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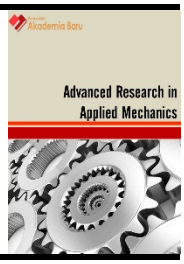

Development of traffic light control system for educational purpose using Motorola 68HC11 microcontroller

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ABSTRACT

Nowadays, traffic congestion has caused many problems such as wastage of time and environment pollution. This paper aims to develop a traffic control system for education level using Motorola 68HC11 microcontroller where the system will try to reduce the possibilities of congestion that caused by the traffic light. In addition, the system will also consider the needs of pedestrian road crossing. This system will be designed based on the sequence-based method where the traffic light sequence and timing are controlled by different receipt that selected by the program under different traffic situations. By implementing the developed traffic control system, the system is able to shorten the traffic waiting period and ensure the safety of the road user at the 4 lanes junction. Switches that represent the detector sensors will be installed at a distance around the traffic displays to monitor the status on each of the lane. When the sensor is blocked by a vehicle or a passenger at the specific location, it will be triggered and inform the microcontroller to change the timing of the green light at the respective lane.

Keywords:
Traffic congestion, Traffic Control System, Motorola 68HC11 microcontroller, Sequence Base Method

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1. Introduction

Nowadays, traffic control has become one of the unique management systems in the public which related with travelling, logistics and transportation. In order to ensure the traffic safety and efficient of traffic flow, the implementation of the modern technology such as the Intelligent Traffic Control System has become one of the achievement among governments. Today, the research of traffic light control aspects can be fully automated, in fact it integrate the entire region into one unique system. In addition, the system can optimize itself base on traffic situation. Research shows that two main designed strategies have been considered to improve the traffic congestion which is the individual type traffic control system and the traffic network management system. The individual type control system will only focus on a single junction where it is being setup. Whereby, the traffic network management system controls several junctions in an urban area with the real time basis. Among all the technologies being implemented, the microcontroller base system which belong individual type control system is simple and costless. At the same time, the system provides lower power consumption and better flexibilities compare to others design. By using microcontroller base system, users can create many more control to the appliances.

2. Overview of Micro-Controller Base Traffic Control System

Research shows that the improper control of traffic lights such as short green light timing setting during peak hour is one of the elements that cause traffic congestion. In Malaysia, most of the traffic control systems are still build base on the timer controller which operated according to the pre-set sequence and does not have the flexibility of modification on the real time basis. This paper is about to develop a practical traffic light control system which the system will solve the traffic congestion issue. To develop the project, there are four objectives that must be accomplished which are:-

- Develop a traffic light control system that able to have self-adjustment according to the road situation and pedestrian request.
- Develop a new traffic light control system using the Fox11 68HC11 microcontroller development board.
- To ensure the safety of the traffic users. • Implement the system on a model of a traffic light at the education level.

2.1 Traffic Control System

The traffic control system is interconnected with electronics system that controls traffic signal. It provides a basic flow of traffic lighting with a given timing when the traffic flow is smooth to control the vehicle movement. However, it is able to detect the road congestion during anytime and updates the lighting sequences or duration accordingly. Beside, this system will also provide a pedestrian traffic control for anyone who wishes to cross over the road.

2.2 Study Overview

This study has three main parts. First, site visit are conducted to focus the area and to evaluate the actual site problems. It followed by traffic survey where it is conducted at appropriate time and durations during traffic congestion. Finally, we proposed a suitable traffic sequence and timing to solve the existing problems.

2.3 Practical System Design

Figure 1 shows the layout of the crossroad which is basically build base on the traffic signal display at a cross junction with EW (East-West) direction and NS (North-South) direction. Furthermore, two pedestrian display PEW (Pedestrian East-West) and PNS (Pedestrian North – South) will also be involved in the traffic system. On the other hand, 6 detectors (normal open switch buttons) will be placed at different location around the junction to monitor the road situation.

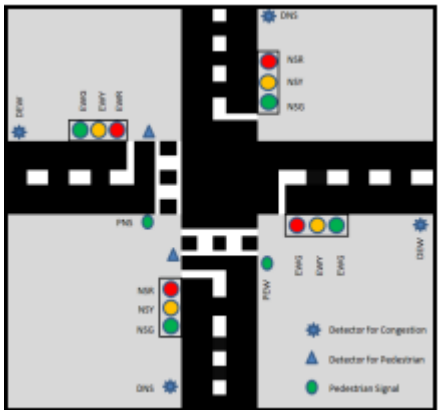

Fig. 1. Layout of the proposed traffic control system

The detectors are mainly use to sense the traffic status and send the signal to the microcontroller for analysis. The microcontroller will then takes decision and updates the traffic lighting sequence and timing accordingly as shown in figure 2.

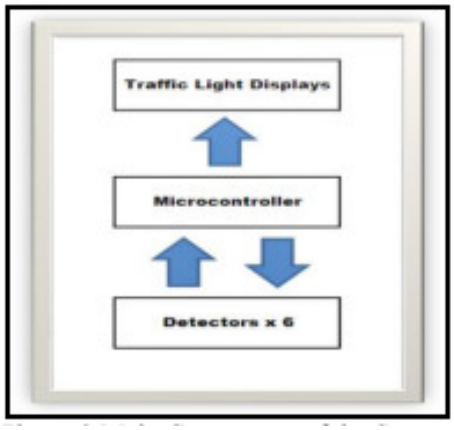

Fig. 2. Main Component of the System

Due to the complexities of traffic control system design, some assumptions have been made in this paper:

- The vehicles will only move in two directions which are horizontal (East-West) and vertical (North-South) direction. In other words, the change of direction between horizontal and vertical directions moving will be ignored.
- There will only have one green signal display for each pedestrian crossing. Pedestrian crossing should stop when the respective signal display is off.

- The pre-setting receipt in this paper is assigned base on the traffic sequence and timing at the location where site visit is conductor. Users are allowed to make any fine tune base on their requirements.

2.4 Sequence Base Traffic Control System

The main core of the system programming will focus on how the microcontroller select the appropriate receipt base on the different situation which is also known as the Sequence Base Method. Figure 3 shows the basic methodology on how the system works.

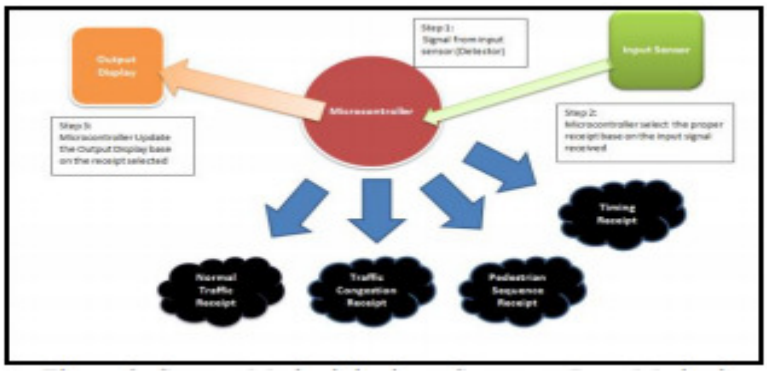

Fig. 3. System Methodologies – Sequence Base Method

The system is programmed in such way that the microcontroller will select the normal traffic receipt when no input signal is received, the output display will light up base on the data given from the normal traffic receipts. However when either congestion or pedestrian input signal are received, the microcontroller will re-select the appropriate receipt and light up the output display according to the data in the selected receipt. Base on the concept above, several lighting sequence and timing receipts will be created to allow the microcontroller make selection base on the input signal received. We believe that the implementation of receipts will provide an easier and flexible configuration and troubleshooting on the traffic control system. In order to make some changes on the lighting sequence and timing, users will only need to change the data in the proper receipt where it reduces lot of times in program tracing.

3. Hardware Implementation

The traffic control system consists of three main hardware parts. The first part is the EVA Fox11 68HC11 development board, which represents the brain of the traffic system. It consists of microcontroller that controls the sequences and timing of the traffic display base on the input signal received. The second part is the signal visualization or the signal display. The signal displays are the main part for controlling traffic in the cross junction. It usually comprise of solid red, yellow and green lights. The third part is the detector or the sensor. This detector is a device to indicate the presence of vehicle or passenger. Switch buttons are used to represent the detectors where users can simulate the traffic situation by just a single press. In the actual situation, these detectors can be replaced by a pressure or the IR sensors. In addition, the accuracy to sense the road or pedestrian traffic can be improved by increasing the number of sensor.

3.1 EVA Fox 11 68HC11 Development Board

The traffic control system will make use on the EVB Fox-11 development board which is build base on the Motorola 68HC11 microcontroller. It provides 60-pin EVA/EVBUcompatible female connector for all I/O ports. However, this paper will only make use on 8 outputs pin at port B and 8 inputs at the port C. As per power requirement of the development board to drive the traffic control system, it required a 9Vdc supply. AC power adapter was ready during the setup. It comprises a 0V ~ 9V transformer to step down the 240 V AC supply to 9V AC. Further a bridge rectifier converts the 9V into 92DC. However, the board could keep resetting itself if the supply lower than 4.6V dc. This board provide dual RS232 ports to communicate with the PC. However, RS232/ USB converter cable is needed when the PC are ready without com port. Figure 4 shows the main parts that will be used for simulating the intelligent traffic control system.

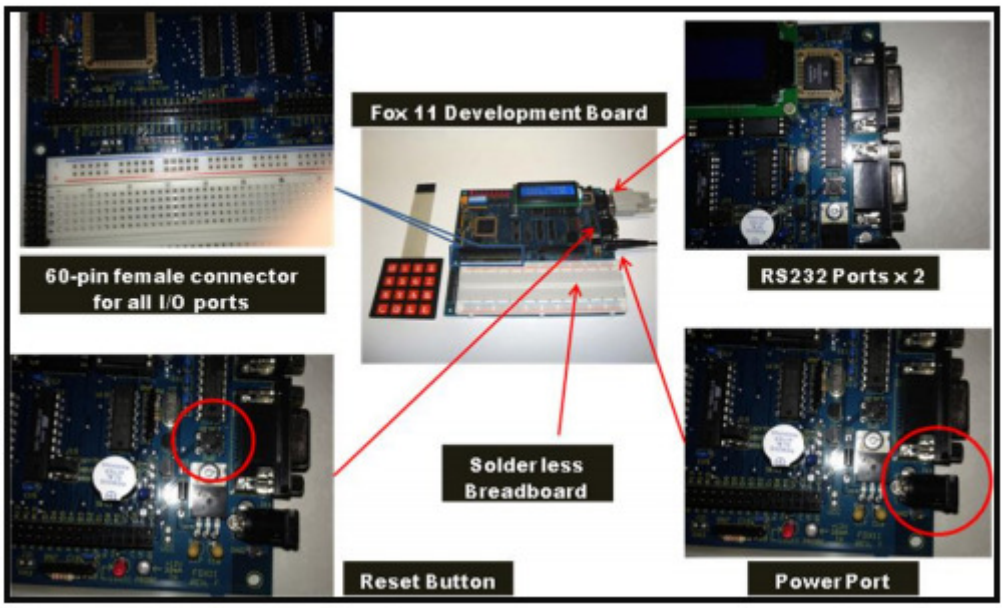

Fig. 4. Fox 11 Development Board

3.2 System Block Diagram

The system block diagram is shown in figure 5.

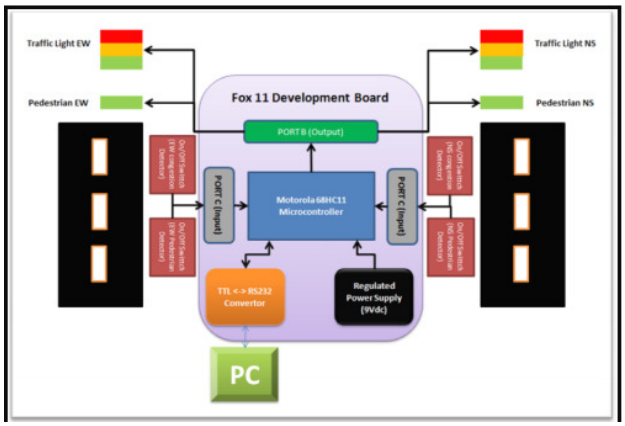

Fig. 5. System Block Diagram

3.3 Circuit Diagram

Base on the system block diagram, port B will be the output of the system and thus 8 sets of traffic display will be connected to B port. Each set of display consists of 2 pcs of LED. On the other hand, 6 pcs of detector will be connected with port C as the input of the system. Figure 5 shows the circuit diagram of the traffic control system.

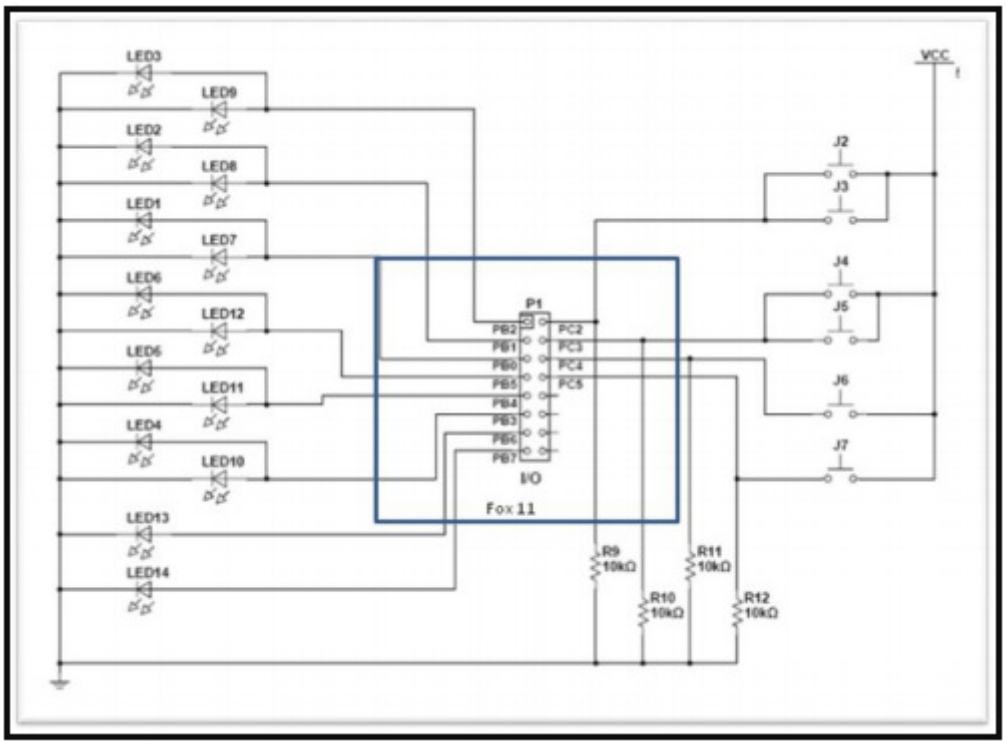

Fig. 6. Circuit Diagram of the Intelligent Traffic Control

4. Simulation

4.1 Assembler

This paper makes use of AsmIDE to communicate with the PC. The AsmIDE is an open source freeware and Integrated Development Environment for 68HC11 and 68HC12 families of embedded microcontroller. It allows programmer to edit their assembler source code with syntax – light lighting editor, and precede a command – line assembler for user. Furthermore, it comes with a terminal window which allow user interact with the microcontroller and download the .S19 files to the microcontroller.

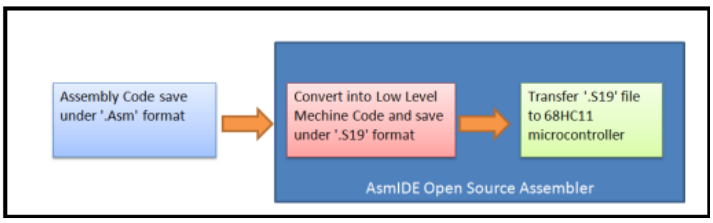

Fig. 7. Block Diagram of Code Access

4.2 Result

By loaded the source code from the Assembler to the Microcontroller trough the RS232 cable. The traffic display was lighting up base on the normal lighting sequences.

Table 1
Normal Traffic Lighting Sequence

Sequence No / Light Code / Port No	Pedestrian		North-South Direction			East-West Direction			Hex Code	Receipt
	B7	B6	B5	B4	B3	B2	B1	B0		
	PEWG	PNSG	NSR	NSY	NSG	EWR	EWY	EWG		
1	1	0	1	0	0	0	0	1	A1	
2	1	0	1	0	0	0	1	0	A2	Main1
3	0	0	1	0	0	1	0	0	24	
4	0	1	0	0	1	1	0	0	4C	
5	0	1	0	1	0	1	0	0	5C	Main2
6	0	0	1	0	0	1	0	0	2C	

Table 2
Conditions Branching during Traffic Congestion

Sequence No / Light Code / Port No	Pedestrian		North-South Direction			East-West Direction			Hex Code	Timing receipt =" Time"	Timing receipt =" TimeJam"	Lighting Receipt
	B7	B6	B5	B4	B3	B2	B1	B0				
	PEWG	PNSG	NSR	NSY	NSG	EWR	EWY	EWG		When PC4=0	When PC4=1	
1	1	0	1	0	0	0	0	1	A1	20	40	
2	1	0	1	0	0	0	1	0	A2	3	3	Main1
3	0	0	1	0	0	1	0	0	24	3	3	
										When PC5=0	When PC5=1	
4	0	1	0	0	1	1	0	0	4C	20	40	
5	0	1	0	1	0	1	0	0	5C	3	3	Main2
6	0	0	1	0	0	1	0	0	2C	3	3	

Table 3a
Traffic Signal when Pedestrian Detector (DPEW) is triggered

Pedestrian EW Sequence										
Sequence No / Light Code / Port No	Pedestrian		North-South Direction			East-West Direction				Remarks
	PB7	PB6	PB5	PB4	PB3	PB2	PB1	Pb0		
	PEWG	PNSG	NSR	NSY	NSG	EWR	EWY	EWG	Timing	
1	Off	On	Off	Off	On	On	Off	Off	2 sec	
2	Off	On	Off	On	Off	On	Off	Off	3 sec	
3	Off	Off	On	Off	Off	On	Off	Off	10 sec	
4	On	Off	On	Off	Off	Off	Off	On	1 sec	
5	Off	Off	On	Off	Off	Off	Off	On	1 sec	
6	On	Off	On	Off	Off	Off	Off	On	1 sec	
7	Off	Off	On	Off	Off	Off	Off	On	1 sec	
8	On	Off	On	Off	Off	Off	Off	On	1 sec	PEWG Blinking
9	Off	Off	On	Off	Off	Off	Off	On	1 sec	
10	On	Off	On	Off	Off	Off	On	Off	1 sec	
11	Off	Off	On	Off	Off	Off	On	Off	1 sec	
12	On	Off	On	Off	Off	Off	On	Off	1 sec	
13	Off	Off	On	Off	Off	On	Off	Off	2 sec	
14	Off	On	Off	Off	On	On	Off	Off	5 sec	
								Total	31 sec	

Table 3b
Traffic Signal when Pedestrian Detector (DPNS) is triggered

Pedestrian NS Sequence										
	Pedestrian		North-South Direction			East-West Direction				Remarks
Port No / Light Code / Sequence No	PB7	PB6	PB5	PB4	PB3	PB2	PB1	Pb0		
	PEWG	PNSG	NSR	NSY	NSG	EWR	EWY	EWG	Timing	
1	On	Off	On	Off	Off	Off	Off	On	2 sec	
2	On	Off	On	Off	Off	Off	On	Off	3 sec	
3	Off	Off	On	Off	Off	On	Off	Off	10 sec	
4	Off	On	Off	Off	On	On	Off	Off	1 sec	
5	Off	Off	Off	Off	On	On	Off	Off	1 sec	
6	Off	On	Off	Off	On	On	Off	Off	1 sec	
7	Off	Off	Off	Off	On	On	Off	Off	1 sec	
8	Off	On	Off	Off	On	On	Off	Off	1 sec	PNSG Blinking
9	Off	Off	Off	Off	On	On	Off	Off	1 sec	
10	Off	On	Off	On	Off	On	Off	Off	1 sec	
11	Off	Off	Off	On	Off	On	Off	Off	1 sec	
12	Off	On	Off	On	Off	On	Off	Off	1 sec	
13	Off	Off	On	Off	Off	On	Off	Off	2 sec	
14	On	Off	On	Off	Off	Off	Off	On	5 sec	
								Total	31 sec	

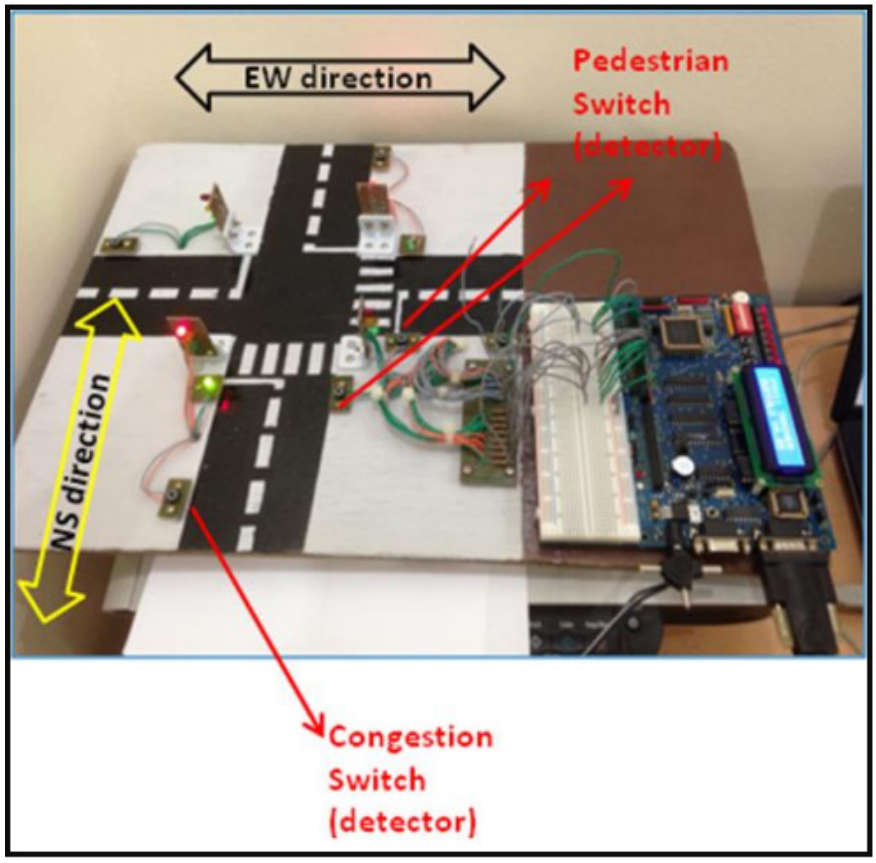

Fig. 8. 68HC11 Sequence Base Traffic Control System

5. Conclusions

The program was running well and only a few minor errors were found when compiling the source code. The simulation was successes in the way that the traffic display sequence meets the requirement that stated in the respective receipt. The control switch which represents the detectors

had successfully caused the light sequence and timing changed when trigger. Finally, the signal timing of the traffic display is accurate with the parameter pre-set in the system (receipt).

5.1 Future Scope

This paper focus on how the basic traffic controls system was build using 68HC11 microcontroller programming. Base on the site visit and the concept from the literature review, we have successfully designed the system based on the receipt selection method. However, it does not come with the intelligent feature as it does not include the data monitoring system. As a result, we can consider improving the system by adding a data logger which connected between the PC and the development board. Base on the data received at the PC, the administrator can update the timings of traffic light delay and the sequence base on the real time status.

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