UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF CROSSWIND DETECTION FOR DIRECTION AND SPEED MONITORING SYSTEM AT HIGHWAY USING ANDROID APP

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Electronics Engineering Technology (Industrial Electronics) (Hons.)

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Industrial Electronic) (Hons.). The member of the supervisory is as follow:

Signature	:	…….
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ABSTRAK

Istilah angin lintang bermaksud angin mendatar yang bertiup 90 darjah dari arah perjalanan dengan kelajuan 12.5 batu per saat. Angin lintang boleh membawa masalah apabila melalui jalan basah atau licin terutama ketika hujan lebat dan ribut petir. Ianya boleh menyebabkan kenderaan terbalik ketika melintasi kawasan angin lintang. Stokin angin yang tidak dapat dilihat pada waktu malam boleh menyebabkan bahaya kepada pengguna jalan raya. Masalah ini boleh meningkatkan risiko terlibat dalam kemalangan. Untuk mengatasi masalah ini, pengesanan angin lintang untuk pantau kelajuan dan arah angin di lebuh raya telah diperkenalkan dalam projek sarjana muda saya. Isyarat dari sensor kelajuan dah arah angin akan diproses oleh mikropengawal dan dihantar ke Blynk. Blynk adalah perisian atau aplikasi yang membolehkan pengguna mengawal peranti mikropengawal dari telefon pintar atau tablet. Keluaran dari mikropengawal akan dihantar ke skrin LCD untuk memaparkan maklumat terkini angin lintang dan memberi amaran kepada pengguna jalan raya. Lampu LED akan menunjukkan status angin lintang. Mikropengawal akan mengemaskini data ke Blynk melalui Wi-Fi. Data yang disimpan dalam Blynk akan diakses oleh aplikasi Blynk. Pengguna boleh mendapatkan maklumat semasa tentang keadaan angin menggunakan aplikasi Blynk. Sebagai kesimpulan, projek ini sangat berguna kerana ia akan membolehkan pengguna jalan raya mengetahui bahaya angin lintang. Projek ini dijangka dapat mengurangkan kemalangan di kalangan pengguna jalan raya di kawasan angin lintang. Objektif projek pengesanan angin lintang untuk sistem pemantauan arah dan kelajuan telah berjaya dicapai.

ABSTRACT

The term crosswinds are mean the horizontal winds blowing at 90 degrees from the direction of travels with the speed of 12.5 miles per second. Crosswind could make a trouble when traveling on wet or slippery roads, especially during heavy rain and thunderstorms. It can make the vehicle overturning when crosswind blows through it. Windsock invisible at night can cause danger to highway users. This problem can increase the risk of being involved in the accident. To overcome this problem, the crosswind detection for direction and speed monitoring system at highway is being introduced in my final year project. The signal from speed and direction sensor will be processed by microcontroller and transmitted to the Blynk cloud. Blynk is a software or app allows a user to control microcontroller devices from a smartphone or tablet. The outputs from the microcontroller will be transmitted to the LCD screen to display the current information of crosswind and give the warning to the road users. LED light will indicate the status of the crosswind. The microcontroller will update the data to the Blynk cloud through Wi-Fi. Data stored in the Blynk cloud will be accessed by Blynk App. Users can get information about wind condition using the Blynk App. As a conclusion, this project is very useful as it will enable the road users to be aware on danger of crosswind. This project is expected to reduce an accident among the road users at crosswind area. The objectives of the project crosswind detection for direction and speed monitoring system has been successfully achieved.

DEDICATION

Special dedicated to my my beloved parents, Zakaria bin Mamat and Tuan Pahsura binti Tuan Daud, my supervisor Mr. Shahrizal bin Saat and friends for giving me strength, ideas, strong and knowledge that helps me to finish this project.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

PLUS	-	Projek Lebuhraya Utara Selatan
ECE	-	East Coast Expressway
LPT	-	Lebuhraya Pantai Timur
Mph	-	Miles per hour
km/h	-	Kilometers per hour
IoT	-	Internet of Thing
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
IC	-	Integrated Circuit
PC	-	Personal Computer
NSE	-	North-South Expressway
HDV	-	Heavy Duty Vehicles
FPGA	-	Field Programmable Gate Array
UART	-	Universal Asynchronous Receiver/Transmitter
EEPROM	-	Electrically Erasable Programmable Read Only Memory
PWM	-	Pulse Width Modulation
GPIO	-	General-Purpose Input/Output
BLE	-	Bluetooth Low Energy
IDE	-	Integrated Development Environment
OS	-	Operating System
GUI	-	Graphical User Interface
IDE	-	Integrated Development Environment

CHAPTER 1
INTRODUCTION

1.1 Introduction

Chapter 1 will briefly discuss and explain about the background of the crosswind detection for direction and speed monitoring system at the highway. In certain areas, especially on the highway, there are a few spots of crosswind that may cause danger to the road users. There is a less awareness about the harmful crosswind in the community. They only put the notice board of crosswind area, the signboard of reducing the speed limit and used the conventional windsock as a manual crosswind indication as for the road user reference. This is important to produce a smart device which can help and alert the road users when the crosswind present. This also can prevent an accident in the crosswind area on the highway. Other than that, this part also discusses the problem statement, project objectives, project scopes and the thesis organization of the project.

1.2 Background

Malaysia has presented the North-South Expressway (PLUS) project across the country from the North-South. Then, the highways are introduced to shorten travel times and make it easier for users to repeat from anyplace. There is three crosswinds area, Senawang-Pedas / Linggi, on the North-South Expressway, Alor Gajah - Ayer Keroh on the North-South Expressway and the East Coast Expressway. East Coast Expressway, ECE or (LPT) is also a highway in Malaysia gives connection from the West Coast of Peninsular Malaysia to the East Coast of Peninsular Malaysia. This highway through three states in the peninsula is Selangor, Pahang, and Terengganu. It

provides quicker alternatives to the old Kuala Lumpur-Kuantan Road FT2 and the Jerangau-Jabor FT14 Highway. Thus, it can decrease the travel time between different town and cities.

The uses of conventional windsocks are no longer effective in preventing accidents. Therefore, this project is proposed to develop the mobile device needed for wind detectors to protect vehicles traveling across highways across the cross by using IoT technology. Speed sensors and direction sensors are used to measure wind speed and wind direction. This system is able to provide awareness to highway users in crosswind areas with LCD screens showing the current speed and direction of crosswind. Road users can also get update on wind conditions using Android App.

1.3 Problem Statement

Unpredictable weather can bring danger to road users especially in the crosswind area. Therefore, road users need devices that can monitor current crosswind speed and direction to avoid accidents. This is important for all road users to adjust their vehicle speed according to the current situation in a way to avoid overturning and side slips that may cause an accident. Then, the crosswind sign is not enough to warn road users and windsock colors that are too faded can cause harm to road users. Another problem is the windsock invisible at night can cause danger to highway users. This problem can increase the risk of being involved in the accident.

1.4 Objectives

The objectives of this project are to:

i. To develop a crosswind detector for direction and speed monitoring system by using Blynk App.
ii. To analyse the speed and direction of crosswind.

1.5 Project scope

The scope of this study involves the study of characteristics for crosswind and the area of the crosswind at highways in Malaysia.

i. Software: This system used the Arduino Software to develop the Arduino Mega 2560. Arduino software is used to provide the program for the whole operation of the system. Blynk cloud is used as a data storage that can be accessed by the Blynk apps.
ii. Hardware: This project developed the system by using the Arduino Mega 2560. Arduino Mega 2560 is the medium platform for transmitting signals from software to prototype. ESP8266 Wi-Fi module is used because the range is wide. Arduino Mega 2560 will connect to the prototype and transmitted the signal to the Blynk cloud. ESP8266 Wi-Fi module is used to communicate between Arduino and Blynk cloud. Then, the crosswind information is transmitted to the LCD display and Android App.
iii. Prototype: The anemometer is a speed sensor that used to measure the speed of crosswind. The anemometer counts the number of rotations which is used to calculate wind speed. The wind direction sensor is used to measure the direction of the crosswind.

1.6 Thesis organization

This thesis contains five chapters. Firstly, Chapter 1 is the important aspects of this report which is project introduction. This chapter included an introduction, objectives, problem statements, work scopes and thesis organization of the project.

Chapter 2 discusses the literature reviews of the previous project that related to the application of this project. The hardware and software used will be discussed in detail in this chapter.

Chapter 3 discusses the method that is used to design a prototype device that can measure the speed and direction of crosswind. The flowchart for all progress, software development and hardware development were discussed in this chapter.

Then, Chapter 4 shows the results and discussions of the project. The results and pictures of each part are shown in this chapter. Data will be analyzed based on the results obtained from the entire project being carried out.

Chapter 5 concludes the overall progress from beginning until the end as well as the recommendation for project improvements.

Lastly, the references and appendixes are attached at the end of this report.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This chapter discusses the research project and theory for the development of crosswind detection for direction and speed monitoring system at the highway. This chapter includes an overview of the previous project and the hardware and software that used in this project.

2.2 Crosswind

2.2.1 Definition

One of the natural disasters that frequently happened in Malaysia is crosswinds. The term crosswinds are mean the horizontal winds blowing at 90 degrees from the direction of travels with the speed of 12.5 miles per second. Malaysia often has high crosswind at a highway, which gives impact to high-profile vehicles especially at North-South highway that is stretching from the border of Thailand in the North to the border of Singapore in the South. Crosswinds can be separated into two components, a crosswind component and a headwind or tailwind component. (Haslinda and Abas, 1998).

2.2.2 Occurrence

Crosswind could make a trouble when traveling on wet or slippery roads especially during heavy rain even in typical weather. Then, the crosswind is the most dangerous wind because it blows from the side of vehicles and gives a huge impact on a vehicle. Crosswind has a significant factor which is its forces and torque will affect the stability of vehicle. Accidents will happen when the crosswinds blow perpendicularly to the vehicles (Afedatul, 2015).

2.2.3 Impact

The impact of the crosswind is one of the most critical issues associated with the safety and stability of vehicles. The crosswind will make the driver execute steering action to stay on the track at the low to medium wind speed. The high lateral forces and high yaw-torque will act on the vehicle when pass other vehicles. The lateral force from the crosswind may lead the driver to an over-correcting in steering-action. So, it can make the vehicle overturning when crosswind blows through it. Moreover, combined vehicle movement and horizontal wind action, it creates a complex and unstable flow field around the vehicle, which determines on its a series of varying strengths and aerodynamics moments. Load interactions with vehicles dynamics can cause different stability problems and in severe cases, even determine the accident or vehicles reversal, thereby affecting the safety of drivers and passengers.

2.3 Malaysian Highway

North-South Expressway was officially established in 1994. Malaysia was introduced North-South Expressway project (PLUS) across the country from North-South. The NSE is the longest expressway in Malaysia with the total length of 772 kilometers running from Bukit Kayu Hitam in Kedah near the Malaysia-Thai border to Johor Bahru at the southern portion of Peninsular Malaysia. Then, the expressway connects many major cities and towns in west of Peninsular Malaysia, acting as the 'backbone' of the west coast of the peninsula. It provides a faster alternative to the old federal route, thereby reducing travel time between various towns and cities. There is three highlighted crosswind area on the North-South Highway which is Senawang-Pedas/Linggi on North-South Expressway Southern Route**,** Alor Gajah – Ayer Keroh on North-South Expressway Southern Route and East Coast Expressway. Figure 2.1 shows The North-South Expressway (NSE).

Figure 2.1: The North-South Expressway (NSE)

2.4 Overview of Previous Project

2.4.1 Wind Speed Detection System: Framework and Implementation

(Nasir et al. 2016) are proposed the Wind Speed Detection System for this project. The aim of this project is to monitor and measure the wind speed at the high-risk crosswind area on the highway in order to provide information to the vehicles and motorists of crosswind conditions. The system measured the wind speed level and alert the motorists and vehicles with warning lamp or light according to the crosswind conditions. The components requirement for developing this system are a wind speed sensor, a microcontroller, MAX 232 IC and a laptop. Firstly, the wind speed sensor will detect the wind speed at the high-risk area. Then, the microcontroller will transmit the data from the wind speed sensor to the laptop. Before that, the data need to be converted by MAX 232 IC converter before it can be sent to the receiver. After the receiver received the data, it will display the result of the wind speed level and will be turned on the warning light or message when severe crosswinds are detected.

2.4.2 Design and construction of microcontroller based on wind speed and direction monitoring system

(Babu et al. 2014) have established that a microcontroller is used to design a portable device to measure wind speed and direction monitoring system. This project used an infra-red light-emitting diode (LED) as a transmitter and a photodiode as an infra-red receiver. The system is developed to know the most common wind direction such as south, east, north, west, northwest, northeast, southwest, southeast and others. These types of optical sensors are given more accurate result than the half-effect sensor. The system showed the angle of the wind at the crosswind areas. To display the speed and the wind direction angle, an LCD has been used for giving awareness to the