Context aware computing algorithms using Location Management Scheme

(Mrs. Sini Anna Alex, Assistant Professor, Department of Computer Science and Engineering, M.S.R.I.T, Bangalore,
Dr. Anita kanavalli, Professor, Department of Computer Science and Engineering, M.S.R.I.T, Bangalore)

Abstract: Context awareness (CA) refers to systems can both sense and react based on their environment. The systems may have information about the circumstances under which they are able to operate and adapt their behavior accordingly based on rules or an intelligent stimulus. Such systems are a component of a mobile computing environment. Currently context has been considered as part of a process in which users are involved, hence specifying and developing context models are needed to support context-aware applications to adapt interfaces, tailor the set of application-relevant data, increase the precision of information retrieval, discover services, make the user interaction implicit, or (f) build smart environments. Context related to human factors is structured into three categories: information on the user, the user's social environment, and the user's tasks. Likewise, context related to physical environment is structured into three categories: location, infrastructure, and physical conditions.

Index Terms|: Mobile Agent, Wireless Ad Hoc Networks, Context aware Apprehension, Aglets, GPS.

I. INTRODUCTION

Context-aware mobile systems are concerned with the acquisition of context, the abstraction and understanding of context, and application behavior based on the recognized context. In some applications, as the user's activity and location are crucial, context awareness has been concentrated more deeply on location awareness and activity recognition. Three important aspects of context are: (a) where you are; (b) who you are with; and (c) what resources are nearby.

About one quarter of all context aware systems stolen are never recovered, an indication that these thefts may be connected to organized theft rings[1]. Most context aware manufacturers now also own anti-theft systems to help reduce automobile theft. Unfortunately, not all such systems are equally effective. Also, most of the antitheft devices are passive in nature [6]. We need to develop new anti-theft systems which are in conspicuous, yet active and robust. The problem is complicated when we consider tracking of these context aware systems. In contrast to physical locking, tracking is transparent to the user. Each context aware with a Global Positioning System (GPS) could be considered as a node in a mobile network. Mobile networks are characterized by their variable resources such as network bandwidth, limited amount of resources (memory, processor cycles) and their battery dependent functioning [4]. These characteristics necessitate the redesigning of applications in order to maintain good quality of service for execution in such environments.

Mobility issues are embedded in the application functionality making them more difficult to develop and maintain.

Location management enables the network to track the context aware's location and their terminals between call arrivals. A distance-based LM strategy is used to adjust the size & shape of the location area for each individual context aware terminal according to the current speed and direction of movement. Location update & paging are the operations for locating a context aware terminal in networks. The geographic area within which context aware's can communicate with a particular Base Station is called a cell. The service area of the VCS is thus composed of cells which overlap with their neighbours at their boundaries.

Ad Hoc networks are basically dynamic mobile networks with ever changing topology. The fact that the devices involved are mobile in nature makes their maintenance very complex, especially when there is no central controller to synchronize the communication channels. Data sharing plays an important role in communication networks. With this comes the added issue of reliability, security and so on, especially in ad hoc networks[3]. As this is an emerging technology, the promise of wireless systems within the automotive sector is significant. It has the potential to deliver greater convenience and a whole host of benefits to context aware users and context aware manufacturers. Wireless technology can be, and has been, applied in the automotive sector to satisfy several entertainment and communications requirements.

II. RELATED WORK

The context information of the context aware systems has to be identified through different models or frameworks. Most of the conflict resolving systems use Collaborative Filtering or Content-based methods or hybrid conflict resolving methods to predict new items of interest. The system called Tapestry is often associated with the genesis of computer-based conflict resolving, recommendation, and collaborative filtering systems. In Tapestry, users were able to annotate documents with arbitrary text comments and other users could then query based on the comments of other users. The key attribute of this system is that it allowed recommendations to be generated based on a synthesis of the input from many other users. Making recommendations based on the opinions of like minded users rather than filtering items based on content has become known as collaborative filtering. To identify the location of a context aware system through a highly variant characteristic location models have to be generated. The paging of the context aware system is described in the

following sections. In Location Area the Node Terminal has to store the Cell Coordinate of its last reported cell (x_o, y_o), the predicted location(x_1, y_1) and the threshold distance, $d_t = 2R$.Here the eccentricity, e is considered as the threshold distance.

III. ARCHITECTURE AND ALGORITHM

A. Agent Registration

For registering a node to the system the location identification is needed. Location Identification system includes tracking the nearby Location areas. If the node is detected its context information has to be analyzed. The location is one of the variant characteristics for identifying a context. To get the context information the system should register for the process. The Algorithm 3a describes the agent registration process

Algorithm 3a: Registration process

1. The System enters a new Location Area and transmits a location update message to the new Base System.

2. The Base System forwards the location update message to the Context aware Service Center which launches a registration query to its associated Context aware Location Register (VLR).

3. The VLR updates its record on the location of the MT. If the new Location Area belongs to a different VLR, the new VLR determines the address of the Home Location Register (HLR) of the Context aware System from its context aware identification number (VIN). This is achieved by a table lookup procedure called global title translation. The new VLR then sends a location registration message to the HLR. Otherwise, location registration is complete.

4. The Home Location Register (HLR) performs the required procedures to authenticate the context aware system and records the ID of the new serving VLR of the Terminal. The HLR then sends a registration acknowledgment message to the new VLR.

5. The HLR sends a registration cancellation message to the old VLR.

6. The old VLR removes the record of the MT and returns a cancellation acknowledgment message to the HLR.

Algorithm 3b: Context Aware Computing

$TS = \{S_1, S_2, .. S_n\}$ is the set of states of all sub transactions in a MUC transaction. S_i, the state of T_i, is one of five possible states: I, E, S, F and C. Each sub transaction starts with state 'I' and ends with 'S' or 'F'.

i. *Coordination algorithm in a request node*
   1. Begin Global transaction management
      $\{ TS=\{I,I,. . .,I\};$
   2. Select subtransaction T_i based on D;
      if (event occurs) then check current context C_i;
   3. Set num=0; and do the following operations
   4. while (num<RetryNum)
   5. if (qualified context)
      Then
         Send T_i to corresponding nodeand set S_i='E';
         Waitfor incoming messages.
            if (message is Successful) set S_i='S';
            else if (message is Failed) set S_i='F';
   6. Increment num and end while
   7. Repeat Step 2 to Step 6 until ((TS∈FS)

   8. if (TS∈FS) Then
      Confirm submitted sub transactions;
      Else
      Compensate submitted sub transactions
   9. End

ii. *Coordination algorithm in execution nodes*
   1. Begin Subtransaction(T_i) execution
   2. Set suc:=true;
   3. Execute application operations;
   4. if (fail to execute current operation)
      Then
                suc:=false;
   5. Repeat Step 3 and 4 until ((all operations finish) or (not suc))
   6. if (suc) then
      send Successful message to requester;
      wait incoming message;
      if (receive Confirm message) then
              report execution results to requester;
      else if (receive Cancel message) then
              execute T_i's compensating transaction;
              send Cancelled message;
       else
              rollback to previous state;
              send Failed message;
   7. End

Table I. Transaction state description

Symbol	State	Description
I	initial state	Ti has not yet started to execute
E	executing state	Ti is executing and has not submitted

S	submitted state	Ti has successfully submitted
F	failed state	Ti has failed to submit and rollbacked to previous state
C	compensating state	compensating transaction Ci of Ti is executing

B. Context Systems Information Management

A mobile agent is an itinerant agent dispatched from source computer which contains program, data, execution state information. Among all the Location Management strategies being reviewed, the distance-based strategy fulfills most of the above requirements, except its implementation is very difficult and location prediction is not considered. In this paper, a simple approach is introduced to implement the distance-based Location Upadte strategy by using the coordinates of centers of cells in calculating the physical distance traveled for comparing with the threshold distance. By using this cell coordinates system, the distance-based strategy can be enhanced by incorporating the location prediction of Node Terminal's to improve performance.

Mobile agents have the unique ability to migrate from one system in a heterogeneous network to another, The ability to travel allows mobile agents to move to a system that contains services with which they want to interact and then to take advantage of being in the same host or network as the service. Java Aglets are lightweight mobile agents that enable the autonomous execution of programs on remote heterogeneous hosts. An aglet is defined as a mobile Java object that visits aglet-enabled hosts in a computer network. Aglets run their own threads of execution after arriving at the host; so it is attributed as autonomous. The Aglets Software Development Kit (ASDK) frame-work is a lightweight mobile agent technology from IBM's Tokyo research laboratory and used for this work.

C. Context Aware Location Management (LM) of nodes

A system model has been developed to evaluate the performance of LM strategies using the cell coordinates system. This model assumes Poisson arrival of incoming calls for the MU. The duration of conversation time can have any distribution. The parameters of the system are as follows:

λ – call arrival rate
τ – mean conversation time
C_u – unit location update cost
C_p – unit paging cost
A_c – average cell size
κ – paging rate

A – size of location area
η – mean time between location updates
$m(v, \Theta)$ – joint probability density function of speed v and Θ direction of movement.
where $m(v, \Theta)$ { ≥ 0 $v \geq 0$, $-\pi < 0 < \pi$
$\qquad$ { $= 0$ otherwise
$\qquad$ In the Circular Location Area the LA is circular in shape with
$r(\Theta) = R$ (d_t for location update)

we have,
$\qquad \eta = R\omega$
$\qquad A = \pi R^2$
$C_t = \kappa (C_u/\lambda R\omega + C_p \pi R^2/A_c)$

In Circular Location Area, the CC of its last reported cell (x_o, y_o) and its current threshold distance $d_t = R$ is stored. Here we took the radius, R of the circle as the threshold distance. The location area is circular in shape and the location update is performed after each location area. When an MT detects a change in the CC it performs location update.

If $(x_i-x_o)^2 + (y_i-y_0)^2 > d_t^2$
where (x_i, y_i) is the new CC detected.

The advantage of CLA is the simplicity in implementation since the MT only needs to calculate the distance from the last reported location.

Since Other Location Area is difficult to implement ELA is considered, because it gives the same performance as the Other Location Area.

Here $r(\Theta) = b^2/a - c\cos\Theta$, where
$\qquad 2a$ = major axis
$\qquad 2b$ = minor axis
$\qquad 2c$ = distance between foci
Eccentricity $(e) = b/a$,
$\qquad$ where $a \geq b$

For uniform distribution of $g(\Theta)$
$\qquad G = 1/2\pi$

The ellipse becomes a circle in this case and both Elliptical Location Area(ELA) and Circular Location Area have the same performance and have the same size and shape. To implement ELA, an MT needs to store the CC of its last reported cell, (x_0, y_0), the predicted location, (x_i, y_i), and the threshold distance, $d_t = 2\tilde{a}$. The predicted location is calculated by

$x_i = x_0 + 2 (a^2-b^2)^{1/2} \cos\phi$
$y_i = y_0 + 2 (a^2-b^2)^{1/2} \sin\phi$

where ϕ is the predicted direction of movement of the context aware system;

i.e. the mean of g(Θ)

When the MT enters a new cell with CC being (x1,y1),it performs a location update if

$$((x1-x0)2+ (y1-y0)2)1/2 + ((x1-xi) 2+y1-yi) 2)1/2 > dt$$

IV. PERFORMANCE EVALUATION

The above algorithms and the mathematical model prescribe a new system capable of monitoring context aware systems more accurately. The time taken for the apprehension of the context aware systems at various capacities of the high way micro-section has to be computed through simulation.

We have to implement and also have to evaluate its performance through simulation. For Location Management System the registration process of n number of nodes has to be done and the agent initiation should happen. After that the context aware computing algorithms has to be implemented.

V. CONCLUSIONS

This context aware apprehensions scheme is agent based and is applied to tracking a stolen context aware in a large environment such as highway. We defined a system model for evaluating the performance of location management strategies using cell coordinates approach. We transformed the basic distance based location updating scheme into the Circular Location Area and proposed the optimal and enhanced distance based location updating scheme, namely, Elliptic Location Area.

We have to prove that the paging methods have the lowest location management cost for mobile users moving in more predictable directions and more random directions, respectively. The paging methods for the Elliptic Location Area have a better performance than other previously proposed schemes like the shortest distance based location updating.

The proposed scheme checks the VIB of each context aware and then upon positive match shuts down the context aware with the fellow inside. Network delays, buffer level, metrics have not been considered, we also assume that all the context aware systems are fitted with the GPS. We have shown how the approach can be promising and they demonstrate feasibility of anti-theft devices complemented by mobile agents. However, several overheads are associated with the scheme such as communication time of the agents, additional memory space for the agent platform, CPU time for computation which are part of the future works.

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