

Survey on Applications of Ambient Intelligence

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Abstract

Ambient intelligence (AmI) is an emerging area in information technology. The AmI's basic idea is that by enhancing an environment with technologies (using sensors, devices which are interconnected with the network) a system can be made that is sensitive to the people's response. Ambient intelligence mainly aims to improve the people's way in interacting with their surroundings to enhance their lives. Some of the major applications of ambient intelligence are; smart home, public transportation sector, education services etc. The main aim of the paper is to survey applications of AmI namely; healthcare and home environment.

Keywords: Ambient intelligence, sensors, decision making, smart home

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INTRODUCTION

Initially, the computers were very expensive and also very difficult to use and understand. Many individuals were using a single computer. In the next step of evolution, one user was able to access multiple computers. Computer science, which is the new branch of science, has gone through a tremendous transformation from the very first decade of its existence. This has led to technological development.

The miniaturization of the electronic devices has made the embedded computing devices, which help us to cook (microwave ovens), wash (washing machines) and drive our cars. The evolution in the field of technology is significant in the birth of ambient intelligence. The past years revealed an interest in the responsibility of information technology to support human's lives. Ambient intelligence (AmI) is an electronic environment that is susceptible and responsive to the presence of people. AmI is a vision on the future of intelligence computing. As the devices used to implement the AmI have grown smaller, it makes it possible for the computer to disappear into the background while the human users will be the main actors [1].

AmI is an area, which has the idea of making available the people computing in a non-interfering way. The presence of intelligence is

the key factor in AmI. Ambient intelligence is based on three key technologies. They are:

1. Ubiquitous computing,
2. Intelligent user interfaces, and
3. Ubiquitous communication.

Ubiquitous computing means the incorporation of microprocessors into everyday objects such as furniture and clothes. People will not be aware of the presence of devices that are working in the background by using the ubiquitous computing. Ubiquitous communication should allow communicating these objects with the user and also with each other. The intelligent user interface in the AmI allows the residents to control and interact in a natural and personalized way with their environment by using voice, gestures, preferences and also by context.

Since the AmI is a real world concept, the sensors play an important role. The existing computational power is linked to the physical application by using the sensors. The environment is perceived by the software algorithms and this information is used to reason about that environment. Perception is consummated by using a wide variety of sensors. For example, there are sensors to determine light's readings, for measuring the position, for detecting the chemical and humidity sensing, temperature sensing etc. Radiation, strain, stress, pressure, velocity, and

physiological sensing can also be done with the help of sensors, especially for monitoring the health. Motion sensors are one of the technologies used to track the individuals. Video camera and microphone are other sensing devices that are used to recognize the individuals. It is feasible to incorporate the sensors into the AmI environment because the sensors are quite small. The environmental monitoring, monitoring the structural safety and situational awareness are some of the applications of sensor networks community. The challenges faced by such networks and wireless sensors are, the management of resources in order to support the data collection which is long-term.

The intelligence algorithms linking to the real world is provided by sensing and acting in which they operate. Different reasoning should take place in order to make such algorithms reactive, adaptive and also favourable to users. The reasoning includes modelling the user, activity prediction recognition, and making the decision. The model user behaviour ability is one of the features, which separates algorithms of computing from those, which are receptive to the user. The most common data source is low-level sensor information for model building. It is easy to collect and develop this data. Bulky nature of the data collection is one of the challenges in using the low-level data. Another challenge faced by modelling the algorithms is the amount of data created by sensors. Ability to predict and recognize the activities that occur in the environment of AmI is offered by reasoning algorithms. Different types of activities can be classified based on the information gathered by different sensors. Accelerometers placed on the bodies will collect the data, which help to recognize actions involving repetitive motions of the body like walking, standing, starts climbing etc. Other activities cannot be easily determined by the positioning of body.

Technologies that support the AmI have emerged, established, and grown. AmI application with full automation is still in progress. Automated decision making and controlling are needed for the accomplishment of such tasks. Mozer's adaptive home is an example of the fully implemented application that is using the decision-making technologies.

Sensing and acting are the activities that connect the reasoning with the real world in AmI system. Mechanisms provided by the assistive and intelligent devices in which AmI system can affect the users of the system. Using robots are other mechanisms. Robot assistants have already been appointed in nursing homes in order to provide the nurturing contact for the old people. Robots support the AmI by providing the wide range of assistive responsibilities. The robots can monitor masters' vital signs and provide eco-friendly urge. They are able to exhibit human-like expressions and also emotion better than the past. Such characters will facilitate human interaction, allow the influence of AmI to saturate culture of humans.

APPLICATIONS OF AmI

The ambient intelligence has many applications. Two of the applications will be discussed in this paper.

Smart Home

Smart home is one of the prominent examples of an environment enhanced with ambient intelligence. Highly automatized homes vision with revolutionary technologies, have been developed like; intelligent home, home of future for decades, already. Such technologies help its inhabitants to live a safe and healthy life, it also perform tasks robotically which reduce the stress of managing the home. These technologies will not interrupt the people because the details of working such technologies will be hidden from the users. The outmoded term intelligent is replaced by terms such as aware house or interactive and alive environments.

The application in the field of housing is broad since most of the time the people will spend their time at home than any other place. The ageing population would like to spend most of their time in their home. The smart home is intended to save energy and also to provide security and safety. Smart home should be viewed from the perspective of supporting families and friends being together and cooperating together with each other [2].

The basic idea of home automation is to control the existing tasks like HPAC (heating, plumbing, ventilation, air-conditioning),

electrical installations, lighting, fire alarms and also electronic appliances control easier. Currently, most of the home automation systems are implemented without using any intelligence. People can control home appliances using existing switches. Already implemented the project at Dallas/Fort worth airport, the sensors will control the lights, which measure the light from the sun. When it is a sunny day the light will dim, and when the sun is blocked by the passing cloud, it will brighten the light. A school at Washington, DC, when there is an open window, the air conditioner will automatically shut off. In intelligent homes, such functions will be organized by using touch panels, even by voice, facial expressions and also by using hand gestures. Here, AmI refers to the home automation system, which will identify the inhabitants and maintain the functions according to their moods. Channels will be switched to admire ones automatically. The degree of lighting, adjusting the windows shade will also be done automatically. The utilities related to HPAC as well as securities have the higher necessity for reliability and also fault tolerance [2].

Sensors can be implemented in the room in order to decide when its resident is out or in, the lights will be turned off or on accordingly. But when a person is reading in resting position, it will confuse the system which leads to darkening the room. If so, the different substance should also be noted for example a person leaving the room will be detected by using the door switch. When executing such environments should not remind you of the laboratory, should provide the cozy environment. However, quite a few artifacts and things in a home can be enhanced with the help of sensors which assemble information about their use and also help to act independently without the intervention of a human [1]. Examples of such appliances are electro domestics like cooker and ovens, household items like taps and sofa, temperature handling accidents like radiators and cooker. ALADIN is one of the projects held in Europe that tackles intelligent utilization of energy for house residents wellbeing [3]. It consists of the adaptive lighting system. It consists of many

components like intelligent open loop control, which can adjust different light factors in response to psychological as well as physiological data it obtains. AmI allows the home to possess intelligence by itself and also to make decisions concerning its state relations with the residents living in that environment. MavHome is a project which treats such environment as an intelligent mediator, it will observe the environment by using sensors and using power line controllers, it will act to surrounding.

The Gator Tech Smart House is another project aimed to provide an assistive atmosphere for elderly people to bear living independently. The home contains many sensors and actuators, which will generate a large quantity of data streams. This project also provides remote monitoring for caring older people. Georgia institute of technology has developed a project named Aware Home [3]. Tracking and sensing technologies are implemented in that house, which will help to find frequently lost items like keys, glasses and also remote controls. RF tags attached to those items will help to track the items. There are many projects developed in different parts of the world in the field of smart homes [4]. Recognizing the reputation of the intelligent homes, many projects lead by industries, are developing intelligent homes. Security is the second concern after the primary needs. Physical access today is mainly provided by using the mechanical locks. Since the burglary rate is increasing, identification and advanced locking systems demand is also increasing. Old age people, children, disabled persons, even parents, when coming home with both hands carrying children or things need a lock that is capable of identifying and allowing the authenticated persons to enter the home, that is hands-free opening. The access control can also be provided using electronic keys like RFID biometrics or tokens as well as a combination of both and also magnetic cards. The surveillance can be done using cameras and sensors.

One of the challenges for AmI is to choose on whose preference should be taken, when there are many residents in a home. Even if only one person is there, it needs to guess from a facial

expression and the mood of that person. Another drawback of existing technologies in smart home is that the user needs to wear the sensor devices in order to position that person as well as for fall detection [2].

Health Care

Nowadays, most of the developed nations are facing complications concerning the quality and the cost of different healthcare and welfare services. Such difficulties will worsen because the old age population is increasing and they need to be cared [5]. The cost for such actions may not be sustainable so that the developed countries must find a way or plan some policies in order to use the limited cost-effective resources efficiently. Providing such kinds of systems for healthcare will help our worldwide society and economy. We have seen many apps providing health services for monitoring the physiological status [6, 7]. But, such solutions lack security issues and privacy issues. And it will not provide an overall view of the health which will be the course of many years, instead only provide physiological condition's snapshot. The network sensors advancement made away to low-cost innovative systems for monitoring the healthcare which is integrated within the living environment [8].

The AmI have the ability to develop a domain of healthcare. The AmI environments maintenance is anticipated to have a major role in health issues. Elderly or old aging people's health status can be supervised using AmI technologies. It can also provide concern to the people who have physical and mental limitations. It provides the monitoring of the health in a transparent way. The advancement in the wireless networks and miniaturization of the devices has led to the growth of BAN [9]. In this, different sensors will be appended on clothes either on the body or under the skin. This will help to monitor the features of health, like the temperature of the body, ECG (electrocardiogram), EEG (electromyography) etc. BANs uses the technological communications for distantly streaming data sensor to the sites of doctors in order to provide a diagnosis in real time. This information is sent for keeping the record in medical databases [9]. Communication efficiency and cost efficiency are some of the

benefits of using the wireless BANs (Body Area Networks). Body sensors will produce physiological signals which can be processed in order to get consistent and correct physiological evaluation. The ultra-low power utilization of sensors will lead to long-lasting batteries of the sensors. Since the body sensors' demand is increasing in the market of electronics, they will be available at low cost.

A different ambient intelligence application was already developed for healthcare. As discussed earlier, many sensors for monitoring different physiological constraints are available in market at low cost. Some of them are in the wearable devices form like wristbands, some are integrated into clothes like smart fabrics. Constant monitoring is not possible in today's centres of healthcare and the tests of physiology will be conducted only during special visits to the doctor. Using such kinds of sensors will help the adults to know about their status of health and also take essential steps for improving their life. Behavioural monitoring is another application of latent monitoring. It is helpful in monitoring the mentally disabled persons. Such kinds of systems can measure mental health and inhabitants' emotional status in a natural manner. It will give automated care and reduce the burden of caregiver. Emergency situation monitoring projects are also done. Using different sensors like passive infrared sensors, British telecom along with the Liverpool city council in the UK have built a project for monitoring the residents [10]. Emergency detection also includes the fall detection. The ambient intelligence can contour modern rehabilitative advance which helps the people to use the resources of rehabilitation.

CONCLUSION

Ambient intelligence represents the idea of the computing next wilds. AmI ensures the successful achievement and interpretation of related information. It also promises a sensitive user interface. AmI can be used to associate smart home with that of the hospital care technology. Using AmI hospitals will be able to enhance their services by analyzing the health of the patients. Since people spend the majority of time at home than any other area, AmI have an immense opportunity in a home environment. The AmI has made a large

amount of work, but it face challenges since it needs to interact with the humans. The AmI has to be aware of the preferences users, objective, and requirements of users. It should know whose preferences should be considered when there are more residents and also when to make decisions and suggestions. The humans need to expand their effort in order to concentrate themselves to have enjoyed the computing advantage. AmI is a rapid establishing area which is intended to help the society using technologies. Still there are different challenges faced and also, improvements are required at every level of algorithms and interaction between human and the systems. Moreover, it should be useful to the world.

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