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Design and Performance analysis of IoT based Smart Street Light & Collision Detection System

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Abstract*: This paper aims for providing solution to design and execute the system for saving energy of street lights and controlling the collisions occurring on roads. Currently we have a manual system where the street lights will be switched ON in the evening before the sunsets and they are switched OFF in the next day morning after there is sufficient light outside and currently there is no such system in India that helps in monitoring or detecting collisions occurred on roads. This we can implement by sensing a vehicle using an Ultrasonic sensor/IR sensor and using some heat & sound sensors for sensing the collision if it occurs. On sensing the movement of a vehicle, the sensor transmits the data to the Raspberry Pi, which will switch ON the next three consecutive street lights in order to give the driver a visible track to drive in dark. Similarly, the Light gets switched OFF according to a timer that gets triggered as soon as the vehicle or an obstacle goes away from the sensor.

***Keywords* : IOT, Android, Raspberry Pi, IR sensor, FIR (First Investigating Report), Collisions (Accidents), Alert Stations**

I. INTRODUCTION

As we all know that, in an extreme collisions the sound produced can be of higher intensity and if a vehicle catches fire then in that case the intensity of heat will also be more. This paper provides the solution by using some modern age technologies emerging in today's era like Internet of Things (IOT), Android, and Cloud Computing etc.

So this can be done by sensing the value through various sensors and if the sensed value strikes above the sensor's threshold then the data will be transmitted to the Raspberry Pi which will further trigger the Pi Camera to click the image of the suspected collision and Raspberry Pi will send the data about the collision to the Dynamic Database or on Cloud. Then the data sent to the database will be fetched from there into the Customized Android App which can be used by the alert stations i.e. nearest police station, fire brigade and an ambulance driver so that they can reach the place where collision occurred with the minimum time for formalities i.e. filing a report, hospital needs the confirmation from police during police case etc. Also this App will provide the police stations to file temporary FIRs for the alerts received on the App with the mandatory data required for filing FIR and also any user can keep track of the investigation of the collision cases for which alerts they have received.

This paper "Smart Street Light & Collision Detection System" is a cost effective, practical and reliable. It clearly tackles the two problems that our country is facing today that are roadside accidents and electric power wastage, very efficiently.

1.1 Motivation

The main motivation behind this paper on "Smart Street Light & Collision Detection System "based on IOT is the need to explore different trending dimensions of IT Industries. Also this paper presents the need of a system in our country India that can reduce the consequences of accidents occurs on roadsides daily.

1.2 Existing Solution

Currently there is no such system in India that help in monitoring or detecting collisions occurring on roads. This proposed paper gives the solution for Traffic manipulation and also the very first system that helps in detecting collisions and controlling the consequences of collisions.

1.3 Hardware Design

1.3.1 List of Hardware

1. **Raspberry Pi:-** The Raspberry Pi is a series of small single-board computers. It is a capable little computer, which can be used in electronics projects, and for many of the things that your desktop PC does, like spreadsheets, programming, browsing the internet etc.
2. **IR Sensor:-** An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. It is also capable of measuring heat of an object and detecting motion.
3. **Pi Camera:-** It can be used to take high-definition video, as well as stills photographs. It supports 1080p30, 720p60, and VGA90 video modes, as well as still capture. It attaches via a 15cm ribbon cable to the CSI port on the Raspberry Pi.
4. **Heat Sensor:-** Heat sensor is used to sense temperature/humidity within the range of the sensor. Its single-bus operation, extremely small size and low consumption enable it to be used in HVAC, automotive, weather stations, dehumidifier and other applications.

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5. **Sound Sensor:-** The sound sensor provides an easy way to detect sound and is generally used for detecting sound intensity. This can be used for security, switch, and monitoring applications. Its accuracy can be easily adjusted for the convenience of usage.
6. **Ultrasonic Sensor:-** This sensor module has a transmitter, a receiver and a control circuit in one single pack. It has very handy and compact construction. It offers excellent range accuracy and stable readings in an easy-to-use package.
7. **GSM Module:-** GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate.

II. LITERATURE SURVEY AND RESEARCH GAP

In smart system based collision detection, peoples are getting help very efficiently and easily. Yasaku Fuzzi Says in his paper that street light system, in which lights on when needed and light-off when not needed. Currently, in the whole world, enormous electric energy is consumed by the street lamps, which are automatically turn on when it becomes dark and automatically turn off when it becomes bright. This is the huge waste of energy in the whole world and should be changed. This article publishes in ACM digital library [1].
In the paper [3] the researcher proposed a system that provide a solution for energy saving. This is achieved by sensing and approaching a vehicle using an IR transmitter and IR Receiver couple. They used the RFID concept that wants to improve.

III. PROPOSED MODEL AND EXPERIMENTAL FRAMEWORK

3.1 Product Perspective

Now-a-days wastage of electricity due to continuously switched ON street lights and lots of accidents happen on roads and highways due to increase in traffic and also due to rash driving of the drivers. And in many situations the family members or the ambulance or the fire brigade and police authority is not informed in time. This result in delaying the help reached to the person suffered due to accident. Our project "System for monitoring & detecting collisions" is designed to avoid such situations.

3.2 Product Functions

Currently there is a manual system where the street lights will be switched ON in the evening before the sunsets and they are switched OFF in the next day morning after there is sufficient light on the outside and Currently there is no such system in India that help in controlling or detecting collisions occurring on roads. This proposed project can be implemented by sensing a vehicle using an Ultrasonic/IR sensor and a heat and sound sensor for sensing the collision if it occurs. On sensing the movement, the sensor transmits the data to the Raspberry Pi, which will switch ON the next three street lights in order to give the driver a visible track to drive in dark. Similarly, the Light gets switched OFF according to a timer that gets triggered as soon as the vehicle or an obstacle goes away from the sensor. Now if the sensor senses a heat or a fire or a sound above the threshold level then it will send the data to the Raspberry Pi which will further trigger the Pi Camera to click the image of the suspected collision and Raspberry Pi will send the data about the collision to the Dynamic Database or on Cloud. Then the data sent to the database will be fetched from there into the Customized Android App which can be used by the alert stations i.e. nearest police station, fire brigade and an ambulance driver so that they can reach the place where collision occurred with the minimum time for formalities i.e. filing a report, hospital needs the confirmation from police during police case etc. Also this App will provide the police stations to file temporary FIRs for the alerts received on the App with the mandatory data required for filing FIR and also any user can keep track of the investigation of the collision cases for which alerts they have received.

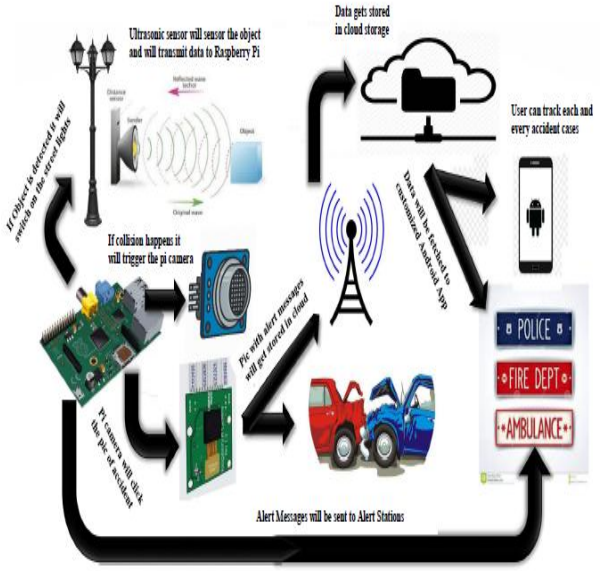

Fig. 1.1 Proposed Model for SSL & CDS

3.3 User Characteristics

No special user characteristics are required for this project as the end users are not directly interacting with the system. Here the end user is treated as an obstacle for sensors.

3.4 General Constraints

Since the project "Smart Street Light & Collision Detection System "is majorly based on IOT the only problem that might occur is that the prototype we are designing is using various sensors. So failure in sensing by any sensor (just an electronic item which can be damaged by unknown means) will be counted as a failure of our whole system.

3.5 Assumptions and Dependencies

We are designing the project by assuming that every roads and highways consist of street lights working properly.

3.6.1 Hardware Interfaces

Raspberry pi

- Hard disk :16 GB
- RAM: 512 MB
- Processor: 900 MHz quad-core ARM Cortex A7 (ARMv7 instruction set)
- Storage: MicroSD
- Size: 85.60mm × 56.5mm

3.6.2 Software Interfaces

Since we are dealing with Hardware mostly in IOT based project.

But still few software interface required are Raspbian Operating System to use Raspberry pi's functionalities and Android Studio for developing Android Application.

3.6.3 Communications Interfaces

To make the alerts generated by various sensors to reach their designated destination on time we are planning to use firebase as a dynamic database or a Google cloud storage that will help the alert messages to reach police stations, fire stations and ambulance on time and also help in filing the temporary FIR to police station.

3.7. Collision Detection Module

3.7.1. Introduction

All other components like the IR sensor, Heat sensor, Sound sensor, Pi Camera and GSM modules are connected via network of jumper wires to Raspberry Pi. The code for the working of this system is written in python. The alarm (alert) is triggered when the sensors connected to each other detect a collision.

3.7.2 Inputs

Ultrasonic/IR, Heat, Sound sensor's sensing value is working as an input for this module.

3.7.3 Processing

The basic logic behind the processing of this module is that the sensing thresholds of all the sensors are set up to certain limit so that if the sensor senses something above that sensor's threshold then the raspberry pi will trigger the Pi Camera to click the image of the suspected collision and Raspberry Pi will send the data about the collision to the Dynamic Database or on Cloud. And Raspberry Pi will also trigger the GSM module simultaneously to send the alerts to nearest police station, fire brigade and ambulance.

3.7.4 Outputs

Alerts send to nearest police station, fire brigade and ambulance.

3.8. Street Light Module

3.8.1 Introduction

The only component is the Ultrasonic/IR sensor and LEDs (street lights) that is connected to this module via wires as a raspberry pi. Whenever the IR sensor senses something then the raspberry pi will switch ON the next three successive street lights in order to give the driver a visible track to drive in dark.

3.8.2 Inputs

Ultrasonic/IR sensor's sensing value is working as an input for this module.

3.8.3 Processing

The basic logic behind the processing of this module is that the sensing of Ultrasonic/IR sensors will make the raspberry pi to switch ON the next three street lights so that the driver can see the track. Similarly if any vehicle will approach the successive vehicle then the preceding street light's sudden blow will work as a signal for the driver that someone is behind you.

3.8.4 Outputs

Switching ON the Next three lights is the output of this module.

3.9 Logical Database Requirements

Since we are not providing any graphical user interface compatible with our project there is no need of any logical database.

IV. RESULTS & IMPLEMENTATION

For better understanding of this proposed model we need some Experimental setup.

Finally various modules of this project are tested successfully and being fabricated on a single board for presentable view. Every module is responding fine with expected outputs for the inputs provided to them. The street light module is successfully switching ON the 3 successive LEDs (resembled as a street light) after detecting obstacle in front of Ultrasonic sensor. The Collision Detection and Alert Forwarding module is also working properly as desired. It is detecting heat and sound values above threshold and reporting it as a collision to trigger GSM as well as Pi Camera to work accordingly. Even our Collision Monitoring module (supportive android app) is receiving images of the alerting or collision situations for the cloud storage successfully.

Furthermore, this IoT based model likewise gives us enough guarantees for the future expansion as it is exceptionally adaptable and we can add new modules without disturbing the working of current modules.

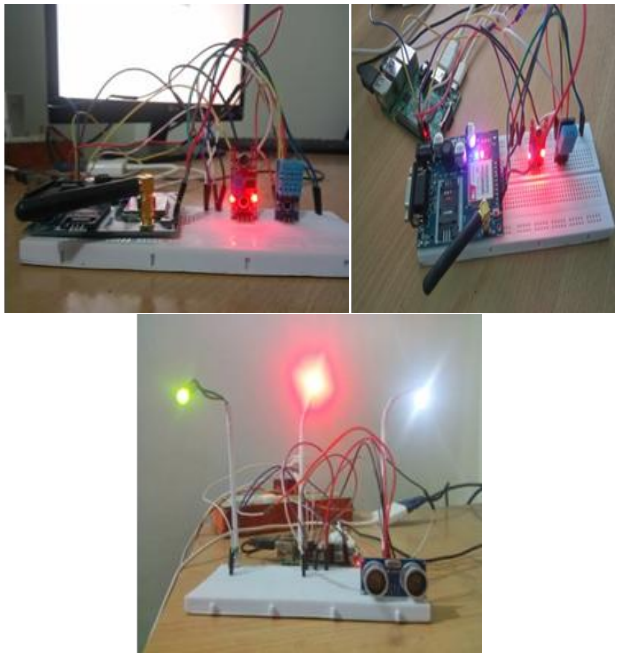

Figure 4.1.: Collision Detection Module, Alert Forwarding Module, Street Light Module

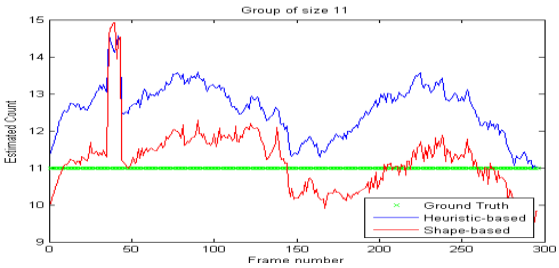

Figure 4.2: Plotting of exact counts of sending massages over an 11 Accident

V. CONCLUSIONS

This proposed model "Smart Street Light & Collision Detection System" has different working modules, for example, Collision Detection, Smart Street Light, Collision Monitoring (Supportive Android Application). After several runs and tests, our all features worked proficiently with a worthy time postponement and all features are effectively integrated into this project and contributing to the best working of the unit. Hence the project has been effectively structured and examined. And combined with android and Cloud Storage for future advancements. The proposed "Smart Street Light & Collision Detection System" can ensure the reduction in electric power wastage and in the consequences of the accidents like deaths, heavy blood loss, timely First Aid etc.

REFERENCES

1. Fujii, Yusaku & Yoshiura, Noriaki & Takita, Akihiro & Ohta, Naoya. (2013) "Smart Street Light System with energy saving function based on the sensor network".
2. O. Litvinski and A. Gherbi, "Open stack scheduler evaluation using design of experiment approach," in Proceedings of the 16th IEEE International Symposium on Object/Component/Service Oriented Real-Time Distributed Computing (ISORC '13),pp.1–7,Paderborn, Germany, June 2013.
3. Parkash, Prabu V, Dandu Rajendra proposed "Internet of Things Based Intelligent Street Lighting System for Smart City" published in International Journal of Innovative Research in Science, Engineering and Technology ,Vol. 5, Issue 5, May 2016.
4. Akash RB, Holabasappa K, Kiran Kumar DM, Kiran Mardi, Asst Prof Smt.B.M.Nandini proposed "Street Light Monitoring and Detectioning System" published in International Journal of Modern Trends in Engineering and Research (IJMTER), Vol. 4, April 2015.

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