Intelligent Street Lights

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Abstract – Intelligent Street lighting systems in areas with a low frequency of passer by are ON most of the time without any purpose. Controlling of streetlight is the mainly important in developing country like India so that it may reduce power consumption. Saving of this energy is a very important task to be performed now days as energy resources are getting diminished day by day. The purpose of this work is to describe the Intelligent Street Lighting (ISL) system; an initial approach is to accomplish the demand for flexible public lighting systems. By automating the system, light are automatically switched ON / OFF in partial road areas based on the IR sensor data.

1. INTRODUCTION

Due to the increase of environmental concerns, lighting control systems will play a key role in the reducing energy consumption. As mentioned theenergy is the single most important parameter to consider when assessing the impacts of technicalsystems on the environment. Smart Street Lighting System is an intelligent street lighting control system [13] that has to light up at the right time and perform seamlessly.Basically an intelligent streetlight system which is designed such that the street lights are automatically switches OFF and ON based on the sunlight.Street lighting system meant for providing safer traffic conditions, safer pedestrian environment and itsignify a improvement to the city's architectural, touristic and commercial output. The main purpose of Smart Street Lighting system is to monitors the status of temperature, light, and power consumption in LED street lights and to automatically on/off the street light based on the sensor.By implementing such type of system that can perform individual dimming and ON/OFF switching of the street lights becomes an easy task.

Municipal road lighting has the task of contributing to traffic safety on roads during the dark hours of the day. For a long time, many municipalities were forced to reduce or switch off street lighting at night due to financial problems. Conventional lighting shutdown has a negative impact on many areas of society. The risk of accidents increases, the quality of life decreases as same as the attractiveness of a city. The LED offers the function of continuous dimming, in contrast to a similar energy-efficient fluorescent energy saving lamp. This essential functional advantage has, so far, hardly been used in LED street lighting.

In the actual state, LED lamps, such as conventional lamps with half-night switching, are either activated or deactivated completely to save power. The pervasive use of LEDs in public street lighting, however, allows new strategies of lighting with the inclusion of dimming.Automatic dimming control, which not only reduces energy consumption but also offers longer life and less maintenance to cut the system cost.The idea is to activate street lights only whenthey will be used to maintain secure and safe traffic reasons. An automated lighting or Light on Demand (LoD) system [5] [14] is required to implement moving light.

2. LITERATURE SURVEY

The rich research is available on this smart street lighting system.

Liuyi Ling, et al. [1] focuses on the utilization of photovoltaic power applied in LED street lighting and an intelligent lighting system is developed. Addition to that a Zig bee based wireless communication module has been developed for potential monitoring the LED street lights for future work.

GulShahzad, et al. [2] suggests a framework for solar power and wirelessly connected group of LED lights, which are switched on and off based on the presence of traffic on the highway. When replaced with LED lights, it saves around 80 % of energy over previously-installed metal halide bulbs.

Ming HwaSheu, et al. [3] explores how the embedded system monitors the road status and output control instructions. As fog or rain is detected, the embedded system immediately instructs the power IC to drive multicolor LEDs for generating the lower color temperature light. An intelligent LED street light which integrates multicolor LED, power driving IC, and embedded image processing is proposed.

Mugdha [4] focuses on one of the solutions for this problem, i.e. by building smart street lights which will reduce power wastagedue to unnecessary lighting of street lights regardless of traffic density and at odd hours. Another method to save powerusing this technique is further elaborated in the paper as well.

Florian Knobloch et al. [5] introduced the deterministic model to control street illumination depending on traffic needs for improving energy efficiency. The light on demand (LOD) system incorporates the traffic velocity into the model and generates results that are more relevant to real-time traffic needs while ensuring safety and security.

K.H.S.D.ABHISHEK et al. [6] describe a scalable, holistic and efficient solution that provides lighting only when necessary (according to the instant weather conditions or the presence of persons and vehicles) with the objective of reducing the related cost in the municipalities, helping the economic recovery. The illumination level will be conveniently regulated, thus avoiding over lighting and glare.

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PilarElejoste et al. [7] focuses on wireless communication technologies, will minimize the cost of investment of traditional wired systems, which always need civil engineering for burying of cable underground and consequently are more expensive than if the connection of the different nodes is made over the air. The deployed solution will be aware of their surrounding's environmental conditions, a fact that will be approached for the system intelligence in order to learn, and later, apply dynamic rules. It also provides tangible solutions to reduce energy consumption according to the contextual needs, an exact calculation of energy consumption and reliable mechanisms for preventive maintenance of facilities.

Moeenuddin Md. Mohsin et al. [8] Proposed street lighting system is highly energy efficient and automated. It uses ZigBee - based wireless devices due to which street lamp system becomes more efficient. ZigBee network i s connected to GSM through computer which is located in base station. Sensor combination is used to control and guarantee the desired system parameters. The information is transferred to a control terminal using ZigBee network which is used to check the prominence of the street light. Appropriate action is taken whenever system fails, by observing the status of street light.

ZhixiongKe, et al. [9] introduces a wireless street light control system based on ZigBee network, which realizes on/off control, power adjustment and fault monitoring. The system gets the street lights parameters and realizes remote monitoring through ZigBee communication.

3. SYSTEM ARCHITECTURE

1.The "ArduinoWeMos" is a micro controller used in the system that can manage the overall functioning of various sensors.

2.Around 5V of required Power is supplied to the microcontroller. Variable DC power supply is recommended, it allows us to adjust the voltage level as per the need.

3."WIFI Module ESP2866" It is also known asself-contained system on chip. It is integrated TCP/IP protocol stack that provide Arduino connection on Wifi network.

4.Light Emitting Diode (LED):
LED is a semiconductor that emits light when activated. MCU outputs a PWM signal to constant current driver to adjust the current going across a LED Street Lamp according to the environment brightness. It saves around 80 percent of energy.

5.Light Dependent Resistor (LDR) Sensor:
A light sensor is used to sense devices illumination level of the street light and surrounding brightness of the sunlight to a micro-controller in order to maintain the constant lighting level of the street light. An LDR is used to sense light i.e. if

light falls on the LDR the LDR turns on and the street light is off or else the LDR turns on the light.

6.IR Sensor:An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion.
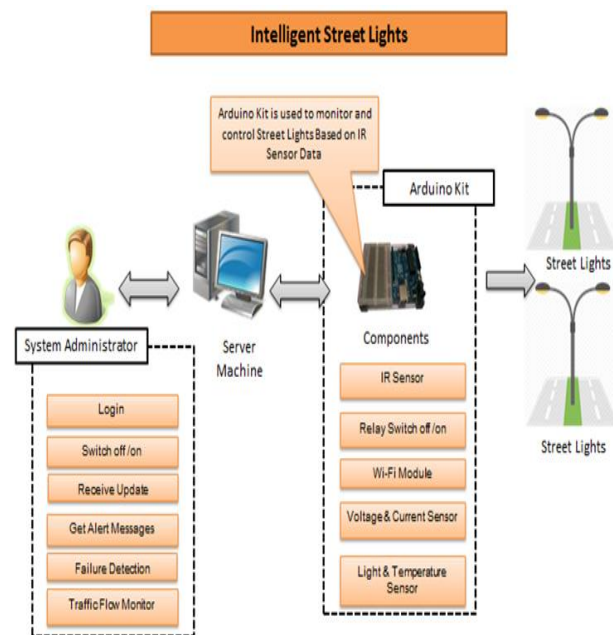

Figure1: System ArchitectureofIntelligentStreetLights System.

4. DETAIL WORKING

- **Street lights can be switched on/off using a relay switch**:-
  The switch is controlled by android board having built in Wi-Fi connection. Street lights are to be smartly switched on/ off using detected light/traffic but admin has a choice to manually start/stop the light.If the first IR sensor is cut then the light is on till the second IR sensor. Also the second IR sensor value is cut then the light ahead of next sensor is on. And remaining lights are off.

- **Monitor Energy consumption:-**
  Each street light is configured with a voltage and current sensor; we measure the amount current and voltage flowing though the light. Sensors also indicate if there is any failure in the light. Energy consumed is also logged on the server.

- **Visualization of Traffic status:-**
  Motion sensor is used to count number of vehicles passing by every hour. This value is also

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synchronized with server to analyze street light operations for next week.

- **Supervise Street lights for failure:-**
  If there is no current flowing through the current sensor and light status is ON then we consider the light in failed state and report it to server.
- **Examine Temperature sensor:-**
  It reports running temperature of the Street light. In case of failure of light, we can check the log of temperature and current sensor. Light sensor is used to detect day and night conditions for on/off operations.

5. ALGORITHM USED
ID 3(Iterative Dichotomiser3) Algorithm:-

ID3 builds a decision tree from a fixed set of examples. The resulting tree is used to classify future samples. The leaf nodes of the decision tree contain the class name whereas a non-leaf node is a decision node. The decision node is an attribute test with each branch (to another decision tree) being a possible value of the attribute. ID3 uses information gain to help it decide which attribute goes into a decision node.

Algorithm:

Step 1:-Start.
Step 2:-Establish Classification Attribute (in Table R).
Step 3:-Compute Classification Entropy.
ENTROPY:

$$H(X) = -\sum_{i=1}^{n} p(x_i) \log_b p(x_i)$$

Step 4:-For each attribute in R, calculate Information Gain using classification attribute.
INFORMATION GAIN:

$$For\ Set\ S, Attribute\ A$$
$$Where\ S\ is\ split\ into\ subsets\ based\ on\ values\ of\ A$$
$$\subset_S^A = Subset\ A\ of\ S$$
$$I_E = Entropy, \ p(\subset_S^A) = \frac{size(\subset_S^A)}{size(S)}$$

$$I_G(S,A) = I_E(S) - \sum^{n} (p(\subset_S^{A_n}) * I_E(\subset_S^{A_n}))$$

Step 5:-Select Attribute with the highest gain to be the next Node in the tree (starting from the Root node).
Step 6:-Remove Node Attribute, creating reduced table RS.
Step 7:-Repeat steps 3-5 until all attributes have been used, or the same classification value remains for all rows in the reduced table.
Step 8:- Stop.

6. EXPERIMENTAL RESULTS
There are following outcomes of our proposed system;
1. Street lights are to be smartly switched on/ off according effect of the sun light on it.
2. Get the approximate vehicle count.
3. Energy Consumption is the key factor and advantage of the proposed system.

7. APPLICATION
1. Airport Area: The road of airport or technical development zone is wide, and with less surrounding buildings, so there will be less interference, which makes them the best place to apply wireless street light system.
2. University Campus: The wireless street light system can be implemented inside the university campus.

8. CONCLUSION
Decreases the energy consumption with minimal overall cost is a popular exploration area in terms of street lighting systems.In this paper, we give a brief review of different methodology of street lighting system.
The literature reviewed shows that much research has been devoted to such a systems.The efficiency andaccuracy reported in the literature survey can be increased in the future with advances sensor and technologies.

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