# Implementation of Modern Traffic Light Control System

**Nang Hom Kham[*], Chaw Myat Nwe[**]**

[*] Department of Electronic Engineering, Mandalay Technological University, Myanmar
[**] Department of Electronic Engineering, Mandalay Technological University, Myanmar

***Abstract-*** There are many problems of congestion with traffic light in many cities. This problem of congestion can be caused by long time delays of traffic light's Red light. When there are emergency case at traffic light intersection which are always busy with many vehicles, this problem can also be caused. The possibilities of traffic jams caused by traffic light can reduce by using the Programmable Integrated Circuit (PIC) 16F877A microcontroller. The intended system is to change the sequence back to the normal sequence after triggering for the emergency modes by using the controller. Many accidents which often happen at the traffic light intersections will be reduced because of using this system. The system that provides the traffic control of six way and four junction of modern traffic light has been implemented with arrowed signal for each direction. The arrowed signal of red, yellow and green light are displayed with LEDs. There are two modes of traffic light sequence in this system. One is the normal sequence and the other is the emergency sequence. The phases of red, yellow and green are determined by computer programming based on the patterns of traffic light congestion.

***Keywords-*** Emergency vehicle, Congestion, PIC Microcontroller, Traffic flow control, Traffic light

## I. INTRODUCTION

Nowadays, vehicular travel is increasing through the world and many countries are facing many problems at traffic light intersection which are caused many accidents between the emergency vehicle and other vehicle [1]. Traffic light control at the intersection point is a matter of concern in large cities. As the number of road users constantly increase and resources provided by current infrastructures are limited, modern control of traffic will become a very important issue in the future [2]. One way to develop traffic light flow and safety of the current transportation system is to apply a modern traffic light control system. Traffic light controlled by microcontroller is becoming a common place in many cities because these units can easily adjust for different timing sequence.

Traffic lights are signaling devices situated on the road at intersection points which are used to control the completing flows of traffic [3]. In generally, a traffic light consists of a set of three lights. They are red, yellow and green. When illuminated the red light, it indicates for vehicles facing the light to stop and the yellow light indicates caution to prepare for stop short of the intersection. The green light is to proceed in the direction denoted [4]. The traffic light sequence may differ from other, and they may be special rules or set of lights for traffic turning in the particular direction.

In this system, there are three order signs for turn-left, forward and turn-right. The timing of red, yellow and green arrowed light at each crossing of road design are based on the total traffic light on all adjacent roads. In a typically cycle, illumination of the green arrowed signal allows traffic to proceed in the direction denoted, the yellow arrowed signal is to prepare for stop short of the intersection and the red arrowed signal prohibits any traffic from proceeding.

## II. SYSTEM AND COMPONENTS

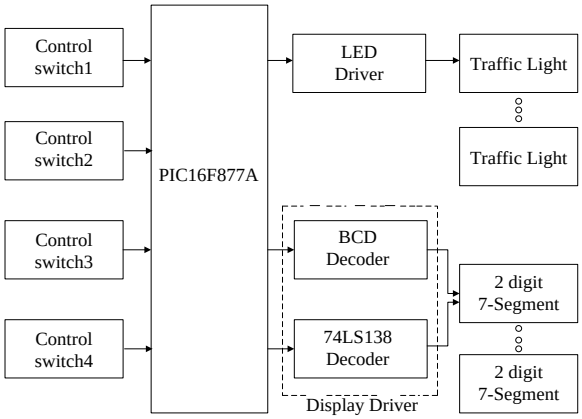


Figure 1: Block diagram of Modern Traffic Light

The Figure 1 shows a block diagram of a modern traffic light control system which consists of four control switches, one PIC microcontroller, one BCD decoder, one 74LS138 decoder or multiplexer. Both of BCD decoder and 74LS138 decoder or multiplexer are used as a display driver to control the four sets of two digit of seven segment. LED drivers are used to control the four sets of traffic light. Four control switches are used to control for the emergency cases such as ambulance, fire brigade and VIP case.

*BCD-to-Seven-Segment Latch or Decoder or Driver*: CD4543B is a BCD-to-seven-segment latch or decoder or driver designed primarily for liquid-crystal display (LCD) applications. It is also capable of driving light emitting diode (LED), incandescent, gas-discharge, and fluorescent displays. It is a display blanking of all illegal input combinations and latch storage of code. For LED applications, a logic 0 is required at the PHASE input for common-cathode devices and a logic 1 is required for common-anode devices [5].

*Decoder or De-multiplexer (74LS138*): These Schottky-clamped circuits are designed to be used in high-performance memory decoding or data-routing applications, requiring very short propagation delay times. In high performance memory systems, these decoders can be used to minimize the effects of system decoding. When used with high-speed memories, the delay times

of these decoders are usually less than the typical access time of the memory. This means that the effective system delay introduced by the decoder is negligible. It is a 3-to-8 line decoders and power dissipation is 32mW.It have three binary select inputs, three enable inputs which is two active LOW (E1,E2) and one active HIGH (E3) and active LOW Outputs (Y0-Y7) [6].

## III. PERFORMANCE AND EVALUATION

### A. *Sequence of Traffic Light*

In a modern traffic light control system, there are four states of direction for users are shown in figure 2(a) to 2(d).

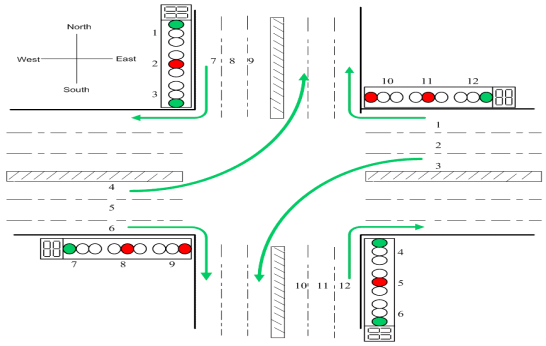


Figure 2(a): Turning lane for East-South and West-North direction

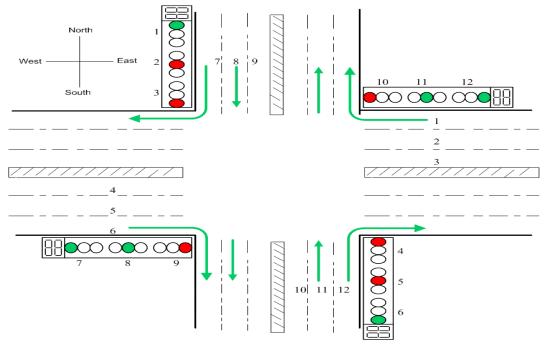


Figure 2(b): Straight lane for North-South and South-North direction

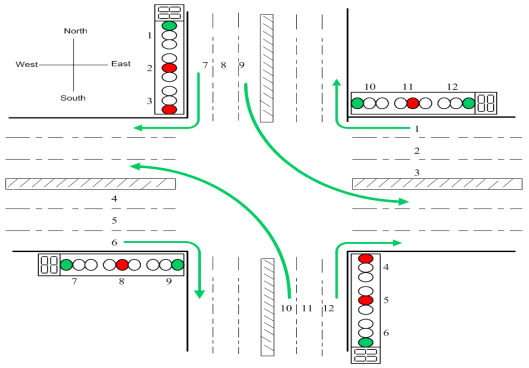


Figure 2(c): Turning lane for South-West and North-East direction

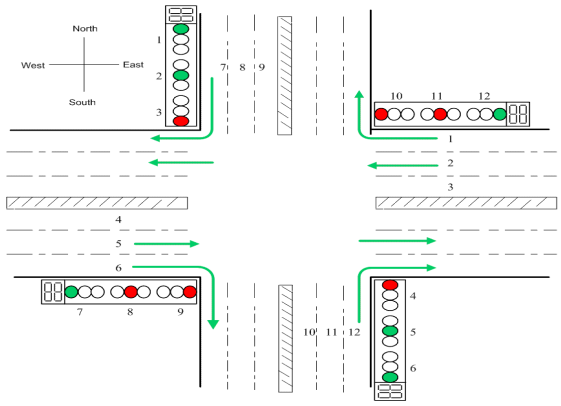


Figure 2(d): Straight lane for East-West and West-East direction

Table I: Table of sequence of modern traffic light

| Direction | East-West Direction | | | | | | | | | North-South Direction | | | | | | | | | Lane Direction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TL No: | 1 | | | 2 | | | 3 | | | 7 | | | 8 | | | 9 | | | |
| Color | R | Y | G | R | Y | G | R | Y | G | R | Y | G | R | Y | G | R | Y | G | |
| State1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | turning lane for ( E-S & W-N) direction |
| State2 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | |
| State3 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | straight lane for E-W & W-E) direction |
| State4 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | |
| State5 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | turning lane for (S-W & N-E) direction |
| State6 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | |
| State7 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | Straight lane for(N-S & S-N) direction |
| State8 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | |

The normal sequence of modern traffic light is shown in table I. The traffic light 1, 2 and 3 is active as the same performance of traffic light 4, 5 and 6 because of they are connected in parallel. And the traffic light 7, 8 and 9 is also active as the same performance of traffic light 10, 11 and 12 because of they are connected in parallel.

### B. *Software flowchart*

The system is divided into two modes for traffic light. One is the normal mode sequence and the other is the emergency mode sequence.

*(1) Emergency mode*

This emergency mode is used when the importance vehicles such as ambulance, fire brigade, police cars or VIP are arrived. If there is no the emergency mode, the importance vehicles will be faced more delay time. Therefore, the emergency mode is very important for every traffic light.

In this traffic light junction, people waiting for the traffic light turns to green. During the traffic jam, the emergency vehicles such as ambulance, fire brigade, police car or VIP vehicles will be stuck in the traffic jam. This case can cause the emergency case that becomes complicated. This case is very critical problem [7].

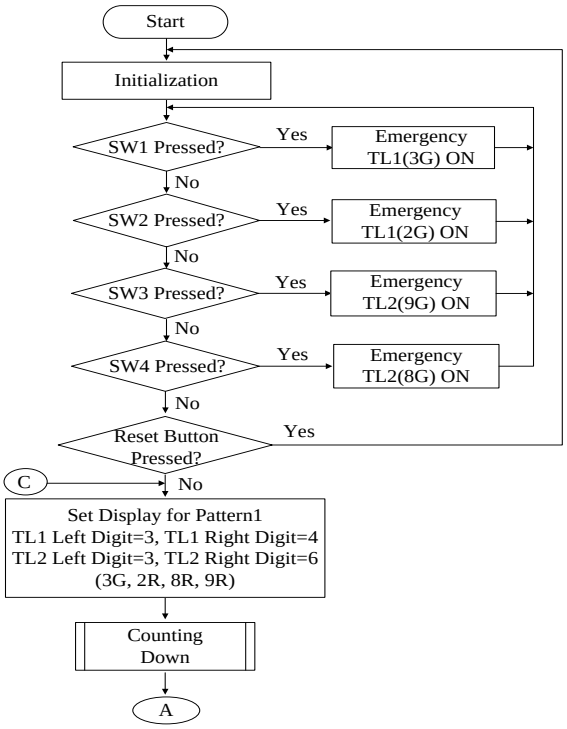


Figure 3(a): System flowchart for emergency mode

This flowchart is showed for the condition of emergency mode sequence. When each of control switches are pushed on triggered, the related emergency of each case is implemented. If each of control switches are not pushed or triggered, the normal mode sequence is implemented as the system flowchart.

*(2) Normal mode*

With the increasing number of vehicles on the road, the problem of a traffic congestion increased in large cities. This usually occurred in the morning and in the evening at the main junctions. Due to the effect of this, people wasted their time on the road. The delay for junctions that have high volume of traffic should be setting longer than the delay for the junction that have low of traffic. This operation is called Normal Mode [8].

Table II: Normal mode sequence of modern traffic light

| Direction | East-West Direction | | | | | | | | | North-South Direction | | | | | | | | | Lane Direction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TL No: | 1 | | | 2 | | | 3 | | | 7 | | | 8 | | | 9 | | | |
| Color | R | Y | G | R | Y | G | R | Y | G | R | Y | G | R | Y | G | R | Y | G | |
| State1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | turning lane for ( E-S & W-N) direction |
| State2 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | |
| State3 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | straight lane for E-W & W-E) direction |
| State4 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | |
| State5 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | turning lane for (S-W & N-E) direction |
| State6 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | |
| State7 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | Straight lane for(N-S & S-N) direction |
| State8 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | |

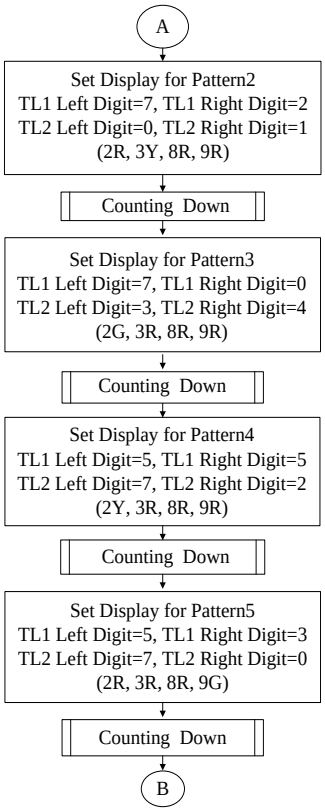


Figure 3(b): System flowchart for normal sequence

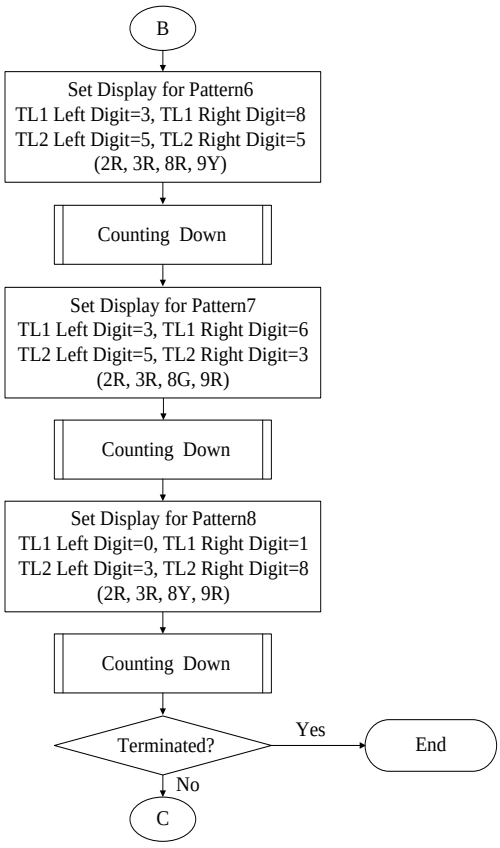


Figure 3(c): System flowchart for normal sequence

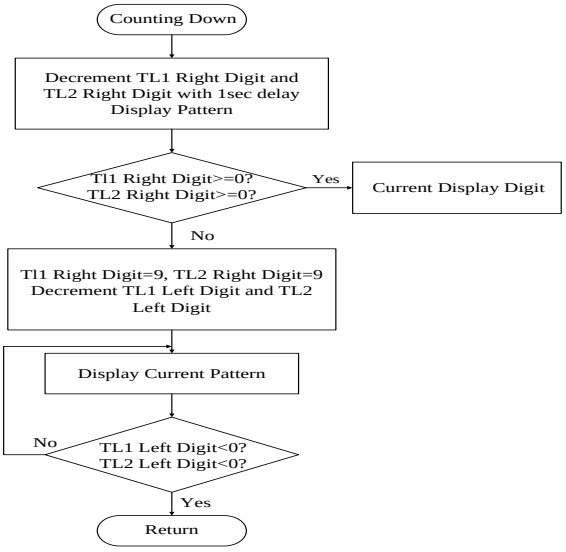


Figure 3(d): System flowchart for counting down of modern traffic light

## IV. HARDWARE RESULTS

The system is implemented as shown in figure 4 when the power is on. The traffic light 1, 2 and 3 is active as the same performance of traffic light 4, 5 and 6 because of they are connected in parallel. And the traffic light 7, 8 and 9 is active as the same performance of traffic light 10, 11 and 12 because of they are connected in parallel. In this system, the traffic light 1, 6, 7 and 12 are used for free lane. Therefore, when the system is implemented as figure 4, the traffic light 1, 6, 7 and 12 will be displayed ever green light.

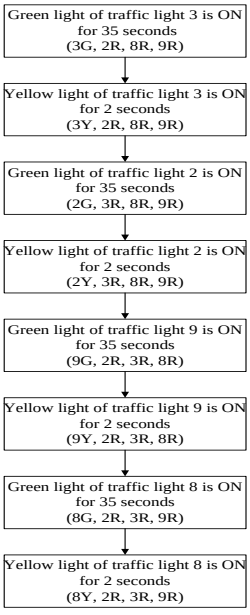


Figure 4: System flow diagram of modern traffic light

Figure 5: Hardware diagram of modern traffic light

The hardware results for normal mode sequence are as followed.

Table III: Table of green light of traffic light 3 and 4 for turning lane (East-South and West-North) direction for 35 seconds

| Traffic Light | Red | Yellow | Green |
|---|---|---|---|
| 1, 6 | 0 | 0 | 1 |
| 2, 5 | 1 | 0 | 0 |
| 3, 4 | 0 | 0 | 1 |
| 7, 12 | 0 | 0 | 1 |
| 8, 11 | 1 | 0 | 0 |
| 9, 10 | 1 | 0 | 0 |

The system is implemented as the above table III. The green light of the traffic light 3 and 4 is ON and the red light of the other traffic lights are ON except for the traffic light 1, 6, 7 and 12 because of they are using for free lane. The duration for green light is 35 seconds.

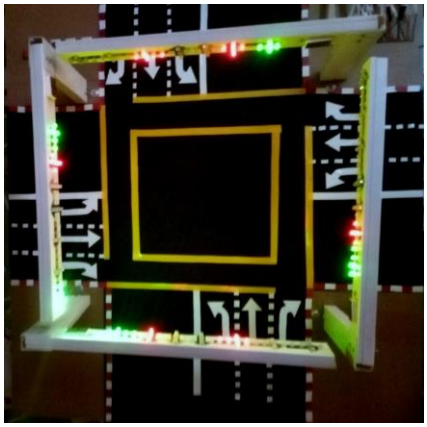

Figure 6: The green light of traffic light 3 and 4 for turning lane (East-South and West-North) direction is ON for 35 seconds

Figure 6 is a result of traffic light 3 and 4. In this state, the users can pass through the road from East-South and West-North

direction until the yellow light of traffic light 3 and 4 is ON. The duration for users in this state is 35 seconds.

When the green light of traffic light 3 and 4 is OFF, the yellow light of traffic light 3 and 4 is ON for 2 seconds.

Table IV: Table of yellow light of traffic light 3 and 4 for turning lane (East-South and West-North) direction

| Traffic Light | Red | Yellow | Green |
|---|---|---|---|
| 1, 6 | 0 | 0 | 1 |
| 2, 5 | 1 | 0 | 0 |
| 3, 4 | 0 | 1 | 0 |
| 7, 12 | 0 | 0 | 1 |
| 8, 11 | 1 | 0 | 0 |
| 9, 10 | 1 | 0 | 0 |

The system is executed as the above table IV. The yellow light of traffic light 3 and 4 is ON for 2 seconds. The result of yellow light is shown below.

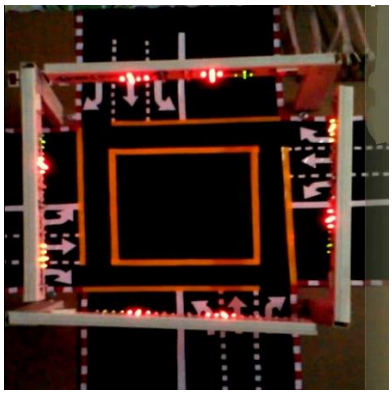

Figure 7: The yellow light of traffic light 3 and 4 is ON for 2 seconds

This figure 7 is a result of yellow light 3 and 4. This result is showed the users to stop and recommaned the users who wanted to pass through the road from East-West and West-East direction.

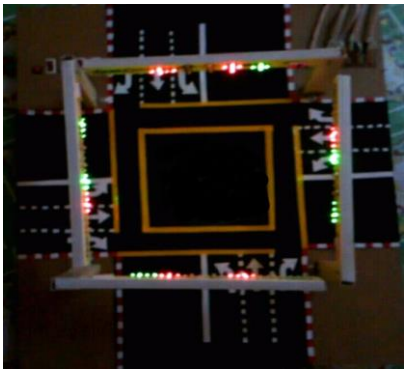

Figure 8: The green light of traffic light 2 and 5 for straight lane (East-West and West-East) direction is ON for 35 seconds

The figure showed the above is a result of traffic light 2 and 5 for the straight lane (East-West and West-East) direction. When the traffic light 2 and 5 is ON, the users on the road can pass through from the East-West and West-East direction until the yellow light is ON. The duration for the users can pass from East-West and West-East direction is 35 seconds.

When the yellow light of the traffic light 2 and 5 is ON, the users on this straight lane is needed to stop and the users who situated on the turning lane from South-West and North-East direction is needed to prepare to proceed. The duration for the yellow light of straight lane is 2 seconds.

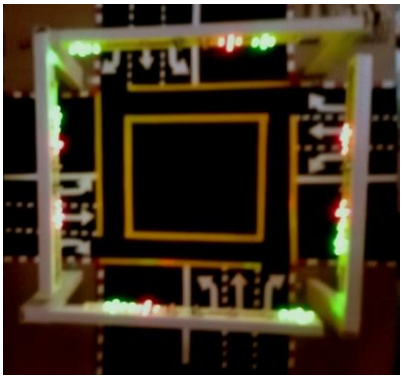

Figure 9: The green light of traffic light 9 and 10 for turning lane (South-West and North-East) direction for 35 seconds

This figure 9 is a result of traffic light 9 and 10 for South-West and North-East direction. In this state, the users from South-West and North-East direction can proceed until the yellow light of this traffic light is ON. The duration for the green light of traffic light 9 and 10 is 35 seconds.

After finishing the green light, the yellow light is ON. In that situation, the users who pass through from South-West and North-East direction is needed to stop from proceeding and the users who situated on the road are needed to prepare to proceed from North-South and South-North direction. The duration of the yellow light is 2 seconds.

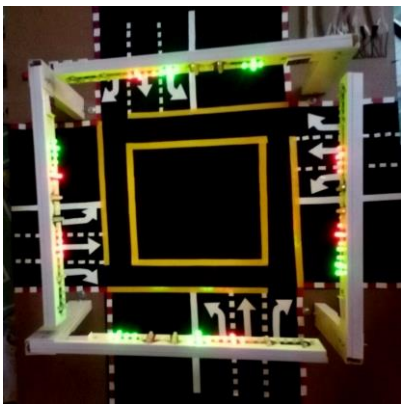

Figure 10: The green light of traffic light 8 and 11 is ON for 35 seconds

As the above figure 10, the users can pass through the road from North-South and South-North direction until the yellow light is ON. The green light of traffic light is taking 35 seconds. The yellow light of traffic light 8 and 11 is ON when the green

light of traffic light 8 and 11 is OFF. The yellow light of traffic light 8 and 11 is taking for 2 seconds.

## V. Conclusions

A modern traffic light of six road and four junction is implemented by using the programming in the PIC16F877A microcontroller. The sequences of this traffic light also have been developed by using the programming in the C language. The prototype of this system is using the frequency of 20MHz. The hardware implementation of traffic light is using the gate logic and the interfacing light is using LED [4]. The system works efficiently over the present traffic controlling system in respect of less waiting time, efficient operation during emergency mode and suggesting alternate route [9]. This prototype system can be developed in future by spending the real traffic position at intersection point.

## Acknowledgement

The author would like to acknowledge the head of Department of Electronic Engineering, Mandalay Technological University. The author is highly grateful to all the teachers, Department of Electronic Engineering, Mandalay Technological University. The author specially want to thank her supervisor, Dr. Chaw Myat Nwe, Associate Professor, Department of Electronic Engineering, Mandalay Technological University for her close-supervision, guidance and constant encouragements throughout a long period of the study and the work.

## References

[1] N. M. Z. Hashim[1], A. S. Jaafar[2], N. A. Ali[3], L. Salahuddin[4], N. R. Mohamad[5], M. A. Ibrahim[6], "Traffic Light Control System for Emergency Vehicles Using Radio Frequency", IOSR Journal of Engineering (IOSRJEN), e-ISSN: 2250-3021, p-ISSN: 2278-8719, Vol. 3, Issue 7 (July. 2013), ||V5|| PP 43-52.

[2] First A. Ms Promila Sinhmar, Rawal Institute of Engineering And Technology, "Intelligent Traffic Light and Density Control Using IR Sensors and Microcontroller", International Journal of Advanced Technology & Engineering Research (IJATER).

[3] Karthic Kumar Reddy, G. Jagadeesh, P. and Venkatramana Reddy, S.*, "Traffic Signals Generation With Bicolor LEDs Using PIC 18F Series Microcontroller", International Journal of Embedded Systems and Applications (IJESA) Vol.1, No.2, December 2011.

[4] Ali M. Abdelrahman, Adil T. Issa, Khalid O.Dafaalla, "Design of and Intelligent Traffic Light Control System", Gezira j. of eng. & applied. Sci. 6 (1): 19-46 (2011).

[5] "CMOS BCD-To-Seven-Segment Latch/Decoder/Driver For Liquid-Crystal Displays", [Online Available], www.ti.com, accessed on 8th October, 2013.

[6] "1-of-8 Decoder/Demultiplexer", [Online Available], www.fairchildsemi.com, accessed on 10th October, 2013.

[7] Shilpa S. Chavan (Walke)[1], Dr. R. S. Deshpande[3], J. G. Rana[2], "Design of Intelligent Traffic Light Controller Using Embedded System", Second International Conference on Engineering Trends in Engineering and Technology, ICETET-09.

[8] Stefan Peelen, Roelant Schouten, Merlijn Steingr Aover, "Design and Organization of Autonomous Systems: Intelligent Traffic Light control".

[9] Liu, "Routing finding by using knowledge about the road network", IEEE Transactions on System, man, and Cybernetics-Part A: Systems and Humans. Vol.27 No. 4, 1997, pp 425-430.

## Authors

**First Author** – Nang Hom Kham, ME Student, Mandalay Technological University, Myanmar and homkham81@gmail.com.

**Second Author**– Chaw Myat Nwe, Associate Professor, Department of Electronic Engineering, Mandalay Technological University and chawmyatnwe77@gmail.com.