

## Smart Emergency Traffic Light System

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**Abstract:** The aim of this study was to design a smart system on traffic light for emergency purpose. The goal of this study is to facilitate the emergency vehicle go through a busy intersection without causes any new accident due to misunderstanding of all road users. There are several objectives of this study which is provides emergency access for emergency personnel at the traffic light. Next, facilitates the journey of emergency personnel during traffic light and avoids any accidents in traffic lights due to misunderstandings and confusion regarding the siren's direction of emergency vehicle. The idea of this system by using RFID control that can interrupt the normal sequence of traffic light to change the path that emergency vehicle is travelling on into green after a few second while the other path will be all red. Thus, it may reduce the delay of emergency vehicle travel to a scene or specific place while providing their emergency service to society efficiently. This system includes transmitter (RFID card/tag) and receiver (RFID reader) part to be fully control by a RFID RC522 module. With a certain operating distance, the receiver and transmitter can communicate with each other to enable the green light on the road passed by the emergency vehicle. The transferred data and signals are read wirelessly by the reader before it is finally sent to the processor for next operation.

**Keywords:** Traffic Light, Emergency, Smart Sytem, RFID.

### 1. Introduction

Traffic light or signal light is a system used to facilitate the movement of traffic from one direction to the other in order to connect multiple intersections at one point. Typically, traffic lights will be installed either at road crossings, pedestrian crossings or in areas that require special attention from drivers especially at school and railroad tracks. The signal light has three basic colours namely red, yellow and green where red gives stop signal, yellow in standby while green gives street signal if no obstruction. It can be said that most of the signal lights are designed in two forms, either vertically or horizontally and mounted on special poles to allow users to see the vehicle even in long distance.

The signal lamp system was first introduced by John Peake Knight in England on 9 December 1868 at the intersection of Bridge Street and Great George Street in the London borough of Westminster. The signal lamp system using a gas lamp and operated manually and a police officer would be stationed next to the signals to operate them [1]. However, only one month later, a police officer controlling the signal was badly injured when a leak in a gas main caused one of the lights to explode in his face and the project was declared a public health hazard and immediately dropped.

Traffic signalling or traffic light are used to facilitate the flow of traffic through an intersection or junctions of any busy area especially in urban area [2]. However, the increase in population was followed by an increase in the number of cars causing traffic congestion and disturbing emergency vehicles. Based on traffic studies conducted in Malaysia, it is clear that the cause of traffic congestion on non-systematic traffic light systems [3]. Therefore, the purpose of this project is to reduce the frequent traffic congestion and facilitate the handling of emergency vehicles.

### 1.1 Problem Statement

This study is focusing on the problem of existing traffic light systems cannot detect the presence of emergency vehicles on the road, especially in emergency situations where emergency vehicles are difficult to pass in traffic jams. The cause of the delay can affect the lives of people in need of emergency vehicles or emergency support while providing their best services to the community. To overcome this problem, a system is implementing to facilitate the emergency vehicle go through a busy intersection without causes any new accident due to misunderstanding of all road users. This system is using RFID control that can interrupt the normal sequence of traffic light to change the path that emergency vehicle is travelling on into green after a few second while the other path will be all red.

### 1.2 Objectives

The specific objectives of this project are as follows:

- Provides emergency access for emergency personnel at the traffic light.
- Facilitates the journey of emergency personnel during traffic light.
- Avoids any accidents in traffic lights due to misunderstandings and confusion regarding the siren's direction of emergency vehicle.


## 2. Materials and Methods






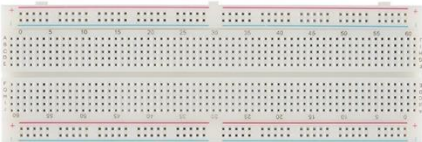





In this part the processes towards the completion of Smart Emergency Traffic Light System are discussed in through the project flowchart, project overview, block diagram, circuit design, and flowchart of the program. The purpose of this methodology is to give the working standard, improvement and technique for the entire attempts of the project works.

### 2.1 Materials

The right choice and economical of the hardware used are essential to complete the project and make the RFID communication system functioning well. Some of the hardware is readily available, so they are not listed, such as a laptop for design the coding in Arduino Uno.

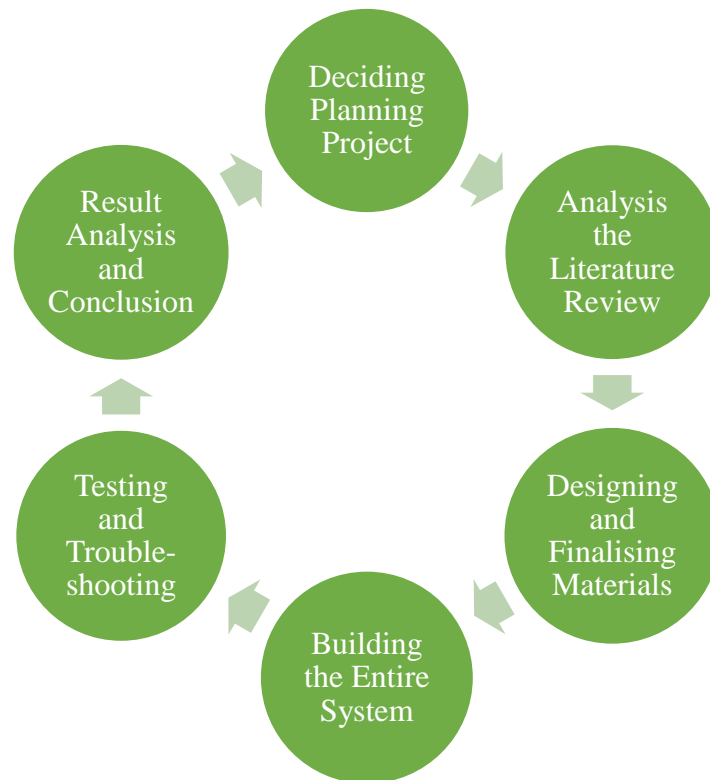
**Table 1: List of materials used for smart emergency traffic light system prototype**

Description	Picture	Quantity
Arduino Uno		3

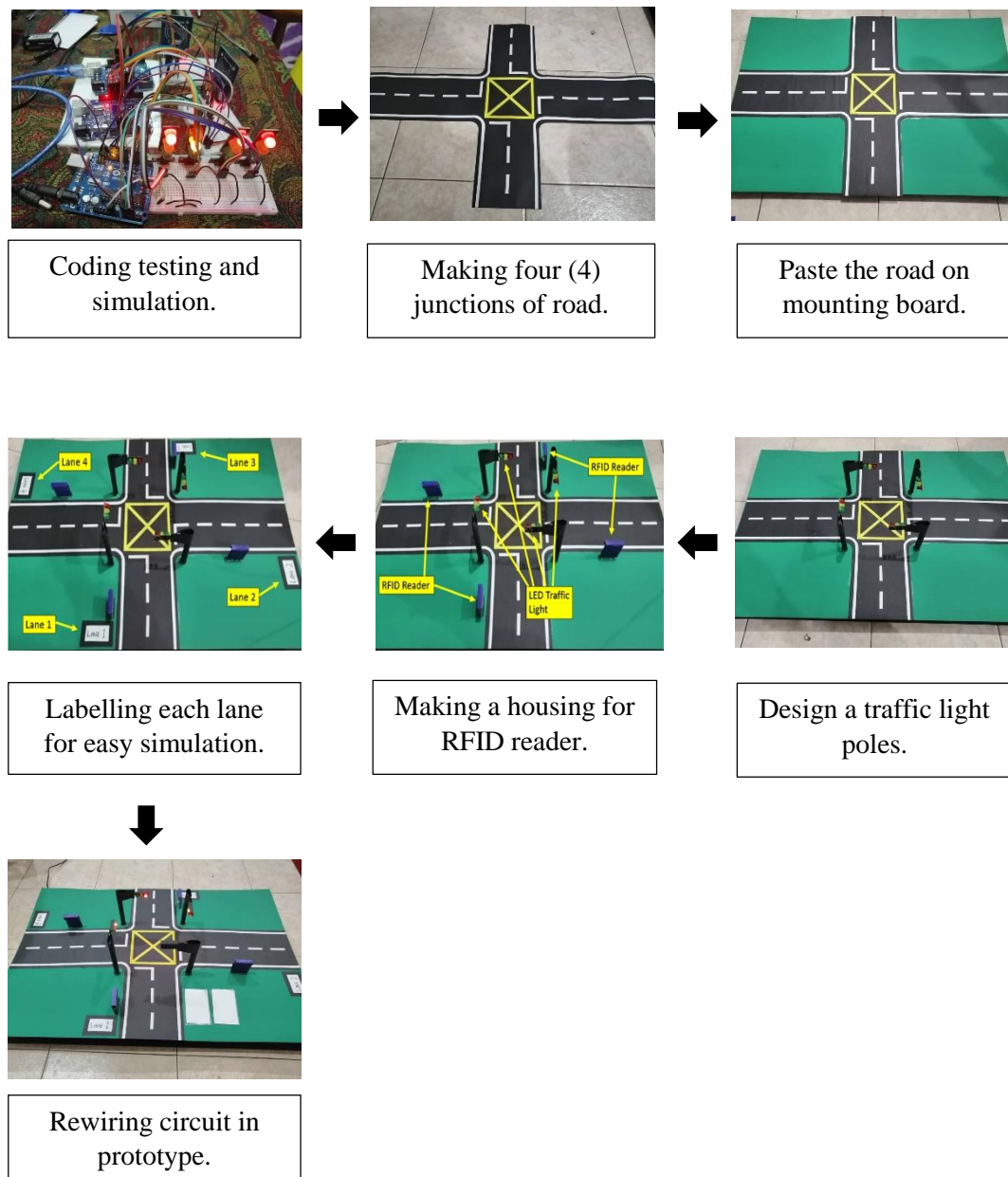
RFID RC522 Module		2 set
3-Pin Plug AC/DC Adapter		1
USB Rechargeable Battery 9V		1
Jumper Wires (Male to Male)		2 set
Jumper Wires (Female to Female)		2 set
Breadboard (Full-size)		2
9V Battery Connector to DC Jack		1
LED Traffic Light Module (5V)		4 set
Mounting Board Colour		1
Mounting Board BlackWhite		1
Impra Board Purple		1

## 2.2 Methods

The methodology starts with the process of finding reference material or information related to the project title. Furthermore, the purpose of this methodology is to give the working standard, improvement and technique for the entire attempts of the project works. This approach encourages the achievement of the task objectives in this project.. In order for the project to run smoothly, the methodology should have a flow chart to guide the implementation of the project. The following Figure 1 illustrates the planning flow chart for this project.



**Figure 1: Flow chart of Methodolog**



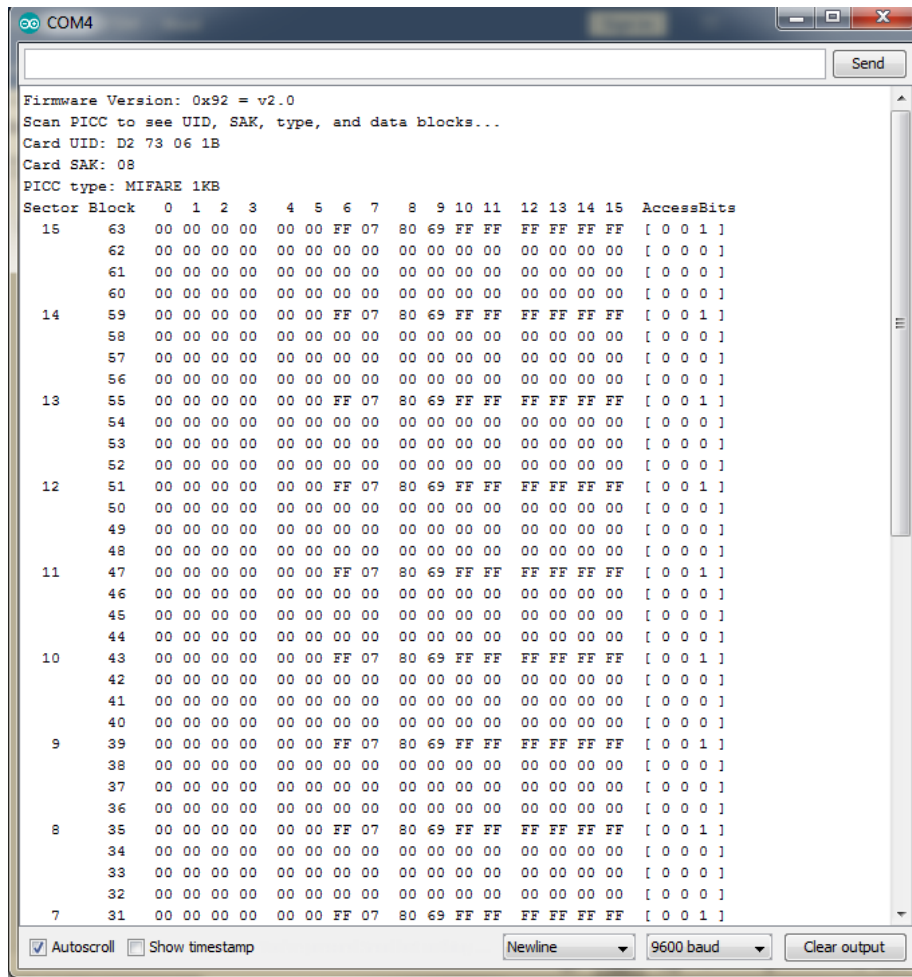
**Figure 2: Flow chart to produce smart emergency traffic light system**

### 3. Results and Discussion

Several testing on RFID reader receiving a data had been tested for a different card/tag to see the details and UID of the card/tag on serial monitor of Arduino IDE. The result of this project is observed and recorded in the form of snapshot figure for more available data analysis. Based on the result and data analysis, the data shown in serial monitor helps the user to find out the specific UID number for each of different card/tag before key in the UID in a full program.

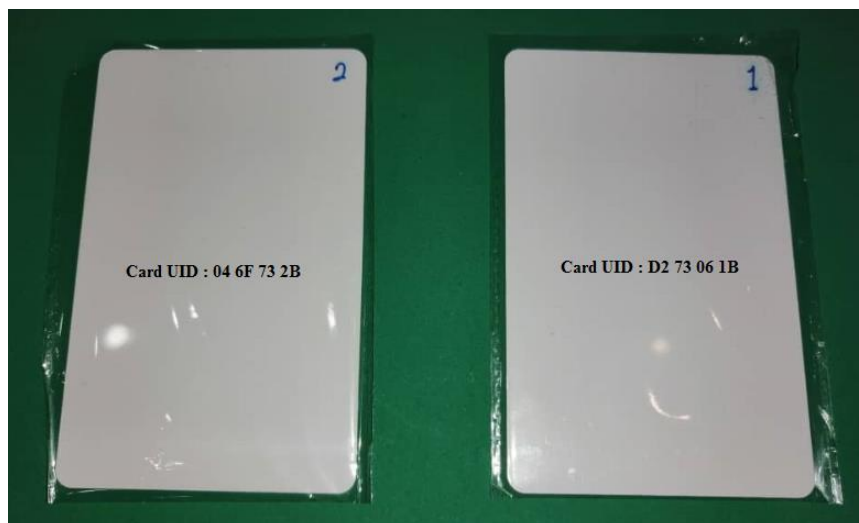
#### 3.1 Results

Each of card/tag have their own specific details and UID. The UID display on serial monitor need to be copied and paste inside a full program. All the data are shows as Figure 3 below:



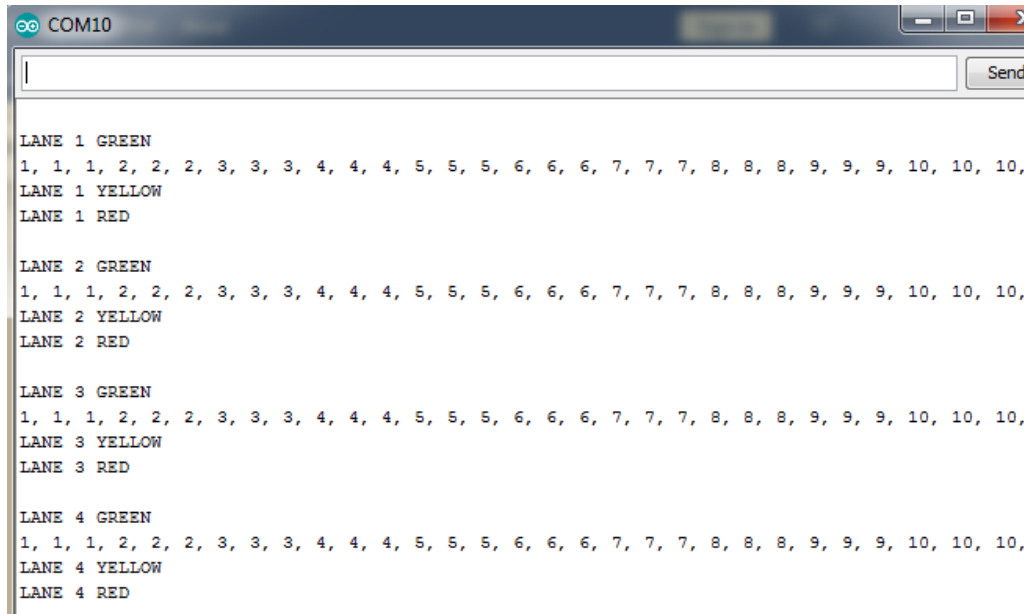
**Figure 3: Serial Monitor Arduino with RFID RC522 Reader Module**

Based on the detail above, each UID of card/tag need to be collected first before it can be set it up inside a program so that only a specific card/tag can be used to trigger the emergency sequence. Therefore, only specific cards/tags can be used to interrupt the system. Figure 4 shows two (2) same types of RFID card but consists a different UID number for each of them.



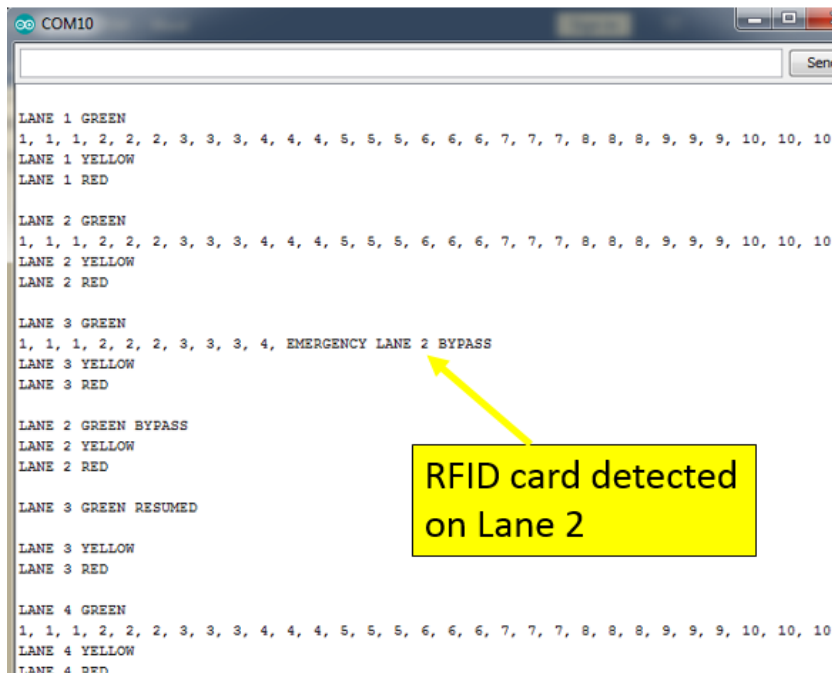
**Figure 4: Two (2) same card with different UID code**

The Serial Monitor of Arduino IDE used in this system to display the sequence taken by the program for easy monitoring and observation. Here, the normal traffic light sequence will be running as long as no emergency sequence are been triggered and the time taken for each lane to green, yellow and red were reduced a bit for easier to observe. The program will keep repeating and running without any interrupt. Figure 4 shows the output of serial monitor based on normal traffic light sequences.



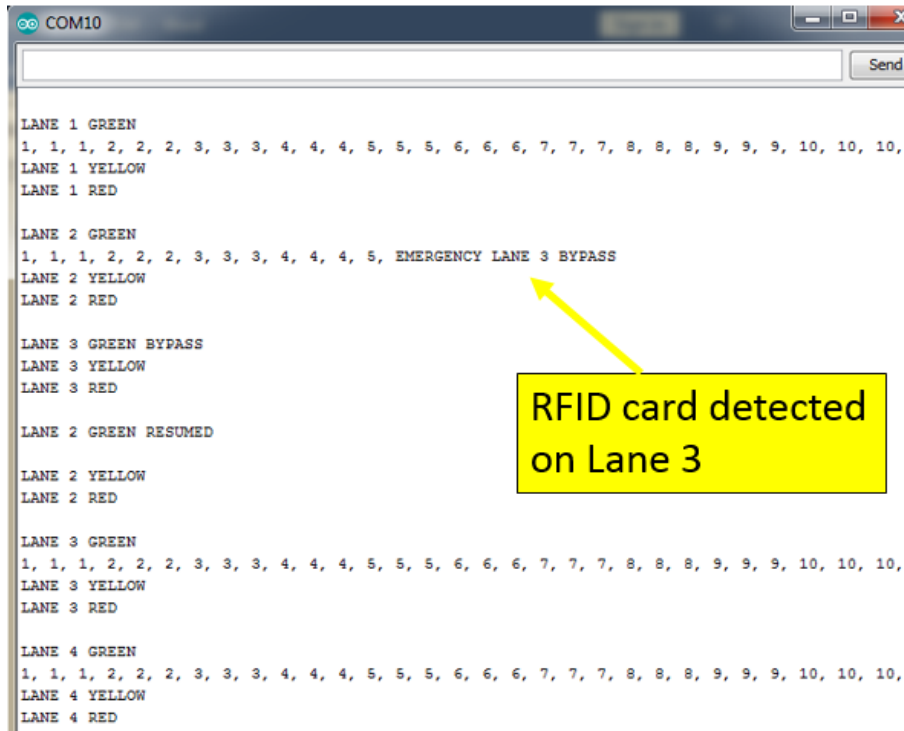
**Figure 5: Serial Monitor for normal traffic light sequences**

Each led will take turn to light up which is green light for 10 seconds, yellow light for 1.5 seconds and red for 0.5 seconds. However, when RFID reader received a signal for emergency purpose, the system/sequence will be changed for a while to provide an access for the specific lane. Figure 5 and 6 are several testing shows that the details display on serial monitor when RFID reader received a signal.



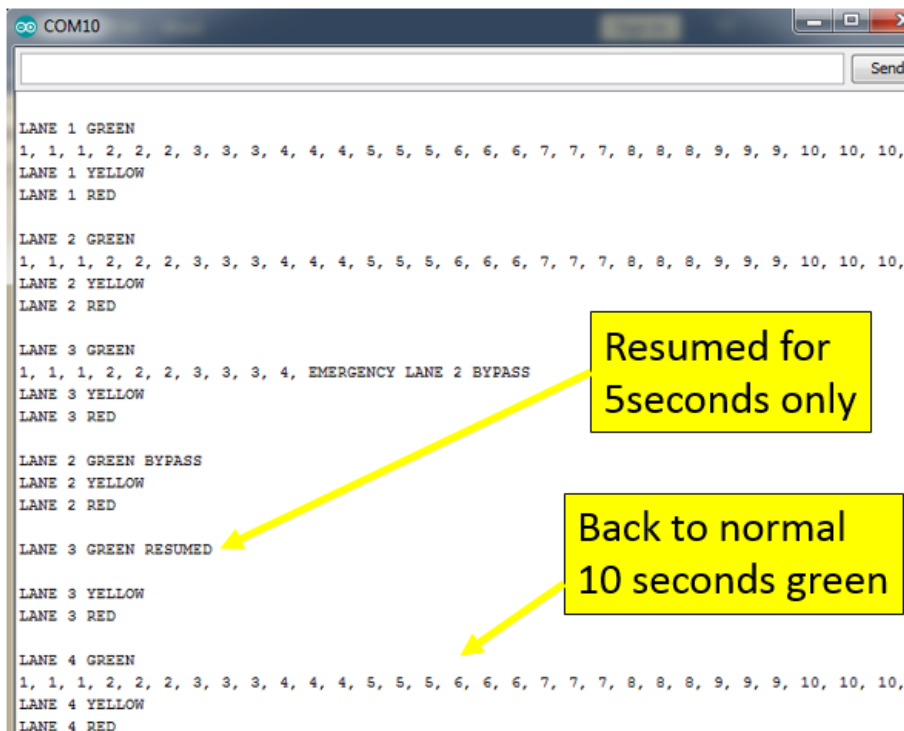
**Figure 6: Serial Monitor for emergency sequence on lane 2**





**Figure 7: Serial Monitor for emergency sequence on lane 3**

In emergency sequence, the delay and time taken for green light to ON are also for 10 seconds before it gets back to yellow and red. The normal sequence will be run as usual once the emergency sequence is done. However, the lane that resumed the green light again will be light up for another 5 seconds only before finally return to 10 seconds normal delay of green light on the next lane. This method is used to provide a fair amount of time for the disturbed/interrupted lane to restore congestion in that lane. Figure 8 below shows how the delay occurs in 5 seconds and back to normal again.

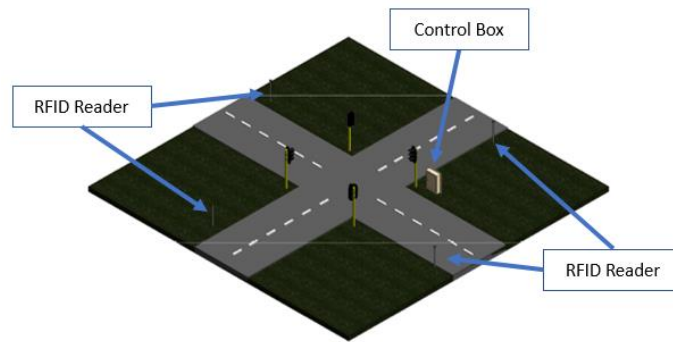


**Figure 8: Serial Monitor for green light delay of program**

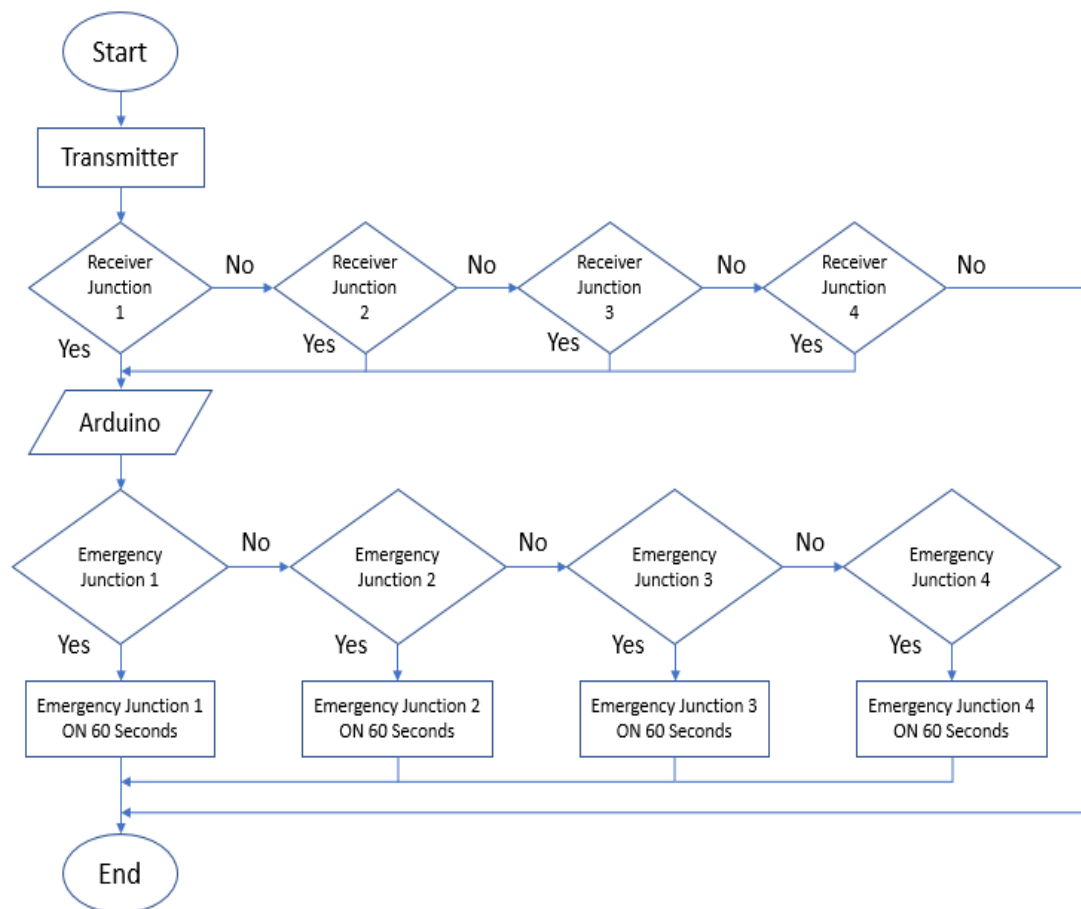


### 3.2 Discussions

There are two significant elements will be discussed, which are hardware designing and software designing. Hardware designing means needs to design the hardware with the several components that are already studied in the literature review. The hardware involves the incorporating processing unit, control unit and output unit. Besides that, the second element is software designing, which is needed to write the program code for the whole system to function as desired. The software used to write the program code is Arduino IDE because this project uses the Arduino as the processing unit. Figure 9 shows the flow of the internal system in this project.

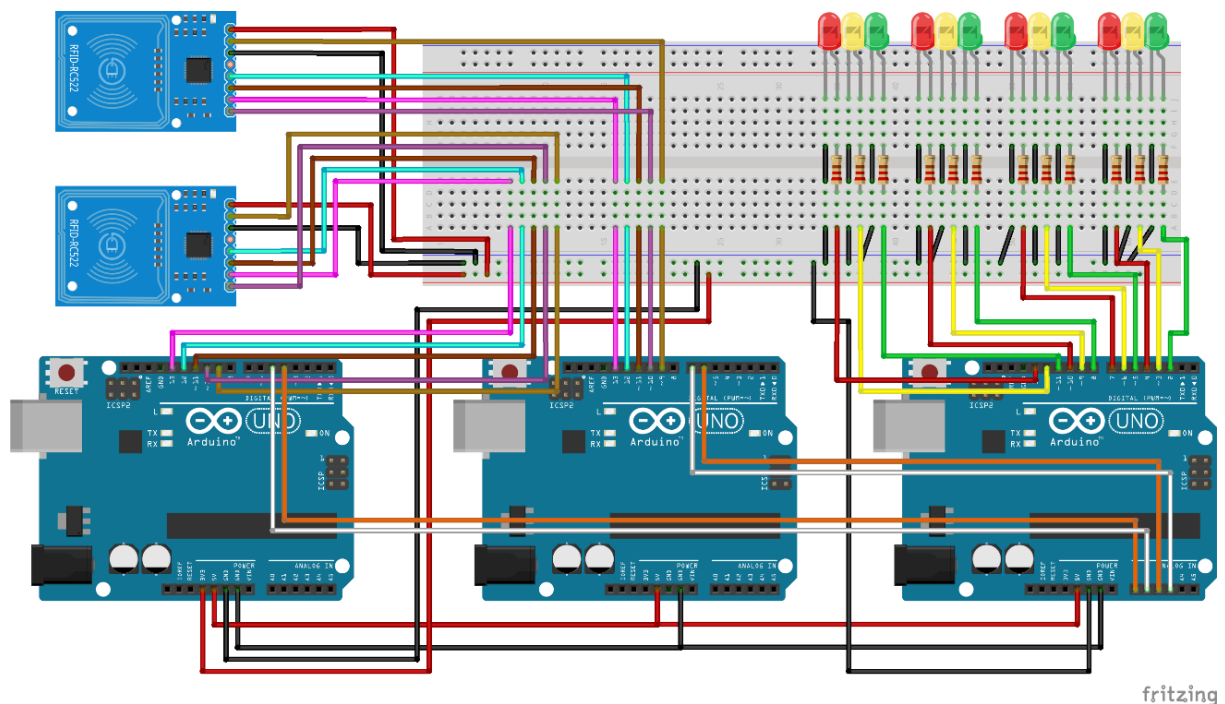


**Figure 9: Project Overview**



**Figure 10: Flowchart of overall system**

In hardware design, the connection of each pin must be correct and tally as declare in programming. Figure 11 shows that circuit diagram of this system.



**Figure 11: Circuit diagram of overall system**

#### 4. Conclusion

In conclusion, through all the study and analysis that had been made, this prototype of Smart Emergency Traffic Light System has been developed. The RFID RC522 module have been successfully collecting the data of RFID card/tag wirelessly then transfer the data to the processor of Arduino. At the meantime, the progress also has been successfully displayed on the serial monitor of Arduino IDE for easier observation and understanding. In this project, the program is made to provides emergency access for emergency personnel at the traffic light. Therefore, the time taken for travelling of emergency vehicle between the scene to the emergency department (ED) can be reduce efficiently. Besides, this module also facilitates the journey of emergency personnel during traffic light especially when it occurs in a busy urban area. In addition, it also may avoid any accidents in traffic lights due to misunderstandings and confusion regarding the siren's direction of emergency vehicle.

The use of RFID modules is intended to facilitate emergency personnel through very busy traffic light areas. In addition, it is also in line with the advancement of RFID technology that is being used now as in tolls in Malaysia. By simply setting a specific identity card/tag into the program, the system will be more secure because any use of a card/tag with a different identity will not cause the program to be interrupted/disturbed. In fact, only the pre-set card/tag will give further instructions to the entire program. Eventually, this module can simply work for real life situation and may save a lot of human life. It also can prevent any accident occur in traffic light intersections due to conflict and misunderstanding among people. The module was successfully developed and met all the objectives. Moreover, this implementing system has been working according to its needs. Nevertheless, there is still some part in this module and system needed to be improved in future, so that it can be the more reliable system produced.

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