A Self-Configurable Student Tracking System Based on Mobile Ad Hoc Networks Consisting of Android Mobile Terminals

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Abstract— *Student Tracking System is asafety support system for Student based on ad hoc net-work technologies. Here we propose a new generation Student tracking system which is based on experiences and findings of the field experiments for Student Tracking System. Our proposed system consists of Android terminals which has Wireless LAN device and Bluetooth device with the ad hoc communication system. Our system manages groups of Android mobile terminals using Autonomous Clustering technique. The data about the android mobile terminals are transferred to a cluster head are then transferred to the server using Wireless LAN. In this paper, we show the system requirements for our Student tracking system and describe the implementation features to satisfy the system requirements.*

Keywords— Autonomous Clustering, An-droid, Mesh Network

I. INTRODUCTION

Student Tracking System [1] [2] using ad hoc network adopts a mobile cell phone network and MANET. Based upon the experiences of the field experiments, we propose a new generation Student tracking system. The following are the major five requirements.

- Easy to implement and add functions
- Able to manage many Students efficiently
- Adaptive for mobility of Student who walk to and from school or college
- Security against suspicious individuals
- Low cost

To satisfy the above requirements, the proposed new gen-ration Student tracking system adopts Bluetooth communication function between Android mobile terminals, and collects Student information using Autonomous Clustering technique. We adopt a mesh network with wireless LAN instead of using the cell phone network.

II. FEATURES FOR SYSTEM REQUIREMENTS

This section describes how the new generation Student tracking system meets the system requirements in the previous section. For Requirement (1), Android [3] mobile terminals are used. Android mobile terminals can install application this easily without issues when compared to the existing mobile terminals.

Therefore, we are able to implement and get functions smoothly. For Requirements (2) and (3), we adopt Autonomous Clustering technique [4]. When a Student walks to and from school or college, either Students form some groups or each Student moves separately. To efficiently manage the mobility of Student, we apply Autonomous Clustering technique for smooth collection of Student in-formation. For Requirement (4), we make use of Secret Sharing Scheme [5][6][7]. This method increases system security by distributing the information to multiple routes by preventing eavesdropping. For Requirement (5), we construct a mesh network, which is much cheaper than that of the mobile cell phone network. As described above, we combine Autonomous Clustering technique, Android mobile terminals, and other techniques to configure the proposed new generation Student tracking system that satisfies the system requirements.

III. STUDENT TRACKING SYSTEM

The new generation Student tracking system consists of tags which collect information of Student group. Android mobile terminals which each Student holds, sends the information about the location, and the server stores the Student tracking information. The outline of this system is shown in Figure 1. A collection of tags (that is, computers with wireless LAN) construct a mesh network. The tag is fixed in a position, and is used for collection of the position information. The Student group information is collected when Student walks to and from school or college is collected using Autonomous Clustering technique. The mobile nodes which are nearer to each other join together to form a group G.The collected tracking information in this system contains the position and time information of Android mobile terminals. The tag T creates tracking information as follows. When group G passes near tag T, tag T requests the group member information to the representative of the group. The representative then sends the group member information (that is, information of Android mobile terminals which belong to group G) to the tag T.

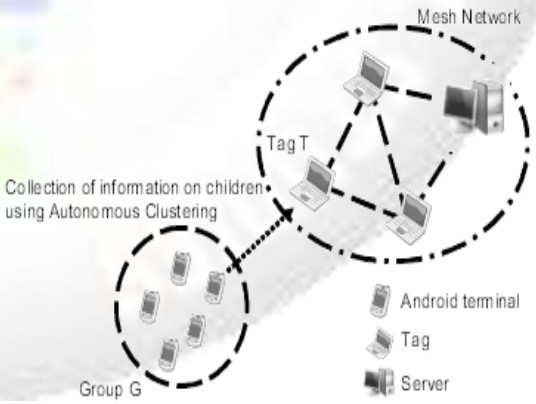

Fig. 1: GroupStudentG tracking system using Android mobile Server terminals

The tag T which received the group member information records each mobile terminals position and time information to its database. Thus, tag T creates the tracking information on the existing group G near tag T on the received time. Tag T then sends the information which it received from various groups G, to the server through the

mesh network. The Autonomous Clustering technique is used for collecting information on Student when Student group walk to and from school or college. Since only the representative of the group communicates with the tags, collision is hard to occur for communication, even when the number of mobile terminals is large.

A. Behavior of mobile terminals

1) Cluster formation:

A group of Student, having an Android mobile terminal in hand, constructs a cluster using Autonomous Clustering technique. Each and every Android mobile terminal has a unique ID. When an Android mobile terminal with the youngest ID changes its role as a cluster head it manages the cluster. Other Android mobile terminals change their roles to be as cluster members. An Android mobile terminal which is the neighbor of different clusters changes its role to a gateway. The cluster head periodically broadcasts control messages to the mobile terminals within the cluster and collects the information among the cluster members in the cluster. All these information are managed by the cluster head. The cluster member information is delivered by multi-hop communication using Bluetooth.

2) Communication with mesh network:

The group of tag forms the mesh network. Each and every tag sends the request messages to the cluster heads periodically to receive the data about the mobile terminals. The cluster head which acts as the head of different mobile terminals replies with the cluster information to the tag which sent them

B. Behavior of mesh network

1) Acquisition of the tracking information:

A collection of tag is located along school or college routes where Student walks to and from school or college. Each tag is installed with position information system, which acquires tracking information as well as the cluster member information provided by the communication between the tag and the cluster heads.

2) Communication for management server:

The tracking information as well as the cluster member information is transferred to the server through mesh network. Communication between tags and the server happens using wireless LAN in the mesh network.

IV. Implementation

A. Hardware and software for implementation

The Android mobile terminals used are Google Dev Phone 1 and 2. The operating system used by the terminal is Android 2.1 (Froyo). We develop mobile software using Java programming language.

B. Functions for Implementation

We have implemented communication software to construct a mobile ad hoc network by Bluetooth for the Student tracking system. Bluetooth is used for communication between each pair of mobile terminals. Dynamic pairing should be established between the mobile terminals for the communication to occur between them. Dynamic pairing enables two mobile terminals to communicate with each other thus preventing the interference by other mobile terminals. To perform dynamic pairing the mobile terminal sends a pairing request with password called PIN to the other terminal. The terminal after received the pairing request enters the PIN and then sends another PIN to the terminal which sent the pairing request. If both the PINs are correct, the requested dynamic pairing takes place, and both mobile terminals safely communicate with each other. Hence, any person without knowing the password cannot perform dynamic pairing. This scheme prevents eaves dropping communication between mobile terminals. Therefore, high security can be maintained in the communication between the Android mobile terminals. In addition, multi-hop communication is required to use the mobile ad hoc network technique and Autonomous clustering technique. We have implemented a multi-hop communication function after performing the dynamic pairing between Android mobile terminals.

1) Multi-hop communication function:

It is necessary the cluster head should broadcast messages to all the members in its cluster using multi-hop communication to maintain the cluster. Each Android mobile terminal should relay packets to its neighbouring mobile terminal. We have implemented the multi-hop communication function to Android mobile terminals.

2) Dynamic pairing function:

When two mobile terminals communicate with each other by Bluetooth, it is necessary that dynamic pairing should be established before communicating between them. Since the mobile terminal is hand-operated, we must set it up by ourselves. The Android mobile terminal does not have the ability to automatically discover other neighbouring mobile terminals. Hence a limited detectable time is not suitable to discover a mobile node. In order to improve this drawback, we have developed automatic dynamic pairing function in Android mobile terminals.

V. Preliminary Experiments

A. Experimental purpose and procedures

The purpose of the experiment is to measure the turn-around time it takes to broadcast a packet by multi-hop communication to all mobile terminals in the whole network. We checked out that the dynamic pairing has been established between the neighbouring mobile terminals. Then, we broadcast a packet from one of the mobile terminals in the Group and check whether that packet reaches all mobile terminals in the whole network by multi-hop communication. Finally, we measure the turn-around time taken by the packet to arrive at all mobile terminals.

B. Experimental Results

Figure 2 shows the turn-around time for the network in hierarchy structure.

Although communication using Bluetooth is one to one, it takes about one second, if the communication between the neighbouring mobile terminals is not interfered by the other neighbouring mobile terminals.

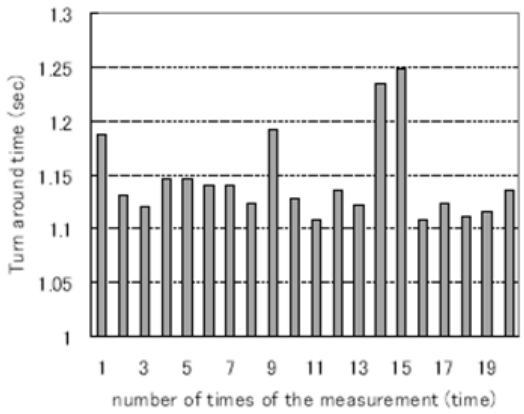

Fig. 2: The turn-around time for the network in hierarchy structure

VI. SUMMARY

In this paper, we have showed requirements for new generation Student tracking system and system features to meet the requirements. Using Autonomous Clustering technique, the proposed new generation Student tracking system can adapt to various mobility of Student by the formation of cluster. The current implemented system almost satisfies requirements (1), (2) and (3). Through preliminary experiments, we confirmed that the collection of Android mobile terminals can constitute a mobile ad hoc network by dynamic pairing and multi-hop communication.

REFERENCES

[1] Yoshiaki Kakuda, TomoyukiOhta, Shinji Inoue, Eitaro Kohno, and Yusuke Akiyama, "Performance improvement of Student tracking system by correction of wrong registrations on school or college routes," Proc. 9th IEEE Inter-national Symposium on Autonomous Decentralized Systems (ISADS 2009), Athens, Greece, pp.261-265, 20

[2] Atsushi Ito, Yoshiaki Kakuda, TomoyukiOhta and Shinji Inoue, "New safety support system for Student on school or college routes using mobile ad hoc networks," IEICE Transactions on Communications, vol.E94-B, no.1, 2011, to appear.

[3] Android Developers http://developer.android.com/index.html

[4] TomoyukiOhta, Shinji Inoue, Yoshiaki Kakuda, and Kenji Ishida, "An adaptive multihop clustering scheme for ad hoc networks with high mobility," IEICE Transactions on Fundamentals of Electronics, Communications and Computer Sci-ences (Special Issue on Multidimensional Mobile Information Networks), vol.E86-A, no.7, pp.1689-1697, 2003.

[5] Eitaro Kohno, TomoyukiOhta, and Yoshiaki Kakuda, "Se-cure decentralized data transfer against node capture attacks for wireless sensor networks," Proc. 9th IEEE International Symposium on Autonomous Decentralized Systems (ISADS 2009), Athens, Greece, pp.35-40, 2009.

[6] A. Shamir, "How to share a secret," Commun. ACM, vol.22, no.11, pp.612-613, 1979

[7] E. D. Karnin, J. W. Greene, and M. E .Hellman, "On secret sharing systems," IEEE Transactions on Information Theory, vol.IT-29, no.1, pp.35-41, 1983