DESIGN AND DEVELOPMENT OF IoT-BASED PARKING MANAGEMENT SOLUTION USING ARDUINO AND ANDROID

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DESIGN AND DEVELOPMENT OF IoT-BASED PARKING MANAGEMENT SOLUTION USING ARDUINO AND ANDROID

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This Report is submitted in Partial Fulfillment of Requirements for the Bachelor Degree of Electronic Engineering (Wireless Communication) with Honours

Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
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To my beloved project supervisor, family and friends

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ABSTRACT

In the urbanization era, the globe is within reach via the introduction of transportation. Personal vehicles are one of the commonly seen land transportation used as daily commutes. Gradually, city is congested with vehicles and a large parking space is required. To avoid or reduce parking hassles, a smart guiding parking management system has been implemented to solve the overwhelming demands for parking. To ease user's driving experience, a mobile application has been developed to enable more tasks to be done with a single smart phone on hand.

Globalisation has caused pollutions on Earth and logging activity is getting out of control due to high demand of usage. In this project, the conventional ticketing system has been digitalised with the usage of smart phone. On another aspect, introduction of Internet of Things (IoT) has bring objects to live by interconnecting devices via the internet. People around the globe is literally connected through the internet. IoT technology has been implemented in this project to facilitates data exchange seamlessly.

In the development of the proposed project, a parking system has been developed. An Android application is developed using Android Studio Integrated Development Environment (IDE) and Arduino Mega is used as the brain of the hardware prototype coded using Arduino IDE. Both parts are then integrated via ThingSpeak cloud platform. At the end of this project, an Android application and

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hardware prototype are developed to visualize the project outcome. The effectiveness and robustness of the designed and implemented system is evaluated and validated.

With the flexibility of Android application, the proposed parking solution has been proven to be time-efficient and cost-effective with the features implemented. The application is able to substitute conventional parking ticketing system and payment through application can be done. The car park searching hassles have been reduced with parking allocation by the application and vehicles can be located through the application. The implementation of IoT is realised in this project, promoting real time data exchange.

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ABSTRAK

Pengenalan rangkaian lalu lintas telah berjaya menghubungkan seluruh dunia. Kenderaan peribadi merupakan salah satu pengangkutan yang lazim dijumpai setiap hari. Permintaan tempat letak kereta semakin meningkat dengan bilangan kereta yang kian menambah. Untuk menangani dan menyelesaikan masalah kekurangan tempat letak kereta, sistem pengurusan tempat letak kereta yang bijak telah dilaksanakan. Dalam usaha untuk mempertingkatkan pengalaman pemandu, aplikasi mudah alih telefon pintar telah direka untuk menyelesaikan tugas dan masalah.

Aktiviti pembalakan telah dijalankan tanpa had disebabkan oleh globalisasi. Dalam projek ini, sistem tiket tradisional telah didigitalkan dengan menggunakan telefon pintar. Sebaliknya, IoT telah diperkenalkan dan digunakan secara berleluasa. Melalui internet, peranti-peranti telah diberi nyawa dengan komunikasi data antara peranti-peranti malah manusia di seluruh dunia juga dapat berhubung melalui Internet. Teknologi IoT telah dilaksanakan dalam projek ini untuk memperlancarkan pertukaran data.

Dalam pembangunan projek yang dicadangkan, sistem tempat letak kereta aplikasi android telah dibangunkan menggunakan Android Studio IDE, perkakasan prototaip telah dibangunkan dengan Arduino IDE dimana Arduino Mega sebagai pengawalan utama. Kemudian kedua-dua bahagian telah diintegrasikan dengan platform awan ThingSpeak. Pada akhir projek ini, prototaip perkakasa dan perisian

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Android telah dibangunkan, untuk menggambarkan hasil projek. Keberkesanan dan keteguhan reka bentuk sistem dan pelaksanaan telah dinilai dan disahkan.

Dengan fleksibiliti aplikasi Android, ia adalah disyorkan penyelesaian letak kenderaan telah terbukti berfungsi dengan pelaksanaan masa yang cekap dan berkos efektif. Telefon pintar boleh menggantikan sistem tiket letak kereta konvensional, dan juga boleh membayar yuran letak kereta melalui telefon pintar. Masa diperlukan untuk mencari tempat letak kereta telah dikurangkan dengan fungsi peruntukan tempat letak kereta oleh aplikasi tambahan pula kenderaan boleh dikesan melalui aplikasi. Konsep IoT telah direalisasi dan objektif projek telah dicapai.

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LIST OF ABBREVIATIONS

API	-	Application Programming Interface
GPS	-	Global Position System
GUI	-	Graphic User Interface
IDE	-	Integrated Development Environment
IoT	-	Internet of Things
IRLED	-	Infrared Light Emitting Diode
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
M2M	-	Machine-to-Machine
NFC	-	Near Field Communication
PWM	-	Pulse Width Modulation
QR	-	Quick Response
RTC	-	Real Time Clock
UI	-	User Interface
UTeM	-	University of Technical Malaysia Malacca

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CHAPTER I

INTRODUCTION

1.1 Background

The ideal of creating a Smart City is now becoming possible with the emergence of the Internet of Things. One of the key issues that smart cities relate to are car parking facilities and traffic management systems. In present day cities finding an available parking spot is always difficult for drivers, and it tends to become harder with ever increasing number of private car users.

The use of private vehicle as daily commute has been increasing massively. Statistic shows a leap in the percentage of Malaysian households owning cars from 77.8% to 83.9% between 2012 and 2014 [1]. This had thus contributing Malaysia being the third highest rate of car ownership in the world, according to Nielsen [2], a global information and measurement company. While owning a car seems to be a status symbol in Malaysia, every driver encounters the same struggle which is the lack of parking space. The provided car park facilities do not cater the overwhelming demand

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and lead to social consequences like double parking or cars stop at shoulder of the road causing more traffic incidents. This scenario is no exception for shopping mall parking.

Shopping mall management has been expanding their car park to cater this overwhelming demand but is never sufficient to fit all needs. Shopping mall management has then embedded LED sensor on each car park lot to reduce time spend by users circling looking for an empty slot with Green LED representing an empty slot while Red LED for an occupied slot. However, it is not efficient to ease user driving experience as driver will need to look at the indicators row by row, not to mention when others take over your intended car park space. Some of the recent IoT utilization is by allowing car park slot booking feature via an application where users can reserve themselves an exclusive parking space in advance without even being in the car park parameter. In the recently renowned parking application known as “Park Easy”, this application does include all the crucial features that are effective and time saving.

Moreover, the existing car park management systems do not digitalize the parking tickets, which is less likely to be environment friendly. In 2011, Chicago alone recorded 33.1 million meter receipts and about 54.5 tonnes of waste [3]. Therefore, in some cases NFC function of smart phone is used to substitute parking ticket.

This is where this proposed project kicks in, the implementation of this system will be time-efficient optimizes to search for an exclusive car park spot leading to cost-effective as less time is required and not worry about where the vehicle is parked as the proposed application will remember the location.

1.2 Problem Statement

Parking facilities in crowded areas are typically troublesome for commoners of vehicles’ users. Various parking solutions have been implemented to solve the overwhelming demand for car park. One of the common solution is car park slot reservation. However, issues have been brought up with the car park slot booking in

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existing parking management system when people started to abuse this feature. People who were not intending to park would simply book up the entire day, leaving an inefficient, empty, car park. To improve this, there is a need to create specific guided parking system with smart management based on car counts. In this proposed project, parking allocation to the nearest entry will be used when user enters the car park to substitute car park reservation to avoid any parking abusing. Besides, this application will be able to remember where you have parked your vehicle, avoiding the vehicle searching race in car park.

The renowned parking application, "Park Easy" works in a way where parker requests for parking on the spot and wait for a moment while the application match the parker with a leaver. There is a contradict when there is no leaver at that particular moment. This application requires communication from both sides which place this application at disadvantage. Therefore, in this project it works in a way that user can simply checks parking availability or condition of the car park via an application.

Manual ticketing system with parking ticket collection requires user to pay at kiosk which is not efficient. Some of the recent researches use NFC to substitute ticketing system and to pay parking fee. Nevertheless, one of the major issue of this implementation is not all phone comes with NFC technology. QR code will be used in this project to replace this technology as any android phone with camera will be able to enjoy this convenience. The parking payment method will be maintained in this project.

1.3 Objectives

- To design and develop a time-efficient smart guiding parking management system which able to allocate best vacant spot and to locate user's vehicle using Android application;

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- To display parking availability on Android application by implementing IoT platform that facilitates data exchange seamlessly;

- To digitalize manual ticketing system and implement automated parking payment method using Android application.

1.4 Scope of Project

Hardware

- Arduino Mega will integrate with 1.8" TFT LCD, Chronodot Real Time Clock, IRLED Sensors, Servo Motors and ESP-8266 WiFi Module.
- LCD will display QR code with encoded present time. The LCD screen will update in real time every ten seconds.
- Chronodot Real Time Clock will provide real time to the Arduino Mega.
- IRLED Sensors will be embedded on each car park slot to check its availability.
- Servo Motors as the entrance gate and exit gate.
- WiFi Module will enable Arduino Mega to send data into the Cloud via internet access.

Software

- Android Studio IDE (Integrated Development Environment)
  - to scan and decode QR code
  - to log user's entry time and exit time on the application.
  - to save the parking location in the application.
  - to display car park availability, car park layout and guide user to the car park slot.
  - to calculate parking duration and parking fee.

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