Design Of Semi-Automatic Traffic Light Control System

Abdelrasoul Jabar Alzubaidi, Arwa Abdel Mohsen Ahmed Hassan

Abstract—Today’s traffic light system has a lot of limitations at road junction. The system is not flexible or in other words cannot modify on real time. The static traffic control have fixed timing for the three traffic lights “the green, yellow and red”. The cars waste a lot of fuel and surely the driver waste a lot of time. To solve and monitor the traffic light system and make it more efficient, we have to use an intelligent technique taking the advantage of the sensors, microcontroller and the GSM modem which could add the real time benefit to the system. This paper explores the design of semi automatic traffic light control system. The traffic light is designed using microcontroller ATMEGA32 programmed by BASCOM AVR, power supply, IR sensor and GSM modem. The system solves the wasting time and fuel problem and the problem of the emergency car which waits a lot in the road intersection as well as it solves the problem of the congestion that occurs when an accident in the path happens. The system can be used for the traffic at the road intersections.

Index Terms—control system, PC, Bascom, traffic, microcontroller, GSM system. Traffic light

1 INTRODUCTION

The Traffic Light Controllers are based on the microcontrollers and the microprocessors. These Traffic Light Controllers have some limitations due to using a pre-defined hardware, which is programmed according to fixed time that never change. Hence, there is no flexibility of modification on real time basis. Due to the fixed time for the three color signals, the waiting time is more and cars waste more fuel. The goal of the driver is to reach at destination without wasting time and money. But the resources provided by the current infrastructures are limited. So the traffic management at road is crucial to reduce waiting and traveling times, save fuel and money. Many times accidents happen due to the poor performance of the system. The proposed system provides the map feature, which controls the traffic on request. The traffic density is increasing at an alarming rate in developing countries which calls for the need of advance intelligent traffic signals to replace the conventional manual and time based traffic signal system. The system should give priority to the density of traffic on the roads. This can be done by making a bridge with IR sensor on the road intersections and make the decision according to the information that the sensor senses. The timings of the traffic lights at each crossing of road will be intelligently decided based on the total traffic on all adjacent roads. Thus, optimization of traffic light switching increases road capacity and traffic flow, and can prevent traffic congestions. The primary role of a microcontroller unit in an embedded system is to provide inexpensive, programmable logic control and interfacing to external devices. This means microcontroller unit typically is not required to provide complex functions. It is well suited for monitoring a selected variety of inputs and responding to them in real time using the preprogrammed instructions that are executed by the built in processor. An embedded microcontroller can respond to these inputs with a wide variety of devices. The IR sensor detects vehicles. To detect the emergency vehicles, The GSM modem will be used to receive signal from user and send signal to the microcontroller to change the state of the traffic light, the GSM also reduce the congestion’s problem that happen after the accident, by change the lane’s traffic light to stop mode. In this paper, intelligent traffic light controller based on microcontroller system was implemented using the IR sensor and GSM system to provide users who wish to obtain the latest position of traffic on congested roads.

2 APPROACH

The paper covers the area of microcontroller based system, data acquisition, interfacing and wireless data exchange. The system design method will be divided into three phases as follows:

Phase one: the sensing unit.
Phase two: control algorithm.
Phase three: GSM model.

The figure (1) below shows the block diagram for the system.

- Abdeltasoul jabar alzubaidi-Sudan university of science and technology, Sudan, 00249912444672. E-mail: author_rasoul46@live.com
- Co-Author name is currently pursuing masters degree program in electric power engineering in University, Country, PH-01123456789. E-mail: author_name@mail.com

Figure (1) Block diagram of the system design
The designed system can operate in three modes of operations. Mode one: Normal traffic operation. (i.e. No emergency cars are requesting passage and no accident occurs). Here, the traffic lights will operate according to the equation no. (1) below; Traffic lights timing (TN) α Density of traffic on the lane (D) ..............(1)

Mode two: Emergency traffic operation. (i.e. Emergency cars are requesting passage and no accident occurs). Here, the system will give lane passage command and traffic lights will operate according to the equation no. (2) below; Lane emergency timing (TE) α Duration emergency car passage (E) ... (2)

Mode three: Accident traffic operation. (i.e. No emergency cars are requesting passage and an accident occurs). Here, the system will give divert commands and traffic lights will operate according to the equation no. (3) below; Accident timing (TA) α Duration for settling the accident (A) ....... (3)

3 SYSTEM COMPONENTS

3.1 The GSM system:
The GSM-III alarm base system is interfaced to the microcontroller. It sends and receives SMS messages. The GSM provides the microcontroller with the commands and accordingly gives response based on the program embedded in the microcontroller. Figure (2) shows the GSM-III alarm base system.

![Figure (2) GSM-III alarm base system](image)

3.2. PC Computer:
PC computer is used to program the microcontroller. The BASCOM language is used to program the microcontroller. A lab link connects the PC to the microcontroller while programming.

3.3 HD74LS373 Latching IC:
The HD74LS373 is eight bit is register IO mapped used as a buffer which is used for storage of data. Different types of latches are available HD74LS373 octal D-type transparent latch will be used in this system. This type of latch is suitable for driving high capacitive and impedance loads.

3.4 ULN 2001A Darlington IC:
The ULN2803A is a high-voltage, high-current Darlington transistor array. The device consists of eight NPN Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of each Darlington pair is 500 mA. The Darlington pairs may be connected in parallel for higher current capability.

3.5. Traffic lights:
Three different colour lamps are used (RED, ORANGE, GREEN).

3.6. ATMEGA 32 microcontroller:
It is programmed to perform the tasks in the system.

4 ALGORITHM
The microcontroller algorithm includes a sequence of steps for the operation of the traffic system. The algorithm is; Start

--- Normal mode: This mode counts the traffic density and accordingly activate the traffic lights.

--- Check the incoming message: - If the message comes from an emergency vehicle, then revert To the emergency operation mode of the system. - If an accident message comes from the traffic control officer, then revert to the accident operation mode of the system. - If force ending message comes, then the system reverts to end.

--- If not loop to normal mode. End.

5 V. RESULTS
Following are the results for the system operation.
Normal operation  ---- Traffic lights timing depends on the traffic density.
Emergency mode operation ---- Give pass command to the lane.
Accident mode operation ---- Divert traffic command.

Table (1) below shows the resulted traffic timing relative to the cars queuing on the lane.

<table>
<thead>
<tr>
<th>Traffic density (D)</th>
<th>Emergency cars</th>
<th>accidents</th>
<th>Timing (TN) secs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>NON</td>
<td>NON</td>
<td>30</td>
</tr>
<tr>
<td>7</td>
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<td>NON</td>
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</tbody>
</table>

6 VI. CONCLUSION
The number of road’s users is constantly increases; hence the need for an intelligent control of traffic becomes an important issue in the present day. However, some limitations to the usage of intelligent traffic control exist. Avoiding traffic jams for example and makes the priority always to the emergencies car is thought to be beneficial to both environment and economy.

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