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| Module Code: PUSL2021 | Module Name: Computing Group Project |
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| Deadline Date:  Wednesday,25 October 2023, 3.00 PM | Member of staff responsible for coursework: Mr.Pramudya Thilakarathne |
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| Please note that University Academic Regulations are available under Rules and Regulations on the University website [www.plymouth.ac.uk/studenthandbook](http://www.plymouth.ac.uk/studenthandbook). | |
| Group work: please list all names of all participants formally associated with this work and state whether the work was undertaken alone or as part of a team. Please note you may be required to identify individual responsibility for component parts.  **Names** **Plymouth Id No.** **Contribution**  D.J.M. Dissanayaka 10899506 Description & Gantt Chart  M.V. Punchihewa 10899672 Target Users  A.Y.B. Athukorala 10899161 Overview, Budget Report & Made the Report  A.P.V. Kodithuwakku 10899591 Application Features  M.P.S. Rupasinghe 10899683 Objective  L.D.R. Silva 10899703 Created the Document Structure  ***We confirm that we have read and understood the Plymouth University regulations relating to Assessment Offences and that we are aware of the possible penalties for any breach of these regulations. We confirm that this is the independent work of the group.***  Signed on behalf of the group: | |
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# Overview

The Arduino Smart Car Park System is an innovative way to replace traditional car parks with workers. Utilizing Sensors, Microcontrollers, and Communication modules the Smart Car Park is fully automated from entrance to exit ensuring maximum efficiency and requiring no human workers to function. One of the key highlights of this smart car parking system is the ability to see whether the car park is full or not and to pinpoint the available parking spaces before entering the car park.

The way this smart car park works is that when a vehicle enters the car park, the user will have to pick up an RFID (Radio Frequency Identification) card that helps the system identify vehicles individually. The user then must scan the RFID card in the scanner that is installed at the entrance. Then the gate will open for the vehicle to pass through the entrance to a parking space. There will be IR (Infrared IR Obstacle avoidance) sensors installed in each parking space to identify whether there is a vehicle parked or not. When a vehicle is parked in the parking space, the sensor will send a signal to the Arduino board to start a timer to calculate the parking fee. When a vehicle leaves the parking space, the IR sensor will send a signal to the board informing that a vehicle has left the parking space. Then the Arduino board will stop the timer and calculate the parking fee. When the vehicle reaches the exit, the IR sensor installed in the exit will detect that the vehicle that left the parking space has arrived at the entrance. After the user scans the provided RFID card in the scanner installed in the exit, the system will identify which vehicle has arrived at the exit. (The RFID cards will help the system to identify each vehicle individually to avoid confusion to the system in case multiple vehicles exit the parking spaces at the same time) And his due payment amount and the time he parked the car will be displayed. After the payment is completed the gate in the exit will be opened and will be closed after the vehicle leaves the car park.

Since all of this is automated, everything will happen seamlessly, and it will help the user to reduce the time spent searching for parking spaces leading to quicker parking.

# Objective

## Goals

This system aims to replace traditional manual parking methods with an automated one, reducing the need for human intervention and offering a seamless parking experience.

1. **Automated Car Park Operation:** The primary goal is to fully automate the car park's operation, from entrance to exit, with minimal human intervention, improving efficiency and convenience.
2. **Real-time Parking Availability:** Implement a system that allows users to check in real-time whether parking spaces are available before entering the car park, reducing time spent searching for parking spots.
3. **Enhanced Security:** Ensure the security of the car park by using RFID cards to uniquely identify and track vehicles, reducing the risk of unauthorized access.
4. **Efficient Payment Processing:** Implement a payment system that accurately calculates parking fees and provides a seamless payment process for users upon exiting the car park.
5. **Reduced Operational Costs:** Achieve cost savings by reducing the need for manual labor in managing the car park, making it a more cost-effective and sustainable solution.

## Specific

* Implement RFID (Radio Frequency Identification) card-based vehicle identification and access control at the car park entrance.
* Install IR (Infrared IR Obstacle avoidance) sensors in each parking space to detect vehicle presence.
* Develop an Arduino-based control system for monitoring and managing parking spaces.
* Create a user interface for displaying parking fees, vehicle identification, and payment details at the exit.
* Ensure the system can distinguish between multiple vehicles exiting the parking spaces simultaneously using RFID cards.

## Measurable

* Achieve 100% RFID card-based vehicle identification and access control at the entrance.
* Ensure accurate detection of vehicle presence in parking spaces through IR sensors.
* Successfully implement the Arduino-based control system for managing parking spaces.
* Create a user-friendly interface that provides real-time parking fee information and payment details.
* Validate the system's capability to handle multiple vehicles exiting simultaneously.

## Achievable

* The implementation of RFID card-based access control and IR sensors is achievable within our available resources and budget.
* The development of the Arduino-based control system is feasible with the allocated technology and team capacity.
* Designing a user interface is attainable within the project's scope.

## Relevant

* The project's focus on automation aligns with the broader goal of improving efficiency and convenience for users.
* Enhancing parking management and reducing manual labor is relevant to providing a modern parking solution.

## Time Bound

* The emphasis is on ensuring that the tasks are accomplished in a timely manner, without the need for specific timeframes. This flexibility allows for adaptability to changing project conditions while still underscoring the importance of timely execution.
* The user interface and the overall system, while allowing us some freedom in setting the exact timing. It represents the intention to reduce delays and provide the technology to users as soon as possible. Develop and deploy the Arduino-based control system within a reasonable timeframe.
* RFID card-based access control and IR sensors should be implemented within a realistic and determined timeframe. These aspects should be put in place as soon as possible, allowing for flexibility while still emphasizing the need for timely execution.

By adhering to these SMART objectives, we aim to achieve a fully operational and efficient Arduino Smart Car Park System that provides a hassle-free and automated parking experience for users while reducing the need for manual intervention.

# Target Users

## Schools

Schools can have a special place for parking so that students and teachers can easily find a spot to park their cars. This helps them get to school on time and stop worrying about being late, especially when it is really busy during the school day.

Ex: - Government Schools.

Private Schools.

## Supermarkets

In supermarkets and shopping malls, there can be signs to show people so they can park their cars. This makes it easier for shoppers to find a parking spot. when shoppers do not have to find for parking, it makes their shopping tours more enjoyable. They might even stay longer because they are not worried about finding a location to park, which can improve the full shopping experience between.

Ex: - Keells.

Cargills.

Arpico.

## Hospitals

In hospitals, they make it easy for patients and people visiting patients to find a place to park their cars. This helps reduce their worries when they come for medical appointments or to see loved ones in the hospital. When you don't have to stress about finding a parking spot, it makes the whole experience at the hospital less scary and more comfortable.

Ex: - Government Hospitals.

Private Hospitals.

## Universities

In universities, they make certain that students and teachers can find a parking space suitable for them. This makes sure they do not have to face the difficulty of searching for parking, which can be a big issue. It helps them start their school day in a more relaxed way, therefore they can concentrate on their studies without any concerns about parking.

Ex: - Private Universities

## Office Buildings

In office buildings, they makes plans for workers and visitors to find parking spaces without trouble. This makes it easier to get to work or meetings. When you do not have to allocate a lot of time searching for parking space, it allows everyone to get to their destination on time. Therefore, people can be more on time, and that is good for business.

## Airports

At airports, they have a system to help travelers quickly find parking spaces for their cars. This makes the whole experience of starting or finishing a trip less stressful. When you don't have to worry about where to park, it helps you relax and enjoy your journey more. So, finding parking easily at the airport is a big relief for travelers.

Ex: - Bandaranaike International Airport.

Colombo International Airport, Ratmalana.

Mattala Rajapaksa International Airport.

## Residential Areas

In residential areas, people who live there get to enjoy parking that is easy to find and well-organized in their neighborhoods. It means they do not have to struggle to search for a spot to park after they get back home. It makes their lives easier and less stressful. Therefore, having a good parking selection in residential areas is a big advantage for the people living there.

Ex: - Hilton Residencies

## Hotels and Restaurants

In hotels and restaurants, they make sure that guests can easily find parking spots without any trouble. This makes the whole experience of visiting a hotel or restaurant much better. When you don't have to worry about where to park your car, you can enjoy your stay or meal without any stress. So, having smooth parking experiences at hotels and restaurants makes guests very happy and satisfied with their visit.

Ex: - Shangri-La

Hilton

## Stadiums and Events

At stadiums and events, they arrange things to help people that attend the events find parking without lots of traffic and stress. This makes it easier for everyone. When you can park your car without any trouble, it means you can have a better time at the event without worrying about being late or getting stuck in traffic. Therefore, having less crowded and stressful parking areas makes going to events more fun.

Ex: - Mahinda Rajapaksa International Stadium.

Pallekele International Cricket Stadium

## Public Transport Places

In areas where people take public transportation, they make sure there are places to park for passengers. This makes it simple for folks to leave their cars and start using buses, trains, or subways. It makes changing from driving to public transport very easy. When you can easily find a parking spot, it makes more people want to use public transportation, which can cut down on traffic and make everyone's daily travel simpler. So, having available parking at transportation centers is a big help for people who are travelling.

Ex: - Makubura transport hub

## Cities

In cities, they work on making parking in urban areas better organized. This helps the people who live in the city and those who come to visit. When parking is well-managed, it means there's less confusion and fewer cars driving all over searching for parking spots. This, in turn, reduces traffic jams and makes it easier for everyone to get around the city. So, improving parking management in cities benefits both the people who live there and those who visit by making transportation smoother and less crowded.

## Parking Garages

For people that use parking garages often, they can have a better and more convenient experience. This means they do not waste time searching for parking because they know they can go to the garage and easily search for a spot for their car. It is efficient because they can get in and out quickly, and it is convenient because they do not have to find parking on the street. Therefore, using parking garages makes life simpler and more effective for those who depend on them.

## Smart Cities

In a smart city, people who live there and those who visit enjoy the advantages of a well-organized system, which includes easy parking. It is like a big puzzle where all the pieces fit together, making it easy for everyone to get around. When parking is part of this system, it means less time finding a parking spot and less traffic. Therefore, being part of a smart city's plan c life smoother for the people in the city, whether they live there or are just visiting.

Ex: - Port City.

# Application Features

## Automated Entry and Exit System

An "Automated Entry and Exit System" for a car parking facility using RFID cards means that cars can come in and go out of the parking area without needing a human attendant. Here's a simplified breakdown:

### Automated Entry

* When a car arrives at the parking area, it doesn't need a person to open a gate or check a ticket.
* Instead, the driver can simply hold up an RFID card (like an electronic card) to a sensor or a reader.
* The system will recognize the RFID card and automatically open the gate to let the car in.

### Automated Exit

* When a car wants to leave the parking area, it's the same process.
* The driver shows the RFID card to a sensor or reader at the exit.
* The system recognizes the card and opens the gate to let the car out.

This system is more convenient and faster for drivers because they don't have to wait for an attendant or deal with tickets. It's also efficient for the parking facility because it reduces the need for human staff to manage entries and exit.

## Automated Entry & Exit System

A "Time-Based Payment System" is a way for customers to pay for parking based on how long they stay in the parking area. Here's a simple explanation:

### How it Works

* When you park your car, the system keeps track of when you entered.
* When you're ready to leave, the system calculates how much time you spent there.
* You pay for parking based on the time you used. If you stayed for 1 hour, you pay for 1 hour, and if you stayed for 2 hours, you pay for 2 hours.

### Payment Methods

*"Below payment methods may vary depending on the company's payment policies."*

* You can pay for parking in different ways, like using your credit card.
* Some systems also let you pay by scanning a QR code with your phone.
* So, you have options on how to pay that are convenient for you.

This system helps make sure you only pay for the time you use, which is fair.

It's also easy to use because you can choose how you want to pay.

## Real-Time Parking Space Availability

A "Real-Time Parking Space Availability" system is like a digital sign or a website that tells you how many parking spots are open right at that moment. Here's how it works:

### Digital Displays

* In the parking area, there are big digital screens like TVs.
* These screens show you how many parking spaces are empty. For example, it might say "10 spots available."
* Digital displays a map of the parking spaces, color-coded for availability (green for open, red for occupied). This visual map makes it easy to find open parking spaces in real-time, which is especially handy in large, crowded parking lots.

### Website

* You can also check this information on a website, maybe on your phone.
* The website will show you the same numbers, like "10 spots available."
* Website also a map of the parking spaces, color-coded for availability. This visual map makes it easy to find open parking spaces in real-time, which is especially handy in large, crowded parking lots.

### Benefits

* This helps you know if there's space to park before you even get to the parking area.
* It saves you time because you don't have to drive around looking for a spot.
* It's user-friendly because you can see the information on screens or online, making it easy to plan your visit.

## Payments

* We're setting up self-service machines at the parking area
* These machines will let you pay for parking using your card or by scanning a QR code with your phone.

## Data Analytics & Reporting

* Implement data analytics to gather insights on parking usage and generate reports for business optimization.

# Description

## Functionality

Here, the car park is automated. Drivers can see the available parking spaces through a screen, and they have the ability to park their vehicles at the most convenient and desired place. This will help the drivers to save time and avoid confusion that might occur during parking.

## Architecture

For this system, we use an Arduino board, different types of sensors, and a display. And through a display, it will output information such as the number of available parking spaces, and where is the available parking spaces.

## Components

The components that are used in the project are,

1. Node MCU Esp8266

* We decided to use esp8266 due to the low cost and built-in WI-FI.
* In the project, the esp8266 board will act as the brain of the parking system.

1. IR Infrared Obstacle Avoidance Sensor

* This sensor is used to detect if the car is nearby.

1. RFID Module

* The RFID Module will be used to scan the RFID cards that are provided to the driver.

1. Servo Motors

* The Servo Motors will be used to open and close the gates that are located in the entrance and the exit.

1. Display

* The display is used to output the information to the users.

## User Interface

We know that a UI is an essential part of any system. Therefore, the UI of our system has been developed in a more user-friendly manner. We have managed to make a user interface that is easier for the user to understand and work with without needing any additional knowledge. The information given to the user is shown through a display.

## Scalability

We have used a separate entrance and an exit to facilitate parking and to avoid congestion problems that might occur when multiple vehicles enter and exit at the same time.

Vehicles can enter the car park one at a time to avoid entering the car park when it is full.

The roads inside the car park have been designed so that the available spaces can be reached easily and quickly.

## Methodology

Each of these mentioned tasks is done by using agile methodology.

# Budget Report

## List of the Components

1. Node MCU esp8266 X 1
2. IR Infrared Obstacle Avoidance Sensor X 8
3. RFID Module X 2
4. RFID Cards
5. Servo Motors X 2
6. Jumper Wires set X 1
7. Display X 1

## Research Prices

1. Node MCU esp8266

=LKR 1250. 00

1. IR Infrared Obstacle Avoidance Sensor

= LKR 150 \* 8

= LKR 1200. 00

1. RFID Module

= 400 \* 2

=LKR 800. 00

1. RFID Cards

= LKR 85. 00

1. Jumper Wire Set

= LKR 365. 00

1. Display

= LKR 940. 00

TOTAL = LKR 4640. 00

# A screen shot of a computerGantt Chart