POLITEKNIK UNGKU OMAR

PARK-TECH EVOLUTION

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(01DKA21F2029)

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CIVIL ENGINEERING DEPARTMENT

SESSION II 2023/2024

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This report was submitted to the Civil Engineering Department
as partially fulfilling the conditions of the award
Diploma of Civil Engineering

CIVIL ENGINEERING DEPARTMENT

SESSION II 2023/2024

DECLARATION OF ORIGINALAND OWNERSHIP

PARK-TECH EVOLUTION

1. I, **WAN MOHAMMAD SYAFIQ BIN WAN ABD AZIZ (01DKA21F2029)** is a student of **Diploma in Civil Engineering, Politeknik ungku omar**, with address at **Jalan Raja Musa Mahadi, 31400 Ipoh, Perak**.
   (Hereafter referred to as 'The polytechnic').

2. I, acknowledge that 'the above project' and the intellectual property contained therein are the work of our original work/invention without taking or imitating any intellectual property from any other party.

3. I agree to transfer ownership of the intellectual property of 'The project' to the Politeknik Ungku Omar to meet the requirements for the award of the **Diploma in Civil Engineering** to us.

Made and truly acknowledged by the said;)

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As project supervisor on date:		ZAHOREEN BIN ABDULLAH

DECLARATION OF ORIGINALAND OWNERSHIP

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Note:

Only one page

ABSTRACT

The project aims to develop a smart parking prototype, "Park-tech Evolution," using IoT technologies to enhance monitoring and control, while evaluating its performance and feasibility. The initiative followed a structured approach, beginning with clear objective-setting and designing a robust research methodology. Data collection involved surveys, interviews, and sensor recordings, followed by rigorous analysis to evaluate system effectiveness. Findings highlight significant benefits such as improved urban mobility, reduced parking search times, and more efficient space utilization. However, the study also identifies areas for improvement, particularly in ensuring reliable QR scanner connectivity, enhancing accessibility for people with disabilities, and improving data security. The integration of smart parking technology with broader smart city initiatives has contributed to optimized traffic flow, reduced congestion, and improved environmental sustainability. Despite advancements, challenges like initial investment costs, interoperability issues, and concerns over data privacy and cybersecurity remain. Addressing these challenges through collaborative efforts among governments, technology providers, and stakeholders is crucial to ensure continued evolution and adoption of parking technology. Overall, technological advancements in parking play a critical role in urban development, fostering safer, more efficient, and environmentally friendly cities. Continued innovation promises further transformation in urban mobility, underscoring the importance of addressing identified weaknesses to enhance the overall effectiveness and user experience of smart parking systems.

ABSTRAK

Projek ini bertujuan untuk membangunkan prototaip tempat letak kereta pintar, "Park-tech Evolution," menggunakan teknologi IoT untuk meningkatkan pemantauan dan kawalan, sambil menilai prestasi dan kebolehlaksanaannya. Inisiatif ini mengikut pendekatan berstruktur, bermula dengan penetapan objektif yang jelas dan mereka bentuk metodologi penyelidikan yang mantap. Pengumpulan data melibatkan tinjauan, temu bual, dan rakaman sensor, diikuti dengan analisis yang teliti untuk menilai keberkesanan sistem. Penemuan menyerlahkan faedah yang ketara seperti mobiliti bandar yang dipertingkatkan, mengurangkan masa carian tempat letak kereta dan penggunaan ruang yang lebih cekap. Walau bagaimanapun, kajian itu juga mengenal pasti bidang untuk penambahbaikan, terutamanya dalam memastikan sambungan pengimbas QR yang boleh dipercayai, meningkatkan kebolehcapaian untuk orang kurang upaya, dan meningkatkan keselamatan data. Penyepaduan teknologi tempat letak kereta pintar dengan inisiatif bandar pintar yang lebih luas telah menyumbang kepada aliran trafik yang dioptimumkan, mengurangkan kesesakan dan meningkatkan kemampanan alam sekitar. Walaupun terdapat kemajuan, cabaran seperti kos pelaburan awal, isu kesalingoperasian dan kebimbangan terhadap privasi data dan keselamatan siber kekal. Menangani cabaran ini melalui usaha kerjasama antara kerajaan, penyedia teknologi dan pihak berkepentingan adalah penting untuk memastikan evolusi berterusan dan penggunaan teknologi tempat letak kereta. Secara keseluruhannya, kemajuan teknologi dalam tempat letak kereta memainkan peranan penting dalam pembangunan bandar, memupuk bandar yang lebih selamat, cekap dan mesra alam. Inovasi yang berterusan menjanjikan transformasi selanjutnya dalam mobiliti bandar, menekankan kepentingan menangani kelemahan yang dikenal pasti untuk meningkatkan keberkesanan keseluruhan dan pengalaman pengguna sistem parkir pintar.

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Symbol	
mA	milliamp
V	volt
μA	microamp
g	Gravity intensity

LIST OF ABBREVIATIONS

IoT	Internet of Thing
OKU	*Orang Kurang Upaya*
GUI	Graphical User Interface
WSN	Wireless Sensor Network
JKM	*Jabatan Kebajikan Malaysia*
DOF	Degrees of Freedom
Q-BaGOS	Qr-code Based Barrier Gate Opening System

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

In this globalization era, controlling home appliances using a mobile phone is a revolutionary concept that has been made possible through the Internet of Things (IoT) technology. The Internet of Things, with its interconnected devices and sensors, revolutionizes how we interact with technology in our daily lives. IoT devices, ranging from smart thermostats to fitness trackers, gather and exchange data to streamline tasks and enhance user experiences. Smart cities employ IoT sensors to manage traffic flow and reduce congestion. IoT sensors embedded in roads monitor traffic flow, providing real-time data to adjust traffic signals and manage congestion efficiently. IoT-connected sensors in parking spaces guide drivers to available spots, reducing traffic congestion caused by cars searching for parking.

IoT technology has revolutionized the concept of smart parking, introducing various appliances and innovations to optimize parking management. IoT-enabled sensors embedded in parking spaces detect occupancy in real-time, transmitting data to a central system or a mobile app to guide drivers to available spots. IoT integrates with mobile applications, allowing users to access real-time parking availability, reserve spots, and make payments seamlessly.

IoT-based smart parking solutions can be designed with features specifically catering to individuals with disabilities. IoT sensors can designate and monitor parking spaces reserved for disabled individuals, ensuring these spots remain available and are easily identifiable through connected signage or

mobile apps. IoT systems can provide real-time notifications or alerts to disabled drivers, guiding them to available accessible parking spaces nearest to their destination.

By incorporating these IoT features into smart parking systems, the aim is to enhance accessibility, convenience, and safety for individuals with disabilities, creating a more inclusive and accommodating environment within parking facilities.

1.2 BACKGROUND OF STUDY

The background of study on smart parking is rooted in the availability of parking spaces limited due to space constraints in densely populated students. Additionally, Ungku Omar polytechnic might have zoning regulations that restrict the construction of parking facilities.

Some parking spaces might be underutilized or occupied for extended periods, leading to reduced availability for others. This inefficiency can occur due to improper management or lack of turnover in parking spots. Stringent parking policies, such as time limits, permit requirements, or restricted parking zones, further limit the available spaces and add complexity to finding suitable parking.

The act of individuals who do not have disabilities using parking spaces designated for people with disabilities is often due to a lack of awareness, misunderstanding, or disregard for the importance of these designated spaces. This can happen frequently in all places and times.

The implementation of IoT (Internet of Things) in smart parking systems could bring about several significant changes and benefits. IoT-enabled smart parking systems can efficiently manage and optimize parking spaces, reducing the time spent searching for available spots. Sensors can detect and relay real-time information about vacant spaces to users via apps or digital displays, streamlining the parking process.

Smart parking apps or interfaces linked to IoT systems provide users with convenience and ease in finding, reserving, and paying for parking spaces, ultimately improving their overall experience.

Overall, the integration of IoT in smart parking solutions has the potential to transform urban mobility, making parking more efficient, convenient, and accessible while positively impacting traffic flow, environmental sustainability, and overall user experience.

1.3 PROBLEM STATEMENT

Parking a vehicle in congested areas frequently results in excessive driving time in search of empty space, causing traffic congestion and environmental pollution. One explanation for inefficient parking behaviour is a lack of guiding information regarding vacant parking places. Smart parking sensors and technologies guide drivers to free parking places, boosting parking efficiency. Currently, no such sensors or technology are in use in open parking lots. This study examines the literature on the use of smart parking sensors, technologies, and applications, and assesses their suitability for open parking lots. Parking a vehicle in congested areas frequently results in excessive driving time in search of empty space, causing traffic congestion and environmental pollution. One explanation for inefficient parking behaviour is a lack of guiding information regarding vacant parking places. Smart parking sensors and technologies guide drivers to free parking places, boosting parking efficiency. Currently, no such sensors or technology are in use in open parking lots. This study examines the literature on the use of smart parking sensors, technologies, and applications, and assesses their suitability for open parking lots. Magnetometers, ultrasonic sensors, and machine vision were a few of the most employed sensors and technologies in closed parking lots. [1]

A Wireless Sensor Network (WSN) demands a high level of robust and fault-tolerant sensing and actuation capabilities, especially when the application is designed to collect sensitive and urgent data with appropriate.

latency. As a result, evaluating the behavior attributes in the presence of faults remains a critical stage in designing an application over a wireless sensor network. To manufacture and inject 'any' known error into the system, a thorough study of fault characterization and understanding is necessary. To ensure the emergence of all faults and potential flaws in the system, the concept and development of a fault injector that generates and injects any specified fault into the system appears promising. [2]

Cruising for parking restricts movement in urban networks. Before arriving at their destinations, drivers may have to scour the streets for available parking. The accessibility and cost of parking have a considerable impact on people's travel behavior. The cruising flow eventually causes delays for everyone, including those with destinations outside of limited parking locations. It is critical to assess the effects of parking restrictions on mobility and to propose effective parking strategies for lowering travel costs. Most recent research on parking fail to reproduce the dynamic spatiotemporal aspects of traffic congestion in general, do not address the dynamics of the cruising-for-parking phenomenon, or require comprehensive input data that are often expensive and difficult to get. In this study, we present an aggregated and dynamic technique for modeling multimodal traffic with a focus on parking, and we use the approach to develop dynamic parking pricing strategies. The suggested method is based on the Macroscopic Fundamental Diagram (MFD), which can represent congestion dynamics at the network level for both single-mode and bi-modal (car and bus) systems. A simple parking model is included into the MFD-based multimodal modeling framework, which considers the dynamics of vehicle and passenger flows as well as changes in aggregated behavior (e.g. mode choice and parking facility selection) causedby cruising and congestion. Pricing plans are developed with the goal of minimizing congestion and lowering overall travel costs for all users. A case study is conducted on a bi-modal metropolitan network with a crowded downtown area. An elegant feedback dynamic parking charging strategy can significantly reduce cruise traffic delays and overall congestion. Surprisingly, such a method, which is usable in real-time management with limited availabledata, is roughly as efficient as a dynamic pricing scheme derived from the system.

optimal circumstances and global optimization with complete knowledge of the system's future states. Stackelberg equilibrium is also researched in competitive behavior among parking facility operators. Policy recommendations for on-street storage capacity management and price are presented. [3]

1.4 OBJECTIVES

The project's goal is to develop a prototype of a smart parking that uses IoT technologies for better monitoring and control. The primary purpose is to assess the system's efficacy, which includes performance and feasibility. To accomplish the study's goals, the initiative intends to

i. To design prototype of Park-tech Evolution
ii. To build up prototype Park-tech Evolution
iii. To test the effectiveness of Park-tech Evolution

1.5 PROJECT QUESTIONS

Our team gathered to brainstorm the project's question, aiming to define the main problem that needs to be solved.

i. How does smart parking work?
ii. What are the benefits of smart parking?
iii. Is it cost-effective?
iv. What technologies are used in smart parking?
v. How secure is smart parking data?
vi. What is IR 4.0 used in this project?

1.6 SCOPE OF PROJECT

Create an application for the public and (OKU) that willfacilitate all users with:

i. Count cars coming and going in the parking area.
ii. Displays how many empty slots are available in the parking area.
iii. Make special parking for OKU users without interruption.

1.7 IMPORTANCE OF PROJECT

Smart parking systems optimize the use of available parking spaces, reducing congestion, and maximizing the efficiency of parking infrastructure in crowded urban areas. By guiding drivers to available spots efficiently, smart parking systems minimize traffic congestion caused by vehicles circling in search of parking, contributing to smoother traffic flow.

1.8 DEFINITION OF OPERATION

The definition of "operation" in the context of a smart parking project refers to the practical implementation and ongoing functioning of the system. It encompasses the activities, processes, and procedures involved in running and maintaining the smart parking infrastructure to achieve its intended objectives. The operation phase is critical to the success of a smart parking project, as it involves maintaining the functionality, reliability, and efficiency of the system to provide users with a seamless and convenient parking experience.

1.9 EXPECTED RESULT

With (iot) being able to change people's daily lives, by getting data easily and quickly. This can also show the public's responsibility towards the disabled (OKU).

1.10 CONCLUSION

In conclusion, the implementation of smart parking systems represents a significant advancement in urban mobility solutions. These systems leverage technology to optimize parking space utilization, enhance user convenience, and contribute to a more sustainable and efficient transportation ecosystem.

CHAPTER 2
LITERATURE REVIEWS

2.1 INTRODUCTION

This chapter explains ideas and concepts related to the project to complete the project correctly. The goal of this discussion is to demonstrate the views and techniques utilized to study and develop the project in accordance with theory. This chapter also refers to current theories for dealing with project- related challenges. Theoretical understanding is useful as a guide, and the outcome of a study cannot be evaluated without reference to the theory. This chapter also briefly describes the materials used in the project to better their knowledge. This literature review aims to improve knowledge of objective research studies utilized in this project by referring to numerous books, journals, and other sources available through libraries and internet access.

2.2 SMART PARKING

The difficulties in locating parking spots in privately owned parking lots (such as those in shopping centers, office buildings, or apartment complexes) will be covered in this article, along with the cutting-edge solutions used in the Malaysian market. These problems are unavoidable for most people who have ever operated a vehicle or traveled in one. First, an inordinate amount of time, especially on weekends or public holidays, is spent searching for parking spaces that are available. Finding that one available parking space could take an excessive amount of time, consuming precious gasoline (or depleting the battery in the case of an EV). Occupancy sensors now count the number of parking spaces available in most Malaysian mall parking lots and display it at each floor's entrance.

Secondly, the restricted methods of payment for parking fines. Nowadays, most parking lots still accept cash payments, either manually at payment desks or automatically through automated devices. There has been progress in this area, with more convenient payment methods being introduced. Among these are cashless transactions, such as Visa Debit cards and TouchNGo cards, which eliminate the need for you to search through your wallets for small change. If you still needed to manually reload your payment cards, though, you would still have a problem with cash shortages.

Thirdly, parking systems that rely on tickets are cumbersome and ineffective. When cars back up outside parking lot doors, it can cause traffic congestion while they wait for people to manually scan their payment cards or accept admission tickets. The concept of a "smart city," where a great deal of time is lost by compounding these minor inefficiencies, is at odds with all of this.

2.3 IOT BASED SMART PARKING SYSTEM

The idea of "smart cities" has been very popular recently. The concept of a smart city now appears feasible because of the advancements made in the Internet of Things. IoT professionals are working tirelessly to increase the dependability and productivity of urban infrastructure. IoT is addressing issues including traffic congestion, a lack of parking spaces, and road safety. The development of IoT-based smart parking systems is revolutionizing urban infrastructure management. The IoT module for the proposed smart parking system is deployed on-site and is used to track and indicate the availability of each individual parking space. [4]

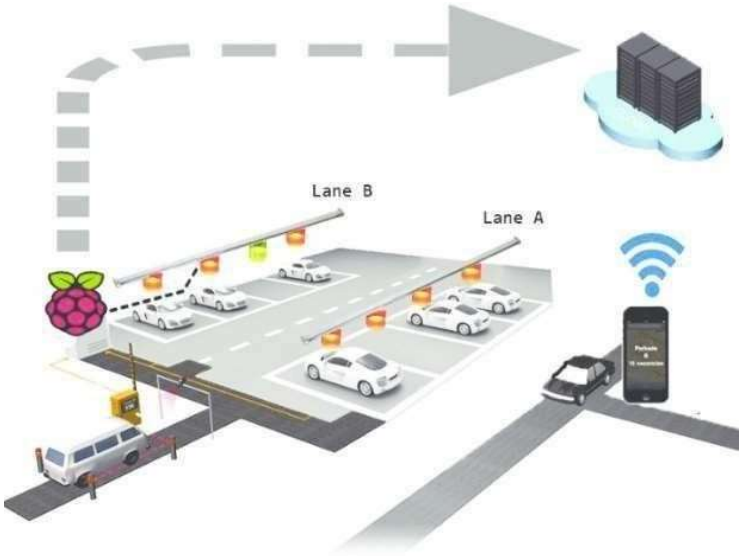


Figure 2.1: Smart parking system

2.4 REAL TIME MONITORING SMART PARKING

The Real-Time Monitoring System for Parking Space Management Services is an advancement over the traditional parking system. It allows users to easily search for empty parking spaces by giving them access to real-time information. Additionally, it gives operators the power to monitor and simulate actual parking situations. The goal of this project is to simulate parking systems using the concepts of queuing theory. Through analysis and computation, the queuing system model makes it possible to estimate arrival and service times inside the system. In addition, the Graphical User Interface (GUI) is incorporated into the parking system to enable parking zone operators to keep an eye on the condition of the parking lots and see. [5]

Figure 2.2: Cloud system

2.5 A CLOUD-BASED SMART PARKING SYSTEM BASED ON IOT TECNOLOGIES

The increasing population poses a significant challenge to resource management. The necessity for smart cities is a result of population growth. Internet of Things (IoT) technologies are used in the development of smart cities to solve various issues. Parking is one such issue. Parking on busy streets can be challenging and quite inconvenient for people. The challenge is that individuals won't be aware of the parking spaces' availability. The purpose of this article is to investigate how a smart parking system might alleviate people's parking problems. IR sensors linked to an Arduino board and the data they collect are used to determine which parking space is empty. [6]

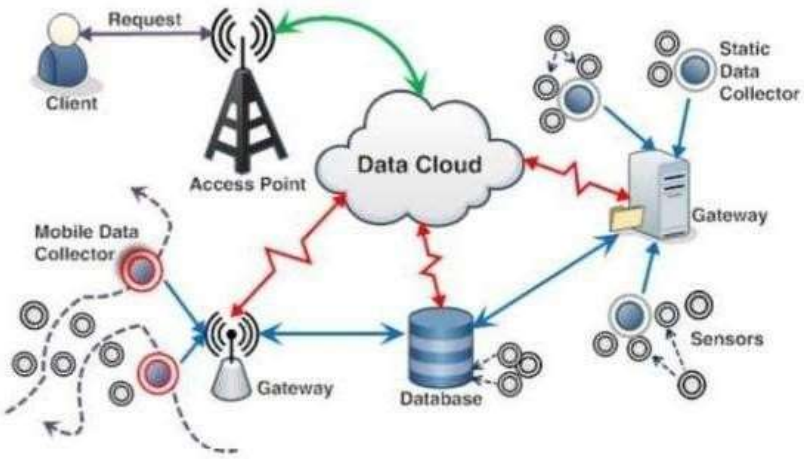


Figure 2.3: Data cloud system

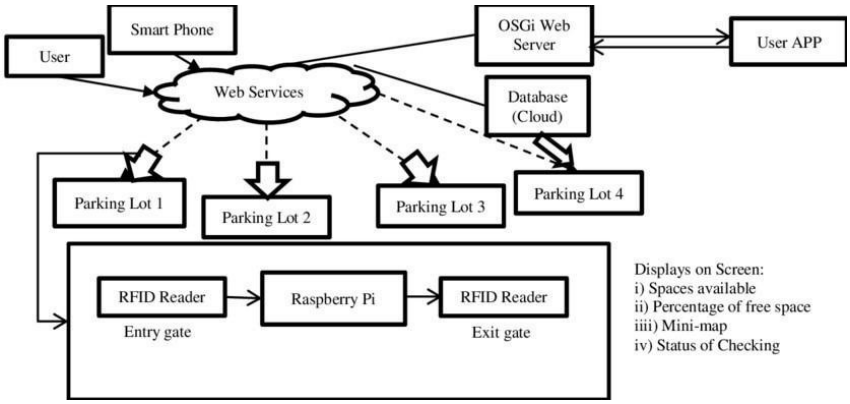


Figure 2.4: Web system

2.6 SMART PARKING WITH SENSORS

When a car is parked in a busy area, it is common to drive longer than necessary to find a spot which clogs roads and pollutes the environment. One factor contributing to wasteful parking behavior is a lack of guidance information about available parking places. Parking efficiency is increased when cars are guided to available spaces using smart parking sensors and technologies. Such sensors or technologies are not being used for open parking lots currently. This paper examines the research on smart parking sensors, technologies, and applications and assesses how well they work with open parking lots. Among the often-utilized sensors and technologies on closed parking lots were magnetometers, ultrasonic sensors, and machine vision.

Nevertheless, this research proposes combining convolution neural networks andmachine vision. [7]

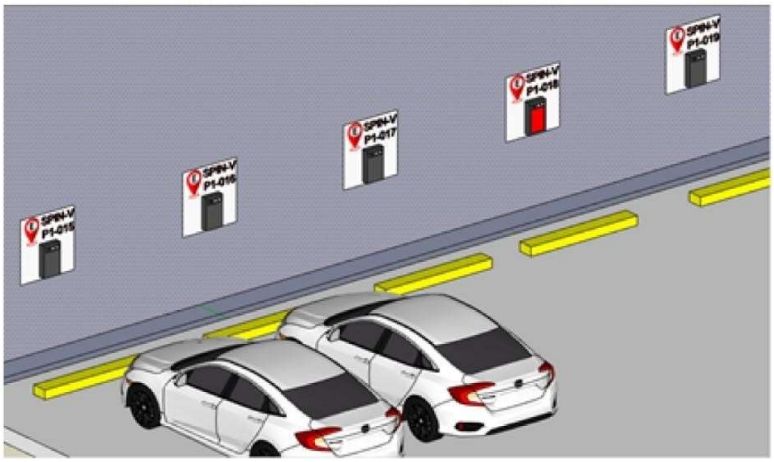


Figure 2.5: Sensor placement

2.7 PARKING SENSOR USING MAGNETIC SENSOR

Essential information about parking occupancy and traffic flow is provided by vehicle detectors. Due to their high deployment and maintenance costs, wired sensor networks are not practicable for covering wide areas lacking a proper electrical infrastructure. It may be more cost-effective to use wireless sensor networks (WSNs) with independent sensor nodes. The ideal vehicle detectors for a WSN should be compact, robust, low power, reasonably priced, and simple to install and maintain. The following criteria are not met by the car detectors that are already on the market, which has prompted the search for substitutes. These detectors are based on inductive loops, ultrasound, infrared, or magnetic sensors. It consists of both an optical and a magnetic sensor. Magneto resistor-based magnetic sensors are incredibly sensitive and can identify magnetic anomalies in the Earth's magnetic field caused by cars. However, they would require more than 1.5 mA of power to operate continuously at 3 V, which would reduce the autonomy of a sensor node that is powered by batteries. Low-power, passive optical sensors can identify the shadow an automobile casts over them, but they are prone to false positives. When power-efficient event-based software is paired with optical

triggering to activate a magnetic sensor, the result is a low-power, low-complication, dependable, and compact sensor node for vehicle detection with a quiescent current drain of 5.5 a. Other autonomous sensor nodes canbenefit from this strategy of using a low-power sensor to initiate a second, more focused sensor.[8]

2.8 OKU SMART PARKING

In Malaysia, those with disabilities are referred to as Orang Kurang Upaya (OKU). OKU residents have several benefits, such as their own private parking lot. However, residents who lack civic awareness frequently exploit the parking lot. To stop residents from misusing the parking lot, this study proposes a system that uses preventive measures early on. According to the system, a mechanical barrier that keeps people out of the parking lot should be installed. Only an OKU RFID card that has been provided by the local government is required to enter the parking lot. The user can access the parking lot once the mechanical barrier lowers after successful verification. It is anticipated that the system's installation will enhance citizens' quality of life and stop them from misusing the OKU parking lot. [9]

Radio Frequency identification technology plays a significant role in many Internets of Things application scenarios, including smart systems. This paper describes a system that develops an embedded RFID system using the Raspberry Pi microprocessor as a platform. The system also includes an RFID reader and RFID tags that function as an OKU smart identification card. Since this project is a collaboration with JKM, the system can be used to further advance the development of RFID technology, most notably as a registration platform for valid OKU registrar under JKM. Using a smart system that is linked to OKU's distinct smart identity card—which has a data storage capacity of up to 1 KB—JKM employees can save and monitor data entering. This system's goal is to make JKM's long-term processing and organization of the massive volumes of OKU data easier. [10]

2.9 REVIEW FOR CORE COMPONENT

This section analyzes the potential core components such as the sensors, board, database and application development tools and the selection of the best potential components based on the comparative analysis done.

2.10 IR SENSORS

This work presents the development of a prototype of a self-adaptive traffic signal management system based on infrared sensors. One practical way to reduce urban traffic congestion is through the implementation of an autonomous traffic light system. By modifying the traffic signal characteristics based on the volume of vehicles in each lane, the system enhances the effectiveness of traffic management on metropolitan road networks. A closed loop control system is a self-adaptive traffic signal system. Each lane's intensity of traffic is measured, and the lane with the greatest intensity of traffic receives a priority green signal, while all other lanes receive a red signal. The kind of intersections and road network, however, determine the precedence. The Arduino Mega microcontroller board receives data from it,and as a result, prioritizes the lane with the highest concentration. Each component has been thoroughly described, along with its pin diagram and technical specifications. System architecture, a block diagram, a flow chart, and a closed loop control system diagram have all been used to demonstrate how the system operates. Proteus 8 simulation software has been used to simulate the system. The hardware connections have been broken down step by step so that anyone may assemble this prototype. The prototype's findings in managing traffic are fascinating. [11]

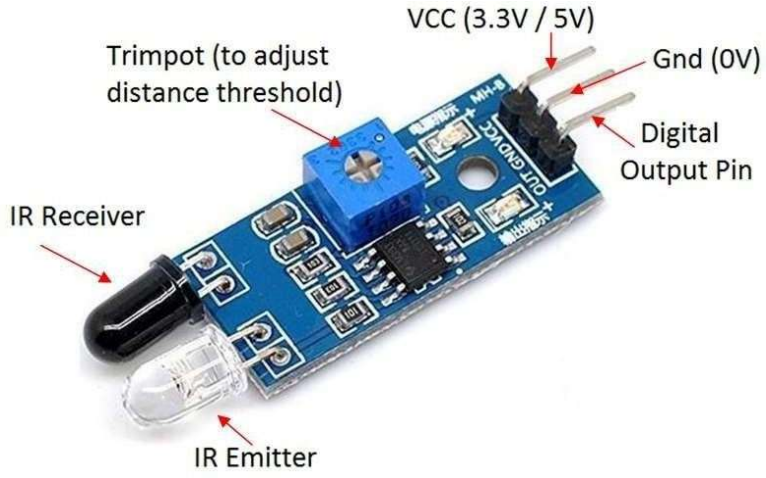


Figure 2.6: IR sensor

2.11 SERVO MOTOR

A robotic arm with five degrees of freedom (DOF) has been created. It is managed by an Arduino Uno microcontroller, which can receive human input signals via a series of potentiometers. The arm consists of an end effector, which receives rotary motion from a servomotor, and four rotary joints. Every link was initially created with Solid Works Sheet Metal Working Toolbox and then constructed with an aluminum sheet that was 2 mm thick. The finished arm shape was created by assembling the servomotors and links that were thus created with fasteners. Each servo motor has its rotation supplied by the Arduino according to the potentiometer shaft's rotational force.[12]

The model, design, and build of an Arduino-based robotic arm—which can be operated remotely via a mobile application—are shown in this paper. For this study, a robotic arm with six degrees of freedom has been created and put into operation. Via Bluetooth wireless controlling signals, the user's mobile application issues commands to the Arduino platform-controlled design. The servo motor provides rotary motion to the end effector, which consists of five rotary joints in the arm. Solid Works was used to design each link before a 3D printer was used to produce it. The final arm prototype is created by assembling the robot's components and the mechanical shapes of the motor.

The Arduino has been configured to rotate each servo motor that corresponds to the sliders in the mobile application, allowing for remote usage. [13]

Figure 2.7: Servo motor

2.12 ESP32 BOARD

The described contribution outlines the application of an ESP32 micro controller-powered Internet of Things device with dual-core data processing and wireless communication implementation. To leverage this technology and reduce the cost of more expensive hardware solutions, aninnovative approach was tested, utilizing low-end hardware and software optimization to construct the software architecture. The objective of establishing the overall framework's foundation, specifying its use cases, and implementing components to realize these scenarios was achieved. The separate software components of the framework were evaluated on an embedded vibration measuring testing system, which is detailed in the paper alongside its gradual evolution. An application for the components was developed utilizing ESP32 processing cores, distributing the responsibilities of these cores across the framework's constituent parts. [14]

Designing an embedded system with a variety of micro controller platforms has grown more flexible with the advent of numerous low-cost development platforms. However, before choosing the micro controller the brains of embedded systems it is necessary to consider several criteria. This study contrasts two popular development boards for embedded system design with the ESP32, one of the newest boards made for high- performance, low-cost embedded system design. Both programming tools and hardware specs are used in the comparison. An ESP32 module was used in the design and implementation of a Wi-Fi analyzer system as an example of low- cost, low-energy embedded systems architecture. The design also includes a Graphical LCD as an output device in addition to the ESP32. On the other hand, not much research has been done on setting up serial connection between the ESP32 module and the Graphical LCD. As a result, this work clearly explains how to connect the ESP32 module and Graphical LCD using just three GPIO pins. [15]

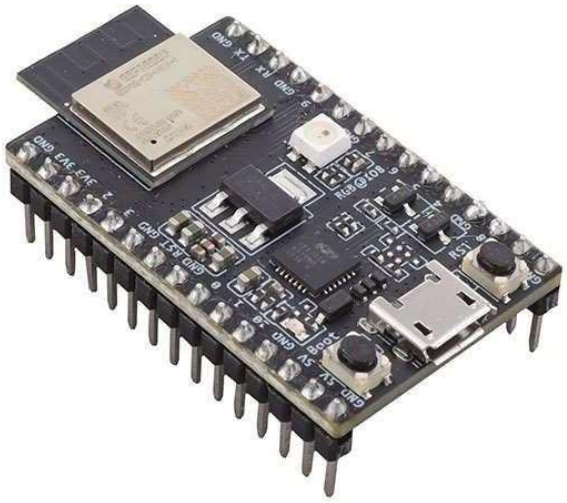


Figure 2.8: ESP32 board

2.13 ARDUINO UNO

The development of sophisticated electronic gadgets in recent years has made computer science, information technology, and electronics education closely tied to physics education. How to incorporate this knowledge into schooling is the key question. The components and methods of new technology can also be applied to education; teachers and students used instruments and parts that engineers could only operate. One excellent example is the widely used Arduino board, which is essentially an industrial microcontroller with pins connected to user-friendly connections on a printed circuit board. To facilitate experimentation and comprehension of some educational ideas pertaining to the free fall, we have created a basic Arduino-based platform in this work. Excel Data-Streamer was used to automatically record the acquired data. As a result, this platform is helpful as a teaching tool since it allows students to confirm the value of the gravityintensity, or "g." It can also be used to teach or study principles linked to free fall. [16]

This essay will provide a brief overview of the Arduino microcontroller, some of its uses, and how it might be applied to education. An open-source microcontroller called Arduino is employed in electronic prototyping. We will examine the hardware and components of Arduino. Additionally examined are the software and environment on which Arduino operates. A few use cases will be presented to illustrate how to add interest to the Arduino learning process. This may be a powerful tool for inspiring others and students to pursue further education in electronics and programming. [17]

Figure 2.9: Arduino uno board

2.14 SCANNER V3.0

Using cell phones with Android operating systems is like having a personal assistant that is essential to supporting human activities. Based on this, this study uses Android to develop the Q-Bagos (QR-Code Based BarrierGate Opening System), a control device for access rights that uses a QR-Code to open the barrier gate where the data is added to the database server. This access system's design makes use of an in-house created QR-code scanner application that has been customized with code to tell Android to open abarrier gate that has a QR-code on it. The application has options for barcode data, status, and login with password and username. User data that you now possess can be utilized as an access privilege to open the barrier gate. In this instance, a web server is constructed to interface with an Arduino Uno to handle the security system. It does this by capturing user data that runs scanners, storing user access permissions data, and opening ports. A set of data that is represented by lines and spacing is called a barcode or barcode. The technology operates on the concept that users must first check in with their username and password to access a scanner application on an Android device. The QR-code scanner camera automatically opens after logging in. The servo door opens automatically when the scan procedure automatically enters.

the data on the web database server. Once the user enters, the barrier gate immediately closes again due to the operation of the ultrasonic sensor. [18]

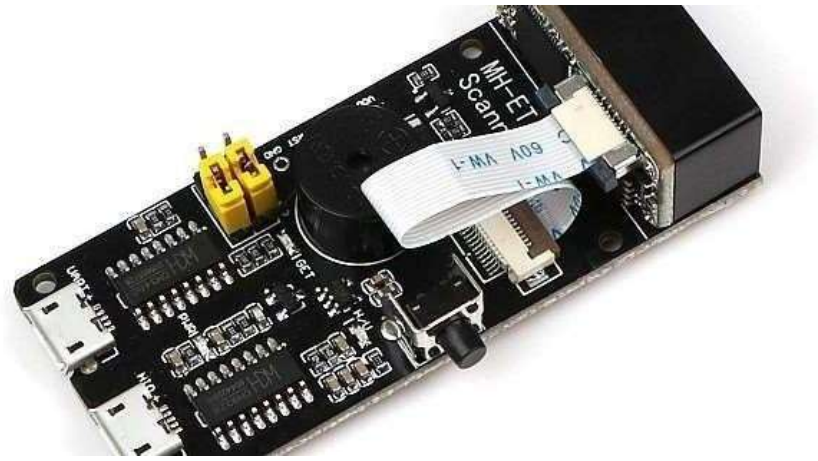


Figure 2.10: Scanner V3.0

2.15 LCD SCREEN

An LCD is a type of video display that uses the ability of liquid crystals to modulate light to show text or images on a screen. LCD screens were first developed in 1964 and are now utilized in a huge range of products, such as instrument panels, televisions, and computer monitors. Using an Arduino microcontroller is one method of making use of an LCD. An Arduino microcontroller can be programmed to display a desired text string or image on the screen by hooking it to the pins of an LCD display. [19]

It can be difficult to locate a parking spot in most cities, especially during rush hour. The problem stems from not knowing where parking spaces are available at any one time. Despite the availability of this information, several cars may compete for a small number of parking spots, causing severe traffic congestion. In addition, the need for parking increases as the number of people using cars increases. The Smart Parking System is presented in this paper as a simple and straightforward parking solution. By offering trustworthy information about parking space availability, our technology helps drivers park their cars with the least amount of lost time. The main part utilized in this project as the microcontroller unit is the Arduino Uno. If

a slot is vacant, this gadget can automatically recognize it and allow further cars to join the automated car park; if not, the servo barrier will stop entry. The status of the car is then represented by the servo motors, which use infrared sensors to detect movement in the vehicle. The number of cars entering and leaving the parking space will be monitored by the infrared sensors, and the availability of the space will be shown on the Liquid Crystalline Display (LCD 1602). [20]

Figure 2.11: LCD screen

2.16 SMART PARKING FROM TECHNOLOGICAL REVIEW

The Internet of Things' (IoT) rapid development and growth have reinforced many facets of society and enhanced people's quality of life. Globally, a lot of cities are eager to become smart. The application of smart parking solutions is one of the most common use cases in smart cities since it enables users to maximize time, cut down on fuel use, and lower carbon dioxide emissions. Sensors, communication protocols, and software solutions are some of the specific components that make up the defined architecture of smart parking systems. Even though a smart parking solution consists of just three parts, it's vital to note that each part comes in a variety of forms that might be employed while implementing these solutions. The most popular varieties of each component are identified in this report, along with consumption patterns during the designated analysis period. It offers a another.

viewpoint and is a highly helpful information source. This information could be used by the scientific community to make decisions about the kinds of components that should be chosen when implementing a smart parking system. To do this, we examine several works pertaining to the implementation of smart parking solutions here. To accomplish this, a systematic review and a semi-cyclic adaptation of the action research technique are utilized to choose relevant papers for the study. Subcategories for each component were determined by reviewing the most pertinent papers; these classifications are displayed in tables to indicate the relative importance of each paper. Every section analysis and discusses usage trends for sensors, protocols, and software solutions. This article establishes a guide of complementary features from the type of components that should be taken into consideration when building a smart parking solution, in addition to the usage patterns. [21]

2.17 DEVELOPMENT OF SMART PARKING

The parking management system is a crucial part of the traffic system and has a significant impact on people's everyday lives. A smart parking system reduces parking disputes by sensing and analyzing data from parking lots and providing drivers with real-time parking information. The globe over, the most common way to conduct daily operations in a more flexible and efficient manner is using intelligent systems. We demonstrate the value of employing smart parking technologies in this research study. Our design objectives for the smart parking systems are to reduce traffic congestion, enhance driver happiness, boost parking revenue, and simplify parking system operations. With the possibility to accomplish the objectives, we present the suggested reservation-based parking system prototype through phases of analysis, design, implementation, and testing. To assess the reliability and validity of the study questionnaire items, we employed Cronbach's alpha. To ascertain the elements that influence the use of intelligent systems through mobile or computer applications for smart parking reservations, such as city, age, gender, automobile type, job, educational level,

monthly salary, and credit card type, we also employed the Spearman Correlation analysis. [22]

2.18 A SURVEY ON SMART PARKING

It can be difficult and frustrating for drivers to park their cars in crowded situations, and occasionally it might get boring. Finding parking spaces can take longer than expected for several reasons, including a lack of available spots, improper or unmanaged vehicle parking, and ignorance of parking information at the destination, all of which increase environmental pollution and waste time, fuel, and energy. Numerous smart parking solutions that combine car recognition techniques, routing strategies, and context awareness with pervasive computing have been documented in the literature. These solutions are based on the Internet of Things (IoT). The proliferation of smart and intelligent gadgets has made real-time traffic monitoring and parking spot discovery quite simple, especially given their application in highly decentralized environments. While travelling to their destination, vehicles can identify open parking spaces with the help of smart parking sensors and technologies. In this article, we have reviewed recently published articles (mostly from the last 5 years) on smart parking systems enhanced with sensors, embedded systems, context-awareness capability, and IoT which yield in time, fuel, energy, and driver stress reduction, taking into consideration the needs, wants, and demands of metropolitan cities. To achieve this, we have examined many models of smart parking solutions that are based on theoretical frameworks, algorithmic formalisms, formal models, smart device-based prototypes, and real-time applications, all while confirming the system's correctness features. The presented results might serve as a foundation for cutting-edge future research initiatives. [23]

2.19 DESIGN A PROTOTYPE SMART PARKING

Finding a parking spot is getting harder and harder due to the recent rapid development of automobile availability and usage, which has led to several practical issues. In every big city, parking issues are becoming more and more common and are developing at an alarming rate. Globally, a great deal of research and development is being done to put more advanced and intelligent parking management systems into place. The increasing adoption of wireless technology and the latest developments in wireless parking applications indicate that digital data distribution may hold the key to solving new parking issues. Because wireless sensor networks (WSNs) have so many potential applications across a wide range of industries, they are gaining popularity and developing quickly. It is anticipated that this buoyant field would offer a practical and affordable solution to the difficulties with effluent car parking. This study offers a wireless sensor network based Smart Parking (SPARK) Management System with sophisticated features like automatic guidance, remote parking monitoring, and parking reservation system. From the perspective of sensor networks, the paper explains the whole system architecture of SPARK, covering hardware and software implementation. We realized the design functionalities and features by implementing a fully functional prototype system for parking management. The preliminary test results demonstrate that this WSN-based system's performancecan successfully meet the needs and requirements of current parking difficulties, reducing the amount of time needed to find a vacant parking lot, rendering information in real-time, and utilizing smart reservation procedures.[24]

2.20 SMART PARKING IN IOT ENABLED CITIES

Significant traffic bottlenecks have developed in current transit systems because of the population's fast development. This not only wastes time and energy and contributes significantly to air pollution, but it also highlights the problem of auto park scarcity. Future cities must embrace smart parking and appropriate new solutions if they are to become more sustainable in the era of Internet of Things (IoT) and smart city ecosystems. With the use of sensors built into vehicles and municipal infrastructure, smart parking may reduce traffic jams, offer residents the highest caliber of services, and turn a profit. However, prior to putting such solutions into practice, several design factors need to be thoroughly examined and analyzed. In this work, we consider both hard and soft design considerations when classifying smart parking systems. We provide a summary of the sensors and enabling technologies that have been frequently used in the literature. We stress the significance of other crucial design elements in such systems, such as data security, privacy, and reliability. With an emphasis on data interchange and interoperability, emerging parking patterns in the ecosystem are examined. In addition, we suggest a conceptual hybrid-parking model and list open research questions on the state of smart parking systems today.[25]

2.21 A SECURE AND PRIVACY FRAMEWORK FOR SMART PARKING

Particularly in the era of the Internet of Things (IoT), smart parking systems are an essential part of the "smart city" concept. Their goal is to alleviate the burden of having to search for a parking space in urban areas where there are more cars than before, particularly during rush hours. IoT-enabling technologies are necessary to make the concept of smart parking a reality, since the conventional approach to creating smart parking solutions involves issues with scalability, compatibility with IoT-constrained devices,

security, and privacy awareness. In this research, we suggest a framework for smart parking systems that is both secure and privacy-preserving. The publish/subscribe communication paradigm is the foundation of the framework, which allows for the exchange of massive amounts of data with several customers. On the one hand, it offers practical services including parking vacancy detection, real-time parking availability information for drivers, driver assistance, and parking reservation services. However, it offers security methods for the application and network layers as well. Furthermore, it facilitates mutual authentication protocols among businesses to guarantee the validity of devices and data while offering users security protection. This makes our suggested framework resistant to different kinds of security breaches, including phishing, replay, and man-in-the-middle attacks. Lastly, we examine the compute and network overhead performance of our framework, which is appropriate for Internet of Things devices.[26]

2.22 EVALUATION ON SMART PARKING

This study presents the outcomes and methodological approach of an evaluation process for a smart parking application that offers real-time parking availability information. The effort is a response to the growing demand for parking spots in the Cultural District of Pittsburgh, Pennsylvania, as well as the goal of enhancing the parking experiences of customers. Primary data were used for the stakeholder analysis, baseline data, process assessment, and outcome evaluation stages. This data was collected through semi-structured interviews and in-person and online surveys of customers. Count data extracted from website usage logs was used as secondary data in the output evaluation stage. The insights the assessment framework offers on how the major problems brought about by the setting in which the system was implemented were handled are what make it valuable. The framework may also be used to address response-shift bias by use of a binary system technique that distinguishes between different respondent cohorts. Given how expensive it would be to use a supply-side strategy to solve parking issues in cities, how.

simple it is to replicate the evaluation framework and the product design, and how much valuable information the study adds to the body of knowledge regarding the assessment of technological products, the report is especially timely.[27]

2.23 OPTIMIZED REAL-TIME PARKING MANAGEMENT

The population of the modern world has increased dramatically over the last few decades, which has led to a rapid expansion of the car industry. The world's smooth traffic flow has been interrupted by an exponential rise, which has also created serious issues like traffic congestion and poor management. Some hardware- and data-driven-based solutions have already been put forth to address these problems. The hardware-based solutions are less scalable, difficult, expensive to install, and maintain since they rely on various kinds of sensors placed at pertinent locations to monitor the status of parking slots. The constraints of sensor-based solutions are circumvented by data-driven solutions, which make use of the infrastructure of security cameras already present in parking lots. To monitor the state of the parking slots, only classification-based techniques are now widely used, which limits the generality of the systems and results in slower performance and less scalability. To overcome the shortcomings of data-driven solutions, this study suggests an intelligent parking management system that uses deep learning. It does this by using YOLO v5's high performance and quick inference capabilities for vehicle recognition rather than parking slot classification. The Plot dataset, a benchmark for determining the parking lot's status with state- of-the-art performance attained with an accuracy of 99.5%, was used to assess the model. To enhance the algorithm's real-time performance, a pretrained YOLO v5 model on the MS COCO dataset was utilized to identify and allocate open parking spaces and produce car information. With a virtually real-time speed of 45 frames per second and an accuracy of 96.8% attained on our unique dataset, the suggested system performs more effectively, scalable, and broadly.[28]

2.24 COST AND BENEFITS SMART PARKING

These days, cities account for about 75% of garbage generation, 80% of emissions, and 75% of energy use. About 20% of all CO2 emissions in Europe are produced by road travel, of which 40% are produced by urban mobility. In an urban downtown area, cars cruising for free parking places are thought to be responsible for thirty percent of the daily traffic congestion. In this paper, we quantify the potential economic and social benefits of intelligent traffic systems (ITS) and use a simulation and assessment model to demonstrate how ITS may affect urban parking management that considers both passenger and freight transportation. There are currently few quantitative models available to evaluate the effects of ITS technology on urban parking, even though several advantages have already been studied by other authors (such as the reduction of time spent looking for a free parking space). This article's unique contribution in this regard is that it unifies modes of transport for both people and freight into a single model. Initially, a model was created to replicate the urban parking system both prior to and during the implementation of the Smart Parking solution. The simulation model's result is a % decrease in the amount of time drivers of cars and vans spend looking for a spot to park. The economic and social advantages of a smart parking program in Milan, Italy, where "pay and display" parking spaces have sensors that can determine whether they are free, have then been evaluated using this proportion. The study considers two viewpoints: on the one hand, the parking operator business, which stands to gain money from fewer unpaid parking spaces. However, city users (residents, visitors, off- campus students, etc.) can cut down on the amount of time they spend looking for a parking space, which will save them fuel and cut down on CO2 emissions. The findings indicated that these technologies could save drivers an average of 77.2 hours annually, 86.5 euros in fuel expenses, and 44,470 tons of CO2 emissions annually (of the 4,144,000 tons that are produced annuallyby road traffic in the Milan area). Furthermore, the parking operator company

benefits from this technology by increasing its annual revenue by approximately 9 million euros. The discounted payback period for the parking operator is less than two years when the costs associated with implementing the smart parking solution are considered.[29]

2.25 SMART PARKING WITH DYNAMIC PRICING

Long-lasting traffic congestion and challenges managing traffic in cities are a result of the rapidly increasing number of automobiles in recent years. Unauthorized and non-permitted parking is a major contributing factor to the rise of traffic bottlenecks on the road. Additionally, due to poor management, a lack of real-time parking guidance for drivers, and general ignorance, regulating the number of parking spaces available cannot achieve the anticipated reduction in difficulties related to traffic congestion. A growing demand for an intelligent, dynamic, and efficient parking solution is noted given the lack of large increases in the number of roads, highways, and related resources. Accordingly, a smart parking system can assist in efficiently managing parking and make it easier for the owners of the vehicles using several sensors, an adequate communication network, and the sophisticated processing capabilities of edge and cloud computing. In thisstudy, we offer a multi-layer architecture for smart parking systems, using Edge-Cloud computation, the newest long-range low-power wireless communication technology, and multi-parametric parking slot sensor nodes. Through near real-time vehicle tracking, the proposed system allows for dynamic parking management over vast regions while giving drivers helpful information about available parking places and related services. In addition, wesuggest a dynamic pricing mechanism that will maximize parking authority revenue and provide vehicles with the best potential parking slot availability.[30]

2.26 SMART PARKING SYSTEM THROUGH AUTOMATION IN LICENSE PLATE RECOGNITION

From its initial discovery to its steady development over the years and eventual peak use during the COVID-19 pandemic in 2020, technology has gone a long way. Every single item that comes to mind uses technology in one way or another. From early banking systems that needed to enter data rows into ledgers to the creation of completely automated computer systems that could store millions of dollars' worth of data. Amidst all of this, there was a concurrent rise in the quantity of new cyberthreats, which caused humanities to refocus on cyber security to the point where real physical threats are now seen as antiquated and of lesser significance than safeguarding company data on both online and offline platforms. These overlooked physical risks, though, are equally significant and primarily concerned with maintaining the general security of the property's boundaries. ANPR, or automatic number-plate recognition, is useful in this situation. From assisting in the correct enforcement of the law to maintaining the Deco Drum through smart parking software. Many support systems can be built around a technical tool. Since everything would be totally automated, security personnel wouldn’t need to go outside to verify stickers on cars. Since all the data will be recorded directly in the database and neither the teachers nor the students will need to remember to carry it with them, there won't even be a need for stickers in the first place. at order to resolve the concerns raised at our educational institution, this article recommends doing away with the conventional parking system and using an ANPR-based smart parking application instead.[30]

2.27 CONCLUSION

The term "smart parking" describes a cutting-edge system that effectively manages parking spots in metropolitan areas by using technology. To track and maximize parking availability, sensors, cameras, and data analytics are used. By giving vehicles access to real-time information, these systems ease traffic, cut down on time wasted looking for a place to park, and lead drivers to open spots. Mobile apps and digital platforms that make it easy for users to search for, reserve, and pay for parking spaces are frequently included in smart parking solutions. Smart parking seeks to maximize the use of parking resources in cities and urban environments, improve traffic flow, lessen environmental effects, and improve user experience by utilizing cutting-edge technologies.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

Drivers nowadays spend an average of 10 minutes looking for free parking and an average of 20 minutes a day in traffic jams looking for open public parking. The search for a parking space has caused traffic jams that lead to negative effects on the environment, economic losses, lost time and more. Irresponsible drivers are tempted to double park in busy areas causing more traffic jams. Several efforts have been made to overcome the problem of finding parking spaces in various cities outside Malaysia. We have discussed driver survey statistics on the need for smart parking systems. Proposed solutions include utilizing lot technology, such as cameras and sensors, for efficient monitoring and allocation of parking spaces. Additionally, the implementation of designated parking spaces for disabled drivers aims to provide accessibility and convenience. We have provided several indoor parking solutions with different approaches, including using ultrasonic sensors or magnetic sensors in each parking lot, cameras to monitor several parking lots, and The Internet of Things (IoT) has been proposed for further research. Different smart parking concepts are proposed to overcome parking problems, such as parking reservations to allow drivers to make short reservations for parking time to save time when they arrive. In addition, we provide special parking spaces for OKU drivers that cannot be used by normal drivers. This is to avoid the case of OKU drivers deliberately parking.

3.2 FLOW CHART

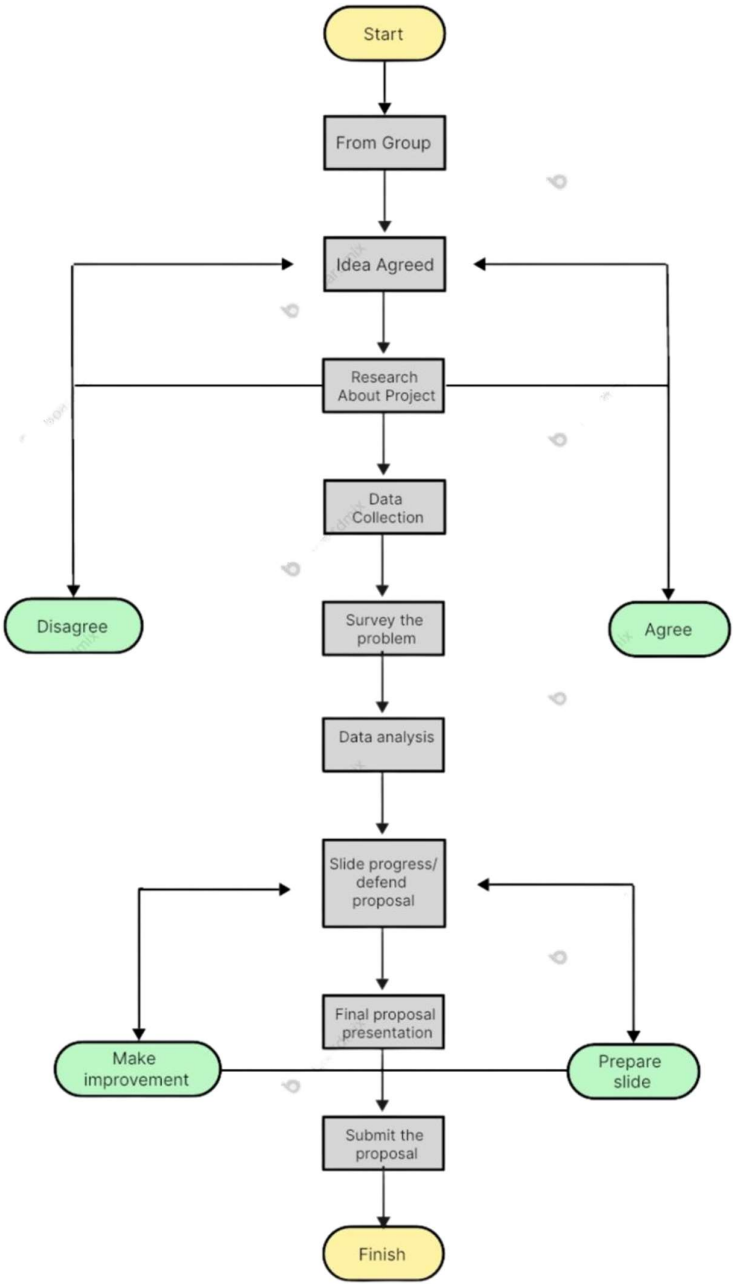


Figure 3.1: Flow chart

The data findings of Park-Tech Evolution were developed through a comprehensive process involving concept development, rigorous testing, and operational implementation. This iterative approach ensured that the smart parking system was exhaustively evaluated at each stage of its development.

The process of finding data for Park-Tech Evolution involved several important steps. This initial stage involved outlining the objectives and parameters of the study, determining what data would be relevant and valuable to collect.

Next, a research design was devised, outlining the methodology for data collection. This included decisions about the type of data to be gathered, such as qualitative or quantitative, and the specific methodologies to be used.

Once the research design was established, data collection methodologies were implemented. This could involve surveys, interviews, observational studies, or data recording from sensors within the smart parking system.

After accumulating the data, it was analyzed to identify patterns, trends, and correlations. Statistical analysis or qualitative classification may have been employed, depending on the nature of the data collected.

The analyzed data was then interpreted to derive conclusions and insights about the effectiveness and performance of Park-Tech Evolution. This step involved contemplating the context of the findings and comparing them to the initial objectives of the study.

To ensure the validity and reliability of the findings, they may have been subjected to peer review or validation by experts in the field.

Finally, the findings were presented in a clear and coherent manner, often in the form of a report or presentation, detailing the methodology, results, and conclusions of the data analysis process.

3.3 PROJECT DESIGN

The project design phase comprises producing blueprints for both the hardware and software components of the smart parking system, including the location of sensors, the user's interface, and integration framework, assuring a strong and scalable solution.

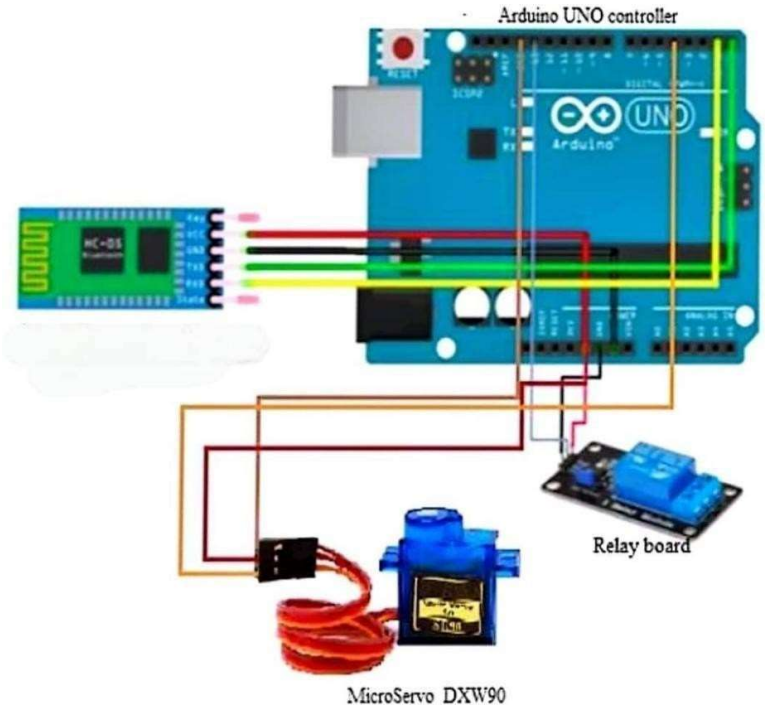


Figure 3.2: The circuit of prototype

3.4 PROJECT PRODUCTION TECHNIQUES

This study will be conducted using qualitative methods. The project is a kind of prototype. This design was taken as an example from some literature reviews and have made the appropriate modifications to produce the design. Some of the materials used to make this project consisted of construction waste and some purchased items such as cardboard boards and others. Will also

perform tests several times to obtain data to analyze the effectiveness and identify if there are problems or deficiencies.

3.5 MATERIALS AND EQUIPMENT

Material and equipment that we will used: IR sensor , Sg90 9g Micro Servo Motor Tower PRO, SMD uno R3, Scanner V3.0, Wire, Cardboard, Fit wooden stick, Glue Gun, Glue Stick

Table 3.1: Material and equipment

i)Material and equipment	Image	Price
IR Sensor		RM2.90 per unit
ii)Sg90 9g Micro Servo Motor Tower PRO		RM7.80 per unit

iii)SMD uno R3		RM27.90 per unit
iv)Scanner V3.0		RM138.60 per unit
v)Wire		RM1.00 per unit

vi)Cardboard		RM10.50 (10pcs)
vii)Fit wooden stick		RM1.50 per pack
viii)Glue Gun		RM4.65 per unit

ix)Glue Stick		RM2.70 (20pcs)

3.6 PROTOTYPE DEVELOPMENT

This code is for an Arduino project using an ESP32 microcontroller to monitor parking spaces with IR sensors and serve the status through a web server.

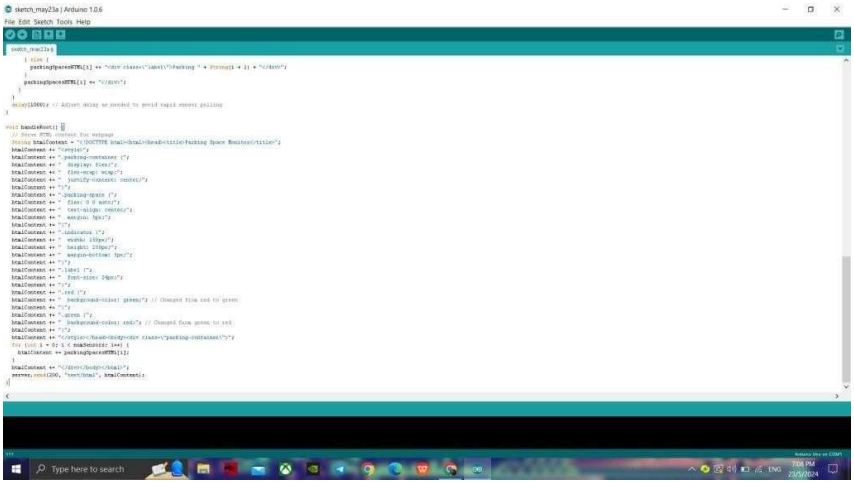


Figure 3.3: Coding for ESP32 board

This code sets up an Arduino to read data from a QR scanner via a software serial connection and controls a servo motor based on the scanned QR code content. When a QR code is scanned, the data is read. and printed to the Serial Monitor. Depending on the content of the scanned data, the servo motor is moved to different positions: 0 degrees for "LEFT", 90 degrees for "CENTER", and 180 degrees for "RIGHT". This setup allows Arduino to perform specific actions based on the scanned QR codes.

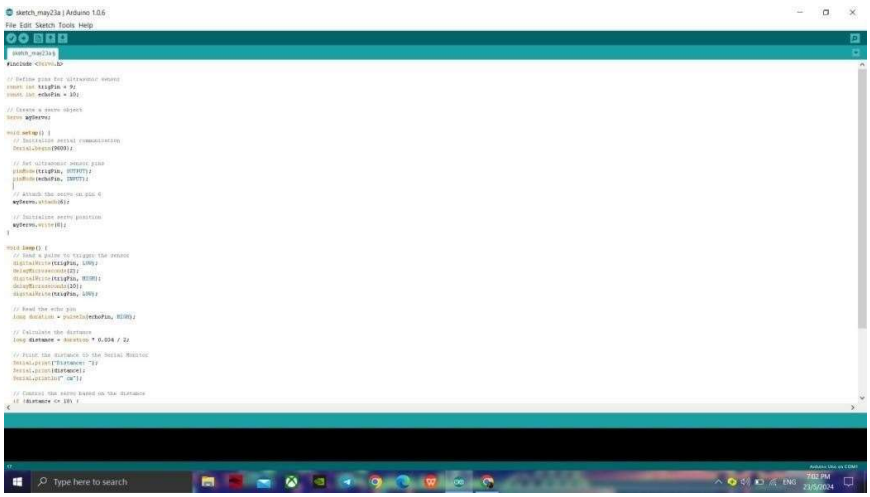


Figure 3.4: Coding for QR scanner V3.0 and servo motor

The servo motor responds to the readings from the IR sensor, allowing you to create interactive projects where the servo motor's position changes based on proximity or obstacle detection.

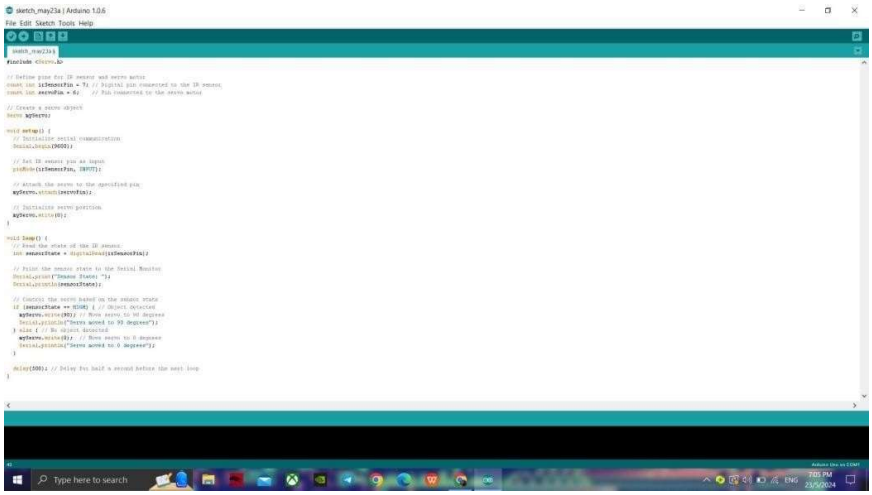


Figure 3.5: Coding for IR sensor

This setup allows you to control an LED based on the presence of an object detected by the IR sensor.

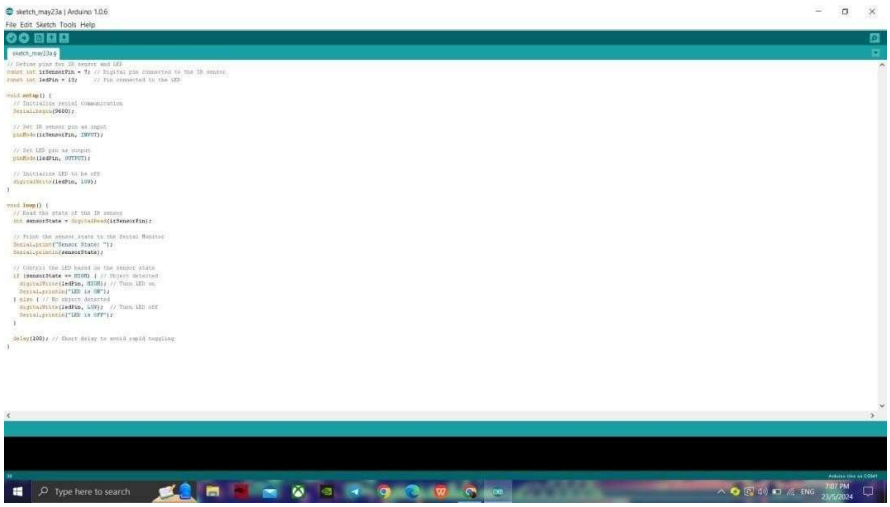


Figure 3.6: Coding for LED

3.7 CONCLUSION

The methodology section briefly details how the research study was designed and conducted, including information on research design, sampling, data collection methods, and analysis procedures. This section serves as a roadmap for readers to comprehend the systematic approach employed in the study.

The research design is explained by describing whether the study is experimental, observational, qualitative, or quantitative. This choice is informed by the research questions and objectives. For experimental studies, details about the variables manipulated and the control measures implemented are important.

The sampling strategy is one of the critical aspects, as it determines the participants or subjects to be investigated. This includes specifying the population of interest and the sampling method used is random in any facility and the rationale behind the approach chosen.

CHAPTER 4
RESULT AND DATA ANALYSIS

4.1 INTRODUCTION

This chapter shows the data, inferences, and expert insights obtained during testing, representing the completion of a study intended to evaluate the effectiveness and effects of Park-Tech Evolution. It specifically looks at how IoT technology is incorporated into smart parking systems. In addition to optimizing parking spot usage and possibly earning income, smart parking systems also reduce traffic congestion, improve driving convenience, improve air quality, increase safety, and provide useful data insights.

4.2 APPLICATION CONCEPT

In the application concept of Park-Tech Evolution, the focus rests on optimizing parking management through real-time monitoring and user-friendly interfaces. This concept entails leveraging IoT sensors to provide drivers with up-to-date information on available parking spaces, reducing congestion and enhancing overall efficiency. Integral to this concept is the seamless integration with existing infrastructure, ensuring accessibility for all users while prioritizing data security and privacy. Additionally, provisions for scalability and adaptability are considered, enabling the system to evolve alongside technological advancements and changing urban landscapes. Overall, the application concept of Park-Tech Evolution embodies a holistic approach targeted at enhancing urban mobility and improving the parking experience for drivers.

4.3 APPLICATION OPERATION

i. Scan the QR to website to monitoring parking space.

Figure 4.1: Scan the QR code.

ii. The parking space will be displayed on the website.

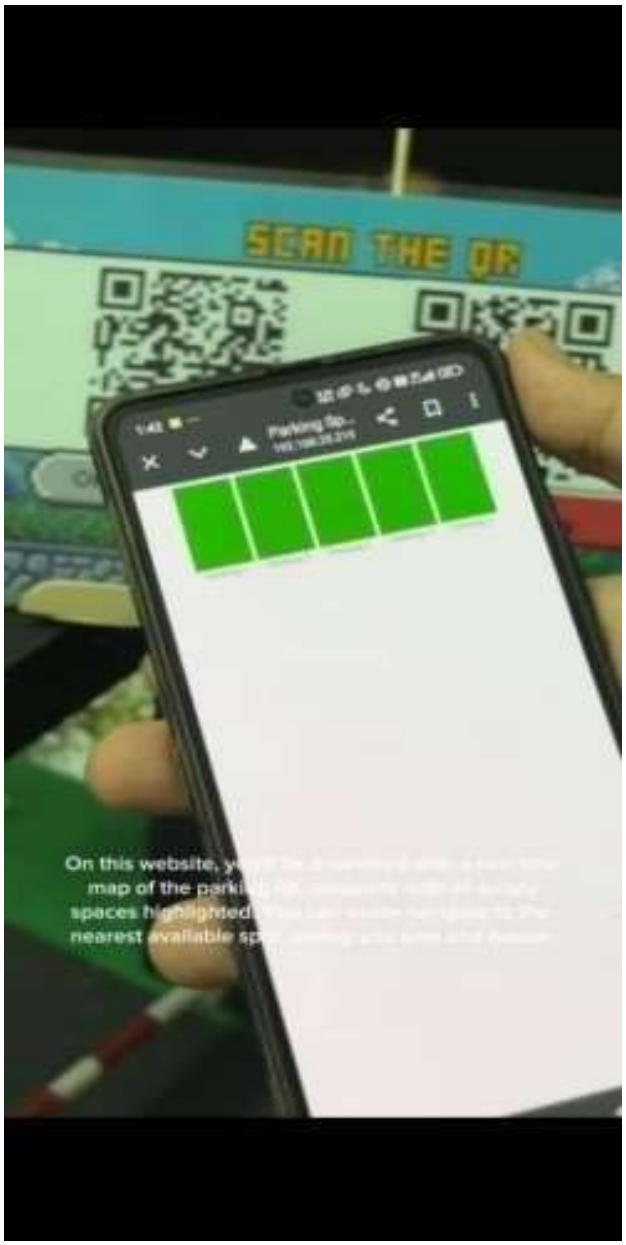


Figure 4.2: Parking space monitor

iii. Repeat Step One and Scan QR for OKU then Scan QR given to QR Scanner

Figure 4.3: Scan QR code for OKU

4.4 ANALYSIS AND RESULT

The research and results of Park-Tech Evolution tell us a lot about how well and how much the smart parking system has changed things. Key results about different parts of the system's performance and the user experience are found through careful data collection and analysis. Some of the things that might be looked at in an analysis are how often parking spaces are used, how long people usually must look for parking, how satisfied users are with the system, and how much it helps reduce traffic and pollution. The results usually show real benefits, like better urban movement, shorter search times for drivers, and more efficient use of parking spaces. Also, getting direct feedback from users and other important people in the system may help you understand its strengths and weaknesses better. Overall, the analysis and results of Park-Tech Evolution provide valuable proof of this.

4.5 CONCLUSION

In summary, Park-Tech Evolution is a notable development in parking management technology that has practical advantages for both urban areas and drivers. By means of the incorporation of Internet of Things sensors and intuitive user interfaces, the system efficiently maximizes parking space utilization, minimizes search times, and boosts overall productivity. The system's study and outcomes show how beneficial it is for easing traffic jams, boosting air quality, and improving urban mobility. While the results show the system's advantages, they also emphasize how crucial it is to continuously improve and modify it to satisfy changing user needs and keep up with technological improvements. Going forward, further funding for intelligent parking systems like Park-Tech Evolution is expected to improve urban transportation even more, making cities more livable and sustainable.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

In an era characterized by rapid urbanization and a growing population, traditional parking infrastructure faces unprecedented challenges. Our final year project prototype entitled "Park-tech Evolution", aims to reduce traffic congestion, and reduce waste time in car parking areas. However, amidst these challenges there are opportunities for innovation and transformation. This report traces the evolution of parking technology, from basic coin-operated meters to today's sophisticated data-driven systems such as adding QR scans to check for empty slots in parking lanes so as not to waste time looking for parking and reduce congestion in parking areas. In addition, we upgraded OKU parking by placing QR scans and bars and only drivers who register with OKU cards can access the QR scans to prevent parking theft from undisciplined drivers. Through comprehensive analysis of emerging trends, advances, and case studies, we aim to shed light on the profound impact technology is having on the parking landscape.

5.2 CONCLUSION

In conclusion, the technological evolution in parking has had a profound impact on urban mobility, sustainability, and the overall urban experience. Through innovations such as dynamic pricing, real-time availability tracking, and intelligent parking guidance systems, parking technology has significantly increased efficiency and convenience for drivers and city planners.

Additionally, the integration of parking technology with broader smart city initiatives has led to a more interconnected and sustainable urban environment. Data-driven insights gained from parking infrastructure provide valuable information to optimize traffic flow, reduce congestion and improve environmental sustainability.

Despite these advances, challenges such as initial investment costs, interoperability issues and concerns about data privacy and cybersecurity remain. Addressing these challenges requires collaborative efforts from governments, technology providers and stakeholders to ensure the continued evolution and adoption of parking technology.

Overall, technological evolution in parking represents a critical component of urban development, contributing to more efficient, safer, and more environmentally friendly cities. As technology continues to advance, the future of parking promises further innovation and transformation in urban mobility.

5.3 RECOMMENDATIONS

It has been more and more clear from the thorough and in-depth examination of the research findings that the current version of the product contains several serious flaws and weaknesses. These shortcomings underscore the imperative requirement for a comprehensive reevaluation. Considering the weaknesses that have been recognized, there is a wide range of strategic approaches that may be taken to strengthen the product's overall effectiveness and target the areas that need attention. Among the many facets of this improvement strategy are, but are not restricted to:

i. Utilize personal internet or Wi-Fi connections to access the QR scanner: It is essential to put in place a smooth way for users to utilize personal internet or Wi-Fi networks to access the QR scanner. This will guarantee that the QR scanner functions dependably and effectively, irrespective of the user's location or the state of the network.

ii. Make sure the internet connectivity for the QR scanner is always uninterrupted and smooth: It is essential to ensure that the internet connectivity needed for the QR scanner is always uninterrupted and smooth to avoid parking lot congestion and to keep cars moving in an efficient manner. This will entail putting strong connectivity solutions in place and optimizing network infrastructure.

iii. Make smart parking solutions universally accessible to all users, including people with disabilities: Ensuring that smart parking solutions are accessible to everyone, with a focus on inclusivity for people with disabilities, is a crucial part of developing the product. This can be accomplished by including cutting-edge technologies like voice-guided navigation systems made especially to help people with visual impairments. To meet a variety of user needs, additional accessibility elements like tactile interfaces and easily readable visual displays should be considered.

iv. Put strong security measures in place to protect user data and privacy: Since using a QR scanner requires more and more internet and Wi-Fi connectivity, it's critical to put strict security measures in place to protect user data and privacy. This entails using cutting-edge encryption methods, conducting frequent security audits, and making sure that applicable data protection laws are being followed.

By implementing these extensive and well-planned improvements, the product would not only rectify its current shortcomings but also position itself as a more reliable, effective, and user-friendly option on the market. The product will fulfil the greatest standards of dependability, accessibility, and security thanks to these enhancements, which will also greatly improve the user experience overall.

5.4 CONCLUSION

This paper examines the evolution of technology in parking systems and its impact on urban mobility. It explores advances such as dynamic pricing, real-time availability tracking, and smart parking guidance systems, highlighting their role in increasing efficiency and convenience for drivers while optimizing parking resources for city planners. Additionally, the integration of parking technology with broader smart city initiatives is discussed, emphasizing the potential of data-driven insights to improve traffic flow and environmental sustainability. Despite challenges such as initial investment costs and interoperability issues, the ongoing evolution of parking technology provides opportunities for further innovation and transformation in urban mobility.

REFERENCE

[1] Paidi, V., Fleyeh, H., Håkansson, J., & Nyberg, R. G. (2018). Smart parking sensors, technologies, and applications for open parking lots: a review. *IET Intelligent Transport Systems*, *12*(8), 735-741.

https://ietresearch.onlinelibrary.wiley.com/doi/full/10.1049/iet-its.2017.0406

[2] Karbaschi, G., Sailhan, F., & Rovedakis, S. (2012, November). Towards a Fault-Tolerant Wireless Sensor Network Using Fault Injection Mechanisms: A Parking Lot Monitoring Case. In *2012 IEEE International Conference on Green Computing and Communications* (pp. 783-787). IEEE.

https://ieeexplore.ieee.org/abstract/document/6468409

[3] Marsden, G. (2014). Parking policy. In *Parking issues and policies* (pp. 11-32). Emerald Group Publishing Limited.

https://www.sciencedirect.com/science/article/abs/pii/S0191261515002234

[4] Khanna, A., & Anand, R. (2016, January). IoT based smart parking system. In *2016 international conference on internet of things and applications (IOTA)* (pp. 266-270). IEEE.

[5] Hong, T. P., Soh, A. C., Jaafar, H., & Ishak, A. J. (2013, December). Real-time monitoring system for parking space management services. In *2013 IEEE Conference on Systems, Process & Control (ICSPC)* (pp. 149-153). IEEE.

[6] Pandit, S. N., GVL, R. M. K., Akash, R., & Moharir, M. (2019, November). Cloud based smart parking system for smart cities. In *2019 International Conference on Smart Systems and Inventive Technology (ICSSIT)* (pp. 354-359). IEEE.

[7] Paidi, V., Fleyeh, H., Håkansson, J., & Nyberg, R. G. (2018). Smart parking sensors, technologies and applications for open parking lots: a review. *IET Intelligent Transport Systems*, *12*(8), 735-741.

[8] Ahmad, M. H., Cheah, N. A. C. Y., & Seman, M. T. A. (2022). Embedded RFID system: OKU smart parking. In *Proceedings of the 12th National Technical Seminar on Unmanned System Technology 2020: NUSYS'20* (pp. 203-219). Springer Singapore.

[9] Yasser Cheah, N. A. C., Abu Seman, M. T. B., Abdullah, M. N., & Din, S. (2023). Embedded RFID System: OKU Smart Card Detector. In *IT Applications for Sustainable Living* (pp. 81-89). Cham: Springer Nature Switzerland

[10] Patel, D., & Rohilla, Y. (2020, September). Infrared sensor based self–adaptive traffic
signal system using arduino board. In *2020 12th International Conference on Computational Intelligence and Communication Networks (CICN)* (pp. 175-181). IEEE

[11] Bhargava, A., & Kumar, A. (2017, April). Arduino controlled robotic arm. In *2017 International conference of Electronics, Communication and Aerospace Technology (ICECA)* (Vol. 2, pp. 376-380). IEEE.

[12] Mohammed Ali, H., Hashim, Y., & A AL-Sakkal, G. (2022). Design and implementation of Arduino based robotic arm. *International Journal of Electrical and Computer Engineering*, *12*(2), 1411-1411

[13] Foltýnek, P., Babiuch, M., & Šuránek, P. (2019). Measurement and data processing from Internet of Things modules by dual-core application using ESP32 board. *Measurement and Control*, *52*(7-8), 970-984

[14] Zhang, Z., Tao, M., & Yuan, H. (2014). A parking occupancy detection algorithm based on AMR sensor. *IEEE Sensors Journal*, *15*(2), 1261-1269

[15] In *2021 4th International Conference on Circuits, Systems and Simulation (ICCSS)* (pp. 130-135). IEEE.

[16] El Hadi, M., El Moussaouy, A., Ouariach, A., Essaadaoui, R., Hachmi, A., Laabidi, K.,
... & Meziani, Y. M. (2020). Real time free fall investigation for educational purposes using Arduino Uno board. *Physics Education*, *55*(5), 055027

[16] Galadima, A. A. (2014, September). Arduino as a learning tool. In *2014 11th International Conference on Electronics, Computer and Computation (ICECCO)* (pp. 1-4). IEEE.

[17] Merdana, O. (2020). QR-Barcode Application for Barrier Gate Opener based on Android. *IJCONSIST JOURNALS*, *2*(1), 31-35

[18] Clary, M. (2015). Interfacing to an LCD screen using an Arduino. *College of Engineering*.

[19] Yusni, Z. I. M., Rajah, K. N., Johnny, J. K. M., Fakaruddeen, A. F. A., Yusof, K. H., Aman, F., & Sapari, N. M. (2022). Development of A Smart Car Parking System by Using Arduino Uno. *Borneo Engineering & Advanced Multidisciplinary International Journal*, *1*(2), 50-54

[20] Barriga, J. J., Sulca, J., León, J. L., Ulloa, A., Portero, D., Andrade, R., & Yoo, S. G. (2019). Smart parking: A literature review from the technological perspective. *Applied Sciences*, *9*(21), 4569.

[21] El-Seoud, S. A., El-Sofany, H., & Taj-Eddine, I. (2016, October). Towards the development of smart parking system using mobile and web technologies. In *2016 International Conference on Interactive Mobile Communication, Technologies and Learning (IMCL)* (pp. 10-16). IEEE.

[22] [Zulfiqar, H., Ul Haque, H. M., Tariq, F., & Khan, R. M. (2023). A survey on smart parking systems in urban cities. *Concurrency and Computation: Practice and Experience*, *35*(15), e6511.

[23] Srikanth, S. V., Pramod, P. J., Dileep, K. P., Tapas, S., Patil, M. U., & Sarat, C. B. N. (2009, May). Design and implementation of a prototype smart parking (spark) system using wireless sensor networks. In *2009 International conference on advanced information networking and applications workshops* (pp. 401-406). IEEE.

[24] Al-Turjman, F., & Malekloo, A. (2019). Smart parking in IoT-enabled cities: A survey. *Sustainable Cities and Society*, *49*, 101608.

[25] Alqazzaz, A., Alrashdi, I., Aloufi, E., Zohdy, M., & Ming, H. (2018). Secsps: A secure and privacy-preserving framework for smart parking systems. *Journal of Information Security*, *9*(4), 299-314.

[26] Fabusuyi, T., Hampshire, R. C., & Hill, V. (2013). Evaluation of a smart parking system. *Transportation research record*, *2359*(1), 10-16.

[27] Rafique, S., Gul, S., Jan, K., & Khan, G. M. (2023). Optimized real-time parking management framework using deep learning. *Expert Systems with Applications*, *220*, 119686.

[28] Mangiaracina, R., Tumino, A., Miragliotta, G., Salvadori, G., & Perego, A. (2017, September). Smart parking management in a smart city: Costs and benefits. In *2017 IEEE international conference on service operations and logistics, and informatics (SOLI)* (pp. 27-32). IEEE.

[29] Sarker, V. K., Gia, T. N., Ben Dhaou, I., & Westerlund, T. (2020). Smart parking system with dynamic pricing, edge-cloud computing and lora. *Sensors*, *20*(17), 4669.

[30] Petiwala, F. F., Shukla, V. K., Mishra, V. P., & Saini, S. (2021, September). Smart Parking System through Automation in License Plate Recognition. In *2021 9th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions)(ICRITO)* (pp. 1-7). IEEE.

APPENDIX

APPENDIX A Questionnaire

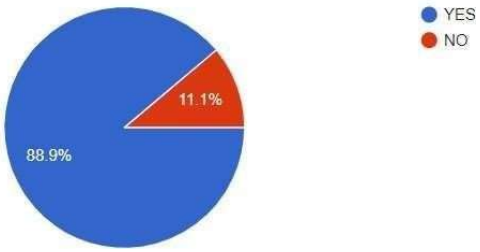
APPENDIX B Respondend

APPENDIX C Gantt chart

APPENDIX A
Questionnaire

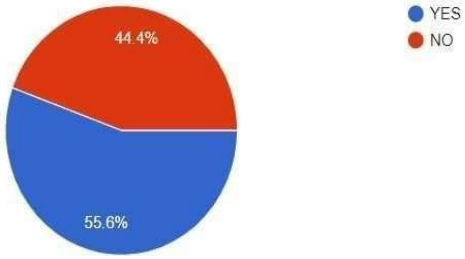
Do you currently experience difficulties finding parking in your area?

36 responses



Are you familiar with the concept of a smart parking system integrated with IoT (Internet of Things)?

36 responses



Would you be interested in using a smart parking system that guides you to available parking spots using a mobile app or digital interface?

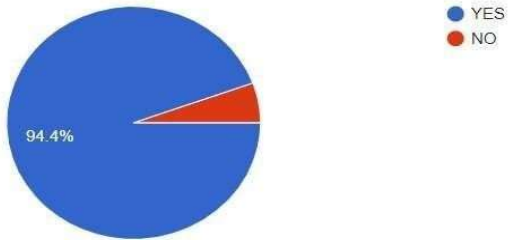
36 responses

Do you think a smart parking system would significantly reduce the time you spend searching for parking spaces?

36 responses

Do you think a smart parking system would be beneficial for individuals with disabilities in accessing parking spaces?

36 responses



Would you consider a smart parking system integrated with features for individuals with disabilities an important aspect of urban infrastructure?

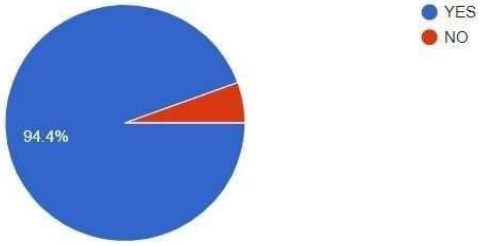
36 responses

Do you believe a smart parking system could contribute to reducing traffic congestion in urban areas?

36 responses

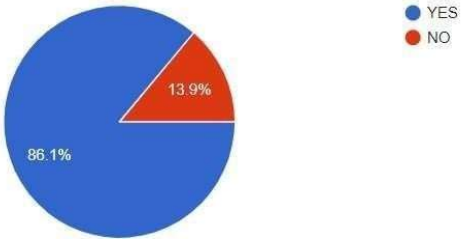
Would you prefer using a smart parking system if it was supported by robust customer service and assistance?

36 responses



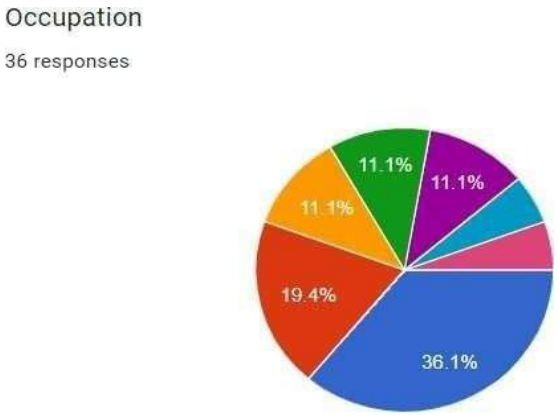
Would you be willing to provide feedback or suggestions to improve a smart parking system if it were implemented in your area?

36 responses



APPENDIX B

Respondend



APPENDIX C

Gant Chart

NO	ACTIVITY/WEEK	STATUS	W1	W2	W3	W4	W5	W6	W7	W8	MIDSEM BREAK	W9	W10	W11	W12	W13	W14	W15
1	Student registration	P																
		E																
2	Student briefing	P																
		E																
3	Submission of calendar and log books	P																
		E																
4	Project implementation and supervision sessions	P																
		E																
5	Student identify the tittle of the project in accordance with the criteria of the project in the department	P																
		E																
6	Delivery of video A individually which contains the implementation method of "empathy study" that is proposed	P																
		E																
7	Following the tittle that has been identified, student then determine the objectives which is to be achieved in the project that will implemented	P																
		E																
8	Estimated cost of project expenditure is determined by student	P																
		E																
9	Presentation session	P																
		E																
10	Student make follow-up improvements from the mid-presentation session semester considering the comment from the panel	P																
		E																
11	Sending video individually contains idea for solving issues/problems which is focused in the shaped FYP innovation	P																
		E																
12	Student make improvements and identify the significance of the statement problem, objective and scope of the study	P																
		E																
13	Student design procedures/methods/methodology for the project will be carried out by him based on significance and also a logical structure	P																
		E																
14	Student prepare a proposal includes chapter 1, chapter 2, chapter 3 and chapter 4	P																
		E																
15	Slide presentation by student "Defend proposal" proposal	P																
		E																
16	Presentation of "Defend proposal"	P																
		E																
17	Sending the final proposal to the supervisor after making follow-up correction from "Defend proposal" session	P																
		E