Assisted Living using Ambient Intelligence and Sensor Technology
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Abstract—The goal of this paper is to contribute to the quality of life of the elderly people and help them to have a healthier and independent lifestyle with the use of Ambient Intelligence, sensors, signal and the communications infrastructure. Ambient Intelligence is the concept emerging from Artificial Intelligence, where people are assisted by using computer as the proactive tool. It is network of the hidden interfaces or sensors which are able to recognize our presence and respond to our immediate need. It makes use of three important technologies namely Ubiquitous Computing, Ubiquitous Communication and Intelligent User Interface. This paper provides a view on how ambient intelligence can be used to provide better quality living. Our aim is to make the use of wireless sensors in our everyday life to serve the purpose. We mainly focus on the health care domain. Combining the technological development such as wearable devices, sensors, sensor network with the user-centred design methods makes it more capable of providing better quality life in non-intrusive way. Elderly people with or without disabilities would be clearly benefited from it. It provides them an opportunity to live more independently through continuous monitoring with the use of sensors in non-intrusive way. It will enable them to live in their homes with sufficient confidence and security.

Key words: Ambient Intelligence, Artificial Intelligence, Assisted living, Sensors, context aware

I. INTRODUCTION
The Ambient Intelligence (AmI) paradigm represents the future vision of intelligent computing where environments support the people inhabiting them. In this new computing paradigm, the conventional input and output media no longer exist, rather the sensors and processors will be integrated into everyday objects, working together in harmony in order to support the inhabitants. By relying on various artificial intelligence techniques, our paper promises the successful interpretation of the wealth of contextual information obtained from such embedded sensors, and will adapt the environment to the user needs in a transparent and anticipatory manner. It is particularly identified by several characteristics:
- Context Aware: It exploits the contextual and situational information.
- Personalized: It is personalized and tailored to the needs of each individual.
- Anticipatory: It can anticipate the needs of an individual without the conscious mediation of the individual.
- Adaptive: It adapts to the changing needs of individuals.
- Ubiquity: It is embedded and is integrated into our everyday environments.
- Transparency: It recedes into the background of our daily life in an unobtrusive way.

Fig. 1: Example of an AmI architecture
In this paper, we provide information and the application of various ambient sensors which can help elderly people to live safely at home through continuous monitoring of their health.

II. PROPOSED APPLICATION
Our paper is intended to enhance the health care domain dramatically. The main idea is to make use of various sensors to monitor and support the people in their own homes. Home monitoring is a great way to help detect and monitor elderly people with or without disabilities. Regular readings taken over a period of time can track the history and indicate any changes, fluctuations or elevations. The figure given below gives us an idea about the flow:

Fig. 2: System Flow
For example, it can be used to monitor the health status of older adults or people with chronic diseases, and it can provide assistive care for individuals with physical or mental limitations. It can be useful to motivate people to
lead a healthier lifestyle independently. It also can be used in rehabilitation settings or in general in enhancing the wellbeing of individuals. Ultimately, it can support the health care professionals in terms of providing innovative communication and monitoring tools. These systems will provide health monitoring in a transparent and unobtrusive way.

III. IMPLEMENTATION

It can be implemented by embedding sensors into our environments, resulting in intelligent and pro-active living environments capable of supporting and enhancing daily life, especially in case of elderly people or individuals suffering from mental or motor deficiencies.

A. Needed Equipment

In the environment equipped with ambient intelligence there is no need of any instruction to be given by the individuals. The sensors serve this purpose. The sensor enable the environment to be sensitive and responsive to the humans. But care should be taken to install these sensors around elderly persons’ environment in an ethical way.

B. Connection and Communication Technology

Bluetooth and ZigBee provides the way to connect and exchange information between devices. Bluetooth and ZigBee both are types of IEEE 802.15(wireless personal area networks).Bluetooth uses high data rate, higher power consumption and works with large packet devices. While ZigBee uses low data rate, lower power consumption and works with small packet devices. However, ZigBee network can support large number of devices and longer range between the devices than Bluetooth.

C. Supporting Infrastructure and Technology

Here we will introduce the infrastructure used in AmI system in context of the health care domain. In particular, Wireless Mesh Sensor Networks(WMSNs) and Body Area Networks (BANs) needs to be implemented.

D. Benefits

- Continuous Health Monitoring.
- Continuous Behavioral Monitoring.
- Monitoring for Emergency Detection.

IV. SYSTEM FLOW

An AmI system can be built in many ways. Typically it needs sensors and devices to surround occupants of an environment (interactors) with technology. The technology can provide accurate data to the system on different contexts. The data collected is transmitted by a network and pre-processed by middleware, which collates and harmonises data from different devices. In order to make decision-making easier and more beneficial to the occupants of the environment the system will have a higher level layer of reasoning which will accomplish diagnosis and advise or assist humans with responsibility for intervention.
Elements that may be included in the high level ‘Decision Making’ process are a ‘Knowledge Repository’ where the events are collected and an ‘AI Reasoner’ which will apply for example spatio-temporal reasoning to take decisions. For example, a decision could be to perform some action in the environment and this is enabled via ‘Actuators’. Knowledge discovery and machine learning techniques learn from the acquired information in order to update the AI Reasoner in the light of experience of the system. A typical information flow for AmI systems is depicted in Figure 4.

V. NEED AND APPLICATIONS

Here we present few applications or cases where ambient intelligence and the sensors can be required for the assisted living.

An important area of emergency detection in the case of elderly people is fall detection, which can be especially useful for them. Fall detection techniques depend on several technologies such as wearable devices, ambient sensors, and cameras. Wearable fall detection systems measure posture and motion using sensors such as accelerometer and gyroscope and by measuring orientation and acceleration. The gyroscope and accelerometer sensors can be used to measure joint angles like hip, knee and ankle joints. In human basic daily motions, such as walking, sit-to-stand, and stand-to-sit motions need to be measured. The deviation from this results can help us to detect the fall. Passive alarm system can be used to raise alarm. Passive alarms are the alarms that turn on automatically. The information is sent to an evaluation system which automatically sends an alarm signal to the emergency service station, in case of strong deviations of standard values.

High blood pressure is a common risk factor for heart attacks, strokes, so diagnosing and monitoring it are critically important. Visits to the doctor's office can make the elderly person anxious that can affect the blood pressure readings, and even when accurate, it provides only one-time snapshots of the patient's condition. Hence a wearable blood pressure sensor can be made use of which provide continuous monitoring. The information collected can then be transmitted over a wireless sensor network. Regular readings taken over a period of time can track the history of the results and indicate any changes, fluctuations or elevations in the blood pressure.

ECG and EEG are also part of wearable sensors that can be used for the health check-ups and continuous monitoring of the person. ECG monitoring device detects the cardiac events, and reports anomalies by generating different alarm or automated notifications that can be issued via various means of telecommunications. It is used in the form of a wristband and measures various physiological signals. EEG still require the use of invasive devices and sensors. Measuring EEG requires the use of electrodes that are attached on the human scalp. Regardless of the form of the sensors, such sensors allow the patients to be in control of their health condition by benefiting from continuous monitoring and anomalous situation detection.

People with respiratory diseases need a climate adjusted to their condition. A bad climatic condition inside the home can increase the risk of illness - asthma, mites and mold infestation are just a few of relative humidity and temperature RH/T-dependent health risk factors. The integration of temperature and humidity sensors into wearable devices allows measurement of not only the ambient conditions but also the user's physiological information, such as skin temperature or sweating rate. The information can also be used to automatically control the indoor climate. If skin temperature and sweat rate is shared with a climate system, the room ambience can be optimized to personal preferences without the need of human intervention.

A. Types of Sensors used in AmI Systems:

1) Humidity And Temperature Sensors:
This sensor is used to measure the temperature of the human body. It can also be used to measure the humidity of the immediate environment around the person. The indoor environment can be optimized using the collected information. An alarm signal can be issued in the case of drastic change in the human body temperature.

2) Accelerometer/Gyroscope:
Accelerometer and gyroscope are important sensor that can be used in field of health care domain for fall detection. The Accelerometers are used for recognizing body postures like standing, walking, running, sitting etc. The accelerometer-based posture monitoring for BANs typically consists of 3-axis accelerometers (or tri-axial accelerometers) positioned on well-defined locations on a human body. Gyroscopes are used for measuring orientation, based on the principle of conservation of angular momentum. Gyroscopes are typically used together with accelerometers for physical movement monitoring.

3) ECG sensor:
ECG Sensor is to help diagnose heart disease. It measures the heart’s electrical activity. They can also use it to monitor how well different heart medications are working. Here several electrodes are attached at specific sites on the skin. The electrodes measure tiny electrical changes. The potential differences between these electrodes are measured.

4) Blood Glucose:
The quantity of sugar present in blood is referred to as Glucose or blood sugar. It is very important to control blood glucose to avoid complication. An optical meter (glucometer) is used to analyze the blood sample and gives a numerical glucose reading. Non-invasive glucose monitoring is also available which makes use of infrared technology. Using this sensor there is no need to draw blood and hence causes less pain to the people.

5) Blood Pressure:
The blood pressure sensor is a noninvasive sensor designed to measure human blood pressure, utilizing the oscillometric technique. Recently the sensor embedded in the form of wristband are also used to measure blood pressure.

6) EEG Sensor:
This sensor measures electrical activity within the brain by attaching small electrodes to the human’s scalp at multiple locations. Then, information of the brain’s electrical activities sensed by the electrodes is forwarded to an amplifier for producing a pattern of tracings. Synchronous electrical activities in different brain regions are generally assumed to imply functional relationships between these
regions. In a hospital, the patient may be asked to breathe deeply or to look at a flashing light during the recording of EEG.

VI. SOCIAL AND ETHICAL ISSUES

Some of the services provided by wireless networks or Body Area network can pose ethical questions. Location and monitoring of people can be of vital importance for the security of some disabled and elderly users but these techniques are very intrusive and must only be used with the permission of the user or his/her family. On the other hand, some remote services provided by networks can contribute to personal isolation if they substitute human care. Therefore, to avoid abuses or intrusions it is necessary:

- To provide the designers with guidelines that implement ethical design criteria.
- To promulgate laws to protect autonomy and privacy and avoid social exclusion and isolation.
- To establish compensatory measurements to enhance socialization.

Since most of these problems arise in the design phase, designers must be provided with design guidelines that are aware of ethical and social issues.

VII. CONCLUSION

Ambient Intelligence is an emerging area based on ubiquitous computing that proposes new ways of interaction between people and technology, adapting them to the needs of users and their environment.

The proposed application considers very specific restrictions of applying sensor networks in clinical situations. In this survey, we explored the application of ambient intelligence to the health care from various perspectives. We discussed the use of AmI in health care based on individuals medical conditions, such as physical disabilities, chronic disease or rehabilitation situations. Our application is intended to improve the quality of life of the people by monitoring them through the use and implementation of various sensors using ambient intelligence. However, we are aware that the goals set up for AmI in health care are not easily reachable and there are still many challenges to face.

REFERENCES

[1] Ambient Assisted Living and Home Care: 4th International Workshop https://books.google.co.in/