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Using Esp32 IoT Based Wi-Fi Enabled Smart LED Systems

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Abstract: Established street lighting systems have certain drawbacks as they are worked truly. Accepting that this system is not monitored suitably, this could provoke more energy consumption. This structure requires genuine checking and energy management techniques to lessen energy wastage. To diminish this energy wastage, we propose a structure which works thus and also can be remotely supervised and controlled with virtual switches using GUI. This Wi-Fi enabled structure uses ESP32 as both a controller and Wi-Fi module. Here we use low bandwidth,a lightweight show like MQ Telemetry Transport show forIOT execution. To reduce cost of the structure, all streetlight(Wi-Fi) center points are related with a singular switch using Wi-Fimesh association. Each center point is having ESP32 and different sensorsfor power assessment and article disclosure. This structure can be controlled therefore established on periodic data set aside in central base station.In street light failure condition ESP32 will send a fail signal to base station and base station will suggest maintenance operator through mail. Here base station and each node communicate through cloud.For remotely control and supervision a GUI is developed using HTML and JavaScript.

IndexTerms: Wi-Fi, Meshnetwork, sensors, IOT, cloud, MQTT, SMTP, NTP protocol.

1. Introduction

The established streetlight system brings challenges for administration & maintenance department.This also has numerous issues such a slow level of intelligence, poor reliability, high power usage, and so forth. To reducepowerconsumption,conventionallampslikeCFLlampsandHalogenlampsarereplacedbyLEDlamps.Thepowerconsumed by 8 Drove lights is counter parts to the power consumed by 4CFL lamps and a single Halogen Lamp[1].

This is due to LED lights are more useful than the customary lamps(CFL, Halogen). Despite the power viability, LED shave on numerous occasions more future than CFL and on numerous occasions more life span than Brilliant lights. By super seding CFL and halogen lamps with LEDs we can save energy upto 80% [4].

Day light hours change starting with one season then onto the next basically in summer and winter, so the lights should be turned on considering the sunset time [9]. To additionally foster energy efficiency, we really want to make an automatic structure which turns on and switch off the streetlights based on seasonal data[2].

Initially this automation system is developed with wires. Later on, to diminish the connection cost and effort lessness of movement, it is replaced by wireless technology. Nowadays Zig Bee[3], Bluetooth[6], radiofrequency[7], Wi-Fi[8] technologies are applied for streetlighting system. Bluetooth and Zig Bee have some limitations. Bluetooth is a short-range wireless communication show with a limited extent of 10 meters.

ZigBee is used for individual locale putting together which is more expensive than Wi-Fi. Wi-Fi relies upon the IEEE 802.11 standards wireless net working technology and it uses internet protocol-based technology.Wi-Fi enabled devices use WLAN and distant paths related with the web.

Wi-Fi works on 2.4GHz(12cm) UHF and 5GHz(6cm) SHFISM radio gatherings and it hides the extent of to 100m. As compared to real layer development, this gives better datasecurity.

2.Devices And Methods

The conceptual scheme of the proposed system is shown in fig.1. It contains streetlights and a central base station.Central base station is arranged in a nearby by building. This system is actually expandable. Here, central base station and streetlights communicate through cloud.Adafruit.io is used as a cloud service provider.

The street lights are turned ON/OFF according to seasonal data.These periodic data are taken care of in central base station. From this central base station controlling (ON/OFF) signals are sent to each streetlight through cloud.

2.1Street light Nodes:

Each street light node consists of severalmodules.TheyareESP32, current sensor, voltage sensor, PIR sensor and ZCD circuit as shown in figure 2. The voltage sensor and current sensor are communicated with ADC pins of ESP32 and passive infrared radiation sensor, zero crossing detector are interfaced with GPIO pin of ESP32.Using current sensor, voltage sensor and ZCD data, power use is assessed and it is sent in to cloud. Suitably current sensor data, streetlight status ON/OFF are more over transport off cloud. This power and status dataare further more displayed on GUI. PIR sensor is used to pick the intensity level of streetlight.

2.2 ESP32 as Controller:

ESP32 is a system on achip microcontroller with integrated Wi-Fi. It is made and made by Espress if systems. In this a Tensilica Xtensa LX6 central processor and an inbuilt antenna switches and other communication components, for instance, enhancers, channels, etc are used. It is best suited for Internet ofThings applications.

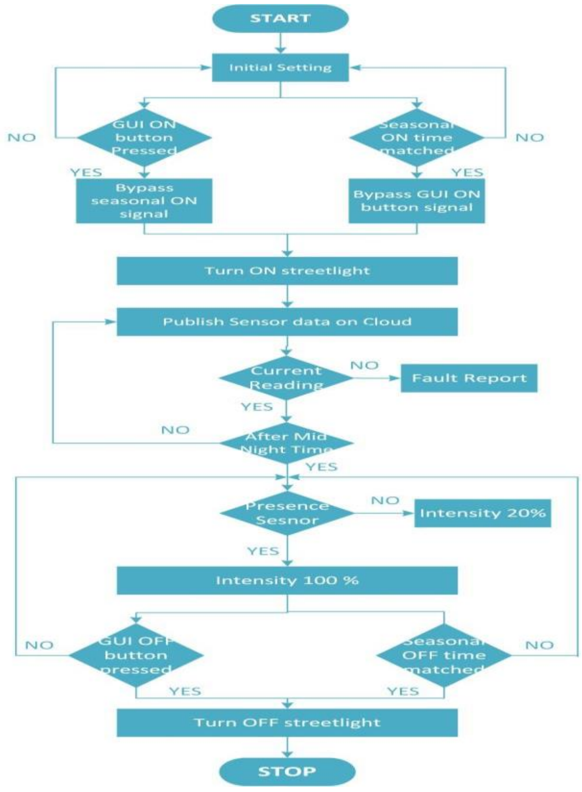

Fig.1 Flow chat of the software runs on ESP32

Fig. 3 shows the flowchart of the item runs onESP32. This system can be controlled in two ways. One way is according to seasonal data and another way is using virtual sw itch of GUI.

3. Presence Sensor:

This sensor is used to perceive the presence of a person on road or passage of a vehicle. Placement of this sensor is the chief test. To avoid any mixed up acknowledgment of small animals and to avoid failure to recognize kids, the sensor should be placed at a perfect height, neither too low nor exorbitantly high. Here we used PIR sensor, to have good performance and affordable in its price.Detecting range of this sensor is around 10 meters with a 120-degree viewing point. As demonstrated by the after effect of this sensor, streetlight intensity is changed, avoiding waste of energy.

1) Power Measurement sensors:

In this paper to evaluate dynamic power, current sensor, voltage sensor and ZCD circuit are used. Here we used PT based voltage sensor and CT based current sensor. Both sensors are operated at 5V and interface with ADC pins of ESP32. ZCD is used for assessing power factor. Zero crossing locater is made using Over controlled Amp. Fig. 4 show the circuit of ZCD.

The web based power usage information is reported to the cloud. The continuous sensor is similarly used to recognize thebroken-down light. The system current is 130mA, so a sensor must be capable to detect this current.To detect the operation of the light, a fitting edge regard has been set between 70mA and 130mA. As current sensor we used is ZMCT103c and voltage sensor ZMPT101b. Both are suitable for Ac and DC current sensing and economical.

I. Central Base station:

Central Base station is the middle mark of the system. As central base station we use Raspberry Pi3B+. Raspberry Pi3 model Bis an ARM based charge card assessed minicomputer made by the Raspberrypi foundation.It has a 1.2GHz quad core cortet A-53 Broad com BCM2837 64bit ARMv8 processor and on-board Wi-Fi capacity, this central base station sends control signal to the streetlights through cloud according to seasonal data. For that we request persistent clock to keep actual time.

Here we stored the seasonal data and run the software that continuously contrasts steady and ON/Slow time of year of the seasonal data. To keep authentic time, we used NTP protocol instead of RTC. NTP protocol is Described below:

a) Networking Time Protocol:

This protocol keeps real time without RTC. NTP is used by default on Raspbian and other association contraptions and computer. This show changes contraption clock to match the clock at the server‟s computer. It‟s a client and server-based protocol. NTP client initiates a time exchange request with the NTP server. As a result of this request NTP client is able to calculate the link delay and its local offset. Adjust its local clock to match server‟s PC clock.Almost six exchanges over a period of about 5 to11 minutes are supposed to set the clock from the get go. Transition occurs through the UDP on port 123. NTP uses coordinated universal time UTC to synchronize PC clock with extreme precision.

Fig.5 shows the logic for the seasonal data.According to the month separate the seasons. Set the sunrise and sunset time of each season and difference it and the real time. This software logicis continuously running on raspberrypi.

In failure condition, fail signal issend by ESP32 controller to raspberry pi through cloud. Upon receiving this signal, raspberrypi send letters to head. For sending the mail, SMTP protocol is used.

b) Simple Mail Transfer Protocol:

SMTP is a web standard for email transmission. It is a text based, affiliation arranged, application layer protocol. SMTP is used through mail servers and other mail transfer clients, to send and receive mail on TCP port 25 or 587 or 465. TCP relationship on the port (25) to the SMTP server is opened by the client who necessities to send the mail and then sends mail across this connection. To communicate between different affiliations end to end model is used and for within organization store and forward method is used.

II. Cloud figuring:

In this proposed system, Adafruit.io is used as cloud. It is MQTT broker or sever,providing dashboard facility to monitor or control the structure. To talk with this cloud, used MQTT show. ESP32 and raspberry pi, both used adafruit.io client libraries, to talk with this cloud.
ESP32 and Raspberry pi the two goes about as MQTT client. To connect this with the cloud,use the following information.

- Host:io.adafruit.com
- Port:1883or8883
- Username:Username of Adafruit account
- Password:Adafruit IOkey of your account

To prevent excessive load on the service, it imposes a rate limit.

4. Results and Discussion

The arrangement of IoT relies upon Wi-Fi engaged streetlight system has been successfully done. 5Streetlights are installed with this system at ERDA grounds, Vadodara. Fig. 8 showsthe GUI plan of the proposed system. This GUI developed using HTML and JavaScript.

Fig.2 Email Notification

5. Conclusion

In this paper, plan of Web of Things (IOT) based intelligent streetlight controller is discussed.ESP32 isused as a controller as well as Wi-Fi module. To provide internet to the other end of campus,Wi-Fi repeaters are made using ESP32 only.

The thought has been taken to caution support bunch aboutfailure of streetlight. An email is created from the system,toinformmaintenanceteamfortakingnecessaryactions.

The user friendly Graphical User Interface(GUI) is developed to screen what is going on with street light and besides tocontrol it forcefully incase of maintenance.

By making customized and traffic adaptable structure, energy saving from the systemis increased to 46.6%.

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