

IoT Based Parking Management

MOTIVATION :

The motivation behind the Smart Parking Management System project is to address the growing problem of parking scarcity in crowded areas. With the increasing number of vehicles on the road, finding a parking space quickly and easily has become a challenging task, leading to traffic congestion, pollution, and frustration for users. The project aims to develop a prototype that uses IR sensors and a camera module to detect and validate parking spaces and provides a user-friendly interface for users to book parking spaces. By automating the process of parking space detection and booking, the project can significantly reduce the time and effort required for users to find and book parking spaces. The project has the potential to enhance the user experience, reduce traffic congestion, and minimize pollution, making it an innovative solution to the problem of parking scarcity.

LITERATURE SURVEY:

In recent years, many smart parking systems have been developed to address the issue of parking scarcity. A study conducted by P. Bansal and P. Bansal revealed that smart parking systems have several benefits such as reducing traffic congestion, minimizing air pollution, and increasing parking space utilization efficiency. Smart parking systems use a variety of technologies such as sensors, cameras, and mobile apps to automate the parking process.

One of the most commonly used technologies in smart parking systems is the use of sensors to detect parking space occupancy. A smart parking system using IR sensors to detect the presence of vehicles in a parking space. The study demonstrated that the use of IR sensors can effectively detect the presence of vehicles and can provide accurate real-time data on parking space occupancy.

Overall, the literature survey reveals that smart parking systems have several benefits and use a variety of technologies to automate the parking process. The proposed Smart Parking Management System project aims to leverage the benefits of smart parking systems by using IR sensors and a camera module to detect and validate parking spaces and by providing a user-friendly interface for users to book parking spaces.

PROJECT SCOPE :

The scope of the Smart Parking Management System project is to develop a prototype that uses IR sensors, an ESP32 camera module, Arduino Uno, Node MCU and a Servo Motor to detect and validate parking spaces and provides a user-friendly interface for users to book parking spaces. The project aims to automate the process of parking space detection and booking, thereby reducing the time and effort required for users to find the parking spaces. The Software part of the project involves developing a backend using Flask to handle various functionalities such as registering a parking space, login for users, booking a space for users based on time and name of parking, generating and scanning QR codes using ESP32. The frontend of the project is built using React framework and has firebase security for authentication of the user. This frontend is a user interface to check real time slot availability and book slots.

PROJECT ROADMAP / TIMELINE :

1. Week 1-2: Define project requirements, create a project plan, and assign roles and responsibilities to team members.
2. Week 3-4: Research and purchase necessary hardware components, such as Arduino, IR sensors, camera module, and servo motor.
3. Week 5-6: Develop and test the prototype circuit using Arduino and IR sensors to detect parking spaces and servo motor to simulate gate opening.
4. Week 7-8: Develop and test the backend using Flask to handle various functionalities such as registering a parking space, login for users, and booking a space for users based on time and name of parking.
5. Week 9-10: Develop and test the frontend using React framework that calls the APIs provided by the backend.
6. Week 11-12: Integrate the frontend and backend, and test the complete system.
7. Week 13: Conduct user acceptance testing and make any necessary revisions.
8. Week 14: Finalize the project report and present the project.

TEAM MEMBERS ROLES AND RESPONSIBILITIES:

1. Rishikesh (ME20B2040) : Rishikesh is responsible for writing the embedded C code in Arduino for IR sensors to detect parking space and servo motor to automate gate opening. He is responsible for designing, coding, and testing the embedded C code to ensure that the parking space detection and gate opening functionalities work seamlessly. He was responsible for collecting all the local sensor data and sending it to the firebase backend using nodemcu esp8266 wifi module so that local parking availability is uploaded on cloud. He played a major role in ideation of the physical deployment of parking lots and its prototype.
2. Vishnu (CS20B1129): Vishnu is responsible for developing the backend of the Smart Parking Management System using Flask. His responsibilities include designing and coding the APIs for functionalities such as registering a parking space, login for users, and booking a space for users based on time and name of parking. He is also responsible for testing the backend code and ensuring its functionality.
3. Samarth (ME20B2016): Samarth is responsible for developing the frontend of the Smart Parking Management System using React. His responsibilities include designing and coding the user interface, integrating with the backend APIs developed by Vishnu, and testing the frontend code. He is also responsible for ensuring that the user interface is user-friendly and intuitive and security is maintained for the site using firebase.
4. Utkarsh (CS20B1124): Utkarsh is responsible for developing the camera module and integrating it with the rest of the hardware and also for QR code generation/validation functionalities in the backend. His responsibilities include designing and coding the camera module functionalities, and integrating it with the QR code generation/validation functionalities. He has also written functionalities in python to convert the captured QR code to a string which is sent to the backend for verification. He is also responsible for testing the camera module and QR code functionalities to ensure their accuracy and reliability. Since his responsibilities include interacting with the backend, he has also done troubleshooting in the backend pertaining to the QR code verification.

METHODOLOGY:

The Smart Parking Management System was developed using a multi-stage process that began with requirements gathering and ended with final testing and deployment. The following steps were taken to develop the system:

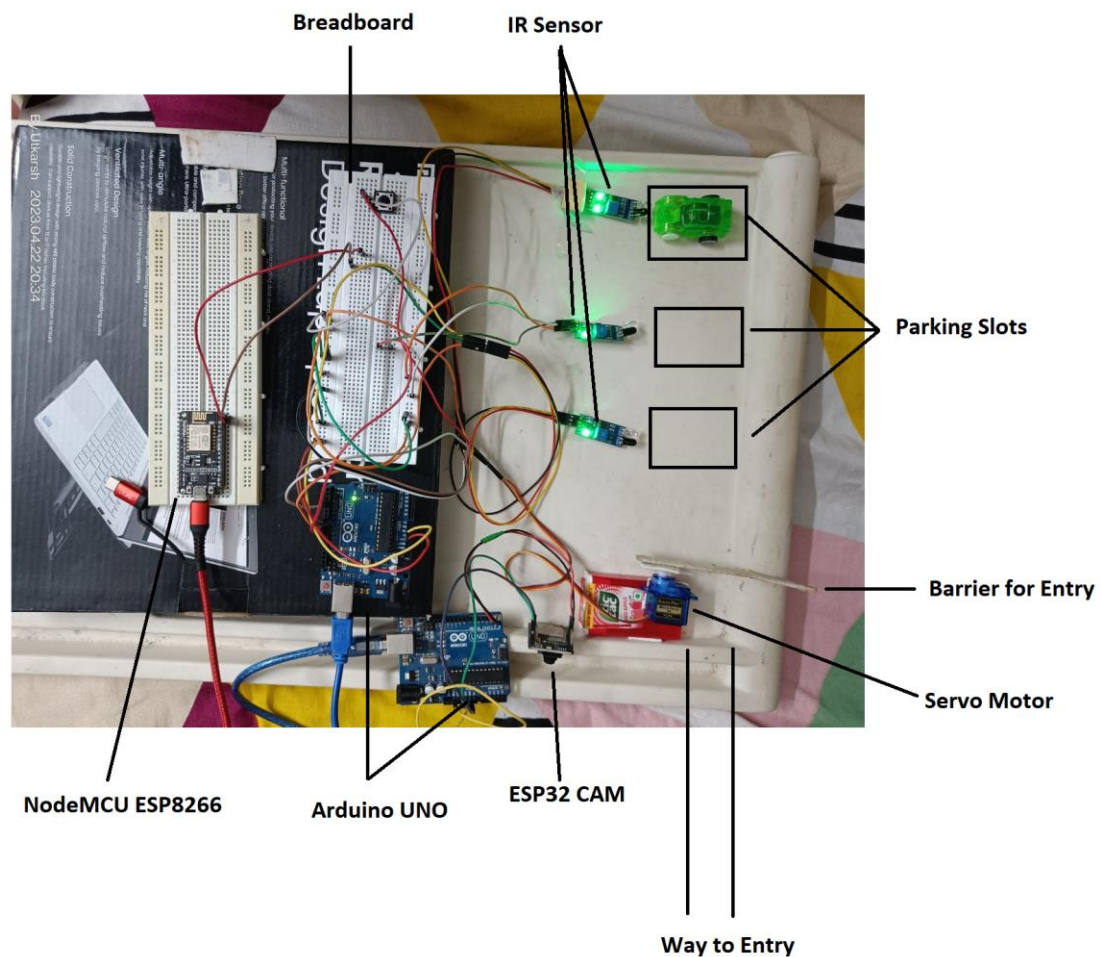
1. Requirements gathering: The team gathered the requirements for the Smart Parking Management System, including the functionalities of the system, the hardware and software components required, and the timeline for development.
2. Design: Based on the requirements gathered, the team designed the system architecture, including the embedded C code for Arduino, backend using Flask, and frontend using React and firebase.
3. Implementation: The team implemented the design by coding the functionalities and integrating the different components of the system.
4. Testing: Once the implementation was complete, the team tested the system thoroughly to ensure that all the functionalities were working as expected.

Throughout the development process, the team communicated regularly and collaborated effectively to ensure the success of the project. The methodology emphasized testing and quality assurance, and the team remained focused on delivering a high-quality product that met the requirements of the stakeholders.

BILL OF MATERIALS:

Product	Quantity	Rate	Price
Camera Image Sensor Module for Arduino	1	1090	1090
IR sensor	1	429	429
Micro Servo Motor	1	230	230
9v Battery	1	147	147
Total	-	-	1896

Picture of prototype/CAD model with labels :



Key takeaways/learnings from course:

- 1) Learnings specific to the project: The course provided us with valuable insights into various aspects of software and hardware development. Specifically, we learned how to design and implement a complete system using Arduino, Flask, and React, as well as how to develop and test each component effectively. We also learned the importance of regular communication and collaboration between team members, as well as the significance of quality assurance and testing in ensuring the success of the project. Furthermore, we learned how to gather and document requirements, as well as how to prioritize and manage tasks effectively to ensure the timely delivery of the project. Overall, the course provided us

with the necessary skills and knowledge to successfully complete the Smart Parking Management System project.

- 2) General learnings from the course: The course on prototyping and testing provided us with a fundamental understanding of the prototyping and testing process, which can be applied across various technologies and platforms. We learned about the importance of identifying and understanding user needs and requirements, and how to use this information to design and develop a prototype. The course emphasized the iterative process of prototyping, and how to use feedback from users to refine and improve the prototype.

Additionally, the course taught us various testing methodologies, such as black box testing and white box testing, and how to use them to ensure the quality of our prototype. We also learned about the importance of usability testing and how to conduct it effectively.

Overall, the course equipped us with a holistic understanding of the prototyping and testing process, which can be applied to various technologies and platforms. We gained valuable skills and knowledge in identifying user needs and requirements, designing and developing prototypes, and testing and improving the quality of the product. These skills are essential for any product development process, regardless of the technology or platform being used.

Future scope:

The Smart Parking Management System project has the potential for several future developments and improvements. Firstly, we can enhance the system by integrating real-time occupancy data to improve the accuracy of parking availability information. This can be achieved using various technologies, such as cameras and sensors, and can provide users with up-to-date information on parking availability. Secondly, we can incorporate automatic payment systems, allowing users to pay for their parking electronically, eliminating the need for manual payment processes. Additionally, we can enhance the security of the system by incorporating facial recognition technology, which can be used to identify users and prevent unauthorized access.

Furthermore, the system can be scaled to accommodate larger parking areas and multiple parking lots, allowing for greater coverage and accessibility. Finally, we can expand the system to include additional features, such as navigation assistance, parking history tracking, and user feedback mechanisms. Overall, the Smart Parking Management System has vast potential for future developments and enhancements, which can be achieved using various technologies and features.

Conclusion :

In conclusion, the Smart Parking Management System project was successfully developed and implemented, achieving the desired objectives of automating the parking management process, enhancing the user experience, and improving the efficiency of the system. The project team effectively utilized their skills and expertise to design and develop the system, employing various technologies such as Arduino, Flask, and React. The project also provided valuable learnings and insights into the prototyping and testing process, as well as the importance of teamwork, communication, and project management. Overall, the project demonstrated the potential of technology to address real-world problems and provided a solid foundation for future developments and improvements.

Yukti Portal Screenshot:

Resolution Example : CS2012-Artificial Int... Resolution Example : 1 Address jobs ADDVERB RCS Documentation Blizzard Support - Ph... Blizzard Support - B... YUKTI-National Ino... YUKTI-National MHRD | Innovation

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Indian Institute of Information Technology, Design & Manufacturing, Kancheepuram

HI RISHIKESH KUMAR YADAV

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Submitted Ideas/PoCs

Sr. No.	Innovation ID	Innovation Title	Sector/Domain/Theme	Team & Mentor Details	Action	First Stage of Evaluation Status	Upgrade
1	IR2023-853644	lot Parking Management	IoT based technologies (e.g. Security & Surveillance systems etc)	Team Members Details	Edit Delete View Details		

CONTACT

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References and Citations

<https://www.ijert.org/research/smart-parking-management-system-and-traffic-reduction-in-parking-slots-using-iot-IJERTCONV8IS07026.pdf>

Survey of smart parking systems: <https://www.mdpi.com/2076-3417/10/11/3872>

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