An Intelligent Public Transportation Management System

Enoch Tetteh Amoatey, Henry Kwame Atiglah

Abstract— The growing need for the public transportation system in urban cities is on the rise as the influx of migrants from rural areas to seek greener pastures continue to increase. The high cost of living in such urban cities is largely the reason for this growing need for public transportation systems. There should be a mechanism to, however, manage these transport systems as the keep expanding per the demand in order to reduce road carnage through fatal accidents, save bus waiting time and needless traffic congestion. Bus stop shelters are usually erected at defined locations for passengers waiting to board public buses. Unfortunately, passengers are sometimes made to wait for long periods before a bus may show up usually because of the idle nature of such routes. This paper, however, seeks to proffer a solution to the difficulty. This is achieved by designing a system that notifies drivers of commercial vehicles of the number of passengers in a bus shelter by keeping track of these passengers as they make their way to the respective bus stop shelter. The counting is done by using an arrangement of infra-red(IR) transmitter and receiver at the entrance and exit of the respective shelters. The method employed also utilizes a Global System For Mobile Communications(GSM) module to send a Short Message Service (SMS) about the real-time status of a shelter to the drivers. In order not to steal the driver's attention, the message will be displayed on a Liquid Crystal Display(LCD) screen instead of his mobile phone. This should, therefore, the prompt timely arrival of these vehicles since the drivers know the situation at the respective bus stops. The result of this project seeks to provide commercial buses with the requisite information on the passengers in different bus stop shelters which will effectively help both the public transportation system and the passengers in a specific area, reduce the number of buses operating in a single route, hence reducing the traffic congestion and also road accidents, helping passengers get to their destinations in time.

Index Terms— Bus Shelter, GSM, Infrared Sensors, Microcontroller, Public Transport, SMS, Traffic Congestion

1 INTRODUCTION

AN intelligent system to aid public bus transport is a system designed to assist public vehicle drivers to determine the number of passengers waiting at a bus shelter to be picked up by public transport. This is done by notifying the commercial drivers through SMS, the exact number of potential passengers in a bus shelter. This system offers to efficiently assist road usage by public bus drivers, maximum use of fuel, reduce the amount of vehicle operating at a single route. The major components of this system include Infrared sensors, microcontroller, LCD screen, GSM module (Transmitter and Receiver).

The GSM module is used in this system to send SMS from the bus shelter to an LCD display screen on the public bus. A GSM module consists of a transmitter and receiver. The GSM transmitter is responsible for sending the SMS periodically from the bus shelter to the GSM receiver. The receiver is interfaced to a microcontroller and an LCD display module. In this system, the time period for each SMS to be sent to the receiver is approximately one minute. This time period was considered for demonstration purposes and may be adjusted to suit the circumstances.

The basic operation of this system revolves around the microcontroller. The intelligent system to aid bus transport consist of three stages. The first stage is the passenger detection and counting. In this stage, the IR sensor at the entrance gate counts how many people that enter the bus shelter and how many people leave the bus shelter at the exit gate. The sensor at the entrance gate increments the number display by plus one (+1), while the sensor at the exit gate decrements the number display by minus one (-1).

The second stage, however, involves the transmission of the SMS. This is done by using a GSM module. The GSM module has a transmitter and also a receiver side. The transmitter is used to send the number of passengers counted at the bus shelter to the receiving side of the GSM module. The receiver accepts this SMS and then sends it to a microcontroller, which then decodes the message and then displays it on an LCD display screen.The third stage involves an emergency protocol. This stage was introduced in case of emergencies in the bus shelter such as fire outbreak, possible fights etc. An emergency control switch is placed in the bus shelter. When this switch is pressed, it initiates a protocol which opens a larger exit gate (i.e. emergency gate) and also reset the passenger counting display to zero.

2 SYSTEM DESIGN ASPECTS

The preoccupation of this section chapter is the system design involving block diagram, circuit diagram, description of the design blocks, description of the circuit diagrams and their requirements.

2.1 Block Diagram And Description

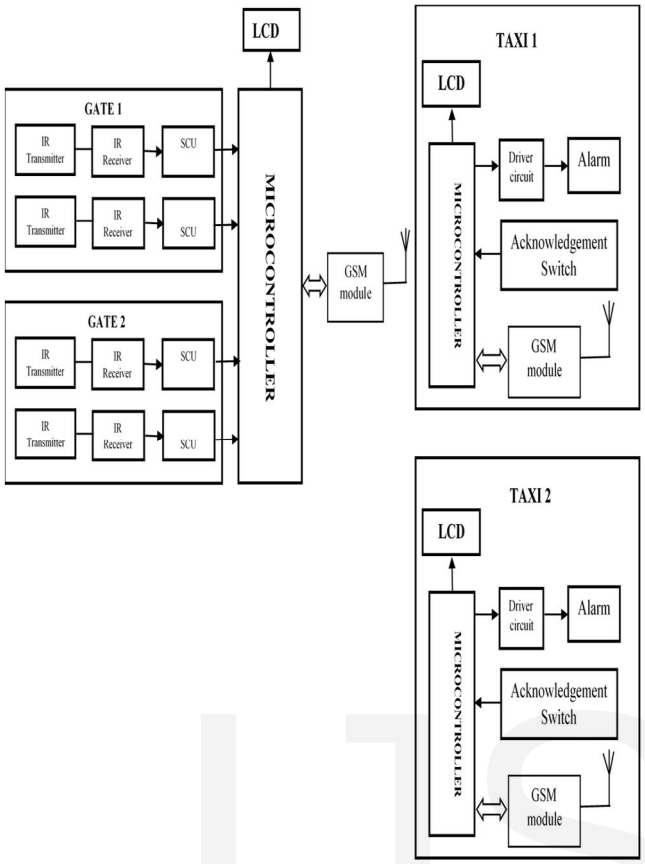

Fig 2.1 Block Diagram Of An Intelligent Public Transportation Management System.

2.1.1 Power Supply

The purpose of a power supply is to take electrical energy in one form and convert it into another. It is designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can be broken down into a series of blocks, each of which performs a particular function. It consist of a step down transformer, a bridge rectifier, and a 7805 voltage regulator.[1]

2.1.2 Microcontroller

A microcontroller is a tiny cheap computer that have great capabilities for sensing and controlling the event in the physical world. They are useful for cheaply embedding a little memory, a rule, a communication channel or anything that computing offers into almost any object no matter how small, inexpensive or mobile. [2]

2.1.3 LCD Display (16 X 2 Character LCD)

LCD (Liquid Crystal Display) screen is an electronic display module. A 16x2 LCD can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD [3].

2.1.4 IR Sensors

An infrared sensor is an electronic device that emits and/or detects infrared radiation in order to sense some aspect of its surroundings. Infrared sensors can measure the heat of an object, as well as detect motion. An infrared sensor consists of a transmitter and a receiver. [4].

2.1.5 GSM Modem

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network[5].

2.2 Circuit Diagrams

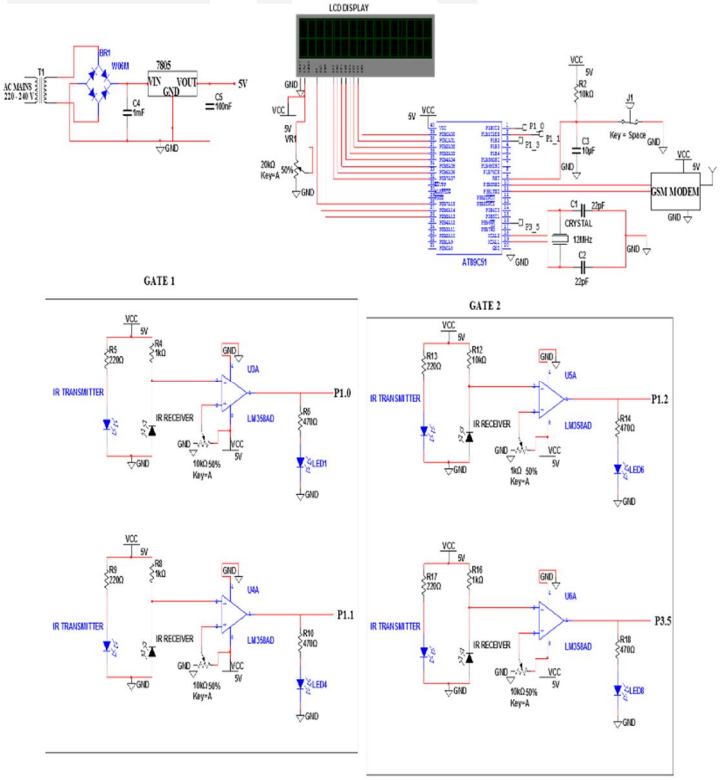

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Fig 2.2 Circuit Diagram for Bus Shelter

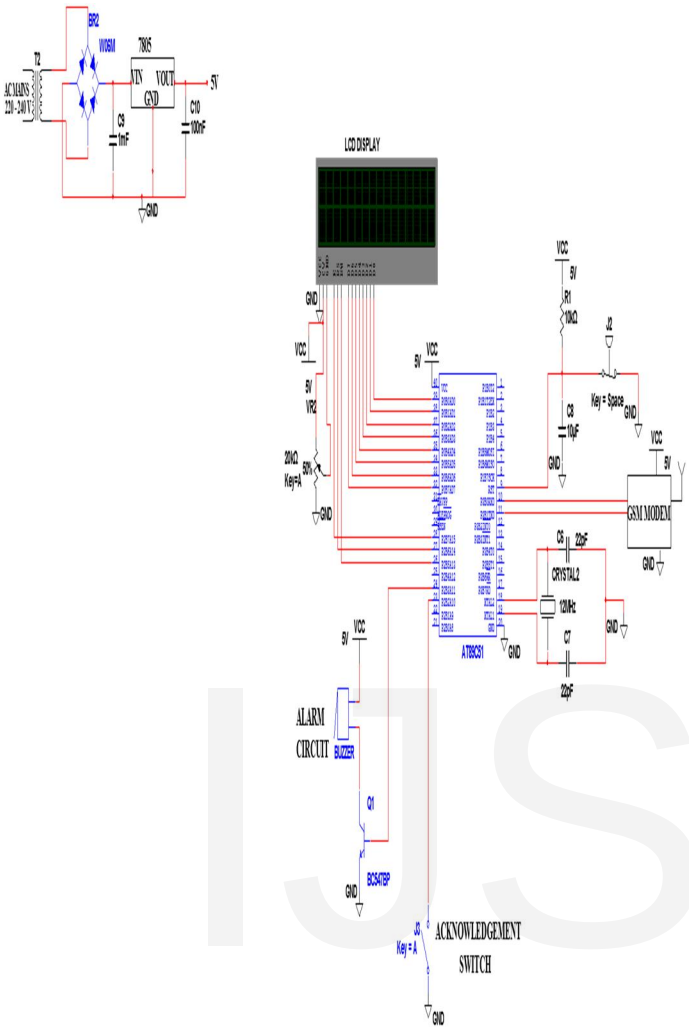

Fig 2.3 Circuit Diagram For Bus

2.3 Circuit Description And Operation

From above figures, the power supply module supplies a regulated +5V DC voltage.The infrared sensor module detects a passenger when the transmitted light signal from the IR LED to the IR receiver is blocked by the passenger. The receiver diode has a very high resistance, typically of the order of mega ohms when the IR is not incident upon it. However, when the IR TX is incident upon the receiver, the resistance decreases typically in the order of a few kilo Ohms or even lesser. A resistor of 1 Kilo Ohms is then connected in series with the IR RX and the output voltage is taken from the point of connectivity between the IR RX and 1K Ohms resistor. This output voltage is in an analog form and must be converted into digital form for proper communication between the IR sensor and microcontroller.

The conversion of the output voltage from analog to digital form, is done by configuring an operational amplifier (OP-AMP) into a voltage comparator. The voltage comparator compares two voltages and produces a digital output which can either be "HIGH" or "LOW". The sensor module triggers a high pulse to be sent through the LM358 output pin 1 whenever it detects a change in the voltage level.

This pulse is read by the microcontroller and used to detect when a passenger enters the bus shelter and also count how many passengers are in the bus shelter. When the microcontroller has done the counting process using the IR sensors and LM358, the LCD is used by the system to present visual output of system operations to the passengers at the bus shelter and the commercial bus drivers, displaying the number of passenger him or her is supposed to pick up at the bus shelter. The microcontroller communicates with the LCD using a 4-bit parallel interface. The communication connection between the microcontroller and the LCD is established using four (4) data pins (D4 to D7) and two (2) control pins (RS and E).

The GSM module is used in transmitting the number of passengers present in the bus shelter (i.e passengers entering and passengers leaving) to the public bus operator. There are two sets of IR sensors in each gate. The number of passengers entering is gotten when the voltage comparator gives an output of "HIGH" at IRS1 first before given a "HIGH" output at IRS2.when the output "HIGH" is gotten from IRS2 first before IRS2, a decrement is made by the microcontroller which means there is an exit made by a passenger. This information about the passengers are sent to the bus shelter after every 60 seconds.
An Acknowledgement switch is placed on the bus operator circuit. This switch is turned on when the operator of the bus decides to go to the bus shelter to pick up the passengers in it. The information of how many bus drivers that switched on their acknowledgement switch is sent to the bus shelter via the GSM module and also displayed on the LCD in the bus shelter.

3 Results And Discussion

The smart system to aid public transit project consists of three different circuits.The circuit is one for the bus shelter and two of the same configuration for the two buses used for demonstration.The circuit of the bus shelter contains IR sensors placed at the gates.The testing of this IR sensors to be functional was done successfully.Since the IR rays are not visible to the human eyes it was tested using a camera to view the emission of the IR rays from the transmitter.

All other components in these electronic circuits were soldered into a printed circuit board. In achieving an efficient soldering process, it was ensured that the soldering iron was not overheated to avoid melting the PCB and legs of the electronic components.The IC pins were extended using copper wires so it can sit inconveniently and also done to help with the connection of the electronic circuits.The GSM modules used in this project are configured with a SIM number and synchronized using an IC.The SIM number can be changed using the reset in the circuit. After every 60 seconds, an SMS is sent to the GSM modules on the buses and acknowledgment from the bus is sent back as a reply to the GSM module in the bus shelter.The sending and receiving of this messages verify the successful working of this project.

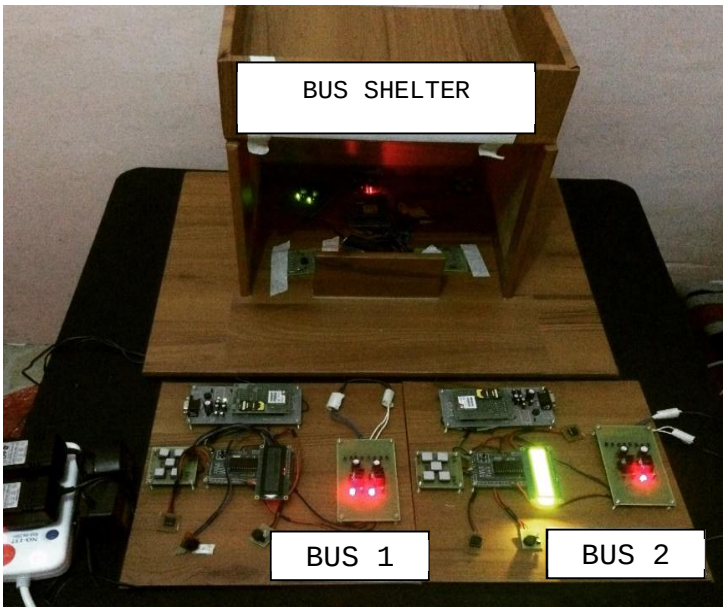

Fig 3.1 Picture For Overall Hardware

4 CONCLUSION

The project was based on constructing a system which will change the way public transportation is managed especially in developing countries.The system based on Atmel microcontroller was found to be more compact, user friendly and less complex, which can readily be used in order to perform several tedious and repetitive tasks. Though it was designed purposely in response to the growing need for public transport, it can be extended for other purposes such as commercial & research applications. This system can only be used when there is a bus shelter modified for the purpose entirely constructing new bus shelters.

5 FUTURE SCOPE

The Improved design of this project can be with the communication system with both GSM and GPS tracking so the passenger can see the location of the bus coming to the bus shelter.

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