International Journal of Engineering & Technology, 7 (2.31) (2018) 74-75

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Raspberry PI based advanced communication for disaster management

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Abstract

When a natural disaster occurs one of the major crisis is communication. This is mainly because when a calamity occurs all the cellular networks, towers and other contemporary means of network goes down making it impossible to communicate with others. Thus in this paper we propose an alternative solution for communication during disaster which can be achieved using a Long range radio transceiver module, which can operate without the help of any towers or base stations. The proposed transceiver model is a standalone device which can transmit and receive voice signals which operates on ISM band of frequency range 902 to 928 MHz, providing a hinderance free good communication, and as an additional feature is made to receive FM station signals using FM radio module, to keep us updated with the news, rescue and relief activities.

Keywords: *Disaster management, communication, tower-less, wireless transceiver, emergency communication, LoRa, FM receiver.*

1. Introduction

With the rapid development in the telecommunication sector, new and better services are being introduced with newer networks which require more towers. In this traditional method of wireless communication, towers play a major role. The main purpose of a tower is to facilitate the mobile nodes and other wireless communication devices with signal reception.
But during any natural disasters or calamities like earthquakes, floods, etc these towers go down making it difficult to communicate with others. Communication during disasters are very crucial for rescue operation and when these systems are completely or partially down, it has a huge impact on life and death matters. In such cases, the public safety and emergency management organizations like fire departments, rescue squads, emergency medical services (EMS) and other NGOs protect the well-being of the public. The ability to efficiently communicate without any hindrance increases the probability of saving lives and also helps in timely reach of the amenities given to the victims affected by the disasters. On considering all these facts we need to come up with an alternate solution where the main goal is to provide a faster and reliable communication capable of working in a challenging environment where the infrastructure is impacted by the unplanned emergency events.

2. Existing ideas and models

There are few existing traditional devices like Walkie-Talkie, Land Mobile Radio System and Ham radios which have been in use for a long time now. Walkie-talkies are hand-held half-duplex portable two-way radio communication devices, mainly used in military applications. They use a single radio channel through which any number of users can connect and listen. Major drawback of this system is the limited range of coverage, it can cover only up to 5 miles. And also only one person can talk at an instance and it is very easy to 'Tap in' and listen to a conversation. Similarly, the LMRS is also a two-way communication device used widely by police, fire force and military for rescue operations. But the major drawback of this system is that it has short range of coverage and is mostly used only by the police and military. The Ham radio or amateur radio is used for non-commercial exchange of information, experimentation and recreational purposes. It is a professional two-way radio services which plays a major role in public safety situations like disasters, floods, etc. It provides a standard connectivity even during worst case scenario and a world-wide connectivity. The major disadvantage is that we wont be able to call a specific station unless the meeting has been scheduled in advance. And also for the radio to reach out world-wide we need a better antenna and repeaters.

3. Proposed model

In this paper we are proposing an alternate idea for communication during such critical times like natural disasters or calamities. This is achieved with the help of a Raspberry Pi along with LoRa module which together is made to act as a transceiver system. LoRa is a long range radio transmission module which can transmit signals in the ISM band frequency range from 902Mhz to 928Mhz. The LoRa supports Mesh networking. This LoRa module along with helical antenna for the same ISM frequency range helps in transmitting signals even during disasters up to a radius of 15Km without the help of any base stations or towers.
Thus this system can act as a standalone device which is reliable and capable of working even during disasters when all other

contemporary networks are down. It consumes low power and can transmit to a long range thus making it more advantageous.

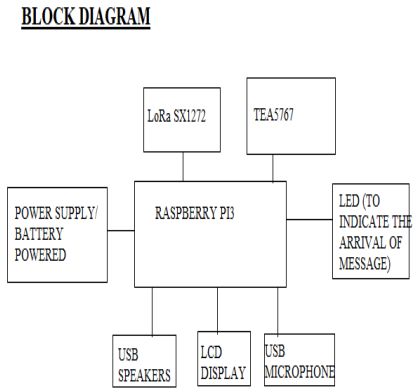

Fig. 1: Block Diagram

4. Working

The raspberry pi takes up the voice signal to be transmitted from the user through the USB microphone (As raspberry pi doesn't have a sound card of its own). This signal is then transmitted through the frequency band of range 902 to 928 MHz (ISM Band). A transceiver named LoRa SX1276 is used for the transmission and reception purpose in the ISM band frequency range of 902 to 928 MHz. The modulation preferably used here is FSK modulation techniques. A speaker and a LCD display screen is interfaced with the Raspberry Pi for receiving of the signals and for interactive purpose. A LED light circuit is connected in order to indicate the reception of any messages, thus alerts the user about an incoming message.

A TEA 5767 FM radio signal tuner is used to access the FM radio stations in order to obtain any news or updates. Since in case of any natural calamities like floods, cyclones, etc. Due to power cuts it will be difficult to power up the device. Thus, here in this model we are providing another alternate, the device can be made as battery powered. So that the device can be made to work even in case of power cut or other emergencies.

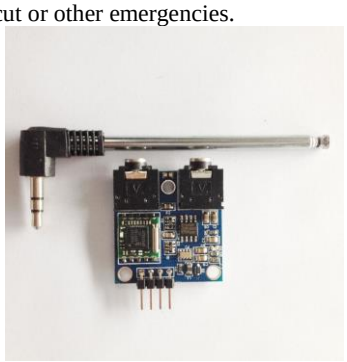

Fig. 2: TEA5767 FM radio module

Fig. 3: LoRa SX1276

5. Comparison of different transceiver modules

PARAMETRES	LoRa	ZigBee	WiFi	Bluetooth	Sigfox
Frequency of operation	863 to 870MHz and 902 to 928MHz	2.4GHz	2.4 GHz	2.4 GHz	868MHz, 915Mhz
Coverage distance	15Kms	10 to 100m	100m	10m	17Kms
Power consumption	Lower than ZigBee	Lower than Bluetooth and WiFi	High	High	Low
Data Rate	10Kbps	250Kbps	144Mbps	22Mbps	100bps

Based on this comparison table we have come to a conclusion that LoRa is more preferable for our work than all the other potential transceivers.

6. Conclusion

Communication plays a vital role in our day-to-day life. When natural disasters or calamities occur they drastically affect the contemporary networks of communication, which has a major impact on life and death matters. And thus to avoid such cases we are proposing an alternative method of communication using Raspberry pi and LoRa. We have chosen LoRa as our transceiver module after inferring from the table that they can work at low power for long ranges and at preferable data rates when compared to other potential transceiver modules. Thus this device can provide a reliable connectivity to communicate during any emergency situations like natural disasters or calamities.

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