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A Technical Review on Health Monitoring System at Household Using IOT

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ABSTRACT: Vital Signs like breathing, heart rate, temperature etc are required for monitoring the health of a person. Here we use household devices like mouse, mirror, chair etc to measure and monitor these signs. These devices are connected to each other using IOT and the output is sent to a Web Portal and a mobile application that runs on Windows Operating System.

KEYWORDS: Internet of Things (IOT), Sensors, Vital Signs, Windows Phone Application, Desktop Application

I. INTRODUCTION

Non-communicable diseases are the diseases in which the cause of the disease is not due to infections. They are non-transmissible i.e.; the pathogens (disease causing agents) cannot be transferred from one person to another [1]. According to WHO, the four main reasons for deaths due to non communicable diseases are cardio vascular diseases, cancer, diabetes and respiratory diseases and these types of deaths are majorly increasing in countries with population having low income [2].

In developing countries, the maximum numbers of deaths are due to non-communicable diseases. In India, cardiovascular diseases are the major causes of death. The next biggest cause of deaths is chronic respiratory diseases. The leading risk factors for these diseases are high blood pressure, air pollution, particulate matter and unsafe drinking water. Smoking is also one of the biggest risk factors in India even more than cholesterol, iron-deficiency anaemia etc [3].

According to WHO, the countries with high income have systems that collect and record information regarding the cause of deaths but, the countries with low income does not have any such system and they have to analyse the cause and estimate the number of deaths due to any particular cause with incomplete information. Therefore, high quality systems to collect such valuable information are very important in maintaining and monitoring health in these countries [4]. Most of the deaths due to NCD's such as cardio vascular diseases can actually be prevented. With proper and periodic monitoring of the patients these diseases can be detected earlier and such deaths can be prevented [5].

According to "A Design and Analysis for Ubiquitous Healthcare monitoring system over Wireless Sensor Network", we can get the health data of the user by monitoring the patient by integrating an health monitoring system in his daily life. According to the author, this can be done by installing various RFID's in various places [6].According to "Ubiquitous Health Monitoring System Design", these health monitoring systems must monitor the patient irrespective of the location and it must be done at any point in time. Such a system is required for monitoring purpose. The location must never act as a constraint in monitoring the health and the patient must be monitored in such a way that he should not know that a system is monitoring him all the time. For this, Ubiquitous computing can be used [7]. Ubiquitous computing is a concept in which the computing is done anywhere and at any time. Here the user interacts with a computer. This computer can be in any form including a laptop or a washing machine etc [8]. In health monitoring systems, these devices are used to measure the vital signs of a human body.

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Vital signs are used to measure the primary body functions. They are used to evaluate the health of a person. The normal ranges of these measurements vary with various factors such as gender, age, weight etc. Primarily there are four major vital signs: Body –Temperature, Blood- Pressure, pulse and breathing rate.

- Body Temperature: The normal body temperature of a person ranges from 97.8 degree Fahrenheit to 99.1 degree Fahrenheit or slightly higher. Any temperature that is way more than this temperature is considered to b a fever.
- Blood Pressure: The measurement of the force of blood against the walls of the arteries. A normal blood pressure of a healthy adult is less than 120/80 mm Hg.
- Pulse: It is the number of times the heart beats per minute. Normally, the pulse of a healthy person at rest is 60 to 80 beats per minute.
- Respiratory or breathing rate: It is the measurement of number of times a person breathes per minute. The normal respiratory rate is between 12 to 20 breaths per minute [9].

II. LITERATURE SURVEY

Ubiquitous Health Monitoring System (UBI Health) is built for the needs of continuously monitoring human health condition. By monitoring human health conditions, irregular vital signs will be detected early. Potential increase in temperature, heart rate variability, diabetes symptoms and arthritis symptoms could also be detected early, then notification could be raised. UBI Health design consist of Smart Mouse, Smart Mirror, Smart Chair, Windows Phone App, Desktop App, Online Monitoring and Expert System. Smart Mouse will detect heart rate and body temperature. Smart Mirror is designed to detect heart rate, respiration rate and body temperature. Smart Chair detects heart rate, measure body temperature and body weight. Heart Rate measurement is also applied by utilizing the camera on WP. Visual Acuity Test, Hearing Test and Colour Blind Test also built in Windows Phone platform. The other designed application in Windows Phone is Drug Application and Health Education App. Desktop App also built to detect heart rate and respiration rate. Online Monitoring System is built to monitor vital sign periodically. In Smart Mouse implementation, user excessive hand movements will disturb the measurement of heart rate and body temperature. Low light levels will affect the validity of the measurements on the Smart Mirror. Heart rate measurement application on Windows Phone still needs improvement in terms of user experience. On Online Monitoring section, the system already can read progression of vital signs from patients in a real time manner.[13]

III. REQUIREMENTS FOR HEALTH MONITORING SYSTEM

According to “Ubiquitous Health Monitoring System Design”, the health monitoring systems must consist of the following:

- The system has to provide the information by monitoring the vital signs.
- Here, ubiquitous computing is used.
- The system must be in accordance with legality of law.
- The system primarily focuses on adults and senior citizens.

IV. DEVICES

We can monitor the patients using the following devices:

A. Smart Mouse:

It consists of the following modules:

- Input module: It consists of an infrared sensor MXL90620 and a photodiode.
- Processor module: It consists of an arduino and a PC/Laptop for display.
- Output Module: The data obtained in the processor module is sent to a database.

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Here the hardware consists of the infrared sensors, photodiode ad limit switches. The arduino acts as the processor. The information was communicated to the PC using a serial port. The display interface was created using Windows Presentation Foundation. From the tests that were performed on the smart mouse, the error was estimated to be below 5%.

B. Smart Mirror:

It consists of the following:

- Input module: It consists of a camera and infrared sensors (MLX90614 and MLX90620).The camera is used to identify the user and detect the image for the face and the chest. The sensors are used to measure the temperature of the body.
- Processor module: It consists of a processor and an arduino. Here the temperature is measured using an arduino and the image is processed. The processor consists of motherboard, hard disk, memory, processor and power supply for the entire system.
- Output module: It consists of a display.

Here the hardware consists of a webcam which has a capability to record a video of 720HD. The hardware components that were mentioned in the input module are used to recognize the user, measure the user's respiratory or breathing rate and also to measure the heart rate.

According to "Ubiquitous Health Monitoring System Design", during the tests the error rate was more during poor lighting conditions. The results also varied with the type of clothing and the distance of the user from the device etc.

C. Smart Chair:

It consists of the following:

- Input Module: It consists of an electronic stethoscope, temperature sensor (MLX90620) and a sensor to measure the weight.
- Processor Module: It consists of an arduino. The data from the arduino is sent to the server.
- Output Module: It consists of a monitor and a database.

The output of the electronic stethoscope was first passed through a low pass filter and a high pass filter. The output of these filters is then passed through an offset and then through the arduino. The test results from the arduino were then displayed on the screen.

D. Windows Phone App:

It can be used for the following:

- It can be used to provide information to the user based on the measurement of the vital signs.
- It can be used to remind the user about the use of medicines. It can also be used to find out how the user feels after taking a medicine.
- It can provide some health tips, medical advice to the user and cam also be used as an educational tool.

We can also create various applications to measure heart rate, test colour-blindness, hearing test, drug use etc. In order to test if a user has colour blindness an application that asks the user to fill in responses based on the pictures shown to them is created. Based on the responses given by the user, the user is evaluated. Similarly for a hearing test, a tone is played. The volume can be increased or decreased. Based on the responses given by the user, the user is evaluated. When the medicines are almost about to get over, the user can alert the pharmacy about the medicines using an application. We can also make applications that provide medical advice based on the measurements of vital signs of the user.

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E. Desktop Application:

Here the user is monitored using a laptop or a PC.

- Here the respiratory rate and the heart rate of the user are measured using a web cam.
- These applications run on the desktops as default applications.
- Once the user switches on the computer, he is first recognized.
- On successful recognition, his heart rate and respiratory rate is measured.
- These measurements are sent to the server.

As any other application that involves a webcam, these measurements will have an error rate that will vary with light conditions, clothing and distance of the user from the device [7].

Fs. Expert System:

Here the information is collected from various devices and the diseases are detected in an early stage. Due to early detection, the risks of deaths due to such diseases can be minimized by providing the users with proper medical advice. It consists of the following:

- Emotions Reading Application: It is used to read the emotional changes such as analysing the behaviour of employees in a company etc [10].
- Heart Rate Variability (HRV) : It is a fluctuation of the rhythm of the beat to beat. It is used to determine the risk of cardio vascular diseases [11].
- Blood Pressure Prediction: It is used to measure the pulse and respiratory rate of the user [12].
- Diabetes and Arthritis Prediction: It is used to find the risk of diabetes with the help of the slope of a PPG signal. The users with diabetes have a presence or absence of dicrotic notch.

V. CONCLUSION

IOT is an evolving area of computer science. Using it we integrate intelligence in our environment which in turn makes it more interactive. Intelligence here means that the systems can sense the environment, recognize the actions of the user and respond to the user. The systems act according to the activities performed by the user. In this paper, we focus on how this technology can be used in household to monitor the health of a user.

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