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Heart Disease Treatment in Telemedicine using Internet of Things

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ABSTRACT*: Due to the unfold of infectious diseases, like COVID-19, and flu, and speedy virtualized services, telemedicine has received sizeable popularity. As a consequence of huge expand in smart devices and availability of internet facility, Internet of Things has massive demand for saving money on human labor, and providing security. With the growing needs for health requirements, telemedicine in the Internet of Things guarantees to be transformational due to the fact that physicians can track patients' health more effectively. We have proposed an innovative model for adoption to enforce a heart ailment detecting device for a telemedicine system. Our objective is to record and detect the heartbeat of the patient to screen the risk of a heart attack alongside with ordinary check-ups. The design of this low-cost and Internet of Things enabled fingertip-based critical heart disease detecting device makes our model innovative in contrast to existing models. Besides that, the proposed model provides feedback and notifications to the patient to control and mitigate various health complications. The heart rate module picks up heart rate signals from the patients and sends them wirelessly to a computer or Android application for visualization.*

KEYWORDS –*Disease, Heart, IoT, Patient, Telemedicine*

1. INTRODUCTION

People of South Asian descent have a tendency to develop heart diseases at an early age. Heart ailments is four times more frequent in India, Pakistan, Bangladesh, Nepal, Sri Lanka, Bhutan, and the Maldives than in the rest of the world. In India today, approximately 35,040,000 people die as an end result of cardiovascular disease (CVD). Usually, patients with heart diseases are given healthcare services solely after they get sick. But this risks their probabilities of dwelling due to the fact, most of the time they only get sick at the very remaining stage of the disease. Hence, by then, the damage is done. This is one of the reasons why most patients with heart diseases die even before they can receive any treatment.

In order to keep away from such a regrettable demise, need to take a look at and monitor the physical status of the patients. The results ought to be dispatched to the respective doctors and ambulances if any serious fluctuations are seen. With the Internet of Things (IoT) emerging as one of the most powerful and effective techniques, we can monitor the vital roles of humans whenever required. Also, the statistics accumulated is sent at a low cost, ensuring that experts know the physical status of the patients. Besides this, IoT provides amazing security to the IoT devices and the network these devices use. Securing the company against cyber threats requires securing all devices connected to the corporate network. IoT security is a vital component of a corporate cybersecurity strategy because it limits the risks posed by these insecure, networked devices.[1]

In this paper, we propose an Internet of Things-enabled critical heart disease treatment in telemedicine where we can monitor patients' vital functions such as blood pressure, SpO2, pulse rate, and body temperature through the sensors. This system also monitors whether or not these vital functions have deviated significantly from their normal states. But this paper is more beneficial because it additionally contacts the relatives, ambulance, or doctor with their location and data in the most economical way when it senses that the patient is very sick. The results of this system as well show that the proposed system is definitely an affordable solution for IoT based telemedicine system, as compared to existing systems.

2. RELATED WORK

Traditional healthcare cannot keep up with the number of patients with chronic diseases. In cases of emergencies, it is very inconvenient for the patients to reach a hospital and be admitted immediately. So, the new concept of checking the health of patients beforehand is very useful. This concept is known as pervasive healthcare, which can deliver healthcare services to everyone, everywhere, at any time. Many pervasive healthcare systems have been proposed up to this point.

D. Uniyal, and V. Raychoudhury, in their paper[2], gave a classification of several common diseases in different age groups of patients that are addressed by pervasive healthcare. These pervasive healthcare applications can be classified into various types: monitoring,detection algorithms, intelligent emergency management and patients self-management. The most widely managed among these is the monitoring system. A lot of research projectsand prototypes have been developed to deal with different diseases. For example, the monitoring projects proposed by Nuria Oliver and F. Flores-Mangas[3] presents a real-time wearable system for monitoring, visualizing and analysing physiological signals, focusing on sleeping issues[4]. Lin et al. even proposed a paper to monitor a driver's vigilance status in real-time to link the fluctuation of driving performance with changes in brain activities [5]. The system is aimed at monitoring people's brain bioelectrical activities. The posture monitoring projects[6][7] are also designed especially for elderly people, which can give certain results based on the postures. Some systems are also designed to detect falls in the elderly[8] and provide glasses for blind[9]. These have different architectures and aims, making their monitoring modes diverse. In some cases, physical parameters are involved while in others physiological ones are considered.

It is also known that these are possible with telemedicine and Internet of Things (IOT)[10][11][12]. IoT helps in secure and wireless routing[13]. IoT and telemedicine has such huge impacts that there are reviews of recent measures of telemedicine adopted during the course of the pandemic[14]. There are IoT based drones for improvement of crop quality in agricultural field[15]. Managing disaster[16], waste[17], garbage[18][19] and pollution[20] is done easily with the help of IoT. It is even used for smart cities[21] and home automation systems[22]. There are even scopes of benefit in the field of Industrial Supervision and Maintenance using IoT[23]. It is also significant in agricultural system application and challenges[24][25]. Besides these, IoT has huge implementations in bio-technology[26]. Among medical applications, IoT evolved an automatic ambulance system[27]. Hence Internet of Things and telemedicine are benefiting and advancing the healthcare[28][29][30][31][32].

This field, telemedicine and Internet of Things in healthcare, has large opportunities in future as well as huge impact on humankind[33][34]. Various technologies like cloud system can also be integrated with these to have a stronger field[35][36].

3. PROPOSED MODEL

We have proposed a model where we monitor various parameters of the patient and take further actions according to them. The general architecture of the Internet of Things consists of three layers: perception (the sensors, gadgets, and other devices), network (the connectivity between devices), and application (the layer the user interacts with). This architecture is most suitable for our monitoring system because it supports data collection and processing. Figure 1 below shows the architecture of this Internet of Things enabled critical heart disease treatment in telemedicine.

One of the most important parts of our system is acquiring data on the vital functions of the patients. This data collection is carried out with the help of sensors that are intended to be worn or carried by the patients. But there are a lot of such vitals to be taken into account. However, it is troublesome and not very convenient to monitor all such parameters. Hence, we need to select the most necessary parameters to monitor. In this paper, we have selected the following parameters: blood pressure, blood oxygen level(SpO2), pulse rate, and body temperature. With the help of our collected data, it will be easier to know the condition of the patient.

As it is shown in the Fig 1, the parameters like blood pressure, blood oxygen level(SpO2) and pulse rate, and body temperature are sensed through the sensors Transducer MP3V5050, IC MAX30100, IC LMT70 respectively. The location of the patient is also read through the GPS(Global Positioning System) sensor. These data are processed by the Microcontroller, NodeMCU (ESP8266).

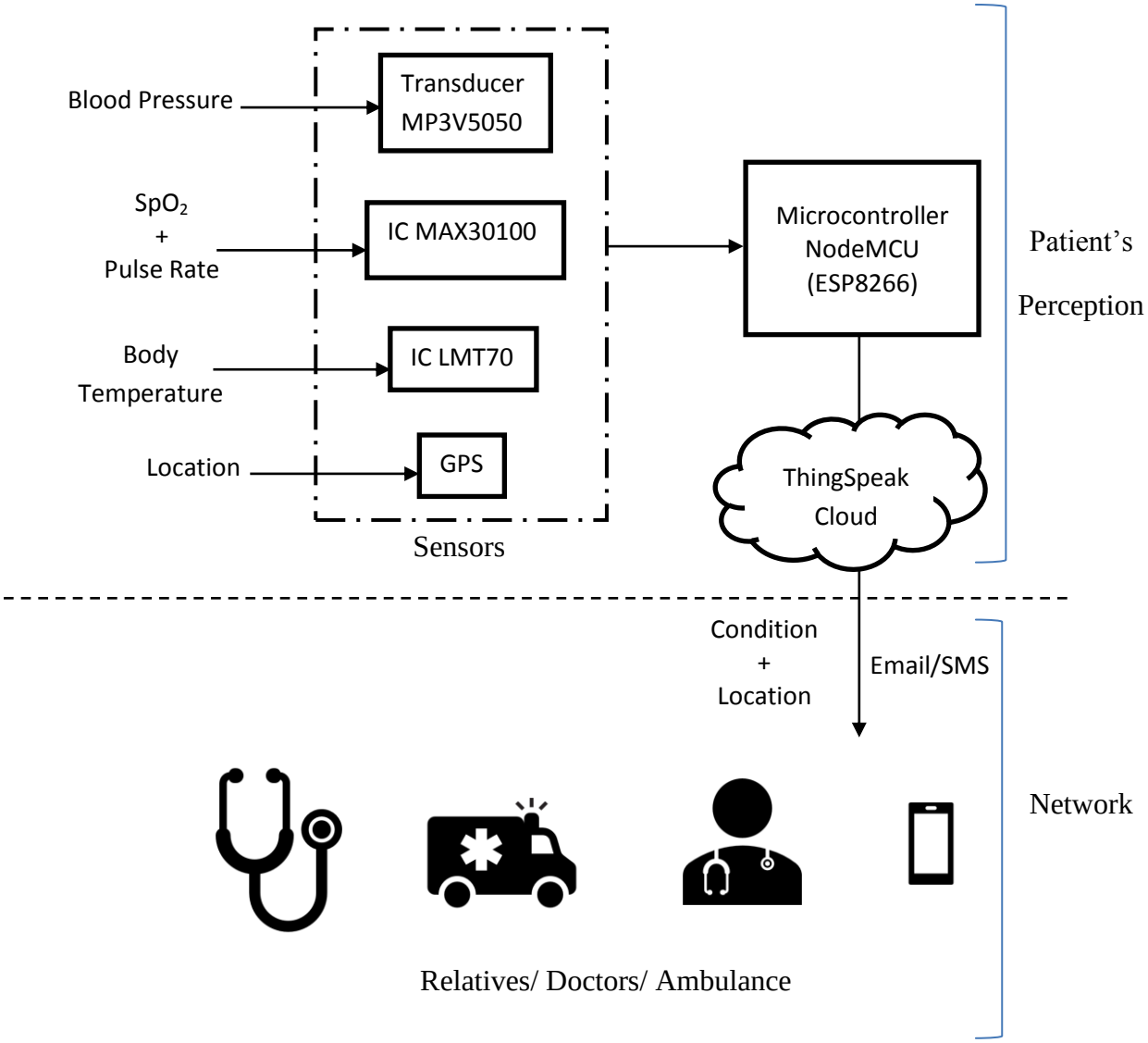


figure 1

All these data are sent to the cloud using ThingSpeak platform. ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. In this platform, data collection in the cloud with advanced data analysis is done.

We take this data from cloud and, using IFTTT platform, and create alerts so as to send SMS and emails to required people. IFTTT is short for If This Then That, and is the best way to integrate apps, devices, and services.

Our project is more useful because, after it receives the data, it will check if any of the vitals have fluctuated greatly from the normal level. If this happens, then the relatives of the patient, the ambulance, or the doctor are contacted via SMS or email, and the data(the condition of the patient) along with its location is sent to them.

4. METHODOLOGIES

In this system, parameters like blood pressure, blood oxygen level(SpO2) and pulse rate, and body temperature are sensed.

The Fig 2, shown below, is the flowchart of our proposed system that explain the methodology. A flowchart is a diagram, depicting a process, a system or a computer algorithm. It is a diagrammatic representation of the solution to a given problem but, more importantly, it provides a breakdown of the essential steps to solving the

problem. It displays the sequence of activities in a process and who is responsible for those activities. Each process starts with the Start node and ends with the End node. Here, all the conditions are checked one by one.

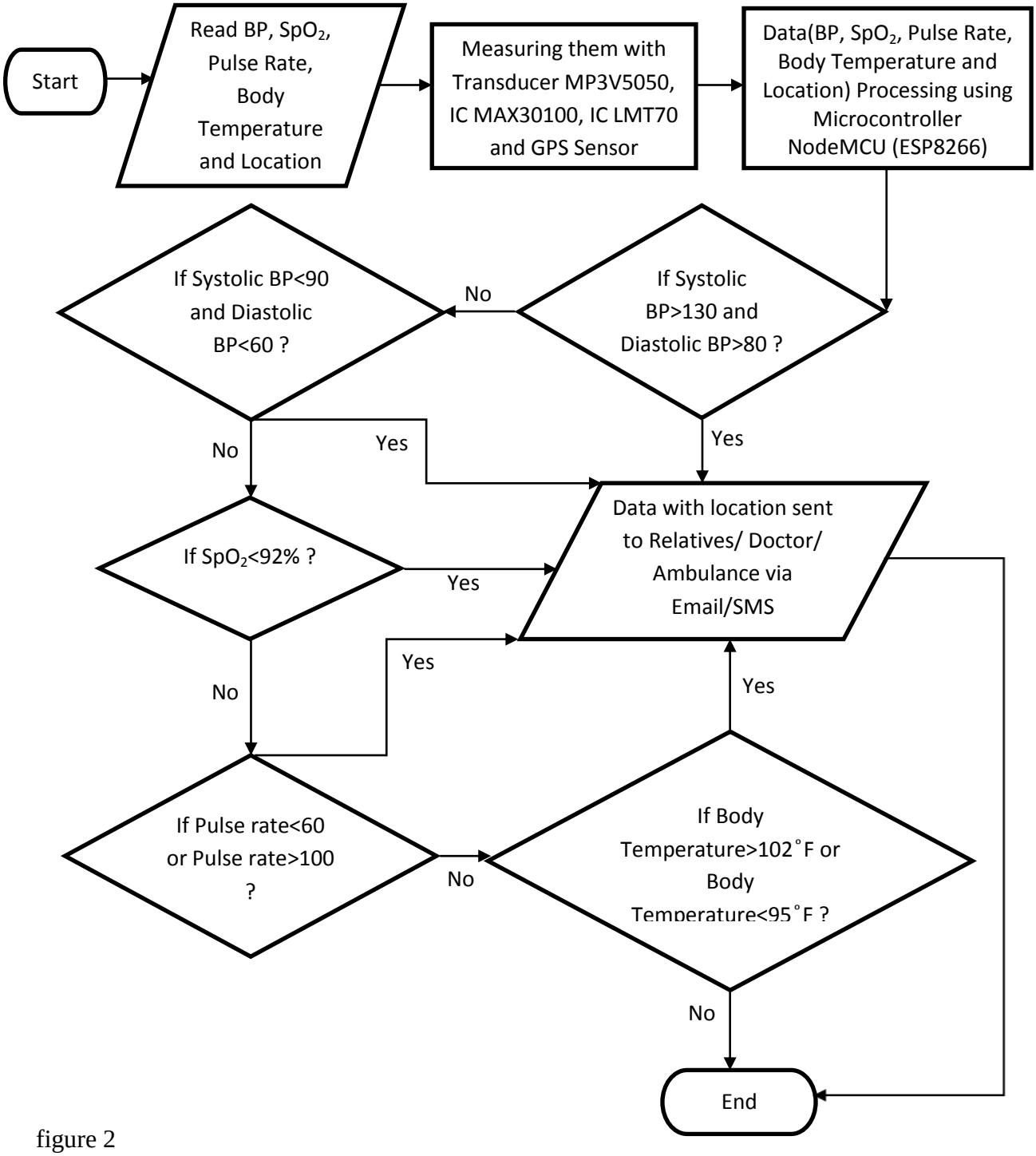


figure 2

There are a number of sensors to measure pressure on the market. But the Transducer MP3V5050 is the most medically qualified as well as being the most affordable. Hence, the arterial blood pressure is detected in the arteries, namely the systolic and diastolic blood pressure measurements, using the transducer MP3V5050.

The IC MAX30100 is used to measure blood oxygen saturation and pulse rate. It combines two LEDs, a photodetector, optimized optics and low-noise analogue signal processing to detect pulse oximetry and heart-rate signals.

The body temperature is another important factor in determining the state of health of the body. There are numerous biomedically qualified sensors for body temperature available on the market. However, the IC LMT70 is a highly accurate and low-cost temperature sensor available in the market that is suitable for wearable biomedical devices.

Global Positioning System sensors are satellite-based navigation system receivers with antennas. So, it is selected to read the position of the patient so that, in case of emergency, the patient's location can also be known and help can be sent their way.

Therefore, the blood pressure is measured using Transducer MP3V5050, the blood oxygen level(SpO2) and pulse rate are measured from IC MAX30100, the body temperature is measured by IC LMT70 and the location is read by the GPS(Global Positioning System) sensor. These data are sent to the Microcontroller, NodeMCU (ESP8266).

Initially, the patient's blood pressure (BP), oxygen level in the blood (SpO2), pulse rate, body temperature, and location are read. They are measured using the transducer MP3V5050, the IC MAX30100, the IC LMT70, and the GPS sensor. All these data(BP, SpO2, Pulse Rate, Body Temperature, and Location) are processed using the microcontroller NodeMCU (ESP8266). The data is now checked to see if it deviates significantly from its normal range.

The normal blood pressure is 90–120 (mm Hg) Systolic and 60-80 (mm Hg) Diastolic. A patient with a systolic blood pressure greater than 130 mm Hg and a diastolic blood pressure greater than 80 mm Hg is said to have high blood pressure. They might have hypertension and, hence, need to seek medical help. A patient with a systolic blood pressure less than 90 mm Hg and a diastolic blood pressure less than 60 mm Hg is said to have low blood pressure and also needs medical help.

The normal oxygen saturation level is 95% or higher. In older people, it is around 95%, while in younger people, it around 99%. But if their oxygen saturation readings drop below 92%, it may be hypoxia(a condition where not enough oxygen reaches the body tissues). Hence, they need medical attention.

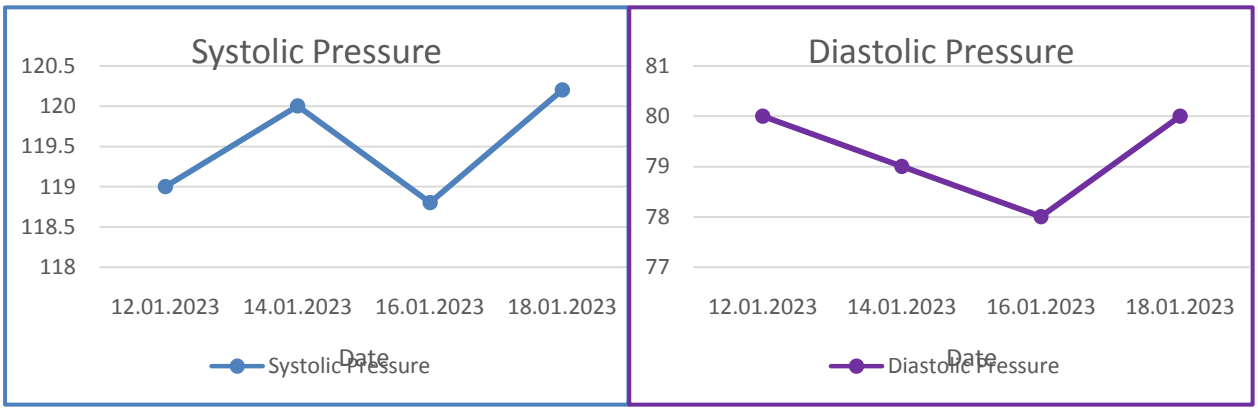
The normal pulse rate or heart rate is 60–100 beats per minute(bpm). If a heart rate is over 100 bpm, it might be tachycardia, and the patient needs to visit a healthcare provider. Also, if the patient's pulse rate is below 60 bpm, they have bradycardia and may experience shortness of breath, dizziness, light-headedness, or palpitations in their chest. These are times when medical help is needed.

The normal body temperature is around 98.6°F (37°C). If the patient's body temperature falls below 95°F (35°C), it may be hypothermia , and healthcare services need to be contacted . If the patient's body temperature is more than 102°F (38.89°C), medical help should be sought.

All these data(the condition of the patient) along with their location are sent to the cloud using ThingSpeak, and SMS and email is sent to relative, doctor, or ambulance if any one of the conditions are true, using IFTTT.

5. RESULT AND ANALYSIS

The data collected from the patients, through the sensors, are sent to the relative of the patient, doctor or the ambulance if any one of the health parameters deviates significantly from the normal levels. If none of the health parameters are fluctuating from the normal levels, no action is taken.



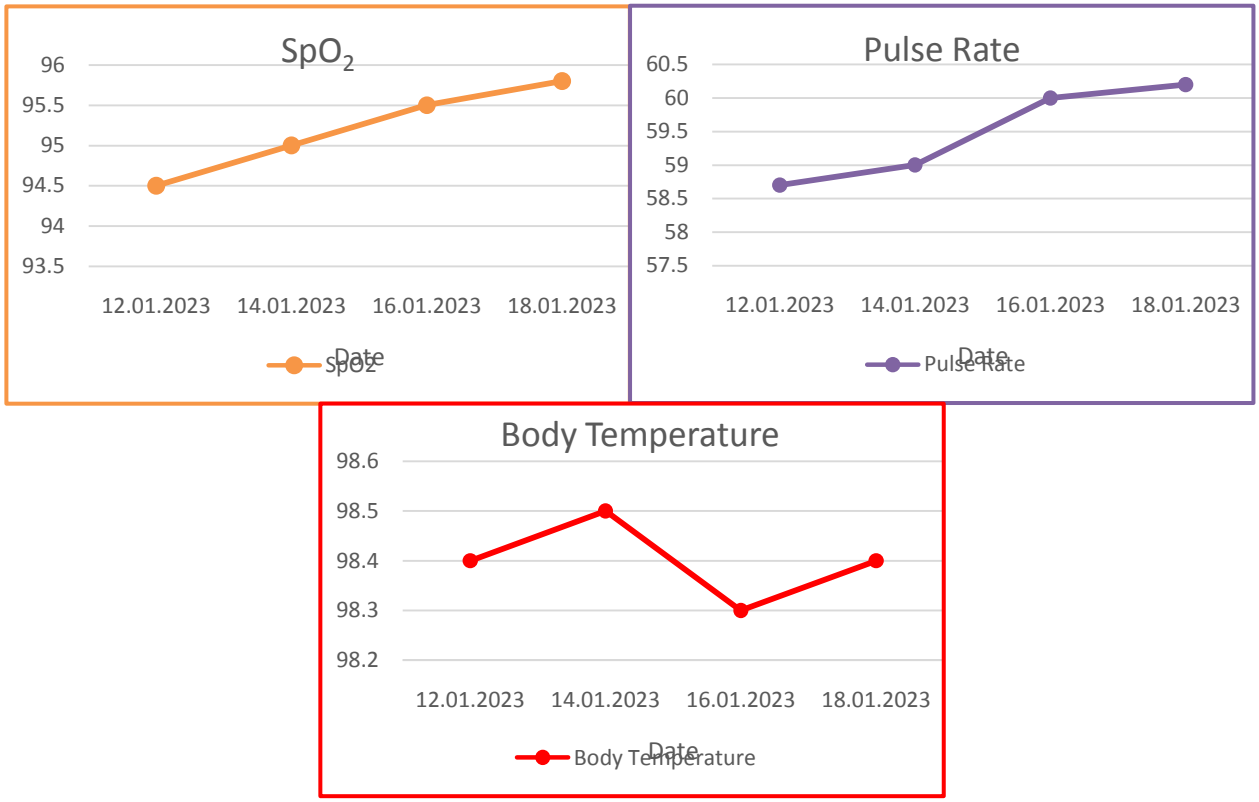


figure 3.1

Each patient's input data can be presented in a graph. Once such data set of a healthy patient (patient number 6) is given in Fig 3.1.

We designed a pie chart representing the various illness of patients, using our system, below in Fig 3.2.

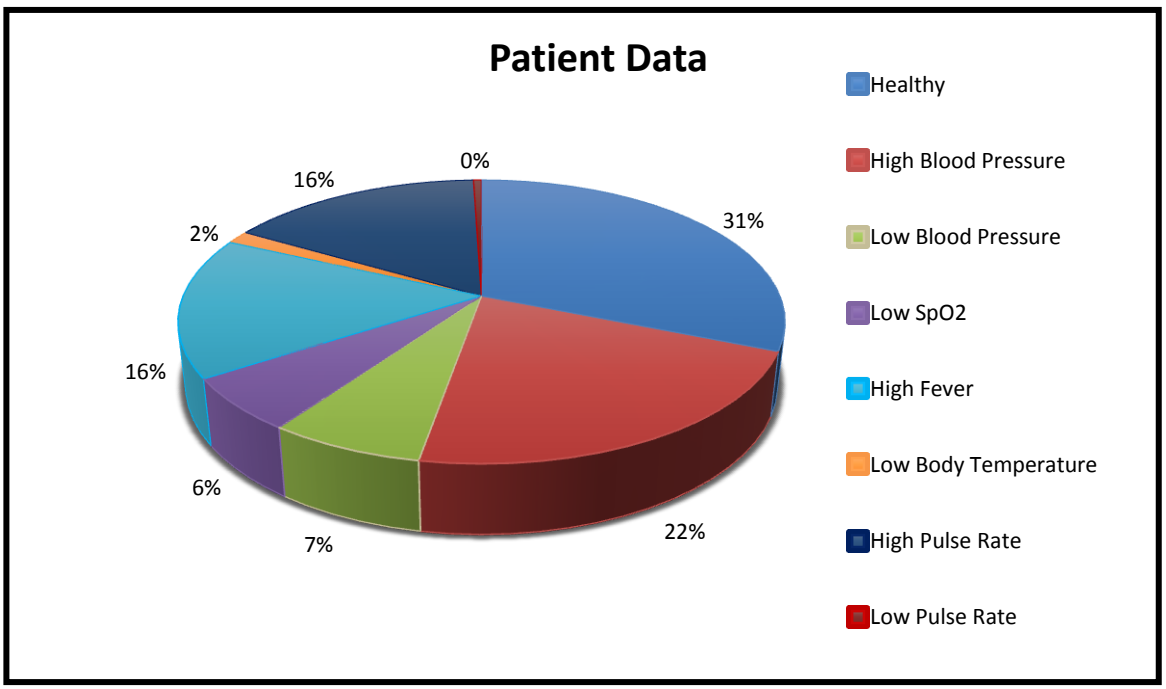


figure 3.2

The accuracy level of our system increases with increase in number of patients using this system. The

accuracy graph is shown in Figure 3.3, shown below.

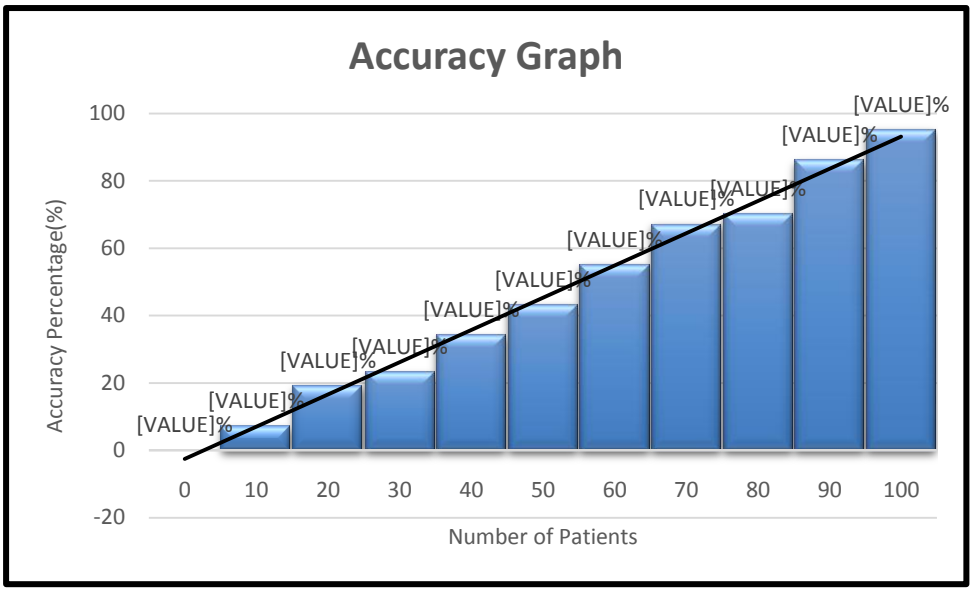


figure 3.3

This graph has number of patients in its X-axis and accuracy percentage level in its Y-axis. The trendline is shown with black color. As it is shown, the accuracy of this system is found to be around 95% with 100 patients.

6. CONCLUSION

In this paper, we propose a design for a low-cost Internet of Things-enabled critical heart disease treatment in telemedicine where we monitor the patients' physical signs such as blood pressure, SpO2, pulse rate, and body temperature. The feature that makes this paper stand out is that this system checks if the vitals are too far from normal levels. Further, this system automatically contacts the doctor or ambulance in such cases when it receives the patient's condition and their location.

To use this system, it is recommended to take a doctor's opinion on how often a day the patient should check them. Then the patient can use this system and if at any point their vitals are measured far from normal levels, the doctors can act accordingly. Their location is important to send because there may be an instant where the patient fainted due to some illness. In these cases, they can be recovered from their location and be given medical aid immediately along with letting their close relative know about their situation.

In the near future, we plan to increase the accuracy of the measurements by measuring large amounts of data at a time and working with their average. This is because taking an average from the huge data set would give us better and more accurate results. All the health parameters that we are taking into consideration may not be same for a healthy group of people with different sex, age and weight. So, in future, we can also incorporate sex, age, and weight parameters. This will enable us to get more accurate results.

REFERENCES

[1] H. N. Saha, D. Bhattacharyya, A. K. Bandhyopadhyay and P. K. Banerjee, "Two-Level Secure Re-routing (TSR) in Mobile Ad Hoc Networks," 2012 International Conference on Advances in Mobile Network, Communication and Its Applications, Bangalore, India, 2012, pp. 119-122, doi: 10.1109/MNCApps.2012.31.

[2] Uniyal, D., and Raychoudhury, R.(2014).Pervasive Healthcare: A Comprehensive Survey of Tools and Techniques. Computing Research Repository. 2014

[3] Oliver, Nuria and Fernando Flores-Mangas. "HealthGear: a real-time wearable system for monitoring and analysing physiological signals." International Workshop on Wearable and Implantable Body Sensor Networks (BSN'06) (2006): 4 pp.-64.

[4] H. N. Saha, M. Nandi, U. Biswas and T. Das, "Heart-rate detection and tracking human body movements through walls at home," 2016 IEEE 7th Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON), 2016, pp. 1-4, doi: 10.1109/IEMCON.2016.7746291.

[5] Lin, Chin Teng ; Chuang, Chun Hsiang ; Huang, Chih Sheng et al. / Wireless and wearable EEG system for evaluating driver vigilance. In: IEEE Transactions on Biomedical Circuits and Systems. 2014 ; Vol. 8, No. 2. pp. 165-176.

[6] Lin, Wen-Yen et al. "Development of a Wearable Instrumented Vest for Posture Monitoring and System Usability Verification Based on the Technology Acceptance Model." Sensors (Basel, Switzerland) 16 (2016): n. pag.

[7] Wu, Wen-Shao et al. "Forward-flexed posture detection for the early Parkinson'S disease symptom." 2014 IEEE International Conference on Systems, Man, and Cybernetics (SMC) (2014): 1181-1185.

[8] E. E. Stone and M. Skubic, "Fall Detection in Homes of Older Adults Using the Microsoft Kinect," in IEEE Journal of Biomedical and Health Informatics, vol. 19, no. 1, pp. 290-301, Jan. 2015, doi: 10.1109/JBHI.2014.2312180.

[9] R. Agarwal et al., "Low cost ultrasonic smart glasses for blind," 2017 8th IEEE Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON), 2017, pp. 210-213, doi: 10.1109/IEMCON.2017.8117194.

[10] P, Sharon & A, Devaroshini & Prakash, Navya. (2021). IOT IN TELEMEDICINE-REVIEW ON SMART HEALTH CARE MONITORING SYSTEM WITH PERSONALIZED TREATMENT. IJIREEICE. 9. 10.17148/IJIREEICE.2021.91007.

[11] H. N. Saha, A. Mandal and A. Sinha, "Recent trends in the Internet of Things," 2017 IEEE 7th Annual Computing and Communication Workshop and Conference (CCWC), 2017, pp. 1-4, doi: 10.1109/CCWC.2017.7868439.

[12] H. N. Saha, N. Saha, R. Ghosh and S. Roychoudhury, "Recent trends in implementation of Internet of Things — A review," 2016 IEEE 7th Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON), 2016, pp. 1-6, doi: 10.1109/IEMCON.2016.7746345.

[13] H. Moudni, M. Er-rouidi, H. Mouncif and B. El Hadadi, "Secure routing protocols for mobile ad hoc networks," 2016 International Conference on Information Technology for Organizations Development (IT4OD), Fez, Morocco, 2016, pp. 1-7, doi: 10.1109/IT4OD.2016.7479295.

[14] Garg, Suneela & Galwankar, Navya. (2020). Official Publication of the Academy of Family Physicians of India. Journal of Family Medicine and Primary Care. 10.4103/jfmpc.jfmpc_918_20.

[15] A. K. Saha et al., "IOT-based drone for improvement of crop quality in agricultural field," 2018 IEEE 8th Annual Computing and Communication Workshop and Conference (CCWC), Las Vegas, NV, USA, 2018, pp. 612-615, doi: 10.1109/CCWC.2018.8301662.

[16] H. N. Saha et al., "Disaster management using Internet of Things," 2017 8th Annual Industrial Automation and Electromechanical Engineering Conference (IEMECON), Bangkok, Thailand, 2017, pp. 81-85, doi: 10.1109/IEMECON.2017.8079566.

[17] H. N. Saha et al., "Waste management using Internet of Things (IoT)," 2017 8th Annual Industrial Automation and Electromechanical Engineering Conference (IEMECON), Bangkok, Thailand, 2017, pp. 359-363, doi: 10.1109/IEMECON.2017.8079623.

[18] H. N. Saha, S. Gon, A. Nayak, S. kundu and S. Moitra, "Iot Based Garbage Monitoring and Clearance Alert System," 2018 IEEE 9th Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON), Vancouver, BC, Canada, 2018, pp. 204-208, doi: 10.1109/IEMCON.2018.8614840.

[19] S. Kanta, S. Jash and H. N. Saha, "Internet of Things based garbage monitoring system," 2017 8th Annual Industrial Automation and Electromechanical Engineering Conference (IEMECON), Bangkok, Thailand, 2017, pp. 127-130, doi: 10.1109/IEMECON.2017.8079575.

[20] H. N. Saha et al., "Pollution control using Internet of Things (IoT)," 2017 8th Annual Industrial Automation and Electromechanical Engineering Conference (IEMECON), Bangkok, Thailand, 2017, pp. 65-68, doi: 10.1109/IEMECON.2017.8079563.

[21] H. N. Saha et al., "IoT solutions for smart cities," 2017 8th Annual Industrial Automation and Electromechanical Engineering Conference (IEMECON), Bangkok, Thailand, 2017, pp. 74-80, doi: 10.1109/IEMECON.2017.8079565.

[22] J. Saha et al., "Advanced IOT based combined remote health monitoring, home automation and alarm system," 2018 IEEE 8th Annual Computing and Communication Workshop and Conference (CCWC), Las Vegas, NV, USA, 2018, pp. 602-606, doi: 10.1109/CCWC.2018.8301659.

[23] S. Chakraborty, S. Mukherjee, S. K. Saha and H. N. Saha, "Autonomous Vehicle for Industrial Supervision Based on Google Assistant Services & IoT Analytics," 2019 IEEE 10th Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON), Vancouver, BC, Canada, 2019, pp. 1061-1070, doi: 10.1109/IEMCON.2019.8936288.

[24] Nayak, Padmalaya & Kavitha, Kayiram & Rao, Ch. (2020). IoT-Enabled Agricultural System Applications, Challenges and Security Issues. 10.1007/978-981-13-9177-4_7.

[25] Saha, H.N., Roy, R., Chakraborty, M. and Sarkar, C. (2021). Development of IoT-Based Smart Security and Monitoring Devices for Agriculture. In Agricultural Informatics (eds A. Choudhury, A. Biswas, M. Prateek and A. Chakrabarti). https://doi.org/10.1002/9781119769231.ch8

[26] H. N. Saha et al., "Internet of Things (IoT) on bio-technology," 2017 8th Annual Industrial Automation and Electromechanical Engineering Conference (IEMECON), Bangkok, Thailand, 2017, pp. 364-369, doi: 10.1109/IEMECON.2017.8079624.

[27] O. Udawant, N. Thombare, D. Chauhan, A. Hadke and D. Waghole, "Smart ambulance system using IoT," 2017 International Conference on Big Data, IoT and Data Science (BID), Pune, India, 2017, pp. 171-176, doi: 10.1109/BID.2017.8336593.

[28] H. N. Saha, D. Paul, S. Chaudhury, S. Haldar and R. Mukherjee, "Internet of Thing based healthcare monitoring system," 2017 8th IEEE Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON), 2017, pp. 531-535, doi: 10.1109/IEMCON.2017.8117245.

[29] H. N. Saha, N. F. Raun and M. Saha, "Monitoring patient's health with smart ambulance system using Internet of Things (IOTs)," 2017 8th Annual Industrial Automation and Electromechanical Engineering Conference (IEMECON), 2017, pp. 91-95, doi: 10.1109/IEMECON.2017.8079568.

[30] Kelly, Jaimon & Campbell, Katrina & Gong, Enying & Scuffham, Paul. (2020). The Internet of Things: Impact and Implications for Health Care Delivery (Preprint). 10.2196/preprints.20135.

[31] A. Moghadas, M. Jamshidi and M. Shaderam, "Telemedicine in healthcare system," 2008 World Automation Congress, 2008, pp. 1-6.

[32] H. N. Saha et al., "Health monitoring using Internet of Things (IoT)," 2017 8th Annual Industrial Automation and Electromechanical Engineering Conference (IEMECON), 2017, pp. 69-73, doi: 10.1109/IEMECON.2017.8079564.

[33] Chaudhary, Aryan & Mukhopadhyay, Saikat. (2021). IoT , The Future of Health Care. 10.13140/RG.2.2.29311.94881.

[34] Saha, H.N., Chakraborty, S., Paul, S., Ghosh, R. and Bhattacharya, D.C. (2022). Impact of Healthcare 4.0 Technologies for Future Capacity Building to Control Epidemic Diseases. In Smart Healthcare System Design (eds S.H. Islam and D. Samanta).

[35] Stradolini, Francesca et al. "IoT for Telemedicine Practices enabled by an Android™ Application with Cloud System Integration." 2018 IEEE International Symposium on Circuits and Systems (ISCAS) (2018): 1-5.

[36] J. Saha et al., "Advanced IOT based combined remote health monitoring, home automation and alarm system," 2018 IEEE 8th Annual Computing and Communication Workshop and Conference (CCWC), 2018, pp. 602-606, doi: 10.1109/CCWC.2018.8301659.