Development of the Elderly Healthcare Monitoring System with IoT

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Abstract Stroke is a brain attack (or infarction of a portion of the brain) caused by the sudden disturbance of blood supply to that area. In recent years, even though the number of stroke-related deaths has been decreasing in Korea, the incidence of stroke is increasing, and the incidence increase with age. The chances of surviving from an acute and sudden infarction are much higher if the elderly people get emergency medical assistance within a few hours of occurrence. Elderly health monitoring and emergency alert system are mentioned as one of the main

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application areas of pervasive computing and biomedical applications. Moreover, a proactive elderly health monitoring system involves active capture of brain and body movement signals, signal analysis, communication, detection and warning processes. The primary objective of this research will be concerned itself with ambient assisted living issues for the successful detection and generation of alarms in cases of stroke onset, which will allow the timely delivery of medical assistance, to mitigate the long-term effects of these attacks.

Keywords Aging · Elderly healthcare monitoring system · Internet of things · Stroke · Cerebral infarction

1 Introduction

Stroke is a brain attack (or infarction of a portion of the brain) caused by the sudden disturbance of blood supply to that area [1]. In recent years, even though the number of stroke-related deaths has been decreasing in Korea, the incidence of stroke is increasing, and the incidence increase with age [2]. Stroke is still the leading cause of death in Korea [3]. Stroke is an important health burden in Korea as well as worldwide. The stroke population as well as global population is aging [4]. On average, every 5 min stroke attacks someone in Korea [1]. A patient suffering from the onset of a stroke needs a trained care assistant close by to recognize the symptoms; in many stroke situations, an isolated individual would be unable to request help alone. The chances of surviving from an acute and sudden infarction (i.e., stroke) are much higher if the elderly people get emergency medical assistance within a few hours of occurrence. Wireless health monitoring is the most interesting research application field for wearable electronics. Smart healthcare monitoring using IoT (Internet of Things) is the integration of smart computing and remote health monitoring. It can be considered as the major application field of remote computing technologies for rapid communication between patients and healthcare professionals. Elderly healthcare monitoring and emergency alert system are mentioned as one of the main application areas of pervasive computing and biomedical applications. The primary objective of this research will be concerned itself with ambient assisted living issues for the successful detection and generation of alarms in cases of stroke onset, which will allow the timely delivery of medical assistance, to mitigate the long-term effects of these attacks. This paper is organized to give some of the background information related to the development of the elderly healthcare monitoring system with IoT.

2 Background

2.1 Aging in Korea

Korea is one of the most rapidly aging countries in the world, people over 65 years old will account for 38.2 % of Korea's population in 2050. Aging results from increasing longevity, and most importantly, declining fertility [5]. The life expectancy of males is expected to rise from 77.2 years in 2010 to 83.4 years in 2040. The life expectancy of females is expected to increase from 84.1 years in 2010 to 88.2 years in 2040. Unless Korea responds adequately to the decline in the working-age population, it is certain that the country will witness a slowdown in its economic growth [6]. As stated by the Korea's National health insurance company, the elderly are expected to consume 65.4 % of total health care expenses in 2030, which is huge comparing with the current state (37.9 % as of 2015). In Korea, the elderly dependency ratio is projected to increase. By 2060, the elderly dependency ratio is expected to exceed 80 % (about 20 % as of 2015), i.e., the number of "elderly dependents" will increase [7]. The elderly Koreans are more likely to live alone and the proportion of single person households is expected to increase further. As of 2010, the proportion of single person household was 34.2 % and it is expected to increase to 38 % by 2035 (Fig. 1).
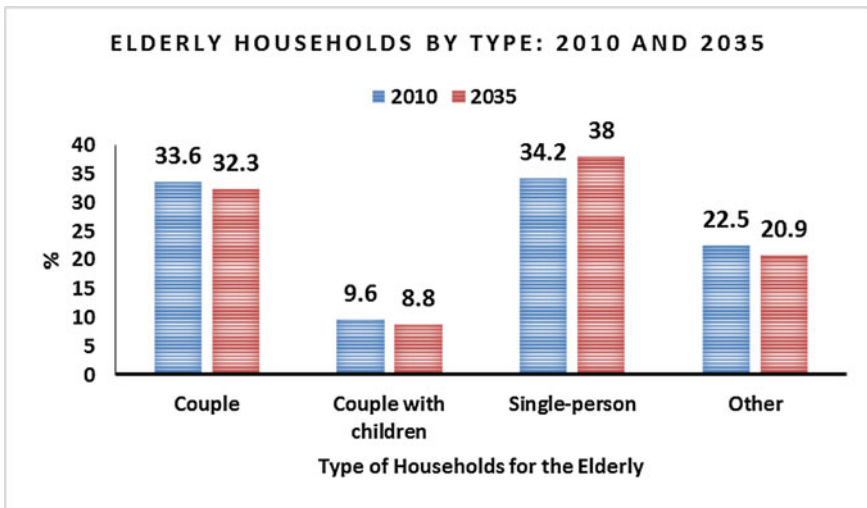

Fig. 1 Types of households for elderly aged 65 and over

2.2   Elderly Smart Healthcare Monitoring System

In this 21st century, technology has made human lives very easy and advanced. With the increasing aging population day by day, demand is increasing for smart healthcare systems to encounter the various healthcare related incidents because the aging population is much more prone to living alone than before and they are more likely to have an accidental death [8]. The conventional and old health monitoring system comprises of individual human health parameter sensors to measure one single health parameter while each was connected to a data collection device to make a database for healthcare record, which is time-consuming and not suitable for tracking down the emergency. Recent internet based technology developments have allowed the successful integration of several sensors equipped with one wearable healthcare system which can be wearable in the human body, or can be transported with the elderly patient to any remote place where emergency health care can be required. The newer internet based wearable healthcare monitoring systems have been developed for emergency and elderly health care, thus making the smart health monitoring very simple, portable and faster communication based [9–12]. Programmable emergency alarms are also integrated into the healthcare monitoring systems, which indicate emergencies to notify healthcare personnel for help.

2.3   IoT-Based Elderly Smart Healthcare Monitoring System

IoT-based smart healthcare systems depend on the vital definition of the IoT as a network of wearable smart devices, which connect with each other to measure the parameters, interpret the results and make the emergency alert to notify the medical personnel. IoT devices can be utilized for operating on a remote basis for smart health monitoring and emergency notification systems. For the elderly, smart healthcare monitoring systems are objectively designed to get the immediate measurements required to track down several health parameters in an urgent situation and in a cost effective way. In the smart elderly healthcare monitoring systems, several parameters like systolic and diastolic blood pressure, body temperature, pulse rate, heart rate, important muscle activity, blood sugar level testing, blood oxygen content(SPO_2), human brain activity, motion tracking etc. are all very important to track down the healthcare status [13–15]. Specialized sensors for health monitoring can also be equipped with a wearable device within living spaces/rooms/homes of elderly to monitor the health and emergency of senior citizens. Sensor mobile gateway integrated with healthcare sensor can ideally be presented on a small, wearable and portable device, suitable for daily and continuous use, such as a smartphone or PDA (personal digital assistant) [16–19]. Therefore, IoT-based systems are radically reducing the costs and improving health by increasing the availability and quality of care [20–23].

2.4 Application Areas for IoT-Based Elderly Smart Healthcare Monitoring System

A wide variety of application for IoT-based elderly smart healthcare monitoring system is possible. For example, smart car, smart home, smart bed, etc., In the Smart car, there have been numerous researches undertaken. Researchers at Nottingham Trent University [24] are working on new kind of car seats that could measure vital signs such as ECG of the driver to prevent accidents caused by drivers falling asleep. The sensor system can be used to detect heart signals, which indicate a driver is beginning to lose alertness and trigger a warning to pull over. In another study [25], the smart seat belt (Harken device) have been developed to sense heart rate. The Harken device is an innovative solution because it measures both variables on a scenario affected by vibrations and user movements, using intelligent materials embedded in the seat cover and the seat belt. The sensor system can be used to detect heart signals, which indicate a driver is beginning to lose alertness and trigger a warning to pull over. Most recently [26], Ford's European Research and Innovation Centre in Aachen, Germany is working on a car seat that can detect heart attacks. The device uses six embedded sensors to monitor heart activity. The system will then notify the necessary authorities in an emergency. Faurecia's concept Active Wellness seat has built-in biometric sensors to analyze a driver's heart rhythms and breathing patterns.

3 Conclusion

In this study, we presented some of the background information related to the development of the elderly healthcare monitoring system with IoT. As stated, the primary objective of this research will be concerned itself with the development of ambient assisted elderly healthcare monitoring system with IoT. The developing system can successfully detect and generate alarms in case of stroke onset, which will allow the timely delivery of medical assistance, to mitigate the long-term effects of these attacks. With the use of IoT, wearable healthcare devices collect and share information effectively in a database system with patient and medical personnel to make it feasible to make a faster communication and decision about the emergency situation much more accurately. IoT offers bigger promise in the field of healthcare and rehabilitation, where its smart remote technologies are already going to be applied to improve access to care, increase the immediateness of care and most importantly accuracy of the care.

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