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Design and Implementation of Smart Surveillance for Energy Saving of Street Lamps in Rural Areas

Dr. S.KanagaSuba Raja [1],M. Vivekanandan[2],T. Ameer Salman [3],M.Arun Sathya[4],V. Koushik[5]
[1,2,3,4,5]Easwari Engineering College,Chennai, India..

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Abstract

Nowadays, there are a lot of street lamps present in each area in order to prevent the darkness. The city street lamp has to be monitored in order to maintain both safety and energy conservation. Therefore, street lamps are an integral part of an urban area. To overcome certain problems, smart surveillance of street lamp is proposed. In the existing system, the street lamps are monitored manually. A common switch will be present in any control station which is used to switch on and off the lamps. So this creates unwanted power usage in an unnecessary time period. So in the existing system, the power consumption is very high and theft of street lights cannot be restricted. Both manual management and light perception control adopt manual patrol to check broken street lamps.

Keywords; *Smart surveillance, urban areas, manual management, light perception control*

I. INTRODUCTION

An urban area can refer to towns, cities or suburbs. They are very developed, meaning there is a density of human structures such as houses, building, playgrounds, public points, etc. Urban areas relate to safer, more suitable, more agreeable and better energy conservation, Therefore making an urban area smarter is considered important. The smart surveillance of street lamps is an essential implementation that can closely monitor safety and energy conservation. Street lighting is a major concern for public authorities in developing countries because of its strategic importance for economic and social stability. Around 10% of the total lighting corresponds to outdoor lighting. The lamp used in street lights varies in size and consumption (typically between 35 to 250 Watts) depending on area of usage such as residential area, main road or a city junction. It is generally assumed that the average wattage of a street light is about 80 watts. Time has now come to gradually adopt the surveillance of street lights, particularly in the areas where power availability is reliable. Moreover, it is necessary to improve the efficiency of power supply to street lamp management because of its high energy consumption in unwanted areas.

The normal street lamps adopt manual management and light perception control which has some disadvantages as follows:

1) Higher support period- A manual check-up patrol is required to periodical check the lamps for faults. Along these lines, the upkeep time frame is excessively long, particularly for the rural road lights, it can be much longer than a few months. Nonetheless, the risk increases soon after the street lamps are broken, hence there could happen more crashes and more burglary also, taking.

2) High vitality utilization- Every street lamp has only two states ON and OFF. One cannot control the brightness of the light. Therefore, they consume unnecessary energy, which affects the economy.

3) One switch control- It is evident that a single switch controls multiple street lights which is not efficient. In case of a single faulty street lamp, the remaining street lamps under the control of the same

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switch had to be switched OFF for the period of repair.

4) Easily stolen- There is no powerful strategy to forestall taking of street lights. There are countless street lights so it is especially difficult to control every one of them constantly. So as to abstain from taking, the powerful path is to influence the street lights to have a self-regulate capacity.

So as to upgrade the previously mentioned disservices and to set up the savvy urban areas, another age of street lamps has to enhance the light by presenting the accompanying highlights- Lessen support period, Decline vitality utilization, Fulfill fine grain control, Self-governing alert.

In this paper, we propose the design and implementation of smart surveillance for energy saving of street lamps in urban areas to meet the previously mentioned capabilities. The proposed implementation method provides the following features:

Excess usage of electricity can be minimized with the intelligence surveillance of street lamp by adjusting the level of brightness.

Fast transmission of information from the device to the database server can be very effective and in order to maintain a clean and regular updating of the conditions of street lamps.

The management of servers and the street lamps should be advanced and automated to overrule the idea of manual recoveries. Moreover, this implementation can reduce the manual check-up of the street lamps.

II. LITERATURE SURVEY

Some savvy street lamps have been proposed dependent on numerous innovation such as Zigbee, Low power wide region (LPWA), GSM, etc. Moreover, there are numerous other correspondence innovations, for example Bluetooth [2], broadcast communication framework, Long term evolution (LTI), etc. Each innovation has different characteristics.

The Bluetooth [2] wireless technology is meant as a short-range property resolution for private, portable, and hand-heldelectronic devices. Since might 1998 the Bluetooth SIG has steered the event of the through the
event of associate open trade specification, together with each protocols and application situations, and a qualification program designed to assure end-user price for Bluetooth merchandise.

The expansion of Internet of Things (IoT) and the accomplishment of rich cloud administrations have pushed the skyline of another figuring worldview, edge computing [5], which calls for handling the information at the edge of the system. Edge processing can possibly address the worries of reaction time prerequisite, battery life requirement, transfer speed cost sparing, just as information wellbeing and protection. In this paper, we present the meaning of edge figuring, trailed by a few contextual investigations extending from cloud offloading to brilliant home and city, just as a synergistic edge to appear the idea of edge computing. At long last, we present a few difficulties and openings in the field of edge computing and trust this paper will pick up considerably from the network and move more research toward this path.

Wi-Fi[1] is that the name of a preferred wireless networking technology that uses radio waves to supply wireless high-speed web and network connections. A common idea is that the term Wi-Fi is brief for "wireless fidelity," but this is often not the case. Wi-Fi is simply a trademarked phrase that means IEEE 802.11x.i-Fi networks have no physical wired connection between sender and receiver by using radio frequency (RF) technology -- a frequency within the spectrum related to radio emission propagation. When associate degree RF current is equipped to associate degree antenna, associate degree magnetic force field is made that then is ready to propagate through the house. A

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general rule of thumb in home networking says that Wi-Fi routers operative on the normal two.4 GHz band reaches up to 150 feet (46 m) indoors and 300 feet (92 m) outdoors. Older 802.11a routers that ran on five rate bands reached more or less third of those distances. Newer 802.11n and 802.11ac routers that treat each two.4 rate and five rate bands vary within the reach equally. The main characteristics of the Wi-Fi are high transmission rate and short coverage.

III. SMART SURVEILLANCE OF STREETLAMPS

The proposed implementation consists of three parts which are as follow

Excess usage of electricity can be minimized with the intelligence surveillance of street lamp by adjusting the level of brightness.

Fast transmission of information from the device to the database server can be very effective and in order to maintain a clean and regular updating of the conditions of street lamps.

The management of servers and the street lamps should be advanced and automated to overrule the idea of manual recoveries. Moreover, this implementation can reduce the manual check-up of the street lamps.

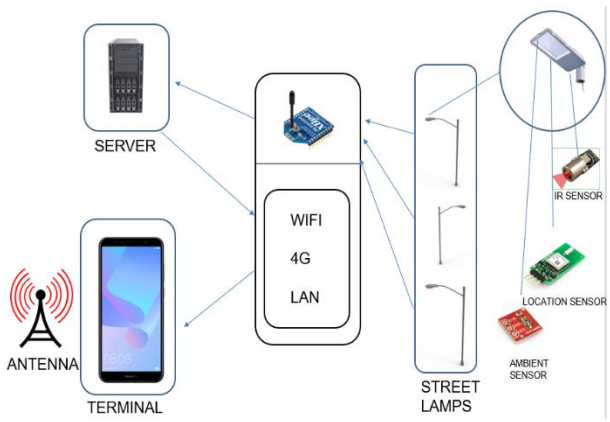

Fig.3.1- Architecture of street lamps for smart surveillance.

A. Intelligent Surveillance

The smart lamp is furnished with few sensors such as IR sensor, location sensor and ambient sensor for making a better street lamp to conserve energy. The sensors enable a way of communication with the servers with the help of networks. This paper explains the sending and receiving of reports to the server about the voltages and amount of energy consumed over a period of time. Depending on the amount of voltage consumption, the server can decide on the usage of power by the particular street lamp. For-say a street lamp has zero current and not a zero voltage, it is indicated as a faulty lamp.Theft of street lamp is notified with the location sensor and this gives us the ability to find the missing street lamp. This sensor also helps the server to send the responsible person about the location of missing or broken street lamp with accuracy and this can enhance the efficiency.The use of infrared sensor can help improve the street lamp's automation ability. The street lamp can manage the need of brightness with respect to crowd. With the use of light sensor the person can live the ambience with a perfect feel which proves the street lamp to be more automated and self-adjustable. The street lamps are made to follow specific commands from the server based on the conditions around the lamp. This can effectively reduce the manual operation of the lamp to turn down or turn up the brightness with respect to the crowd.

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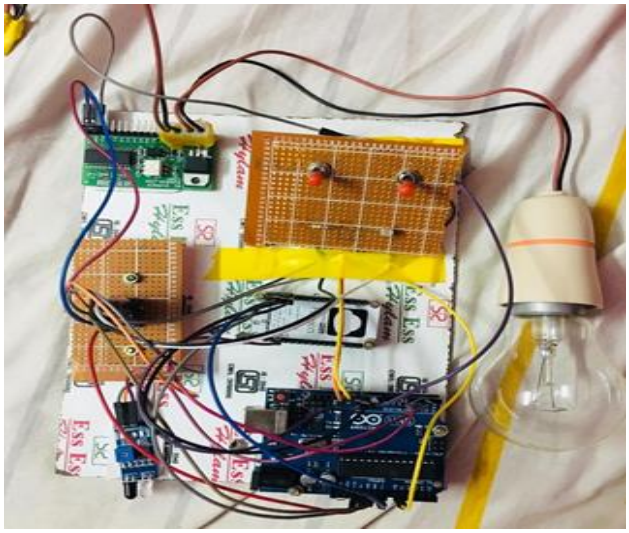

Fig 3.2- Integrated Kit for Smart Surveillance.

B. Fast transmission of information

Using multiple technologies on the field of network to communicate with the device and the server can improve a huge time of efficiency for conserving energy. Compared to wired and interlinked street lamps which had a manual operator to do the operations, this can drastically increase the methods of communicating faster about the status of the lamp. Technologies in network include Bluetooth, WIFI,4G, GSM, ZigBee, etc. This had to be implemented with a wide number of street lamps. The operation should be more reliable as it can involve much of automation for improving efficiency. The server must have a strong wall of security as it involves the safety of the streets, poor network security can lead to large number of threats on streets. The street lamp is well maintained with the latency as the lamp must be ready to execute the command given from the server. Communications from server and the device must be cost efficient in order to implement the technology to a large number of street lamps. NB-IoT can be very effective in this upgrade as it has a low level of latency and a highly reliable interface, it also can have its disadvantages from that it does not have a large number of connectivity with the street lamps limiting to its bandwidth. Sequencing the commands from and to the server can reduce this problem as it cannot process multiple commands to a bunch of street lamps at a time. Periodic data from the street lamps are recorded over a regular interval of time and hence a huge data is sent to the database which is surveyed all together. This can give the priority of the street lamp's usage within the particular area with respective to external brightness, higher brightness is required for an area of more darkness prevailing for a large amount of time.

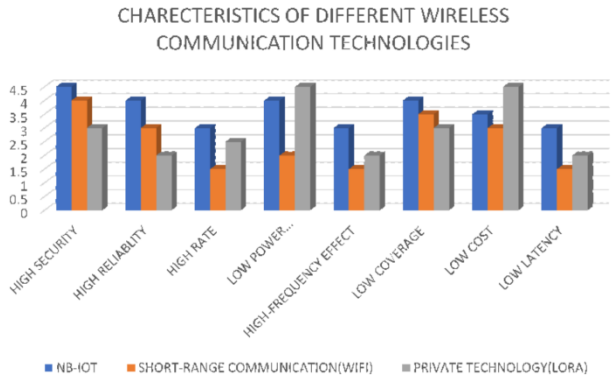

Fig 3.3- The characteristics of different wireless communication technologies in terms of the transmission rate and coverage

C. Effective Management

Fog computing has given us a perceptive view on the usage of street lamps and the effective ways to conserve energy with the use of sensors and advanced technologies. The management platform can be highly responsible for the control of servers and maintenance of street lamps. Fog computing can be more expandable based on user's needs and can be fast on processing commands as they are concentrated to a specific area of usage and is restricted to a particular server of management. As discussed earlier, a street lamp is evaluated over a specific period of time and this record is made to store at the database, when the time period of cycle is set to a higher interval, damages on street lamps are recognized late but with a regular check and shorter cycle of time period faster maintenance is possible.

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Area	Id	IR	Ambience	Control	Status	Watts (w)	Voltage(v)	Kit
Porur	PASL 01	3	2	Auto	Normal	10	220	Yes
Porur	PASL 02	1	3	Auto	Normal	8	220	Yes
Porur	PASL 03	4	3	Auto	Normal	14	220	Yes

Fig 3.4- Dashboard for Monitoring Street Lamps.

calculating power consumption for each lamp (watts) based on IR and Ambience Value

```
if(IR>3 && Ambience>3)///noon &Trafic / W =7.5
{ powerConsumption =(Ambience /2)+(IR);}

else if( ((IR>=2)&& (IR<4)) && Ambience >3)
// noon &ModerateT / W=6.5
{  powerConsumption=(Ambience)+(IR/2); }

else if(IR<2 && Ambience>3)
 // noon &LowT / W= 3.5
{powerConsumption=(Ambience/2)+(IR); }

else if(IR>3 && ((Ambience>=2)&&(Ambience<4)) )//
M/E & HT / W = 16
{ powerConsumption=(Ambience *2 )+(IR*2);  }

else if(((IR>=2)&& (IR<4))
&&((Ambience>=2)&&(Ambience<4)) )//M/E * MT /
W=  12
{  powerConsumption=(Ambience * 2)+(IR *2); }

else if(IR<2 && ((Ambience>=2)&&(Ambience<4))
)//M/E * LT / W=  8
{ powerConsumption=(Ambience * 2)+(IR*2);}

else if(IR>3 && Ambience<2)// N & HT / w= 45
{if(Ambience!=0) powerConsumption=(Ambience *
25)+(IR*4);
Else powerConsumption=45; }

else if(((IR>=2)&& (IR<4)) && Ambience<2)   // n &
MT /W = 37
{if(Ambience!=0)  powerConsumption=(Ambience *
25)+(IR*4);
elsepowerConsumption=45; }

else if(IR<2 && Ambience<2)// N & LT  /W =  29
{ if(Ambience!=0)
powerConsumption=(Ambience * 25)+(IR*4);
elsepowerConsumption=45; }
```

Fig 3.5- Pseudocode for Calculation of Power Consumption of each Street Lamp.

IV. RESULT ANALYSIS

From the above inputs and the tables that explain the graph, we can have a clear view on the data that has been recorded from time to time. The data that has been updated every three seconds can be made into various graphical forms to show the amount of current used per street lamp during various situations. The difference in each lamp with its brightness can help in conserving energy with respect to requirement of brightness. An ample amount of electricity can be supplied to each street lamp which reduces the excess supply to be conserved. The result which we have derived can give a detailed view on the electricity used from a specific street lamp over a specific time with altering values of brightness with respect to the amount of traffic around it.

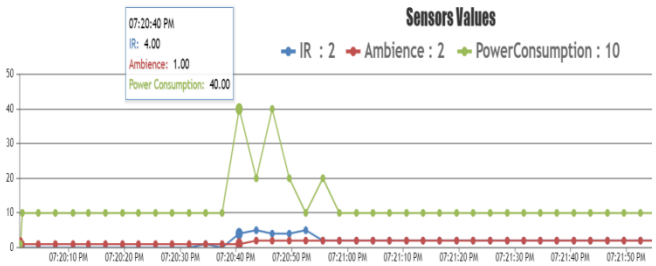

Fig 4.1- Graphical Representation of Power Consumption of each Street Lamp.

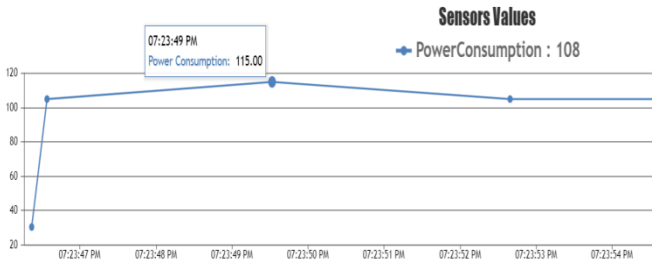

Fig 4.2- Graphical Representation of Power Consumption in a Particular Area.

V. CONCLUSION

In order to reshape an urban area into a smarter city, this paper proposes smart surveillance of street lamps. The proposed implementation consists of

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three parts which are as follow 1) Excess usage of electricity can be minimized with the intelligence surveillance of street lamp by adjusting the level of brightness. 2) Fast transmission of information from the device to the database server can be very effective and in order to maintain a clean and regular updating of the conditions of street lamps. Nb- IoT which is very effective because of low cost and high connectivity density is used.3) The management of servers and the street lamps should be advanced and automated to overrule the idea of manual recoveries. It updates the data periodically. Moreover, this implementation can reduce the manual check-up of the street lamps. By successful implantation of this method, it can be used in various fields where lights are involved.

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