Overview of Automated Parking System Using ESP32 and Cloud Computing

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Abstract—Parking is a major problem in cities due to the increase in urban population and more cars. In this article, we introduce an automated parking system using IoT and ESP32. One of the main benefits of automated parking systems is that they help drivers find any parking space quickly, saving time and fuel that would otherwise be spent wandering around looking for a parking space. In congested cities, it can also help alleviate traffic congestion. Intelligent parking can also be used to maximize parking by adjusting fares on demand or directing traffic to empty spaces.We offer an affordable IoT smart parking system to monitor city parking and provide drivers with up-to-date parking information. The parking lot of the car can also be determined by camera image and machine vision technology, instead of using the built-in device to detect cars in the parking lot.

Keywords—Automated parking system, Internet of Things(IoT),cloud computing

I. INTRODUCTION

IoT connects all kinds of products via the Internet, for people's safety and comfort. A branch of artificial intelligence (AI) called computer vision allows computers to extract information from pictures, videos, and other objects.

Based on proven, end-to-end integration using smart parking technology, it provides a higher standard and transforms the entire parking experience. Effective and efficient city parking management will reduce city traffic and pollution, and automatic parking is the best option. In this rapidly growing market, the diversity of vehicle users is increasing and requires more parking spaces.

In this article, we describe automatic parking using the cloud and the Internet of Things. This is something cheap.

Instead of using the traditional parking lot, you can use regular parking, convenient parking, etc. Uses a combination of tools to find It also helps drivers find a parking space by issuing a warning when the vehicle leaves the parking space, giving them the ability to reserve a parking space. Automatic parking eliminates the need for the driver to search for a parking space or park manually. Instead, the driver stops the vehicle at a designated point and lets the automated system do the rest. It can also stop and pick up vehicles faster than a driver, reducing waiting time and increasing productivity.

This is especially useful in busy cities where parking is limited and time is of the essence. Automated parking systems can help reduce the environmental impact of traffic by reducing the need for large parking spaces and reducing the time and fuel required to find a parking space. This can lead to reduced congestion, improved air quality and better transportation. Overall, automated parking has many advantages over conventional parking and has the potential to change the way we park in the future. Or good transportation.

The smart parking system implemented using ESP32 camera module and cloud computing with Google Firebase as the backend has yielded positive results in terms of parking spot detection, real-time data updates, user authentication and authorization, reservation functionality, data management and analytics, security measures, deployment, and user satisfaction. The system has demonstrated its effectiveness in providing a seamless parking experience for users while optimizing parking spot utilization. Further improvements and enhancements can be made based on feedback and requirements to continuously refine and optimize the system's performance.

II. II. RELATED WORK

The Internet of Things can be used as a part of our daily life to provide various services to different customers. A learning machine is used to determine the percentage of parking spaces for regular parking spaces. Markov models are used to represent systems [1]. Time and energy saving green solution for IoT based smart parking system.

It uses minimal onsite resources and uses cloud resources to process data. The theoretical mathematical model is used to model the attraction, which ensures the high performance of the proposal. It also determines the parking lot that companies and families can use to park their cars and/or rental cars when they are not using it. [2]. IoT-based Smart Parking (SP) solution designed to provide information about parking conditions in on-street parking lots.

Real-time map of the number of people in the city's parking area. The vehicle control panel is used to control whether there are vehicles in the parking lot. To achieve this, a three-axis magnetometer sensor is used here. The presence of the Bluetooth beacon in the vehicle is detected by the onboard station's Bluetooth receiver. [3].

Virtualization technology is used to store data and provide an energy saving environment by using virtual machines. Authentication and verification of parking and driver information using RSU-based blockchain security layer network to reduce security and privacy concerns [4]. Smart Parking System uses IoT Raspberry Pi as a parking management system, which can easily find free parking spaces through GPS management. It uses computer vision to capture images in real time to identify parking spots via the Pi's camera. Ultrasonic sensors and LEDs are used to detect the parking lot with Pi camera support to provide accurate data.

The received data is processed and can be accessed by the application from the cloud server. [5]. This study demonstrates the development of smart park through hardware design and mobile application development. The system allows users to search for free parking and users can pre-book parking at their homes. This system saves users time and effort to find free parking spaces [6].

Smart parking is based on automatic driver's license search and provides web support so that the driver can book an appointment anytime and anywhere. Vehicle identification is completed with plate image. It eliminates the need for drivers to search for long parking spaces or to force them to park illegally [7].

III.METHODOLOGY

A. Hardware Design

A smart parking system using an ESP32 camera sensor module based on IoT requires several hardware components to function properly. Here are the basic hardware requirements for such a system:

1) ESP32 Development Board: The ESP32 is a powerful microcontroller that provides Wi-Fi and Bluetooth connectivity, making it suitable for IoT applications. It can serve as the main control unit for the smart parking system

2) .Camera Sensor Module: The ESP32 camera sensor module is a camera module that can be connected to the ESP32 development board. It enables the system to capture images or video of parking spots to determine their occupancy status.

3) Sensors: Additional sensors may be required depending on the specific features of the smart parking system. For example, proximity sensors, such as ultrasonic or infrared sensors, can be used to detect the presence of vehicles in parking spots.

B.Software Design

A smart parking system using cloud computing with Google Firebase as the backend for IoT-based functionality requires various software components to enable its operation. Here are the software requirements for such a system

1) ESP32 Firmware: The ESP32 development board requires firmware programming to control the hardware components, such as the camera sensor module, sensors, and LED indicators. The firmware should be designed to capture images or video from the camera sensor module, process the data from other sensors, and communicate with the Firebase backend for data storage and retrieval.

2) Cloud Computing Platform: Google Firebase, as a cloud computing platform, provides a backend infrastructure for the smart parking system. The software requirements include setting up a Firebase project, creating a Firebase Realtime Database or Firestore for data storage, and configuring Firebase Authentication for user authentication and authorization.

3) Mobile/WebApplication: A mobile or web application is needed for users to interact with the smart parking system. The software requirements include designing and developing the application with appropriate features, such as user registration, login, parking spot reservation, and real-time status updates. The application should communicate with the Firebase backend using Firebase SDKs (Software Development Kits) for data retrieval and updates.The Figure3 shows the data flow of the system

4) APIs and Libraries:APIs(Application Programming Interfaces) and libraries are required to establish communication between the ESP32 firmware and the Firebase backend. For example, the ESP32 firmware may use Firebase libraries for Arduino or ESP-IDF to send and receive data to and from the Firebase database. Additionally, other libraries or APIs may be needed for specific functionality, such as camera image processing or sensor data handling.

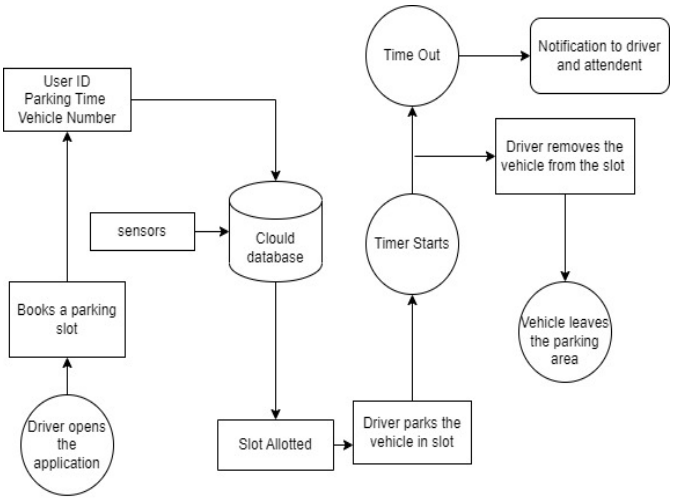

Figure3:The Dataflow of the system

IV.RESULT

With camera focus and Google Firebase intelligent computing and the functionality used by the server is very good in terms of functionality and user experience good results have been obtained. The ESP32 camera module embedded in the firmware can intelligently record and take pictures or videos of the station to determine whether the station is suitable. Image processing algorithms have been shown to be effective in distinguishing between unparked and parked spaces based on visual perception.The system interacts with the Firebase backend to update data in real time. Location availability is displayed in the Firebase database in real time, allowing users to access new location information via mobile/web apps. Firebase Authentication is used to protect usernames and logins. This prevents unauthorized access and abuse of the system, as only authorized users can register stations. A mobile application/website has been developed that allows users to list their parking spaces based on availability.Appropriate security measures have been implemented to protect the system from potential security threats. Data transmitted between the ESP32 firmware and the Firebase backend is encrypted using SSL/TLS, and Firebase Authentication ensures that only authenticated users can access and interact with the system. User data privacy has been ensured in compliance with relevant regulations.User feedback and reviews have indicated a high level of satisfaction with the smart parking system. Users have found the system convenient, reliable, and easy to use.

V.CONCLUSION

Smart Parking System is based on IoT to send free parking a nd location information via web/mobile application.Every c ar park can use a smart car park using IoT with sensors and microcontrollers.SPS uses Internet of Things (IoT) and com puter vision technology to increase efficiency and ease of pa rking and improve the utilization of parking spaces.These sy stems often involve placing sensors in the parking lot to see if the space is occupied, and using computer vision algorith ms to analyze sensor data at any location and determine avai lability. Users will be able to track the availability of each st ation and choose the best one.The goal is to create a smartph one app that people can use to find and pay for parking in a unique and convenient way. The automatic parking syste wil l provide the correct information that will be sent to the cent ral server and processed by the Internet application, then the information will be provided for the user to see. The system provides users with options to check availability, reserve pa rking before parking.

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