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Wearable Textile for Persistent Illness Monitoring

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Abstract:
Persistent illness includes Asthma, fits, Cardiac problems and many other diseases which they have right from their birth till death. Those patients required continuous monitoring. So we implement a smart architecture for persistent illness monitoring, that the caregivers (parents and doctors) to remotely monitor the health of the patients based on the sensors embedded in the smart wearable textile connected with a smart phone. In this paper, we propose ECG sensor (AD8232) and temperature sensor (Thermistors). The main advantage is to reduce their dependence on hospital or constant supervision by the caregivers. The device gives them the chance to enjoy their day to day normal life as like common people do.

Keyword: persistent illness, ECG sensor, Thermistors, wearable textile, smart algorithm

I. INTRODUCTION

Persistent diseases are the chronic and long-term diseases. These diseases can't be curable. As per the reports of WHO (World Health Organizations) shows that, over 20% of Indians suffers at least one persistent disease and it kills about 38 million people globally every year. By definition the Persistent diseases are long-term and nonreversible.

The common persistent diseases are Asthma, Cardiac failure, diabetes, epilepsy, etc. These persistent disease patients need continuous monitoring. The Self management is important and many countries are organizing different programs for their awareness. Self-management in patient is necessary to ensure efficient treatment. However it supposes a Challenge for patient, families and physicians. The main aim of the self-management is to increase the life quality of the patient by improving the self-care and facilitating the interaction doctor-patient. Proper monitoring of heart rate and temperature can reduce possibility of dependence on hospitals. It also helps the caregivers to take them into hospital without time delay. Thus, the patients can improve their quality of life.

The electrocardiogram (ECG) can analyze the functions of the heart. It includes lots of pathological information about patient's heart activities. Important analysis in the ECG is the classification of heartbeats such as PR interval (P wave, PR segment) and QT interval (QRS complex, ST segment, T wave). The use of Information and Communication Technologies (ICT) along with artificial intelligence techniques and smart devices, can be an essential part of the self-management plans.

They have been successfully used to improve human health. In accordance with this we present a smart system for persistent illness monitoring. Using the data gathered by the sensors and data from wearable textile, the patient can be remotely monitored by the caregivers (parents and teachers). As a result our system can grab data from the different sensors in real-time and detect automatically the alarm situations in order to send a warning message to the caregivers.

2. LITERATURE SURVEY:

In order to bring solution for this problem, the designed architecture consists of two major positions and they are as follows (1). The mobile application as a local server that are installed in the smart phone of the caregivers(2). The patient's smart device that collect the data embedded sensors such as ECG sensor (AD8232) and temperature sensor (Thermistors). Wearable Textile as well as other devices such as wearable band, chest band can also be considered which are usually gets communicated via. Bluetooth. The communication between mobile application and the smart device can be performed using Wi-Fi or 3G/4G technology. The mobile application also called as Processing Unit, (1) installed in the caregivers' smart phone is composed by three components: (i) decision support components, (ii) graphical user interface and (iii) semantic data store. The patient's wearable device (2) should be attached in a way that assures the patient comfort and a wireless connection with the smart phone of the patient. The smart phone sends information to a processing unit. The processing unit is the caregivers' mobile application that may be located at workplace (when the patient are at work) or at home (when the patient is outside the workplace). The application will automatically switch between them as a function of a preconfigured time table. When an emergency situation is detected, i.e., the system has detected some value out of the specified threshold, the processing unit is sent to the caregivers. The connection between (2) and (3) is also performed using 3G/4G technology. Finally, data taken from the wearable textile and smart phone device is stored in a database. Each medical register is tagged as NORMAL if it corresponds to a measurement where data are OK. It is tagged as POSITIVE if data come from an emergency situation. Once after identifying the data is true the acknowledgement is send to the physicians by the caregivers As it has been aforementioned, heart disease can cause the death in

patient [5]. The vital signs that will be monitored are the following ones: heart rate, breathing rate, oxygen saturation and activity index. This vital signs correspond from one side to the effects of heart rate pattern during heart attack alteration of breathing. The detection of changes in heart rate can be very useful to define preceding symptoms of many illness and emotional states including fear [4]. By the other side, the main medicines for heart attack treatment can cause side effects as increase the heart rate and the patient activity. Other sensor like temperature sensor and are included to detect other abnormal situations of the patient. No one of the revised systems is specially designed and developed for persistent illness monitoring. There are many proposals for senior citizens (such as [6], [7] and [8]), and for disabled people such as [9]. However no specific architecture or protocol found in the related literature is focused on the use of eHealth for patient with persistent illness. The few examples that can be found about disease with pediatric purposes are web-based services. Moreover, the telephone call systems for pediatric heart rate control [10], [11] need the interaction of caregivers (parents/guardians).Our proposal will no need the direct interaction of caregivers to trigger the System in order to send data or generate alert signal (alert messages). In our proposal, alert messages are activated by the data gathered (based on normal or abnormal data).

3. PROBLEM DEFINITION

This system is used to perform Cardiac Defense Response of Human and provides the diagnosed result of the heart beat when it crosses the threshold range. The main issue is, it can't monitor's the heart rate periodically. The other key issues are, it can't keep contact with the caretakers automatically. And also the device monitors only the heart rate of the patient.

4. METHODOLOGY

4.1. SMART ALGORITHM FOR CONTROLLING THE WEARABLE TEXTILE

SMART (**String Matching Algorithm Research Tool**) is a tool which provides a standard framework for researchers in string matching. Since 1970 more than 80 String Matching Algorithms have been proposed. The main functioning scenario, the wearable device attached to the patient's textile. And a smart phone put in the patients bag/pocket when he or she is walking to work/outside. The signals send by these devices are received regularly by the processing unit which are responsible for recording data in two different types of information: Heartbeat/Temperature.

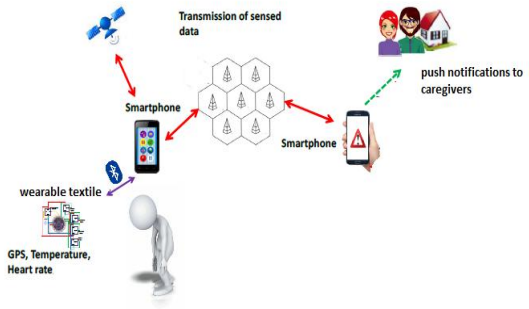
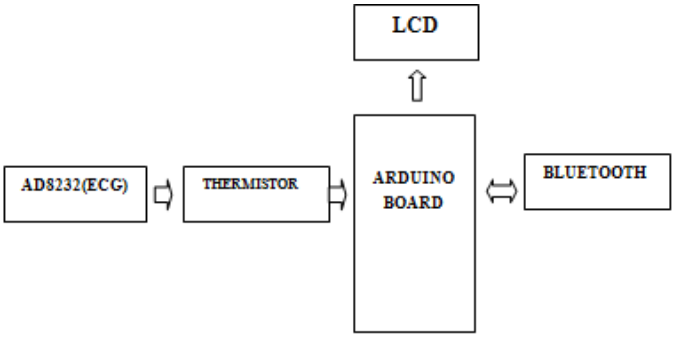


Figure.1. Architecture of persistent illness monitoring.

4.2. FLOW DIAGRAM



5. SYSTEM IMPLEMENTATION

5.1 MODULES

5.1.1 Application Development

An android application consists of two personal contact numbers to get proper notifications, if there is any variation in Temperature and Electrocardiogram(ECG). The threshold range are given as follows,

- Temperature: above 38˚c
- Heart beat: above 60bpm – below 100bpm

5.1.2 Implementation of Embedded Kit

The wearable textile is based on a LyliPad Arduino module and a HC-05 Bluetooth interface. It has a diameter of 50mm and a thickness of 0.8mm. The Bluetooth interface is used to connect with the smartphone. As sensors, we have selected a AD823sensor which is able to measure the heart beats through the photoplethy smography effect. To do this, the wearable device encapsulates information from each sensor in a frame. This frame contains information about the two care givers mobile number, data from the patient health and information about the heart rate and the temperature.

5.1.3 NOTIFICATION ALERT

One of the most important steps in the communication process is the Bluetooth connection between the wearable textile and the smartphone. This connection should be reliable at the time of ensuring the data security for avoiding vulnerabilities. For this reason, after wearable textile has sent the request to connect with the patient's smartphone, both devices should pair using a pin code. A request to connect is sent when an emergency situation has been detected. Then, the wearable textile can start sending data. The kind of packed exchanged will vary as a function of the sort of data. The packet exchange between the two main components of this architecture. As we can see, the smartphone is in charge of transmitting data to the caregivers and to the monitoring server. When the caregivers receive the data, they acknowledge if abnormal values have been registered. When something wrong has been detected, caregivers will get notification and try to arrange all the medical help for the patient. The first one is sent to the monitoring server in order to inform it that it should send the corresponding data to the physician. Finally, the caregivers will receive the data from the monitoring server. These data will be the sensors information of the current sample and the immediately previous values stored in the monitoring server.

6. RESULTS

To check the correct operation of our device, we have connected two different sensors: a heart rate sensor (ECG), and a temperature sensor (Thermistor). We have measured the energy consumption during a normal use to check how many hours it can be working without problem. It has a battery of 4.5 V and a capacity of 850 mAh. We would be able to continuously work with this system during 33 h. Finally, the consumed bandwidth in bytes per second (Bytes/s) between both devices. In this case, we observe that the biggest bandwidth is consumed during the connection Process with values higher than 1000 Bytes/s. Using this kind of technology, we can improve the medical attention and decrease the number of patients hospitalization or shorten hospital stays. As future work, we want to test our system with many patients in a hospital. In addition, we are also analyzing the possibility of adding this smart system as a part element of a big and secure medical infrastructure [1] to monitor patients in hospitals and disabled and elderly people inside the Ambient Assisted Living (AAL) paradigm [3] [4].

7. CONCLUSION

The main challenges of 21st century is designing and developing a cost affordable smart device for e-health monitoring. The monitoring of persistent diseases, can help patients and caregivers to improve their own welfare. In this paper, we have presented an intelligent architecture specially designed to monitor patients that suffer some persistent illness. The system is based on wearable textile and a smartphone that continuously monitors the patients heartbeat and temperature. If some abnormal value is detected the systems sends a set of messages to caregivers. To implement this, the measurement system is based on a smart algorithm. After the appropriate training, the system improves the accuracy in their detections. Using this kind of technology, we can improve the medical attention and decrease the number of patients hospitalization or shorten hospital stays.

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