WSN based Intelligent Traffic Safety System

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Abstract **-** The study is based on the design of Intelligent Traffic Safety System with an emerging field of wireless sensor technology. The aim of this study mainly based on making public transportation safer and secure with the use of advanced communication means. In the proposed study, different sensors gathers useful data by RSU (roadside unit) and the same is processed by controller for further instructions purposes. The proposed system will collect data at night time for making a group of lamps on as long as there is a vehicle on road. As soon as, the vehicle is passed by the group of lamps will be off. Thus, it achieves energy conservation. Compared to existing systems that was based on Zigbee, this system offers one time implementation cost with the use of GSM for communication purpose. Also, Android can be used for graphic user interface purpose.

Keywords **-** ATMega, road safety, Android, GSM, vehicle detection.

I. INTRODUCTION

As a vital part of country's infrastructures, roads and highways are necessary for economic activity and people's movement. Thus, they need to be safe and secure. In order to ensure this, we need to take into account that, a number of accidents happened at night time as compared to day time. The reason behind this is lack of illumination on roads, though that may be a street light or a highway light. Thus, we can see that the conventional, traditional street lighting systems are out dated. Firstly, traditional road lighting systems remains continuously on throughout night time at full intensity. Thus, it accounts a large amount of energy wastage throughout night and ultimately higher energy bills to be paid by corporations. Secondly, as those street lights remains on continuously so, there is a tendency that to avoid high energy costs, a number of street lights remains off. Thus, there is no proper illumination of highways of country.

Increasing awareness for climate change and impeding shortage of energy sources accelerate the urge for more efficient light sources and road lighting system. Since, lighting appears for around 20% of the world's total electricity consumption, a massive changeover to more efficient lighting can help observing climate changes, increasing energy prices and maintenance costs. Thus, the main purpose of road lighting system should be to consider information regarding transportation via sensor data and take necessary action.

The concept of Intelligent Street Lighting has been advanced in recent years, prompting the employment of cost-effective schemes that would primarily reduce the electrical power and maintenance costs and thus ensure maximum safety of road traffic.

Currently, out-dated road lighting systems, which are very inefficient in terms of cost and energy consumption, are widely deployed all around the world. In these systems, luminaries are controlled with timers or photocells without any remote control or information retrieval options. There is no knowledge of exact amount of energy spent by each luminary and possible power leaks. Additionally, existing systems do not support any type of real time information exchange or interactive communication for adapting to changes in their surroundings. However, such a system requires not only the necessary communication infrastructure but also specific sensors to understand those changes.

II. LITERATURE REVIEW

Due to increase of environmental concerns, lighting control systems will play an important role in reduction of energy consumption of the lighting without impending comfort goals. The energy is the single most important parameter to consider when assessing the impacts of technical systems on the environment. Lighting is often the largest electrical load in offices, but the cost of lighting energy consumption is low when compared to personnel costs. Thus, its energy saving potential is always neglected. According to study, global grid based electricity consumption for lighting was about 2650TW in 2005, which was an equivalent of their electricity for lighting, whereas the share of electricity lighting is around 20-30% in hospitals, 15% in factories, 10-15% in schools and 10% in residential buildings.

Intelligent lighting control and energy management system is a perfect solution for energy saving by 40%, saves lights maintenance costs by 50%, and prolongs lamp life by 25%. The system application in street light control for each lamp will reduce in streetlight electricity and maintenance cost, and increase availability of street light. List of papers and a brief introduction of it is given as below:

A. *Fabio Leccese, "Remote-Control System of High Efficiency and Intelligent Street Lighting Using ZigBee Network of Devices and Sensor", IEEE TRANSACTIONS ON POWER DELIVERY, VOL. 28, NO. 1, JANUARY 2013*

This paper describes a new intelligent street lighting system which integrates new technologies available on the market to

offer higher efficiency and considerable savings. This can be achieved using the highly efficient LED technology supplied by renewable energy of solar panels, for which the cost of energy is independent from the power supplier prices, combined to an intelligent management of the lamp posts derived by a control system switching on the light only when necessary, increasing the lamps' lifetime. Another advantage obtained by the control system is the intelligent management of the lamp posts by sending data to a central station by ZigBee wireless communication. The system maintenance can be easily and efficiently planned from the central station, allowing additional savings. The proposed system is particularly suitable for street lighting in urban and rural areas where the traffic is low at a given range of time. The independent nature of the power-supply network enables implementing the system in remote areas where the classical installations are prohibitively expensive. The system is always flexible, extendable, and fully adaptable to user needs. The simplicity of ZigBee, the reliability of electronic components, the feature of the sensor network, the processing speed, the reduced costs, and the ease of installation are the features that characterize the proposed system, which presents itself as an interesting engineering and commercial solution as the comparison with other technologies demonstrated.

B. Imane L'hadi, marwa Rifai, yassine salih alj, "An Energy-Efficient WSN-based Traffic Safety System" ; 2014 5th International Conference on Information and Communication Systems (ICICS) IEEE Conference 2014

This paper suggests an energy-efficient WSN-based traffic safety system. The latter consists of vehicle detection for light providing through the use of sensors and actuators. Retrieved data and processed instructions are communicated through Zigbee network. The latter is ensured by the use of repeaters according to their relaying range. The VDLPS would enable the efficient lighting of dangerous highway portions. The main goal of the system is to provide light only when needed in order to optimally and efficiently use the solar light poles battery energy. When considering the implementation of such a system, it is important to keep in mind the efficiency of the LEDs which can be ensured through encapsulation. In other words, covering the LEDs with a material that can both increase their inflexion rate and protect them from dust is to be considered.

C. Cagdas atict, tanir ozcelebi, johan J.Lukkien, members IEEE, "Exploring user-centered intelligent road lighting design: a road map and future research directions"; IEEE Transactions on consumer electronics, vol.57, No. 2, May 2011.

This paper describes that, designing an intelligent road lighting system is a necessity because of the inefficiencies in the traditional systems. These old systems not only consume huge amounts of energy but also are capable of reacting to the changes in their environment.

This paper describes an intelligent road lighting system to carry out user experiments on a real dynamic testbed and identify social and technical challenges. While building a software-controlled road lighting testbed, various research problems are addressed in detail. Authors have investigated intelligent road lighting systems from user experience, technology, energy perspectives and proposed useful services that can be enjoyed using the same infrastructure.

D. 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.

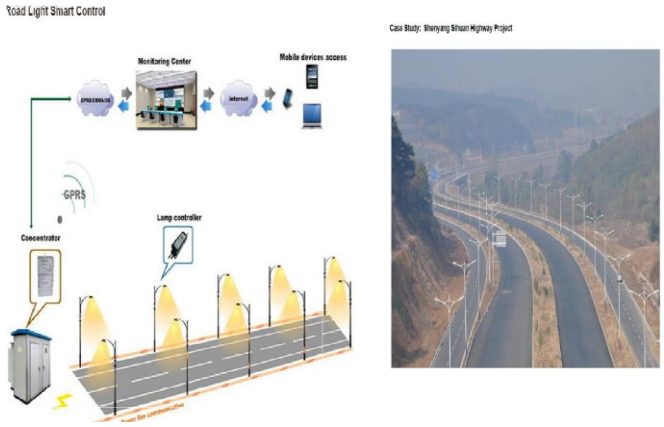

Fig.1: IoTComm Technologies, China.

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.

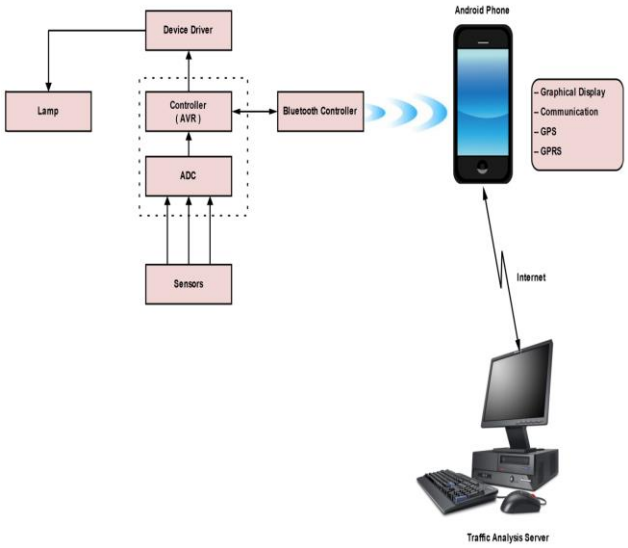

Fig.2: System Block diagram

As shown in figure (2), different sensors are deployed along the roadside unit. When a vehicle passes by the IR sensor, immediately, the data is passed to signal conditioning unit. The converted data is then given as an input to the controller unit for processing it. The controller will process the data and accordingly will generate instructions for device driver. Here, device driver is used to make group of light poles on or off depending upon input condition.

The same processed data of controller is transmitted along serial link to the Bluetooth module and then via Bluetooth module to Android. Android is used for graphical user interface and communication purposes. Also, different apps can be developed on android. Here, Android is also used for video feed for analyzing traffic on specific part of highways.

After that, android will further communicate to server for maintaining database or updating it. The communication is done via internet or wi-fi or GPRS.

Along with IR sensor that detects a vehicle at night time, this system also monitors different environmental parameters such as temperature sensor, gas sensor etc. Also, mic can be used to sense noise parameter at that point, so that, if an accident happens in particular area, then it will be informed to Central Server and then to rescue system.

Also, as, this system is able to monitor different environmental parameters at particular location, therefore, while travelling from one city to another, user can get information about environmental condition of other city to which he has been travelling.

Different apps can be developed on android such as traffic monitoring at particular location via video feed at that location, another app for different environmental parameters monitoring. Also, for maintaining graphical user interface, an app can be developed.

This system uses GPRS/internet/wi-fi as communication medium. Therefore, as compared to existing Zigbee based communication in this area, the implementation cost reduces to great extent. Also, as at night time, only after detecting vehicle, light is provided for that vehicle. Thus, it achieves energy conservation and reduced energy bills.

IV. HARDWARE DETAILS

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 microcontroller, 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

Different sensors are used to collect data such as IR sensor, temperature sensor, gas sensor, LDR, and mic for detection of accidents happened.

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. RESULTS

Sr.no.	Locations	Temp.	Gas (Co2)	LDR
1	ShivajiNagar	37.3	125	33
2	Aundh	36.8	110	35
3	Katraj	38.9	99	39
4	Hadapsar	37.5	130	33
5	Swargate	38.8	127	34

Table (1)

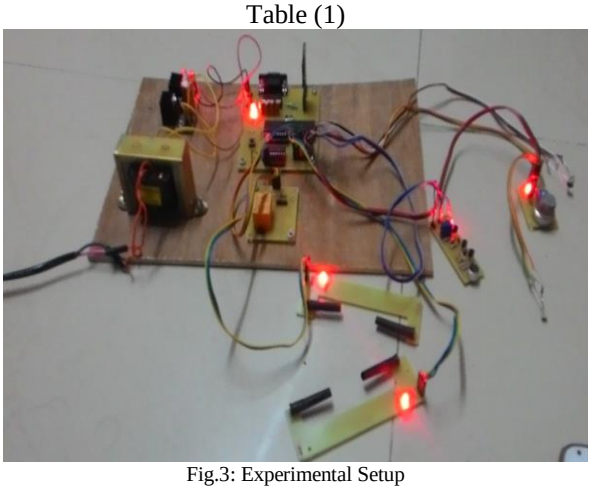

Fig.3: Experimental Setup

Fig.4

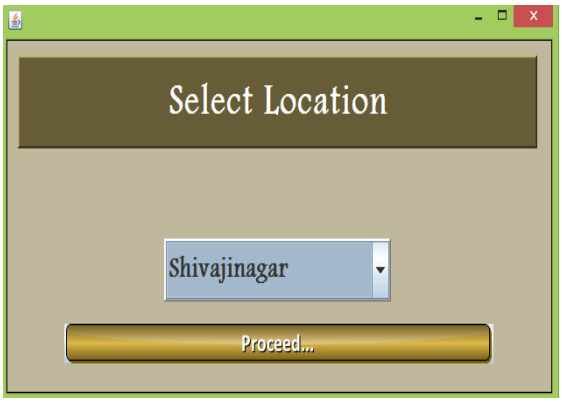

Fig.5

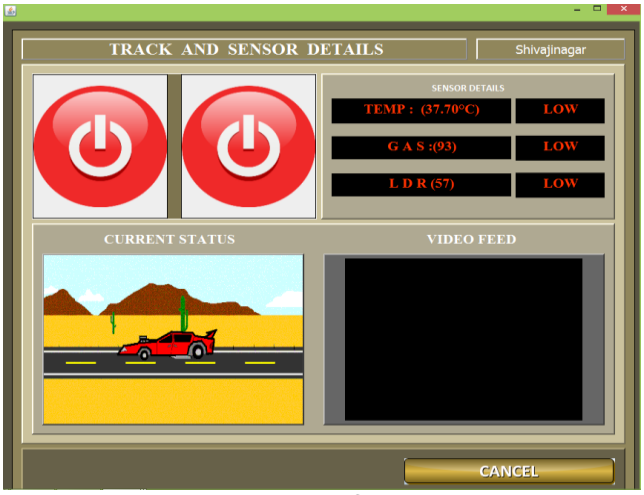

Fig.6

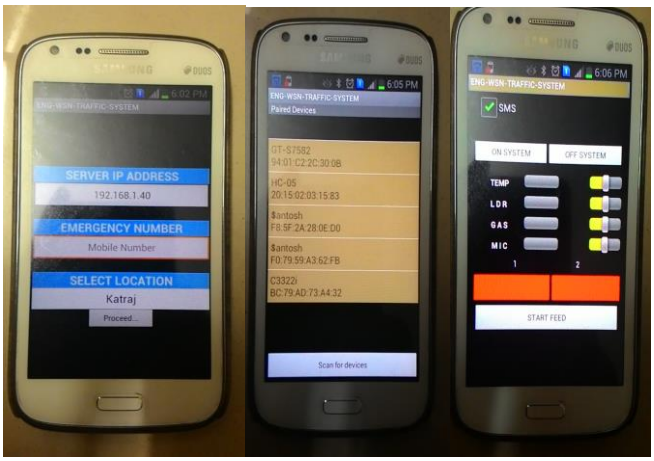

Fig.7: Android application development

Figure 3 to 7 shows the experimental setup and graphic user interface at server, designed using Netbeans and java. Here, figure 8 shows an interface to enter into the interface. Then, figure 9 shows a window that asks for selection of location for which we want to analyze details then figure 10 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. Figure 11 shows windows of android apps development. Here first window shows initial requirements such as centralized server details, emergency number for sending messages regarding emergency accident detection and selection of location. Next window shows selection of Bluetooth module used in circuit and last window shows sensor values measured at different locations.

VI. CONCLUSION

Thus, the proposed system describes a design and implementation of energy efficient traffic safety system. The proposed system works fully automatically. This system

eliminates drawback of conventional street light system, as it reduces energy consumption of street lights which were continuously on throughout night. Thus, achieving a significant amount of energy efficiency. In this system, different sensors are deployed across roadside to collect data. This data, i.e. sensed by sensors are communicated to central server station for maintaining activity log. The communication along server and roadside will be through Internet, wi-fi, or GPRS. Thus, compared to conventional systems, this system offers an advantage of one-time cost of implementation. The use of new advanced smart device Android enables attractive graphical user display. Also, it is used for communication between roadside unit and central server. Therefore, there will be no data loss in communication.

VII. REFERENCES

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