CSE360: Computer Interfacing [LAB]

Section 3

Project Proposal

Fall 2023

Group Member

MURSALIN AHMED [ID: 19301228]
SHAHRIAR RAHMAN ANUVAB [ID: 21101094]
PRINCE SAHA [ID: 19301212]
MISHKAT SULTANA [ID: 19201028]
MD. MEHERAB HOSSAIN NOWSHAD [ID: 20301308]

Submitted To:

Mehedi Hasan Emo,
MD. Mahadi Hasan
Department of Computer Science and Engineering

Introduction

In the bustling, ever-expanding urban landscapes of the 21st century, parking has become an escalating challenge, a seemingly insurmountable obstacle that drivers face daily. The Smart Parking System project emerges as a beacon of innovation, offering a holistic solution to mitigate the ever-mounting frustrations tied to parking. In this section, we delve into the heart of the project, unraveling its multifaceted layers and the profound impact it promises to have.

Parking has transitioned from a mere convenience into a critical urban issue. As cities continue to grow, the number of vehicles on the road soars, and available parking spaces dwindle. The result is an aggravating and time-consuming quest for a vacant spot, often characterized by frustration, congestion, and wasted fuel. This issue doesn't just inconvenience drivers; it carries broader implications, including increased traffic congestion and air pollution. In the face of such challenges, our Smart Parking System emerges as a beacon of hope, addressing not only the inconvenience but also the environmental and logistical problems tied to inadequate parking infrastructure.

The Smart Parking System is not merely a response to the problem; it represents a forward-looking vision. It embodies an intersection of innovative technologies, thoughtful design, and a genuine commitment to improving urban life. At its core, this project aims to simplify the parking experience for all involved, from drivers desperately seeking a spot to parking operators grappling with the management of limited space.

This report, a comprehensive exploration of the Smart Parking System, takes you on a journey through its various facets. We delve into its broad applications, the intricacies of the technologies and tools it employs, the seamless interplay between sensors and microcontrollers, the elegant coding that underpins its functionality, and the financial and human resources invested in making it a reality. In a rapidly urbanizing world, the Smart Parking System offers a beacon of hope, and this report is your key to unlocking its potential.

Application Area

The Smart Parking System is a versatile and adaptable solution that finds its relevance across diverse settings. It is tailored for deployment in urban and commercial parking facilities, shopping malls, airports, and public parking areas, to name a few. The system's primary objective is twofold: to optimize parking space utilization and to fortify fire safety protocols.

In bustling city centers, finding a parking spot can often feel like an insurmountable task. Our system leverages RFID technology to streamline the process. RFID readers facilitate quick and secure user verification, ensuring that only authorized users gain access. This not only eases entry for drivers but also bolsters the overall security of the parking facility.

Technology and Tools

The foundation of the Smart Parking System rests on a carefully curated selection of technologies and tools, each playing a pivotal role in its functionality.

Technology Utilized: RFID (Radio-Frequency Identification), Infrared (IR) Sensors, MQ2 Sensors, Microcontrollers, Alarm System, Water Sprayer Mechanism.

Tools Employed: RFID Readers, IR Sensor Modules, MQ2 Sensor Modules, Alarm Circuits, Water Sprayer Systems.

In the heart of our system, RFID technology acts as the key that unlocks a seamless parking experience. Each user is provided with an RFID tag, which they present at the entrance for verification. Once authenticated, the parking slots become accessible. This robust, yet user-friendly technology guarantees that only authorized personnel can utilize the facility, effectively deterring unauthorized entry.

Programming Language

The software underpinning the Smart Parking System is predominantly coded in C. Additionally, the development environment of choice is the Arduino Integrated Development Environment (IDE). This combination of language and platform has proven to be both reliable and flexible for microcontroller programming.

The programming is the brains behind the system's operations. The code orchestrates various functions, from managing RFID user authentication to overseeing real-time parking slot occupancy. It's responsible for ensuring that the system accurately displays slot availability, efficiently tracks user access, and, most importantly, responds effectively in the event of a fire emergency.

Working Mechanism of Sensors

A vital component of the Smart Parking System is the sensors, which serve as the eyes and ears of the operation.

- **RFID:** RFID readers are strategically placed at the entrance and exit points. They scan the RFID tags issued to users and grant access to verified individuals, thereby maintaining a controlled environment within the parking facility.

- **Infrared Sensors:** Installed in every parking slot, IR sensors are the key to monitoring occupancy. These sensors use infrared light to detect the presence or absence of vehicles. When a car occupies a spot, the sensor registers it, updating the central system in real-time.

- **MQ2 Sensors:** These specialized sensors are distributed throughout the facility to monitor air quality. Their primary function is to detect the presence of smoke, a critical aspect of our system's fire safety measures.

Connection with IC's

The sensors, in concert with microcontrollers, enable seamless data transmission and processing. Here's how it works:

The RFID readers validate user access and connect to the central microcontroller. Each microcontroller is responsible for managing a specific section of the parking facility. Meanwhile, the IR and MQ2 sensor modules communicate with the microcontroller, relaying occupancy and fire-related data. This critical link between sensors and microcontrollers ensures that data flows efficiently within the system.

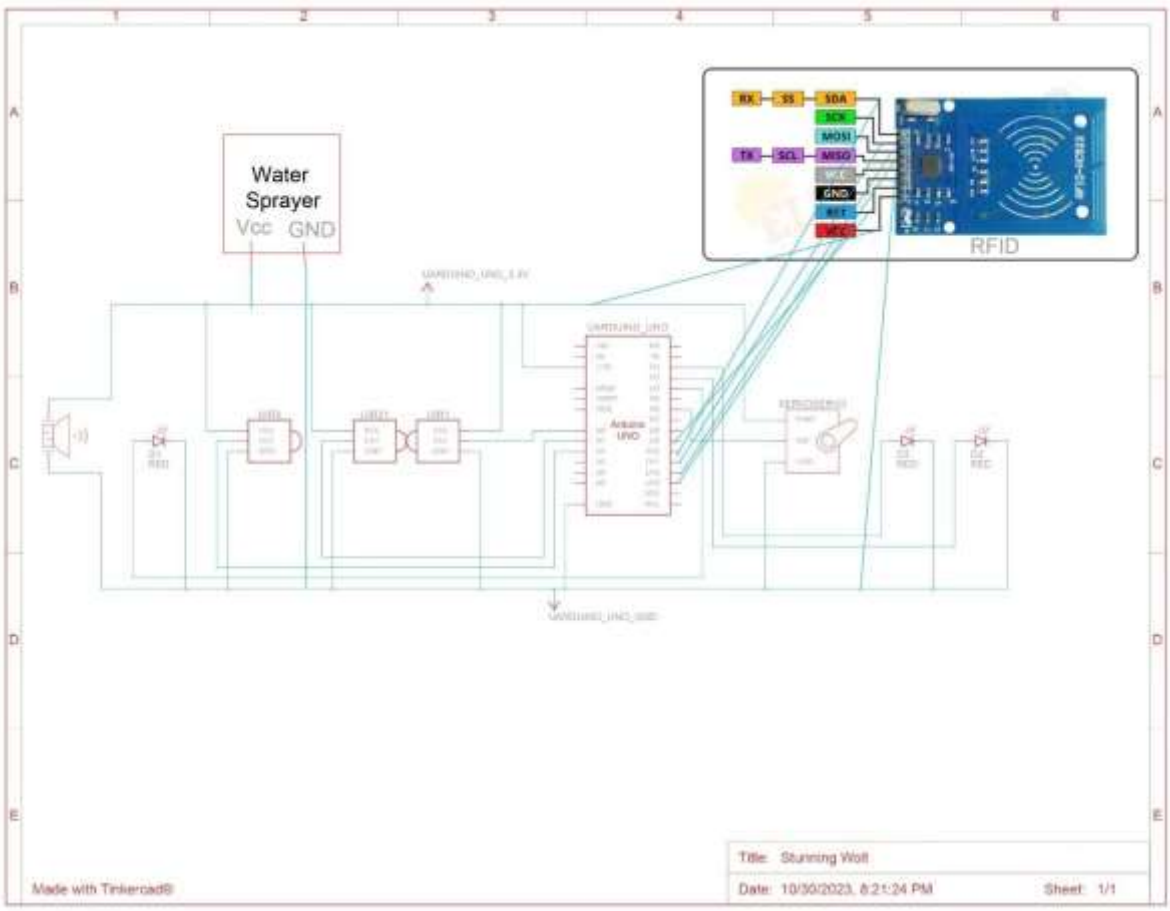


Fig: Circuit Design

Data Flow from Sensors through IC's to I/O Device

The data collected from the sensors is processed and transmitted to the central control unit. This unit serves as the hub, orchestrating the key functionalities of the system, including parking space availability display, fire alarm, and the water sprayer system.

When a user presents their RFID tag for verification, the RFID reader forwards this information to the microcontroller, which cross-references it with the database of authorized users. Upon successful verification, the microcontroller triggers the opening of the corresponding parking slot. Simultaneously, the IR sensors in each slot send continuous occupancy data to the microcontroller, which updates the central system in real-time.

The MQ2 sensors, stationed throughout the facility, continuously monitor air quality. If smoke is detected, the sensor communicates this information to the microcontroller responsible for fire safety. The microcontroller instantly triggers the fire alarm and activates the water sprayer system, creating a swift and effective response to fire hazards.

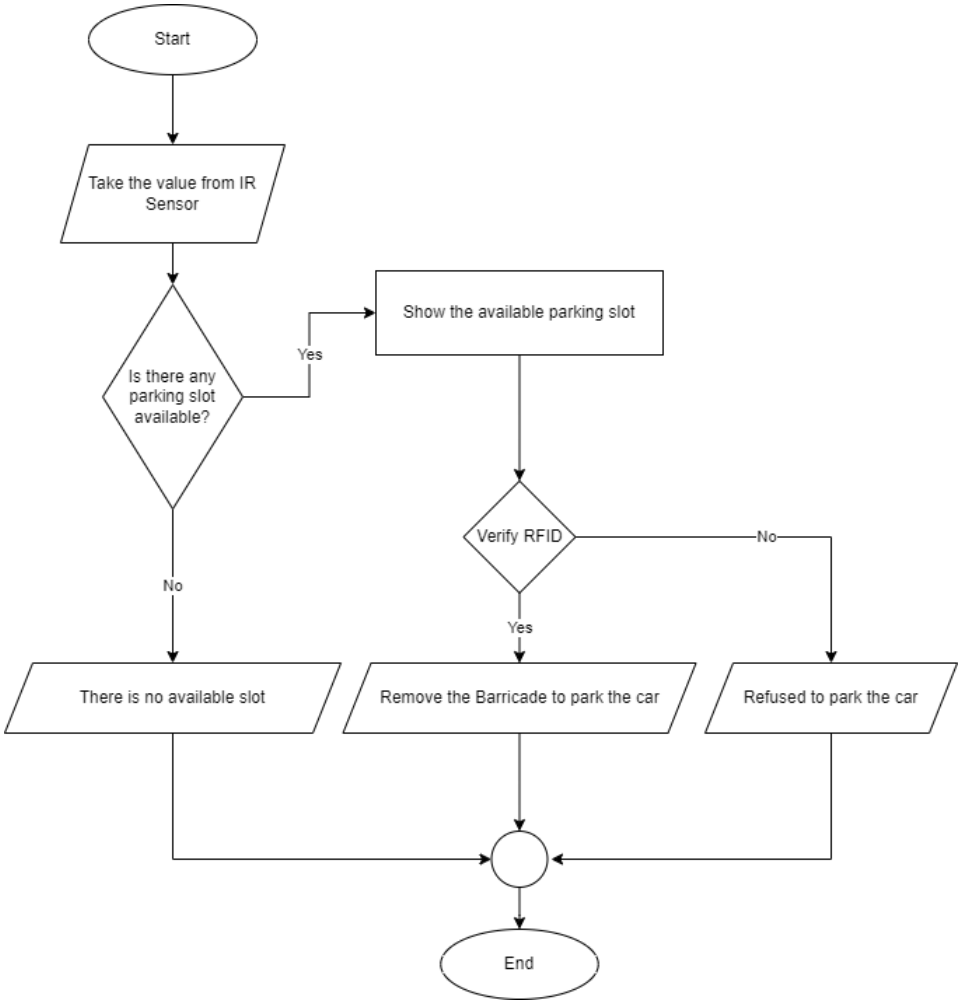


Fig: Data Flow 1

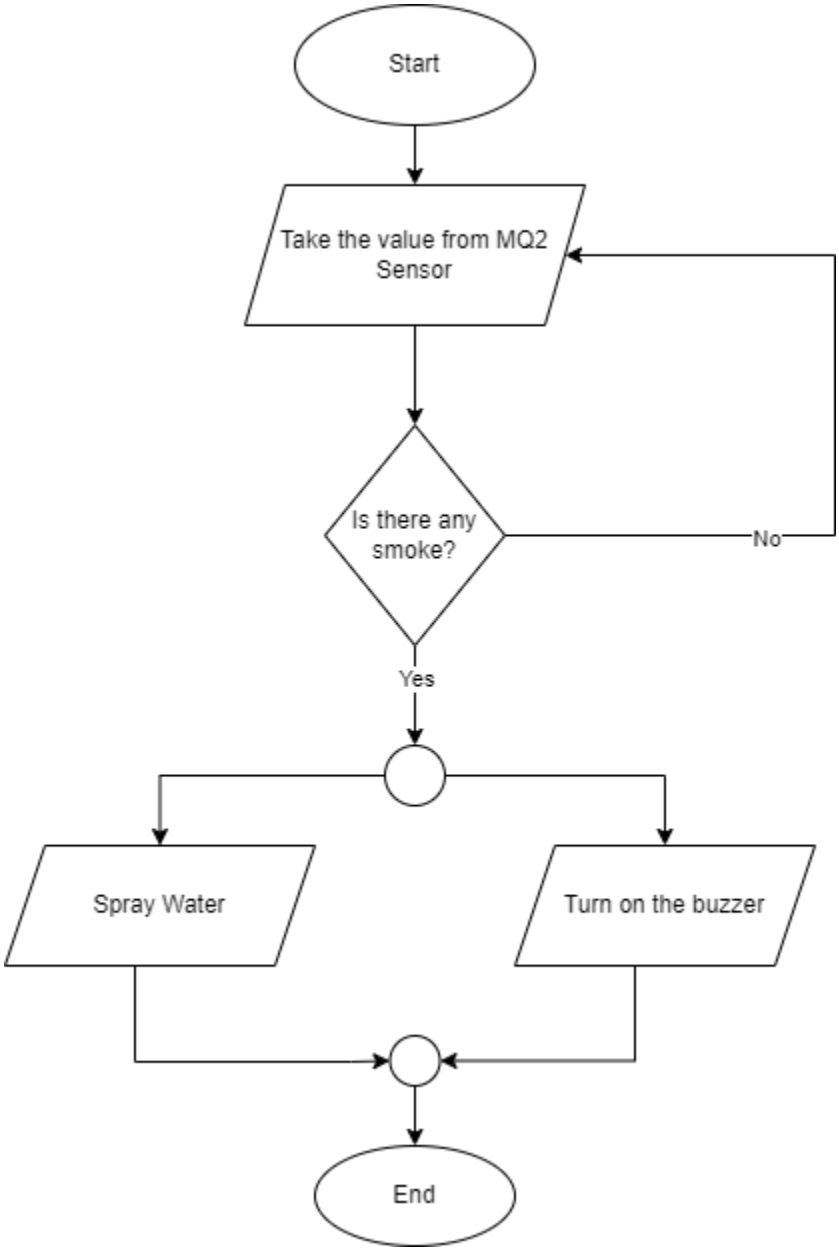


Fig: Data Flow 2

Code

The codebase of the Smart Parking System is a testament to the project's sophistication. Written in C, it will be available with the Project Update. The code performs a multitude of tasks, ranging from user authentication to tracking real-time parking slot occupancy. Below are some of its core functionalities:

- **Parking Slot Occupancy Tracking:** It continuously updates the status of each parking slot based on information received from IR sensors. Users can view slot availability in real-time.

- **User Authentication:** The code governs the verification process for RFID-tag-bearing users. It checks the RFID tag against the database of authorized users and grants or denies access accordingly.

- **Fire Detection and Response:** In case of smoke detection by the MQ2 sensors, the code initiates the fire alarm and triggers the water sprayer mechanism for rapid fire suppression.

Estimated Cost Analysis

The Smart Parking System's successful implementation hinges on the careful management of financial resources. A detailed cost analysis is described below and provides insight into the various expenses incurred throughout the project.

The cost breakdown includes components such as RFID readers, IR sensor modules, MQ2 sensor modules, microcontrollers, alarm circuits, water sprayer systems, installation costs, and ongoing maintenance expenses. Understanding these costs is essential for project planning and budgeting.

Components	Quantity	Unit Price	Net Price
Arduino Uno	1	840	840
RFID Sensor	1	180	180
IR Sensor	3	75	225
MQ-2 Sensor	1	150	150
Breadboard	1	88	88
Jumper Wire (m2m)	20	3.5	70
Jumper Wire (m2f)	20	3.5	70
Servo Motor	1	150	150
LED	3	1	3
Buzzer	1	15	15
Water Sprayer	1	70	70
PVC Board	1	150	150
Total Price			2011

Table: Total Budget

Responsibilities of Each Member (Tabular Format)

The success of any project is deeply rooted in the division of responsibilities among its team members. Here's a tabular representation of the key roles and responsibilities within the Smart Parking System project:

Team Member	Responsibilities
MURSALIN AHMED [19301228] (Software Developer 1 [SD-1])	Specializes in RFID technology, focusing on the development of RFID-based user authentication systems. Develops and tests the code responsible for RFID tag verification and access control. Write the Code of RFID-Based User Authentication Systems, IR Sensors and Concentrates on Microcontroller Programming. Collaborates with Software Developer 2 for seamless integration with the central system.
SHAHRIAR RAHMAN ANUVAB [21101094] (Software Developer 2 [SD-2])	Concentrates on microcontroller programming, creating the central system that manages parking slot occupancy tracking and fire detection and response. Write the code for MQ-2 Sensors, LED, Buzzer, Water Sprayer. Collaborates with Software Developer 1 for the integration of RFID-based user authentication.
PRINCE SAHA [19301212] (Hardware Developer 1 [HD-1])	Focuses on the physical sensor integration, including RFID readers and IR sensors. Ensures that these sensors are correctly interfaced with the microcontrollers and that they effectively communicate with the central system. Collaborates with Hardware Developer 2 for system reliability.
MISHKAT SULTANA [19201028] (Hardware Developer 1 [HD-2])	Specializes in sensor integration, with a focus on MQ2 sensors for fire detection. Develops and tests the integration of MQ2 sensors into the system, including safety protocols and testing procedures. She will integrate the MQ2 sensors, Buzzer, LED, Water Sprayer. And also collaborate with Hardware Developer 1 for system reliability.

MD. MEHERAB HOSSAIN NOWSHAD [20301308] (Quality Assurance Tester [QT])	He is responsible for ensuring that the system functions reliably, performs accurate user authentication, accurately detects parking slot occupancy, and responds swiftly to fire emergencies. And also collaborate with Software Developers to handle the error in code. Besides, he will be monitoring the hardware connections and helping the Hardware Developer.

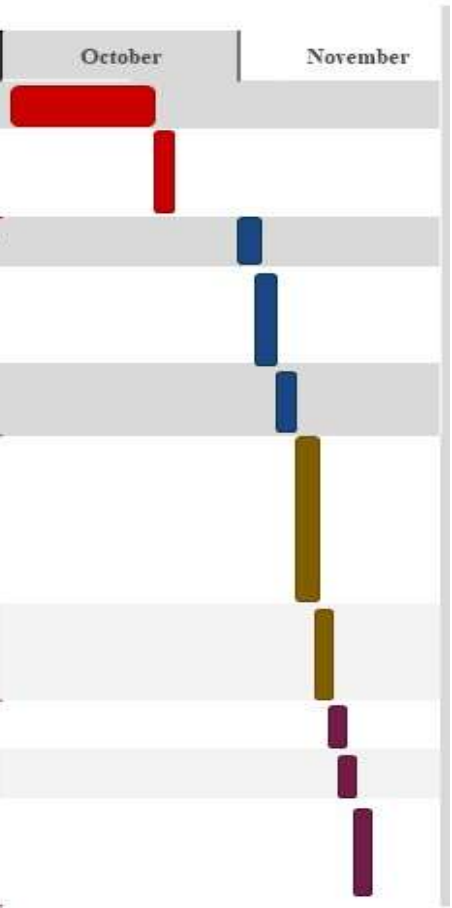
The collaborative efforts of the project team are instrumental in ensuring the successful execution of the Smart Parking System. Each member brings unique expertise and contributes to the project's holistic development and implementation.

Workplan (Gantt Chart)

For a comprehensive understanding of the project's timeline and the sequential execution of tasks, a Gantt chart has been thoughtfully prepared. This chart serves as a visual representation of the project's progression, highlighting task durations, dependencies, and milestones.

Gantt Chart:

Sprint		Tasks	Starting Date	Target Date	Responsible Person
1	Project Planning	Initial Project Planning	Oct 3, 2023	Oct 17, 2023	All Group Members
		Idea Finalization	Oct 17, 2023	Oct 20, 2023	All Group Members
2	Hardware Development	Circuit Design	Oct 31, 2023	Nov 2, 2023	HD-1, HD-2, QA
		RFID Readers and IR Sensors Integration	Nov 3, 2023	Nov 4, 2023	HD-1
		Integration of MQ2 sensors, Buzzer, LED, Water Sprayer	Nov 5, 2023	Nov 6, 2023	HD-2
3	Software Development	Write the Code of RFID-Based User Authentication Systems, IR Sensors and Concentrates on Microcontroller Programming	Nov 7, 2023	Nov 8, 2023	SD-1
		Write the code for MQ-2 Sensors, LED, Buzzer, Water Sprayer	Nov 9, 2023	Nov 10, 2023	SD-2
4	Quality Check	Hardware Testing	Nov11, 2022	Nov 12, 2022	QT
		Code Testing	Nov 13, 2023	Nov 14, 2023	QT
		Overall System Testing	Nov 15, 2023	Nov 16, 2023	QT



Conclusion

The Smart Parking System project represents a significant technological advancement in the domain of parking solutions. It not only optimizes parking space management but also enhances safety measures through its cutting-edge fire detection and suppression mechanisms. This project report has delved deep into the intricacies of the system, providing a comprehensive understanding of its components, technologies, and the collaborative efforts of the project team.

In a world where urbanization is on the rise, and parking space is a premium commodity, the Smart Parking System promises to be a game-changer. It addresses the contemporary parking challenges with sophistication and effectiveness, offering an elegant solution that combines convenience, safety, and efficiency in a single package. The impact of the Smart Parking System is poised to be profound, bringing much-needed relief to both drivers and parking operators in urban settings.