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Systematic Review of Health Monitoring System using the Internet of Things (IoT)

Pooja Mishra, Dr. Sandeep Malik
Computer Science and Engineering Department, Oriental University, Indore, MP,
Computer Science and Engineering Department, Oriental University, Indore, MP,
pooja26.mishra@gmail.com , sandeepmalik@orientaluniversity.inE-mail

Abstract

The challenges of health and social care are explicitly reflected by the increasing environmental levels. Technology-dependent livelihoods have become investigators' focal point. In order to solve these healthcare issues, technology has played a crucial role in completing these important tasks. While using technological solutions, expert advice must be used to design , implement and validate them. There is a genuine need for healthcare expenses to be regulated or even reduced while enhancing service quality. The real-time monitoring of the health status of the body organ may be used to assess the health status of a specific organ in order to resolve these challenges; therefore, it would be possible to enable early provision of medical facilities. The technology used in this paper focuses on the ability to concentrate on the physiological data of a person to detect the health of body organs, which may help cure defects. This is done by correctly processing and assessing the collected data from sensors when transmitting health status detection. It supports the finding of organ health status that will facilitate clinical decision-making to provide care.

Keywords: *Internet of things, Healthcare, Medical ,Real-time monitoring, Wireless sensor networks*

1. Introduction

In this paper, using the IoT, we monitor various parameters related to patient health. In the IoT paper-based patient health tracking system, the real-time parameters of the health of a patient are submitted to the cloud using Internet connectivity. These parameters are sent to a remote location on the Internet so that the user can access these data, regardless of geographical location, from anywhere. However, by combining various technologies, such as Android phone apps, wearable devices and sensors, the caregiver of a patient can be remotely monitored easily. Healthcare providers are more often visited in our busy lifestyle to meet individual needs, since the enormous population increase leads to more customers in our new and static healthcare systems. On the other hand, there is still insufficient investment in healthcare in new technology to manage these populations. In addition, we are significantly concerned about our health and interested in continuously monitoring our physical activity everywhere at any time using different healthcare and fitness tracking products, similar to other individuals. Moreover, as we do our day-to-day work, when we leave them home alone for a long time, we worry about our wounded family member and disabled people's welfare. Therefore, in order to provide a secure and convenient world for all to live in, it is becoming important to engage innovations such as healthcare sensors and wearables with our healthcare systems. The growing population, followed by the prevalence of ageing-related chronic diseases, would have significant consequences for decades to come for the health care system. Therefore, we suggest a model that allows continuous real-time observation of health of elderly people to prevent chronic diseases, thus avoiding hospitalization that burdens healthcare systems and costs. This paper provides a system for Health Tracking using the Internet of Things. The machine accumulates physiological data from patients in real-time via

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sensors. The data is transmitted to a data archive, where any defaults are stored and verified. Therefore, any diagnosis of a patient's health condition can be reported in real time to the patient's physicians and/or hospital to respond rapidly to stop a variety of complications, such as a sudden heart attack. Technologies are capable of providing real-time physiological data from patients from their locations to doctors anywhere. Proposal system would recommend appropriate medical tests, local centers and physicians available for testing, measures should be taken.

2. Literature Survey

This section describes a review of literature. We also researched numerous papers to review the current method.

Md Anam Mahmud et al [1], The structural health monitoring system was implemented by them. Interaction with various devices and applications using IoT was provided by the structural health monitoring system. The hardware component of the device includes the Wi-Fi module ,Raspberry pi and ADC. Signal processing was used along with mathematical calculation. To minimize noise, the Butterworth filter was used . Mathematical calculation for getting size and location of affected portion. System can access remotely with the help of internet.

Alvee Rahman, Sazzad Hossain, Tahsinur Rahman, Nawab Haider Ghani, Jia Uddin [2], Authors implemented health monitoring system with help of IoT. This system specially designed for patients which are admitted in ICU and bedridden at home. System embedded with two sensors i.e. ECG Sensor and digital thermometer. System continuously monitoring patient health and updating data on cloud after certain time period. Caretaker or family member can easily monitor patient’s health status continuously from anywhere. System generates and sends automated notification to respected member, it helps to take fast action in a critical condition. Threshold set for temperature and ECG signal.

S.Gayathri, N.Rajkumar, V.Vinothkumar [3], provided simulation of patient’s real time monitoring using PROTEUS. It used to obtain and process input from sensor. They had overcome disadvantages of 8051 microcontroller by replacing it with PROTEUS software. Authors suggested more reliable and user friendly system as compare to system embedded with 8051 microcontroller .

S. Met al.[4] Usage of wireless communication technologies to transmit to the doctor's PC data that is sensed from the patient. With adequate accuracy, the proposed device will track heart pulse rate, body activity and body temperature. By using the scheme, healthcare practitioners will monitor their patients all the time. Physiological information is preserved and made accessible online. Healthcare practitioners may also monitor their patients at any moment from a remote location.

T. D. McAllister et al [5] In order to provide a low-cost alternative to conventional real-time locating systems, LoCATE is developed as an asset tracking device incorporating cloud, IoT, and 802.11 wireless technologies. Obser vational results
(II) indicates that from 802.11 wireless management frames, a fairly accurate distance measurement can be achieved. The ability to estimate these distance measurements between distributed wireless access points offers an opportunity for more than just data transmission using 802.11 wireless network technologies. This ability to establish an IoT-centric approach to healthcare environments is leveraged by LoCATE. Due to the embedded computing capacity of client devices which provide a telemetry interface, the potential benefits of the LoCATE localization method are simplicity. Scalability through cloud storage and online resource

integration, health centre services optimization, and resources management through historical data acquisition.

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Table 1. Healthcare using sensors

Year	Key methods	Results	Issue	Proposed Solution
2018	Structural health monitoring system	System can access remotely	remove noise	design and develop the IOT device which will check and analyze the body organ is healthy, seek or damage and based on that analysis system, automatically send the notification for how to take a precaution
2019	Health monitoring system with help of IoT.	System continuously monitor patient and update data	Threshold set for temperature and ECG signal	test the health parameter after some time intervals, if any problem arises related to the health parameter of the patient then the system will automatically send the notification to the relative patient.
2015	PROTEUS	used to obtain and process input from sensor	overcome disadvantages of 8051 microcontroller by replacing it with PROTEUS software	System detects the affected body organ with the help of sensors or IOT device and suggests which medical test is mandatory for better diagnosis.
2017	wireless transmission technology	Tracking their cases all the time	Online storage of physiological data is.	Alert message to ambulance, hospitals or relative with GPS location with the help of IOT device
2017	cloud, IoT	The potential to measure such location information between wireless access points distributed	This potential is leveraged by LoCATE to create an IoT-centric alternative for health care environments.	To balance Environmental parameters are taken into consideration for some specific diseases

Fan Wu et al [6], Presented wearable sensor for safety application namely WE - Safe. This work primarily focused on hardware integration. Data collected and sent to cloud through LoRa network. System worn user if constraints fail to match with normal health parameter. IoT used for sensor integration in wearable device.

C. G. Butca et al [7] The authors proposed an experimental model in this paper based on a network of wearable sensors linked to a cloud platform that aggregates the data received from the sensors to monitor patients ' health status. Investigators used multiple body temperature sensors, air humidity, which a microprocessor transmits through a gateway to a cloud storage platform. Cloud Computing

optimizes architectural scalability and operating costs when adapting flexibly to conditions of poor network efficiency.

Table 2: Healthcare using sensors

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Year	Key methods	Results	Issue	Proposed Solution
2018	WE-Safe	Data sent to cloud through LoRa network.	fail to match with normal health parameter	To obtain the alert message to ambulance, hospitals or relative with GPS location with the help of IOT device
2014	Database-as-a-Service storage system	tracking patients 'health status'	optimizes scalability and operational cost	To obtain the nearest hospital and diagnosis centers contact details and address provided according to your diseases and location
2015	wearable sensors network	cloud storage system	Adjusting to environments with low network quality.	To obtain the alert message to ambulance, hospitals or relative with GPS location with the help of IOT device

Butca, Cristina & Suciu, George & Ochian, Adelina & Fratu, Octavian & Halunga, Simona. [8], In this paper , they proposed an experimental model focused on a wearable sensor network linked to a cloud platform that aggregates the sensor data collected to monitor the health status of patients. They used multiple body temperature sensors, air humidity sensors that are transmitted to a cloud storage device through a microprocessor via a gateway. For a period of one month, they tested the sensors. On the basis of the high scalability of infrastructure, apps and applications, they picked a cloud solution. In a Database-as-a-Service storage environment, the architecture given uses the cloud to set up data gathered from sensors. Cloud Computing optimises architectural scalability and operating costs when adapting flexibly to conditions of poor network efficiency.

Table 3: Devices used in health detection

Year	Key methods	Results	Issue	Proposed Solution
2019	remote control	used in the field of bio medicine an d various ap plication of health monitoring	remove all oversight of the past work	testing health parameter after some time intervals, if any problem arises related to the health parameter then the system will automatically send the notification to the relative patient

M.A.Rahaman and Q.Delwar Hossain[9] The recommended antenna is for biomedical use. As part of numerous medical applications, biomedical antennas have been used, such as remote control of well-being, disease treatment, hyperthermia, stomach observation, tumour location. It is also used for various cancer detection types. It suggested that in a comparative way, the antenna delete all scrutiny of past function. This paper proposes a low body profile that fits the antenna with wide bandwidth, increased gain, and low loss of return and biocompatibility.

Table 4: Health diagnosis and advice suggestion

Year	Key methods	Results	Issue	Proposed Solution

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2016	homogeneous platform	remote health monitoring	Wireless signal transmission	System detects the affected body organ with the help of sensors or IOT device and suggests which medical test is mandatory for better diagnosis
2018	Bio signal-Special Processing toolbox (Bio-SP tool)	provide more automatic and reliable extraction	continuous BP and ICG bio signals	alert message to ambulance, hospitals or relative with GPS location with the help of IOT device in case of emergency
2019	Creating a jacket with wearable technology only	The ability to make different kinds of warnings	The sensors do not cause the user any discomfort.	design and develop the IOT device which will check and analyze the body organ is healthy, seek or damage and based on that analysis system
2017	Knowledge Graph (KG)	It has been shown to include the history of current illness and past medical history.	Comparison to the CMemNN model of state-of-the-art	design and develop the IOT device which will check and analyze the body organ is healthy, seek or damage and based on that analysis system, automatically send the notification for how to take a precaution

P. Nithia, S. Ullas [10] The authors worked on the various gases present in the kitchen in this proposed method. With the assistance of Arduino Uno, various gases were detected using various gas sensors. It also sends a message to the telephone with an acceptable recommendation or warning when the current gases reach the threshold level. They also rely on the detection of gas in this system inside a kitchen by integrating multiple sensors. Female working in kitchen survives from health

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issue due to continuous presence of various gases. Health issues of lungs, respiratory system and many more were focused in this system. They have proposed solution over problem, but work is limited to gases produced in kitchen.

M. Nabian, Y et al [11], The Special Processing Toolbox (Bio -SP tool) was presented based on state-of-the-art algorithms published in scientific literature and feedback for preprocessing and feature extraction of ECG, EDA, EMG, continuous BP and ICG bio signals. In order to provide more automated and accurate extraction of signal-specific physiologically important characteristics from multiple bio signals for use with a wide range of machine learning and pattern recognition algorithms, this open source toolbox accommodates scientists in machine learning, affective computing, and psychophysiology.

M. Batista, P. Sebastião and R. Cortesão[12] The proposed Wear IoT sensor network was developed and placed in a jacket made from sustainable fabrics containing sensor-connected conductive wires that allow multiple measurements to be made in contact with the human body. One of the key objectives is to create a comfortable jacket with just wearable technology, in which the sensors do not cause the consumer discomfort. This is supposed to be a jacket that can be used, i.e. it could also be cleaned, with and without technology. This method reduces the cost of patient care and seeks to bring the consumer benefits. 24-hour supervision is allowed by the system. The device has the potential to render different types of warnings, either by notifying the user by Short Message Service (SMS) or directly calling emergency services. The locations of users are submitted to the emergency services.

V. Datla et al. [13] In this paper , the authors identified a clinical diagnosis inference method based on Information Graph (KG). They performed systematic studies considering different parts of a clinical note on the MIMIC -III benchmark dataset. Results have shown that, relative to other sections, the content of current disease history and previous medical history sections will contribute most to the inference of clinical diagnosis. Moreover, they showed that, relative to the state -of-the-art CMemNN model for a relaxed precision metric, the proposed KG -based approach would work well.

Ghosh et al[14] An integrated solution for this is given by the developed framework. The measured parameters may be put together in the near future on a homogeneous platform. Wireless signal transmission can also be introduced such that remote health monitoring can be achieved. A number of other metrics can also be analysed to establish a more compact health monitoring device, such as blood pressure , blood sugar, body weight, oxygen level, etc. MATLAB measures the average heart rate of the human body. The patient being diagnosed here, on average, has a heart rate of about 65. Thus, it is shown on the monitor that the patient's average heart rate is within the normal range and there is no bradycardia or tachycardia in the patient.

Table 5: Hospital suggestion using patient location

Year	Key methods	Results	Issue	Proposed Solution
2014	developed android application	maintain record of blood bank	A* for search shortest path to nearest hospital.	alert message to ambulance, hospitals or relative with GPS location with the help of IOT device

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2014	LBS , ArcGIS software	identifying the closest healthcare facilities in a city	does not allow the user to find the exact position	obtain the nearest hospital and diagnosis centers contact details and address provided according to your diseases and location

R. A. Nimbalkar and R. A. Fadnavis [15], developed android application which kept record of nearest hospital to patient in case of emergency suggest hospital. Authors take into consideration emergency type, Doctors availability, distance from patient, Blood bank availability. This system maintain record blood bank. Efficiently working on locate nearest hospital; make available contact details of ambulance, doctors. They used A* for search shortest path to nearest hospital.

V. Poornima and R. Ganesan,[16], Their location-based system is designed for desktop and mobile devices, and typically LBS is used to build desktop applicati ons where users can access location information. In the existing system, the drawback does not allow the user to find the exact position on their shift LBS is an information service that is available through the mobile network from mobile devices, which provides information based on the device's geographical position. LBS provide programs that classify a person's location or an object or facility, such as identifying the closest facilities according to the needs of the user. The approach suggested identifying closest health care facilities. The suggested approach for identifying the closest healthcare facilities in a city is based on a network analysis that uses ArcGIS software to assess the closeness and the shortest route to healthcare facilities. This technique uses a new Bidirectional algorithm called the shortest path.

Table 6: Environmental effect on human health

Year	Key methods	Results	Issue	Proposed Solution
2019	GIS and data mining	Prevention and compliance with environmental laws.	To contribute to the conservation of the quality of the atmosphere (water, air, soil).	Balance Environmental parameters are taken into consideration for some specific diseases like Asthma
2014	As biological pollutants and organic volatile compounds	Analysis, as well as the inclusion of other parameter groups	Review of the parameters according to the physical, human and financial resources available	design and develop the IOT device which will check and analyze the body organ is healthy, seek or damage and based on that analysis system, automatically send the notification for how to take a precaution

Vitkar, Swati & Singhal, Rekha, [17] In order to analyse environmental data, researchers have implemented GIS and data mining and obtained a series of results. There is a real need for research to improve the development of technologies that

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contribute to the conservation of environmental quality, in order to encourage indicators for environmentally sustainable growth. The first phase in this research programme is to collect and analyse data in order to provide valuable environmental monitoring and forecasting tools. For pollution control and compliance with environmental laws, such tools are beneficial.

Elias G.A., Calil S.J. [18], The layout of the technique is more importa nt than the parameters analysed by it. The development of the methodology allows the inclusion or exclusion of the criteria to be evaluated, as well as the inclusion of other parameter categories, including biological contaminants and volatile organic compounds, alarms, vibration and component arrangements. It is still possible to conduct a more detailed review of the parameters depending on the physical, human and financial resources available.

Table 7: Medicine reminder for patient

Year	Key methods	Results	Issue	Proposed Solution
2017	8051 Based Medicine Reminder	Recall the medication and dosage from the workers	Owing to non-adherence to drugs, complications occur for all.	Test the health parameter after some time intervals, if any problem arises related to the health parameter of the patient then the system will automatically send the notification to the relative patient
2016	IOT	Improving the quality of the prescription medication and reducing the economic factor	The purposes of RFID identity and encryption / decryption	System detects the affected body organ with the help of sensors or IOT device and suggests which medical test is mandatory for better diagnosis
2016	Med-Alert, LED is used as the reminder	The system generates a report of the medicine intake routine of the patient and emails it weekly to the doctor concerned	patient does not take the pills	Design and develop the IOT device which will check and analyze the body organ is healthy, seek or damage and based on that analysis system, automatically send the notification for how to take a precaution
2017	Predicting diseases and recommending medicines using machine learning	Through live chat, doctors can interact freely with the doctor in case of an emergency..	wide range of scope	Obtain the nearest hospital and diagnosis centers contact details and address provided according to your diseases and location

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R. Surender Reddy et al[19] The 8051 Dependent Medicine Reminder is simple , inexpensive, and more reliable to use. For any age group, this method is cooperative and can even be used for a group of people in hospitals. This method can also be helpful in hospitals where there are a lot of patients and it is often difficult for the workers to recall the medication and dosage. So, in hospitals, this device with some changes can also be used. The issue of maintaining the regularity of the prescribed dose is difficult to remember in the busy schedule, remembering the name of the medication to be taken is very difficult, since the life of the patient can become more complicated for the above two reasons.

Zanjal, S. V et al [20], Its scheduling is well concentrated in this paper medication, which is helpful for improving the prescription drug 's efficacy and reducing the economic factor. A variety of monitoring systems have been observed to strengthen the present home health care procedure, contributing to the home health monitoring method. The monitoring system can be implemented with a sensing component and a wireless module that should be secured in order not to corrupt the message containing health-related data. In connecting the two devices, the use of the messaging standard and the communication protocol, IOT (Internet of Things) plays a critical role. We can safely transfer essential hea lth messages. In case of emergency for safe health, open source IOT cloud would be efficient for storing sensor data, the advantage of digitally storing is that data recovery is easier and quicker. RFID is best for the device's personal identity and encryption / decryption purposes.

Abdul Minaam et al [21] This paper is proposed and revised in a canny pillbox. It enlightens the elders to take medicine. The season for senior citizens to take medicine is productively monitored. It also reduces the proportion of medication missed and delayed by the patient. The remote user interface joins programming with the RoboRemo applications so that the patient can be supported by the parental figures. Which adds more functionality by applying more usability locally through networking or if it is available using the internet. For the drug bundles, the outline style is too suitable. Later on, we believe that sparing and compact vitality can be taken into account.

S. Jayanth et al [22] Med-Alert offers intimation about the correct drug to be taken at the specified time via audio-visual warnings along with an E-Mail sent to the user 's smartphone. A buzzer is used for the audio alert. Whereas the LED is used as a reminder for the visual. If the patient does not take the pills, despite the system's warnings, an e-mail is sent to a family member to advise the patient to take the drug. The device produces a report of the drug intake regimen of the patient and emails it to the doctor concerned on a weekly basis.

Disha Mahajan et al ,[23] Designing a system that uses user friendly application of android mobiles to help predict the disease. In order to predict diseases and propose medications using machine learning techniques such as classification, association rule mining, the system should be effective. In the case of diseases, it has a very broad spectrum of scope. Furthermore, the scheme can be applied to N number of diseases with proper drugs existing. It can be made accessible to doctors via live chat so that, in case of an emergency, the end user can openly communicate with the doctor.

Muneeb ahmed sahi1, haider abbas et. al. [24] In healthcare, e-Healthcare seems to be the next important wave. It provides all the advantages and benefits that both the patient and the client can imagine. Current e-Healthcare systems, however, are not

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yet fully developed and mature, and thus lack the degree of confidentiality, integrity, anonymity, and user confidence necessary for widespread adoption. Quality in healthcare facilities and patient trust in the healthcare industry are two key elements in every operating healthcare field. Trust is intertwined with concerns
such as privacy, integrity accountability, authenticity, identity, and data management, to name a few. Privacy remains one of the greatest challenges, as it implicitly addresses most security issues, to ensure that e-Healthcare solutions succeed in attracting patient interest. Addressing privacy problems includes addressing security issues such as access security, authentication, non-repudiation, and transparency, without which it is difficult to guarantee end -to - end privacy. It is an important undertaking that involves comprehensive work to protect privacy from the data collection point in wireless sensor networks, to the convergence of the Internet of Things, to communication connexions, to data storage and access.

M. A. Alyami et al [25], They proposed an untethered personal health record structure in this article. How to use Dublin Core metadata to capture and organise heterogeneous personal health data has been seen in our proposed framework, MCRS. The reorganised DC tags were used to retrieve the organised data, enabling body parts to organise clinical data for easy retrieval.

Table 8: E-medical record

Year	Key methods	Results	Issue	Proposed Solution
2018	big wave	Data storage and access, is a huge undertaking and requires extensive work.	e-Healthcare systems are not yet fully developed and mature	Design and develop the IOT device which will check and analyze the body organ is healthy, seek or damage and based on that analysis system, automatically send the notification for how to take a precaution
2017	medical industry, MCRS,DC tag	allowed the organization of clinical data by body parts for easy retrieval	Personal emergency clinical data to emergency crew only by their license number at the time of need.	Obtain the alert message to ambulance, hospitals or relative with GPS location with the help of IOT device
2017	OMBD,DPG, OPG	efficient tri-party authenticated key agreement protocol	only accessible by a user	Test the health parameter after some time intervals, if any problem arises related to the health parameter of the patient then the system will automatically send the notification to the relative patient
2016	MedRec	providig auditability, interoperability and accessibility via a	MedRec need to do enables	System detects the affected body organ with the help of sensors or IOT device and suggests which medical test is mandatory for better diagnosis

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		comprehensiv e log		

H. A. Al Hamid et al [26] This paper focuses on using fog computing to secure the user's multimedia data within the cloud. There are two photo galleries created for that purpose. In the cloud, the OMBD is secretly stored and the DMBD is used as a honeypot and stored in the fog. Thus, the user accesses the DMBD by default instead of only retrieving the DMBD when any unauthorised access is detected. An OMBD is only accessible to a user after the legitimacy of the user has been tested. Thus, the original multimedia data becomes more robust by setting the default value of the DMBD, while the OMBD is stored in a hidden gallery. An effective triparty-authenticated key agreement protocol based on paring cryptography has been proposed between the user, the DPG, and the OPG to facilitate the above process.

In above survey the following are the challenges observed in health monitoring system, in which the proposed methodology tries to overcome. i) monitoring of particular body organ ii) analysis of organ health status iii) In existing system they can't suggest test for affected body organ iv) suggest nearest medical, pathologist center and hospitals v) There is not any consideration in existing system for environmental parameter. In proposed system we will solve t his entire problem.

3. Expected Result

The proposed framework system addresses the health parameter of the patient, so system scalability and precision can aim to achieve high performance in coping with health parameters of disabled and injured people and efficiently monitor their health in real time. In addition , the system would be versatile in order to extend the population and patients who use the system accordingly. In Addition to existing system we will provide health status detection, assistance for recover from defects, monitor bedridden patients, precaution measures according to patient's medical history. We will achieve system performance in term of accuracy, efficiency and scalability.

Table 9. THE PHYSIOLOGICAL PARAMETERS RANGES AND ACCURACY

Signal	Range of parameter	Signal frequency	Accuracy
BPM	50-90	0-0.1	Excellent
SPO2	95-98%	0-0.1	Excellent
ECG	0.5-0.4mV	0.01-250	Good
Breathing	2-50 breaths/min	0.1-10	Good

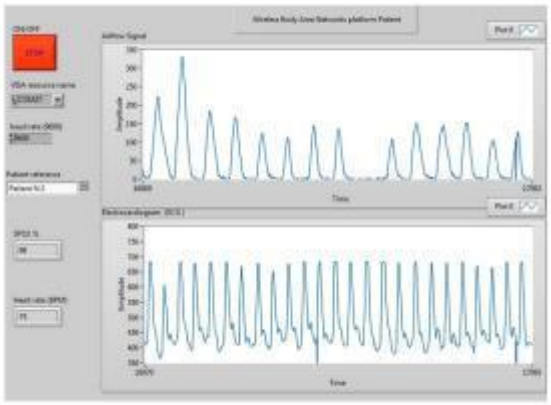

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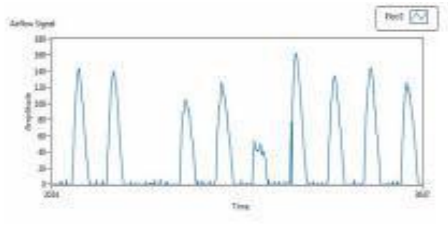
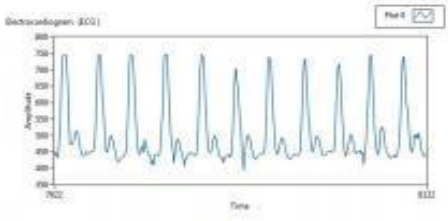
Fig.1 On a graphical interface, the critical parameters result.



(a)



(b)

Fig.2 The signals collected in central node : Breathing (a)ECG (b)

Breathing 4. Conclusion

In this paper, the IoT-based health monitoring framework was proposed to resolve the challenges of providing health monitoring and avoiding expenditure in hospitalisation time and expense. The literature indicates that there is a strong demand for an efficient health monitoring solution to be developed that monitors the body organ, evaluates its health status, and recommends medical assistance in their home and in real time. We suggest a framework that will contribute significantly to providing all individuals with a secure and healthy atmosphere. The framework makes it possible to live independently by continuous health monitoring without fear of any emergency or urgent health situation. In short, the device will collect physiological data from patients through wearable sensors and transmit it for data collection , analysis and processing to the cloud. Any disease in the health of the patient is observed, data will be recorded to the patient, and local hospitals will also be available. The framework will be implemented in a modular architecture that in the future can be easily scalable and extended. The system would thus provide a secure and cost-effective forum for tracking the health of patients.

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