Peer Review - Smart Campus Parking System

Team Members :

Upre Ashish Kumar - 21CSB0B62

Naman Mulani - 21CSB0B38

Harshit Gupta - 21CSB0B21

Supervised by :

Prof. Shiva Darshan S L

Internet of Things [CS-451]

Course Assignment

Department of Computer Science and Engineering

National Institute of Technology Warangal

Telangana, India – 506004

April 2025

Table of Contents

1 Overview

Parking congestion is a significant challenge in many educational institutions, leading to **wasted time, increased fuel consumption, and frustration** among students, faculty, and visitors. Traditional parking systems often lack real-time monitoring, forcing drivers to search for available spots manually. This inefficiency contributes to **traffic congestion, unnecessary emissions, and overall inconvenience** on campus.

With the advancement of **Internet of Things (IoT) technology**, smart parking solutions have emerged as an effective way to **optimize parking space utilization**. By integrating **ultrasonic sensors, microcontrollers, and real-time data processing**, campuses can **automate parking management**, providing users with **instant availability updates** while reducing congestion and improving overall campus mobility.

Our team consists of Upre Ashish Kumar(me), Naman Mulani and Harshit Gupta. All of us played an integral role in the successful completion of this project. It is needless to say that without any single person, the project would not have been successful.

2 Review of Individual Team Members

This section contains details about each of the team members, the work they have done, what role they played in the successful completion of this project and so on.

2.1 Naman Mulani

Naman took the initiative to play the role of leader for our team. He took up the responsibility to split up the work among us. He has split the work in such a way that the project can be completed in an efficient manner and the whole process can be done concurrently.

2.1.1 Technical Work

Naman has done all of the 3D visualizations for the project work. It was his intuitiveness and agility in the domain that helped him and, by extension, our project be successful in that regard. All the 3D models are his contribution. Needless to say, his designs were creative and original while being very intuitive for everyone to understand the system and its essence better.

He is also the high-level architect of the project. One major technical contribution of Naman was the inclusion of the idea of a real-time dashboard through Firebase integration. This will be one of the key areas where our work will be set apart from the competitors. He also made some design contributions such as the addition of an LCD for the display of information gathered from the sensors that we have used in the project. This is very intuitive for the end user.

His supreme ability made it possible to assess the scenario and infer that what we were working with wasn’t adequate, leading him to make architectural changes to the project along with providing alternatives for successful risk mitigation while also being the first one to identify the faults and risks in the existing architecture of the system during the development of our project. His timely identification of the fault made it possible for the team members to not lose any morale and jump to the fixation of the fault. He was the one who proposed that

we make use of Wokwi for our design consisting of ESP32. Furthermore, Naman integrated the WiFi module into the ESP32 code, enabling seamless wireless communication between the hardware and cloud services. This allowed real-time data transmission, ensuring that sensor readings and system status updates could be accessed remotely. His implementation not only improved system accessibility and monitoring but also played a key role in cloud integration, making the system more scalable and efficient.

Naman has also worked towards the cloud integration of our project using the Thingspeak platform. All the data that is sent to Thingspeak for our cloud integration was his doing. Apart from that, Naman has helped immensely in documenting our dive into the project.

Furthermore, Naman worked on the integration of Thingspeak with MATLAB to create various visualizations, such as time-series plots, heatmaps, occupancy histograms, and cumulative usage graphs, which would help in better analysis of parking trends and system performance and handled the integration of Wokwi circuit code with Thingspeak and Firebase, enabling seamless real-time data transmission and remote access to parking lot information. This allows users to monitor availability and receive alerts, enhancing the overall functionality of the system.

Additionally, Naman worked on integrating the 20×4 I2C LCD into the circuit, ensuring that parking slot statuses are displayed locally. This enhances user experience by providing real-time slot availability information directly on-site. He was also instrumental in the design of the circuit diagram, ensuring clarity and precision in the overall system structure.

2.1.2 Non-Technical Work

As stated in the introduction, Naman is the leader of our team, and he played a great role as one. His early risk assessment and mitigation helped us to not lose any time and morale and finish the project as early as we did.

His leadership made it easy to work as a team towards the successful completion of the project.

His valuable contribution and guidance during documentation of the project ensured that the documentation brings justice to our whole project making sure nothing that we have done goes unnoticed.

2.1.3 Strengths

Here I have highlighted some of the strengths of Naman that helped us tremendously. This is by no means exhaustive and Naman is much more capable.

- Top of the notch leadership skills.
- Work split that facilitates high level of concurrency and makes the work asynchronous.
- Fast to identify issues and facilitate change in requirements.
- Best of the class 3D modelling skills.
- Top tier web experience facilitating smooth cloud integration for the team.
- Great data analysis and visualization skills, including integration of Thingspeak with MATLAB for insightful analytics.

2.1 Harshit Gupta

Harshit took the responsibility for web development for our team. His agility in the domain helped us towards the timely and successful completion of our project.

2.1.1 Technical work

Harshit has made a user friendly interface for a dashboard for our project. This is one of the key things that will set us apart from the competition. The dashboard contains login user functionality so that only authorized users are given access to it. This is a very nice solution that promotes quality of life for the end users while still maintaining security.

Harshit has also helped for the visualization of the slots available which is a great feature to put all the raw information extracted from the sensors as a nice readable format. This will also be one of the places where our team will be better than the competition.

Apart from these, Harshit has also created an alert system that will propagate alerts about where the slots are free. This is a great tool that facilitates the project moving towards the objectives specified. This also helps end users to know about the availability of the parking slots in real time.

To facilitate the new functionalities and requirements of our project, Harshit took the initiative to integrate our project to Firebase which is a real time database. Needless to say this is of critical importance to fulfill the real time requirements of the dynamic parking spaces where the project will be deployed facilitating high user satisfaction due to fast knowledge transfer to them regarding the availability(or lack thereof) of slots. Apart from these, his high level of concurrency and asynchronicity made sure that the rest of the team is not blocked on his work.

2.1.2 Non-technical work

As stated in the prior Harshit's knowledge and agility in the domain helped us tremendously during our project.

He made it such that the others were not blocked and everything went smoothly. His help in the documentation made sure that the work of us is seen.

2.1.3 Strengths

Here I have highlighted some of the strengths of Harshit that helped us tremendously. This is by no means exhaustive and Harshit is much more capable.

- Top notch development skills.
- Fast paced through new and changing requirements.
- Facilitation of asynchronous workflows to achieve high throughput.
- Top tier web experience facilitating smooth database integration for the team.

3 References

- ESP 32 - https://docs.espressif.com/projects/esp-idf/en/release-v4.2/esp32/hw-reference/esp32/get-started-devkitc.html

- ESP32 wiki - https://en.wikipedia.org/wiki/ESP32

- Wokwi - https://wokwi.com/

- Sensor (HC-SR04) - https://osepp.com/electronic-modules/sensor-modules/62-osepp-ultrasonic-sensor-module
- Arduino Uno R3 - https://docs.arduino.cc/hardware/uno-rev3/ https://docs.unity3d.com/Packages/com.unity.xr.interaction.toolkit@2.3/manual/xr-device-simulator-overview.html
- TinkerCAD - https://www.tinkercad.com/dashboard
- Thingspeak - https://in.mathworks.com/help/thingspeak/

- Firebase - https://firebase.google.com/

- Matlab - https://www.mathworks.com/products/matlab.html