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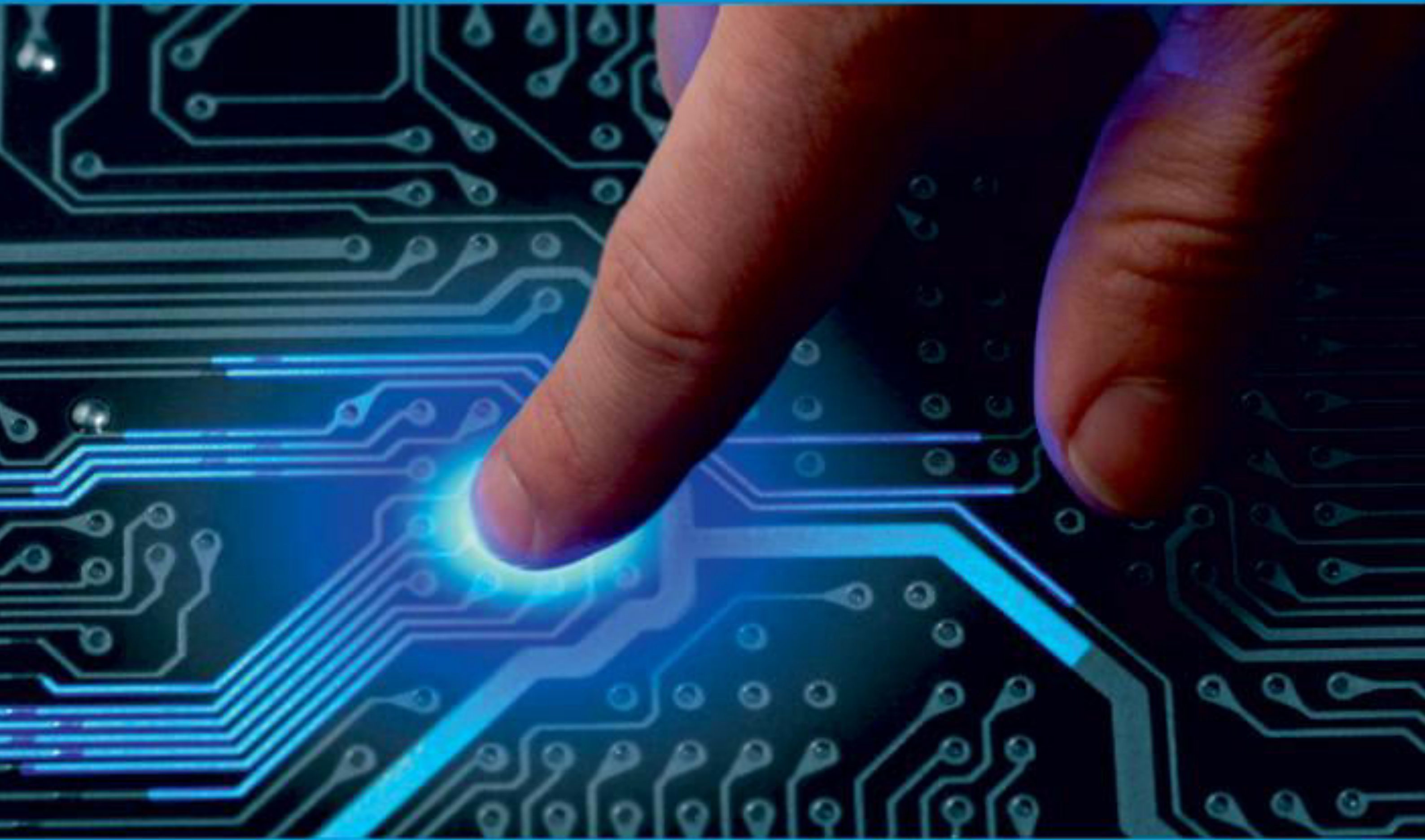

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Smart Roads for Smart City using ATmega16 and NodeMCU

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ABSTRACT:A "Smart City" is a city which serves the purpose of making life easier for human beings by causing minimum damage to the environment. This project aims to make a city smarter. Nowadays, there is increasing traffic on roads due to advancements in the field of mobility. So, in our project, our prime focus is on developing the roads and traffic management in a city. The system uses a combination of three sub-systems viz. Accident Detection and Reporting Using GSM, Smart Streetlight and Smart Traffic Light System. We know that road accidents are increasing day-by-day. Many lives are lost because of delay in proper medical assistance. Our system will help to reduce this time gap between the time of accident and arrival of medical help. The system will also help us manage the traffic by using dynamic traffic lights instead of the traditional lights. These traffic lights will control the duration of 'green' signal based on the traffic density. The Smart Streetlight System has lights which will turn ON only when a person/vehicle is detected and remain in a OFF or dimmed state, otherwise. Thus, our system will be able to reduce the casualties in road accidents, significantly improve traffic flow, and save a huge amount of power which is wasted today.

KEYWORDS:Smart City, Roads, Accident, Streetlight, Traffic, GSM.

I. INTRODUCTION

The concept of "Smart City" has gained a lot of significance and popularity in the past few years. We have seen a remarkable progress in transport and mobility sector. However, we need to improvise in the field of roads and traffic management. So, this system takes a step ahead to achieve the same. A combination of three sub-systems is used in order to make the system as a whole, work successfully and effectively. Simple components like GSM, GPS, Microcontroller, IR sensors are used. The system will solve issues of power wastage and traffic jams. It also reduces casualties in case of road accidents by sending an SMS alert using GSM, to the emergency contacts/ambulance. Thus, no accidents will go unnoticed and many lives can be saved. The system will have a great impact in accident-prone regions. It will also improve traffic flow in a crowded city by replacing a fixed duration of green light to dynamic signals where, the duration will be adjusted based on traffic density. The system will save power in conditions where there are no visitors for a long duration.

The paper explains history and related project work in Section-II. Block diagram, methodology used and flowcharts are explained in Section-III. It is explained in three different sub-sections. Section-IV discusses the simulation results. Finally, the conclusions are discussed in Section-V.

II. RELATED WORK

There are many research projects in the world today, that have come up with an idea of telematic solutions for emergencies. Some of them are discussed here. [1] In this paper, the system detects drunken driving and sends GPS coordinates of that location to the owner and turns OFF the engine. Thus, probable accidents can be avoided and driver can also be traced. [2] India is witnessing a rapid growth of population in urban areas. Around 4% of rural population turned to urban population over a period of 10 years (2001 to 2011). This is explained in detail in paper. [3] This paper uses a sensor network (WSN technology) and a Zigbee module to monitor the streets and control streetlights based on sensor data. The sensors communicate with each other and report when an object is detected. So, the system then turns the lights ON and keeps them in a dimmed state when the object passes by.

The existing projects and related work are discussed above. The limitations of these projects motivate the need of a new, more efficient and compact system, which can satisfy all the above needs in a better way. The infrastructure required is

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reduced significantly in this proposed system. The cost and maintenance of these projects is high as compared to the proposed system in this paper.

III. METHODOLOGY

The block diagram is basically divided into 3 parts or nodes for easy understanding and implementation of the system. The nodes are later combined (i.e., connected to single microcontroller) to work as a single system. They are as follows:

A. Smart Streetlight Control

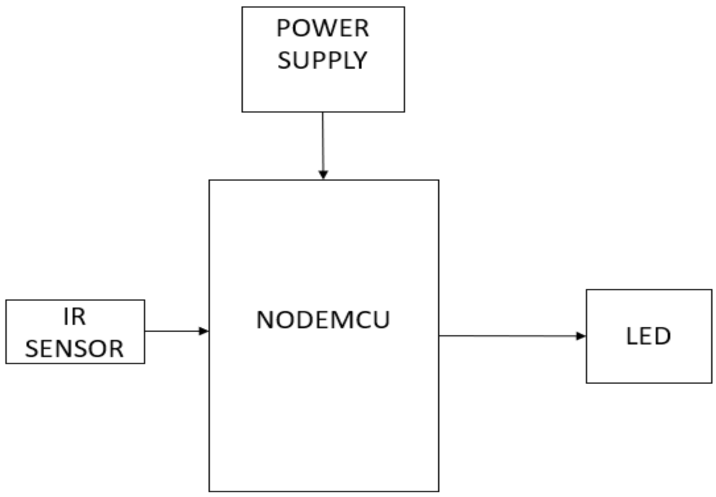

Fig 1(a): Smart Streetlight Control-Block Diagram

As shown in above diagram [Fig 1(a)], Smart streetlight system is a simple system consisting of a microcontroller NodeMCU which has inbuilt Wi-Fi module to communicate with the cloud. The system reads data from IR sensors, sends it to the cloud. Then it decides whether to turn ON the lights or not based on detection of a person/vehicle.

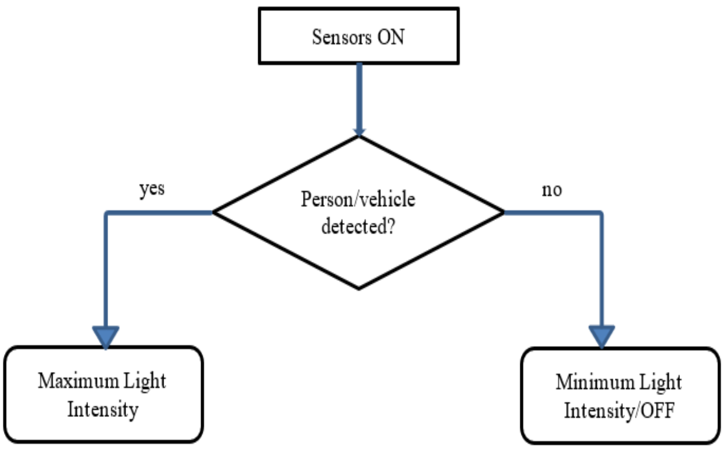

Fig 1(b): Smart Streetlight Control-Flowchart

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The flowchart in Fig 1(b) explains the working of this subsystem. If the person or a vehicle is detected by the IR sensors, it will turn the lights ON. On the other hand, if the person or a vehicle is not detected, then it will turn the light OFF or switch to dim state as desired.

B. Dynamic Traffic Lights Control

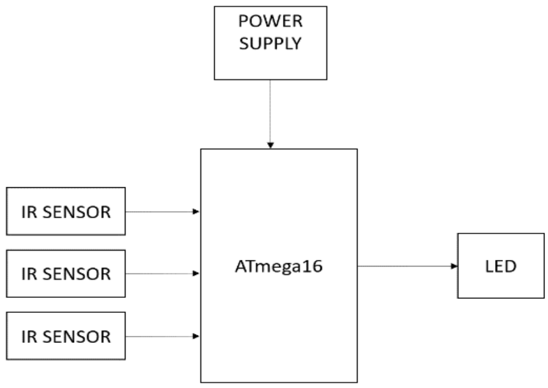

Fig 2(a): Dynamic Traffic Lights Control- Block Diagram

The above fig [Fig 2(a)] represents a model of dynamic traffic lights control system. Suitable number of IR sensors (3 in this case) are installed along the roadside at an appropriate distance to monitor the traffic on that lane. Based on the traffic density, the microcontroller decides the duration of green signal. For example, consider low traffic density. In this case, the duration of green signal will be 20 seconds(supposedly). So, in case of moderate density, the duration of green signal will be increased to 40 seconds. Similarly, in case of high density, it will be increased to 60 seconds. The implementation of this is shown in flowchart below [Fig 2(b)]. The sensors read data from lane. Then, if the density is greater than or equal to a fixed threshold value, the density flag is set to ‘1’. Hence, green light duration is increased by a step value (e.g., 20 seconds). If the flag is not set, then we reduce the duration by that step value.

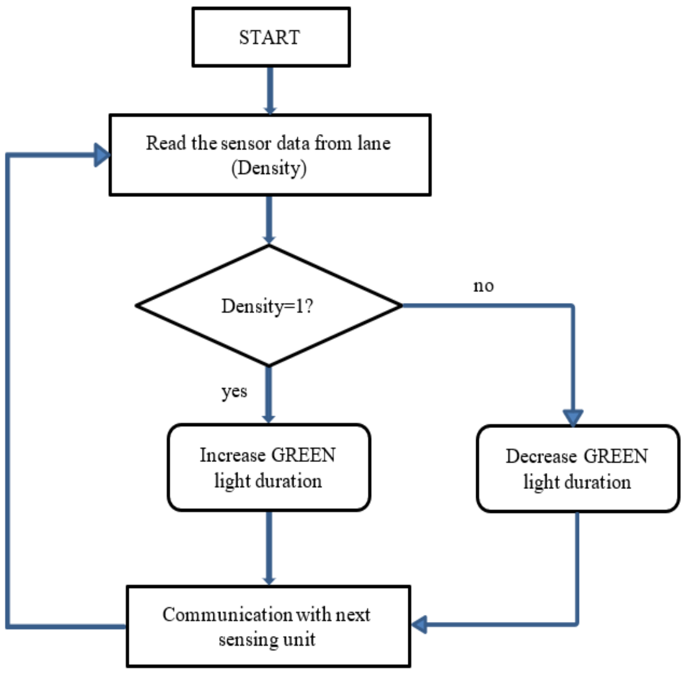

Fig 2(b): Dynamic Traffic Lights Control- Flowchart

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C. Accident Detection and Reporting

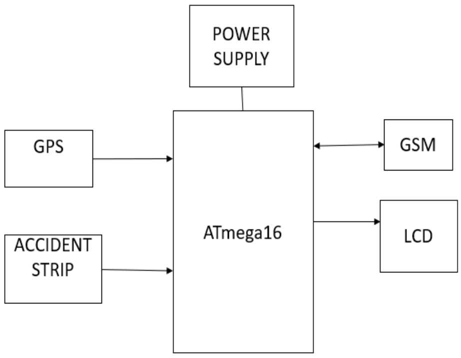

Fig 3(a): Accident Detection and Reporting- Diagram

As shown in above block diagram [Fig 3(a)], an ATmega16 microcontroller is used to control the system. It collects the GPS coordinates of accident location from GPS module and sends instructions to the GSM module to report emergency contacts/ambulance via SMS containing the location. To demonstrate the application, 16x2 LCD is used to display the message that will be displayed on mobile screen. The accident strip consists of elements to detect an accident, like, vibration sensor, temperature sensor, etc. The system runs on an external power supply.

The flowchart shown below [Fig 3(b)] explains the functioning of this subsystem. There is no action until an accident is detected. Once an accident is detected, the microcontroller gets the coordinates of that location and commands the GSM to send these coordinates to the registered emergency contacts list or ambulance via an SMS.

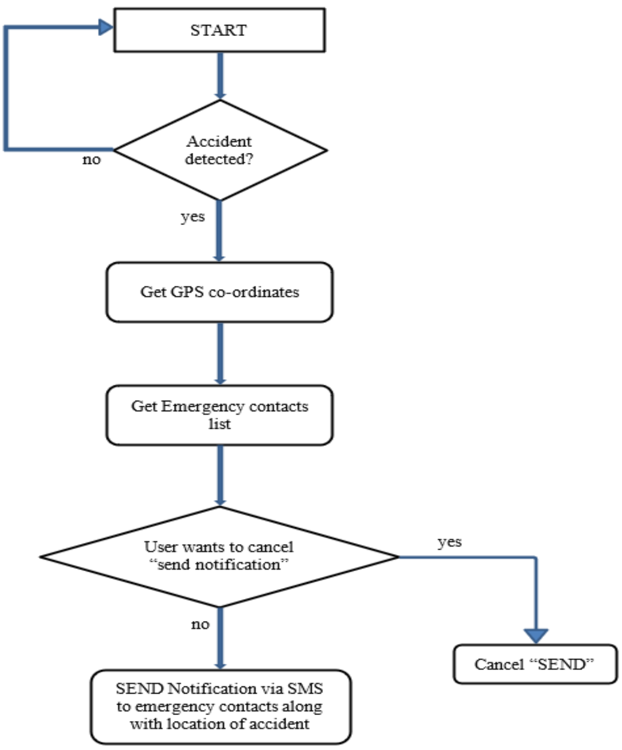

Fig 3(b): Accident Detection and Reporting- Flowchart

The implementation of an option to let the user decide whether or not to send an SMS is optional. It can be used if the user is not injured in case of very minor accidents.

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IV. EXPERIMENTAL RESULTS

Figures shown below represent the snapshots of circuit in simulation software. The software used for simulation is Proteus (version-8). AVR Atmel Studio is used for writing and compiling the code of microcontroller. The microcontroller used is ATmega16. Below fig. 4 shows the circuit diagram of Dynamic Traffic Lights Control and Smart Streetlight System combined.

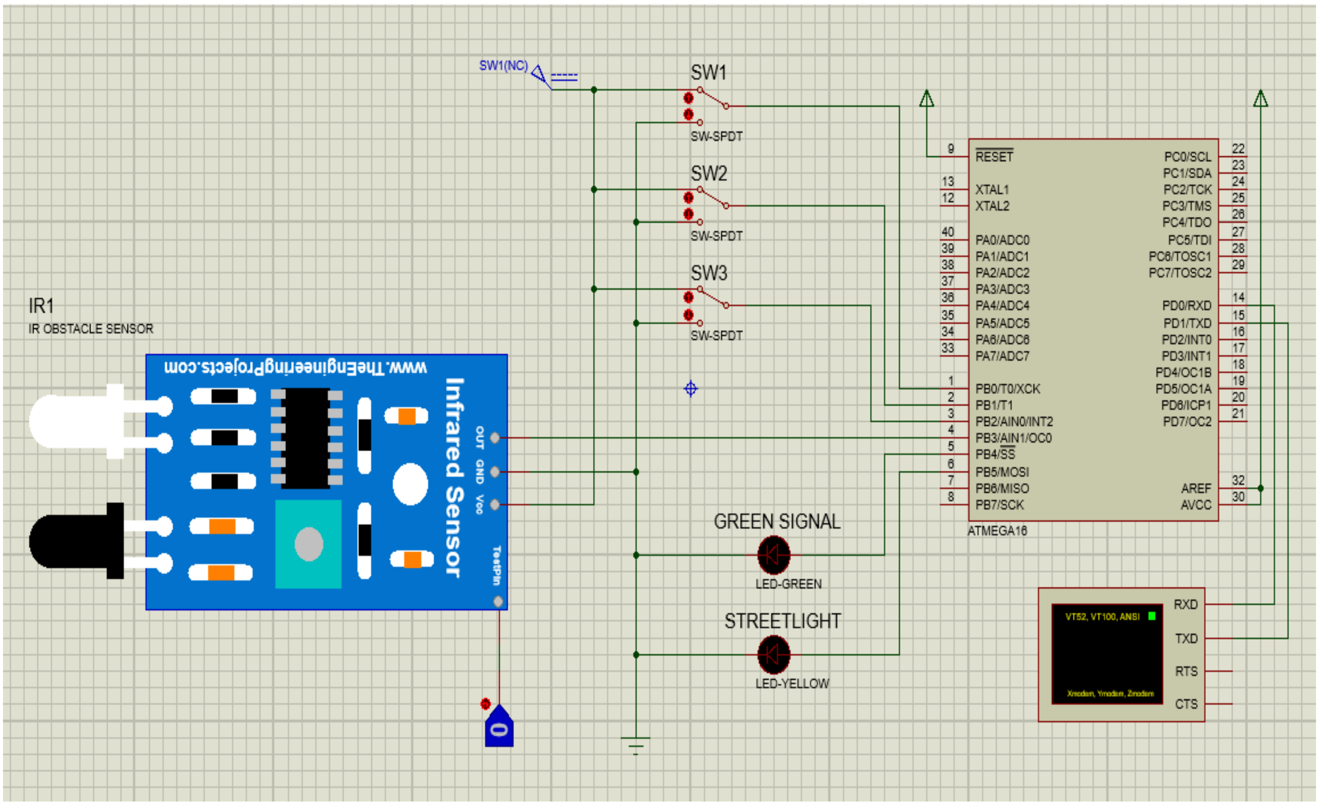

Fig 4: Dynamic Traffic Lights and Smart Streetlights- Simulation

The switches SW1, SW2 and SW3 are used instead of IR sensors to fit the whole circuit in frame and avoid confusion. ‘Green light’ shows the green signal in traffic signals and ‘Streetlight’ is used to show lamps in streetlights. The simulation of Accident Detection and Reporting is not shown because of unavailability of some required libraries in proteus.

V. CONCLUSION

This system can be used to tackle various problems and significantly improve the roads and traffic management in a city. The system can save many lives which are unfortunately lost today due to lack of immediate proper medical assistance. It reduces time gap between the time of accident and arrival of medical assistance. It can efficiently regulate the flow of traffic by reducing or increasing the duration of ‘green’ signal. It helps to maintain a smooth traffic flow and reduce waiting time for long lanes. We can say it serves ‘justice’ instead of ‘equality’. The system is capable of considerably reducing power wastage caused by streetlights. It will save the power by standing in OFF or dimmed state in conditions where no person/ vehicle is present.

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