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IOT BASED HEALTH MONITORING SYSTEM FOR AGED PEOPLE USING NODE MCU

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Abstract- In everyone's life, health plays a vital role, but in today's environment, people do not have enough time to take care of themselves and their family's health. It is an important duty for everyone to take care of their parent's health and be aware of their medical status. In the current system, some models are available, they are either for distance or for direct monitoring but not for both. This system uses the Internet of Things (IoT) to continuously gather and monitor elder's health-related data using sensors, which include temperature, pulse rate, oxygen level, piezo electric, sound and saline water level. The information obtained from elders will be stored on the cloud. Furthermore, the system can alert the carers (doctors, a nearby clinic, a caretaker, and a family member) during an emergency scenario such as abnormal health conditions or if the elders fall, a notification in the telegram is to alert the carer who are far away, and a buzzer that is rung to alert the caretaker near the patients. The carers can access or check the health status of the elders on the app from any place at any time and at an affordable cost.

Keywords: *Healthcare, IoT, Sensors, Cloud, Monitoring, App, Fall detection, and Alert.*

I. INTRODUCTION

Internet of Things is the main catalyst in revolutionizing healthcare services. IoT applications provides healthcare benefits because they enable secure as well as real-time remote patient supervising because it improves the quality of people's lives. The IoT monitoring system regarding healthcare aims to track people and connect various services and things in the world via internet to collect, share, monitor, store, and analyze the data generated by these things. However, the IoT is a new paradigm where all physical objects that are connected in any intelligent applications assigned with smartness are addressed and controlled remotely.

The data gathering architecture of IoT not only on sensors and includes various sources such as software applications, web resources. All these sources require a massive storage system. The development in data collection devices and its applications improves the life style, simultaneously the amount of data is also increases exponentially. So that it is essential to manage, store and analyze such information via internet of things is the recent research trend. IoT is widely used in various application in engineering and science, though the necessity to improve health care system, IoT is employed in recent times. Cloud computing provides support to various applications and its related services which are further improved by incorporating cloud with IoT. In health care applications the significant features such as remote data processing requires high degree of dependability.

Several advantages are here while using Nodemcu ESP8266 in IoT it has integrated WiFi module 2.4 GHz & integrated TCP/IP protocol stack which are not in other processors like Arduino & Raspberry Pi. Node mcu consumes low power and cost than other processors [1]. So implementing these kind of advantageous system in health monitoring process have huge benefits.

II. RELATED WORK

The related work involves creating a health monitoring system for elderly people that helps continuously monitor their body parameters and alerts the caretaker during emergency situations. In day-to-day life, taking care of elderly people at home is a big challenge for everyone, for whom they have appointed a caretaker, yet it is difficult for them to know their health conditions immediately and take them to the hospital during an emergency. The solution below was previously developed for this problem, but it contains some limitations or requires some advancement. The related work involves creating a new IoT-based health monitoring system for older people that helps monitor elders' health parameters from anywhere. The below work was a previously developed solution for this problem.

B. Linet al., [2] discussed about the neural network model of the back-end computer is streamlined and transferred to the edge computing platform in this study to create a fall detection system based on neuromorphic computing hardware. The object photographs taken by the camera are translated into human motion features by the neural network model with integer 8-bit accuracy deployed on the edge computing platform, and a support vector

machine is subsequently employed for classification.

L.Balakrishnanet al., [3] This paper provides a brief overview of the usage of IOT-based frameworks in medical services, starting with an early wearable sensor-based design for medical care monitoring and moving on to a discussion of more modern fog/edge computing technologies for smart healthcare framework. Small healthcare is one of the major application areas for IOT, which has seen widespread use in many different fields. Medical care monitoring frameworks with new innovations are currently a major issue for many nations around the world. The remote medical care monitoring framework in the hospital and many healthcare centres has encountered crucial development. In order to support real-time applications and leverage artificial intelligence on the data produced by the wearable, a hybrid model of cloud and IOT architectural design is implemented.

S. Gera et al., [4] discussed to develop outstanding patient support systems that can be used even in rural locations. These systems could be intelligent enough to interpret the data gathered by wearable IoT sensors and make recommendations for a check-up. The suggested system is made up of five fundamental parts: patient data collecting, patient main report creation, patient care in hospitals, patient care in pharmacies, and diagnostics. The suggested system will also facilitate communication between the patient, doctor, pharmacist, and diagnostician, as well as enhance decision-making abilities and facilitate the conventional flow of the conventional healthcare system.

Trayush et al., [5] provided an overview of IoT frameworks used to monitor apps for older individuals in this study. The integrity and security of patient data are also covered in the report. Remote senior patient monitoring is becoming more prevalent as a result of the ageing population and the rising demand for healthcare services in clinics. Smart homes, which feature wearable sensors and medical actuators along with modern communication and information technology, have the capacity to remotely monitor the health and well-being of the elderly in an easy and affordable manner. The elderly will therefore choose to stay in their cosy homes rather than visit hospitals, where they may occasionally incur high medical costs.

U.Hariharan et al., [6] discussed the problems and solutions for WBAN healthcare application are discussed in this study. Healthcare applications' use of Wireless Sensor Networks (WSN) is expanding quickly. A new field known as Wireless BODY Sector (WBAN) has evolved to deal with the growing use of sensor engineering in this particular area. Privacy and security concerns are probably the biggest factors to be concerned about because almost all equipment and applications are wirelessly connected to it. Individuals may be prevented from taking advantage of all the benefits of the product if information on them is collected with their consent or obtained without it due to device demand, misuse, or security concerns. The devices safe for daily use may go unnoticed bypeople.

K. A. Moid et al., [7] proposed a system which includes, Temperature sensor, ADC, pulse sensor, SQL, userb application, Raspberry Pi module via IoT patient's data is uploaded on the userb page in order to access from anyplace. It requires small area and can be easily modified according to the condition by doctor.

A. Gupta et al., [8] discussed the accession procedure of the stored data ,an android application is designed for the medical expert who will examine the fall in the elderly patients and provide them with desired assistance, in addition with this here a complete algorithm is designed for the detection of genuine fall.

P. K. Maduri et al., [9] discussed the major problems related to healthcare as well as medicine are due to the lack of proper medication and proper monitoring in the specific time. They proposed that people can contact the doctor using WSN i.e. wireless sensor network in which they had covered heartbeat and temperature using different sensors.

V. Yeri et al., [10] recommended to implement a low cost system and transmit patients health related data to an application using sensor and cloud based Wi-Fi module with controller. The limitation in this system is doctor's availability and it doesn't include blood pressure monitor in it.

A. alkhayyat et al., [11] discussed to use WBAN in E-healthcare system which provides continuous monitoring report of health parameters and discussed the problem about the overlap of 2 or more WBANs cause interference, which in turn cause transmission failures. Using honeycomb grid model based on different MAC protocols, number of nodes and their degree of different area of service as a result, expected value of signal to interference capacity is controlled.

Al-Mahmud et al., [12] proposed a work to store medication time data of patients for proper medication. Aged people who need regular monitoring of their medication time and other health related information are transferred using

protocols, temperature of the patients also detected continuously using temperature sensors. But this work does not give alert during emergency conditions to anybody.

K. Guizani et al., [13] introduced a summary of elderly people monitoring applications using IoT frameworks. With this, they discussed about the patient data security and integrity these will be followed by the highlights of famous wireless principles as well as online health monitoring technology.

M. R. Ruman [14] This system describes about the capability to monitor physiological parameters from patient body at every 15 seconds and it also responsible for collecting pulse, body temperature and heart bit from the patient's body and send the data into IoT Cloud platform and health condition of patient stored in the cloud. It enables the medical specialist or authorized person to monitor patient's health, where the medical specialist or else that specified person can continuously monitor the patient's condition on the cloud server. Giving patients access to appropriate and effective medical facilities is the research's suggested outcome.

V.Tamilselvi et al., [15] discussed major problems about coma and its causes by diffusion like traumatic, head injury, stroke, brain tumor, alcohol in toxication, etc. It additionally arise even a underlying infection which include diabetes or an infection. So we reveal the coma patients frequently. Continuous fitness monitoring can store up to 60% of human lives through timely detection. The equipment is specifically made for real-time monitoring of coma patients' health indicators. It has more suitable by means of the use of GSM and IoT to recognize the status or condition of the patient. This proposed method consists of numerous smart sensors like Temperature, Heartbeat, Eye blink and SPO2 (Peripheral Capillary Oxygen Saturation) sensors for fetching the patient's body temperature, coronary heart rate, eye movement and oxygen saturation percentage of the patient. The microcontroller for this system is an Arduino Uno board, and cloud computing is used.

A. D. Acharya et al., [16] describes the design and implementation of an IoT based smart doctor kit for emergency health condition that system provide a versatile connection to Iot data it can be used in ICU. It provides continuous monitoring reports to doctor from anywhere and also delivers health status to patients without visit to hospital.

R. Jayaysingh et al., [17] focused mainly on the medical safety for patients having blood pressure problem. With the help of nodemcu and pulse sensor they delivered an idea using IoT, doctor can monitor the patient's blood pressure from anywhere. But this system needs extra advancement in future by adding extra modules in it since it has only 2 parameter measurement in it.

Manduva Siri Chandana et al., [18] proposed a patient monitoring system with node mcu, Arduino and some health-related sensors with display on it and alert is send via the userb browser, this patient monitor will be helpful in prevention of hospital death occurs by lack of proper monitoring system.

R.K.Parate et al., [19] proposed a health monitoring system to display temperature, SpO2, heart rate using node mcu ESP32 to the nearby carers. The prototype discussed here can be used in any place and the structure of the prototype is minimum so it can be easily portable and low cost.

G. Xu [20] recommended a new quality IoT-assisted signal analysis framework app for lightweight access control for secured data, a reduction of false alarms, and real-time evaluation results show that the proposed light-weight ECG Signal Strength Analysis (SSA) decreases the battery energy consumption considerably by transmitting appropriate ECG signals in IoT devices with an unacceptable ECG signal.

W. Lindquist et al., [21] discussed about the new requirements not addressed in traditional IoT systems along with examples, classifies IoT into device and user interaction requirements. It shows implementation and evalutions in health field and influence the design of more generalized iot architectures.

Rajendran T et al., [22] The author of this paper reviewed several search methods, but it should be able to produce the results that are most pertinent to the user's query and meet their needs. Information retrieval methods are also given in a variety of ways. On a ranking basis, several search engines and methods are given for quick access to and retrieval of pertinent multi-media material. This ranking methodology is based on textual material that has been extracted from massive amounts of visual data. So, by removing duplication, this study's effective ranking approach (R-TPM) based on text parsing from multi-source documents produces information retrieval.

Souri, A et al., [23] This study suggests a paradigm for IoT-based student healthcare monitoring that continually monitors students' vital signs and uses smart healthcare technologies to identify biological and behavioural changes. In this concept, crucial data are gathered using Internet of Things (IoT) devices, and data analysis is done

using machine learning techniques to identify the likely dangers of students' physiological and behavioural changes. The experimental findings show that the suggested model is effective and accurate for assessing the current condition of the students. The help vector machine has the accurate results of 99.1% after analyzing the conceptual system, which is a better outcome for our goal.

Javaid, M et al., [24] There is a need to study different applications of IoT enabled healthcare during COVID-19.IoT's focus is to help perform the treatment of different COVID-19 cases precisely. By reducing risks and improving overall performance, it facilitates the surgeon's work. By using this technology, doctors can easily detect the changes in critical parameters of the patients and improve the overall performance of healthcare during COVID-19 pandemic days.

Raj,J.S [25] states that IoT supports multi-disciplinary applications as an active entity in engineering, science.Theproposed research work is aimed to develop a novel information processing system in IoT platform via reliable health care monitoring conventional models are used to compare the performances.

Jeong, S et al., [26] This study used a monitoring system with measurement sensors to examine each person's biometric data. Blockchain technology has been deployed to increase the security and reliability of the system information implemented, and it has also improved the reliability of managing personal information. Research Methodology/Objective. This research made use of the blockchain-based Internet of Things for intelligent healthcare utilising blockchain technology. In order to assess individual ECG data, data was also gathered utilising a variety of measurement instruments. By examining the fused threshold, the measured biosignals were monitored for individualised diagnosis.

Kishore A et al., [27] predicts that the disease help doctors to make early decisions to save the life of patients. IoT acts as a catalyst here to capture the patient's data by IoT_sensor and analysis is performed by Machine learning.The main theme is to propose a Machine learning-based healthcare model to accurately predict the different diseases by using seven algorithms such as decision tree, support vector machine, Naive Bayes, adaptive boosting, Random Forest (RF) and artificial neural network. The created healthcare model will assist doctors in making an early disease diagnosis.

Dhruba, A.R et al., [28] states that the quality of sleep is very important in every person's lifestyle, removing various diseases.Real-time monitoring of sleep is thekey to detecting sleep apnea. The development of a real-time sleep apnea monitoring system based on the Internet of Things (IoT) has been made in order to address this issue. It will allow the user to measure different indexes of sleep and will notify them through a mobileapplication when anything odd occurs and the reason for sleep apnea can be also displayed.

Manoj, A.S. et al., [29]. analyses wireless and wearable sensor-based IoT monitoring systems, classifies healthcare monitoring sensors, and goes into detail about the advantages and importance of each.

Philip, N.Y. et al., [30] studies of in-home health monitoring systems presented many benefits including improved safety, quality of life and reduction in hospitalization and cost and also many more improvements in optimized network architecture,indoor networks coverage, increased device reliability and performance,ultralowdevice cost, low device power consumption, and improved device and network security and privacy.

Chaudhary RRK et al., [31] cloud-based solution is adopted to collect and preserve collected personal health information. Secure data transmission is a big challenge. The brief security analysisand the tool shows that the proposed scheme can withstand all network attacks.

The automatic tracking model, communication controller protocols, and Trust Model for Wireless Sensor Network are discussed in [32] – [34].

From the above literature review, it can be understood that the published information on health monitoring systems by different authors over world. These previously proposed system act as the base for the new proposal to overcome the following problems. For bedridden elders, there is a need for a caretaker or nurse to take care of them, but it is highly difficult to continuously monitor them to check their health status and to stay nearby with them. The family members and the doctor will not know their elders' condition until someone informs them. Patients in emergencies need to wait for ambulance service and first aid. If the internet is not available, there is no alert for the local carer from the distance health monitoring devices, which is a significant disadvantage. Many of the deaths of the elderly are the result of information lags.

III. PROPOSED SYSTEM

Using the developed system depicted in Fig.1, people can monitor their elder's health status from anywhere and receive alerts during abnormal health conditions, not only from a distance but also on-site. This system uses sensors, which help us collect and transmit data from the patients to the desired node MCU. This system includes 5 sensors, namely a temperature sensor, a piezoelectric sensor, a sound sensor, a pulse oximeter sensor, 2 infrared sensors, a buzzer, 2-Node MCU, and an application.

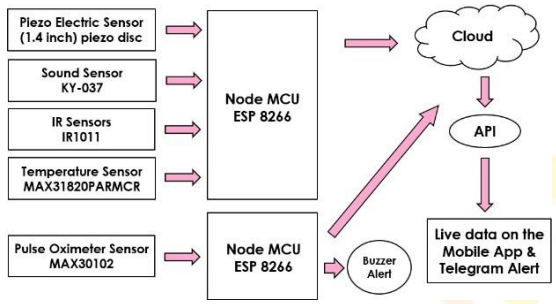

Fig.1 Block Diagram of Proposed System

The pulse oximeter is connected to a separate node mcu to continuously detect and display the pulse rate and oxygen level for each second, which is an important parameter of health. If the pulse rate or oxygen level seems abnormal, it triggers the alert cycle, which in turn rings the buzzer to alert the nearby caretaker as well as send the alert via telegram.

Other sensors transmit corresponding health parameters to the other node microcontroller. These sensors have predefined threshold values to check the normal status; if any abnormal condition is detected, the API in the cloud will inform the caretakers about that health issue via the alert system, as said above.

The temperature sensor in this system senses the body temperature of the elder and transmits that data to the microcontroller; the piezoelectric sensor transmits the body vibration status of the elder to detect their fall-down movement; and the sound sensor is to detect the unpleasant noises that arise around the patient's surroundings.

The IR sensors in this system are used to detect the saline water level in the elder's trip bottle and transmit the data to the microcontroller. Two sensors are there to detect the level of the saline water, whether the bottle is full, has to be filled, or is empty. The IR sensor range is also collected and compared with the critical level; if the saline water level crosses the critical level, the system triggers and an alert is sent to caretakers about the saline water status.

The node mcu and ESP8266 microcontroller collect all sensor data and send it to the cloud (the IoT function begins). In the cloud, the transmitted data from the microcontroller is received and used to display the health parameters such as temperature, pulse rate, oxygen level, and other parameters in the app. Health-related data is also continuously stored in the cloud. The data is then processed in the manner depicted in Fig. 2.

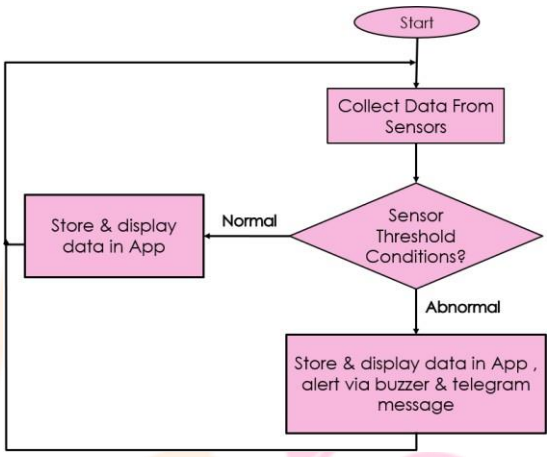

Fig.2 Alert System Working Flow-Chart

The data from all sensors are undergoing this flow; if the vibration is high and the pulse rate is low, then it detects that the elder may be fall, so it informs the caretakers and alerts them about this situation. These alerts are delivered via buzzer to a nearby caregiver, and all health status is displayed in the application for other caregivers, as userll as alerts are delivered via telegram notification, so that everyone is aware of their elder's health status without the assistance of others.

Hence, this system helps the caretakers always monitor the elder's health status, and they can take action immediately according to the data they receive. Also, quick treatment is provided by the respective doctor, because he or she can access and check the patient's (an elder's) health condition via the stored data in the cloud or app (Pro-HC).

Even if the internet is not available, the system will continuously monitor the patient's health details and ring the buzzer to alert the nearby caretaker during an emergency.

IV. RESULT & DISCUSSION

Hardware setup for the health monitoring system is shown in Fig. 3, in which sensors and a node mcu (ESP8266) are integrated. This system transmits the health-related data to the cloud using

APIs(Application Protocol Interface) when connecting to the internet via the built-in WiFi module in the node mcu.

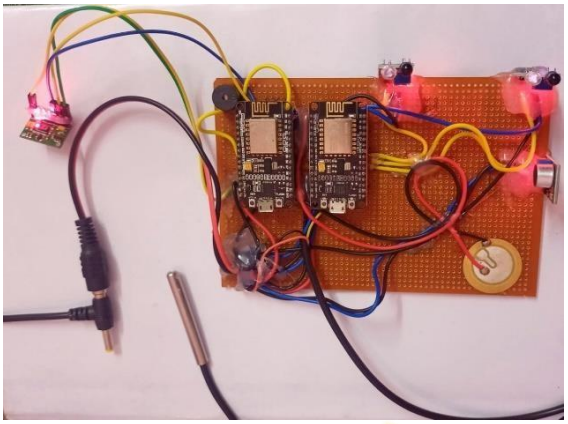

Fig. 3 Final Project Setup

Output for the system is vieuserd via an application in which the user is required to create a credential for the elder by signing up using the patient's name, the doctor's name, and a password. Caretakers can access or monitor the health parameters of their patients from anywhere and on any device by logging in to the app (Pro-HC) which is shown in the Fig.4.

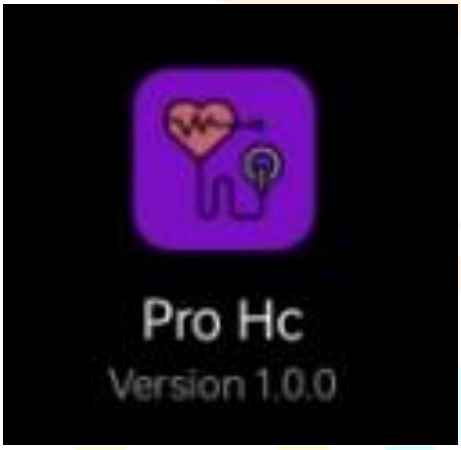

Fig.4 Pro-HC App Icon

Technical person would created an account on the Firebase platform to upload the local project codes of the node mcu to run and store the health parameter data continuously, as shown in Fig. 5. It shows the continuous health parameters storing details in the cloud database using the Firebase platform, in which technical person can upload and deploy the program user used in the local coding platform, and user can access and monitor the data from any location by connecting the wifi to the hardware module. All the sensor outputs, such as pulse rate, heart rate, temperature, noise around the patient, vibration, saline water level, and oxygen level in the body, are continuously displayed and stored in the cloud platform.

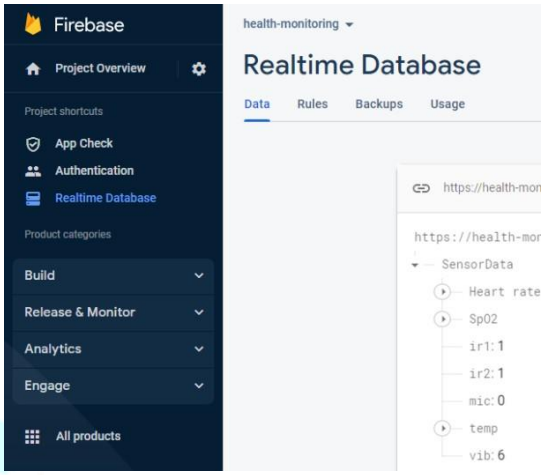

Fig.5 Firebase Platform

The application's user interface is shown in Fig. 6, in which its home page asks for the user's name,doctor's name, and mobile number as login credentials. If user login with valid credentials, which user can detect from anywhere, user can track the user's health parameters.

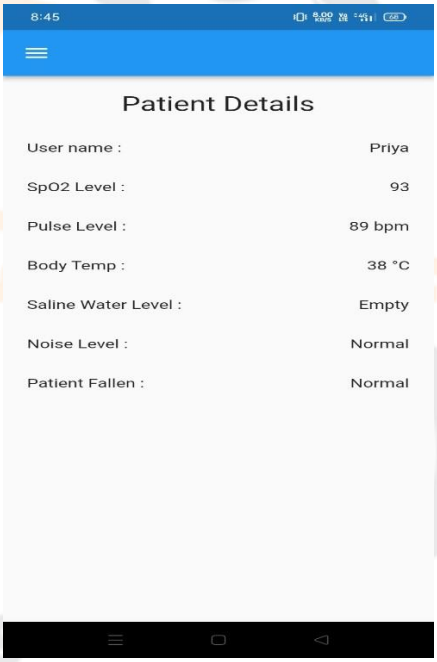

Fig. 6 Application's User Interface

An application is created with the help of the Firebase cloud service to display the continuous health parameters using Flutter programming.

Alerts for the emergency or abnormal health status

of elders are sent via telegram notification to the caretakers, as shown in Fig. 7, which is also done with the help of firebase data details and the alert system flow cycle.

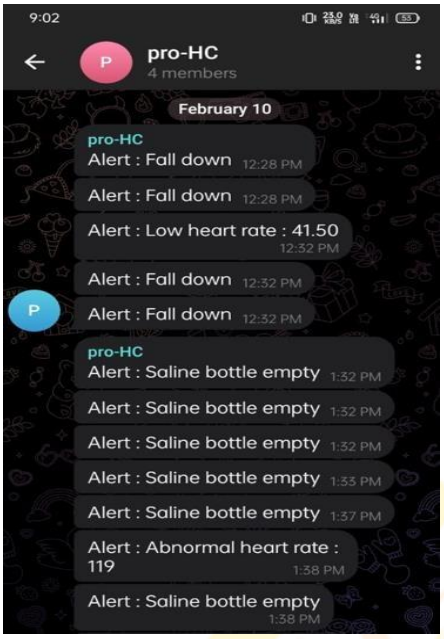

Fig. 7 System Alert In Telegram

V. CONCLUSION

Pro-HC system is primarily focused on the elder's health monitor, based on IoT technology linked to the cloud platform with the mobile application, and facilitates the traditional workflow by providing all systems in one place at an affordable price (around Rs.3000). Direct and distance alerts for carers are provided by this system. The alert will be sent to all essential persons, such as the nearby carer, family members, doctor, and nearby clinic (to provide immediate ambulance service). Pro-HC system will be implemented in real-time applications such as health monitoring bands or small health monitoring kits like portable devices. It will be further developed with a monitor on the hardware side to promote its work as both a direct and a distance monitor. In addition to this, Pro-HC system may include extra health-related parameters measured by sensors such as blood glucose level, etc.

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