TEST Engineering & Management

January - February 2020
ISSN: 0193 - 4120 Page No. 5389 - 5393

Real Time Communication between Nodes using Lorawan for Emergency alert in Elevator

[1]Anupriya, [2] Dr. C Rama Krishna, [3] Ajay Kumar
[1][2][3] NITTTR Chandigarh
[1]anupriya1329@gmail.com [2] rkc_97@yahoo.in [3] ajaygodara12@gmail.com

Article Info
Volume 82
Page Number: 5389 - 5393
Publication Issue:
January-February 2020

Article History
Article Received*: 18 May 2019*
Revised*: 14 July 2019*
Accepted*: 22 December 2019*
Publication*: 27 January 2020*

Abstract:
Abstract— From the last many decades, the elevator is used for transportation of goods or people vertically in the downward and upward direction in an organization or residential buildings. Due to this, the elevator must ensure all the safety standards and requirements before use. In case of a power failure, the system behaves differently and there is a need to come up with a solution that provides a platform which motivates us to strengthen the system precaution measures to increase the trust of individuals. We provide a solution where real-time communication between the end node and Raspberry Pi based gateway via LoRaWAN protocol would take place. End node provides emergency information to the remote control for immediate rescue procedure.

Keywords: *LoRaWAN, Internet of Things, safety*

I. INTRODUCTION

An elevator is used as a transport device within different buildings for reliable movement of individuals from one place to another. There are various types of elevator that are already in use and hold a good place in the market such as paddles and chain elevator. Otis Company introduces the elevator in 1852 for the first time with safety feature if the elevator cable or wire gets broken [1].In 1857, the first passenger carrying elevator was installed in 488 Broadway, New York City [2]. Later the technology gets evolved and steel beam elevator comes into existence and becomes popular as this elevator provides reliability to the individuals. Later in the 19th century, elevators were used in mines and factories for moving goods.

While designing the elevator, the main features that must be taken into consideration by companies are speed, capacity, reliability, cost and safety. Individuals using the elevator should not get stuck at the time of emergency in the elevator. Every year many accidents happen, therefore to provide the smooth and proper functioning of the elevator system, the construction company of the building and installing engineers are responsible for reliability. As for the proper functioning of the elevator system, building constructed engineers should provide proper structural support and proper support.

Today, technology is evolving very rapidly and reorganizes the way of communication between two devices. The beauty of the technology is that everything in the universe today communicate with each other but still we are unable to make LoRaWAN wireless communication technology to utilize in this area. IoT-based smart elevator application includes an emergency button utilizes LoRa-based standard. LoRaWAN is a low power wide area network based on LoRa alliance.

In this paper, we design and implement a system to transmit the information from the end node device to the gateway. It consists of two parts such as gateway and end node. The gateway can communicate with all the end node devices. End nodes are used to collect information and transmit the same information to the gateway.

In this paper, our main objective is to provide emergency alert information to the remote control room by using LoRaWAN. The proposed paper is arranged as follows, Section I provides a brief introduction and our approach of the system. Section

January - February 2020
ISSN: 0193 - 4120 Page No. 5389 - 5393

II gives LoRaWAN overview. Section III provides an overview of the proposed system design with its working and flow diagram about the existing work. Section IV gives hardware implementation details with results. In section V, we conclude the designed system with references.

II. LORAWAN OVERVIEW

LoRa i.e. Long-Range is a modulation technique originated by Cycleo of France, Grenoble and Semtech, a founding team member acquired LoRa in 2012 [3]. It is defined by two layers such as LoRa modulation, which specifies the physical layer and second is LoRaWAN standard, which specifies the MAC layer. LoRa modulation can be depicted as a Chirp Spread Spectrum and also the first commercial technique to use chirp spread spectrum and it also increases the reliability of the receiver by enabling forward error correction (FEC) method. CSS is used because it provides long-range communication and robust with respect to any interferences. Compared to traditional networks, the private, public or hybrid network takes advantage of LoRa technology as it provides features like long-range, lower power utilization and secure data transmission for IoT applications. This technology can easily be adapted to the existing network and enables the user to use low-cost battery-operated IoT application.

LoRaWAN defines the Low Power Wide Area Networks standard by LoRa modulation technique [4] [5]. LoRaWAN specifies the MAC protocol for those networks that require to use low-cost and low power consumption sensors. In this method, we can use different classes of nodes for a different type of network for downlink communication while maintaining battery life. LoRaWAN is consist of the following parts such as end-nodes, network and application server, and gateway. LoRa gateway transmits the information messages between end-node and a remote control network server. It specifies data rates such as: from 250 bps to 50 kbps range when used in the EU 868 MHz, from 980 bps to 21.9 kbps when operated in the US 915 MHz.

III. EXISTING WORK

The elevator can balance the goods weight with the help of counterweights. An electric motor is used as braking system when the elevator hoists in upward and downward direction. The elevator should maintain the balance between the weight and space capacity while moving between different floors of the building. The size of the elevator also taken into consideration as it affects the building structure.

In [6], they proposed a system to stop the elevator during emergency condition with magneto rheological fluid damper. As the speed of the elevator dramatically increased in abnormal situations like earthquakes or motor malfunctioning which require to emergency stop of the elevator.

An elevator system framework is one of the most widely recognized applications of the induction engine/motor, as it is utilized in numerous applications. The wellbeing and unwavering of the elevator framework is one of the incredible significance as it conveys individuals and its failure can bring about spontaneous blackouts making the structure truly uncomfortable. The simple scrutiny is not very ready to distinguish some early organize faults in the elevator system like the ones due to the building gaps and developments, bringing about the misalignment of the elevator system guides. In [7], they proposed a system in which induction motor itself is used as a sensing node in order to find the technical fault.

In [8], they proposed a system and alert the remote control room by using short range standards such as: Bluetooth and Wi Fi. In [9], they use machine learning algorithms to control the movement of the elevator. In [10], they patent their work, as they proposed an interactive system design which is used for managing and monitoring the elevator system and building facility by sensing the building quality like material used, gases that affect the building quality, metric audit and each part of the building is connected to the remote control room.

The paper proposed a system based on LoRaWAN to reduce the accidents happens when power failure happens and enhance the trust and reliability of the elevator. To reduce the accidents happen in the

January - February 2020
ISSN: 0193 - 4120 Page No. 5389 - 5393

elevator every year, here end node is used to collect the information about the current emergency condition and alert the remote control room at the same time. The designed system demonstrates that by alerting the remote control room, we can control many buildings at the same. As LoRaWAN provide long range coverage and deep indoor wireless connectivity.

IV. SYSTEM STRUCTURE

In fig. 1, represents the system design of the elevator and LoRaWAN module. The elevator controller resides in the remote control room, which is used to rescue emergency situation. The system is consisting of two parts such as: end node and gateway. End node is used to collect information about the emergency situation and this information is then transmitted to the gateway. Gateway is a node located in the remote control. Gateway receives the information and alert the control team members. Gateway is a combination of the Raspberry Pi and LoRa module and one LED to tell the emergency alert like red color represents emergency happens and send the rescue team to the respective elevator and green color of LED represents the normal working of the elevator in the building. In remote control room, team also the relevant information on the screen.

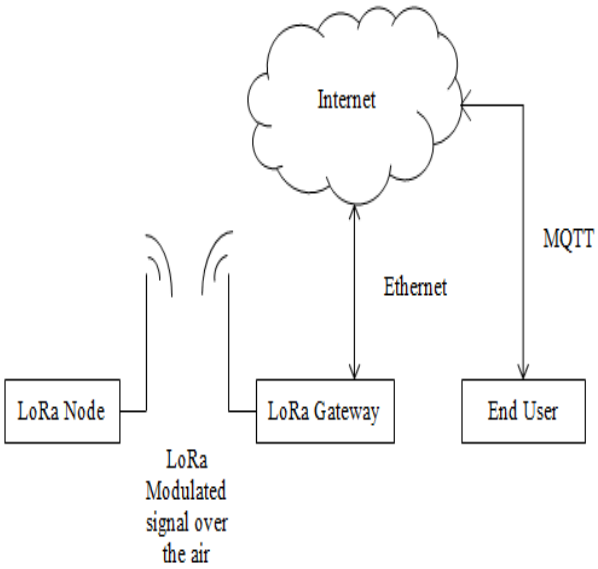

Fig. 1 System design

A. LoRa Node

LoRa end node is consist of Ardunio Uno, antenna, LoRa module and emergency button. Fig. 2 represents the end node. Ardunio Uno helps to enable the LoRa module. LoRa module is connected to the Ardunio Uno via SPI. SPI used to provide the serial communication between Ardunio Uno and LoRa module. TTN is used to register the end node so that we can access end node anywhere by using end node location. The length of the antenna is set according to the following formula:

$$c = \lambda \times f$$

$$L = \tfrac{1}{4} \times \lambda$$

Wwhere, c= Speed of light, f=Frequency, λ=wavelength, L=antenna length

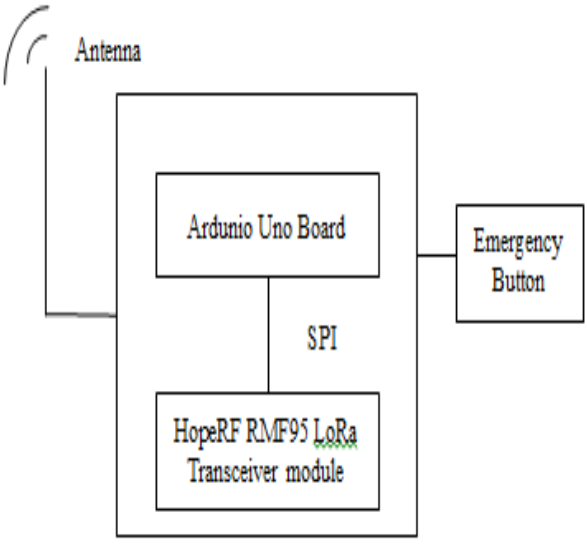

Fig. 2 End node

The end node sends the emergency button information to the gateway using LoRa module.

B. Gateway

Gateway is used to collect information about the emergency button and alert the rescue team members by showing results on the screen and change the color of the LED from green to red. Gateway is located inside the remote control room near the rescue team. Gateway is also register via TTN (The Things Network), by specifying the title of the gateway and location of the gateway node. Set the "Active" status of the node and check whether TTN receives information from the gateway.

January - February 2020
ISSN: 0193 - 4120 Page No. 5389 - 5393

C. Implementation strategy

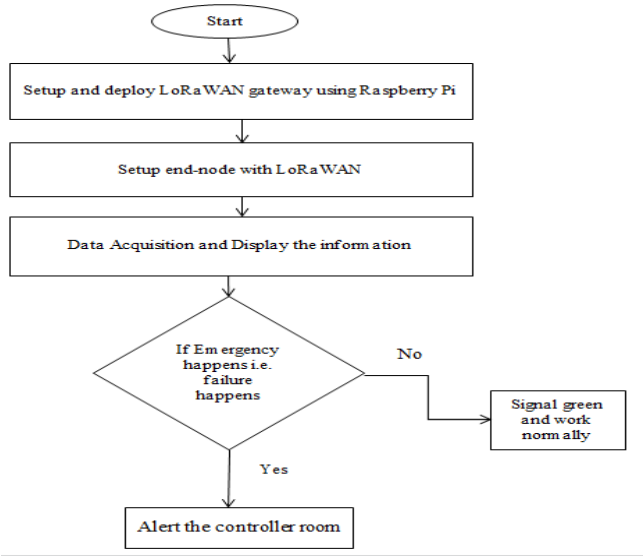

Fig. 3 System flow diagram

The flow chart of the emergency alert system shown in Fig. 3. Firstly, LoRaWAN gateway is deployed using Raspberry Pi and LoRa end node is deployed using LoRaWAN. Whenever, user gets any emergency situation like power or system failure user can press the button attach inside the elevator. As end node detects any emergency alert i.e. pressing of emergency button, end node transmits the information to the gateway. Gateway receives any emergency information; it alerts the control room rescue team members by signal i.e. change the color from green to red of the LED and display the information on the system.

D. Results

When emergency button is pressed and control room gets the emergency information. It displays the information on the screen as shown in fig. 4.

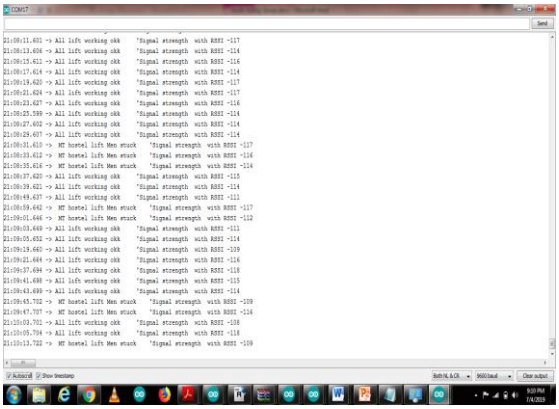

Fig. 4 Control room screen

When emergency button is pressed at the user side and the end node display the message as shown in fig. 5.

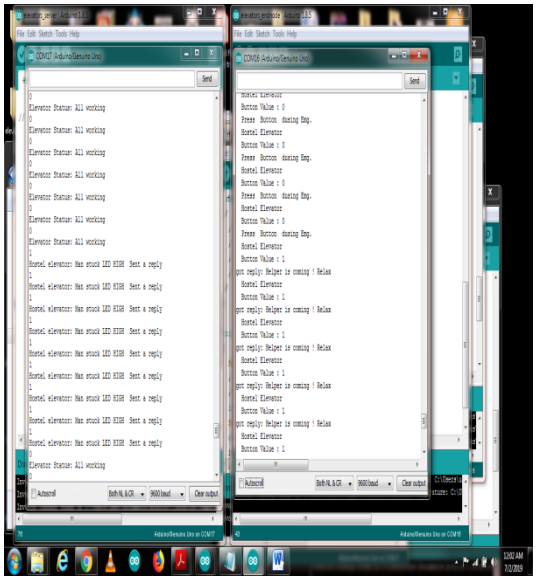

Fig. 5 End node screen

Fig. 6 represents the emergency alert signal at the remote control room by signal through blink green color LED.

Fig. 6 LED glows

V. Conclusion

The advancement in technology has motivated us to customize the conventional emergency rescue mechanism in order to provide an enhanced safety feature. As the demand of elevator increases in many organisations or residential areas, the issues like frequently system or power failure, or busy action or low maintenance, increases the property and personal hazards.

We design and implement an emergency rescue system for elevator using LoRaWAN technology. The design system consists of two parts such as end node and a gateway. End node is a combination of

January - February 2020
ISSN: 0193 - 4120 Page No. 5389 - 5393

microcontroller i.e. Ardunio Uno and emergency button and is connected with the LoRaWAN RF95 module. End node is used to get the information about the emergency situation and send this information to the gateway for further action to be taken by the specified rescue team members. The gateway resides inside the remote control room for getting the information from the end node.With the help of our system, in conventional elevator, we can do rescue operation of personnel who are stuck inside the elevator by sending the alert via message or mail to the control room using IoT.

VI. REFERENCES

1. https://time.com/4700084/elevator-patent-history-otis-safety/
2. https://cr4.globalspec.com/blogentry/1544/March-23-1857-The-First-Passenger-Elevator-is-Installed
3. https://lora-alliance.org/
4. https://lora-alliance.org/about-lorawan
5. https://www.tuv.com/media/corporate/products_1/electronic_components_and_lasers/TUeV_Rheinland_Overview_LoRa_and_LoRaWANtmp.pdf
6. T. Uchida, S. Yasuno and T. Nakagawa," A Proposal of an Emergency Stop System Utilizing Elevator's Double-cage Structure", IEEE 18th International Conference on Electrical Machines and Systems, pp. 517-520.
7. Q. Flores, J. B. Carvalho and A. J. M. Cradoso, "Mechanical Fault Detection in an Elevator by Remote Monitoring", IEEE International Conference on Electrical Machines", pp. 1-5, 2008.
8. Jing and G. J. Zhao, "Design and implementation of an Elevator Wireless Adjustment System", IEEE 2nd International Conference on Systems and Informatics, pp. 350-355.
9. Hang Li, "The Implementation of reinforcement learning algorithms on the elevator control system", IEEE 20th Conference on Emerging Technologies Factory Automation (ETFA), pp. 1-4, 2015.
10. Chun Ming LAU, " System and method for managing and monitoring lifting systems and building facilities, United States Patenr Application Publication, Pub. No. US 2019/0023529 A1, 2019