

Deployment of Assisted Living Technology Using Intelligent Body Sensors Platform for Elderly People Health Monitoring

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Abstract. Many of the Ambient Assisted Living Technologies (AALT) available to the end-users as off- shelf products have no common inter-operational protocol (Language). Each product has its own communication protocols, different interfaces and interoperation which limits their solution efficiency for long term health condition monitoring systems. This paper presents assisted living technology (ALT) solution for elderly people based on wireless sensors networking technology. The system includes biofeedback monitoring body sensors, such as: blood pressure, heart rate and body temperature. Each sensor has been integrated with the necessary real time embedded protocol and system to work in ad-hoc bases. The data will be send wirelessly and shared though cloud network. The collected data will be processed and relevant algorithms will be deployed to take certain actions when any changes occur or health warnings arise. These will be treated with high confidentiality to ensure end-users integrity and dignity have been maintained. The proposed solution system will provide the flexibility to analyse most of the health conditions based on near real time monitoring technology. It will also enable the population of elderly to manage their daily life activities within multiple environments i.e. from their comfort home, care centers and hospitals.

Keywords. Ambient Assisted Living, Remote Healthcare, Patient Monitoring.

1. Introduction

The raising population of seniors with long term health condition in the EU and around the world faces significant challenges in managing their daily life activities. To live independently and have a good quality of life is very challenging, since the majority of older adults have a long term health condition (LTC) which requires some interventions. This burden is replicated across health service providers throughout the EU and is shared by informal and formal care providers who play a major role in providing the point of care services and support. Furthermore, older adults are affected by a range of chronic diseases such as: cardiac infarction; stroke; macular degeneration; glaucoma; diabetes, dementia and high blood pressure.

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All of which require active monitoring and intervention, failure to deliver the necessary care to this community can lead to reduced quality of life and ultimately death. 63% of all deaths in the world are within the older adult population and may have been due to one of these chronic LTC's. Out of the 36 million people who died worldwide from disease in 2008, 29% were under 60 and half were women [1]. By 2020 it is predicted that there will be more than 15 million more elderlies with long term health condition each year [2]. It is envisaged that these diseases will in the future contribute to seven out of every 10 deaths in developing countries. Many of the non-communicable diseases can be prevented by tackling associated risk factors. The cost of care and treatment of long term health condition diseases for elderly in the EU is estimated to consume over 70% of the overall Health Service (HS) provider budget [3].

The "state-of-the-art" of the current technology of daily life activities, telecare and telehealth solutions products, particularly in respect to elderly people conclude that the potential manufacturers of telecare, telehealth products and ongoing projects are: Tunstall / Bosch / Docobo ...etc. These are the major market leaders across EU, with 70% of the current Telehealth and Telecare markets. These vendors have unique platforms and their system architecture differ from each other. The issue is when a certain platform has been chosen in a public or private care nursing house, the risk of system lock-in is exceedingly to happen. For example, if a system from any of the above providers were chosen for a resident area or care facility centre, it will be only deployed using software and products manufactured and supported by the supplier only. To use other products and software from different vendors, there will be a need of another system infrastructure which could impact on the system performance and service provided [4]. As well as carrying these installations involves a complexity and various organisations to provide these installations. Which, makes the deployment of ambient assisted living equipment expensive and complicated [5]. In some cases, systems and units are also required to be installed at home "for the end-users" the data collected has to be entered manually to the system to update the healthcare records, which results in increase in cost.

There are many efforts have been undertaken to overcome these teething issues. For example, Mirth Corporation: is an American organisation specialised in open source IT communication software aimed at multiple platforms. Their solution can listen, send and connect to ALL forms of protocols. Medway EPR: is a UK Company: Medway EPR is a family of products, built specifically for the UK health sector, which appear to cover all aspects of patient management and care, however it has been identified that there seems to be no case driven aspect to their EPR with built in alerts and monitoring solutions integrated with monitoring devices and sensors. These show that there is a serious need to develop a new approach that could enable each devices and units to communicate with each other and transfer data wirelessly without any interface technology barriers.

This investigation into the current technology state of the art clarified that none of the manufacturer around the world has develop such technology. This paper presents the initial outcomes of ongoing research program that is planned to develop this technology. The program is also aiming to develop an integrated Assisted Living Technology (ALT) solution that has a multi-functional case driven wireless ad-hoc management system for older adults with long term health condition.

2. Proposed Assisted Living System Architecture

Figure 1 shows the proposed ALT solution system architecture. The system has a number of sub-units. These includes array of sensors, data communication protocols, intelligent algorithms, expert system and decision making unit. It will also have an integrated intelligent self-assessment unit, to enable self-assessment of all the stages of the system hardware and software [7-9]. This is to ensure that the plugged in medical devices are performing well and if there is any sign of degradation, the necessary action can be taken to replace the device, in appropriate time, to maintain real time monitoring. These sub-units can be clustered into three main stages: The front end part: this is to integrate different health measurement devices from different manufactures in ad-hoc interface based protocol. This is where data will be send wirelessly. The middle part: this includes all the relevant algorithms to process the received data and provide the necessary information to the end-users and main care centres and hospitals. The back end part: this is mainly a user friendly interactive interface system that will show the processed data outcomes.

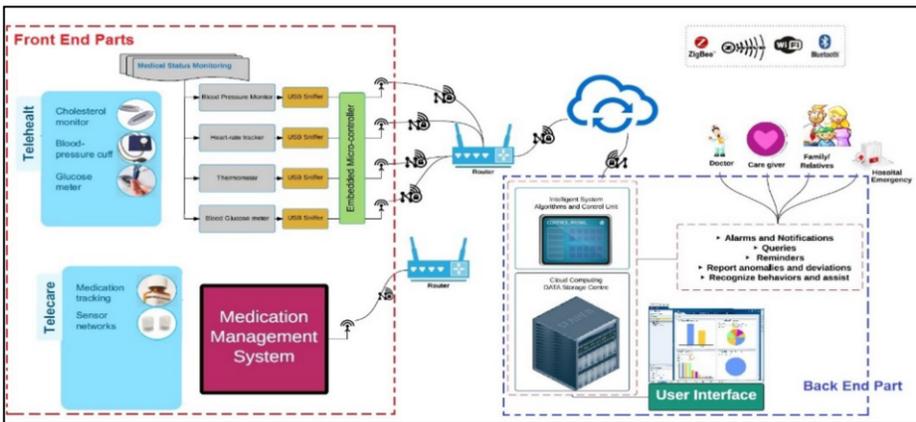


Figure 1. Proposed Assisted Living Solution System Architecture, include front and back end units, processing stages and other relevant ad-hoc technology platform

3. Assisted Living System Inter-Operational Scenario

The inter-operational principle of the ALT system is based on the principles of automatically integrate and interface any device made from any manufacturer to the ALT system in ad-hoc ideologies and this is part of the main innovation of this program proposed solution. The data will be collected, processed with the relevant algorithms and the outcomes will be communicated to the relevant end-users, family, general practitioner, and hospitals. This will enable individuals to monitor their vital signs, daily life and lifestyle activities. This will also help to detect any deterioration of their telehealth or habits so that clinical decisions can be made and emergencies actions can be swiftly addressed.

4. Assisted Living System Design and Development

4.1. Body Temperature Sensor:

The normal temperature level for average body is normally 37.0°C. This temperature fluctuates by 0.5°C through the day. One of the objectives in this project is to keep track of the body temperature changes for elderly health monitoring. Figure 2 (a) shows the body temperature sensor arrangement used and Figure 2 (b) shows the sensor Connection and Setup.

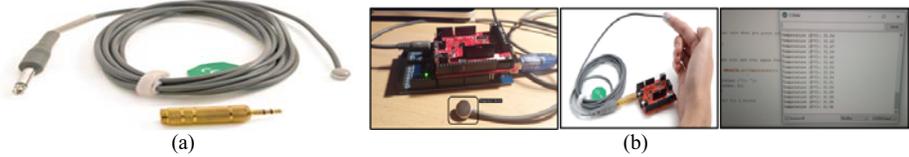


Figure 2. (a). Body Temperature Sensor (b). Body Temperature Sensor Connection and Setup

4.2. Blood Pressure Sensor

The blood pressure is normally recorded as two numbers—the systolic pressure (as the heart beats) over the diastolic pressure (as the heart relaxes between beats). High blood pressure (hypertension) can lead to serious problems like heart attack, stroke or kidney disease. High blood pressure usually does not have any symptoms, so it is very critical to have it checked regularly, especially for elderly with long term health condition. Figure 3 (a) shows blood pressure monitor setup connection and Figure 3 (b) shows device development board and data interface connection setup.

Figure 4 shows ZigBee XBee Modules Configuration and integration to the initial ALT platform. ZigBee is the main protocol of data transfer between devices and units in ad-hoc principles.



Figure 3. (a). Blood Pressure Monitor Setup connection (b). Blood Pressure Device Development board and data interface connection

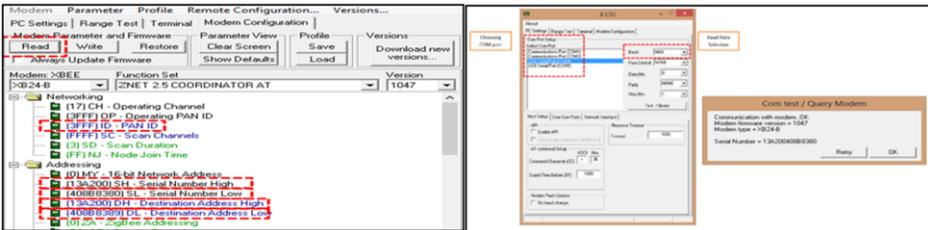


Figure 4. ZigBee XBee Modules Configuration and integration to the initial ALT platform

4.3. ALT Execution Process

The execution process of the system, is initiated as soon as the front-end devices (body temperature and blood pressure) are switched on. Data will be sent wirelessly for processing and then displayed in the back-end part of the system i.e. user friendly interactive interface screen.

4.4. User Interactive Interface Screen

The data displayed in the back-end user interface screen will be updated in a table for record measurement and an alerting indications will appear on the screen depending on the state of the emergency care, which needs attention.

5. Assisted Living System Prototype, Test and Results

The initial testing of the system functionality was carried out, by obtaining the data from the blood pressure as well the heartbeats sensors. Figure 5 shows the user interface window with the data received at the back-end User Interface Screen. The screen shows the monitored information of patient health condition, with level of normality or any sudden changes that may need some attention from carer ort the patients.

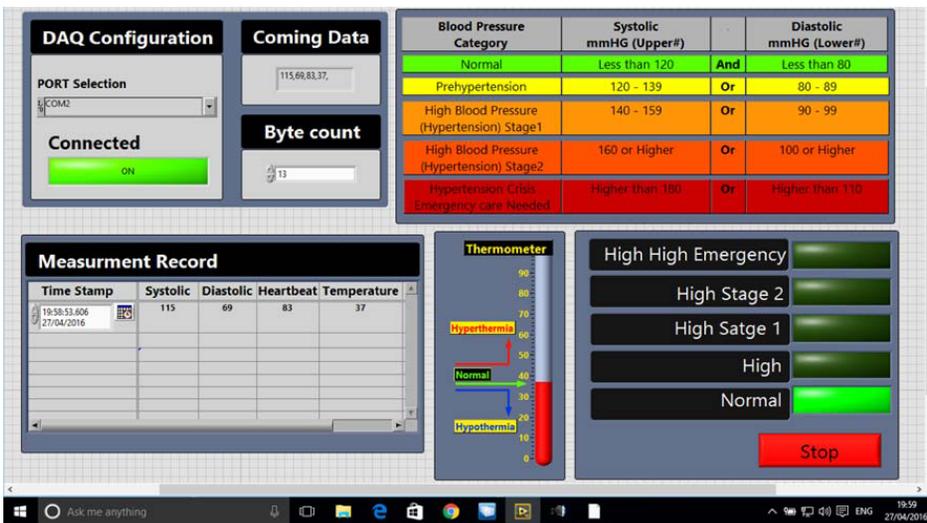


Figure 5. LabVIEW System Main User Interface and results obtained using developed ALT system prototype

6. Conclusion

The initial prototype of an Intelligent Medical Care Solution for Elderly People with Long Term Health Condition Based on Wireless Sensors Network Technology is

presented in this paper. The developed prototype of the system has shown the possible potential of the solution. A wireless communication link has successfully established between front-end devices, ZigBee modules and back-end units. The data was processed and displayed in the serial monitor using LabVIEW software user friendly interface screen. The research program at early stage and there are still a number of ongoing activities. This is mainly aiming to conclude with an integrated assisted living technology multi-functional case driven wireless ad-hoc management system for elder adults using smart sensors and actuators, 3D-video, audio, radio frequency identification and wireless technology, combined with secure cloud and semantic data technology.

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