AN INTELLIGENT TRAFFIC SAFETY SYSTEM USING WIRELESS SENSOR NETWORK

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Abstract— This paper presents design and development of Intelligent traffic safety system using wireless sensors network. A sensor node is developed for sensing the presence of vehicles to automatically light up a group of lamps at night time. This will give an advantage of energy conservation because the street lamps will remain on only when it is necessary. Other sensors are also used to monitor environmental parameters and to detect if any accident happened at particular range. The novelty of this system lies in the use of latest android technology in road safety systems.

Index Terms— ATMega, road safety, Android, GSM, vehicle detection

I. INTRODUCTION

Most roads and highways are important part of country's infrastructure. Thus, for transportation purpose, the roads and highways should be safer and secure. One of the major problems this transportation vehicle face is poor visibility at night time. As driving is purely a visual task, therefore being properly see and observe roads become very hard. The percentage of road accidents happen at night time is far more than as compared to accidents happen at day time.

This paper describes the design of an intelligent traffic safety system with an emerging field of wireless sensors technology. The proposed study develops a system that would enable an efficient use of Android technology for many purposes.

The aim of this study is mainly based on making public transportation safer and secure with the use of advanced wireless communication means. In the proposed study, different sensors gathers useful data by RSU (roadside unit) and which is processed by the controller for further instruction purposes. The main purpose of developing this system is to provide light at night time at dangerous portions of highways. This is because, due to lack of light at night time, number of accidents happen is more as compared to day time. Also, as per the large amount of energy consumption, some mechanism is required to efficiently use the lamps. Here, the proposed system enables use of light at dangerous portions of roads, only when requires. For example, when there are vehicles on the road, light is required, but we don't require for whole night. Thus, on detection of vehicle the system will enable light by a group of lamps and it will turn off after the vehicle passes by. Thus, light can be introduced which can avoid accidents and also, energy conservation can also be achieved due to reduced energy bills. Along with this use of the system, the system can also sense environmental parameters at a remote location such as temperature, pollution. It is also useful to detect presence of day or night.

Accidents if happened at a remote location can be traced.

II. Literature Review

Number of research works published in last few years in the field of road safety at night has been studied giving following information.

A. Traffic safety at night.

The different methods adopted for traffic safety at night are reviewed in [1]. The methods include common way for detection of vehicle with the help of sensors and light up the group of lamps. The method described in [2] has solar panel to charge the battery. This system utilizes the battery at night to light up dangerous portions of highways. Here, actuators are used to turn on a group of light poles. Zigbee is used for communication between system components.

The vehicles passing by the equipped highways are detected by the sensors. This data is transmitted to the controller which after processing the data will give instructions to the group of lamps to become ON through actuators. Similar instructions are given to make lamps OFF after passing by the vehicle. All the communication between system components is carried out through zigbee communication. Here, the solar panels are used at every light poles to charge the battery.

The method described in [1] has monitoring stations located at each lamp post consisting of several modules such as presence sensors, emergency switch, light sensor, and failure sensor. These devices work together and transfer all the information to a microcontroller which processes data and gives appropriate instructions. After the initial setting, the system is controlled by light sensor which activates the microcontroller only when sunlight illumination is less than a fixed threshold level. Here, the system monitors the state of emergency switch, and switches on the lamp when it is active. The same will happen in case of vehicle detection. Once the lamps are on, the failure sensor starts monitoring and in case a fault occurs, an alarm is signaled to control station. At the stop input, the lamps are turned off and cycle is restarted. Here, PIC microcontroller is used to develop algorithm.

B. Case study: IoTcomm Technologies, China.

On similar paths, IoTcomm Technologies, china works. They have developed smart road light control as shown in fig (1). They also have developed smart tunnel light control system. A project of Shenyang-Sihun Highway project is developed under smart road light control system. Here, lamp controllers are communicated through Internet/GPRS to the monitoring centre. Another project realized by Australian government was about designing an intelligent transportation system. This system will address community issues concerning poor visibility during winter time by the use of high-visibility LEDs.

Figure (1) IoTComm Technologies, China.

III .Overview Of System

After review of past and existing techniques followed in Traffic safety system at night, we develop and propose a simple traffic safety system with other purposes such as temperature monitoring, day/night monitoring, pollution monitoring, accident detection and rescue system etc. The proposed system consists of two parts roadside unit that will be implemented on street light and central server that may be a computer or laptop. The roadside unit consists of ATMega32 microcontroller. Both the units communicate with each other through Wi-Fi network. Android phone is used at roadside unit mainly for displaying graphic user interface,

applications development, and for communicating with server through Wi-Fi network. Also, upon detection of accidents at road, it will automatically send messages to rescue system.

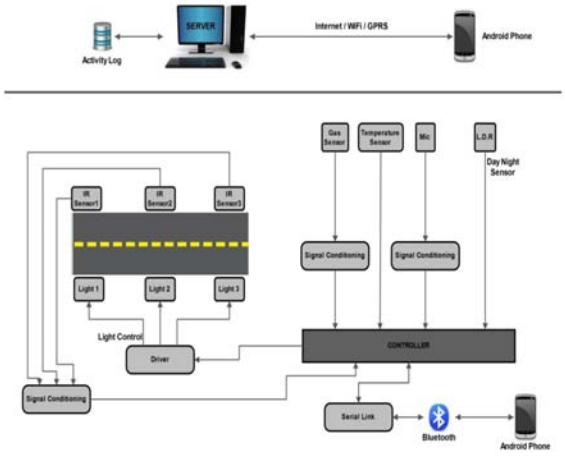

FIGURE (2) SYSTEM BLOCK DIAGRAM

IV. Hardware Design

The hardware components used to implement this system are summarized as follows-

A. Microcontroller

The AVR is a modified Harvard architecture 8-bit RISC single-chip microcontro ller, which was developed by Atmel in 1996. The AVR was one of the first microcontroller families to use on-chip flash memory for program storage, as opposed to one-time programmable ROM,EPROM, or EEPROM used by other microcontrollers at the time.

The ATmega32 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega32 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

B. Sensors

I. IR Sensor

An IR sensor is a device which detects IR radiation falling on it. There are numerous types of IR sensors that are built and can be built depending on the application. Here, IR sensor is used to detect presence of vehicle at night. This is the most fundamental type of sensor available in the market. The basic concept is simple. There is an emitter which emits infrared (IR) rays. These IR rays are detected by a detector. The circuit diagram of a basic IR sensor is given below.

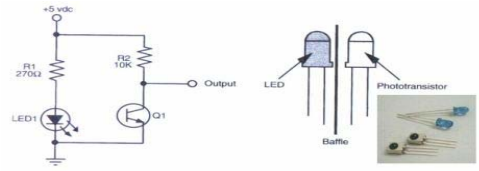

Figure (3) IR Sensor

II. Light Dependent Resistor

A light-dependent resistor alternatively called an LDR, photo-resistor, photoconductor, or *photocell*, is a variable resistor whose value decreases with increasing incident light intensity. An LDR is made of a high-resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance. Here, LDR is used to detect day or night conditions.

Figure (4) Light Dependent Resistor

III. Temperature Sensor

A thermistor is a type of resistor whose resistance varies significantly with temperature, more so than in standard resistors. The word is a portmanteau of thermal and resistor. Thermistors are widely used as inrush current limiters, temperature sensors, self-resetting overcurrent protectors, and self-regulating heating elements. Thermistors differ from resistance temperature detectors (RTDs) in that the material used in a thermistor is generally a ceramic or polymer, while RTDs use pure metals. The temperature response is also different; RTDs are useful over larger temperature ranges, while thermistors typically achieve a higher precision within a limited temperature range, typically -90°C to 130 °C.

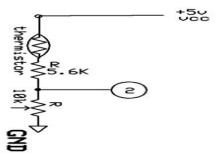

Figure (5) Temperature sensor circuit.

IV. Gas Sensor

For detection of carbon monoxide which is the major toxic gases in underground coal mines, MQ-6 gas sensor is used.

Figure (6) Gas sensor

C. Bluetooth module

Here, for communication between microcontroller and Android phone, Bluetooth module HC-05 is used.

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

D. Display unit- Android GUI

This system uses an Android phone for many purposes such as, graphic user interface, communicating with centralised server unit, displaying and selecting location, displaying sensor values, and displaying video feed of a particular location. Microcontroller will send data to the Android phone through Bluetooth module. This data will be displayed on application developed on Android. The same will be communicated to the server for maintaining activity log.

V. Software Design

A. MicroC pro for AVR

MicroC Pro for AVR programs the microcontroller and AVRFlash is used to burn the code into chip.

B. Server- Apache Tomcat

Apache Tomcat is an open source servlet container developed by the Apache Software Foundation (ASF). Tomcat implements the Java Servlet and the Java Server Pages (JSP) specifications from Sun Microsystems, and provides a "pure Java" HTTP web server environment for Java code to run.

C. Netbeans

Netbeans refers to both a platform framework for Java desktop applications, and an integrated development environment (IDE) for developing with Java, JavaScript, PHP, Python, Ruby, Groovy, C, C++, Scala, Clojure, and others. The NetBeans IDE is written in Java and can run anywhere a JVM is installed. Here, netbeans is used to design graphic user interface for centralized server unit.

D. Eclipse for Android

Eclipse is a multi-language software development environment comprising an integrated development environment (IDE) and an extensible plug-in system. It is written mostly in Java. Here, it is used to design an app for this system on Android.

VI. Results

Figure (7)

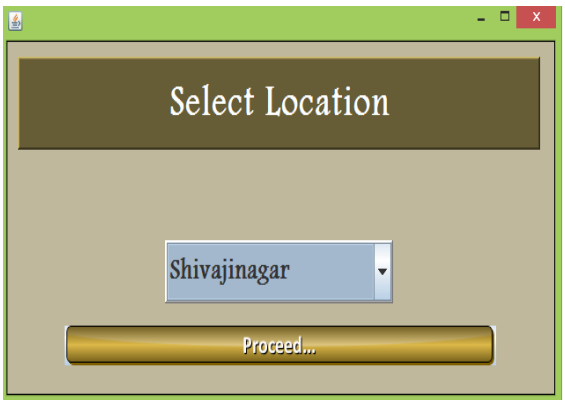

Figure (8)

Figure (9)

Figures 7, 8, 9 shows the graphic user interface at server, designed using Netbeans and java. Here, figure 7 shows an interface to enter into the interface. Then, figure 8 shows a window that asks for selection of location for which we want to analyse details then figure 9 shows the window displaying details such as sensor values, video feed and the status of lights that is on or off. Also, when the mic value goes beyond threshold value, then it shows accident happened and sends an emergency message to rescue system through Android.

VII. Conclusion

The developed system has an advantage of fast execution. The sensors used for demonstration of concepts are in general. The MQ-6 gas sensor is sensitive to carbon-dioxide.

We found more heating of sensors if operated for long time. The resistive type temperature sensor also shows good sensitivity. The ATMEGA AVR shows low power consumption system. The android provides a great means for communication, and display purpose. With use of sophisticated sensors, the system can work more accurately in real time.

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