UBIQUITOUS INFORMATION INTERACTION UII IN MANAGING NATURAL DISASTER CHALLENGES

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ABSTRACT: *Ubiquitous Computing is viewed as one the latest emerging technology trends now-a-days. Ubiquitous Computing as an emerging application of information and communication technology (ICT) is embedding in everyday life of humans. The main objective of Ubiquitous Computing is to enhance human and machine interaction by embedding computers, sensor embedded devices, and other people in everyday lifestyle. Ubiquitous Computing will facilities users to interact with other smart objects embedded in the physical environment for information exchanges in seamless fashion. These embedded devices sense the environment and disseminate information without intervention of the user. Natural disasters are the increasing phenomenon on the planet and disaster management is one of the utmost research domains around the globe. Developed and developing countries are imposing great research efforts in disaster management domain. This research study provides an understanding of Ubiquitous Computing, builds the relationship between Mobile Computer Systems (MCS) and Ubiquitous Computing and surround the idea of Information Interaction in ubiquitous environment using mobile devices. This research study also focus the disaster management as an important application domain of ubiquitous computing paradigm and investigate some critical problems in disaster management which can be effectively solved by using Ubiquitous Computing, Mobile Computer Systems and Ubiquitous Information Interaction (UII).*

KEY WORDS: Ubiquitous Computing, Ubiquitous Information Interaction (UII), Mobile Computer Systems, Natural Disaster Management, Ubiquitous Dead Bodies Management

INTRODUCTION

Ubiquitous computing idea firstly introduce by Weiser in 1991 [1]. A system consists of computers and software that encircle the user which provides seamless assistance to the user during navigation of his or her routine life and work [2]. This is a new type of computing, the idea behind Ubiquitous Computing is to building a computing environment in which user can access provided computing resources in transparently [3]. In this type of computing environment variety of diverse computing devices are placed to different locations in the physical environment which perceive the real world conditions from the surroundings and automatically exchange information between the other coordinated devices [4]. So it is the way to enhance or enrich the use of computers and computing devices which are available through physical environment but seamless to the user [5]. Ubiquitous computing refers to interaction between computers and human. Ubiquity and transparency are two major aspects ubiquitous computing. Ubiquity refers interaction to the system whenever user needed and transparency means the system interaction is seamless or non-interfering. In Ubiquitous computing, variety of computers and computing devices with associated software surrounded the user and assists the user through his professional and personal life invisibly and transparently. In this kind of computing environment, information sense or collected from the environment through different devices placed at different location , exchange information between coordinated devices, processing of collected information and convert and present this information to the user in the form of valuable knowledge for his current and future activities including some specific tasks and decision making. This ubiquitous way of collecting, storing, processing and exchange of information is called the Ubiquitous information Interaction. Ubiquitous computing as envisioned by [6], the interaction of computer and computational devices with Human and environment whenever they needed it. According to him these devices can vary in size and ranging from hand held personal devices such as personal digital assistants (PDAs), laptops, tablets etc. to shared devices like wall sized electronic white board.

Ubiquitous Information Interaction and Ubiquitous Computing

Ubiquitous computing is refers to intercommunication of tiny devices having microprocessors and equipped with embedded sensors in the objects which are almost invisible. These devices interact with the environment of the object in which they embedded, and facilitate storing, processing and sharing information of the environment invisibly and seamlessly. [7] The word *ubiquitous* is derived from the modern Latin word *'ubique'* which means *everywhere*. Ubiquity reflects the concept of presence or appears everywhere which can be almost similar to the other computing concepts including 'Pervasive computing', 'ambient intelligence' and 'the Internet of things '. The ultimate objective of all above defined concepts is to providing continuous invisible assistance to the by embedded objects into the environment. The ubiquitous computing can be illustrate by the following features

- Embedded objects or Smart Objects concept (Embedded hardware and software in the objects of daily life)
- Decentralization (Transferring the system and their networks into modules)
- Anywhere Presence (Providing mobility to the user through information services availability anytime anywhere)
- Context Awareness (Information system is context aware)
- Invisible (Without user interference automatic identification and self-governing processing) [7]

The possessing above defined characteristics is called Ubiquitous Computing.

Ubiquitous Information Interaction means management of information in an environment where devices are intercommunication with each other without interference of the user or users no need to give instructions to access the required information. The devices with embedded sensors and microprocessors are capable of storing, retrieving and processing the information invisibly or seamlessly. In this kind of information interaction, information flow is based on events when a specific event occur or objects with embedded devices sense the environment in which they embedded , encounters a particular event then flow of information based on that particular event is started.
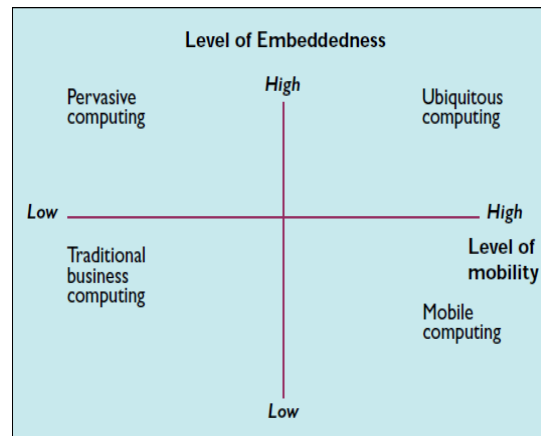
Ubiquitous Computing concept leads to the concept of Ubiquitous Information Interaction. An information system comprises on embedded or smart objects of daily life into the environment, understands and reacts to the environment, automatically identify the different objects placed at different geographical location into the environment, perform autonomous information processing, invisible to the users, capable of context awareness and provide great mobility. In assisting to the human beings with the help of tiny sensor devices embedded into the daily life objects and these devices connected to each other wirelessly sensing and reacting to the environment in the form of collecting, storing and disseminating information from one device to another device seamlessly and user get the awareness of the current situation. These devices continuously recording the environment and transmitting information to each other for the assistance of the people and the information passing to and receiving from each device is invisible to the user of the system. This information system or information interaction supports the

Figure 1: Mobility/ transparency Matrix [9]

user in better decision making with the help of intelligence of the environment achieved by smart objects. This flow of information of users' surroundings is called the Ubiquitous Information interaction. So the information management in a

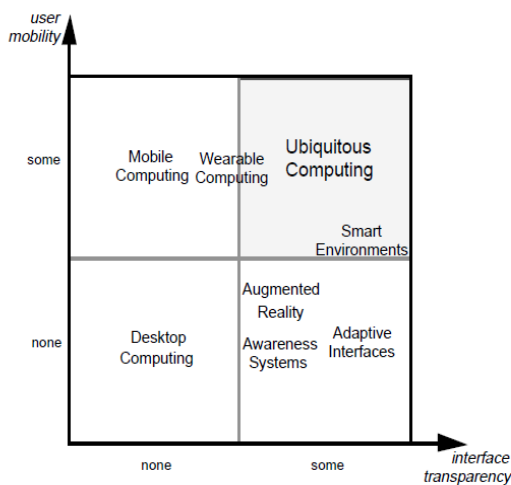ubiquitous environment is called ubiquitous information interaction.

Mobile Computing V/s Ubiquitous Computing

Mobile computing generally refers to the anytime anywhere computing by using tiny computing devices (smart phones , tablets) and advance wireless technology like Wi-Fi with the limitations of changing computing models [8] with the movement of user while ubiquitous computing , is the interaction of human, environment and computers seamlessly and invisibly. Another type of computing in which computers are also invisible and capable to obtain information from their environment and dynamically used this information to build the computational model this is called the pervasive computing [8]   . Mobility is the main feature of mobile computing while the ubiquity and transparency are the attributes of ubiquitous computing furthermore pervasive computing poses the intelligence. Following is figure that exhibits the mobility and transparency aspects of mobile computing and ubiquitous computing.

Figure 1 shows the user mobility and user transparency

Figure 2: Mobility and Embeddedness [8]

attributes in mobile computing environment and ubiquitous computing environment along with two dimensions some and none. The mobile computing provides some user mobility and none user transparency interface. Ubiquitous computing facilitates by some user mobility and some user interface transparency.

Ubiquitous computing interchangeably called pervasive computing [3]. Following is the figure that demonstrates the level of embeddings and level of mobility of above defied computing paradigms.

Mobile Computer System:

A technology that permits data transmission via computers without having physical connection and fixed location is known as Mobile Computing(MC).MC enables mobile devices to create , store , process, and access the information without having spatial and temporal constraints   [10].

Ubiquitous Computing:

 A system consists of computers and software that encircle the user which provides seamless assistance to the user during navigation of his or her routine life and work [2]. Ubiquitous computing means interaction of human and computing devices placed in the environment, invisibly. Tiny

devices having computational power, connected and communicating to each other wirelessly, located in the physical environment at different locations, sense and store environment and also capable for communication and processing information, this type of invisible intercommunication of devices and transparent information processing, without any invitation of one device to another, is called ubiquitous information interaction.

Now, we are going to build the relationship of MCS and ubiquitous computing, in this relationship ubiquitous computing definition is same as above; the user interaction with the computing devices located in environment is not through the desktop computers but the mobile devices. So the Human's mobile devices interact with small computing devices (even sensors) and environment ubiquitously and transparently. Furthermore the relationship between MCS and Ubiquitous Information Interaction can be defined as, information senescing, storing, intercommunicating and processing by these microprocessor embedded devices and user's mobile devices in non- interfering fashion. The relationship between the ubiquitous computing and Ubiquitous Information Interaction is can be defined as the information captured in a ubiquitous environment can be disseminate to any other computer, device or a person placed in physical environment invisibly even to a mobile device and these mobile devices are capable of accessing information ubiquitously with the help of mobile based applications.

Figure 1: Ubiquitous Information Interaction

MATERIALS AND METHODS:
The increasing adoption of mobile devices and wireless technologies development changing the way of human's life and creating more opportunities in the variety of domains with promising of great efficiency, accuracy in anywhere anytime computing, neglecting the time and space constraints. Mobile and ubiquitous computing shifting the learning approach by combining the learning resources from the real world and the digital world [11]. In ubiquitous learning approach students are situated in real learning environment and getting support of digital environment with the flexibility of mobile devices [12]. Healthcare domain is also getting the technology advantages and mobile computing and sensor networks are widely used in healthcare monitoring and wellbeing management [13], personal health monitoring and management [14] in which tiny embedded devices (sensor) are placed on the patient's body and form a sensor network generally called Body Area Network (BAN) and

these sensors are capable of sensing, processing and communication physiological signals, physical activity and environmental parameters as well. Agricultural industry is also using sensor network and ubiquitous computing for agricultural environment monitoring [15], rice intake management system [16] for rice cultivation, smart agriculture services [17] for agriculture development and draw a relationship between factors of crops growth and ubiquitous agricultural information system [18] to know farmer`s ability to use IT devices and informatization status of farmers in agriculture. In the ubiquitous agriculture, sensor nodes collect environment concern information, process this information and store collected information in a repository for future uses and decision making. Smart home is the term used for technology equipped (collaboratively sensor nodes or embedded small computing devices) residence [19] with the capability of observe the people living in it and monitoring the activities of the residents for adding the help to handicapped people, to provide safety by detecting changes in their environment or abnormal activities of residents. In a home where children and old people are living continuous attention and proper monitoring is required for assist them in order to perform their routine life activities. Eldercare and childcare [20] is provided by using smart home that utilize audio-based and computer vision techniques for providing assistance, care and safety for children and elder people. The sweet home [21] project is utilizing audio-based interaction technology for controlling home environment and providing social inclusion for handicapped and elder people by using speech and sound recognition.
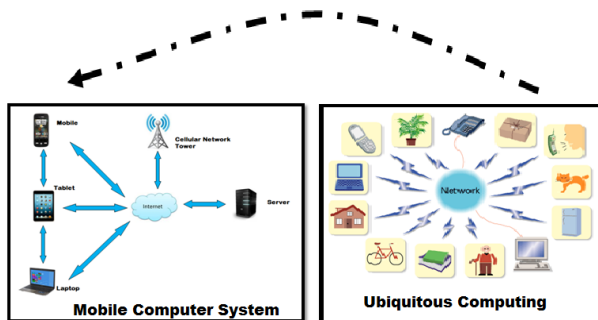
DISCUSSION:
Smart Disaster Management
1.   Ubiquitous Identification of the Disaster Hazardous Zone
Advances of sensor technology, wireless networks technology and mobile devices derived the concept of smart home, smart building, smart environment etc. In the entire defined concepts tiny sensor embedded devices are placed in home or building or environment. These sensor devices sense the environment in which they are placed and intercommunicate to each other without intervention of use. This seamless and invisible interaction of the sensor embedded devices leads the concepts of ubiquitous computing and the sharing of sensed information from one device to another devices, utilization of this information for decision making without user interaction is called ubiquitous information interaction. Use of wireless sensor devices are increasing in various humanitarian assistance domains like healthcare, smart homes, smart buildings, smart cities, environment monitoring, logistic operations, elderly care, child care etc. disaster management is one of the most important field where sensor devices and wireless sensor networks are also incorporating for monitoring environment. These wireless sensor devices sense the environment and in case of any abnormal situation they can alarm the warning signals or messages to the relevant authorities for carrying out necessary steps. Wireless sensors are widely used in under water for monitoring water level of the sea and rives

for alerting flood disaster or tsunami. These wireless sensor networks trigger the early disaster warning for flood or tsunami. Disaster early warning system using wireless sensor networks is deficient in terms of ubiquitously disseminating early warning messages to the specific mobile users' presents in the possible disaster hazardous region. In this type of early warning system , wireless sensors should sense the environment, collect the data ubiquitously , transform the wireless sensor data into spatial data , calculate the approximate boundaries of the disaster region, calculate hazard map on ubiquitous GIS then by using GPS technology disseminate the early warning messages to the mobile devices of inhabitants of the possibly affected region.

2.   Smart Cities leads Efficient/Smart Disaster Management

Smart homes or smart house concept refers to "the home equipped with sensor embedded devices and facilitates inhabitants to remotely control and monitor home functions including lighting, temperature, water, electricity, gas , security and support for the elderly etc. following is figure of smart home. There are some challenges which are must be resolved before Smarts homes becomes reality. Sensor embedded devices placed in the environment that can sense the environment and be able to intercommunicating each other and disseminate information from one device to another device without interaction of user. If the smart homes or smart cities concept sophisticatedly implemented then the information collection, identification, searching and locating of victims, inventory management of the victims, damage estimation made easy and accurate by incorporating ubiquitous computing paradigm in disaster management system.

Figure 2: Smart Home [22]

3. Ubiquitous Disaster Rescue Operations.

During disaster rescue and relief works there are many activities that are executed to save human lives and livelihoods. In a rescue operation, rescue team members trying to locate, search and evacuate trapped people in minimum amount of time to get meaningful results of the rescue operation. during rescue operation activities wearable sensor devices can enhance the rescue activities in order communicate invisibly from one rescue worker to another as well as central disaster management system to collect, store, share, and retrieve information , photos and videos during

rescue work. Similarly relief workers using wearable sensor devices can easily identify the victims (also having some wearable sensor device like RFID tag), track, locate, and monitor the victims as well as other relief workers of the teams. Automatic logging of the activities can be performed ubiquitously. Inventory management of the relief commodities can be done using ubiquitous computing, RFID tagging and wearable sensor networks. Information sharing during relief work using ubiquitous information interaction can add help in managing disaster relief work more efficiently.

4. Ubiquitous Dead Bodies Management.

Disasters are resulting in unbearable losses of lives. In Disaster rescue operation the priority work is to search, locate and evacuate the unfortunate people trapped in disaster event commonly called as Victims. Victims can be injured people, seriously injured people, fortunate people who are not affected by disaster and the most unfortunate people who died in disaster event. During disaster rescue operation in search of victims when someone's dead body found then these dead bodies are shifted to hospitals or mortuary. After that the relatives of the victim's starts searching the dead body of their beloved sometimes dead bodies can be found easily sometimes this task is too difficult even they didn't found. Management of dead bodies in a disaster situation is an important task. Sensor technology and RFID in conjunction with mobile computers can facilities dead bodies' management efficiently. Tracking and record keeping of dead bodies in a mass casualty, is not an easy task. Ubiquitous computing can play a pivotal role in managing dead bodies in disaster scenario. When volunteers found dead bodies they can tag dead bodies using RFID technology. These RFID tags which are stick on the dead bodies containing the information regarding dead body e.g. time and place where found, who found this dead body, where this dead body is being shifting etc. this data can be read using RFID reader can be stored in central dead bodies information system and transmitted to the mobile device. RFID automatically identify, track and monitor this dead body. Whenever the information updated in the RFID tag this change will be reflect to the central information system and dead bodies information keep consistent. RFID technology in combination of mobile and wearable devices can track and monitor dead body easily using Bluetooth technology. Ubiquitous information interaction can helps in tracking, monitoring and identification of dead bodies in a disaster scenario from the beginning of time when the body found as spatial and temporal data is the basic part of the information collection of dead bodies. Adding photos and of dead bodies and synchronization with web technologies can also enhance the identification and management of process of dead bodies.

CONCLUSION:

Ubiquitous Computing is the latest emerging technology trends and facilitates humans to provide great assistance by fabricating computers, small and tiny sensor embedded devices, processing power and other people by merging physical and computational infrastructure. There is a variety of application areas of ubiquitous computing and mobile

technology. Ubiquitous computing is widely used in personal identification, transportation and logistics, healthcare, industrial management, material management etc. ubiquitous Computing has the potential to solve the challenges of disaster management such as managing dead bodies, information management during disaster rescue operations, information interaction between rescue teams during disaster relief operations, automated victims and their family identification in a refugee camp. This research study explores some new dimensions in enhancing disaster management activities by incorporating ubiquitous information interaction idea.

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