and affordable applications. This study focuses on these requirements."

Objectives

This study presents a cost-effective smart solution to save time spent searching for parked vehicles in road parking lots.

Applying technique, plates are identified by identifying individual characters and digits from sub-images obtained during segmentation.
The system is composed of an ESP32 wireless camera connected to the controller wirelessly through a local Wi-Fi network.
The whole system operates efficiently and smoothly

PROPOSED METHODOLOGY

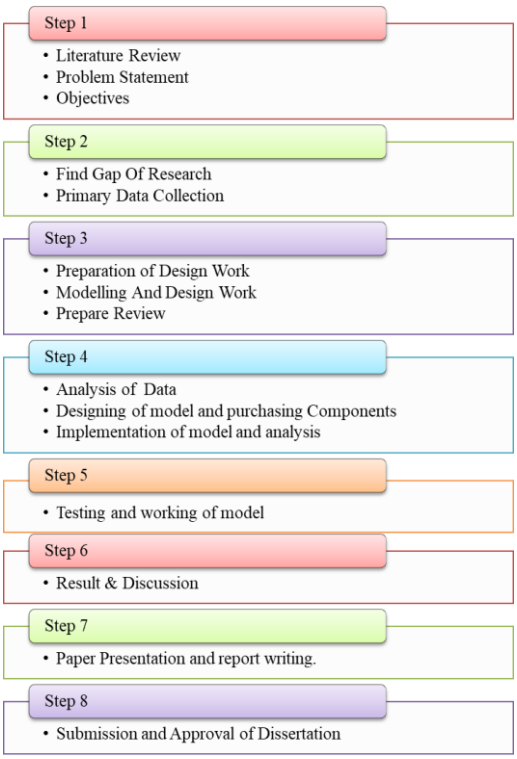

Figure1.1: Research Methodology Flow

Research Work

The study aims to analyze existing smart parking solutions by examining adopted approaches, sensors, and network technologies in the development of Smart Parking Systems (SPSs). The research involves identifying keywords such as "smart," "parking," "system," "solution," "sensors," "networks," and "methods." Utilizing online scientific databases like IEEE Xplore, ScienceDirect, Springer Link, MDPI, ACM Digital Library, and Hindawi, the research develops primary search strings to uncover literature findings. The methodology involves establishing search standards, employing rigorous criteria for creating search terms, and utilizing reputable publishers for

data collection. Additionally, pre-processing techniques, including license plate image enhancement and segmentation for optimal performance, are implemented to detect license plate characters.

Functional Requirement

Web Application for parking admin

1. Selecting parking areas and which slot to choose, as well as how much it will cost to park there, how much it will cost per minute and how long a vehicle can stay there will be included.
2. The admin is constantly updating the data for the parking area. Doing so will ensure that customers do not face any problems.

Android Application for end users

1. Vehicle details and customer details need to be registered here. The first task of the end user is to collect evidence and store it in the system. Find the parking area from the list of areas registered by the parking operator.
2. View details such as selected parking area name, price per minute, total number of available spaces. Reserve the available parking space and specify the reservation period.

Back End Management System

1. When editing or deleting a data, it is important to properly consult the user and then edit or delete that data.
2. When giving a booking slot the admin must properly collect the user credentials. An Id should be assigned to each slot.
3. Customers must contact the parking operator to modify the parking slot. The parking area allows the customer to cancel the slot if it is not comfortable.

Non-Functional Requirement

- The information we provide must be separate, only then can the website retain the information or the data will not be stored.
- The server collects and resolves user requests only in those cases where it must be properly from separate users.
- Consumers should take due care as before when any problems arise.
- For example, when your device is stolen, the user should see to it that the data is connected to a different system.
- We have made this Android application very secure. If you use it, you can keep your data very secure.

SYSTEM DESIGN

Block Diagram

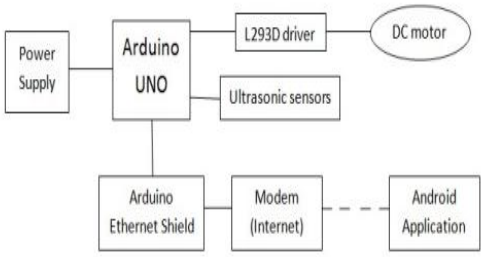

Figure1.2: Block Diagram

Components Description

Arduino

Figure1.3: Arduino

- The Arduino Uno is a microcontroller board. It is used ATmega328p. Arduino Uno have 14 input/output pins and output pin (PMW outputs as of which 6 can be used) and 6 analogy inputs.
- The Arduino Uno circuit acts as an interface between the software part and the hardware part of the project.
- Arduino board is one type of microcontroller.
- It is able to read input like light sensor, detect motion and gives an appropriate output on it. Arduino works like a brain so here we can store programs code.

RFID CARD

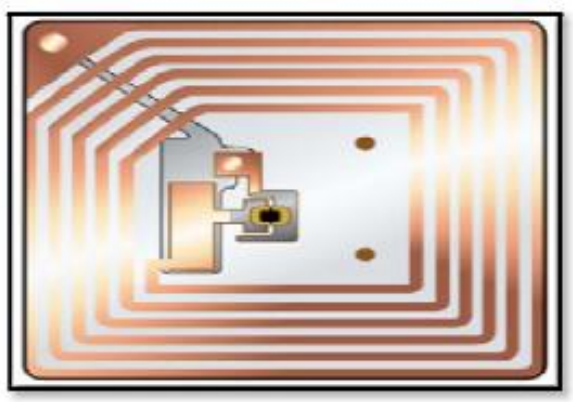

Figure1.4: RFID Card

- A Radio Frequency Identification Tag (RFID) tag is an electronic tag that exchanges data with a RFID reader.
- we are going to use Active tag of RFID. While RFID's original uses were primarily for inventory tracking in retail environment,
- This technology has quickly created a presence in an extremely diverse number of fields including easy gas payment, credit card replacement. RFID tag has chip, memory and an antenna

IR SENSOR

- IR Sensor An IR sensor is an electronic device that emits to sense some aspects of the surroundings.
- An IR sensor can measure the heat of an object as well as detects the motion.
- These types of sensors measure only IR radiation rather than emitting it, that is called as a passive IR sensor

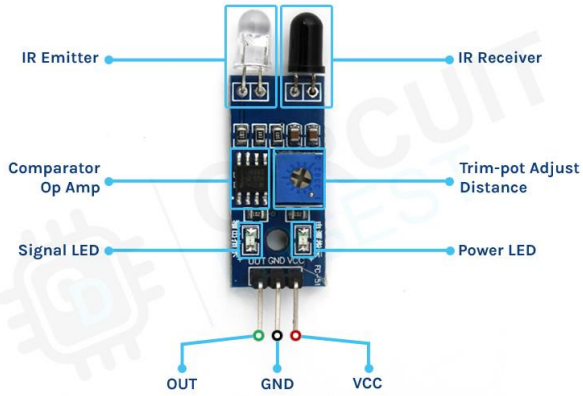

Figure1.5: IR Sensor

Buzzer

The specifications of the buzzer include the following.

- Color is black
- The frequency range is 3,300Hz
- Operating Temperature ranges from – 20° C to +60°C
- Operating voltage ranges from 3V to 24V DC
- The sound pressure level is 85dBA or 10cm
- The supply current is below 15mA

Figure1.6: Buzzer

Ethernet Shield

Ethernet shield it is used for connecting Arduino to internet. This shield allows us to exchange data worldwide through the internet connection. We can use this stuff in controlling the robot or many things with a speed of 10/100 MB. It comes under Arduino Ethernet library.

Figure1.7: Ethernet Shield

CONCLUSION

It is an effective strategy for parking vehicles, which helps to alleviate congestion in the surrounding area.

The scope of this work has been expanded to include a smart parking system for automobiles, complete with an automatic invoicing system and a fully automated system that makes use of the layered parking approach.

Tracing the vehicle's license plate and identifying the driver by face are examples of safety procedures.

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