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Automation of streetlight using Lora Technology

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ABSTRACT

Increase in population and the corresponding increase of roads has increased the number of street light, for the roads and people's safety, which rises investment and energy. Lighting consumes an adequate amount of energy in both outdoor and indoor. However different approaches are being proposed for making systems energy efficient and upgraded with the latest technology. Internet of Things (IoT) has been growing over the last few years in multiple applications and due to a growing need for Smart Street light, an innovative opportunity arises. Proposed work is to develop a smart street light system. This research gives precise and the best control over energy efficient street lighting system. It gives practical implementation using Long Range (LoRa) and Arduino micro-controller using sensors to gather information. The communication part is realized with Low Power Wide Area Network (LP-WAN) LoRa technology that combine low power and long-range capabilities.

Keywords— *LP-WAN, LoRa, Internet of Things, Arduino, Sensors*

1. INTRODUCTION

The thought of outlining a new framework for the street lights is due to the immense power consumption of the present lighting system. Street Light provision is one of the most expensive but important responsibilities of city lighting which accounts for about 10-38% of the total energy bill in typical cities worldwide. Smart street lightening system is a project on intelligent illumination control of street lights to optimize the problem of power consumption and the illumination of the streets, late in the night. The present time street lightning has got many problems. The hindrance of the present framework is that it requires manual operation of the road light which needs labour. In sunny and rainy days, ON and OFF time differ discernibly which is one of the significant hindrances of the present street lights systems. Conventional street lighting systems are on most of the day without purpose because these are operated manually and the consequence is that a large amount of power is wasted meaninglessly. With the wide accessibility of adaptable lighting innovation like Light Emitting Diode (LED) lights and all over accessible remote web association, quick responding, dependable working, and power moderating street lighting frameworks get to be a reality. The reason for this work is to showcase the Smart Street Lighting framework. The goal of this paper is to plan an automated lighting framework which focuses on the saving of power, to construct a vitally energy efficient smart lighting framework with integrated sensors and controllers, to outline a smart lighting system with particular methodology plan, which makes the system more user friendly and that requires less involvement of manpower.

2. LoRaWAN

LoRa means Long Range, this technology enables connectivity, real-time analytics, reporting, and additional functions such as geolocation. It penetrates in dense urban and deep indoor environments, connecting to sensors which are about 15-30 miles away in rural areas, enables multi-year battery lifetime of up to 20 years or more, supports millions of message per base station, helps tracking application without the use of GPS or additional cause for power consumption, LoRaWAN specification ensures interoperability between different applications, Internet of Things (IoT) solution providers and telecom operators, embedded end to end AES-128 encryption of data ensuring optimal privacy and protection & reduces upfront infrastructure investments, as well as operating and end-node costs.

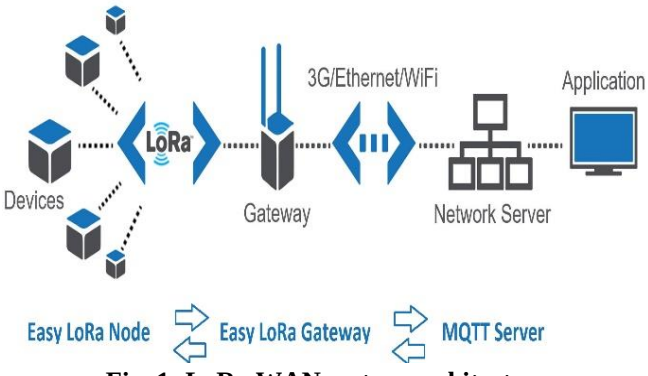

Fig. 1: LoRa WAN system architecture

3. SYSTEM DESIGN

The overall system consisted mainly of four blocks: an end node, gateway, The Things Network (TTN) and an application. The end-node sent the data over the air using the LoRaWAN protocol and the gateways that were close enough (around 5 km) received

the data. Then, the gateways forwarded the packets via UDP/IP to TTN, together with information from the received signal such as the exact time when the packet was received, the RSSI, the working frequency, etc. Afterwards, TTN processed the data from the different gateways and routed the messages to the application using a Message Queue Telemetry Transport (MQTT) client.

3.1 End-node

It is a LoRa module connected to the streetlight from where it collects data and transmits it to the gateway for further processing.

3.2 Gateway

End devices communicate with gateways using LoRa with LoRaWAN. Gateways forward raw LoRaWAN frames from devices to a network server over an interface with a higher throughput typically Ethernet or 3g. They receive the broadcast from end devices and send data back to end devices.

3.3 Network server

It decodes the packets sent by the devices and generating the packets that should be sent back to the device servers that route messages from end devices to the right application, and back.

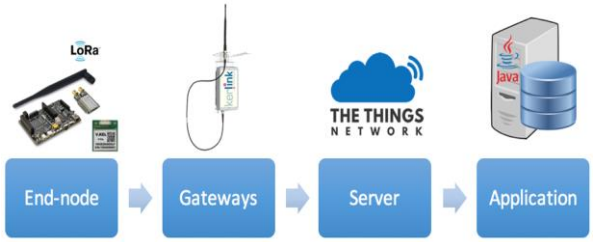

Fig. 2: System design

4. PROPOSED SYSTEM

Components used for lighting can be grouped according to their on their functions, which can generally describe as electrical, structural and optical. These components include:

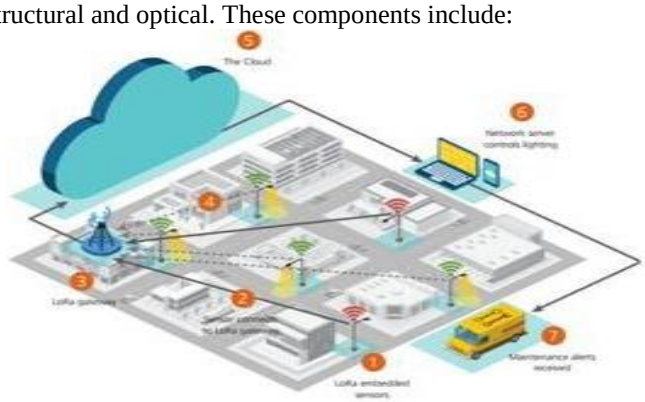

Fig. 3: Proposed system model

4.1 Structural/civil

- Steel or any metallic Pole
- Concrete pole Bases (foundations)
- Steel or any metallic Poles
- Concrete pole Bases (foundations)

4.2 Optical components

- Complete luminaires
- Complete luminaires

4.3 Electrical

- Electric Lamps
- Current Ballasts
- Fuse box for service

Steps involved in this model:

(a) Sensors embedded in each street light have the ability to control light functions.
(b) LoRa Technology in the sensor connects the street light to LoRa-based Gateway.
(c) The gateway sends information to the cloud where the data is analysed by an application server.
(d) Application server controls lighting.
(e) The server sends maintenance alerts.

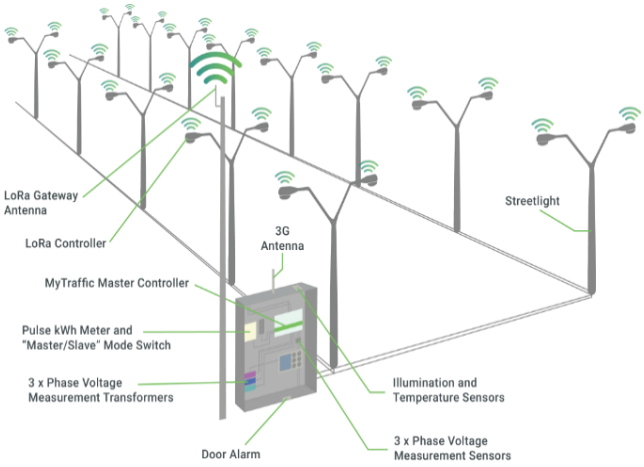

Fig. 4: System installation

5. HARDWARE USED

The LoRaWAN Gateway is designed to operate on the Things Network, however other LoRa networks can easily be installed. The main components that we need consist of A Concentrator board. The Concentrator board is the wireless communications part of the system, responsible for receiving the wireless data signals, from the remote environmental sensors. A small computer to store the software that controls the Concentrator board. We are going to use the Arduino Uno development board. A suitable Antenna.

Fig. 5: LoRa Shield with Arduino UNO and Gateway

6. CONCLUSION

In this proposed method, it is ensured that the energy wastage in the streetlight has been reduced. Functions are automated according to the requirements of road and valuable information is collected. The paper also describes how manual surveillance is reduced and the fault is detected easily. Conclusively it is found out that deploying smart streetlight using LoRa Technology saves energy, cost and also helps save the environment.

7. FUTURE IMPROVEMENTS

LoRa WAN will be inevitable technology in future smart city applications together with the Internet of Things. LoRa technology can be used in Smart lighting, Air quality and pollution monitoring, Smart parking and vehicle management, Facilities and infrastructure management, Fire detection and

management, Industrial Applications, Waste management, Shipping and transportation, Health monitoring devices and management, Wearable technology, Enhanced home security, Smart farming and livestock management, Water level sensors and irrigation control

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