# RFID Based Telemedicine System for Localizing Elderly with Chronic Diseases

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**Abstract.** By 2020, it is predicted that chronic diseases to be account for almost three quarters of all deaths. This aging problem contributes greatly to chronic diseases like Alzheimer's. The major implications of Alzheimer are patient safety and care. The aim of this paper is to develop a Telemedicine system, based on Internet of Things (IoT) technology, for monitoring elderly individuals suffering from Alzheimer's. We describe a working prototype that is able to capture vital signs and deliver the desired data remotely for elderly staying at home, using wearable ECG wireless sensor. In addition, an Active wearable Radio Frequency Identification (RFID) wristband, with IR room locators are used to monitor the whereabouts of the elderly at room level along with an Android APP tool. This prototype was successfully tested on a number of patients at King Fahd University of Petroleum and Minerals (KFUPM) Medical Centre in Saudi Arabia.

**Keywords:** Telemedicine · RTLS · Electrocardiogram · IoT · RFID

## 1 Introduction

Demographic trends indicate 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 means a rise of people with dementia [2]. Telemedicine has the advantage of delivering high quality remote health care, thus avoiding unnecessary hospitalizations and ensuring prompt delivery of healthcare [3, 4]. The application of wireless telemedicine can be facilitated by the utilization of the mobile technology such as RFID [5]. Many systems for localizing Alzheimer elderly exist at the moment, such as the assisted GPS, which uses a combined GPS receiver with cellular technology. However, these systems fail to work in areas with no cellular coverage, such as rural areas. Other researchers use Indoor positioning using Ekahau Wi-Fi RFID active system. Nevertheless, Ekahau is complex and needs a complicated system of access points to locate the Elderly [2]. This paper presents a low cost telemedicine solution for locating Elderly suffering from Alzheimer at home using active RFID and an Android APP tool without the need of complicated and highly computational triangulation algorithms.


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## 2 The Proposed System Architecture

This system architecture aims to provide a telemedicine solution for an elderly suffering from Alzheimer 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 taking care of. We integrate a wireless ECG sensor with the proposed telemedicine system. A number of samples of ECG data are captured from a number of Elderly professors volunteers. Any deviation of the data taken from its normal range indicates the onset of arrhythmia and hence requires immediate intervention by medical experts [6]. In addition, the proposed system has an added value of Real Time Location System (RTLS) utilizing RFID technology on zone based. It consists of an IR-enabled 433 MHz, an active wearable wrist tags, room locators and readers that enable tracking of elderly patients suffering from Alzheimer at the accuracy of room level at their own home or retirement home. We assume that the Elderly home consists of three rooms for simplicity where each room represents a zone. 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 reports specific location data. When the Elderly moves between rooms, its tag transmits the new location that was received from the previous room locater.

IR-enabled wearable active tags get ID location data and then synchronize with room locaters. The active tag range can reach up to 35 feet and suffers far less interference than passive technology, Fig. 1. An Android APP is developed using JAVA to help the elderly beloved ones locate him while moving between rooms at home. A TCP link is established between the reader and the mobile for this purpose. Once the application is launched it will open a TCP socket and start communication with the reader. Once the reader scans the tags in its vicinity, the tag ID is associated with a specific zone where the Elderly is located in by calling a Google map into the APP to draw three zone circles or the three rooms, Fig. 2. The markers represent the scenario when more than one Elderly is living at home. If the marker is outside the circle, this triggers an alarm that the Elderly is wandering outside the safe zone. A successful test bed was performed in the RFID lab for localization.

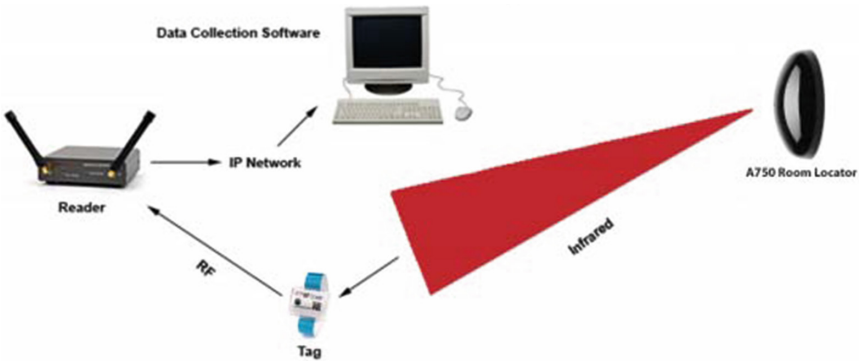


**Fig. 1.** Overall RTLS system architecture

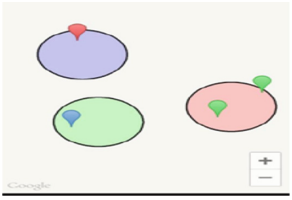

**Fig. 2.** Android APP for localizing elderly

## 3 Conclusions

The successful implementation and utilization of a wireless ECG system in KFUPM clinic has paved the way for establishing a ubiquitous mobile telemedicine system. The use of telemedicine provides high-quality service and increased efficiency to the practice of medicine. The use of active RFID & RTLS reduces the caregiver's burdens in a closed monitored home environment, helps them to monitor the movement of elderly suffering from chronic diseases and guarantees the elderly safety. Currently the wearable ECG sensor and wearable RFID wristband are separate. Ongoing research is under process to integrate them in the future.

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