Health Monitoring System in Emergency Using IoT

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Abstract - *The average lifespan of humans is increasing at a rate that has never been seen before. An ageing population presents a challenge for the development of a health care surveillance system that is both cost-effective and effective. However, the healthcare surveillance systems that are currently available on the market do not have a function that allows for two-way communication between physicians and patients. A Health Monitoring System that makes use of the Internet of Things is the solution that has been suggested for the issue. On the DE1-SoC, a system that can measure electrocardiograms, blood pressure, heart rate, and body temperature was proposed as part of this research as part of a system that contains a prototype of an embedded health monitoring system. Additionally included is the Internet of Things framework, which enables instantaneous data storage on IBM Bluemix via the use of Node-RED. Using http GET and POST, a graphical user interface has been developed for use on the World Wide Web with the purpose of displaying medical recommendations and measurements. Instead of relying on a complicated health care surveillance system, patients can use this system to check their own health at any time and in any location. The sensor's accuracy in measuring body temperature was 99.21 percent on average, while its accuracy in measuring heart rate was 99.26 percent, its accuracy in measuring high blood pressure was 99.17 percent, and its accuracy in measuring low blood pressure was 98.27 percent. The information obtained from the system was analysed, and the results were published on a regional website. This allowed for the anticipation of potential illnesses. When using an internet connection with 100 megabits per second (Mbps), the amount of time needed to store a single piece of data is 1.5 milliseconds. This system's functionality was evaluated with the help of ten different volunteers, and the results showed that the average accuracy of each sensor was able to reach more than 95 percent. In conclusion, the system that was proposed in this study functions effectively and has the potential to be beneficial to patients.*

Key Words: Health monitoring, Internet of thing, Health device, Blood Pressure, heart rate.

1. INTRODUCTION

According to the statistics provided by the WHO, cardiovascular disease is responsible for the deaths of 12 million individuals throughout the globe every single year [3]. Heart disease accounts for 41.8% of all deaths in Malaysia, making it the leading cause of death in the country [4]. These findings come from the WHO. If patients with cardiovascular disease had received treatment earlier in the course of their illness, it is possible that millions of deaths caused by cardiovascular disease could have been avoided. However, it may be challenging to maintain a day-to-day perspective on the health of one's patients. Doctors are only able to monitor and analyse patients' health while they are treating them at a hospital or doing other medical procedures on them. After patients are released from the hospital, it is impossible for doctors to continue monitoring their health. People may be required to make appointments ahead of time or stand in line at the hospital in order to get medical treatment if there are insufficient medical resources in a particular region. Patients are inconvenienced as a result, which contributes to the issue of an excessive number of people occupying hospital beds. In addition, in order for patients to get treatment, they may be needed to go to a hospital or clinic that is located a significant distance from their home. Traditional face-to-face consultations are analogous to live communication telemedicine in the sense that both the patient and the physician are able to view each other while the treatment is being administered. Data about a patient's health may be collected using telemedicine using the store and forwards approach, and then it can be sent to a physician working at a hospital. Live communication telemedicine is not as prevalent as store and forwards telemedicine due to the fact that its functionality is reliant on the quality of the video and the internet connection.

1.1. Internet of Things (IoT)

Telemedicine is shown very well by the Internet of Things-Healthcare Monitoring System. [Citation needed] [Citation needed] Because of the possibility for lower costs, it has emerged as the solution of choice for the limits put on the healthcare system [8]. Patients may not necessary need to be admitted to the hospital in order for Internet of Things (IoT) healthcare monitoring devices to be able to monitor and regulate their health problems [9]. IoT-Healthcare Monitoring System provides patients with healthcare services that are more convenient for them and simplifies the process of making diagnoses. Sensors may be utilised in a monitoring system for healthcare that is based on the Internet of Things (IoT). These sensors may be used to measure vital signs such as blood pressure, heart rate, body temperature, and breathing rate, amongst other things. The vital signs that are gathered by sensors will be saved to the cloud as a record in order to facilitate a future examination by a physician utilising an IoT-Healthcare monitoring system. This will be done in order to help the future you.

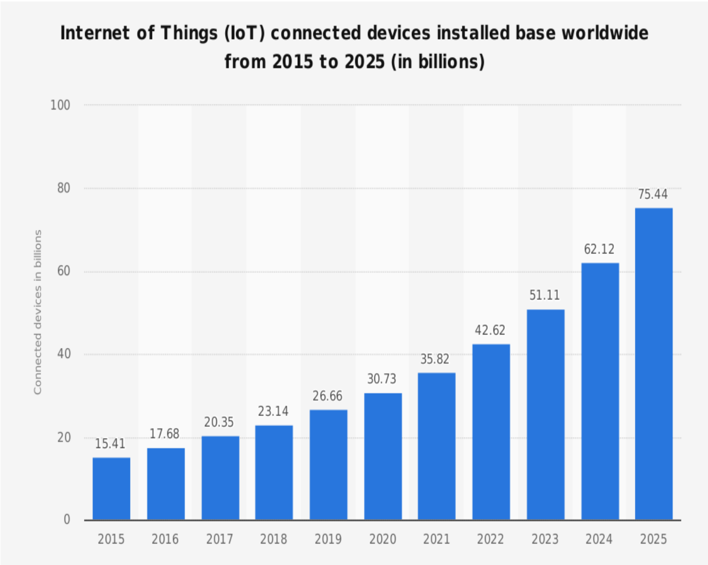

Figure-1: Information of IoT linked devices

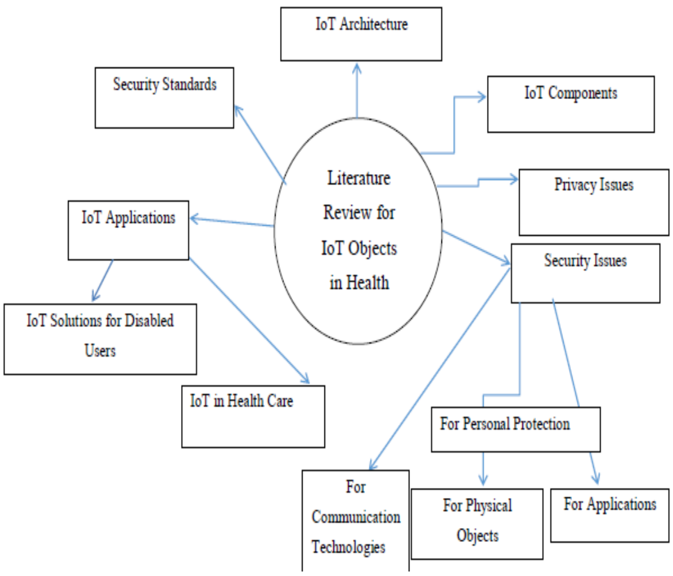

Figure-2: Healthcare IoT Object and Standard Classification in Graphical Form

2. MONITORING SYSTEM FOR PATIENT HEALTH

The sensors that are a component of the Internet of Things are a beneficial tool for the healthcare industry since they make it possible to remotely monitor a patient's physical state. This makes it feasible for medical personnel to continue monitoring the physical state of their patients and providing them with important information in real time, which ultimately leads to an increase in the quality of healthcare that is offered to patients (Bachhav, 2018). It is common practise to implement a three-tiered architecture in the software that is used to keep an eye on the health of distant patients.

3. RESULT AND ANALYSIS

This chapter presents the results that were acquired from the System Testing that was carried out as part of this research project. The testing was carried out as part of this research project. In the paragraphs that follow, the structure of this chapter will be broken down even more and discussed in greater depth. The steps that are outlined in the area of the dissertation that is labelled "methodology" are followed in order to carry out the measurements, and the results of the sensor accuracy test are given in the section of the dissertation that is named "analysis." In order to create a baseline for evaluating the findings of integrated sensors, the data acquired from integrated sensors are compared to the measurements obtained from commercial medical equipment. This allows the findings of integrated sensors to be evaluated. The amount of time that passes when data is being sent from one platform to another using 100Mbps Ethernet; in this scenario, the data is being transferred from the platform that uses DE1-SoC to the platform that uses IBM Bluemix Cloud. The analysis of the system as a whole can be found in the part that is labelled "analysis," and ten different people have been asked for their opinions on how well the suggested system will function in order to get input. The finalised version of the website for the neighbourhood may be found displayed for your perusal in Section 4.5, along with a list of errors that could have been overlooked.

3.1. Accuracy Test of Blood Pressure Sensor

The participants were asked to have their blood pressure measured, and the results of this examination can be seen summarised in the table that is located just below these instructions for the experiment. [T]he results of this examination can be seen summarised in the table that is located just below these instructions for the experiment. [T]he outcomes of this investigation are presented in tabular form for your perusal in the area that is immediately to the right of these guidelines for doing the experiment. The absolute accuracy of the integrated blood pressure monitor is shown in Table 1, together with the device's average degree of accuracy, in the same column. This information may be found in Table 1. Both of these tiers of precision are located in the same row of the table. The first thing that is going to be highlighted is the completely unrivalled precision of the blood pressure monitor that is already included into the device. Finding the average measurement that has been analysed is the first step in determining the average accuracy; next, one must make use of the information that can be gathered from that average measurement; finally, one must identify the average accuracy that has been determined. After that, it will be feasible to determine the average accuracy of the results. After that, it will be possible to determine the overall correctness of the findings by computing the average.

Table -1: Accuracy of Integrated Blood Pressure Monitor

Day	Accuracy (%)					
	Morning		Afternoon		Night	
1	95.80	94.74	100.00	92.13	96.40	98.73
2	99.21	98.75	96.75	90.14	94.96	93.55
3	94.21	100.00	95.87	93.75	97.56	96.47
4	97.14	92.65	99.18	94.19	98.45	100.00
Average	99.17/98.72					

The integrated blood pressure system is used to measure the Systolic and Diastolic pressure. From the table-1, the Systolic pressure lies between 102 to 133 mmHg while the Diastolic pressure lies between 58 to 88 mmHg. The deviation between measurements from two blood pressure system is ranging between +7 and -7 mmHg. These deviations may cause large error if the measured blood pressure is Diastolic pressure.

3.2. Accuracy Test of Surrounding Temperature Sensor

The temperature sensor LM35 and IT-903 are used to measure the surrounding temperature and the results are shown in Table 2. Seven locations are chosen and three measurements are collected using both devices.

Table-2: Comparing Result of Surrounding Temperature Test.

Location	1	2	3	4	5	6	7	Average
Difference (degree Celsius))	0.10	0.20	0.20	0.10	0.10	0.00	0.00	0.03
Accuracy (%)	99.69	99.37	99.37	99.68	99.69	100.00	100.00	99.91

From above Table, the average accuracy for LM35 temperature sensor to measure the surrounding temperature is 99.91% and the largest deviation in measurement is 0.20℃A graph of Surrounding Temperature versus Location is plotted and shown in Figure-3. The graph shows small deviation between the measurement IT-903 and LM 35.

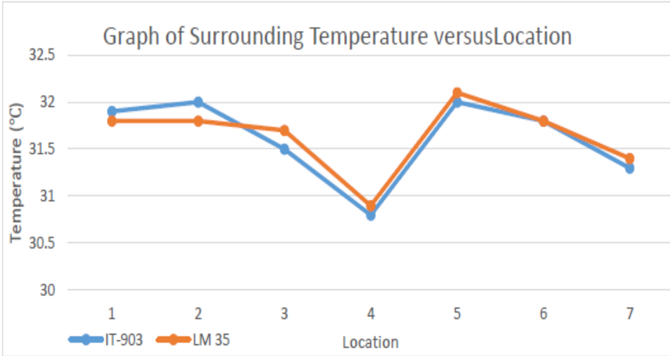

Figure-3: Graph of Surrounding Temperature versus Location.

Generally, this test shows that the sensitivity of the LM35 temperature sensor to temperature is about ±0.2℃deviated from IT-903.

3.3. Body Temperature Test

The LM35 temperature sensor and IT-903 are used to measure the body temperature and the results are shown in Table-3. The surrounding temperature during body temperature test is between 30.9 to 32.9 ℃ The measurements are taken by measuring the fingertip of user.

Table-3: Comparing Result of Body Temperature Test.

Day	Difference			Accuracy (%)		
1	0.20	0.40	0.40	99.45	98.91	98.91
2	0.30	0.20	0.20	99.18	99.46	99.45
3	0.20	0.30	0.40	99.46	99.18	98.92
Average	0.29			99.21		

From Table-3, the average accuracy for LM35 temperature sensor to measure body temperature is 99.21% and the largest error in measurement is 1.09 %. According to the graph plotted in Figure 4, the measurements from IT-903 are always higher than the measurements from LM35.

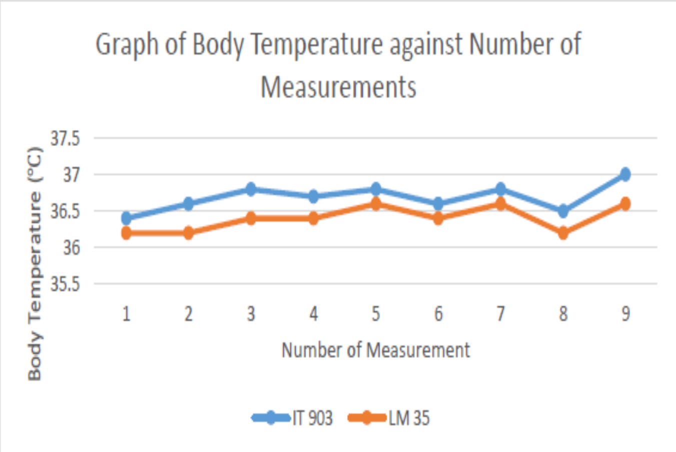

Figure-4: Graph of Body Temperature against Number of Measurements.

3.4. Overall Functionality Test

The overall function of the system is tested on ten volunteers and health parameters are collected. The health parameters from the volunteers also collected using commercial devices.

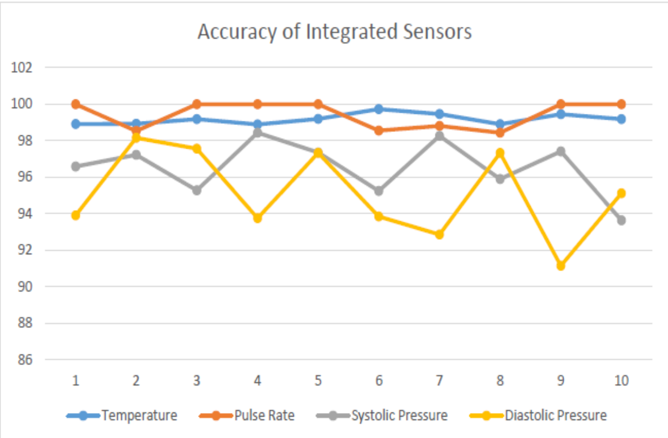

Figure-5: Graph of Accuracy of Integrated Sensors.

The accuracy of each sensor remains above 90% for the measurements. The average accuracy for the test is 99.4% for LM 35, 99.46% for ECG sensor module and above 99% for integrated blood pressure monitor. The accuracy for LM35 and ECG sensor module has less deviation compared to the integrated blood pressure system based on the graph plotted in above graph. The LM35 and ECG sensor module have higher accuracy where their accuracy is above 98% for every measurement. The measurement from the integrated blood pressure system has deviation lied between ±7mmHg and the largest error is 8.86%. The error could be due to body movement during measurement and other environment factor.

4. CONCLUSION

The development of a portable health monitoring system that is capable of measuring ECG signal, pulse rate, body temperature, and blood pressure has been successful. The DE1-SoC platform is used to interface the LM 35, which includes an integrated blood pressure monitor and an ECG sensor module. The temperature sensor has an average accuracy of 99.21 percent, the pulse rate sensor has an average accuracy of 99.26 percent, the systolic pressure sensor has an accuracy of 99.17 percent, and the diastolic pressure sensor has an accuracy of 98.72 percent. The data that have been measured are uploaded to the IBM Bluemix Cloud platform at a rate of 1.53 milliseconds per sample of data. To connect to the internet, the DE1-SoC platform makes use of the onboard RJ45 port. The user will be able to view the results of the measurement and ultimately carry out the disease prediction thanks to a locally hosted web page that has been developed.

The Internet of Things (IoT) function of the system under consideration is able to operate once it has been connected to Ethernet and given an Internet connection. The Internet of Things (IoT) framework that runs on the Internet is developed using the IBM Bluemix Cloud platform, which receives support from IBM in the areas of API and cloud computing. The findings are uploaded to a cloud storage service and organised in accordance with the health parameter type. These historical parameters will be stored in the cloud and can serve as a reference for both the user and the physician when determining the most recent health trend. The saved health parameters are accessible to doctor and users via the web portal based on IBM Bluemix. Once a patient chooses to look at it, the comment feature that the doctor provides has been successfully stored in the cloud and displayed on the website.

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