

A Home Based TeleHealth System for the Elderly with Alzheimer's

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Abstract

By 2020 it is predicted that chronic diseases will account for almost three quarters of all deaths. According to the World Health Organization the elderly population is expected to become 1.2 billion in 2025. This aging problem contributes greatly to chronic diseases like Alzheimer's; Elderly are suffering from Alzheimer's. The major implications of Alzheimer's are patient safety and care. The aim of this paper is to develop a Telehealth system, based on IoT technology, for monitoring elderly individuals suffering from Alzheimer's. We describe a working prototype that is able to capture the vital signs and deliver the desired data remotely for elderly individuals staying at home, using a wearable ECG wireless sensor. In addition, an Active wearable RFID wristband, with IR room locators are used to monitor the whereabouts of the elderly at room level. This prototype was successfully tested on a number of patients at KFUPM Medical Centre in Saudi Arabia.

Keywords: Telehealth; RTLS; Electrocardiogram; IOT, RFID.

Introduction

Demographic trends indicate a rapidly aging population throughout the world, particularly in Europe. In many societies the proportion of elderly population (aged 60 years or over) is expected to double by 2050 [1]. The rise in aging population also means the rise of people with dementia. Dementia is a term for diseases which cause memory loss leading to the problem of wandering elderly individuals who are vulnerable to falls [Indoor-Outdoor]. The elderly patients are at the heart of crisis in healthcare costs that is beginning to occupy the policy discussions of most governments in the industrialized world.

A recent report from the United Nations expects that the world's population will grow to approximately nine billion people by 2050, and that one in four will be over 60. Hence, there is drastic need for technology to cope with the health issues that are expected to arise. For example, in Japan, more than 20% are elderly. One of the emerging technologies that is capturing popularity is telemedicine. This can cut down healthcare costs drastically. The American Telemedicine Association (ATA) defines "telemedicine" or Telehealth as the use of medical & healthcare information exchanged remotely via electronic communications to improve patient's health.

Recently, researchers have started working in area of wireless telemedicine systems. The new telecommunications technologies have made mobile & low cost healthcare a reality. [6]. Telemedicine has the advantage of delivering high quality remote healthcare, thus reducing the cost through avoiding unnecessary hospitalizations

and ensuring prompt delivery of healthcare [7,8].

The advent of emerging technologies such as Radio Frequency Identifications (RFIDs) has opened a great avenue for its utilization efficiently in telemedicine. The emergence of mobile and sensor technologies is expected to make available real-time data about vital signs in addition to other physiological indicators of people's health. The application of wireless telemedicine can be facilitated by the utilization of the mobile technology such as RFID [9]. This paper presents a novel approach to affordable Telemedicine infrastructure for the purpose of early detection of Arrhythmia in KFUPM patients. Consequently, it will satisfy the huge need for the Telehealth solution in Saudi Arabia. An RFID zone based system is installed in the elderly person's home to monitor the whereabouts of the elderly at home to trigger an alarm in case of emergency. The rest of this paper is organized as follows. Section 2 provides a background research in Telehealth with more focus on arrhythmia. Section 3 presents the main research objectives while section 4 presents the proposed architecture of the Telehealth system. Finally, section 6 provides conclusions and possible future work.

Today, with the increase in technological sophistication, it's now feasible to locate anything or anyone in real time anywhere. The system that accomplishes this is the Real Time Location System (RTLS), and this is usually achieved by making use of small electronic devices (or tags) attached to people or things at any time. Location depicts or illustrates where something is well located. With a Real-time Location System, or RTLS, you locate and track people and assets by associating a tag, a small wireless device, with each person.

RTLS at choke point depicts localization of a person or object (an entry or exit point) such as a door. By monitoring a tag seen at a specific choke point, one can determine whether a tag is present inside or outside a certain area (Figure 1).



Figure 1: Scenario of using RFID to locate a wandering elderly person at chokepoint.

The Proposed System Architecture

This section presents the proposed system architecture for Telehealth. This system architecture aims to provide Telehealth solution for the elderly suffering from Alzheimer’s and staying at home. The elderly may be handicapped. Also relatives who might be spread all over the world, would like to be in peace of mind that their loved ones are ok. In case of emergency, the system should have the capability to trigger an alarm by sending a message to a physician or call for help. We have integrated a wireless ECG sensor with the proposed Telehealth system. A number of samples of ECG data are captured from a number of elderly professor’s volunteers. Additional samples were collected from elderly individuals suffering from Arrhythmia. Any deviation of the samples taken from its normal range indicates the onset of arrhythmia and hence requires immediate intervention by medical experts. Figure 2 shows an overview of the vital sign sensors attached to the elderly. The layout of this figure is built and tested in our laboratory for the purpose of using it as a Telehealth solution for use in the home environment (Figure 2).

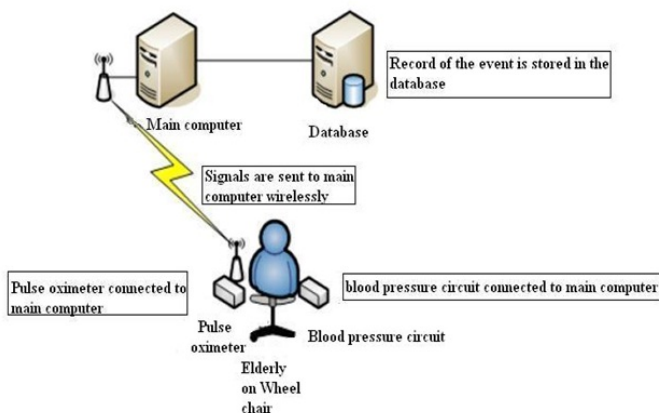


Figure 2: Overall layout of the vital sign sensors.

The system is tested in the laboratory for sending ECG data. A

record of the elderly vital signs measurements; including the Electrocardiogram (ECG) measurements are stored at the local home server for future use. The collected data is from the KFUPM clinic and the University laboratory during the period from 2010 to 2013 [10].

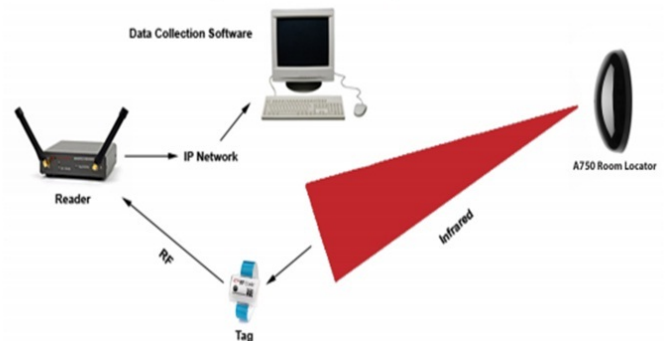


Figure 3: Overall RTLS System architecture.

In addition to that, the proposed system has the added value of RTLS utilizing RFID technology on zone based. It consists of IR-enabled 433 MHz active wearable wrist tags and A750 Room Locators that enable tracking of elderly patients at the accuracy of room level, in addition to readers. An IR signal containing a user assigned location code is transmitted by each room locators. Room locaters are put to cover specific areas, like rooms, entire floors or closets. When transmitting RF location payload to a reader, the IR-enabled tags can report specific location data. When the asset moves between rooms, its tag transmits the new location that was received from the previous room locator. Each room locator has a unique ID for distinct room locations. Large rooms may have multiple room locaters for IR coverage. When room locaters are installed in the same zone they could be configured in a Team Mode where they are synchronized with other room locaters to avoid interface of signals.

IR-enabled active tags get ID location data and then synchronize with room locaters. When the tag is synchronized with a locator, it knows the same locator will send its data location one time every second. A moving tag will check the transmission of the locator every 3 seconds. If the tag has failed to receive the signal at the expected time, then it will revert back to find out the mode where it can scan for an IR transmission over a 1 second period.

When the tag is in stationary mode for minimum of 15 minutes, and has not seen any room locator then it will go into low power mode and check only for transmission every 15 minutes period for the purpose of saving power. When the tag has been in stationary mode for at least 1 minute it will also go into low power mode, and check for locator every 15 minutes period. If the tag didn’t detect any signal it will be relayed to the reader as received location code of zero [11].

The Room Locator Utility is provided to allow the configuration of Room Locator. It has a GUI interface for allowing to set the locator LED intensity levels, location code and other parameters (Figure 3).

Software Interface

We developed our database according to ER diagram shown in Figure 4. Then we suggested to apply this design with different programs such as, Microsoft SQL, Oracle and Microsoft access.

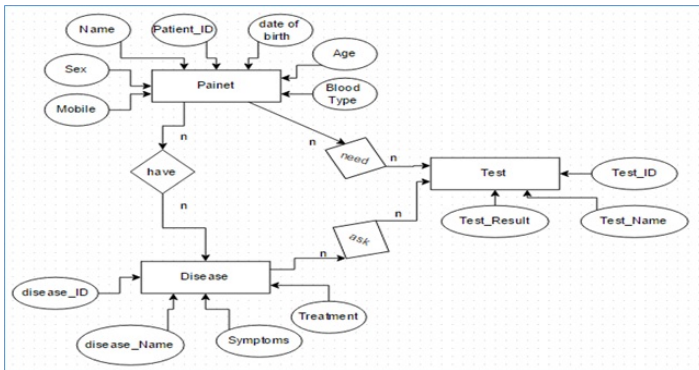


Figure 4: ER diagram for patient database.

We had decided to select the Microsoft SQL since it is easy to use and there is no need for high experience to write the database in it. Our database contains patient name, patient ID, date of birth, blood type, gender and mobile number. The database stores the chronic diseases the patient suffers from & the symptoms. It stores also the treatment and medication prescribed by the physician.

Conclusions

The successful implementation and utilization of the wireless ECG system in the KFUPM clinic has paved the way for establishing a ubiquitous mobile telehealth system. The deployed system provides a big hope for patients with chronic diseases and could therefore avoid catastrophic results in the future by providing immediate medical care. The system opens new opportunities for further research in the area of biomedical signal and image processing. The use of Telehealth provides high-quality service and increased efficiency to the practice of medicine. The use of active RFID & RTLS reduces the caregiver burdens in a closed monitored home environment and helps him to monitor the movement of the elderly individual suffering from chronic diseases like Alzheimer's and guarantee the elderly person's safety.

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