The IoT for Healthcare Applications

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Abstract: The Internet of Things (IoT) is a concept of the internet so that all things in our life can connect to the internet or to other to send and receive data to do all functions through the network. IoT is a new concept based on the use of the Internet to facilitate our way of life. The presence of mobile medical applications and mobile health services that have contributed to drawing innovative features of the way to provide health care services. Also, the spread of emerging technologies such as robotics and artificial intelligence, accompanied by the simple exchange and spread of medical information thanks to the internet, and the discovery methods of treatment. This fundamental shift is reflected positively on patient care after it enabled the doctor to give a more good diagnosis and thus get better treatment results. This combination of the features of the IoT in medical devices contributed greatly to improving the quality and effectiveness of medical services. Mobile devices, wireless networks, and other smart services more than 80% of health care institutions which means that more hospitals, institutions, and health centres have activated smart health devices. Today, "IoT" technologies and digital devices connected to the internet are prevalent in hospitals. It has come to the point where it can be said that many doctors and other health care providers have dispensed with paper and have become either totally or largely dependent on devices connected to WiFi networks and tablets. In this study, nine patients have been applying this technique to them, and their results have varied and will be reviewed.

Keywords— IOT, Remote Healthcare, Network Platform

1. Introduction

IoT application in the healthcare field using remote monitoring, smart sensors, and medical device integration, in addition to activity trackers, wearable biometric sensors, blood sugar and pressure monitors, drug dispensers, and smart beds [1]. The future of healthcare will be hugely promising if the IoT is expanded and invested, so this technology will improve an aspect of healthcare and transform how it is managed [2]. Health care needs the IoT, and therefore many answers give the actual and practical picture of the role of the IoT in the field of health care and convert data into measures. Measurable health, called quantitative health, will be the future of health care because measurable health can be better improved. Therefore, it is wise to benefit from quantitative health technology, as it is known that data affect performance, so the ability to measure people and track health to achieve better results is the reason for the need for the IoT [3], [4]. Improving patient health, especially when using

patient-related wearable devices. It informs when the heart rate is floundering or if it is left behind in taking care of himself and sharing that information on other devices by updating the personal health data of patients who are on technology [5]. The cloud eliminates the need to feed that data into emergency records, as the IoT ensures that every minute detail in account to make beneficial decisions for patients [6]. Moreover, it can be used as a tool for medical compliance and patient monitoring at home [7]. To enhance preventive care, prevention has become a major area of focus as healthcare expenditures are expected to grow in the future, and widespread access to high-resolution real-time data on everyone's health will lead to health care reform by helping people and overcome the disease [8]. Enhancing patient satisfaction and participation, as the IoT can increase patient satisfaction by improving the progress of surgery [9]. Reporting a patient leaving the operating room for his family and this can increase patient participation by allowing patients to spend more time interacting with their doctors., It reduces the need for direct interaction between doctor and patient as internet-connected devices provide valuable data [10]. Contribution to health care management, as the IoT can enable care teams to collect millions of data points and link them to personal fitness through wearable devices such as sleep, sweat, temperature, and activity. So the information is fed by sensors can be sent alerts to patients and in real-time [11]. Actually, they can get event-causing messages such as alerts, triggers to increase heart rate. This will not only improve the workflow process but also ensure that the care is managed at home [12]. To strengthen population health management, as the IoT allows its providers to integrate devices to monitor the growth of wearable devices, as the data captured by the device will fill by the data that is discarded in the electronic data recording, so care teams can obtain vision-driven priorities and use the IoT. To monitor who is at home for chronic diseases, this is another way in which caregivers can demonstrate their presence in patients' daily life [13].

2. Healthcare IoT applications

2.1. Control of medical devices

This wonderful technology makes the integration between medical devices and caregivers, a useful integration that benefits the patient and the doctors with nurses alike. As it makes the process of communication with these devices a smooth and very fast process to transfer the patient's data in recording time, as it facilitates the transfer of the patient's condition before his arrival [14]. Where the data that arrives through it can be approved and converted into practical measures by doctors, and this will help save the lives of many patients instead of waiting for the affected case to arrive in the hospital and then start identifying the case [15]. Figure 1 shows the multi medical devices control.

Figuure 1. Multi device control by IoT.

2.2. Doctor's help

The IoT produces great benefit for the doctor as it helps him to diagnose the patient's condition through what is available from the first information first hand and in the place of the event to be through identifying the problem and taking the appropriate action, whether it is a surgery or writing a suitable medicine for the situation in his hands [16]. The connected devices are provided by the important and vital data of the patient's condition around the clock and the day, and then transmit it wirelessly to the doctor's computer to take the appropriate action for the case by operating or not, writing a medicine, and other measures [17]. The doctor's help is shown in Figure 2.In this study, the data of heart rate and oxygen level in blood is received by Arduino and then sent via lora to receiving port then the data is viewing on the screen.

Figure 2. Types of help that doctors offered to the patient.

2.3. Reducing medical expenses

IoT technology helps to reduce expenses for health and medical institutions. By reducing the human factor and artificial intelligence interference in everything that, it is programmed and controlled automatically.

Remote patient monitoring is among the applications of the IoT in the field of medicine, which is permanent and complete monitoring of patients, and this is done remotely through sensors and cameras that monitor required things of the patient, blood circulation, sanity, temperature, and other things to be monitored as well as shown in Figure 3 [18].

Figure 3. The moniter in front of doctor

3. IoT network connection technology

Smart devices these days are connected to the internet by wireless WiFi signals or other communication technology as Bluetooth technologies or some other communication method. By some of these technologies, we were able to create many electronic devices. The process of data modifying takes place on servers connected to the web in huge data communication centres, which call the communication cloud, and it has a great contribution in enabling ordinary devices to become IoT devices. These devices may be connected through a local communication methodology, such as Bluetooth, Bluetooth Low Energy (LE). Near-Field Communication (NFC) and ZigBee. A direct connection is established via a router and modem using wired or WiFi methods such as Ethernet, cables, (the signal is sent directly to the power lines of home), and it can bypass your entire home network via communications cellular devices. Tools for the communication in the IoT includes computing equipment that includes processors with the program as built-in programming to direct their work and sensors which collect many types of readings such as humidity, temperature, light, movement, heart rate, chemical level, and movement Body, with the communication of send and receive signals. Lychee to help control traffic, smart devices can be work by tagging technologies like RFID tags, barcodes, QR codes, etc. to obtain data. Also, these instruments need an energy source that can be obtained by connecting to a power outlet, or even rechargeable (if the equipment requires a low energy amount). By their software embedded within them, and they can download and manipulate many processes through online cloud-based software that can process large amounts of data. The processing and transmission of the data detector often happen during instantaneous times thanks to the high speed of the internet connection, allowing these devices.

4. Method and materials

4.1 The device components

The device is composed of two main parts :

1. The first part is the sending port which involves an Arduino UNO to receive the data from the sensors (oximeter and heart rate sensors) and a screen to show the data as well as LoRa to send the data to receive points.
2. The second part is the receiving port which also has an Arduino UNO and screen to view the results and LoRa to receive the data.

The parts of the diverse are shown in Figure 4, and the block diagram of the system has been shown in Figure 5

The data can be transmitted and received from different distances. A Bluetooth device will add to the system to connect the system with an Android device such as smartphones. A special Android program will be designed to view the results by a mobile screen. The range for transmitting and receiving will depend on the type of antenna that is used with the system and also depends on the type of LoRa. The flow chart of sending and receiving are shown in Figure 6.

Figure 4. Parts of transmitting system

4.2. Operation procedures

1- Connect each device to the voltage source.
2- Connect the sensors to the hand digits.
3- View the results on the screen of the transmitter port.
4- Transmit the results via LoRa to receiving ports.
5- View the results on the second port of receiving.

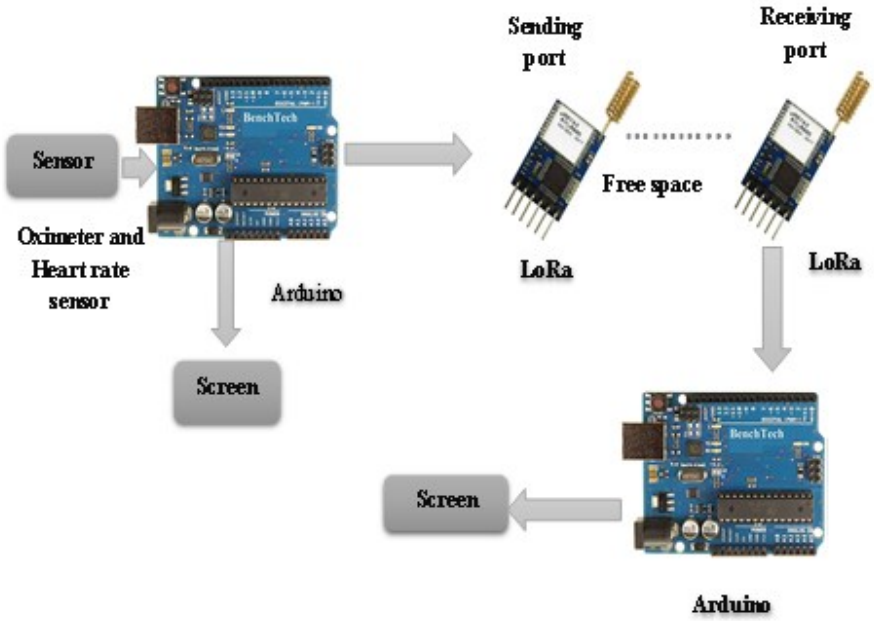

Figure 5. Block diagram of the system that used in this study

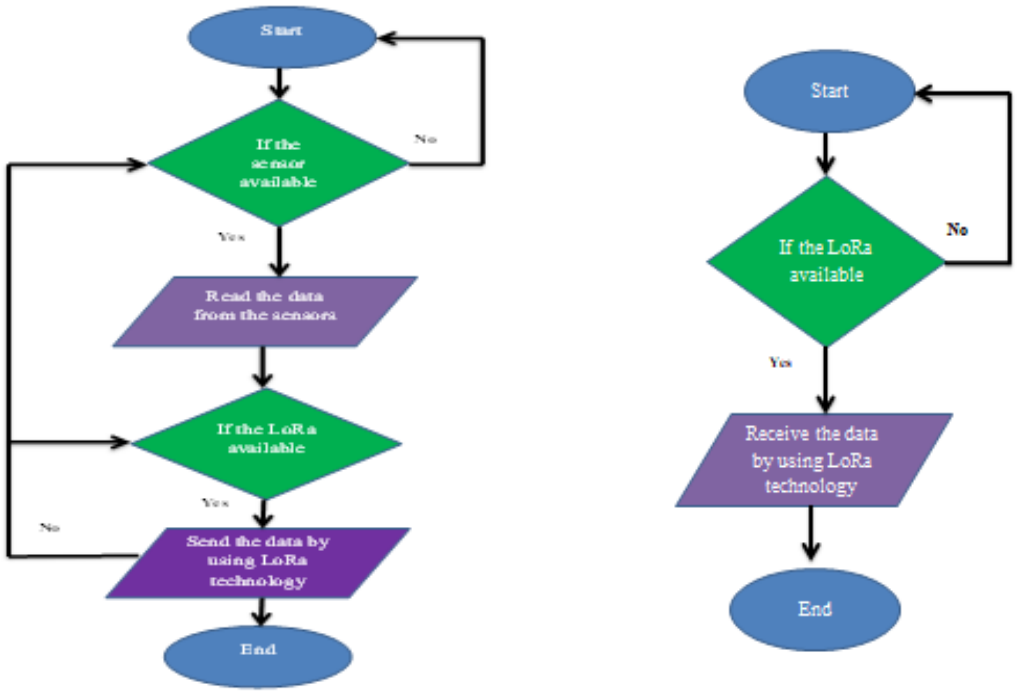

Figure 6. The flow chart of IoT system for sending and receiving parts

4.3. Transferring by the LoRa technology

Those sensors are based on LoRa technology are known as the LoRa sensor. LoRa sensors have geolocation capabilities to allow for low power consumption and long-range transmissions (usually more than 10 km). Hence, we can use it via timestamps from different portals to triple the positions of devices. LoRa sensors allow long-range communication between devices to allow efficient IoT implementation. This has applications across multiple industries.
The data sent by the LoRa node was received by multiple LoRa gateways which redirect the received data packets to a central network server (IoT server). The IoT server filters duplicate packets, manages the network, and performs security checks. The server then sends this data to application units, control panels, or connected smart devices. In this way, the LoRaWAN protocol shows high reliability and accuracy for the moderate load.

5. Results

After applying the device to nine subjects to measure the percentage of SPO2 of the body during rest and exercises, the results are shown in Table 1. The oximeter and heart rate sensor are connected to Arduino at receiving port. The data is viewing on the screen. Then this data is sending to LoRa at receiving port then it is viewing by medical specialities. The sensors measure SPO2 and heart rate during rest and exercise. There is changes in the biological signals during rest and exercise and these changes has been correctly reading on both sides of the system without any error or data losing.

Table 1. the results of 9 patients that are measured

Age	During rest spo2	During exercise spo2
23 years	100 bpm 94%	150 bpm 90%
32 years	94 bpm 95%	140 bpm 89%
36 years	90 bpm 96%	135 bpm 85%
42 years	88 bpm 97%	125 bpm 88%
47 years	85 bpm 98%	120 bpm 89%
51 years	79 bpm 93%	100 bpm 90%
52 years	80 bpm 92%	88 bpm 87%
63 years	75 bpm 96%	94 bpm 86%
67 years	76 bpm 98%	95 bpm 84%

6. Conclusion

In this research, different types of IoT in the field of healthcare are explored. As well as the advantages of this technology and methods of connection. The information was collected from nine subjects by using these innovative technologies. The blockchain could save lives by ensuring patients are treated quickly and appropriately. e patients, the percentage of SPO2 was measured and transmitted to the cloud. This technology holds great hopes for serving the field and improving patient health treatment and safety. When complete solutions become fully available, clinicians will be able to better measuring and improve individuals' conditions remotely. As a comprehensive view of an individual's data will help medical institutions to intervene in advance and before the emergence or deterioration of an individual's health status. Making use of wearable devices and collecting patient information continuously and periodically helps the patient to obtain better care at any time and place, as it is not restricted to visiting the doctor or health institution.

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