Street Lamp Surveillance in Cities Using IOT

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Abstract.. Safety and energy conservation are very important factors in today's life. A street lamp is an imperative part of the smart cities. Though, current street lamps have lack of smart characteristics, which increases both danger and energy consumption. In order to address the problems, a smart street lamp Surveillance is proposed based on the fog computing in the environment using IOT. The street lamp is controlled by three sensors namely Location sensor, Light Sensor and Infrared Sensor for its operation such as Dynamic brightness adjustment, energy consumption , finding the working state of the lamp to avoid traffic accidents and theft. Abnormal state of a lamp is updated manually by ambience value and Infrared values. Power consumption usage is generated for individual street lamp and as well as for the area The experimental results shows that fine management of street lamps for its independent operation, light intensity alteration, autonomous alarm on abnormal states are displayed in dashboard thus eliminates frequent unnecessary human inspections.

Keywords: Energy conservation, safety, smart cities, smart street lamp.

1. Introduction

New technology has upgraded the cities in all aspects. The smart city identifies with more secure, progressively helpful, and increasingly agreeable activity, and better energy conservation. Making an urban infrastructure be smarter is necessary for promoting the smart cities. In a city the vitality costs is road lighting. The keen road lighting framework can lessen metropolitan road lighting into half. The brilliant road light controller must be introduced on the light post which comprise of Arduino alongside different sensor and remote module. Street lamp is equipped with three sensors, such as location sensor, infrared sensor, and light sensor , to form an intelligent sensing street lamp. The intensity of street lamps can be dynamically altered . Using these sensors, the street lamp can communicate with the server through the network. The street lamp can periodically send reports on its current and voltage values. The sensed information is transferred to dashboard to observe the smart system . When the sensors are failed it sends a notification to the server to know that the lamp is in abnormal status. When the sensors are in abnormal status we can operate the lamp manually by giving the IR and Ambient values. When the lamp is in abnormal status the IR and Ambient value become zero. So give the IR and Ambient values to operate the lamp brightness. Then the lamp brightness changes accordingly to the IR and Ambient values.

2. Existing System

In existing system, the street lamps are monitored manually. The common switch will be there in any control station which is operated in order to switch on and off the lamps. So this creates unwanted power usage in unnecessary time period. There is no existing methodology to detect the theft of any street lamps. Both manual management and light perception control adopt manual patrol to check broken street lamps. Therefore, the maintenance period is too long, especially for the suburban street lamps, it can be even longer than few months. However, the danger increases just after the street lamps are broken, thus there could happen more traffic accidents, more robbery and stealing.

Some intelligent street lamps have been proposed based on many communication technologies, such as ZigBee [3], low power wide area (LPWA) [6], global system for mobile communication (GSM) [5] . Moreover, there are many other communication technologies, such as Bluetooth [2], universal mobile telecommunications system (UMTS)/long term evolution (LTE) [4], wireless fidelity (Wi-Fi) [1], and so on. Each of these communication technologies has its own characteristic. The main characteristics of both Bluetooth and ZigBee are low transmission rate and short coverage.

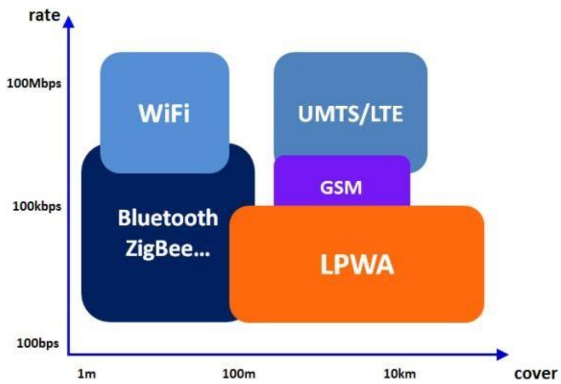


Fig. 1. Characteristics of these different wireless communication technologies.

The characteristics of different wireless communication technologies in terms of IoT [7], which operates with a carrier at 200 kHz. The NB-IoT is designed to have a low cost, long battery life, and high coverage, and can be used to connect a large number of devices [8]. Moreover, the NB-IoT is characterized by low power consumption, less complex transceiver, coverage enhancement, and low-cost radio chip [9]– [11]. The discontinuous reception in the NB-IoT can save power using a sleep mode based on the periodic waking to send data. Moreover, numerous user equipments (UEs) can be supported by a single NB-IoT, even more than 100 000 UEs per NB-IoT channel. Therefore, billions of connections can be supported by the NB-IoT through adding the additional carriers to the network [12]– [15]. The superiorities of the NB-IoT over the other wireless communication technologies are presented in Fig. 2.

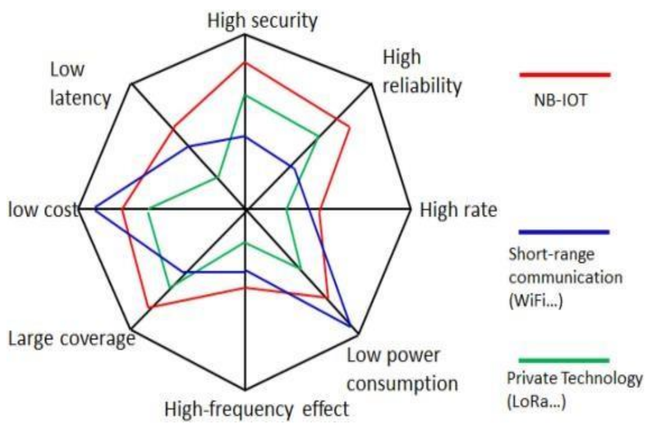


Fig. 2. Characteristics of these different wireless communication technologies.

3. Proposed System

The proposed system consists of Smart lamps , Arduino kit , Remote module as shown in fig 3 .

Smart Lamps

Each lamp is equipped with three sensors, such as location sensor, infrared sensor, and light sensor (Ambient sensor), to form an intelligent sensing street lamp which has unique id , location where the street lamp is present. Using these sensors, the street lamp can communicate with the server on its current and voltage values. Based on the present and voltage values of the

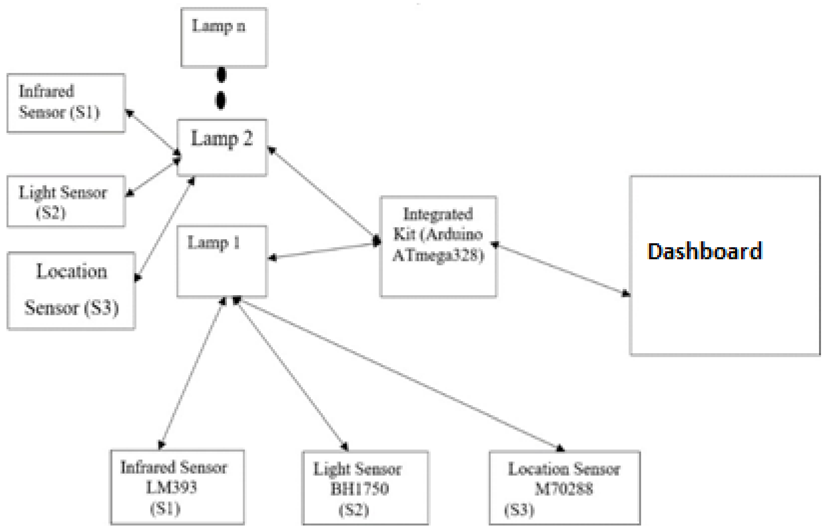


Fig 3 . System Design

road lamp, the server will confirm the road lamp state. If the current of the street lamp is zero, but the voltage is not zero, then the server can conclude that the light bulb may be broken. By the location sensors with the lamp, the server is sophisticated whether or not the road lamp is stolen. If the street lamp is found lost or when the server finds the light bulbs of street lamps are broken, the server can send the detail location to the serviceman for repairing, so the serviceman can locate the broken street lamp accurately which improves efficiency. Thus based on the sensor values the server can process the received data from each street lamp and defines the stability and live status of the smart street lamp.

Dashboard of remote module in a system , display the details of street lamp areawise with working state information using location sensor. Once the kit is integrated with a lamp id in dashboard the sensor values from the kit will be displayed in admin dashboard.

When the sensors are failed, it sends a notification to the server to know that the lamp is in abnormal status. When the lamp is in abnormal status the IR and Ambient value become zero. In that case the lamp is operated manually by giving the IR and Ambient values which increases the lamp brightness.

Lamp can also be searched by giving the area name and the dashboard will show the details of all the lamps . Lamp is indicated by individual lamp id and shows the current IR and Ambient values along with status whether it is normal or abnormal. When it is normal it performs automatically and when it is abnormal it is operated manually.

Power consumption can be shown in the graph for each lamp independently and the graph is updated every 3 seconds. Current status of the lamp is shown in the dashboard. Power Consumption also can be shown by area wise.

Arduino Kit

Arduino Tmega328P kit is connected with street lamp to display information in the dashboard. Location sensor in the lamp identifies where the lamp is exactly located along with the status. Based on intensity of light, Light Sensor informs the working state of the lamp. If the lamp is in abnormal status then the lamp intensity will be low.

Infrared sensor is used for measuring the heat of the lamp. If the lamp is overheated the intensity of the lamp is decreased that is brightness of the lamp is reduced.

Remote Module

An admin who used to monitor all the street lamps will register and login into system. Once admin login to system, information regarding all street lamps will be updated in dashboard. All the data from the sensor value of the street lamp updated regularly in admin dashboard.

Dashboard shows all the lamp id's and all the information about the lamp. Search the lamp by giving the area name in the search dialog box. Then the dashboard will display all the details of the lamp in that area. Select any one of the lamp in the list and select the option connect kit. Then the particular lamp is connected to the kit and will show the status of the lamp whether it is normal or abnormal. If any sensors in the street lamp like Ambience sensor and IR sensor malfunctioned it gets updated in the admin dashboard. Admin will give value and based on that the light intensity will increase or decrease.

4. Experimental Results

Admin Registration

The authorized user registers himself as admin to Remote module by giving adminname , email id , password. Once registration is complete , admin logins and views the dashboard as shown in fig 4. The displayed details are area, lampid , ir value , ambience value , control , status , power consumption inwatts , volts in volts , graph, kit connected or not.

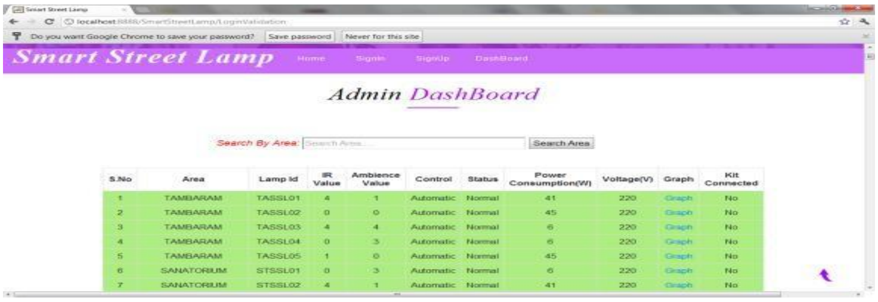


Fig 4 . Dashboard Display

Searching a Particular Area

The working of the lamp is identified by specifying the area name. is shown in fig 5.

Fig 5 . Area wise Lamp Status

When graph option is selected , it updates ir value , ambience value for every 3 seconds shown in fig 6.

Fig 6 . Power Consumption Graph

When the Sensor is normal , lamp intensity increases. When Sensor is Failed lamp intensity decreases as shown in fig 7.

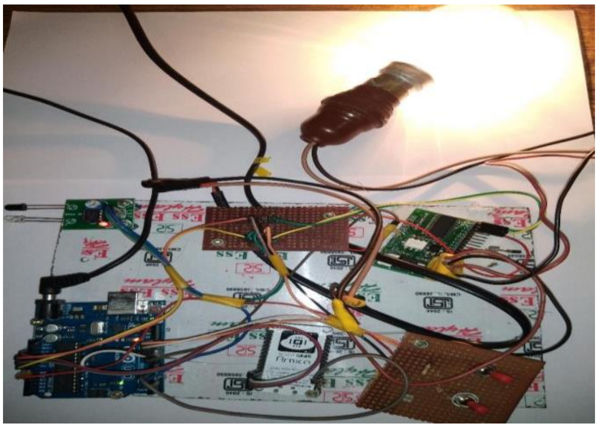
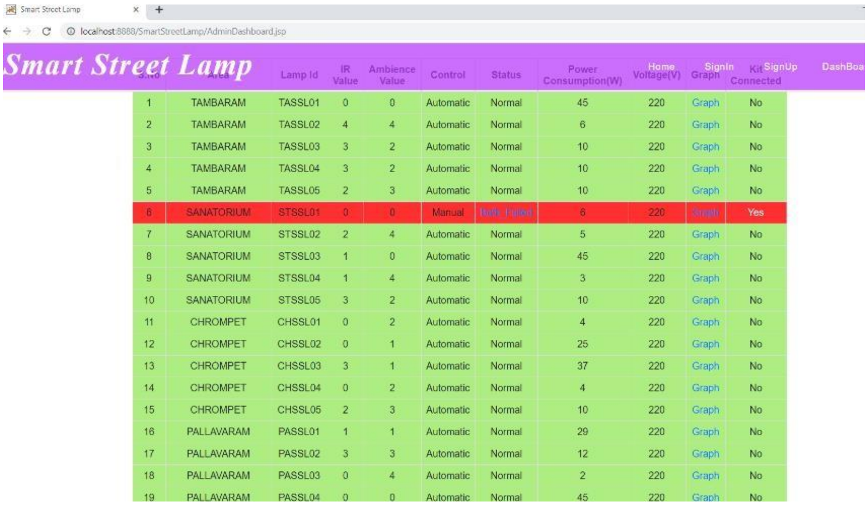


Fig 7. Light with high Intensity for Working Sensor



S.No	Area	Lamp Id	IR Value	Ambience Value	Control	Status	Power Consumption(W)	Voltage(V)	Graph	Kit Connected
1	TAMBARAM	TASSL01	0	0	Automatic	Normal	45	220	Graph	No
2	TAMBARAM	TASSL02	4	4	Automatic	Normal	6	220	Graph	No
3	TAMBARAM	TASSL03	3	2	Automatic	Normal	10	220	Graph	No
4	TAMBARAM	TASSL04	3	2	Automatic	Normal	10	220	Graph	No
5	TAMBARAM	TASSL05	2	3	Automatic	Normal	10	220	Graph	No
6	SANATORIUM	STSSL01	0	0	Manual	Both_Failed	6	220	Graph	Yes
7	SANATORIUM	STSSL02	2	4	Automatic	Normal	5	220	Graph	No
8	SANATORIUM	STSSL03	1	0	Automatic	Normal	45	220	Graph	No
9	SANATORIUM	STSSL04	1	4	Automatic	Normal	3	220	Graph	No
10	SANATORIUM	STSSL05	3	2	Automatic	Normal	10	220	Graph	No
11	CHROMPET	CHSSL01	0	2	Automatic	Normal	4	220	Graph	No
12	CHROMPET	CHSSL02	0	1	Automatic	Normal	25	220	Graph	No
13	CHROMPET	CHSSL03	3	1	Automatic	Normal	37	220	Graph	No
14	CHROMPET	CHSSL04	0	2	Automatic	Normal	4	220	Graph	No
15	CHROMPET	CHSSL05	2	3	Automatic	Normal	10	220	Graph	No
16	PALLAVARAM	PASSL01	1	1	Automatic	Normal	29	220	Graph	No
17	PALLAVARAM	PASSL02	3	3	Automatic	Normal	12	220	Graph	No
18	PALLAVARAM	PASSL03	0	4	Automatic	Normal	2	220	Graph	No
19	PALLAVARAM	PASSL04	0	0	Automatic	Normal	45	220	Graph	No

Fig 8. Dashboard Display – Failed Sensor

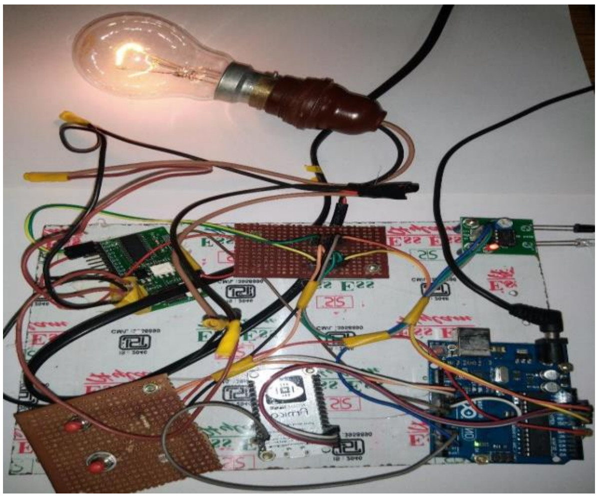


Fig 9. Light with low Intensity for failed Sensor

Manual setting of IR and Ambience value is done and according to the values the lamp starts glowing

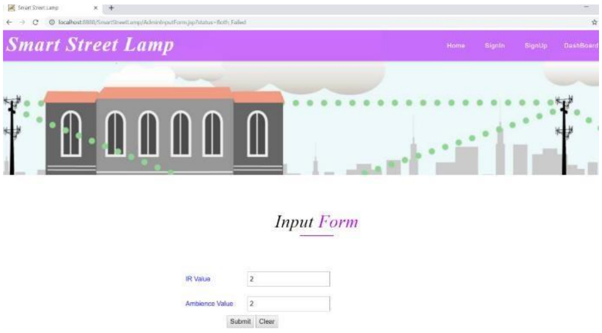


Fig.10 Manual IR & Ambience Value Updation to increase Intensity

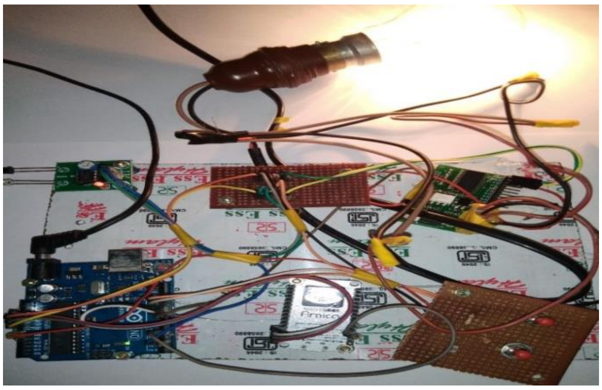


Fig 11. Manual IR & Ambience Value output

5. Conclusion

In order to satisfy the requirements of smart cities, our proposed system has three parts. The first part specifies Intelligent sensing street lamp (street lamp brightness can adjusted and autonomous alarm notifies about lamp abnormal state); The Second part denotes efficient network (real-time communication is achieved, the NB-IoT is adopted for communication between server and massive street lamps, and the internet communication technology, such as Wi-Fi and 4G, is adopted for communication between server and managers); and The third part indicates flexible management platform (management platform can optimize resource scheduling for easy and highly automated management of street lamp system). The average maintenance period, which denoted the time between the abnormal lamp state appeared and the server checked it, was about 20 min. Moreover, the proposed System can reduce human resources by eliminating unnecessary periodic inspections. In the future make the proposed system integrated with VANET in current smart cities and can be used in other areas like parking, environmental monitoring, and rural areas where the traffic is very low.

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