LORA BASED HEALTH MONITORING AND EMERGENCY ALARM DEVICE

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ABSTRACT:

Natural disasters in recent years have shown that people are vulnerable to natural disasters and it is very difficult to protect people from natural disasters. Every year, tens of thousands of people die in various disasters and other similar emergencies. The need for the use of modern technologies and devices in emergencies is growing day by day. A variety of modern devices, techniques, and methods are used in emergencies and post-disaster search and rescue operations. Finding a survivor is a very important issue in post-disaster operations. People's vital signs are very important in determining people's lives. Heart rate (HR), blood pressure (BP), respiratory rate (respiratory rate), and body temperature (BT) are four important vital signs that need to be measured regularly. Various technologies are used to transmit data over long distances from sensors that measure human vital signs. One such technology is Long Range (LoRa). Long-distance transmission of human vital signs data based on Long Range (LoRa) allows monitoring a person's location in emergencies as well as their health status.

In this paper, we develop a health monitoring and emergency alarm device (beeper) based on Long Range (LoRa) that can monitor human vital signs, generate an emergency alarm when human health status is deteriorating and also transmit human vital signs data to web server/ mobile app.

Keywords: LoRa; health monitoring; vital signs; emergency.

INTRODUCTION:

Due to technological advances that have occurred in recent years, the chances of saving lives in emergencies, post-disaster search and rescue operations are increasing. In post-disaster search and rescue operations, various technologies, systems, and devices are used to determine human survival, human health status. During the past decades, several scholars have focused on the development of LoRa based health monitoring and emergency alarm devices.

It is designed as a wearable device as a Lora node has attached with a temperature sensor, blood pressure sensor to measure the temperature, humidity, Blood pressure and heart rate values [1]. It is proposed a smart health monitoring system for the elderly and implemented to monitor the basic vital body parameters such as body temperature, heart rate and some measures of patient's condition as respiratory rate [2]. It is presented technology comparison scenarios for Internet of Things (IoT) concepts on rescue monitoring in [3]. The research focused on rescue monitoring and the goal is the usage of the two wireless technologies used for data transmission from IoT devices: WiFi and LoRa technology. It is presented an overall healthcare system that is performed by biomedical sensors, MySignals and LoRa communication in [4]. It is presented an IoT based health monitoring system using the MySignals development shield for Arduino Uno. In [5], it is presented a comprehensive review of the most recent trends in the research and practical applications of LoRa technology. It is systematically reviewed the most recent research papers related to LoRa covering a wide variety of research themes, objectives, and methodology and proposed a new method of

classifying the research papers into several categories.

It is presented an IoT-based health monitoring approach in which collected medical sensor data is sent to an analysis module via low-cost, low-power and secure communication links provided by LoRaWAN network infrastructure [6]. It is studied the system performance of a heterogeneous WSN using LoRa–Zigbee hybrid communication in [7]. In [8], it is developed a real-time multi parametric human health monitoring and prediction system. It is designed a synchronous management software on ThingSpeak Web server and Blynk app. It is developed an elderly monitoring system in a smart city environment using LoRa and MQTT [9]. It is implemented an effective ambulance system by using GPS, GSM, and LoRa technology in [10]. According to the study, the traffic is also cleared in the route that the ambulance is traveling, for this to happen the GPS location of the accident vehicle is sent to the traffic control cell, where the traffic in the route of the ambulance is cleared and thus the vehicle arrives as earliest as possible. It is outlined the design and development of a cost-effective and reliable wireless sensing device that is based on a NODE MCU microcontroller for collecting real-time health vital signs such as human body temperature and heartbeat rate in [11]. It is developed an e-health monitoring system for senior citizens based on LoRa technology in [12]. In the proposed system, it is used low-cost media and data processing, supported by LoRa (Long Range) technology, which engages various sensors (personal and residential), allowing authorized people to access the personal information of users, concerning their health. It is presented an IoT based health monitoring system using the MySignals development shield with LoRa wireless network system in [13]. It is designed a model for multi-parametric health monitoring system in [14]. It is presented a healthcare system using lora and mysignals based communication technology in [15]. It is proposed a new mechanism to collect and transmit monitoring information based on LoRa technology in [16]. The proposed monitoring device with sensors can collect real-time activity and location information and transmit them to the cloud server through the LoRa gateway.

Another interesting study found in [17]. In the research, it is presented a LoRa posture recognition system based on multisensor fusion. In the proposed system, it is used sensor modules based on accelerometer, gyroscope, and magnetometer to collect posture information. In [18], it is demonstrated that LoRa can be effectively used in search and rescue operations. It is characterized the LoRa Path Loss in three relevant mountain scenarios: canyon, LoRa transmitter over the snow and transmitter buried under the snow [18]. It is presented a novel smart automation system using LoRa technology in [19]. In the proposed LoRa-based system, it is used a wireless system and various types of sensors that work with a smartphone app and run on a low-capacity battery, with a working range of 3-12 km. It is proposed a novel phone-based Emergency Communication System (ECS) enabling long-range communication among survivors and rescue teams over critical environments where 3/4G cellular connectivity is not available and the traditional geo-localization technologies provide only partial coverage of the environment in [20]. It is proposed a wearable LoRa-based system for remote safety monitoring of people performing activities in remote areas with no network coverage in [21]. The designed system could identify possible problems in the heart and/or a "man-down" condition. It then sends an emergency alert to the surrounding recipients via LoRa, which includes information about the person's condition and location. Finally, it is developed a system that can provide location and health monitoring of human during disaster using Wearable – IoT [22]. The proposed method

is helpful for the safety and health of humans affected/lost in disaster by locating their position and monitoring their vital signs using a wireless wearable device to the search or rescuing team.

Overall, the overview of the previous contribution on the health monitoring system witnesses the tremendous attention devoted during the past decades to the development of various wireless methods, algorithms, and systems. However, none of the aforementioned contributions ([1] - [22]) is likely to integrate human vital signs monitoring with an emergency alarm. We investigate the issue of integrating biomedical sensors with emergency alarm signals by developing human health monitoring and remotely emergency alarm device based on LoRa technology. The proposed device has been used to monitor a patient's vital signs, which is essential for human health and transmit data gathered from biomedical sensors to web server/mobile app using LoRa technology. The device also generates a strong alarm signal automatically when human health is deteriorating and humans in a difficult situation when rescue is needed. This technique is useful as it could help to inform others if there is a need to find survivors in emergencies.

MAIN PART

The proposed health monitoring and emergency alarm device (beeper) uses the following sensors and modules: OLED display; ESP32 board; MAX30102 heart rate sensor; LoRa receiver with the RFM95 transceiver module, and Battery. The proposed device transmits the data received from the biomedical sensor using LoRa technology.
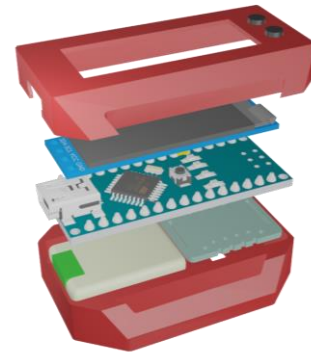

Figure 1. 3D view of the proposed device

LoRa technology is a new wireless protocol developed by a corporation known as Semtech. It is designed for long-distance and low-power communication. The technology allows connecting a number of applications running on the same network to a common or multi-apartment network. LoRa technology uses open frequency ranges that vary in continents. The open frequency ranges for LoRa technology are shown in Figure 2 in terms of continents.
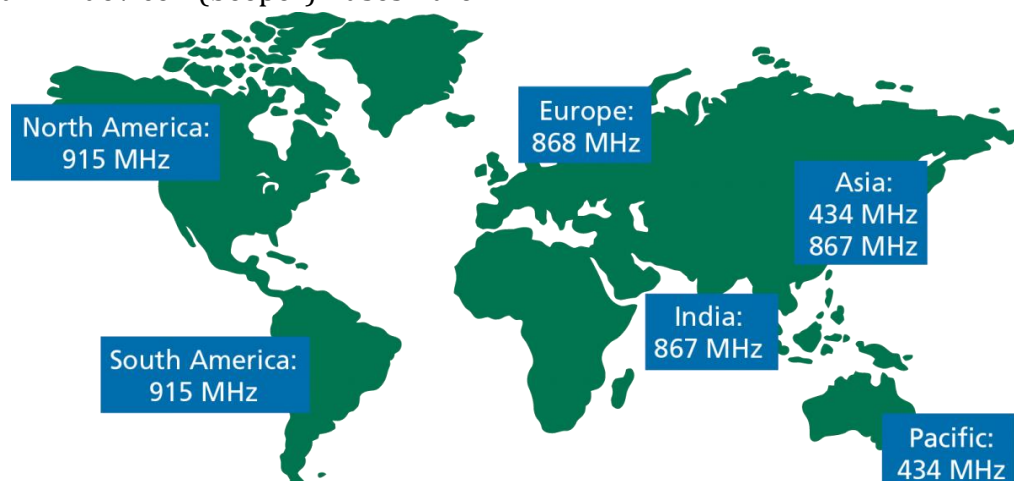

Figure 2. Open frequency ranges for LoRa technology by continents

The following figure illustrates the data transmitting process of the proposed device based on LoRa technology (See Figure 3).
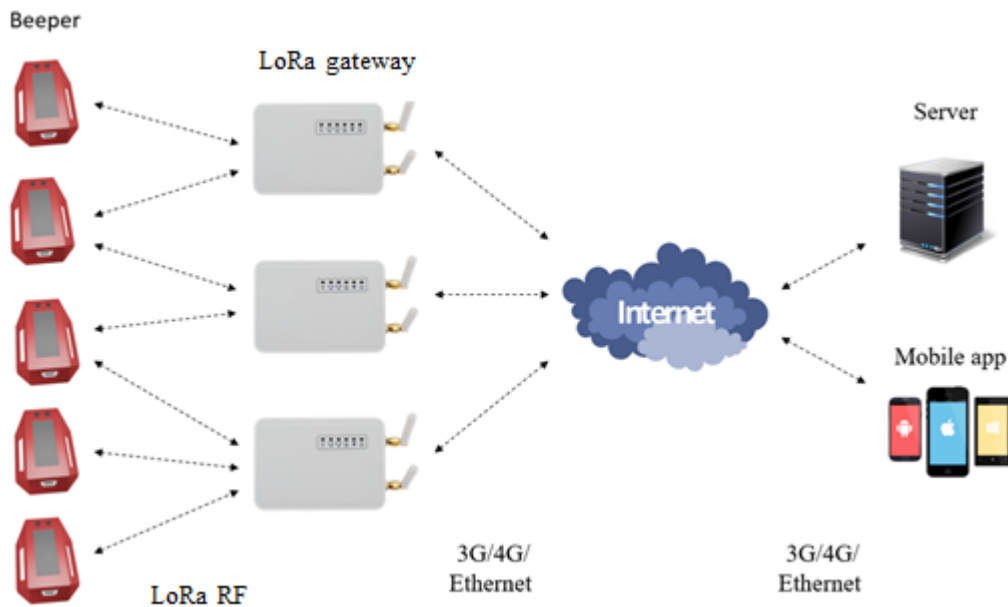

Figure 3. Data transmitting process of the proposed device based on LoRa technology

As can be seen from Figure 3, the device transmits human vital sign data to a nearby LoRa gateway using LoRa technology. The nearby LoRa gateway transmits data from the device using 3G / 4G / Ethernet technology. The receiving side is also received sent data using 3G / 4G / Ethernet technology. A server or mobile app can be used as the receiving side.

One of the key features of the proposed device is that it can monitor human vital signs and transmit the obtained biometric data over long distances using LoRa technology. In the proposed device, vital signs such as body temperature, heart rate, blood oxygen saturation are monitored. This device can be used mainly in emergencies to provide information about the victim, such as his / her health status and need for help.

The proposed device is attached to a human hand. The device monitors a person's heart rate, blood oxygen saturation and body temperature. If a person's health status deteriorates, ie vital signs show abnormal values, the device automatically generates an alarm signal. As a result, the person will be aware of his / her health status and will be able to consult a doctor to recover his / her health. Also, if a person needs help in an emergency, he or she can create a strong alarm signal by pressing a button located on the device and use it to give a warning signal to the rescuers around him/her about himself/herself whereabouts.

With the help of this device rescuers will be able to get information about the health status of survivors by distance in search and rescue operations in emergencies. As a result, it will be easier to separate the survivors. It saves time in searching for and rescuing rescuers, thereby saving the lives of more people.

CONCLUSION:
In this paper, a LoRa based health monitoring and emergency alarm device is developed. Compared to other similar devices, the device has its own advantages, long distances, low power consumption, convenient design, generating emergency alarm signals directly.

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