Survey on Energy Efficient Smart Street Light System

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Abstract—**This paper introduces a smart street light controlling system to boost energy efficiency of the city. Now a days people are so busy that they rarely find the time to switch OFF the light when it has no use. This results in consumption of lot of energy. This paper proposes the system where street light changed to ON state in the evening before sun sets and they are switched off in the morning after sunrise when there is enough light on the street. This leads to reduce of energy consumption. In this system the movement of vehicle and human is detected on highways to switch on a chunk of street light ahead of it and switch off the trailing lights. This is achieved by processing the image of the object and sending control message to the street light block. Additional feature of the system such as using a suitable sensors of the detection of failed street light and then sending the SMS to control authority using GSM mode to take appropriate action regarding failure**

Keywords- LED lamps, Raspberry Pi,Sensor,LDR

I. INTRODUCTION

Due to the need of environmental concerns, lighting control system plays an important role inflation of energy utilization without compromising with comfort goals. As we all are aware that the energy is the only one significant constraint to be taken care while assessing the later effects of the technical system on the surroundings. In order to decrease the number of road accident rate and increase flow of the vehicles and the safety, the street lights is to be lighted constantly for more than 13 hours per day. This it requires a plenty of electric power. Nearly 30% of total electrical power of any country is utilized for the lightning the roads the street. Thus the expenditure on energy is very high. In addition to this the emission of CO2 gas causes environmental pollution to the large extent. The system application for street light control for each lamp will require small amount of electricity and availability of street light will also increase.

In some area or lane the number of vehicles passing is very low and still there is overwhelming electrical power. It is possible to automatically slash the electricity in the area where there are no vehicles and resume the electricity for these parts once there are some vehicles in the scene? If we can implement this type of system, then the efficiency of the energy is increased to the larger extent.

The proposed system Smart Street Light, is a hardware application which takes the video as an input to the system and it detect the movement of the vehicles and human beings to switch ON a chunk of the street lights that are ahead of it, and to switch OFF the trailing lights in order to save the energy or power consumption. We are using the Object Level Frame comparison methodology to detect the vehicles and humans that are passing by. In this paper we are also including the sensors to detect the temperature and the poisonous gases that are exceeding in particular area and send the SMS immediately to the corresponding department. It also sense the change in environmental conditions i.e. sometimes it become dark in the afternoon due to cloudy weather and should immediately send the SMS to switch ON the lights.

II. RELATED WORKS

In this section we have introduced the object level frame comparison and the sensing capability of the street light to check the various environmental conditions.

A. Object Level Frame Comparison

Object Level Frame Comparison: There are various methods for the video detection, namely, pixel domain processing and compressed domain processing [1,6,7]. In the pixel based domain method it contain the pixel to pixel comparison and block to block comparison, histogram based approach. While in compressed based domain method it uses direct encrypted

data. Various comparisons of the shot detection method shows that the pixel domain technique is more accurate than that of the compressed based domain method [4,5]. But the compressed domain method is more faster. Also, among all the pixel domain strategies, histogram based technique is has better performance as compared to all techniques. But it has one drawback that the understanding of the illumination condition of the video is difficult. Thus to avoid this condition, we searched for the better technique and came across the method called as Object-Level Frame Comparison (OLFC) method for the detection of video shot.

In this method initially there is a classification of the pixel in the image either true color or gray color pixel w.r.t to the calculated threshold value. Then there is representation of the pixel in three different parameters known as position of pixel, which specifies whether it is a true color or gray color and its value. Then there is a grouping of the pixel using K-means clustering algorithm [8]. Then we perform connected component analysis of the pixels for the determination of the different object in a frame. Also we recognize the components of the size that is smaller than a particular percentage (typically 1%) of the size of the frame; then the smaller region is merged with the nearby region with which it has a maximum overlap. Then we use Algorithm for the frame-to-frame similarity calculation [9].After finding the object-level frame-to-frame similarity, an adaptive threshold value is used for the identification of the shot boundaries.

B: "Design and Development of Intelligent Wireless Street Light Control and Monitoring System Along With GUI" by B.K. Subramanyam proposed a system, it became the crucial for the people to work during night and return back homes late night; also mounting the rate of crimes occurred during the night times. This is done by proper implementation of the solar based lighting system on the streets. The expenses is reduced by the use of solar panel. Also saving precious time and reduce the huge individual power by the use of the LDR,IR sensors. The street lights are controlled through by designing a special Graphical User Interface (GUI) in the PC. For the purpose of street lights and controlling at the PC end, technology Zigbee is used.

C: Thomas Novak [10] proposed a system designed which is based on traffic flow. Traffic sensors are implanted on the road that monitors the volume of the traffic continuously. All lights communicate through Zigbee communication modules and they are controlled separately. The design of the proposed system is based on the detection of the human and the vehicle. All the lights have Data modem communication modules and they can be controlled separately. A camera is installed on to the first pole light; the input that is obtained from the camera is processed by the Raspberry pi. The main advantage of this system is it reduces the need of using many sensors.

This system was developed using Atmel 8-bit microroller along with various sensors sensing climatic and geographical locations. The camera and LDR circuit is used to identify the passage of vehicle or pedestrian that causes the street light to be turned OFF/ON.

The malfunction message is send to the authority by GSM modem which is initiated by public on the button press.

When the vehicle comer in the area near the street light, the LED will be glowing and when there is no motion it will switched back to its OFF state. This is achieved by measuring the coordinate of the bounding box that is drawn around to detect the object. This system is expensive but the maintenance cost is reduced.

III . SYSTEM MODEL AND COMPNENT

Smart street light is a hard ware application that take input s the video and activate the street lights according to the input given to it. We make use of the Raspberry Pi as our platform is based on the emerging technology and it is having more capacity of RAM. It also enables the number of modules to be connected through the various ports. A camera is connected to the Raspberry Pi which is the element through which we take the input image. Initially first image will be converted to the grey scale image. Then set the threshold value by using this threshold value a binarized image is obtained. By applying contour mapping extract the existing image from the background. Then find the area of that object and eliminate the small area object. This module is then connected to the hardware section of the streetlight with a data modem for controlling its status. Temperature, gas sensor, LDR and the button are the input that is given to the raspberry pi. The Smart street light works during the darkness. To ensure this we use LDR to measure the intensity of the light. Public is provided with the button to inform the control department regarding the failure or malfunctioning of any street light. A critical value is setup in the sensors is setup in the sensor if the value goes beyond that the SMS is send to the corresponding authority via GSM module.

Components used:

- Camera
- Raspberry Pi
- Data modem
- Microcontroller
- Comparators
- GSM Modem

As Raspbian is Linux operating system it has good protection feature , rate first in the networking and the capabilities and right to use to 1000's of free programs and utilizes the called packages that is installed from the terminal.

Raspberry Pi is a mini computer that is designed for students which is cost efficient and will fit into a computer monitor or a TV, it also uses standard keyboard and mouse. It is minicomputer that enables the people of all ages to discover computing and also learn how to do coding in scripting languages like python and scratch.

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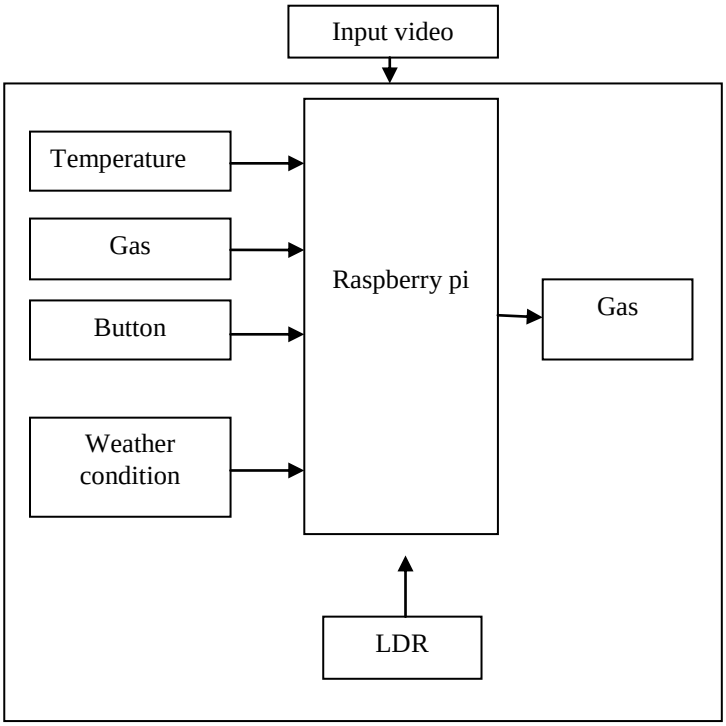

Fig 1: Block diagram for Smart Streetlight System

IV. IMPLEMENTATION

Smart street light implementation is done in such a way that it illuminates the lamp when there is presence of human or vehicle. Camera is placed on to the first street light and it captures the image from street and then process the image. When it founds any vehicle or human the light nearer to object will glow and the other will be turned off. Sensors that are installed will check the environmental conditions there will be gas sensor, temperature sensor and LDR sensor. If sensor value is found to be true then message will be send to the corresponding control station.

The procedure for implementation Smart street has the following steps:

1. Capturing the video
2. Processing the video frames
3. Determining the state of the streetlight
4. Activating the sensor array
5. Wireless communication Module

A. Capturing the video

A camera is installed on the first streetlight which captures the video of live traffic.

B. Processing the video frame:

After the video is being streamed from the camera it is processed by the following steps.

- Dividing video into the frames
- Converting the frame from RGB to Greyscale
- Performing the binarization
- Determining Coordinate
- Finding the area

C. Determining the state of street light

Through the measurement of coordinates of the object we find the area of same object. If it is greater than specified area then desired light will turn ON.

D. Activating the sensor array

The sensor array consist of temperature, gas and LDR sensor will have predetermined threshold value if it exceeds above that then it will send message to corresponding authority.

E. Wireless communication model

This model is used for the transferring of the message to the succeeding streetlights to tell them about the state of streetlights i.e; the message “it is to be turned ON” to each light so that wiring cost will be reduced.

V. DESIGN

The proposed system has three major components namely, a camera that is installed on the smart street light for image processing. Second is the street light LED based technology that includes communication device module that provides interconnection to street light and third is communication module.

The proposed system consists of the streetlight arranged as continues blocks. In first the street light of each block we install a camera to capture the real-time video of the road and process it using raspberry pi. A wireless message to turn ON/OFF the light is send to succeeding pole light.

The design our project can be improved by making cameras capable of recording violation rule such as not wearing helmet or breaking of signal so that it become useful police department.

VI . ANALYSIS

In table 1, it shows an analysis and comparison of the current system. One of the alternate strategies for cost reduction is usage of the energy efficient lamp with the advanced lighting technique. The advanced technologies such as light emitting diode(LED), are reported as the one of the reduction in energy consumption similar to the more traditional high pressure sodium lights (HPS). The system which uses PIR sensor to detect the pedestrian movement of vehicles is inefficient and not precise as such system needs parallel installation of sensor. This will increase the charge as the number of sensors also increases and also it will detect the movement of bird or animal. Thus it proves to be inefficient because sensor contribute for short range detection.

Table 1: comparison and techniques in proposed street light system

Papers	Components and techniques	Merits	Demerits
Street light control based on traffic condition	Traffic sensors Zigbee technique for communicating	Control illumination and provide safety	Requires large number of sensors and require frequent maintenance
Street light control based on environmental conditions	Pollution detecting sensors, temperature, weather station	Improve energy efficiency Minimize cost	Difficult to design that works in autonomous way
Zigbee based system	Zigbee communication protocol	Reduce manual work, save energy	Complexity in design
Wireless self-localizing systems	Wireless retrofitting of lamps humidity and temperature sensors	Lower cost	Limited coverage
Wireless internet lightning control systems	PIR sensors, skin sensors	Save this energy and meet domestic and industrial needs	Maintenance cost increases

VII CONCLUSION

The project uses raspberry pi which is latest and advanced microcontroller. The main benefit of the proposed system is the power saving. It also uses the latest platform for its implementation i.e. Raspberry Pi. It requires the initial cost for installation but the maintenance is very simple. Thus, such system is more useful for the government to reduce the conventional power. Thus such systems are implemented on a large scale to bring signification reduction of electrical energy. Thus this will help the government to save energy.

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