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Family Health Follow-up Using: the Internet of Things (IoT)

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Abstract: ***This project encourages families to set up and operate a specially designed, installed and operated by individual families in order to record important health parameters of their members, by assembling very economical hardware components easily available in the market, with almost free software. A central family database is constructed, using an ordinary desktop, laptop, or an iPad. Various members of the family group would feed information to the database through either a wi-fi set up or through the Internet irrespective of their geographic locations. Internet of Things (IoT) technology is utilized to gather health parameters of the members and send them to the central database, where these data are stored, analyzed, and results are sent to the concerned member in as clear way as possible, with illustrated graphs, if there is an abnormal situation. Naturally such important information must use the highest security masseurs. In this project it is proposed to use fingerprint identification.***

Keywords: Internet of Things, eHealth, health sensors, medical, family healthcare

1. Introduction

Keeping track of the health status of the members of your family at home is a difficult task. Specially old age patients who should be periodically monitored, as well as your children and loved ones. They all need to be informed about their health status from time to time even if they live anywhere in the world, provided they have an access to the Internet. In this project we propose an innovative system that automated this task with ease. This project proposes installing a smart patient health tracking system that uses Sensors to register patient health parameters and uses the Internet to warn their loved ones in case of abnormal issues. This system uses sensors and other devices to monitor: heartbeat rate, blood pressure, temperature as well as height (for children and young ones) and weight, to keep track of the member's health. Other more expensive sensors (section 2.2) could be added if desired. The sensors are connected to a micro-controller to track the status, which is in turn interfaced to a wi-fi connection in order to transmit any alerts in case the system detects any abrupt changes in patient heartbeat or any abnormal blood pressure or abnormal body temperature. The system will automatically alerts the family member about his status over the Internet, and also shows details of heartbeat and temperature of patient live over the Internet. These alert information could be sent direct to the concerned member's iPhone. And so a system based on the "Internet of Things" can effectively uses the Internet to monitor patient health status and save lives on time. [1]. For those who are not familiar with the Internet of Things (IoT) technology, section-2 will shed some light on it.

2. What are the "THINGS" to be connected to the Internet?

2.1 What is the Internet of Things

According to the Institute of Electrical and Electronic Engineers (IEEE) [2]:
"The Internet of Things (IoT) is a concept reflecting a connected set of anyone, anything, anytime, anyplace, any service, and any network. The IoT is a mega-trend in next-generation technologies that can impact the whole business spectrum and can be thought of as the interconnection of uniquely identifiable smart objects and devices within today's internet infrastructure with extended benefits. Benefits typically include the advanced connectivity of these devices, systems, and services that goes beyond machine-to-machine (M2M) scenarios. Therefore, introducing automation is conceivable in nearly every field. The IoT provides appropriate solutions for a wide range of applications such as smart cities, traffic congestion, waste management, structural health, security, emergency services, logistics, retails, industrial control, and health care.

The interested reader is referred to: [2]-[3]-[4]-[5] and [6] for a deeper understanding of the IoT.

Medical care and health care represent one of the most attractive application areas for the IoT [6]. The IoT has the potential to give rise to many medical applications such as remote health monitoring, fitness programs, chronic diseases, and elderly care. Compliance with treatment and medication at home and by healthcare providers is another important potential application. Therefore, various medical devices, sensors, and diagnostic and imaging devices can be viewed as smart devices or objects constituting a core part of the IoT. IoT-based healthcare services are expected to reduce costs, increase the quality of life, and enrich the user's experience. From the perspective of healthcare providers, the IoT has the potential to reduce device downtime through remote provision. In addition, the IoT can correctly identify optimum times for replenishing supplies for various devices for their smooth and continuous operation. Up-to-date healthcare networks driven by wireless technologies are expected to support chronic diseases, early diagnosis, real-time monitoring, and medical emergencies. Gateways, medical servers, and healthy databases play vital roles in creating health records and delivering on-demand health services to authorized stakeholders." [7]

2.2 What is "IoMT (Internet of Medical Things) or healthcare IoT"

The Internet of Medical Things (IoMT) is the collection of medical devices and applications that connect to healthcare IT systems through online computer networks. Medical devices equipped with Wi-Fi allow the machine-to-machine communication that is the basis of IoMT. IoMT devices link to cloud platforms such as Amazon Web Services, on which captured data can be stored and analyzed. IoMT is also known as healthcare IoT.

Patients and providers both stand to benefit from IoT carving out a bigger presence in healthcare. Some uses of healthcare IoT are mobile medical applications or wearable devices that allow patients to capture their health data. Hospitals use IoT to keep tabs on the location of medical devices, personnel and patients.

The progression of healthcare IoT, or the Internet of Medical Things, is not without its challenges. Some physicians and health IT departments are still adjusting to using and securing mobile devices during work. Could IoT-derived data be too much for them to handle? [8]-[9]

2.3 eHealth-Sensors

The following are few samples of sensors available in the electronic market for eHealth.

It is to be noted that sensors for height and weight are not mentioned in these samples, we recommend:

a) For weight, either refer to reference [link B bellow] which explains how to make an accurate weight measuring device in detail together with software suitable for this project, get a commercial sensor from the link shown bellow.
b) For hight: you can measure it manually and enter it in the system's database.(See reference E bellow.)

Figure 1.1: Pulse, Heart Rate Sensor

Figure 1.2: Fingerprint Sensor

Figure 1.3: Pulse &Oxygen in Blood

Figure 1.4: Electrocardiogram (ECG)

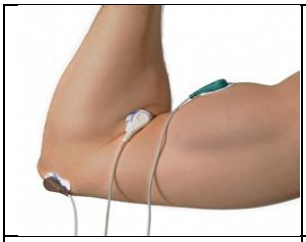

Figure 1.5: Electromyography Sensor (EMG)

Figure 1.6: Body Position Sensor

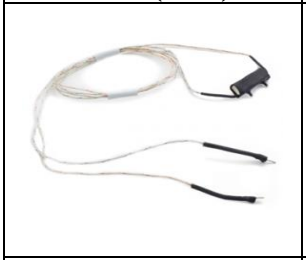

Figure 1.7: Airflow Sensor(Breathing)

Figure 1.8: Glucometer Sensor

Figure 1.9: Body Temperature Sensor

Figure 1.10: Blood-Pressure Sensor

Figure 1: Samples of Medical sensors

Notes:

1- References for the above items:.

a) https://www.cooking-hacks.com/ehealth-sensor-shield-biometric-medical-arduino-raspberry-pi
b) http://www.instructables.com/id/Arduino-Load-Cell-Scale/ (for weight sensor)
c) https://www.cooking-hacks.com/pulse-and-oxygen-in-blood-sensor-spo2-ehealth-medical
d) http://www.robotshop.com/en/pulse-heart-rate-sensor-arduino.html?gclid=Cj0KEQiA88TFBRDYrOPKuvfY2pIBEiQA97Z8MSrgNl6oKDjv2LxLc1dE036G4fQxRlVYLzCRhnu5USUaAhc28P8HAQ
e) http://tutorial.cytron.com.my/2015/04/26/build-a-height-measurement-machine-arduino-2/ (for hight sensor)

3. Examples of Microprocessors for e-Health

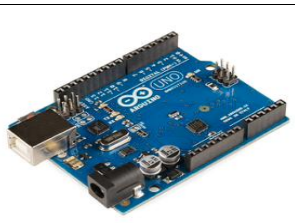

Figure 2.1: Microprocessor-based unit for IoT

Figure 2.2: Another Microprocessor-based unit for IoT

Figure 2.3: Microprocessor-based unit for eHealth sensor Platform

Figure 2.4: LCD display (12*2)

Figure 2: Examples of Hardware for the system

3.2 The Software:

One disadvantage of these microprocessor-based modules is that they have no operating systems as in computers, so they provide, free of charge, their own computing environment called (IDE). An integrated development environment (IDE) is a software suite that consolidates the basic tools developers need to write and test software. Typically, an IDE contains a code editor, a compiler or interpreter and a debugger that the developer accesses through a single graphical user interface (GUI). An IDE may be a standalone application, or it may be included as part of one or more existing and compatible applications.

The software suitable for the project depends mainly on the microprocessor chosen. Each manufacturer recommends his own IDE to operate the hardware he produces, such IDE usually contains comprehensive library covering software for projects in different fields. The user can copy and paste from these libraries according to the setup at hand.

3.2.1 Open CV
Open CV Stands for Open Computer Vision it is source library of functions. Open CV is released under a BSD license hence it is free for both Academic and Commercial users. It is an open source library written in C/C++.Open CV support many languages like C, Perl, Ruby. It is originally developed by Intel. Mainly aim at real-time computer vision It is a cross-platform (Linux, OS X, Win2K, Win XP).

3.2.2 Visual Studio
Microsoft visual studio is an integrated development Environment [IDE] from Microsoft. It support different programming languages and allows code editor and debugger to support nearly any programming language and provide language specification service. Also visual studio generate native an managed code.

3.2.3 Raspbian OS
Raspbian is free OS based on debian optimized for the raspberry device an operating system is the set of basic programs and utility that make your Raspberry pi run. Raspbian provides more than a pure OS it's comes with over 35000 packages, precompiled software bounded in easy format of installation on your Raspberry pi device.

3.3 The Database

There are two choices for the type of a database: either an ordinary database specializing on the health aspect of the family member status (as obtained from this project, or a relational database which includes other data collected from other sources, such as school and college records, business information, contact information like: telephone numbers, email address, updated location, etc...as well as the data from this project.

It is naturally assumed that the family owns a computer: desktop, laptop or other type in order to download the software required by any microprocessor. So this computer can be used to manage the suggested database. Many databases are available (at very low prices) in the electronic hyper market, which makes it easy to feed it with the obtained data from the project.

4. Security

Of all the personal data we accumulate in our personal and digital lives, health data is one of the most sensitive categories. Inappropriate sharing of health information has the potential to damage careers, harm reputations and worse. At the same time, digitizing and streamlining the sharing of health data has the potential for dramatic gains in efficiency with significant cost savings – the. It's a challenging dichotomy, as CIOs continue to look for ways to manage the risks of IoT and capture the benefits. [10]

In this proposed system the fingerprint sensor is a must item for both inputting the health data and when receiving the results. In the case of locally closed system, i.e. the whole family lives in one dwelling, the fingerprint identification will be sufficient in order not to cause mixup of results. Otherwise, when connecting to the Internet, other usual precautions must be taken, as explained in references: [11]-[12]

5. Summary

We have covered in this paper the basics of the eHealth technology and using the technology of the Internet of Things to follow-up families healthcare. We shed some light on the: sensors, processors and software requirement, without commercial hints. Unfortunately this handicap prevented us from explaining an actual setup of a working system as this will be considered as publicity for the manufacturers of the hardware and software used in the working system.

The Internet of Things is becoming more and more applicable to almost any activity, particularly in the medical sector. Almost every university in the world is involved in taking part in its research in this field as well as prestigious establishment such as the Institution of Electrical and Electronic Engineers (IEEE). You will notice that most of the references, mentioned bellow, are from this source.

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