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

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Research Article

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ABSTRACT: These days, time wasting and environmental pollution are only two of the numerous issues brought on by traffic congestion. The purpose of this work is to create a traffic control system at the educational level utilizing a Motorola 68HC11 microcontroller. The system will attempt to lessen the likelihood of traffic light-related congestion. The technology will also take pedestrian road crossing requirements into account. This system will be built using a sequence-based approach, in which several receipts chosen by the software under various traffic conditions regulate the timing and sequence of traffic lights. The traffic waiting time can be reduced and road user safety at the four-lane intersection can be guaranteed by putting the proposed traffic management system into practice. To keep an eye on each lane's condition, switches that mimic the detector sensors will be placed at a distance from the traffic displays. The sensor will be activated and notify the microcontroller to alter the time of the green light in the appropriate lane when it is obstructed by a car or a passenger at the designated spot.

Introduction

These days, one of the most distinctive public management systems pertaining to travel, logistics, and transportation is traffic control. The use of contemporary technology, such as the Intelligent Traffic Control System, has become one of the accomplishments of governments in order to guarantee traffic safety and effective traffic flow. These days, traffic light control research may be completely automated; in fact, it unifies the whole area into a single, distinct system. Furthermore, the system is capable of self-optimization based on traffic conditions. According to research, two primary planned strategies—the traffic network management system and the individual type traffic control system—have been taken into consideration to reduce traffic congestion. Only one junction will be the focus of the individual type control system when it is set up. In an urban region, several intersections are managed by the traffic network management system on a real-time basis. The microcontroller base system, which belongs to the individual type control system, is the most straightforward and inexpensive of all the technologies being used. In addition, the system offers more flexibility and less power usage than competing designs. Users may add a lot more control to the appliances by using microcontroller-based systems.

Overview of Micro-Controller Base Traffic Control System

According to research, one of the factors contributing to traffic congestion is inappropriate traffic signal regulation, such as short green light time during peak hours. The majority of traffic control systems in Malaysia are still based on timer controllers, which function in accordance with predetermined sequences and lack the flexibility to be modified in real time. The goal of this study is to create a workable traffic light control system that will address the problem of traffic congestion. Four goals must be met in order to advance the project, and they are:-

Create a traffic light control system that can self-adjust based on pedestrian requests and road conditions.
Using the Fox11 68HC11 microcontroller development board, create a new traffic light control system.

To guarantee traffic users' safety. At the educational level, apply the system to a traffic light model.

Traffic Control System

The electronics system that regulates traffic signals is linked to the traffic control system. In order to regulate vehicle movement, it offers a basic traffic lights flow with a specified period when the traffic flow is smooth. Nonetheless, it can identify traffic jams at any moment and adjust the lights duration or sequences appropriately. Additionally, anybody who wants to cross the road will be able to do so thanks to this system's pedestrian traffic management.

Study Overview

There are three primary sections to this research. Site visits are first carried out to concentrate the area and assess the real site issues. It is followed by a traffic survey, which is carried out during periods of traffic congestion at the proper times. In order to address the current issues, we finally suggested an appropriate traffic sequence and time.

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.

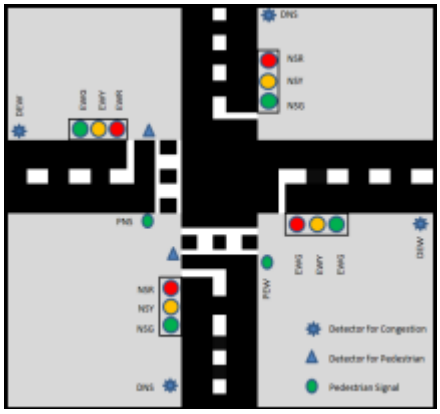


Fig. 1. Layout of the proposed traffic control system

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.

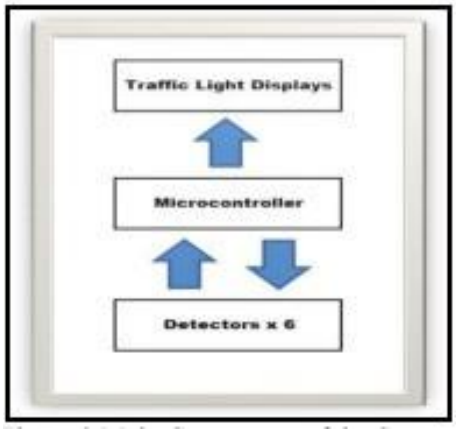


Fig. 2. Main Component of the System

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.

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.

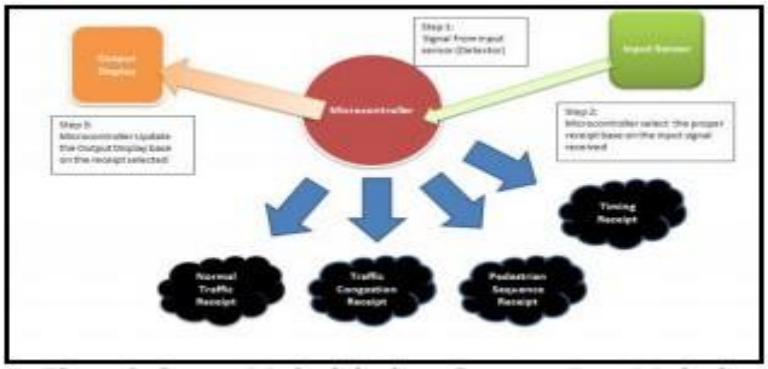


Fig. 3. System Methodologies – Sequence Base Method

The system is configured such that, in the absence of an input signal, the microcontroller will choose the regular traffic receipt, and the output display will illuminate based on the information provided by the normal traffic receipts. However, the microcontroller will re-select the correct receipt and illuminate the output display in accordance with the data in the chosen receipt when either a pedestrian input signal or a congestion signal is received. In order to enable the microcontroller to make decisions based on the input signal received, a number of lighting sequence and timing receipts will be developed based on the aforementioned approach. We think that using receipts will make it simpler and more adaptable to configure and fix the traffic management system. Users will simply need to modify the data in the appropriate receipt to make certain modifications to the lighting sequence and timing, which will save a significant amount of time in program tracing.

Hardware Implementation

There are three primary hardware components that make up the traffic control system. The EVA Fox11 68HC11 development board, which serves as the traffic system's brain, is the initial component. It is made up of a microcontroller that regulates the traffic display's timing and sequences based on the input signal it receives. The signal display, also known as signal visualization, is the second component. The primary component for managing traffic at the intersection is the signal displays. Typically, it consists of solid red, yellow, and green lights. The detector, often known as the sensor, is the third component. The purpose of this detector is to show if a car or passenger is present. The detectors are represented by switch buttons, which allow users to mimic traffic conditions with a single stroke. In the real world, pressure or infrared sensors may take the role of these detectors. Increasing the number of sensors may also increase the accuracy of sensing pedestrian or road traffic.

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.

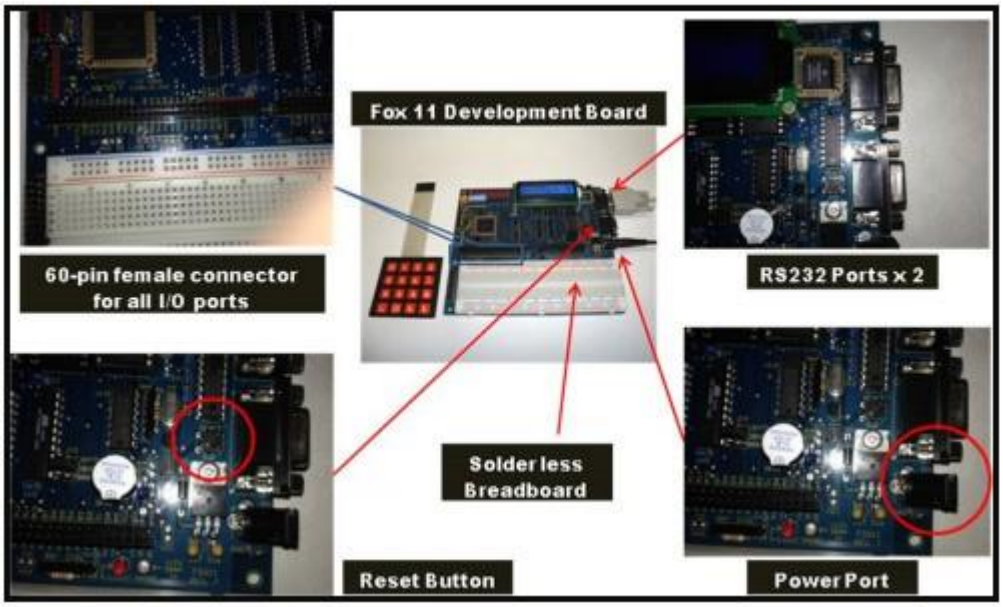


Fig. 4. Fox 11 Development Board

System Block Diagram
The system block diagram is shown in figure 5.

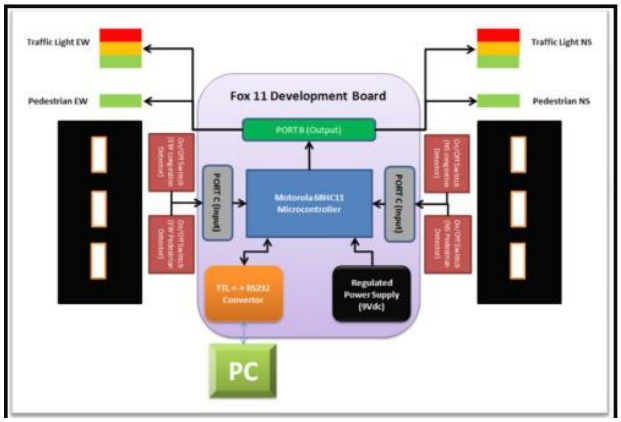


Fig. 5. System Block Diagram

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.

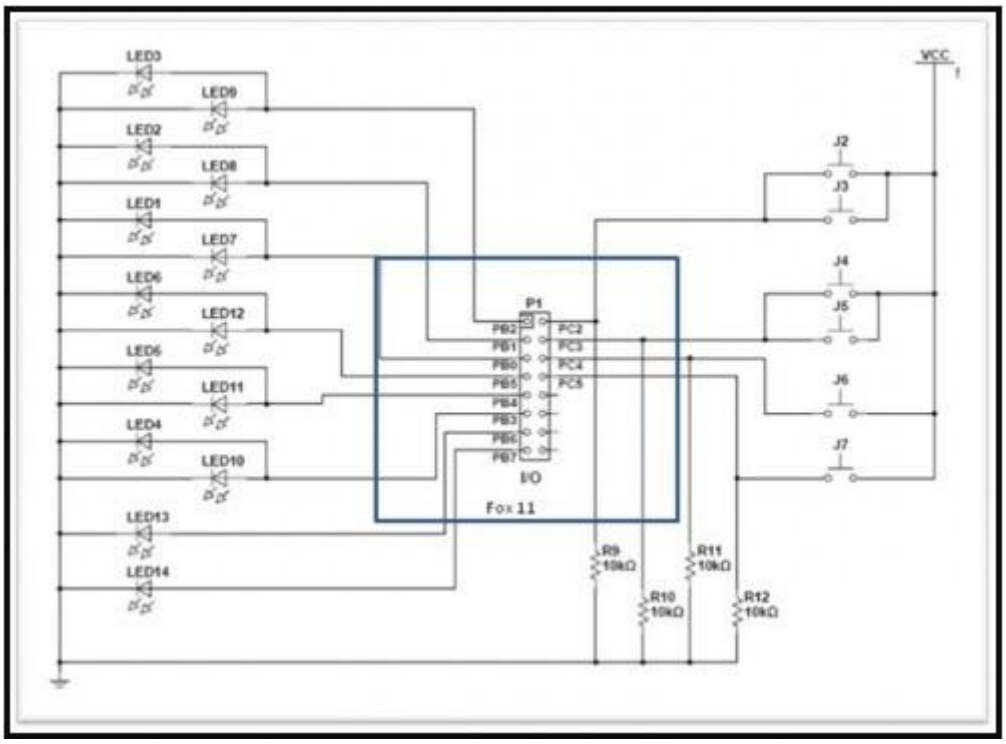


Fig. 6. Circuit Diagram of the Intelligent Traffic Control

Simulation

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.

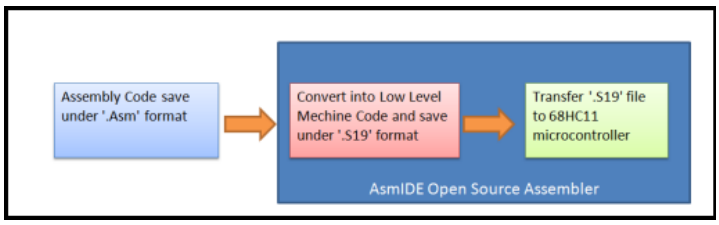


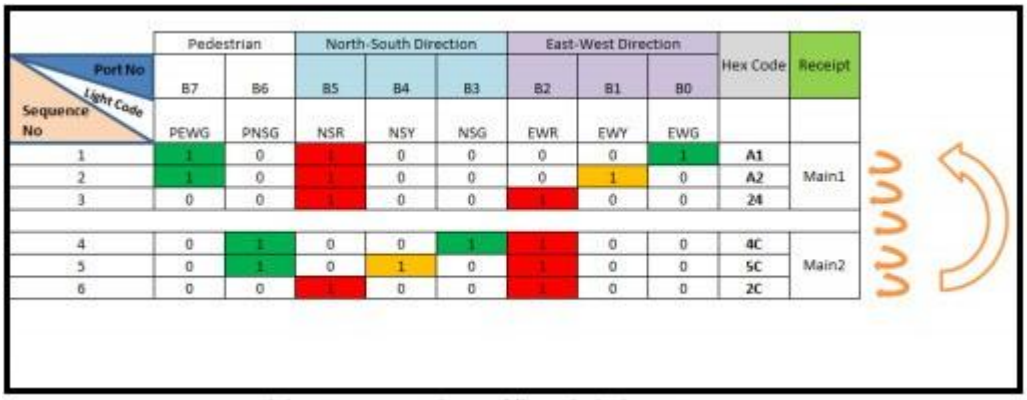
Fig. 7. Block Diagram of Code Access

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



Port No / Light Code / Sequence 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

Port No / Light Code / Sequence 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

Port No / Light Code / Sequence 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	

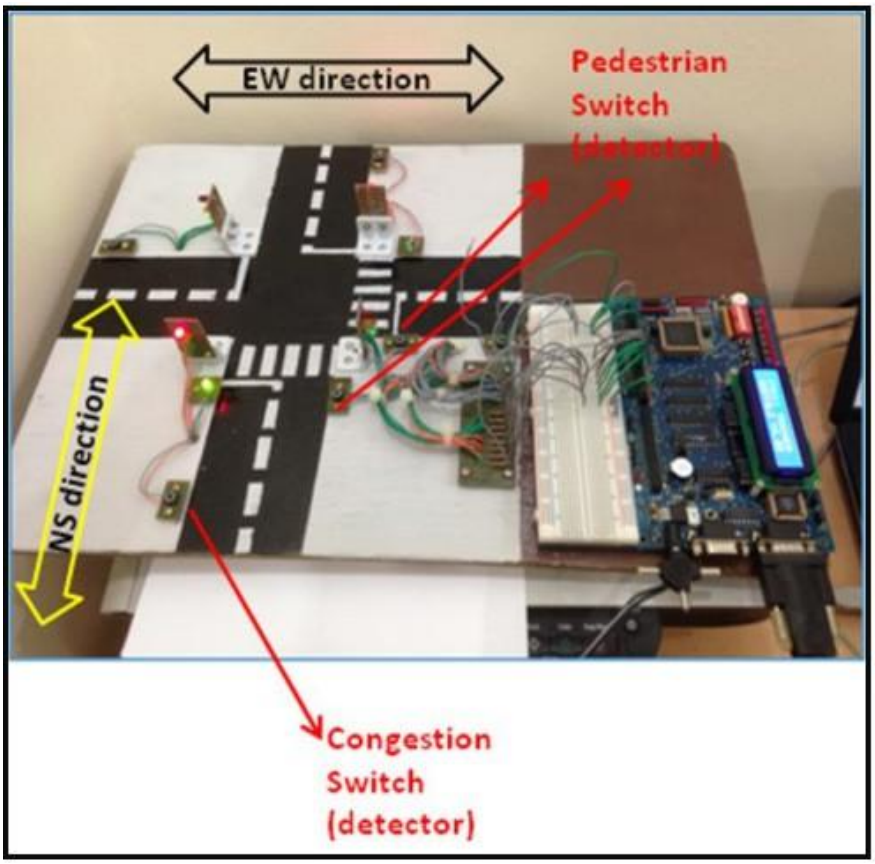


Fig. 8. 68HC11 Sequence Base Traffic Control System

Conclusions
When the source code was compiled, just a few small problems were discovered, and the application was operating well. The traffic display sequence satisfies the requirements specified in the corresponding receipt, indicating that the simulation was successful. The detectors are represented by the control switch.

had successfully altered the time and light sequence when triggered. Lastly, the traffic display's signal time is precise with the system-pre-set parameter (reception).

Future Scope

This study focuses on the 68HC11 microcontroller programming used in the construction of the fundamental traffic control system. We have effectively created the system based on the receipt selection approach based on the site visit and the idea from the literature research. However, since it lacks a data monitoring system, it lacks the intelligent function. Therefore, we may think about enhancing the system by connecting a data logger between the development board and the PC. The administrator may modify the traffic light delay timings and the sequence based on the current status based on the data received at the PC.

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