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# Ubiquitous Tele-health System for Elderly Patients with Alzheimer's

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**Abstract**

Chronic diseases are becoming one of the world's leading causes of death and disability. By 2020, it is predicted to account for almost three quarters of all deaths. A potential approach to monitor patients with chronic diseases is the implementation of home healthcare systems, using new technologies. The Internet of Things (IoT) and the Radio Frequency Identification (RFID) technologies are evolving rapidly with innovative applications, particularly in the healthcare sector. The aim of this paper is to develop a Tele-health system, based on IoT technology, for monitoring elderly individuals suffering from Alzheimer's. This paper describes a working prototype that is able to capture the vital signs and deliver the desired data care remotely for elderly patients staying at home, using wearable ECG wireless sensor. A UHF passive wearable RFID wristband is used to monitor the whereabouts of the elderly. This prototype is successfully tested on a number of patients at the King Fahd University of Petroleum and Minerals (KFUPM) Medical Centre in Saudi Arabia.


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*Keywords*: Tele-health; Ubiquitous; Electrocardiogram; Arrhythmia, RFID.

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## 1. INTRODUCTION

During the last few years we have witnessed an increasing interest in wearable/mobile health monitoring devices, both in research and industry. These devices are particularly important to the world's increasingly aging population, whose health has to be assessed regularly or monitored continuously. Chronic diseases are becoming one of the world's leading causes of death and disability. By 2020, it is predicted to account for almost three quarters of all deaths[1]. Tele-health, the area where medicine, information, and telecommunications technology meet, has probably the greatest impact on healthcare delivery. A Tele-health system can be defined as the delivery of medical information over a distance by using telecommunication means. Home Tele-health, on the other hand involves the use of Tele-health techniques in a non-institutional setting such as home, or in an assisted-living facility. In store-and-forward Tele-health, vital signs and clinical data are captured and stored, and then sent to caregivers for further analysis. Physiological monitoring leads to richer data and therefore to improved decision-making[2,3].

The implications of wearable health monitoring technologies are paramount, because they could provide the following: (1) enable the detection of early signs of health problems; (2) notify healthcare providers in critical situations; (3) find correlations between lifestyle and health; (4) bring healthcare to remote locations and developing countries, and help doctors and researchers with accessing multi-sourced real-time physiological data [4]. With the advent of advanced telecommunication technology, long-term home care of the elderly or what is called Tele-health is becoming a rapidly growing area of healthcare industry. Lately, many researchers became interested and begun investing more time in the research area of wireless Tele-health systems. The proponents of wireless systems claim that the increased mobility and the lower cost of the systems are highly beneficial to Tele-health. Mobility and lower cost healthcare solutions are benefiting from the new telecommunications technologies[5].

The advent of emerging technologies such as Radio Frequency Identifications (RFIDs) has opened a great avenue for its utilization efficiently in telemedicine. The application of wireless telemedicine can be facilitated by the utilization of the mobile technology such as RFID[6,7]. Many researchers tried to infer the human “activities of daily living” by detecting human-object interactions. They used RFID technology for this purpose that made it easy for applications that are triggered by handling “tagged physical objects”. The main advantage of this approach is that is provides high accuracy. To detect user activities, 3-axis acceleration sensors could be worn on thigh, waist and wrist. Using both RFID and accelerometers (fall detection sensors) is necessary for detecting ADL[8,9]. In another direction, researchers have used adhesive skin-contact tri-axial accelerometer that is built with microcontroller and Bluetooth transceiver to detect falls[10].

This paper presents a novel approach to affordable mobile Tele-health infrastructure for the purpose of arrhythmia early detection in KFUPM patients. Consequently, it will satisfy the vast need for the Tele-health solution in Saudi Arabia. For the purpose of this research, samples of ECG data are collected from both young as well as elderly volunteers. An RFID zone based system is installed in elderly 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 the proposed system architecture in Tele-health with more focus on arrhythmia. Section 3 presents the main conclusion.

## 2. THE PROPOSED SYSTEM ARCHITECTURE

This section presents the proposed system architecture for Tele-health. This system architecture aims to provide Tele-health solution for the elderly living at home. The elderly may be handicapped in various ways, as senses and capabilities to remember are not always good. Also relatives who might be spread all over the world, would like to make sure that their loved ones are alright and perhaps keep an eye on them 24/7. The elderly may not be able to visit a physician on times when needed, because of inability to make their way to the clinic or to the hospital. Therefore, it is necessary to develop a system that allows the elderly to talk with their physicians in a user-friendly manner. In order to achieve this, physicians should have a remote-view of the required vital signs to look at like electrocardiogram (ECG), oxygen saturation, blood pressure, heart rate, etc. In case of emergency, a reliable emergency system must call a physician and ambulance for help. Towards this end, we have integrated a portable ECG sensor with a Bluetooth interface (called Alive ECG) into the proposed Tele-health system. A number of samples of ECG data are captured from 30 volunteers, their age’s range from 20 to 23. In addition, a couple of elderly patients are also volunteered who are suffering from arrhythmia using the Alive ECG sensor and Bluetooth to send results to a PC for further analysis.