DEVELOPMENT OF E-BECA MONITORING SYSTEM USING WEB-BASED APPLICATION

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DEVELOPMENT OF E-BECA MONITORING SYSTEM USING WEB-BASED APPLICATION

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A report submitted
in partial fulfillment of the requirements for the degree of
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DECLARATION

I declare that this thesis entitled "DEVELOPMENT OF E-BECA MONITORING SYSTEM USING WEB-BASED APPLICATION" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

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Supervisor Name : .....

Date : .....

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DEDICATIONS

To my beloved mother and father

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ABSTRACT

E-Beca is a solar powered electrical trishaw which is introduced to promote tourism in Malaysia due to its significant identity as a conventional transportation system especially in the state of Malacca. E-Beca is also an innovative product built by a research team from Universiti Teknikal Malaysia Melaka (UTeM) for the purpose of introducing education tourism system in UTeM. In order to assure the safety of user and asset which is the e-Beca, a web-based application monitoring system is proposed to track the real-time location of e-Beca. A smart phone with inbuilt sensors is selected as the tracking device for the project and several software like "XAMPP" and "Notepad ++" are used to develop the web-based application. Programming languages like HTML, CSS, JavaScript and PHP are used to develop the user interface and functionality of the web pages. Besides, an additional development for a mobile application control system is introduced to control the switching of LED and buzzer using Arduino UNO as the microcontroller by assuming LED is the power supply and buzzer is the alarm system of e-Beca. Total of ten experiments are conducted by collecting latitude and longitude coordinates and instantaneous time displayed on both the application and monitoring system in order to determine the performance and reliability of the system in terms of location tracking accuracy and data communication efficiency. Eventually, the e-Beca web-based monitoring system has been developed to provide all the required functionalities to administrator and user of the system. Based on the requirements needed for the monitoring system, administrator is able to track the real-time location of the smart phone which is represented as the target unit while the smart phone user is able to see their real-time location, time left for the ride, e-Beca advertising video as well as making phone call to the host system. Throughout a series of experiments, a mean distance error of 7.12 meter between the actual and displayed coordinate is obtained as a result of location tracking accuracy. Then, a mean time difference of 0.572 seconds is obtained as the time latency of displaying real-time locations for the e-Beca monitoring system. Lastly, the development of mobile application control system is proven to be reliable and stable by switching the LED and buzzer ON and OFF successfully for ten times using an open source mobile application.

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ABSTRAK

E-Beca adalah beca elektrik berkuasa suria yang diperkenalkan untuk mempromosikan pelancongan di Malaysia disebabkan identitinya sebagai sistem pengangkutan konvensional di negeri Melaka. E-Beca juga merupakan produk inovatif yang dibina oleh pasukan penyelidikan dari Universiti Teknikal Malaysia Melaka (UTeM) bagi tujuan memperkenalkan sistem pelancongan pendidikan di UTeM. Untuk memastikan keselamatan pengguna dan aset iaitu e-Beca, sistem pemantauan berasaskan aplikasi laman web dicadangkan untuk mengesan lokasi masa nyata e-Beca. Telefon pintar dengan sensor terbina dipilih sebagai alat penjejakan untuk projek ini dan beberapa program komputer seperti "XAMPP" dan "Notepad ++" digunakan untuk membangunkan aplikasi web. Bahasa pengaturcaraan seperti HTML, CSS, JavaScript dan PHP digunakan untuk membangunkan fungsi laman web. Selain itu, pembangunan tambahan untuk sistem kawalan aplikasi mudah alih diperkenalkan untuk mengawal pembukaan LED dan buzzer menggunakan Arduino UNO sebagai mikrokontroler dengan menganggap LED adalah bekalan kuasa dan buzzer adalah sistem penggera e-Beca. Sebanyak 10 percubaan dijalankan dengan mengumpul koordinat latitud dan longitud dan masa serta merta yang dipaparkan pada kedua-dua aplikasi dan sistem pemantauan untuk menentukan prestasi dan kebolehpercayaan sistem dari segi ketepatan pengesanan lokasi dan kecekapan komunikasi data. Akhirnya, sistem pemantauan berasaskan web e-Beca telah dibangunkan dengan mengandungi fungsi-fungsi yang diperlukan untuk pentadbir dan pengguna sistem. Berdasarkan keperluan sistem pemantauan, pentadbir dapat mengesan lokasi masa nyata telefon pintar yang dikenali sebagai sasaran sementara pengguna telefon pintar dapat melihat lokasi masa nyata mereka, masa tinggal untuk menggunakan e-Beca, video pengiklanan e-Beca serta membuat panggilan telefon ke sistem kawalan. Selepas percubaan telah dijalankan, kesilapan jarak purata sebanyak 7.12 meter antara koordinat sebenar dengan koordinat yang dipaparkan telah diperolehi sebagai ketepatan pengesanan lokasi. Kemudian, perbezaan masa purata sebanyak 0.572 saat telah diperolehi sebagai tempoh latensi untuk memaparkan lokasi masa sebenar. Akhir sekali, pembangunan sistem kawalan aplikasi mudah alih terbukti dapat dipercayai dan stabil dengan berjaya membuka dan menutup LED dan buzzer sebanyak sepuluh kali dengan menggunakan aplikasi mudah alih sumber terbuka.

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LIST OF SYMBOLS AND ABBREVIATIONS

UTeM	-	Universiti Teknikal Malaysia Melaka
LED	-	Light Emitting Diode
TV	-	Television
UI	-	User Interface
SEMS	-	Smart E-bike Monitoring System
GPS	-	Global Positioning System
HTML	-	HyperText Markup Language
CSS	-	Cascading Style Sheets
PHP	-	PHP: Hypertext Preprocessor
E-Bikes	-	Electric Bicycles
AC	-	Alternating Current
DC	-	Direct Current
GNSS	-	Global Navigation Satellite System
API	-	Application Programming Interface
URL	-	Uniform Resource Locator
m	-	Meter
ms	-	Millisecond

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CHAPTER 1

INTRODUCTION

1.1 Overview

Few subtopics including project background, motivation, problem statement, objective and scope of the project are covered in Chapter 1 of this report. Introduction of project background and related work to e-Beca are discussed to show the importance and reasons in developing the monitoring system for e-Beca. Besides, limitations of the project are discussed in this chapter as well.

1.2 Project Background

E-Beca, also known as electrical trishaw, was introduced and launched by a research team from Universiti Teknikal Malaysia Melaka (UTeM) in year 2016. The organization chart of the research team for the development of e-Beca is shown in Figure 1.1 as below.

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Figure 1.1: Organisation chart of e-Beca research team.

E-Beca is built and equipped with plenty of modern technologies such as implementing a green technology by using solar energy as the power source for the electrical trishaw. Green technology is the development and application of products, equipment and systems used to conserve the natural environment and resources, which minimize and reduces the negative impact of human activities [1]. The overall structure and components of e-Beca consist of a main control system with several control switches for the hardware system, a solar system which is used to drive the high power electric motor, a LED TV acts as digital advertising board, an electric fan for cooling purpose, LED lamps as decoration, light and firm framework made of steel and aluminium composite as well as the aluminium rims installed on the trishaw. Therefore, e-Beca has a great capability in promoting the aspect of tourism in Malacca as well as introducing the education tourism system in UTeM since a solar powered electrical trishaw can be known as an upgraded version of the conventional trishaw which plays an important role in representing one of the significant identity of Malacca. An example of the end product of e-Beca is shown as below in Figure 1.2.

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Figure 1.2: E-Beca.

Besides, e-Beca is an innovative project launched by UTeM for the purpose of upgrading the conventional trishaw to an advanced electrical trishaw by integrating modern technologies with the contribution of a research team in UTeM. Apart from that, this project is also aimed to improve the lifestyles of conventional trishaw riders and to trigger tourism economic by attracting more tourists and offering more job opportunities for trishaw riders at the same time. The World Travel & Tourism Council states that Travel & Tourism is an important economic activity in most countries around the world. As well as its direct economic impact, the industry has significant indirect and induced impacts [2].

1.3 Motivation

The e-Beca research project is similar to the existing e-bikes system which has been rapidly becoming mainstream in European countries with developed cycling cultures, appealing to both existing and new cyclists [3]. Therefore, with the existing hardware developed for the e-Beca, it requires a development of the monitoring system which is also known as a software-based system to work as a platform to track and to

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communicate with the users or riders on e-Beca. Figure 1.3 below shows an example of simple user interface (UI) of the real-time location tracking system for the smart e-bike monitoring system (SEMS).

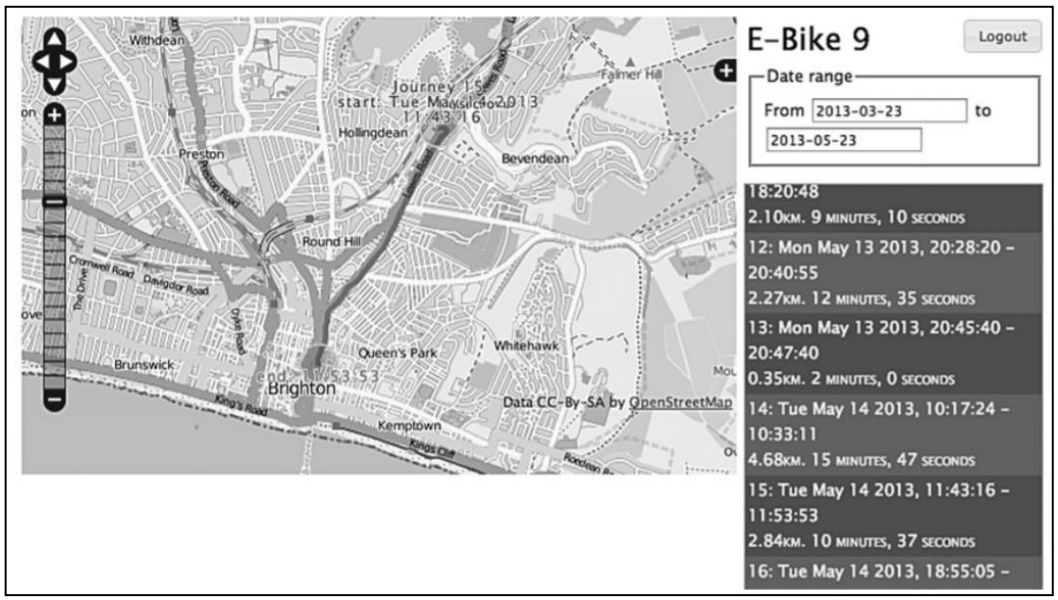

Figure 1.3: Online interface of SEMS [4].

Based on Figure 1.3 shown above, participants or users of e-bikes can view their own ride data via an online interface with secure login system. It is user friendly since the fundamental monitoring system is well developed and it has all the basic functions it needs for both administrator and user of the system.

In order to promote education tourism in UTeM by introducing the e-Beca system, a monitoring system is essential to be developed for e-Beca which is important to monitor and to secure the assets from being damaged or being used inappropriately by using a web-based platform where it can be utilised anywhere as long as there is internet connection for both administrator and user of the system.

1.4 Problem Statement

In order to provide a complete system for the existing e-Beca in UTeM, it is mandatory to develop a software-based monitoring system for e-Beca since there is no existing monitoring system being developed to track and to communicate with e-Beca yet.

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Besides, e-Beca can be easily rode away from the dedicated route or path within the travelling area without a monitoring system for the e-Beca. A web-based application of monitoring system is used to limit the travelling area of users of e-Beca in order to ensure a safe and comfortable environment for the users.

Next, users of e-Beca might exceed the time given for each ride without an appropriate control system to indicate the limited time for each ride of the journey so that the resource management system of e-Beca can be provided.

1.5 Objective

1. To design an e-Beca monitoring system for location tracking purpose.

2. To develop a web-based monitoring system and application to track the real-time location of e-Beca.

3. To analyse the performance of e-Beca web-based monitoring system and application in terms of location accuracy and data communication efficiency.

1.6 Scope

1. The monitoring system is developed as a web-based application.

2. Only a laptop and an Android-based Samsung Galaxy S6 Edge Plus (with built-in Wi-Fi connectivity, GPS, clock, gyroscope, accelerometer, and magnetometer) are used to develop the system.

3. Software like XAMPP and Notepad ++ are used to develop the web-based application of e-Beca monitoring system.

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4. Programming languages like HTML, CSS, PHP and JavaScript are utilised in the development of the system.

5. Several functions such as tracking location, calling function, restricting time of each ride and displaying video will be developed for the web-based application.

6. Experiment to track the real-time location of e-Beca will be carried out within the area in UTeM.

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CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This chapter discusses about the definitions and theoretical background of the main elements covered in this project such as electric bicycles, monitoring system and web-based application. Plenty of previous related studies done by other researchers are taken as references for the development of e-Beca monitoring system.

2.2 Electric Bicycles (E-Bikes)

The concept of constructing an e-Beca is similar to the concept of electric bicycles (also known as e-bikes) but different in overall structure. Therefore, references of the e-bikes development can be taken into consideration with respect to the development of e-Beca.

Nowadays, energy crisis is one of the major concerns due to fast depleting resources of petrol, diesel and natural gas. Thus, an alternating mode of transport like e-bike is needed to encounter the problem of increasing consumption of natural resources caused by fuel-based vehicles. E-bike is a bicycle which is driven with the help of battery that is coupled to electric motor. It works on the principle that the electromotive force of an A.C. motor which receives electrical energy stored in D.C. battery is converted with the help of D.C. to A.C. converter. The solar panels can be alternative source for this by adding it to the system [5]. E-bike system contains plenty advantages such as lower purchase and operating costs compared to conventional vehicles like cars, ability to travel with less physical effort compared to traditional bicycles, and zero emissions during operation. Thus, e-bike adoption has been accelerating widely and globally, with over 200 million being used in China alone [6]. Moreover, in year 2015, 28 percent of all bicycle sales in the Netherlands were e-bikes

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[7]. Specifications of e-bikes used in different countries are shown in the following Table 2.1.

Table 2.1: Specifications of e-bikes in various countries [5].

Country	**Type of Bike**	**Speed Limit (km/h)**	**Motor output power (Watt)**
Australia	Pedal	25	250
Canada	Hand	32	500
China	Pedal/Hand	30	200
Norway	Pedal	25	250
Israel	Pedal	25	250
United Kingdom	Hand	27	250
Taiwan	Hand	25	200
United States of America	Hand	25	750
China	Pedal/Hand	30	500

On the other hand, another type of e-bike which is known as hybrid powered electric bicycle is introduced to improve the performance of an ordinary e-bike in terms of power consumption and environmental friendly. The hybrid powered electric bicycle is a system that involves three different ways of charging a battery such as solar power, Dynamo and 220V Ac wall charge. Such idea is to make the bicycle last longer and can be automatically recharge by renewable solar energy when the bicycle is not in use. The implementation of solar energy is that a high torque motor will be put on the bicycle which will be generated by the solar energy which is absorbed and stored by the portable solar panel. The power that had been absorbed by the panel can be used directly by the motor if the power matches the power requirement. Otherwise, the motor will use the power supplied from a battery. This system is believed to make

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the existing e-bikes to operate more efficiently [8]. A block diagram which illustrates the working principle of a hybrid powered e-bike is shown in Figure 2.1 as below.

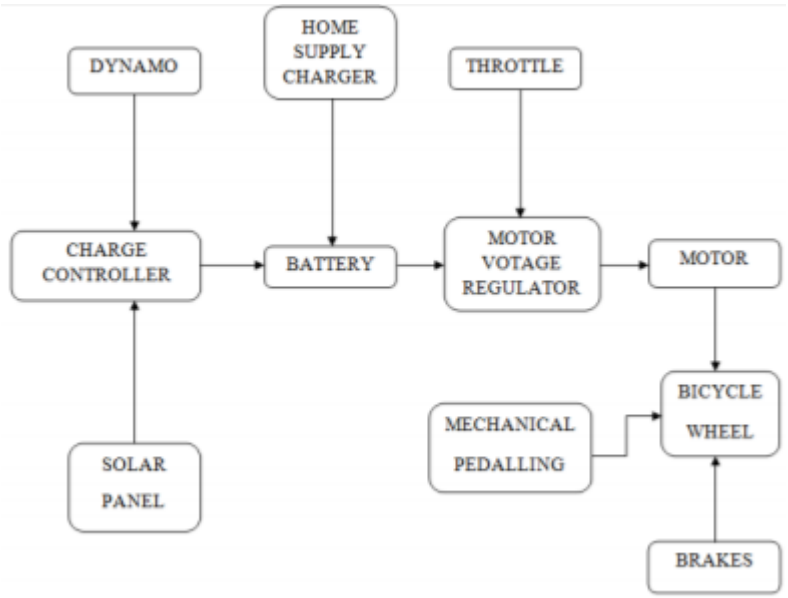

Figure 2.1: Block diagram of hybrid powered e-bike [8].

Since a hybrid powered e-bike uses solar panel as the component to absorb solar energy to generate power, it is similar to the e-Beca which is also using renewable solar energy to drive the motor on the trishaw. A comparison of various parameters between hybrid powered e-bike, e-bike and ordinary bicycle is shown in Table 2.2 below.

Table 2.2: Comparison between hybrid powered e-bike, e-bike and ordinary bicycle [8].

Parameter	Hybrid Powered E-bike	E-bike	Ordinary Bicycle
Max speed limit (km/h)	10-15	25-30	5-10
Drivers pedaling requirement	Optional	No	Yes
Initial unit cost in Rupees	8000	30000	4000
Weight in kg	25	50	15

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