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IMPLEMENTATION OF LORA ENABLING TECHNOLOGY FOR IOT APPLICATIONS

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Abstract
LoRa (Long Range) is a low power wide area network (LPWAN) technology primarily used for the Internet of Things (IoT). LoRa is best suited for applications that deliver smaller amounts of data at low bit rates. Data can be transferred over a larger area than WiFi, Bluetooth, or ZigBee technologies. These features make LoRa an excellent option for low power sensors and actuators. For LoRa to work, license-free sub-gigahertz frequencies like 915 MHz, 868 MHz, and 433 MHz are the best. In order to acquire faster data rates than sub-gigahertz bands, it can also be operated at 2.4GHz. Different LPWAN technologies are now competing for market dominance in order to offer the huge connection needed by a future in which all objects are predicted to be connected to wireless networks and capable of communicating with one another. Here, the wireless communication link has been established between the two LoRa nodes and the output data frames are received by the LoRa gateway and routed through network servers to control the gateways using standard IP technology.
Keywords: LoRa (short for Long Range), LoRaWAN, LPWAN, Sensors, Actuators, ISM bands.

1.Introduction
1.1 IoT Technology
The internet of things, or IoT, is a system of interconnected computing devices, physical objects, digital and mechanical machinery, people, and animals that allows data to be exchanged without the necessity for human-to-human or human-to-computer interaction. Various sensor nodes are dispersed over a large region and are constantly watching every location and occurrence.

These nodes are positioned around the perimeter in our example to monitor events like motion detection, fire alarms, and intrusion detection.They are linked to a Gateway and part of

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a wireless sensor network. This gateway has additional cloud connectivity. In order to monitor and respond appropriately, the end user connects to the cloud.

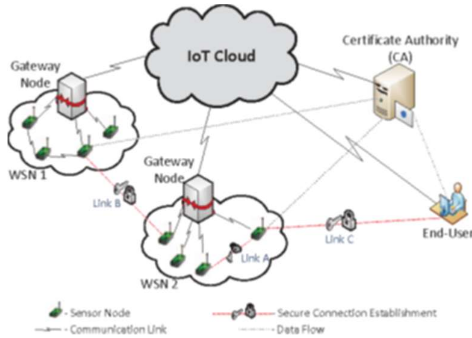

Fig 1:IoTWAN

1.2 LoRaTechnology

The IoT framework is enabled by LoRa (Long Range) devices and LoRaWAN (LoRa Wide Area Network) protocols for low power and long range applications. For IoT, Machine to Machine (M2M) communication, and industrial applications, LoRa offers bidirectional low-cost wireless communication. LoRaWAN is a Low Power Wide Area Network (LPWAN) that uses less power while transmitting over large distances (measured in kilometers) and at a slower data rate to enable dense urban and rural areas a good network access.

LORA uses the Chirp Spread Spectrum (CSS) method, which offers low power long distance networking and communication solutions. LoRa and Wi-Fi technologies together offers improved interior and exterior coverage while lowering the cost of IoT system deployment. Although a LoRa base station may simultaneously support thousands of end nodes, there are a number of security concerns.

1.3 LPWAN Technology

Low Power Wide Area Network(LPWAN), is a type of wireless telecommunications wide area network that develops long-range communications at a low bit rate, as well as other things, such battery-operated sensors.

LPWAN is a term that refers to a variety of low-power, wide-area network technologies that comes in many different shapes and sizes. LPWANs uses open-standard and proprietary frequencies, as well as licensed or unlicensed ones.

In contrast, LoRaWAN connects IoT devices utilizing LoRa wireless technology, which was created and made available for use by Semtech, a supplier of analogue and mixed-signal semiconductors. It guarantees that field devices have lengthy battery lives and covers a wide range. Additionally, it permits two-way communication and excellent indoor IoT solution penetration.

1.4 LoRa Modulation

Similar to frequency shift keying, LoRa modulation operates by adjusting frequencies based on data. In the case of LoRa, the spreading factor (SF) (also known as frequency change with data) changes. More spreading factor means longer transmit times yet highly reliable data. The efficiency will increase with a spreading factor that is optimized.

LoRaWAN is a MAC layer protocol that intends to address network congestion and medium management problems. The following capabilities made available by the standard are available to any node employing the LoRaWAN protocol:

- administration of channels
- energy effectiveness
- Adjustable data rate
- Security

The LoRaWAN network topology is referred to as a star-of-stars, and from the analysis, the system is made up of three primary parts: network servers, gateways (GWs), and end nodes. End nodes use gateways to connect to the network server (or data server), and communication between GWs and end nodes can use either LoRa or FSK modulation with a range of data speeds and channels. Data frames are sent by end nodes, received by GWs, and routed through network servers to control the GWs using standard IP technology.

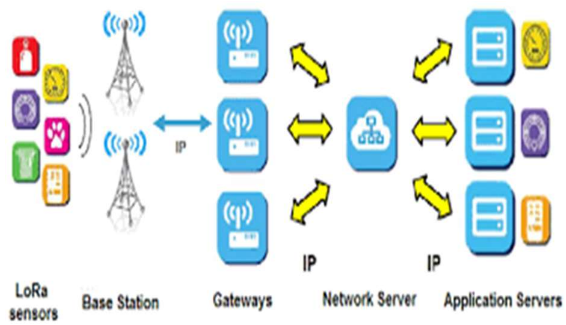

Fig 2: LoRaWAN Architecture

2.Literature Survey

Fire Alerting System With GPS Co-ordinates Using IoT

It was suggested by Jayaram K, Janani K, Jeyaguru R, Kumaresh R, and Muralidharan N that it is vital to protect our environment in today's developing globe. Around the world, a lot of natural and man-made calamities were occurring. One such environmental tragedy is forest fires. Once it gets going, the fire in the deep forest spreads throughout the entire area, burning and destroying everything in its path. Due to dry conditions, fire spreads more readily on hot days and decimates grasses and trees in forest areas. Such forest fire catastrophes need to be reduced in order to safeguard the habitats of the forest's flora and animals. Although they have been tested in forest-like environments, the main difficulty we may encounter will be when they are implemented over a broad region in real time.[1]

An IoT based Weather Information Prototype Using WeMos

The Internet of Things (IOT), as proposed by Ravi Kishore Kodali and Archana Sahu, is a term that refers to the interconnection of objects and people over the traditional internet and social media for a variety of everyday uses, including weather monitoring, healthcare systems, smart cities, irrigation systems, and smart lifestyle. The Internet of Things (IOT) is the newest internet revolution that continuously streams live data on the status of the entire planet, including things like temperature, humidity, thunderstorms, earthquakes, floods, etc. that could endanger human life. This study suggests a low-cost weather monitoring system that delivers the output on an OLED display and retrieves the weather information for any place via a cloud database management system. By using more precise GPS receivers, the system's efficiency can be increased in the future.[2]

Forest Fire Detection System Reliability Test Using Wireless Sensor Network and OpenMTC Communication Platform

By incorporating the Internet and mobile technologies into this system, it was proposed by Anton Herutomo, MamanAbdurohman, Novian Anggis Suwastika, Sidik Prabowo, and CaturWirawanWijiutomo that the Machine to Machine (M2M) communication system has begun gathering real-world pace. Numerous attempts have been made to bind one solution platform for numerous monolithic systems and use this integrated system in a variety of vertical solutions. Utilizing the HTTP REST architecture as a communication platform is a recent idea. The first stage of putting OpenMTC into use as an M2M and IoT communication platform is addressed in this work. Two Device Application components (or DAs, as suggested by the ETSI M2M standard) are connected to OpenMTC and contain sensors for temperature, humidity, and carbon monoxide gas concentration.

The following are proposals for additional research: measure the total transmission time from the sensor to the GSCL to conduct additional reliability tests (over the Internet). Further research may also be conducted to create a testing tool that simulates connections from sensors to gateways and platforms in cases when the quantity of sensors or gateways is still insufficient for a stress test.[3]

Forests Smart fire detection service

Markus Endler, Vitor Pinheiro de Almeida, and Guilherme Borba Neumann have proposed The term "Smart Forest" refers to regions of a forest where remote sensing technology is used to gather information about the surrounding environment. It is taken from the Internet of Things (IoT). Early wildfire detection is one of the key goals of Smart Forests. However, the necessary technology for such monitoring typically necessitates a complicated and pricey sensor and network infrastructure, as well as the ability for central processing to analyse data from thousands of sensors. This work's objective is to put forth a solution for Edge Computing that utilises the idea of Mobile Hubs (M-Hubs). The mobile hub that discovered the fire in this instance could alert nearby mobile hubs to the current[4]

3.Existing Method

The current forest detection system includes a buzzer-equipped fire alarm system as well as a fire monitoring system but no continuous monitoring system. The main issue with using robots is that their interference with sensors. Unmanned aerial vehicles are employed, however they are expensive and require a lot of up keep. As far as its surroundings, the Unmanned Ground Vehicle Navigation requires a cell phone network. If it takes more time, UGV will arrive at that location and put out the fire.

4.Proposed Method

The proposed system for detecting forest fires offers a wide range of features for continuous monitoring; if one system fails, the other will notify the user at the right moment. The monitoring system makes use of a variety of sensors and extends its coverage to large distances.

5.Implementation

Here, we have used two different types of LoRa modules. They are as follows: 5.1 SX1276

The Semtech SX1276 RF transceiver chip, which uses the LoRa Spread Spectrum modulation frequency hopping technology, is integrated into Lora1276. The extended range and high sensitivity (-139dBm) characteristics of this module enables it to outperform FSK and GFSK modules in terms of performance. Even in a crowd frequency setting, multi-signal won't interfere with one another because of its high anti-interference performance. This ultra-compact 100mW module is frequently utilized in the fields of AMR and remote industrial control. The module transmits data using AES128 encryption, which is then decoded and retransmitted to an objective node, for increased security.

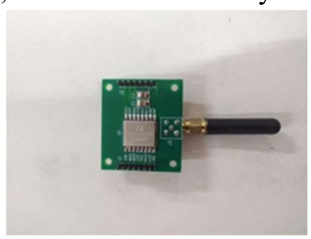

Fig 3: LoRa SX1276

5.2 RYLR 896

The LoRa long range modem, which offers ultra-long range spread spectrum communication and good interference immunity while minimizing current consumption, is a feature of the RYLR896 transceiver module. NCC and FCC have both certified the RYLR 896.

Fig 4: RYLR 896

This module is built into the sensor node and allows for wireless transmission of temperature, motion, and flame sensor data to the gateway, which then sends the data to the cloud. Information is gathered by nodes with various sensors spread out throughout the forest and sent to the gateway via the LoRa concentrator. A gateway must be made accessible to a location with internet access. Gateway can be wired or wirelessly connected to the internet cloud. Furthermore, the application has access to this data. Data is made available by the application for display, warning, and actions.

In order to provide the surrounding forest officials with the relevant information/instruction, these data can be remotely obtained from the cloud at the control centre.

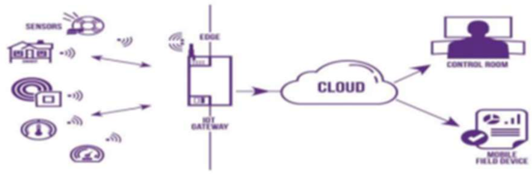

Fig 5: LoRa gateway Architecture

6.Results and Analysis

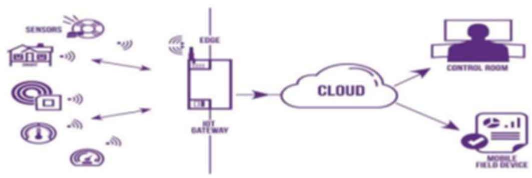

Fig 6:Hardware connections on PCB

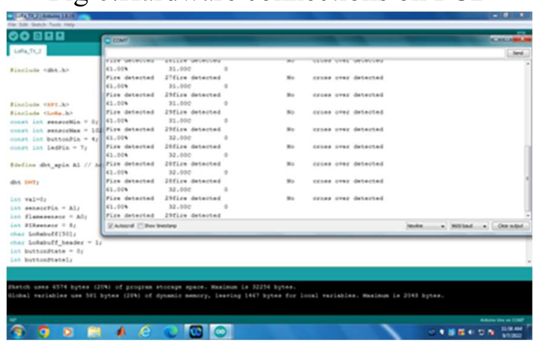

Fig 6:Lora Communication between two nodes

LoRa Nodes with different sensors located at a distance around the forest collects information and sends to the gateway through LoRa concentrator. Gateway has to be made available to a place where internet connection is available. Gateway can be connected to internet cloud through Wifi or through ethernet cloud. Further this data is available for the application. Application facilitates data for display, warning and actions.

7.Conclusion and Future Scope

All the project components and technological requirements have been identified. They are obtained and put through testing in both the lab and the field. The outcomes are acceptable. A few changes have been identified, are already being handled, and will be put into practice. The work being done in this case is undoubtedly unique and will greatly assist one of our most valuable resources. Additional responsibilities are also noted. This technique can be applied to a variety of other sites, including shipyards, farms, and airports. We made an effort to offer a reasonable remedy. To generate this in large quantities, industry and startups can work together to develop the technology.

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