

IOT Based Automated Smart Surveillance and Parking Management

Abhijeet Dhumal^{#1}, PawanKumar Bokka^{#2}, Amit Amange^{#3},
Mrs. Bhagyashree Warhade, Mrs. Gayatri Ambadkar
<sup>#Dept. Of Electronics and Telecommunication Engineering
Nutan Maharashtra Institute of Engineering and Technology, Pune, India</sup>

ABSTRACT

In the urban areas, finding parking spaces for vehicles can be a challenging task during peak hours, leading to traffic congestion. Even if the availability of parking spaces is known, to utilize the space efficiently and to keep record of vehicles in real-time is very difficult. To address these issues and improve the parking experience by efficiently accommodating a growing number of vehicles, as an application of smart city, we suggest implementing an IOT based vehicle surveillance system.

Keywords—IOT, Smart surveillance, ESP32, FTDI, Application.

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1. INTRODUCTION

As the number of auto mobiles increases, so does the problem of parking in cities. This leads to confusion, wasted time and frustration. Moreover, when someone damages another person's car, to identify the responsible person can be difficult. This issue is compounded by the fact that more and more people are bringing their cars to premises, and there are only a limited number of parking spaces available.

One major problem with parking is that people often park their cars inappropriately, which can block other parked cars in the lot. The owners of these blocked cars are then left frustrated and unable to find the person responsible for the obstruction. Security guards are often unable to help because there is no monitoring system in place to enforce parking policies.

This wastes the time of people who uses parking system in order to secure their vehicles. Additionally, users who do not have reserved parking spots may damage other cars while trying to park in appropriately without a proper monitoring system in place, it is difficult to keep track of parking information like the location and duration of parked vehicles. This makes it hard for car owners to find their cars in the lot, leading to further frustration and

wasted time. The current

parking management system at the parking place is manual and only allows authorized vehicles with entrance stickers to enter the slot.

In this paper, we propose a system which implements a vehicle parking management system that will not only automate the existing parking management system by keeping track of in/out information and parking information of vehicles but also facilitate the security of the vehicle.

The remainder of this paper is organized as follows: Section 2 introduces literature survey of this report which consists of exact references taken for this project. Section 3 presents proposed work aspects considered in this project with interfacing between hardware components, backend, frontend user interface, and database integration. Section 4 presents results achieved during this overall application design along with its algorithm. Simulation results for the performance of the proposed framework are provided in Section 5, and concluding remarks with some future research directions are provided in Section 6.

2. LITERATURE SURVEY

The use of IOT technology is widespread in the modern world. M Sri Lakshmi and C Padma explained how 2 IOT can be utilized in the field of surveillance [1]. By integrating IOT with surveillance systems, users can remotely monitor activities and receive notifications of any intrusion detected through connected sensors. This implementation reduces the need for human intervention in surveillance monitoring, minimizing errors caused by manual surveillance.

The authors Amit and Kumar explained that by incorporating sensors and smart devices into IOT-based surveillance systems, real-time monitoring and analysis of security data becomes possible. As a result, security admin surveillance can promptly react to potential security threats and implement necessary measures to reduce the risk. [2]

Rishabh Paunikar et.al., in their paper 'Action Recognition using Surveillance system' [3] proposed an action recognition using surveillance systems. These systems typically use CCTV cameras or other surveillance equipment to record footage continuously. However, a significant portion of the data captured is idle data, where no activity is taking place. When reviewing recorded footage, it can be tedious to go through all the footage to determine when and what activity occurred.

Agrawal et.al in their patent 'Internet of Things: A Hands-On Approach' [4] implemented a system comprehensive guide for building IOT systems using a variety of technologies with numerous examples and exercises that allow readers to build their own IOT systems.

"The Internet of Things: From RFID to the Next-Generation Pervasive Networked Systems" is a book that explores the potential of the Internet of Things (IOT) and its impact on the future of technology. The authors, Roman, Lopez, and Mambo, provide a comprehensive overview of IOT, including its history, current trends, and future implications. [5]

"A stochastic model of TCP Reno congestion avoidance and control" is a research paper that presents a mathematical model of the Transmission Control Protocol (TCP) Reno congestion avoidance and control mechanism. The authors, Padhye, Floyd, and Jacobson, developed a stochastic model that captures the dynamics of TCP Reno, which is widely used in the Internet for reliable data transfer. [6]

As per survey in [7], the data collected from the cameras and sensors is processed and analyzed using machine learning algorithms to identify classify objects and events.

In the system proposed by [8], capability of sending alerts and notifications to security personnel in case of security breaches is discussed.

Another research paper on Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification with the design and implementation of IOT systems, including the hardware and software components, as well as the protocols and standards used in IOT communication [9]. Thus the need of various IOT applications [10] for smart city is still in demand and required in implementation.

3. PROPOSED WORK

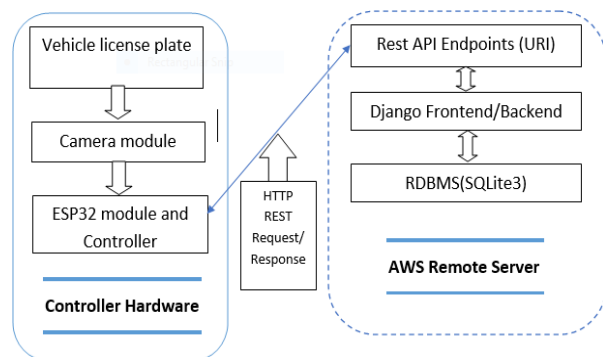


Figure -1: Workflow of components involved in total process

3.1. ESP32

The ESP32 Arduino core provides libraries that enable communication over Wi-Fi using TCP and UDP, setting up SSDP, m-DNS, HTTP, and DNS servers. Another useful device is the Ai- Thinker ESP32-CAM, which is a Wi-Fi and Bluetooth module with additional 520KB SRAM and external 4 MP SRAM. It is also compatible with OV2640 and OV7670 cameras, as well as SD cards. Due to its versatile features, the ESP32-CAM can be applied in various Internet of Things (IOT) applications. It is highly versatile and can be utilized for arrange of IOT applications, including home automation systems, industrial wireless control, and wireless monitoring. Its features make it an ideal choice for those looking to develop intelligent devices for various applications.

Table-1: ESP32-CAM and FTDI pin configuration

ESP32-CAM	FTDI Programmer
GND	GND
5V	VCC (5V)
U0R	TX
U0T	RX
GPIO0	GND

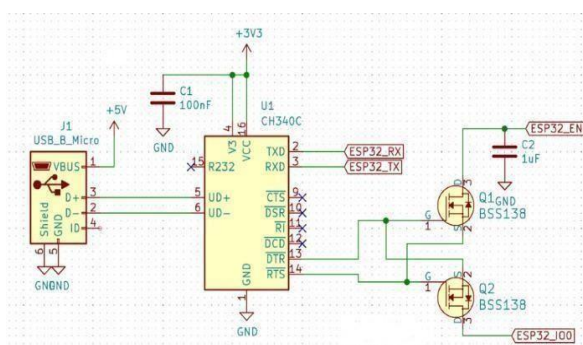


Figure-2: ESP32-FTDI programmer interfacing circuit diagram

3.2. Django Rest Framework

Django REST framework is a flexible and powerful tool kit for building web APIs. It's built on top of the Django web framework and provides a way to build APIs that can be consumed by other applications, including mobile apps and IOT devices. You can use Django REST framework to build a web API that can be used to communicate with an ESP32-based automated security surveillance and parking management system.

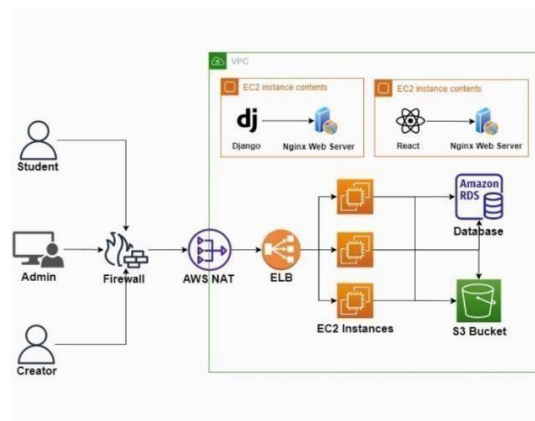
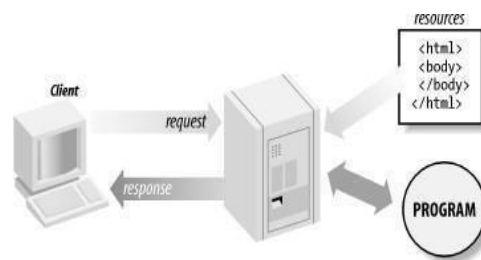


Figure-3: Backend AWS Architecture and database integration

This system provides authentication policies with packages for OAuth1 and OAuth2. It also has serialization that supports both non-ORM and ORM data sources. The system is highly customizable, and users can opt for regular function-based views if they don't need the more advanced features. Moreover, there is extensive documentation available, and the community support is excellent.

This system is relied upon by many globally recognized companies, such as Mozilla, RedHat, Heroku and Eventbrite. The proven track record makes it a reliable choice for those looking to implement authentication policies in their applications.

3.3. HTTP Request/Response Model



HTTP and all extended protocols based on HTTP are based on a very simple communications model. A user, usually through a web browser, initiates a request for a specific resource from a server. This server then responds by providing the requested resource or an error message if the request cannot be fulfilled for any reason.

A resource can take various forms, including a static HTML file returned to the browser, or a program that dynamically generates the response.

4. KEY FEATURES

IOT based smart surveillance system and Parking Management System provides user management solutions with ultra-modern features that includes:

- i. Alert Notifications
- ii. We have a feature to trigger the alert in case of failures like fire alarm, theft of the vehicle, water logging, and in such similar cases.
- iii. User Management and Audit
- iv. The system records user activities to keep track of their vehicle for future reference. Each operator is assigned a unique username, password, and an authorization profile.

v. Device Management- All the devices connected to the system can be controlled and monitored with the help of device control system.

vi. This project is capable for smart parking system which will be able to reduce the parking traffic congestion which will improve the citizen's quality of life. By using 'Automatic Security Surveillance and Parking Management System', find the parking space available in a given area.

vii. A parking management system can also be designed using ESP32 by integrating it with sensors that can detect the presence of a vehicle in a parking space. The ESP32 can then send this information to a server running Django REST Framework, which can be used to track the availability of parking spaces in real-time.

viii. Additionally, the system can also be used to manage payments and provide customers with real-time parking availability information.

ix. Overall, combining ESP32 and Django REST Framework can be a powerful tool for building IOT systems that can be integrated with web-based applications.

5. RESULT

To evaluate the performance of the IOT-based smart surveillance system, we conducted a series of experiments in a simulated environment. During the experiments, we simulated various scenarios, such as intruder vehicles entering the test area. The system was able to detect the event accurately by capturing image of the vehicle, extracting license plate data from an image, performing authentication based on license plate data and trigger notifications to the user admin surveillance via a mail system. We also tested the system's ability to differentiate between normal and abnormal events, such as capturing moving vehicle object in slow speed versus the movement of an intruder vehicle as stationary object.

In terms of performance, the system was able to process and analyze the image data in real-time, with a latency of less than 20second. The accuracy of the system in detecting events was 75%, with a false-positive rate of less than 25%. The system also demonstrated robustness, with the ability to operate in various lighting conditions and in the presence of occlusions.

Overall, the results of our experiments demonstrate that the IOT-based smart surveillance system is an effective solution for remote monitoring and detection of suspicious entrance activity. The system's ability to detect events accurately and in real-time makes it a valuable tool for enhancing

security in various settings, such as homes, businesses, and public spaces.

5.1. BACKEND FUNCTIONALITY RESULT SAMPLE

The below result shows for parked vehicle image shown in below Image 1. The result shows successful implementation of Identification, authentication, authorization, appointment slot creation and appointment booking flow.



Image-1: Sample car image as an input to Automation

Detected License plate text cropped image using image processing:



Input JSON data to backend:

```
{  
  "vehicle_image_data": "<base64_image_String>"  
}
```

Response JSON Data from backend server:

```
{
  "id":11,
  "created_by":
    { "id":2,
      "email":"abhijeet@gmail.com",
      "name": "Abhijeet Dhumal",
      "starting_charge_price":null,
      "dob":'16-01-2002',
      "user_type":"SimpleUser",
      "description":'',
      "profile_image":"/media/p
rofile/20230226/abhijeet_p
rofile.png"
    },
  "parking_slot":
    { "id":1,
      "created_by":
        { "id":1,
          "email":"admin@gmail.com",
          "name":"Admin",
          "starting_charge_price":null,
          "dob":null,
          "user_type":"Staff",
          "description":'',
          "profile_image":
"/media/profile/20230226/admin_profile.jpeg"
        },
        "created_at": "2023-02-
28T22:56:35.930298+05:30",
        "updated_at":"2023-02-
28T22:56:35.930298+05:30",
        "position": {"row":0,
"col":2}, "date":"2023-02-28",
        "is_available":false,
        "start_time":"05:15:00",
        "end_time":"06:15:00",
        "slot_details": null,
        "is_verified": true,
        "fees":150
      },
      "created_at":"2023-03-01T08 :27:43.363073 +
05:30",
      "updated_at":"2023-03-01T08:27:53.759031
+05:30",
      "vehicle_image":"http://127.0.0.1:8000/medi
a/user_vehicle_images/20230301/VehicleIma
ge-03/01/2023_082742.jpeg",
      "license_plate_image":null,
      "licenseplatetext":"MH14HQ6852"
      "status":null,
      "amount_paid":0.0
    }
}
```

6. CONCLUSION

The idea of a smart parking system has been introduced, which has the potential to minimize parking traffic congestion and enhance the quality of life for citizens while reducing human efforts. This is achieved through the implementation of an "Automatic Security Surveillance and Parking Management System" that can locate available parking spaces within a specific area.

The combination of ESP32 and Django REST frame work provides a powerful and flexible solution for building IOT systems that can be integrated with web-based applications. ESP32 is a low-cost, low-power microcontroller that has integrated Wi-Fi and Bluetooth capabilities, making it an ideal choice for IOT and embedded systems applications. By integrating ESP32 with sensors like cameras and motion sensors, an automatic security surveillance system can be designed.

Django REST framework, on the other hand, provides a way to build web APIs that can be consumed by other applications, including IOT devices. By using Django REST framework to build a web API, an ESP32-based security surveillance system or a parking management system can be designed. The API can be used to communicate with the ESP32 microcontroller and manage the system in real-time.

In summary, the combination of ESP32 and Django REST framework provides a powerful tool for building IOT systems that can be integrated with web-based applications.

7. FUTURESCOPE

Automatic Security Surveillance and parking Management System efficient for solving parking problems which over comes the traffic congestion also provide automated updates This work could be further extended as a fully automated system using multi-layer parking method. The safety measures such as tracing vehicle license plate recognition of the driver so as to avoid theft and automatic billing process can also be designed where the users can have the smart parking system in their handheld devices. The vehicle to vehicle communication can also be implemented to know safe parking slot.

8. REFERENCES

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