ISSN 2063-5346

SYSTEMATIC METHOD OF EMERGENCY HEALTH CARE MONITORING BY UBIQUTOUS TECHNOLOGY.

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Article History: Received: 10.05.2023 Revised: 29.05.2023 Accepted: 09.06.2023

Abstract

The dynamic changing context of the user poses unique challenges even on the advanced network and communication system. The system becomes more demanding especially when it has to facilitate appropriate and instantaneous services in emergency medical and health care situation. This paper presents a novel mechanism that integrates context awareness with pervasive computing in healthcare services to meet the dynamic needs of patient precisely. The proposed study uses higher dimensionality in the context design for encapsulating the precise clinical and non-clinical condition of the ill-individual and design a framework based on pervasive computing and Ambient Intelligence for catering up the emergency need using IEEE 802.15 standard and 3G based mobile network. Supported by real time experiments using heterogeneous sensors and accelerometer, the results shows better and effective performance of the system.

Keywords— Ambient Intelligence; Ubiquitous Computing; Context Awareness; Health; Emergency Medical Situation.

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DOI:10.48047/ecb/2023.12.9.91

I. INTRODUCTION

There has been high adoption of modern and advanced technology in the domain of emergency health care services. But till now catering the urgent need of the critical condition patient instantaneous is never guaranteed by any technology due to certain non-clinical constraint e.g. distance between the patient and medical assistant, correct and precise information about the health condition of the patient to the medical assistant staff in case of emergency, which may lead to wrong medication or imprecise dosage administration based on current vital stats. Therefore, it can be said that emergency healthcare services in real-time encounters various constraints which cost the life of the patient. Although, there are already availability of wearable devices that monitors the health statistics of the patient, but real time transmitting the precise information to the medical assistant staff is still yet to be seen. However, such issues could be assured for reliability, interoperability, instantaneous, if designed correctly. The proposed paper introduces a framework that uses higher dimensionality of context parameters in real time and uses Ambient Intelligent and pervasive computing approach for emergency medical and health care situation. The discussion of existing systems has been discussed in Section 2 followed by proposed model in section 3, section 4 describes implementation and results and finally, section 5 summarizes the brief of the proposed study.

II. EXISTING SYSTEM ANALYSIS

There has been tremendous interested into implementation of wireless communication and sensor technologies in pervasive computing and Ambient Intelligence (AmI), along with context-aware computing has consummate an exponential consideration. The design and construction of context-aware applications running in highly dynamic environments and that adapt to changing user requirements remains still a sophisticated and error prone task. Therefore, Ambient Intelligence has come forward to provide a solution in context aware situation. In this section, a brief introduction existing mechanism and system and their deployment techniques in Ambient Intelligent has been discussed.

A. Ontological Approach:

This approach uses ontologies for the establishment of context-aware pervasive computing systems. The work done in [1] makes several research contributions. i) First, as context-aware applications rely on information to adapt their behavior and to decide with whom to cooperate, it presents context modeling abstractions that capture the heterogeneity and the quality of context information. The context modeling abstractions cover semantic, spatial, temporal aspects, as well as certain kinds of context ambiguity. They are used to specify context-aware application behavior and to match decisions made in similar situations of the past. The work also presents efficient context matching algorithms that are appropriate for resource constrained devices as commonly found in AmI environments. ii) Second, the author has presented a middleware support that implements common context management functions of context-aware applications. It encapsulates the functions as modular building blocks that can be activated only when the application needs them. These building blocks are responsible for the acquisition of context information from various sources, the processing and persistency of context to recognize situations of interest from the gathered context information. The middleware provides programming abstractions for the applications to create a high-level constrained view on the collected context information. iii) Third, to support context-driven adaptation of mobile services, we provide modeling abstractions for context-aware applications that encapsulate both functional and non-functional aspects. In this approach context-aware applications have a component based design with variability points to support runtime adaptation. Mandatory and optional components, that are not only syntactically but also semantically described, provide the customizable application logic and their activation is subject to context dependent constraints. As such, the current context not only influences the behavior of a component (e.g. reminder with proximity-based notification), but also drives the decision process that determines how the component composition should change at runtime when conditions change (e.g. change the notification logic from a visual to an auditive cue). These application modeling abstractions are used to coordinate the discovery, selection, deployment and relocation of context-aware applications. iv) it presents algorithms and protocols to mediate context information to and from relevant applications operating in mobile ad hoc networks and mechanisms for context-driven discovery, selection and use of remote applications. By sharing context information in the network, remote applications can take advantage of context that they cannot sense themselves. Furthermore, each node in the network includes in their context description details about its applications, their state and other available resources. This way, we support context-driven discovery and selection of remote applications and can opportunistically replicate applications to other devices closer to the user or with different interaction modalities. By keeping replicated applications in sync, we can increase the usage opportunities and expedite the interaction between a mobile user and an application. This form of application adaptation is achieved by extending the life-cycle of an application with context-driven migration and diffusion of an application to multiple platforms and synchronization of the internal application state. The work finally presents real-world applications and case studies that evaluate the implementation of the middleware, as well as its underlying foundations, and illustrate the process and issues involved in the design of context-aware applications.

B. Mobility, Contextualization and Collaboration Approach

The ambient intelligence is a challenging research area focusing on ubiquitous computing, profiling practices, context awareness, and human centric computing and interaction design. The work discussed in [2] is concretizing the approach in a platform called IMERA (French acronym for Computer Augmented Environment for Mobile Interaction). In order to make work together several sensors, actuators and mobile smart devices, the need of a context-aware middleware for this platform is obvious. The approach also presented main objectives and solution principles concretized in a context-aware middleware based on hybrid reasoning engine (the ontology reasoning and the decision tree reasoning), which retrieves efficiently high-level contexts from raw data. This platform provides an environment for rapid prototyping of context aware services in Ambient Intelligent (AmI). To reach AmI, first, we need to integrate all sensors, actuators, communication objects and computing devices to the system. Low level mechanisms and drivers are necessary but they must be encapsulated to more common and higher level view allowing to collect, treat and propagate the information between these components in an appropriate manner, i.e. take into account the changes in the context, and propagate appropriate decisions. In computing, this kind of concern is known as “context-aware computing” This class of mobile systems that are related with their physical environment needs to adapt their behaviors accordingly to context management and adaptation to deal with the different resources present in the environments. Overall middleware characteristics (multiple sources and destination information management) are to be adapted to the problematic of context-aware computing in order to create an appropriate and efficient environment. To find a solution for our AmI approach expressed by MOCOCO for Mobility, Contextualization and Cooperation and concretized by a platform called IMERA for Mobile Interaction in Real Augmented Environment, we are proposing a context-aware middleware to support AmI. Our context-aware middleware allows a rapid developing of new applications on IMERA platform.

C. Context Modelling Approach

The Ambient Intelligence (AmI) vision implies the concept of "smart spaces" populated by intelligent entities. While most implementations focus strictly on local applications of "AmI", the work in [29-3] represent AmI scenario as a federation of instances of local and application AmI domains. In order to deal with distributed context handling in AmI domains, the work discusses a context model suitable for distributed context acquisition, reasoning and delivery to applications. A hybrid approach is discusses that aims at combining the advantages of object-oriented models for distributed context handling and those of ontology-based models for context reasoning. The model has been applied to the development of a context-aware eTourism application. This application aims at providing tourists with context-aware services supporting communication and knowledge exchange. It integrates already available location-based content delivery services with a context-aware instant messaging service and a provider reputation service. According to the model, the logical architecture is discussed for a context aware system. This architecture has been implemented in the framework of the KAMER Project for the development of a context-aware system supporting knowledge-intensive human activities. Kamer (Knowledge Management in Ambient Intelligence: technologies enabling the innovative development of Emilia Romagna) is an Italian regional project that involves two universities and one industry. The main objective of the Kamer project is to define novel models and technologies of Ambient Intelligence and context awareness supporting knowledge exchange and collaboration among individuals in mobility. The scenario that has been identified for testing out knowledge processes focuses on tourists visiting a cultural city (Piacenza) and its points of interest.

D. Prototyping Approach

Ambient intelligence is an interdisciplinary field that brings together ubiquitous computing, intelligent environments and context-awareness technologies. The work in [4] describes a context-aware prototype for home environments, and the underlying concepts. a Standardized representation of the environment context is discussed in such a way that the integration of new developments (i.e. smart agents) is made simpler. A middleware that supports this standardized representation has been developed. The work also makes an especial emphasis on a proposed ontology that deals with information flows in the smart room. As an example, a ubiquitous broadcasting digital audio application has been implemented and tested in a real environment. Identification-based services by RFID sensor fusion are presented as a complement to the smart room.

E. Agent-Based Approach

In a future vision of Ambient Intelligence the surrounding environment will integrate a pervasive, interconnected network of sensors, intelligent appliances and computer-like devices. This implies, on the one hand, hardware and interface related issues, and, on the other hand, a layer of context-aware services that manages the large quantities of information generated throughout a system formed mostly of devices with limited capabilities. The work in [5] presents the steps toward the realization of the AmIciTy framework: a multi-agent system that relies on local interaction and the self- organization of agents, having as purpose the context-aware sharing of pieces of information. The work also presents the structure of the system, the design of the agents, the manner of building scenarios, experiments and the evaluation of a prototype.

F. Mobile Approach

The work discussed in [6][7] aims at enabling Ambient Intelligence in "Beyond 3G Systems" using wireless sensor networks for making context-rich information available to applications and services. In e-SENSE project, some application scenarios are developed in order to assess the capability of the e-SENSE architecture to sense user's context, to pre-process the gathered information into meaningful data to be input to a user's profile enabling context based services. The system also focuses on the psychological and sociological aspects of context awareness which leads to teach sociology and psychology of user experience to the WSN based system as an integrated feature. E-SENSE project has concretized the notion by focusing on "context awareness" in order to understand what "context" is and how to capture the appropriate context data to enable meaningful applications for mobile user's situations.

III. PROPOSED SYSTEM

The proposed system aims to design a context aware collaborative service provisioning based on Ambient Intelligence. The work of Pallapa Venkataram et al.[8], suggest a framework of context aware services deploying dual attributes viz. context collection & request analysis unit (CCRU) and collaboration unit. In the proposed work , a base framework to capture and manipulate the various contexts with respect to emergency situation of an individual suffering from specific critical disease like myocardial infarction, stroke, leukemia, etc have been suggested. The proposed framework will consider the significant mechanism with refinement of data being captured by the sensor nodes. The system comprises of three functional units e.g. i) context awareness, ii) collaboration, and iii) coordination. The system considers the contexts that are possibly associated with such individual are primarily classified into parts:

- Information of the individual that consists of psychological state and condition, familiarity of habits etc
- Daily activities of an individual e.g. walking, sitting, running, jumping, etc.
- Therefore, based on the above mentioned traits, we define the context associated with ambient intelligence is classified into dual categories:
- Physical location and time of an individual that consists of GPS enabled location and time of an individual with precise coordinates.
- Physical state of an individual e.g. heart rate and temperature. We consider the temperature of two types for more preciseness in designing context parameters using Ambient Intelligence e.g. Room Temperature and Body Temperature

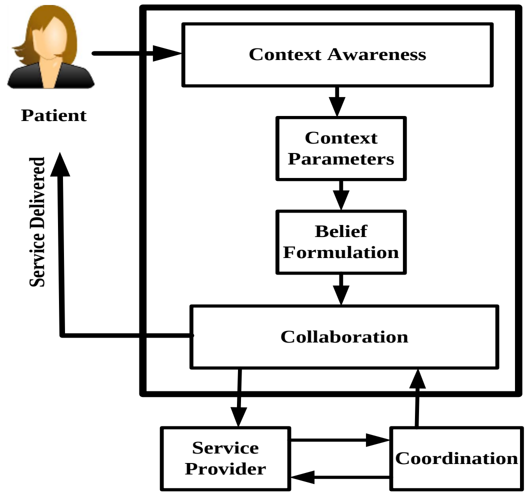

Figure 1: Layered Architecture of Proposed Model

a. *Capturing Context from Accelerometer*

The proposed system uses accelerometer that has the capability of perceiving the accelerated data discretely [36] in 3 spatial orthogonal axes in every position of body considering specific sampling frequency.

b. *Capturing Context from GPS*

The system proposed is experimented in open source Android operating system where the location based services are considered using android. Location package [9]. Using the Location. Manager class, the proposed system will be able to capture the periodic reports of the mobile device user with precise coordinate systems in Google map. The initial attempt will be towards the GPS system which will obtain a reference to the Location. Manager class by deploying getSystemService method in Java. The procedure for locating the mobile device owner is done considering following attributes:

- *Service Provider*: It is basically the GPS service provider which the device owner is using
- *Minimum Time Instant*: The minimum time interval for notifications, in milliseconds.
- *Minimum Distance*: The minimum distance interval for notifications, in meters.
- *Listener*: An object whose on Location Changed method will be called for each location update.

It is to be noted that the attribute Minimum Distance is also considered for the coordination system for finding the location of the proximity of the medical assistant available near to the ill-individual whose vital stats are being monitored.

Figure. 2: Visibility of GPS navigation system

Figure 2 highlights the availability of the Three medical assistant (as seen in Google map) who are also considered to posses the similar healthcare application in Android based mobile application system. It can also check the proximity of the medical assistant from the ill-individual where the location parameters are notified with location longitudinal and latitudinal coordinates. The system tracks GPS and network-based specific position and also the context aware of the specified area. The system uses maximum number of context from the individual states that are furnished by data aggregation process by multiple sensors. In the proposed system, Android based GPS system and usages of navigational services are used for accomplishing the location awareness context in Pervasive Computing, while accelerometer is used for extraction of the situational positioning analysis of the ill-individual. The GPS based tracking system basically constructs a higher level context that includes individual's Name, Age, Blood Group, Address, Phone Number , proximity distance to the requested medical assistant, and situational based context information using Pervasive Computing. The situational based context information captured from the sensors (based on the context parameters connected to the ill-individual using IEEE 802.15 to the Android based mobile device, which further uses the push message API in Java using available service provider and the context information in forwarded to all the medical assistant available. However, it may happen that all the medical assistant are not in proximity or engaged in servicing others, so in such circumstances, the system finds only the availability of the medical assistant in the better proximity of the individual. Upon receiving the message on the receiver unit of the medical assistant, they could use the GPS based tracking system to find out the cumulative context information and act accordingly. Two feasible actions are expected from the medical assistant:

- Prompt Action: The medical assistant could possible rush to the location of the individual with critical condition.
- Monitoring Action: The medical assistant could possibly request for only a specific set of information which is of their clinical interest for better remote diagnosis.

Therefore the proposed unit that is wearable in individual as well as medical assistant act as transreceiver for gaining precise and accurate data related to the clinical condition of the individual.

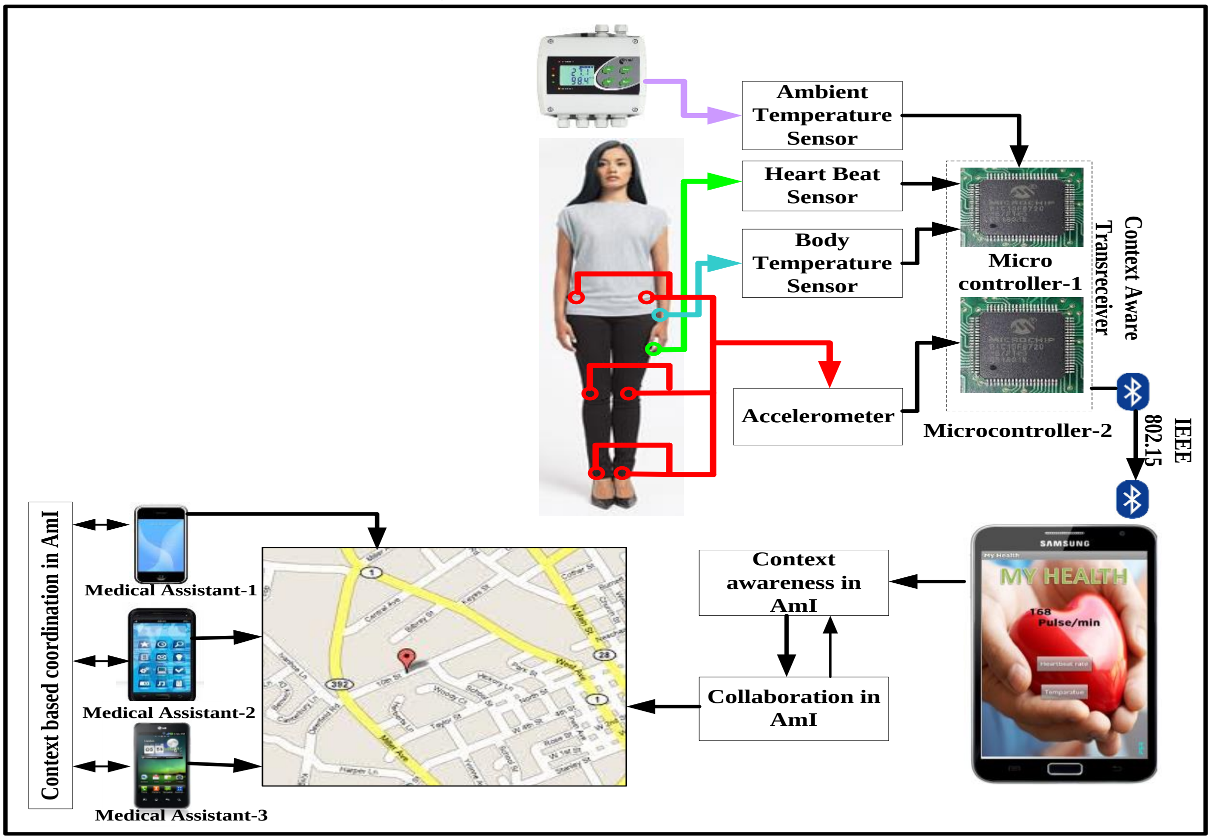

Figure 3 Architectural Process Flow of Proposed Model

Table 1 Basic Format of the Context Parameters

Location	Time	Heart Rate	DOB Blood group	Temperature
Longitude Latitude	20-06-2013 2000 Hrs	100 beats 120 beats	19-06-1980 O+ve	Ambient Temperature Body Temperature

Table 2 Elaborated Context Parameters Design

Encapsulating Temperature Context		
Data collected from Microprocessor-1	Room Temperature	Body Temperature
	Hot	Fever
	Cold	Normal
	Humidity	Cold
	Fire	
	Normal	
Encapsulating Heart Rate Context		
Data collected from Microprocessor-1	Normal	
	High	
	Low	
	Abnormal	
Encapsulating Physical State Context		
Data collected from Microprocessor-2	Walking	
	Sitting	
	Running	
	Climbing Up	
	Climbing Down	
	Jumping	
	Impact and Falling	

IV. Implementation and Results

The proposed context based Pervasive Computing for monitoring emergency clinical situation of ill-individual uses non-invasive sensors to measure heart rate, blood pressure, and body temperature. The sensors used are inexpensive and are easy to use by the patient. Signal conditioning circuits are designed to filter and amplify the signals to provide desired output. All the components used in these circuits are low powered and inexpensive.

The acquired data is real-time and is sent to through the analog-to-digital converter (ADC) and into the microcontroller The pulse rate and body temperature is displayed on the LCD screen embedded on the hardware. The same digital data is transmitted to the smart phone via Bluetooth. The received data is displayed on the android application for the user reference. The data can be recorded for a certain period of time. The application continuously monitors the data, when there is an abnormality; it alerts the predefined mobile numbers by sending an alert message.

A normal, healthy, human heart beats about 72 times per minute. A lower heart rate can result from being a consistent exerciser, from some medications for heart or blood pressure problems, or simply because of genetic disorder. The heart rate at resting position can be measured by recording pulse before arising in the morning on two or three different days and averaging the figures. If the heart rate is less than 50, or more than 90, system intimates the doctor. The system provides accurate readings irrespective of user location and activity. The readings so obtained will be in digital form

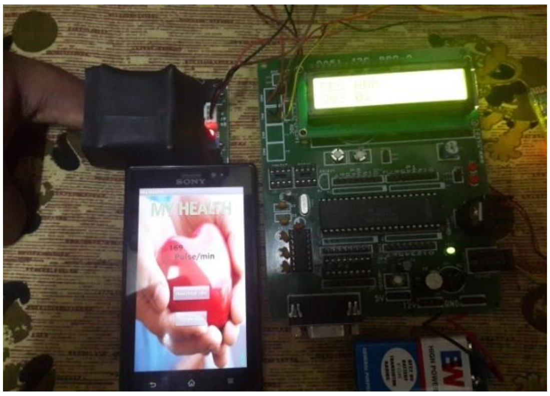

Figure 4 Prototyped Real-time test bed Model

The system allows to continuously monitoring the heart beat and temperature simultaneously, and this is done so as to assist the patients and also helps in monitoring the health of an individual. To do this the system is embedded with a heartbeat sensor and also a temperature sensor (contact sensor).

The heart beat sensor measures the pulse of a human and process as following:

Age(20 - 40) = 140-170 bpm

Age(40-70) = 115-140 bpm

Figure 5 Health Assist Mobile Application

Here the "current health status" gives the present heartbeat and temperature. The application is also provided with a "record tab", which records the parameters and also simultaneously monitors. This option is a very useful tool to monitor the parameters over a certain period of time for the health assessment purposes. The recorded information is saved in a folder called health assist with the respective dates and times. If the user deploys the option "without record" tab then the system monitors the parameters without storing the information being sent from sensors.

The application also provides us with a "settings tab" and on clicking it the same screen opens that had been displayed when the application was installed and opened for the first time. Whenever the emergency numbers or the name is to be changed the settings tab should be clicked.

Figure 6 Data Recorded on the Mobiles Apps

Ultimately the application is given with an "Exit tab" clicking upon which closes or terminates the application. While exiting the application it asks if the application should run as a background app while recording. If yes, then the app records or monitors by running as a background application and if no, then the application terminates completely or it gets dormant. This is the overall process of how the system works and communicates with the phone while monitoring the health or the health parameters, hence the working of the "Smartphone Based Health Emergency Assisting System".

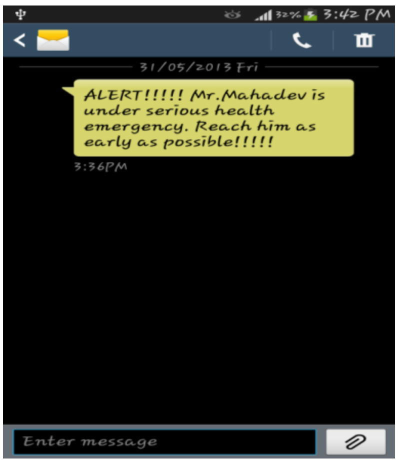

Figure 7 Intimation of Message to the collaborated people during emergency

V. CONCLUSION

The proposed system discusses about the context based framework for Pervasive Computing and found to work efficiently even under data scarcity condition or faulty hardware behavior. As the proposed system purely works on the belief system formulated with the assistant of multiple sets of real time context, so the cost effectiveness of the processing speed as well as computation time is highly minimized. Although the sensors continuously monitors the data, it only sends to the Android based user handheld device when the captured context matches with some of the set of belief parameters. This phenomenon highly preserves the power supply of the sensor node (embedded control unit) which basically optimizes the lifetime of the network backup by external battery. After receiving the belief information, processing and transmission is quite faster due to the adoption of open source Android environment and Java APIs. However, the final transmission from user handheld device to the remote medical assistant will highly depend on the speed and bandwidth capacity of the wireless mobile network services. Therefore, we chose to adopt 3G network which is comparatively faster and quite reliable. Our future direction of the work will be to extend the framework of context based Pervasive Computing system to other complex and emergency situation in real time.

REFERENCES

[1] Dr. ir. Y. BERBERS," Support for context-driven applications in Ambient Intelligence environments", Katholieke universiteit leuven faculteit ingenieurswetenschappen departement computerwetenschappen afdeling informatica, 2009

[2] Tao Xu, Bertrand David, René Chalon, and Yun Zhou. "A context-aware middleware for ambient intelligence", In *Proceedings of the Workshop on Posters and Demos Track* (PDT '11), 2011

[3] Federica Paganelli , Gabriele Bianchi, and Dino Giuli, "A Context Model for Context-aware System Design towards the Ambient Intelligence Vision: Experiences in the eTourism Domain", pp.173-191,2006

[4] Pablo A. Haya, Abraham Esquivel, Germán Montoro, Manuel García-Herranz, Xavier Alamán1, Ramón Hervás2 and José Bravo, "A Prototype of Context Awareness Architecture for Ambience Intelligence at Home", Citeseer

[5] ANDREI OLARU, CRISTIAN GRATIE, "Agent-Based, Context-Aware Information Sharing for Ambient Intelligence" , International Journal on Arti_cial Intelligence Tools,pp. 17-155, 2011

[6] Fabrice Forest, Astrid Oehme, Karim Yaici and Céline Verchère-Morice, "Psycho-Social Aspects of Context Awareness in Pervasive Computing Mobile Systems", Citeseer

[7] Asuman DOGAC, Gokce B. LALECI, Yildiray KABAK," A Context Framework for Ambient Intelligence", Citeseer, 2003

[8] M. Subramanyam, Pallapa Venkataram, A Context aware Collaborative Service provisioning system for Mobile-Commerce, National Conference on Communication, IEEE, 2012

[9] http://developer.android.com/reference/android/location/package-summary.html