



An Intelligent Health Observation System Using Smart Phone and Wearable Sensor

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Abstract- *The leading causes of hospitalization for patients and elderly are Stroke, heart attack and falls. The opportunity of surviving a fall, heart attack or stroke is much greater if the patients gets help within an hour. In this case, we observe a patient who has suffered from heart attack is considered at risk for having another attack. Recently, in many cases, the reason for a patient staying in the hospital is not that he or she actually needs active medical care. Often, the principal reason for an overlong stay in the hospital is simply continual observation. In recent years, emergency admissions and long span of stay have become extremely costly. Therefore, efforts have been made to avoid acute admissions and long span of stay in the hospital. So the intended of healthcare system has shifted away from the provision of reactive, sharp care toward preventive care outside the hospital. Besides the models of care are redesigned and health economies are seeking to provide more care outside the large keen centre. The two main task of the system is continuous observation of patient's vital signs and provide the immediate help when emergency arises. The system is designed to help the patients who need continuous observation and elderly people who wish to monitor their health status.*

Index terms- *falls, Stroke, observation, vital signs,health status.*

I. INTRODUCTION

Now a day's population growth is increasing exponentially and health disease also increase in parallel. Now Aged patients and high risk patients need more healthcare efforts as they present more cases of chronic illnesses involving higher healthcare cost. In intensive care units, there are necessities for continuously monitoring patients. Their vitalsigns like heart rates, temperatures, ECG etc. are continuously monitored. Even though, patients get well soon and back to home from hospital as much as possible yet the disease may return, patients may get infected by a new Disease; there may be a sudden attack that may cause his death. Due to this, patients are released from hospital but still they are strongly advised to be under rest and observation for some period of time from several days to several months. The continuous monitoring is important for high risk patient because, the risk will increase, if they are not being monitored or personally cared, the small incident in home form illness that cause immobility, and many of the problem will be undetected, if no contact is made with them. So there is need of system that can conveniently monitor the physiological parameter of patients and check the health condition of user. There is a need of system to help the user in critical situation. Health Observation system designed in such a way to fulfill the needs of Patient & elderly people provides them with proper HealthCare facilities wherever, they move around. Health Observation system allows patients to engage in their daily activities while they are monitored continuously anytime, anywhere.

Nowadays mobile is becoming an important Communication tool not only in urban regions but also in remote and rural areas. Thus the rapid advancement in the technologies, the more flexibility of use and the falling costs of devices, make the mobile an appropriate and apt tool to bridge the digital divide. It is the best choice that the system will be deployed on mobile phones. Monitoring the 'vital signs' of the patient is an important event of Health Observation system. Sensor and communication technology play a major role in health monitoring system. With the support of mobile phone and wrist sensor the developed system provide Ubiquitous Health observation for patients to help the user in Emergency situation and to avoid unnecessary hospitalization. The emergence of wireless technologies and advancements in on-body sensor design can enable change in the conventional health-care system, replaced by wearable health-care systems, which centered on the individual. The Wearable monitoring systems not only provide continuous physiological data, but also provide better information regarding the general health of individuals. The patient and their family members will feel comfort by knowing that they are being monitored and will be supported if any problem occurs. Furthermore, it offers the potential to alter the current health-care system by enabling out-patient care and preventing unnecessary hospitalizations. Thus the intelligent health observation system help to improve the issues associated with costly welfare systems and also increasing an elderly population.

A. Vital Signs

Vital signs are primarily used to measure basic functions of body. Regarding that these measurements are used to help assessing the general physical health of person, and show progress toward recovery from the disease. The normal

ranges for a person's vital signs vary depend on their age, weight, gender, and overall health. The main vital signs are classified as follows: body temperature, blood pressure, heart rate, and breathing rate.

Body Temperature: The average body temperature is 98.6 deg F.H, but normal temperature for a healthy person can range between 97.8 to 99.1 deg F.Hor slightly higher. Any temperature that is higher than a person's average body temperature is considered a fever. A fever is one of the results of the body trying to fight an infection. A drop in body temperature below 95 deg F.His defined as hypothermia.

Blood pressure (BP): BP is the measurement of the pressure or force of blood against the walls of your arteries. BPcan be written as two numbers, such as 120/80 (mm Hg). Blood pressure that remains high for an extended period of time can result in such health problems as atherosclerosis, heart failure, and stroke. A sudden drop in blood pressure, however, can be life-frightening

High blood pressure (or hypertension) is when the systolic number is equal to or higher than 140 and the diastolic number is equal to or higher than 90. High blood pressure increases the risk of coronary heart disease and stroke. The High Blood Pressure may cause following problem.

- Chest pain&Difficulty breathing
- Irregular heartbeat&Severe headache
- Fatigue or confusion
- Vision problems

Pulse: Pulse is the number of times heart beats per minute. The Pulse rates be different from person to person. A normal pulse rate for a healthy adult at rest ranges from 60 to 80 beats per minute. A faster than average pulse can indicate such health problems as infection, sunstroke, stress, apprehension, a thyroid disorder, astonishment, anemia, or certain heart conditions. A lower and average pulse rates may also be a sign of a heart condition

Respiratory rate: A person's respiratory rate is the numbers of breaths take per minute by person. The normal respiration rate for an adult at rest is 12 to 20 breaths per minute. A respiration rate under 12 or over 25 breaths per minute while resting is considered as abnormal person. Among the conditions that can change a normal respiratory rate are asthma, apprehension, pneumonia, congestive heart failure, lung disease, use of narcotics, or medicine overdose.

B. The Role of Sensors in medical applications

Sensors are used in electronics-based medical equipment to convert various forms of stimuli into electrical signals for analysis. Sensors can increase the brainpower of medical equipment, such as life-supporting implant, and can enable beside and remote monitoring of vital signs and other health factors. An aging and increasing population is accelerating the development of new and different types of health check kit, including various sensors used inside both equipment and patients' bodies. Healthcare organizations want concurrent, reliable, and accurate pinpointing results provided by devices that can be monitored distantly, whether the patient is in a hospital, clinic, or at home.

Sensors can increase the intellect of life-supporting implant as well as enable new types of monitoring towards support more independent patient lifestyle. Patients need to be monitored pre-hospital, in-hospital, at home, in long-term care, and in other locations. It is this stable need for patient monitoring that drive sensor procedure because sensor plans can be programmed to process vital-sign data and alert medical workforce when a particular vital sign, such as heart rate, cascade outside of normal parameter.

II. LITERATURE SURVEY

A. Classification

There are several wireless and wired health monitoring projects and researches [1] [2] [3] [4] [5] that have been designed to provide continuous patient monitoring in hospital, real time collection of medical data in-house as well as hospital health-care monitoring.

Controlled area– This type of a system allow for patient monitoring only inside the boundaries of specific area usually inside the hospital. This system mainly requires BAN and PAN network in addition to the communication architecture.

Wide area– In this system where patient can virtually have any arbitrary location (inside the coverage of WAN).Wide area system compulsory require WAN network.

B. Communication technologies

Based on the ubiquity Level of health monitoring system or remote monitoring system the three different communication technologies are used.

- 1) WAN (Wide Area Network)
- 2) BAN (Body Area Network)
- 3) PAN (Personal Area Network)

BAN

- It composed of tiny smart sensor deployed in, on, around a human body.
- The sensor deployed inside the human body is called In-Vivo or Implantable Body Area Network (IBAN).
- The Sensors are distributed on the human body for measuring the vital sign is called Wearable Body Area Network (WBAN).

- The sensors are, in-charge of measuring the physiological parameters and it communicate directly with the smart device and make the “BAN”

WANs are used to connect LANs and other types of networks together, so that users in one location can communicate with users and computers in other locations.

- Here the WAN can be used to connect different LAN. The user in one Local area network can communicate with medical center in another Local area network by using WAN.
- The widely used WAN are Cellular network (GPRS, GSM, UMTS), Internet.
- A telemedicine application which aims to monitor patient health status requires continuous internet connection when patients are at home.

PAN

- A Personal Area Network (PAN) is used for data transmission among devices such as computers, Mobile phones and personal digital assistants.
- The widely used PAN is Bluetooth, ZigBee, IEEE 802.15.4, and Wi-Fi.
- The data from the Body area network are transferred to WAN by using the personal area network.

C. Health monitoring system developed for self-monitoring

HealthGear [4] is a wearable real time health monitoring system. It can monitor, visualize and analyse the physiological data. HealthGear consist of set of physiological sensor, wirelessly connected via Bluetooth to a mobile phone. The mobile phone store, transmit and analyze the data. The sensor is non-invasive and wearable. The blood oxygen level and pulse can be monitored by the blood oximetry while sleeping. Health Gear system is mainly intended to monitor the user in their sleep in order to detect sleep apnea event. The three different parts used in HealthGear system is oximetry sensor, wireless data transmission, and mobile phone. The HealthGear system uses Nonin flex oximeter. It is off-the-shelf constant monitor sensor which is small, light-weight and flexible. The serial data stream produced by sensor is send to the mobile phone by using a wireless transmitter. The central processing unit of HealthGear is Mobile phone. HealthGear service is registered in the service discovery protocol. The HealthGear system uses two methods for automatic detection of sleep apnea event. Multithreshold time analysis method operates in time domain and spectral analysis method operates in frequency domain.

D. Health-Care System Developed for Controlled Area

J. Ko, J.H Lim , Y. Chen proposed the Medical Emergency Detection in Sensor Networks (MEDiSN) [9] project utilizes a wireless sensor network composed of a network gateway, physiological monitors (PMs), and relay points (RPs), to monitor the health and transmit physiological data of patients. The PMs are sensor devices which collect, encrypt and sign patients’ physiological data before transmitting them to a network of relay points that eventually forwards the data to the network gateway. The RPs self-organizes into a routing tree that facilitates the reliable delivery of periodic data and alerts from the PM to the network gateway, and also from the network gateway to individual PMs. The data received by the network gateway is stored persistently at a backend server, where clients can use a graphical user interface (GUI) to access the data through different queries. Unlike CodeBlue in which the PMs generate and forward data, only the RPs in MEDiSN are responsible for relaying data .As a result, the RPs can use hop-by-hop retransmissions to assure the reliable delivery of bidirectional data traffic that is prone to packet collision and corruption.

III. SYSTEM DESIGN

A. Overview of Health Observation System

The aim of Health Observation System is to develop an intelligent and versatile home safety environment that could help the elderly and individual with disability live independently in their own home. we have proposed a new smart phone based system for health care, monitoring and analysis process, which is specially designed to efficiently increase the public health care system in far-away, countryside, unreached areas of the immature and embryonic countries. The wearable Sensor Provide more comfort for patients, with the absence of wires reducing costs and providing more flexibility. In addition, it offers the prospective to alter the current health-care system by enabling out-patient care and preventing unnecessary hospitalization. Health Observation Systems can help people by providing healthcare services such as medical monitoring, medical data access, and communication with the healthcare provider in emergency situations through the SMS or GPRS. The patient and their family members will feel comfort by knowing that they are being monitored and will be supported if any problem occurs. The figure 1 shows the overall process flow diagram for Health Observation System. Each health monitoring system uses sensor for data collection that can be Wired or Wireless. The on-board body area sensors is mainly used for collecting the physiological parameter [1] [2] [3] [4] [5] such as Blood Pressure (BP), Electrocardiogram (ECG), Blood oxygen saturation (SpO₂), Heart Rate (HR), Temperature (T). Mobile phone is mainly used for gathering and processing data from sensors[4][5][11]. Health care centre periodically monitor the data for registered users and can analyse and process the data. The data analysed by the health care centre can stored the data in appropriate storage server. The history of patient record should be maintained by the server. Initially the sensors collect the physiological data from patient. The data from sensors is supplementary processed in any external processing unit. If the data analysed in processing unit is above than the threshold value then the emergency alert is

immediately given to the health monitoring centre. The monitoring centre can take extra action based on the result. If the data analyzed in processing unit is in the normal range it can be analyzed by HealthObservation centre and the data's are stored in data storage server.

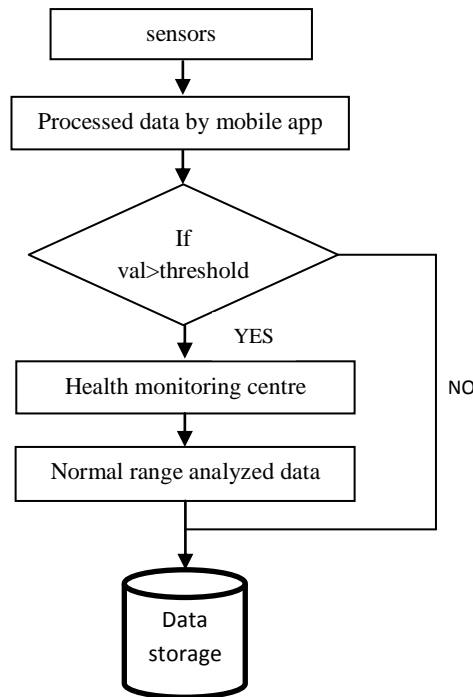


Fig. 1 Overall process flow diagram for Health Observation System

The Health Observation System Mainly Based on Four Parts. Figure 5 Shows the Architecture of Health Observation System.

- Wrist device
- Mobile application
- Health Observation Centre
- Cloud storage server.

Wrist device

The wrist device is a wearable device that can wear on body. The wrist device is an integration of multiple medical sensors. The new wrist device is redesigned for including the more sensors. Bluetooth low energy (BLE) technology is used for connecting with an Android phone to form a personal area network. It was developed by using TI CC2540 which is a system-on-a-chip with BLE support. The work of sensor unit is continuously collecting the data from the patients. The analog value of data can be converted into digital value by sensor unit. The Collected data from the sensor are transferred to Mobile phone for further processing.

Mobile application

The physiological data are measured by wrist device that can be sends to the mobile phone through Bluetooth Low energy technology. The mobile application is developed for analysing and processing data and makes a ensuing decision. The application will consequently access the results of the sensors and check if a threshold level has been reached. Based on the results from the application can establish whether the emergency alert should be raised. The mobile application can receive the data from sensor at different times. e.g. The skin temperature every 2s, heartbeat and SPO2 every 3s, and ambient temperature every 10s. The data can be sent to health care monitoring centre for further analysis.

Health Observation Centre

The Health Observation Centre can monitor the patients' health record and provide help in emergency situation. The data from Mobile application are gathered and processed by health-care Admin. The processed data can be stored in data storage server. It can maintain the patients' health record. Basically, there are two main tasks performed by the Health Observation system which are (a) update the status of user, (b) and to call for help if it is required.

Cloud storage

The Health Observation system maintains the cloud server for data storage. The health record for each user is stored in the cloud server. The cloud server is intended for maintaining chronological patient record. The data from the cloud server can accessed by anyone, wherever at any time, cloud can hold large amount of storage which can be scaled in accordance with application needs. Modern technology is being shifted to Cloud based stand as it is suited for long-term data storage.

Emergency alert system

The emergency alert system is used to help the patients in emergency situation. If the value of physiological signs exceed the threshold, the emergency system automatically send a emergency message to his pre-specified

guardian, clinician and ambulance via SMS (Short Message System). Consequently, the victim can be monitored and cared by Health observation centre in real time. This will increase the chances the elderly (or chronically ill) to be rescued after an accident happened. Figure-6 shows the emergency help line system.

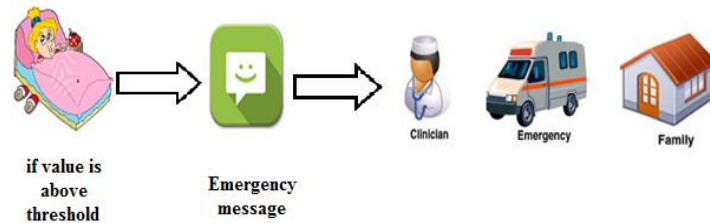


Fig .N Emergency help-line system

IV. CONCLUSION

Health Observation systems are gaining their importance as the fast-growing Health diseases and global elderly population increases demands for caretaking. The real time physiological data's are collected from the patient using a smart wearable sensor. The intelligent mobile application developed for smart phone help to transmit the data. These systems use wireless technologies to transmit vital signs for medical evaluation. Mobile phones and smart sensor make the system comfortable for patients. Health observation system fulfils the need of home based health monitoring system. Health Observation system allows patients to engage in their daily activities while they are monitored continuously anytime and anywhere.

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