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Traffic Flow Control System for Construction Site

Muhammad Helmey Muhammad[1], Rosnah Mohd Zin[1]*

[1]Faculty of Electrical and Electronic Engineering,
Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, MALAYSIA

*Corresponding Author Designation

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Abstract: The project is a system that can control traffic congestion when there is construction of a building near a road that involves a two-way street becoming one-way using traffic lights that can be controlled via a smartphone. This project was proposed to facilitate site-related works, it was easier to control traffic without requiring more manpower, in addition, this system also has 3 modes that allow traffic lights to operate according to traffic congestion. This project has two stages of design namely hardware and software. The hardware uses microcontroller ESP8266 Wi-fi module and an IR sensor Module, while the software is a Blynk app that can be controlled via a smartphone. The position and orientation of the traffic flow control system can be achieved using vehicle movement through three specially created modes. The system trial was carried out in three modes, which are mode 1 representing normal traffic, mode 2 representing a busier traffic and mode 3 representing vehicles entering and exiting the construction site. All the results show that the system can work well with accurately.

Keywords: Control System, Blynk Application, Sensor

1. Introduction

Congestion in urban places, including Malaysia, was major issue that has to be addressed. The operational efficiency of the transportation system and its safety and security may both benefit from the use of intelligent transport systems (ITS) [1]. The conventional method of controlling traffic lights has a major flaw in that the control period is always the same, regardless of the actual traffic circumstances at any given moment. The periods at which the lights will be green, red, and yellow at certain junctions are permanently established. Because of this flaw, sensible approaches to easing traffic congestion are not implemented [2].

Since this time is crucial, an intelligent signal traffic management system must be created to guarantee it and priorities certain lanes based on actual traffic circumstances. Through better management and increased road usage efficiency, this approach may help alleviate traffic congestion [3]. As our culture evolves and people's level of livings rise, so too does the number of cars on the road,

*Corresponding author: rosnah@uthm.edu.my

leading to more frequent road accidents that may result in not only human and material losses, but also a halt in traffic flow and greater congestion [4].

It is a well-known fact that Kuala Lumpur, the capital city, was plagued by traffic congestion. Traffic congestion and harmful accidents are a major problem. This is a problematic area since it is in close proximity to several building projects [5]. It might be impacted by the accessibility of nearby transit options. Keeping a building site or a road in good working order often requires some time. Users are trapped in the gridlock that has engulfed the impacted districts. Since there are numerous users and construction sites in Kuala Lumpur, a different approach might be used to address the issue. As if things couldn't get much worse for Malaysia.

This initiative is initiated with the intention of establishing a new national structure, this plan seeks to do just that. The project's potential to cut down on labour expenses is an added bonus to the company's expansion. Then it may create innovative tools to address issues in the transportation network. Although this project does not provide a permanent solution to the issue, it does have the potential to improve the user experience and provide financial rewards for businesses who use the method presented here.

2. Materials and Methods

2.1 Materials

Expressive Systems' ESP8266 microcontroller. The ESP8266 runs self-contained apps and bridges the microcontroller to existing Wi-Fi. This module has many pin-outs and a USB connection. Flash the devkit MCU Node like an Arduino using a micro USB cord and your laptop. Breadboards work too. The ESP8266 module uses serial instructions since the chip is a Wi-Fi/Serial transceiver. ESP8266 is easy to become lost in all the manufacturer options. Choose an ESP8266 Wi-Fi module that meets project or application needs. These modules are access points. They may immediately interact in P2P or access it with a computer, smartphone, or other device that can directly connect with ESP8266 Wi-fi module without a network. Figure 1 shows the microcontroller ESP8266 Wi-fi module.

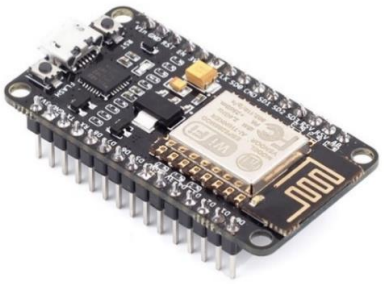

Figure 1: NodeMcu ESP8266 Wi-Fi module

An infrared sensor is a common name for this electrical component. An infrared sensor's primary purpose is to locate a moving target in the surrounding environment. The range of an infrared sensor may be adjusted to detect motion or any object. Infrared (IR) sensors may either detect a break in a beam or reflect off of an object. In the realm of electronics, this is what's known as an infrared sensor. Infrared sensors are used to detect the presence of a moving object in their surroundings. One may adjust the sensitivity of an infrared sensor to detect motion or an item of a certain distance. Infrared (IR) sensors may either disrupt beams or detect reflections. Infrared (IR) reflectance is used in these detectors. An infrared beam is emitted by the emitter and reflected back to it by the target. An infrared beam is reflected and picked up by a receiver. The item modifies the IR's properties or the quantity of IR received by the receiver. The reflectance of the item is the key factor in establishing the degree of variation. Thus, sensing variations in incoming IR helps in ascertaining attributes like a surface's topography and reflectance. Figure 2 shows the IR sensor module.

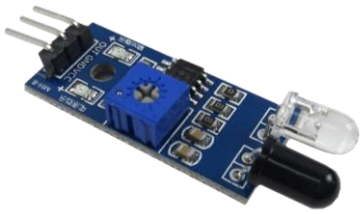

Figure 2: IR sensor module

2.2 Methods Hardware Application

Two hardware and software products make up this project's design. The hardware was the traffic flow control system design, and the software is a smartphone app called Blynk that controls the system remotely. When the Wi-Fi module is connected to the source, both poles' lights will turn on for one cycle. The smartphone's flashing application controls both light poles until they stop. Traffic-based directions are provided by Blynk. Normal traffic, non-congested traffic, and vehicles entering and exiting the construction site were the three modes for this project. IR sensor and Blynk app inputs. The IR sensor module used the sensor. Tracking road vehicles was the goal. For dense traffic, this project used mode one, where the IR sensor only detects the vehicle. The sensor will be the vehicle's input and sense in mode 2, for light traffic.

The Blynk app will set the timer. The app makes traffic light timers easy. Apple and Google Play stores offer this app. To manage settings and use Blynk, this app must be purchased and registered. First, an app bought hardware. The lamp post completes the project. The project uses a two-pole, two-traffic-light system. Traffic lights have green, yellow, and red LEDs. It will run when the smartphone's Blynk app commands this output. It adds modes. Construction and road maintenance anchor everything built.

Traffic flow control at building sites is a system. Near the construction site, it manages a two-lane two-way road. Due to the construction site taking up part of the road, construction near roads might cause traffic congestion. The contractor inserts a cone to make drivers more cautious. The flagman formerly directed traffic near the building site. Flagman controlling traffic with green and red flags. Traffic lights will replace flagmen on construction sites. Traffic lights control vehicle movement. Traffic lights will control vehicle movement.

2.3 Main Operation

Main of flow chart has operation modes 1, 2, and 3. The flow chart starts with selecting the operation based on vehicle traffic through the construction area. During normal traffic flow, the first mode acts like a traffic light. Mode two uses IR sensors. The walkway near the traffic lights will include the IR sensor. It detects passing automobiles. Mode two is utilized during light traffic. The first vehicle the IR sensor sees will enter the building site. The user will wait little. Vehicles will enter and leave the building site using mode three procedures. Both traffic lights will turn red and motorists from both directions will halt for machinery or vehicles accessing the construction site. The flow chart's traffic signal poles are polls one and two. Figure 3 displays the main operating system with smartphone-controlled mode changes. Figure 3,4 and 5 were operation 1, operation 2 and operation 3 work.

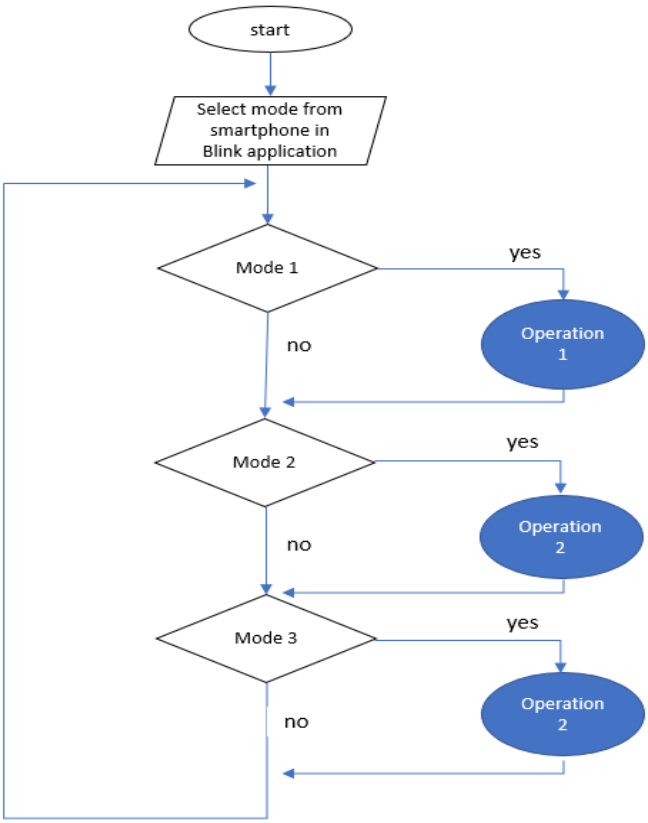

Figure 3: Main flowchart operation system

Mode one operation describes a situation such as a normal traffic that was controlled using a pre-set time period on the system. the typical signal system was a two-way movement. Figure 4 for mode one operation.

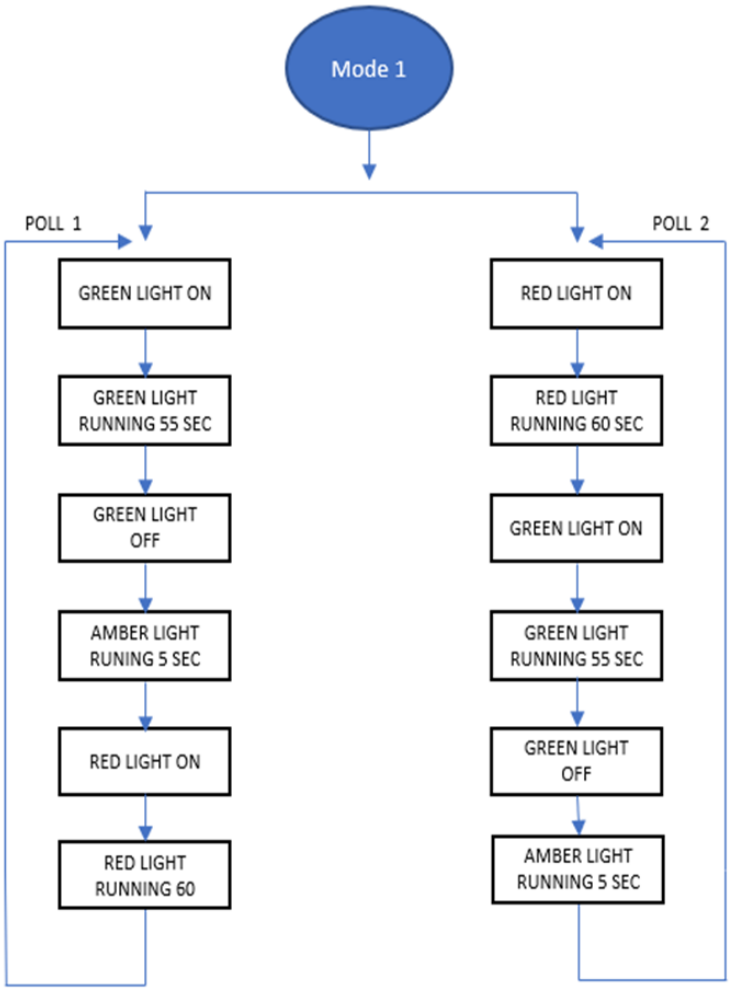

Figure 4: Mode 1 Operation

Mode two operation operates using an infrared sensor that detects vehicles passing the sensor at a certain distance set on the road. This mode 2 was used when the road was less busy because it can speed up traffic. Figure 5 was operation mode two.

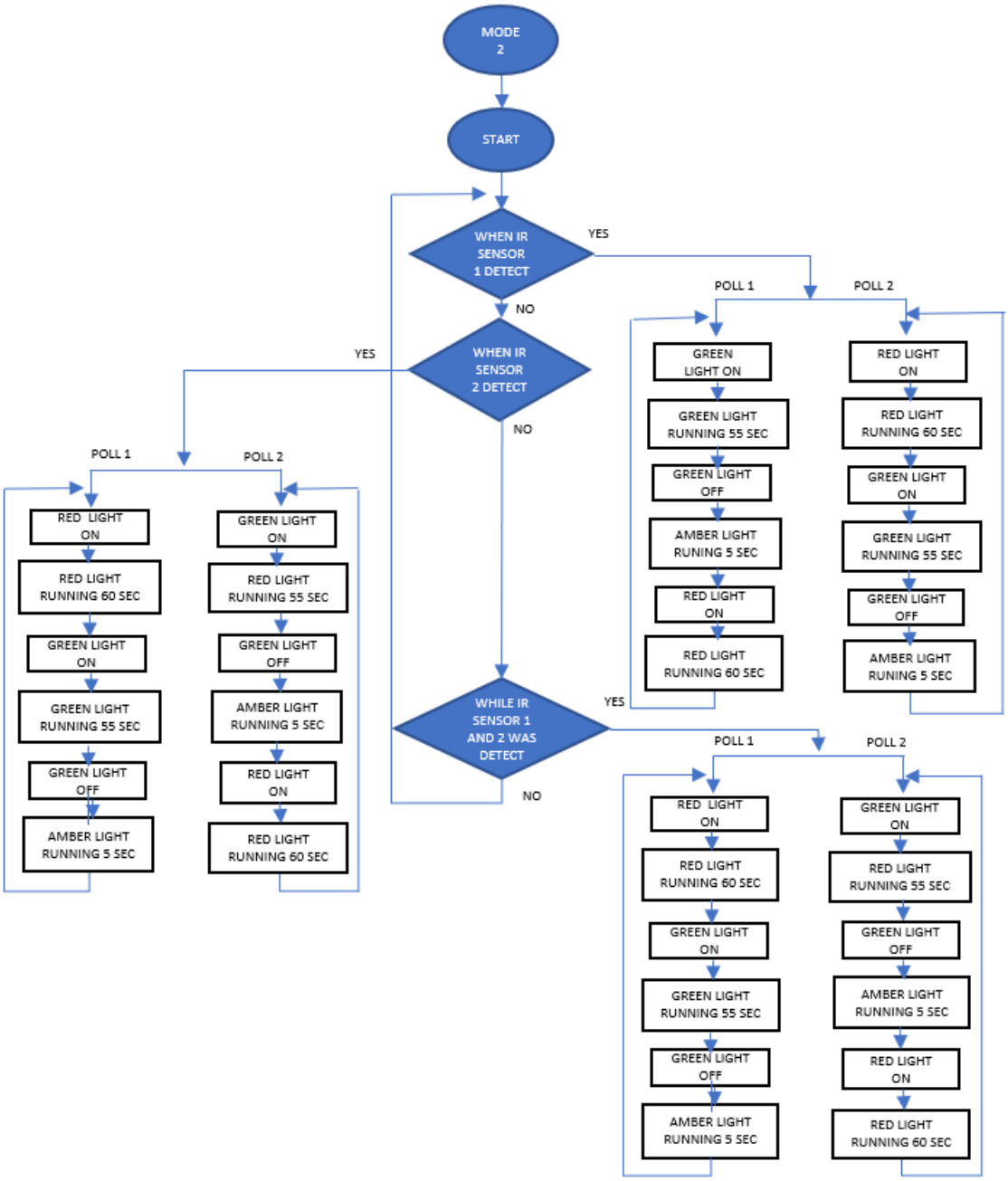

Figure 5: Mode 2 operation

Mode three operation when a vehicle wants to go in and out of a construction site and signals other vehicles to stop in both directions. This mode 3 operation was used only when heavy machinery enters and exits the construction site. Figure 6 was operation mode three.

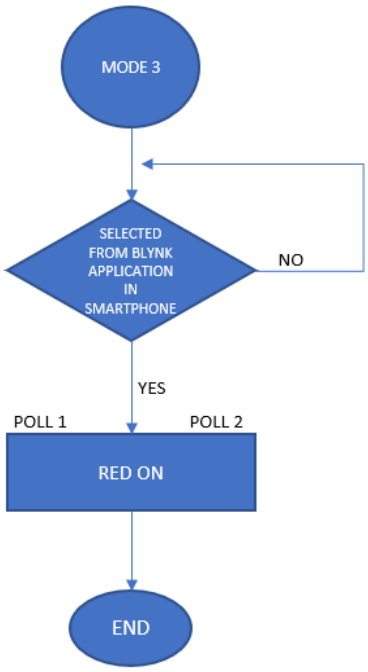

Figure 6: Mode 3 operation

2.3 Software Application

The software development will be design using Arduino IDE as a programming platform to create the coding for ESP8266 and IR Sensor. While for designing the variable of the project the Blynk application will be develop. The variable that will be design have 3 mode, first mode which is describes a situation such as a normal traffic that is controlled using a pre -set time period on the system. The typical signal system is a two – way movement. Second mode operates using an infrared sensor that detects vehicles passing the sensor at a certain distance set on the road and used when the road is not busy because it can speed up traffic. Lastly, mode 3 that will be use in the situation when a vehicle wants to go in and out of a construction site and signals other vehicles to stop in both directions. This mode is used only when heavy machinery enters and exits the construction site.

2.4 Wiring and connection

All connections and wiring for this section are shown in Figure 7. A simulation for the wiring has been designed in the software. The positive (VCC) and ground (GND) power supply pins from the ESP8266 microcontroller are supplied to each IR Module Sensor and LED. The IR Sensor Module is powered by a microcontroller to ensure that each component works. IR Module Sensor has three legs which are VCC, GND and another pin is the command pin (switch). All sensors will receive commands that have been programmed by the microcontroller. The VCC and GND pins are connected so that it is easy for the IR sensor and the LED to be parallelized. Figure 7 shows wiring and connection between microcontroller, IR sensor and LED.

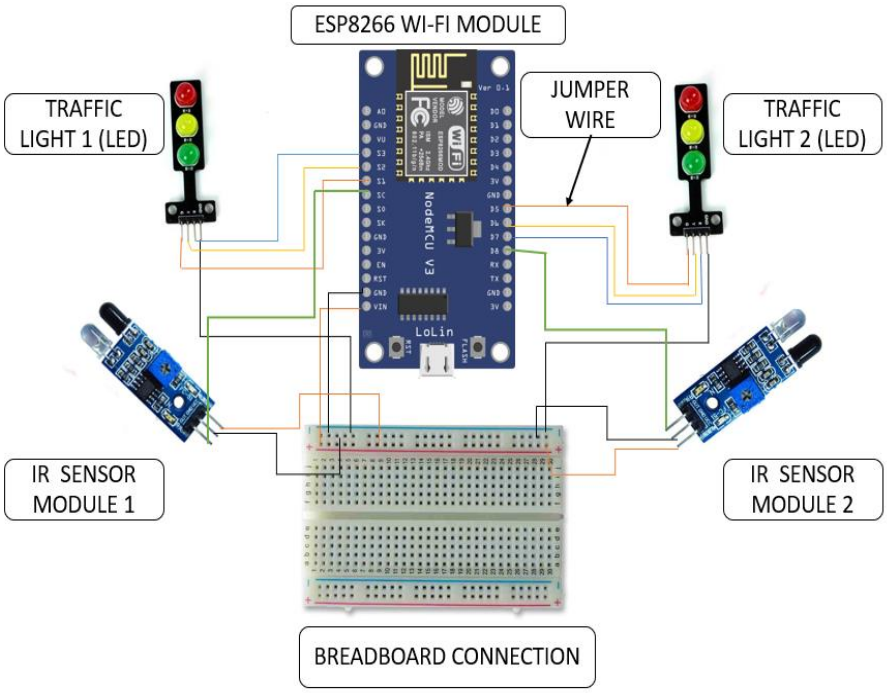

Figure 7: Wiring and connection between microcontroller, IR sensor and LED.

Green, yellow, red wires for LED, 4 pins have been used, 3 pins are connected to the ESP8266 microcontroller while 1 ground pin (GND) is connected to the breadboard to parallel the other ground. on the IR sensor module, 2 pins for VCC and GND and another pin (OUT) is connected to the ESP8266 microcontroller. The IR sensor that functions as a signal to the vehicle during traffic movement detects the movement of the vehicle when it passes through and is connected to the ESP8266 microcontroller.

3. Results and Discussion

The results include an overall prototype assembling the components and creating in the software used to monitor the movement of the system. For software development, this project will be carried out using the Arduino IDE to design the instructions for the ESP8266 Wi-Fi module. After getting results as expected in doing design coding for ESP8266 the project continues to develop the Blynk application. The project will continue by assembling the components and attaching the ESP8266 Wi-Fi module.

3.1 Hardware Result

To achieve the first and second goals of this part, the Traffic Flow Control System for Construction Sites has been controlled using a Blynk application by the regulator. IR sensors and Blynk applications are used for inputs. ESP8266 is a microcontroller and Blynk application to resolve possible errors that occur when the Traffic Flow control system is operating have problems on components such as IR sensors and LEDs because the Blynk app can monitor the entire system is operating.

After the Traffic Flow Control System for Site Construction is created, the installation process needs to be done. This Traffic Flow Control System needs to be installed with the main components of the ESP8266 microcontroller, IR Sensor, LED as the main frame for the circuit connection for the Traffic Flow Control System for Site construction. Figure 8 shows circuit for the system traffic flow controller system.

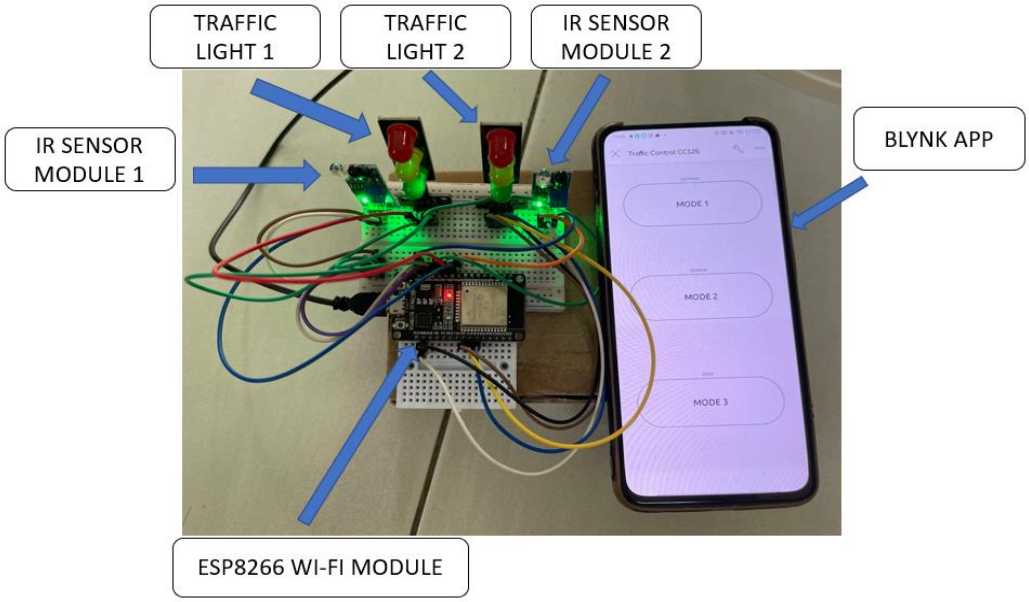

Figure 8: Circuit for the system traffic flow controller system

3.2 Software Result

Traffic flow control system uses software for running the coding. The software used is Arduino IDE. The coding is done according to the movement of the system. This system uses 4 different coding parts to be uploaded to the ESP8266 Wi-Fi Module. First part of coding was design to make a connection between the ESP8266 Wi-Fi module and application that can control this system using a smartphone. The application used is the Blynk app, Blynk app is one of the apps that can relate to any microcontroller and can be monitored using any gadget that have Wi-fi connection. While for this project smartphone were used for employee easier to monitor this Blynk app from a long distance. First part in developing the code for Arduino IDE was making microcontroller ESP8266 Wi-Fi module connect to Blynk app in Smartphone. Even though, an error has occurred during this part, which is mistakenly attach wrong Blynk template id and device name. This error led to malfunction of connection between ESP8266 Wi-fi module and Blynk app.

3.3 Traffic Congestion Based on Hour and Condition of Vehicles

The Traffic Flow Control System has been analyzed by testing against the day with time and vehicle conditions. There are 5 time periods in one day that have been analyzed which are at 8 am, 10 am, 12 noon, 3 pm and 5 pm. These 5-time intervals show the conditions for different vehicles. five fractions of this time to record the current state of the vehicle. The testing phase was done at Taman Universiti, Parit Raja, Batu Pahat. Traffic congestion data based on time difference shown in Table 1 and Figure 9 in bar chart pattern.

Table 1: Data of traffic congestion based on hour and condition of vehicles

Hour	Condition of Vehicles
8.00AM	Normal
10.00AM	Less Busy
12.00PM	Normal
3.00PM	Less Busy
5.00PM	Busy

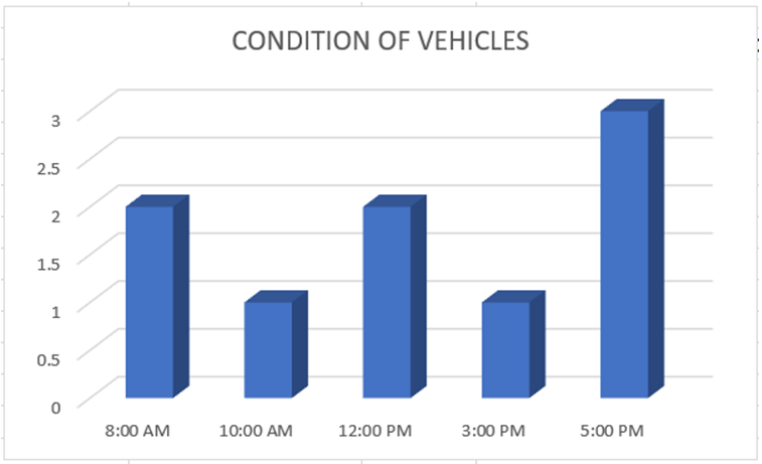

Figure 9: Bar Chart of Traffic Congestion and Condition of Vehicles (1) Less busy (2) Normal (3) Busy

Based on the analysis of this traffic system that was made. There are 3 condition of vehicles that have been classified as less busy, normal, and busy. Figure 6 shows that traffic congestion by time and day. On 8 A.M condition of the vehicles is normal. The reason was because a lot of people usually leave their house to work early than 8 A.M to avoid traffic jam. Other than that, 8 A.M was working hour so that they need to arrive before 8 A.M. On the 10 A.M condition of vehicles was less busy. The condition of vehicles was less busy on that time because basically on the working hour movement of the vehicle is less according to people are working at their work station. Next, on 12 P.M, vehicles condition is normal. On 12 P.M is a started hour for lunch or break time for working people so there were people who leave their working station for lunch or there are a people who just taking their lunch at their working station. So, the vehicle condition is normal. The vehicle condition on 3 P.M is less busy because on that time people were start working back after the lunch hour so there is less movement of the vehicle on the road. Last but not lease, On the 5 P.M the vehicle condition is very busy because on that time is end of working hour so that a lot of people are rushing to going back and arrive early at their house or next destination. The analysis made to find out how to determine the condition of the vehicle is to measure the length of the waiting car based on the number of street lamp posts. The distance between the light poles that has been measured is 10 meters. This analysis of the condition of vehicles was made at Taman University, Batu Pahat.

3.4 Time Change with The Distance Between the Blynk Application (Smartphone) and The Traffic Flow Controller System (ESP8266 Wi-fi Module)

The system has a delay variable changes due to distance. If the distance increase between Blynk app and microcontroller ESP8266 Wi-fi module, the delay for system reaching the Wi-fi also increase. The maximum distance for Wi-fi hotspot from smartphone to microcontroller is 100 feet or 30 meters. When the distance exceeds 30 meter the Wi-fi begin having problem in connection. Table 2 and Figure 10 and show the variables of distance and delay time.

Table 2: Data of distance and delay time Blynk application between the Blynk application

Distance	Delay time
1m	1.20
5m	1.25
10m	1.30
15m	1.62
20m	1.65
25m	1.70
30m	2.00

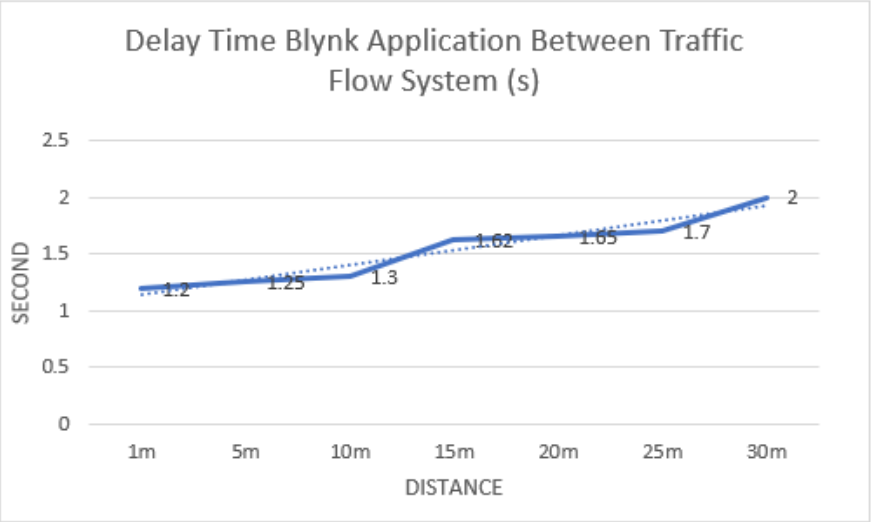

Figure 10: Line Chart of Delay Time Blynk App Between Traffic Flow System

4. Conclusion

Overall, this project aims at the development of Traffic Flow Control for the Construction part based on ESP8266 as Network Software and microcontroller. The ongoing project also aims to implement the Blynk application on smart phones as a control system to achieve the objective of creating a system that can control traffic development works near the road that is being carried out so that there is no traffic jam. In addition, the main objective is to develop a systematic system using IR sensors to minimize human power at the construction site. Previous projects have shown that Traffic Flow Control Systems are often created using standard microcontrollers, such as the Arduino UNO microcontroller. This project includes the development of a microcontroller ESP8266 Wi-fi module as a network software that can be connected and controlled remotely to the Blynk application. Although the proposed method is numerically stable and computationally efficient, various constraints may exist, there is no guarantee that the progress of the project will not experience any errors and problems that occur. In conclusion, this project has achieved and answered the objective to control traffic conditions by reducing labor costs by using the control system that has been created.

Acknowledgement

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