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Mobile Based Location Prediction for Moving Objects

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Abstract: This paper mainly aims to provide the location related information about the target to the tracker with the help of Short Message Service. The two main techniques used in this paper are SMS and GPS.SMS is a user-pay service. So we should not use it extensively.GPS is used because of its high positioning accuracy. It can provide the correct location information with minimum error. The method used to track the position of a target is known as Location Based Delivery. This mobile based application not only reduces the number os SMS transmissions but also maintaining a location tracking accuracy with acceptable range. The three main features used in this method are SMS delivery, location prediction and dynamic threshold. Another secondary feature includes a viewing Map. Location prediction module is built on both the tracker and the target. Dynamic threshold is another feature which will reduce the number of short message transmissions. We are dynamically adjusting the threshold value according to the moving speed of the vehicle in real time. So this dynamic threshold module is coming in target side. this paper can be used to track the location of buses. Once the location information is obtained, this information is sent to the tracker through SMS.

Keywords: Global positioning system (GPS), Short Message Service (SMS), Location Based Delivery(LBD).Mobile Phones, Location tracking, Prediction Algorithms.

I. INTRODUCTION

Nowadays Mobile phones has become an important part of our life. The main reason for this demand of mobile phones is its technological developments and its user friendliness. This demand begins with the entry of Android applications in mobile market. Android is a framework which is developed by Google. It uses Linux kernel, so that it is an open system. It also provides a very flexible mobile application development. Android can be very efficiently used for developing Navigation systems based on GPS. Navigation is possible with the help of Google Maps. People prefer costless services provided by Google maps than paid services provided by some other sources.GPS is used because of its high accuracy in positioning an object on earth.

The passenger information system is created using a technique called Location Based Delivery. It is a combination of Short Message Service and Global Positioning System. The developed system consist of a tracker and a target .These two systems developed on android application platform and performs tracking with the help of GPS.In the tracker there is a trace and message SMS Switch ,first used by the tracker to send the predicted information to the target. The target ,after receiving the SMS will view the message .If the distance between predicted location and the current location exceeds some value, say threshold, then target will send a message with its current location to the tracker. Tracker can view the map according to the received latitude and longitude values. Otherwise target will not send any message back to the tracker. So tracker will update the map with its predicted latitude and longitude values. If this technique is used in passenger information system, it makes public transport system more user friendly.

In the previous systems, the location information is transferred from the target to the tracker using wireless techniques. Tracking is possible when both the tracker and the target should come under same wifi coverage area. If either tracker or target cannot access the wifi,tracking process cannot be possible. The two existing methods for tracking is Time Based Delivery (TBD) and Distance Based Delivery (DBD).In these two methods SMS is used for transmitting location information. In TBD the target will send location information to the tracker at every 30 seconds interval, irrespective of whether it is moving or stationary. The number of SMS transmission is more in this method. In DBD, the target will send SMS only when the current location and previously reported location difference is greater than some threshold say 50 meters. In this method number of SMS is less when compared to TBD.The unnecessary SMS transmissions and the inaccuracy in location tracking in the previous methods are overcome by the new method called Location Based Delivery.

The main objective is to track the movement of object and send this location information to the tracker through SMS delivery. We are using A mobile based navigation system for this activity. In real time the location of buses can be

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tracked. This tracked information is used to generate predictions of bus arrivals in each stop along the route. When this information can be sent as SMS to passengers, they can utilize their time more efficiently and reach the bus stop just before the bus arrives, or they can take some alternate way to reach the destination if the bus is delayed. The main purpose of this paper is to remove the problems in the existing location prediction techniques. The main goal is to reduce the number of unnecessary short message transmissions between the tracker and the target. This goal is achieved by introducing a new concept called dynamic threshold.

II . BACKGROUND AND LITERATURE SURVEY

In the Existing systems, a device is equipped with a global system for mobile communications (GSM) modem and a GPS unit. It transmits short messages containing its GPS coordinates to the server at 30-s intervals. Although transmitting the geo-location information of a target via wireless networks is effective when both the target and the tracker are within Wi-Fi coverage area, the 802.11 wireless networks are not always accessible. When the target or the tracker is unable to access Wi-Fi, it is impossible to perform location tracking. Therefore, SMS is a relatively more reliable and flexible solution because of its wide spread use. However, SMS is a user-pay service. The transmission cost of a tracking system by the number of SMS transmissions while maintaining the location tracking accuracy is high. The three delivery methods, time-based delivery distance-based delivery, and proposed LBD, are evaluated using a given moving pattern of the target. In the time-based delivery, a short message is delivered every 30 s. The number of short messages for TBD is fixed because TBD short messages are periodically transmitted regardless of whether the target is moving or is stationary. The number of short messages for DBD significantly decreases as the stationary time increases. The reason is that DBD short messages are not transmitted when the target is stationary. In the distance-based delivery, the fixed threshold is set to 50 m, among other fixed threshold values.

The target is assumed to be moving at varying speeds and bearings or stationary for an unpredictable period to characterize a moving object. That is, the target used in this experiment is alternately moving and stationary. The new method proposed to overcome the disadvantages of the existing system has two main goals. One goal is to use an alternative to the existing Wi-Fi system. The other aim is to reduce the number of SMS transmissions by using Dynamic Threshold. Object identification system can easily identify a stranger or any object crossing the border where the army cannot reach in regular. Using the satellite communication and GPS tracking the area will be identified. By Object identification system we will be able to get the pictures of that particular area where the strangers has come as well as the details of objects or people who are present there [1]. It is possible to improve the performance of segment-based tracking by automatic re segmentation of the underlying road-network representation. Uses algorithms that modify an initial road-network representation, so that it works better as a basis for predicting an object's position [3].Geo-location update scheme is used to minimize the update frequency while satisfying the QOS of application service. For case study, we consider location based traffic report service (LBS-TR) and location based navigation service (LBSNS) [2]. A novel technique is used to send GPS coordinates to other mobiles through Short Message Service (SMS) based on Global Positioning System technology. The location tracking algorithm with velocity renovation process has been implemented [4].Several representations are used along with associated update techniques that predict the future positions of moving objects. For all representations, the predicted position of a moving object is updated whenever the deviation between it and the actual position of the object exceeds a given threshold [5].A real-time location tracking system using a GPS module for different mobile devices and multiple users, focuses on the management and observation of a majority of people can be foretold. This system for multiple parties uses TCP/IP wireless internet protocol and GPS application in a mobile environment. GPS and wireless network based real-time location tracking system may be extended to various application domains that detect user location information and utilize this anytime, anywhere [6].

A. GPS

The Global Positioning System (GPS) is a global navigation satellite system which is space-based .GPS is meant for providing accurate location and time information on or near the earth. This is possible with the help of four or more GPS satellites orbiting on earth. United States government is maintaining it and providing free access to anyone who has a GPS receiver. The three important parts in GPS are: the space segment, the control segment, and the user segment. The space and control segments are developed, maintained and operated by the U.S. Air Force. GPS satellites broadcast signals from space. GPS receiver uses these signals to calculate its three-dimensional location (latitude, longitude, and altitude) plus the current time.

The global position system (GPS) has become very common technique in handheld devices. Several location-tracking applications have been developed using GPS. Continuous location-tracking of elders and children for safety reasons or to prevent them from being lost, car monitoring and tracking, and intelligent transportation systems are some examples of these. Google has developed the Android platform, which is free. It's high flexibility in development allows it to develop a GPS navigation system on the Android platform with combination of many Google resources. With Google Maps free navigation functionality, people may prefer the costless service from Google over that of paid services.

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Global positioning system is worked on the basis of a number of satellites continuously the earth. All these satellites have atomic clocks. Through the transmission of radio signals which contains the exact time, location and other information, are monitored and corrected by the control stations. This corrected information's are taken by the GPS receiver. In order to plot a 2D position on earth GPS receiver requires only three satellites. But for plotting a 3D position on earth, four or more satellites are required. This will be more accurate than the previous one.

III . IMPLEMENTATION TECHNIQUE

A method called LBD that is location based delivery is used to track the movement of object. The three main features of the proposed LBD approach are a well-defined SMS format, location prediction module, and dynamic threshold module.LBD uses a proprietary SMS format. The location prediction module, which is built in both the target and the tracker side, uses the information on the current location, moving speed, and bearing of the target to predict its next location. The dynamic threshold module, which is used only on the target side, minimizes the number of short messages by dynamically adjusting the threshold TH according to the moving speed of the target. The tracker periodically updates the location of the target on the local screen according to the predicted location. However, when it receives a short message response from the target, it means that the predicted location is far from the actual location. For more accurate location tracking, the tracker updates the target's location using the information encoded in the received message, rather than its prediction. Here, we use the GPS technique to estimate the latitude and longitude value which can be used to track the location. GPS technique is not like the Wi-Fi technique that is able to cover only a short distance.
Location based delivery (LBD) is used to track the movement of object. The three main features of the proposed LBD approach are a well-defined SMS format, location prediction module, and dynamic threshold module and secondary feature that is viewing a map.LBD uses a proprietary SMS format. The location prediction module, which is built in both the target and the tracker side, uses the information on the current location, moving speed, and bearing of the target to predict its next location. The dynamic threshold module, which is used only on the target side, minimizes the number of short messages by dynamically adjusting the threshold (TH) according to the moving speed of the target. The tracker periodically updates the location of the target on the local screen according to the predicted location. However, when it receives a short message response from the target, it means that the predicted location is far from the actual location. For more accurate location tracking, the tracker updates the targets location using the information encoded in the received message, rather than its prediction. Here, we use the GPS technique to estimate the latitude and longitude value which can be used to track the location. GPS technique is not like the Wi-Fi technique that is able to cover only a short distance. Fig6.1 shows the concept of LBD. The GPS coordinates (X1, Y1), moving speed V1, and moving bearing B1 of the target at time t1, are used to predict its next location at time t2, denoted as (X2, Y2). When the distance D between the predicted location (X2, Y2) and the actual location (X2, Y2) exceeds threshold TH, the target transmits the actual location update information to the tracker. Thus, the objective is to determine an approach that minimizes the number of total short messages while maintaining D is less than TH.

A. SMS Format

SMS is the most widely used data application worldwide. SMS is used to transmit location update messages and assumes that the message delayed between the tracker and the target is negligible. A short message is transmitted from the mobile station (MS) to the GSM base station (BTS) through a wireless link and is received in the backbone network of the service provider. The SMC (Short Message Centre) is the entity which does the job of store and forward of messages to and from the mobile station. The SMS GWMS (SMS gateway MSC) is a gateway MSC that can also receive short messages. The gateway MSC is a mobile networks point of contact with other networks. On receiving the short message from the short message centre, GMSC uses the SS7 network to interrogate the current position of the mobile station form the HLR, the home location register.HLR is the main database in a mobile network. It holds information of the subscription profile of the mobile and also about the routing information for the subscriber, i.e. the area (covered by a MSC) where the mobile is currently situated. The GMSC is thus able to pass on the message to the correct MSC.MSC (Mobile Switching Centre) is the entity in a GSM network which does the job of switching connections between mobile stations or between mobile stations and the fixed network. A VLR (Visitor Location Register) corresponds to each MSC and contains temporary information about the mobile, information like mobile identification and the cell (or a group of cells) where the mobile is currently situated. Using information from the VLR the MSC is able to switch the information (short message) to the corresponding BSS (Base Station System, BSC + BTSs), which transmits the short message to the mobile. The BSS consists of transceivers, which send and receive information over the air interface, to and from the mobile station. This information is passed over the signalling channels so the mobile can receive messages even if a voice or data call is going on.

The SME (Short Message Entity) which can be located in the fixed network or a mobile station receives and sends short messages. The mobile switch centre (MSC), home location register (HLR), and visitor location register (VLR) determine the appropriate short message service centre (SMSC), which processes the message by applying the store and forward mechanism. If the recipient is unreachable, the SMSC queues the message for a retry at a

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later time. Two types of SMS are SMS query and SMS response. SMS query includes two commands, Start and Stop, which refer to the starting and stopping of the tracking action, respectively. SMS response, the latitude and longitude fields contain the GPS latitude and longitude information of a target, respectively. SMS received by the passenger consist of information about present target location, when the target will reach tracker location.

B. Location Prediction

The location prediction module, which is built in both the target and the tracker side, uses the information on the current location. Location prediction is performed by using the current location, moving speed, and bearing of the target to predict its next location. When the distance between the predicted location and the actual location exceeds a certain threshold D>TH, the target transmits a short message to the tracker to update its current location.

The target, upon receiving GPS information, including coordinates (longitude, latitude) = (X1, Y1), moving speed V1, and bearing B1 (in radians, clockwise from north), at time *t*1, can predict its next location at time *t*2. However, this prediction is not straightforward because the earth is not a plane. We assume this prediction on the basis of a spherical earth, although the earth is slightly ellipsoidal. Thus, the predicted location information represented in terms of longitude and latitude (X2, ˆ Y2) can be obtained as

$$\hat{Y}_2 = arcsin\big(sin(Y_1)cos(L) + cos(Y_1)sin(L)cos(B_1)\big)$$
$$\hat{X}_2 = X_1 + arctan\left(\frac{sin(B_1)sin(L)cos(Y_1)}{cos(L) - sin(Y_1)sin(Y_2)}\right) \quad (1)$$

Where L is the angular distance (in radians) and expressed as L = d/R, where *d* is the distance travelled and *R* is the radius Of the earth (6371.01 km). Thus we can easily obtain the value of *L* as

$$L = \frac{V_1(t_2 - t_1)}{6371.01km} \quad (2)$$

$$P = sin^2\left(\frac{Y_2 - Y_2}{2}\right) + cos(Y_2)cos(Y_2)sin^2\left(\frac{X_2 - X_2}{2}\right)$$
$$Q = 2\,arctan\left(\frac{\sqrt{P}}{\sqrt{1-p}}\right)$$
$$D = RQ = 6371.01\,(km)Q. \quad (3)$$

C. Dynamic Threshold

The dynamic threshold module, which is used only on the target side, minimizes the number of short messages by dynamically adjusting the threshold TH according to the moving speed of the target. Threshold TH affects both the number of transmitted short messages and the location accuracy. A large threshold reduces the number of short messages as well as the location accuracy; that is, there is a large difference between the predicted location and the actual location. By contrast, a small threshold requires relatively an increased number of short messages; however, it increases the location tracking accuracy. The user tolerance of the perceived location accuracy mainly depends on the moving speed. When the speed of the target is high, that is, while driving, the tracker can tolerate a higher location tracking inaccuracy. On the other hand, when the speed of the target is low, that is, while walking, the tracker requires a higher target location tracking accuracy.

Therefore, a feasible mechanism is to dynamically adjust the threshold according to the current moving speed of the target. This solution satisfactorily maintains the number of transmitted short messages and the location tracking accuracy. Thus, according to the moving speed of the target, the dynamic threshold can be set as TH = VC, where V is the current moving speed and C is a constant.

D. Viewing Map

Electronic maps are stored in the trackers mobile phone in advance to avoid a massive increase in the transmission cost for obtaining online maps. The SQLite database is embedded to save the map information in the mobile phone.

Map updates the target location information according to the received message rather than according to its prediction. Particularly, the messages from the target are received by the SMS Receiver on the tracker side.

The SMS Receiver extracts the location information (e.g., coordinate, speed, and bearing) from the received message and passes it to the Map, which in turn displays and marks the target location on a map. SQLite is sufficient when the amount of processing data is small or when the data is only used by a single user.

The SQLite database is in the form of a single file, thereby avoiding a database system installation. Thus, it is quite simple to copy or create the database on a mobile device. A programming language is used to call the provided functions through the SQLite library.

IV. SYSTEM ARCHITECTURE

The Architecture shown in Fig 1 consists of tracker and target side build on GPS and Android. The process starts when the tracker that is passenger starts the application by switching the start tracking switch present in the tracker side. When this information is received by the SMS receiver on the tracker side that application is launched, it will start predicting its location and compare its current location with the previous one, and if exceeds the threshold then through SMS locator, it will send SMS to the tracker having location details and the time.

The information is received by the SMS receiver on the tracker side, as for SMS receiver , it will longitude and latitude values, so the correct position will predicted by the SMS receiver at the tracker side and displayed on the Map.

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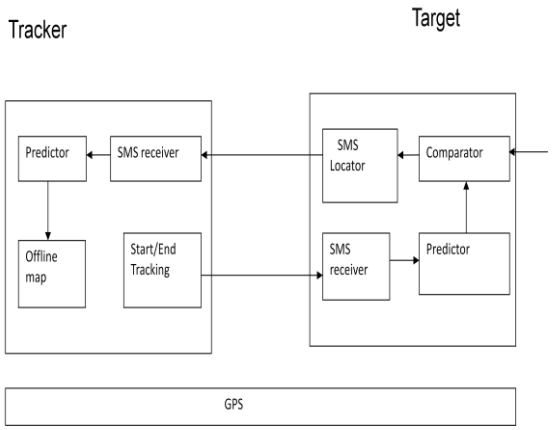

Fig 1 System architecture of location tracking system.

A. Implementation on Android

The GPS services on Android system is accessed by using a new class named the Location Manager .Using this class the upper-layer applications will obtain geographical location updates periodically. When the device approaches the determined geographical Location, it triggers an application-specific task. Location Listener class will continuously monitor movement of objects and Location Updates class will continuously updates objects movement. SMS-related functions on an Android system are accessed by Sms Manager class, send- Text Message class is called to transmit a short message permission-based policy is adopted by Android, that means AndroidManifest.xml file should contain all the permissions required by an upper-layer applications in advance. Sms- Manager class can be used only after the two permissions, SEND SMS and RECEIVE SMS are added to the AndroidManifest.xml file.

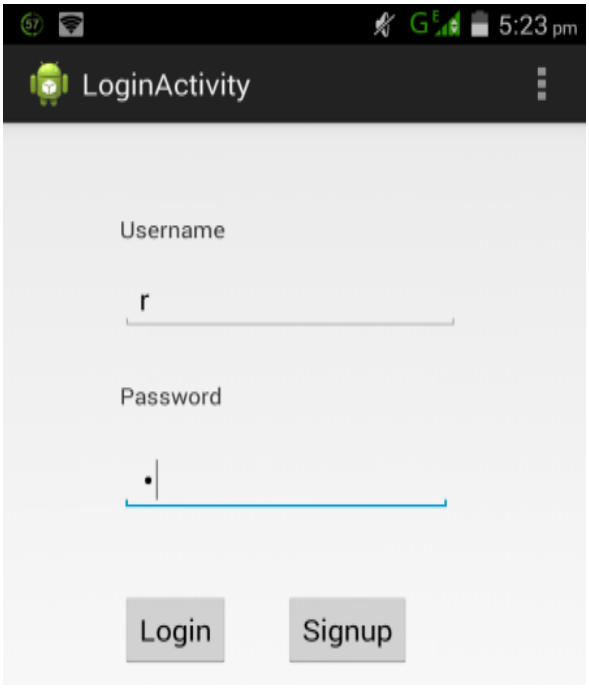

Fig 2 Login Activity.

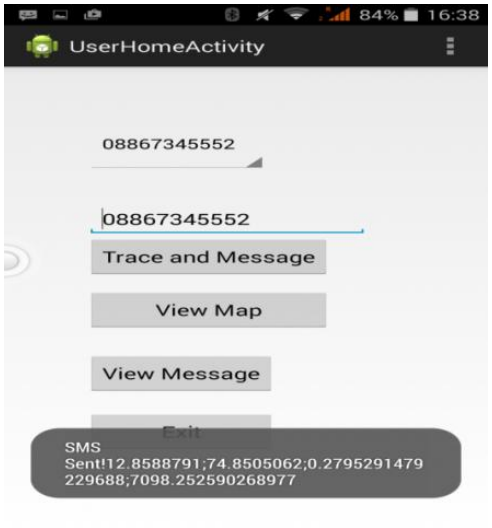

Fig 3 Tracker sending SMS about predicted location

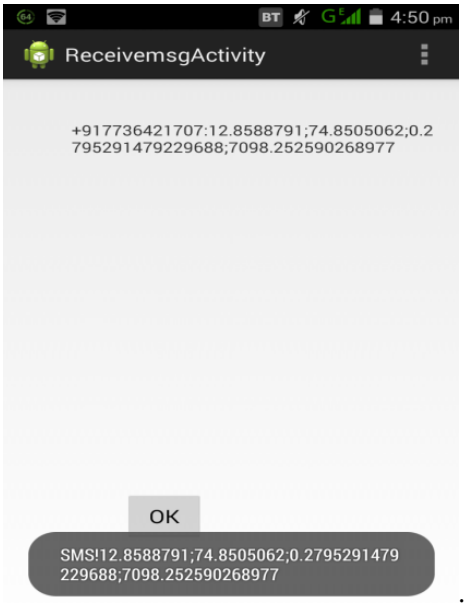

Fig 4 Target Viewing SMS

Fig 5 Target sending correct location to tracker

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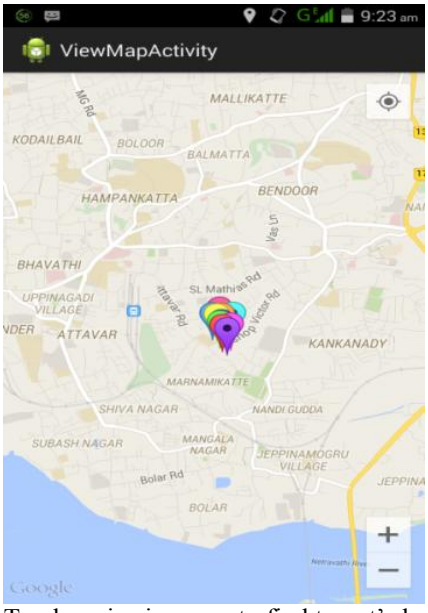

Fig 6 Tracker viewing map to find target's location

V. CONCLUSIONS AND FUTUREWORKS

By adopting location prediction and dynamic threshold mechanisms, Mobile based tracking system reduces the number of SMS transmissions by maintaining location accuracy within an acceptable range. It provides a free and open source navigation and tracking system. The concept LBD that is location based delivery reduces the number of short messages as compared to TBD and DBD. In addition to that, LBD achieves an acceptable location tracking accuracy. Currently this application is developed in android platform. In future, this application can be developed for other Mobile Operating system like Windows, iOS, Blackberry. This will make this application platform independent. One important limitation of LBD is that, It can track only one target at a time. In future we can overcome this limitation by tracking multiple targets simultaneously.

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