RESEARCH ARTICLE

The Study for Application of ZigBee Location Tracing Monitoring System for ATM Device Theft

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Abstract— As the society has been computerized and automated, the crime for the ATM device is increased due to the wide distribution of ATM device, even the banking is easy. The theft is shown over 90%, the very high proportion among the financial accident and crime. With the locational characteristics of external ATM equipment that is always exposed to the crime, its accident even the theft to steal the ATM itself is not many, but it has been gradually every year. With this social situation, the study is going to suggest the method to react rapidly and minimize the loss of damage by realizing the real time location, applying location tracing monitoring system using Zigbee as a rapid reaction to the theft for external ATM equipment.

Keywords- ATM, Zigbee, GPS, Location monitoring

I. INTRODUCTION

As the social computerization and automation has been increased and the ATM and credit card has been installed and spread out to simplify the activity for financial activity, the banking activity has been simplified, however the crime related with financial organization has been increased in proportion to the ratio of spread out of automation and devices. Those crimes for the financial organization has been increased gradually from year 2000 to 2003, little bit decreased in 2004,and then increased again from year 2005. In the year of 2007,212,530 of theft and 4,439 of robber cases are happened, and 269,410 of theft and 4,409 of robber cases are happened in year 2010, so that the cases of theft and robber have been increased gradually during past 10 years [1].Among the crime for financial organization, the cases of theft and robber have very high proportion of over 90%. and the crime for the ATM has been increased because the external ATM in the gas station and convenience store has been increased and it is always exposed to the crime. Therefore, this study is going to suggest the method of rapid reaction and minimization of loss by detecting the location of the machine real-time when it has been stolen by applying GPS module in Zigbee in the accident of theft of external ATM machine which is installed in the convenience store and gas station.

II. RELATED STUDY

1. ATM (Automated Teller Machine)

The first ATM in Korea was installed by Korea Exchange Bank in 1975, and after installation of ATM by Shinhan Bank in 1982, the civilian can use the ATM of various banks with starting of operation of common CD network which is controlled by Korea financial telecommunications & clearings institute [2].The number of installed ATM machine has shown the trend of

increasing continuously with the high increasing ratio in the first half of year 2000s, and gradual increase after the year. Especially external ATM machine has been increased continuously [2]. The external ATM machine is located in the entrance of kiosk booth and sidewall generally. The security system of those external ATM protects the 1st stage with the signal lamp installed in the machined itself, and covers the others with the open and impact detecting sensors. The impact detecting sensor generates and sends the signal to the security center immediately to protect the ATM machine. The control center has a rule if the emergency signal is sent and order to dispatch to the agent, the agent shall be the location within 25 minutes at the latest, however the late dispatch due to the lack of responsibility of agent and lack of number of agent and equipment will not be done of proper and rapid reaction for the ATM theft. Therefore, if the Zigbee with GPS system which is to suggest in this study is installed in the ATM, the advanced security system can be setup with the rapid reaction by monitoring the location of criminals real-time even the theft is happened.

2. ZigBee

The ZigBee which is one of the representative wireless sensor network which has low-power, low-cost and convenience to use, is standardized the higher protocol and application based on the PHY/MAC layer by IEEE 802.15.4 subcommittee in 2003. ZigBee can realize the local communication and ubiquitous computing, and can transfer the date with 250kbps within 100m radius range, and connect about 65000 units in single wireless network by utilizing mesh network organization. The key characteristics of ZigBee/IEEE 802.15.4 is low power consumption. The end devices of ZigBee network are able to use 2 to 3 years maximum with installation of a battery and can be use more period under the condition with lower communication frequency [3].
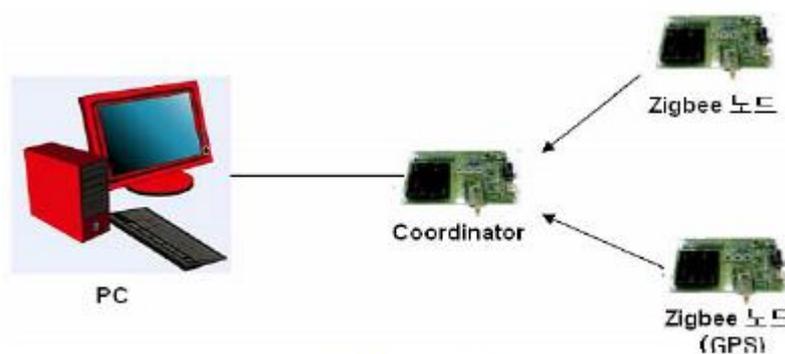

Figure 1. *ZigBee Network Organization*

3. GPS Technology

GPS which is developed by DOD, is the wireless navigation system using satellite. User can calculate the location, velocity and time correctly by provided information of location and velocity from GPS satellite. GPS has been operated since 1993 and legally operated from 1995 and has following characteristics[4]:

　　Measuring correct 3D location, height and time.
　　Providing 24 hours service worldwide.
　　Robust to the weather condition and interference.
　　Passive and able to be used unlimitedly.
　　Using global common coordinate system, WGS(World Geodetic System)-84.

GPS Node sends the received information for location from satellite to Node 0 with NMEA-0183 type of message. NMEA(National Marine Electronic Association) is defined as electric interface and data protocol for communication between ocean equipment [5], the GPS signal receiver is the standard protocol in transferring data [6].

3.1 GPS Module

The GPS module which is applied on the ZigBee node is applied with KBE168 elements. The GPS module has a type that can be attached and detached from Zigbee node with 50 pin connector. When a client wishes to query the cloud for a certain mHealth monitoring program, the *i*-th client and TA run the TokenGen algorithm. The client sends the company index to TA, and then inputs its private query (which is the attribute vector representing the collected health data) and TA inputs the master secret to the algorithm. The client obtains the token corresponding to its query input while TA gets no useful information on the individual query. During the last phase, the client delivers the token for its query to the cloud, which runs the Query phase. The cloud completes the major computationally intensive task for the client's decryption and returns the partially decrypted cipher text to the client. The client then completes the remaining decryption task after receiving the partially decrypted cipher text and obtains its decryption result, which corresponds to the decision from the monitoring program on the clients' input. The cloud obtains no useful information on either the client's private query input or decryption result after running the Query phase. Here,

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we distinguish the query input privacy breach in terms of what can be inferred from the computational or communication information. CAM can prevent the cloud from deducing useful information from the client's query input or output corresponding to the received information from the client. However, the cloud might still be able to deduce side information on the client's private query input by observing the client's access pattern. This issue could be resolved by oblivious RAM technique [29], but this is out of the scope of this paper.

III. PROPOSED METHOD

The most weakness of external ATM device is theft because the device is always exposed to the crime. The operation of location tracing monitoring system by applying ZigBee wireless module which is proposed in this study for the external ATM theft is as follows:

1. Location monitoring system
1.1 System design

The location monitoring system is composed of Node 0(Coordinator), as a master node which is in charge of serial communication with PC and Node 4 (that is, GPS node) which contains GPS module. GPS Node which contains GPS module transfers the location information of itself using wireless network.
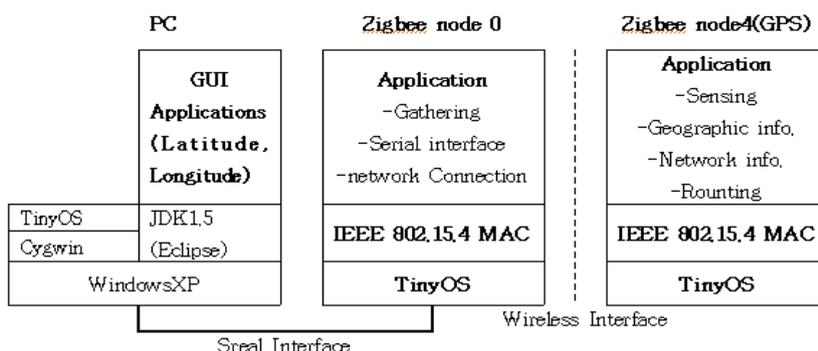

Figure 2. Software organization of location monitoring system

1.2 Monitoring Application (Master Node to PC)

The monitoring application provides interface through Node 0(Coordinator) which collects sensing information of nodes, and provide user information after analyzing information received from nodes (Fig. 3).
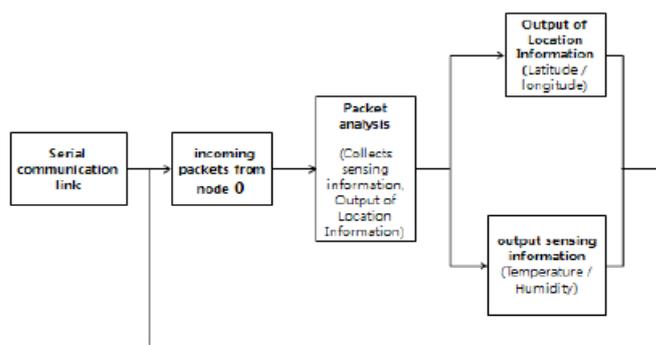

Figure 3. GUI Application Sequence [8]

1.3 Transferring between ZigBee nodes (between nodes)

GPS Node transfers sensing data of itself and location data additionally to the PC using serial communication. (Fig. 4) shows the location monitoring system after providing information to the PC by communication between nodes which contain GPS module. If the case is happened by location monitoring, sending information to the police and control center to make order to go to the monitored location more rapidly.
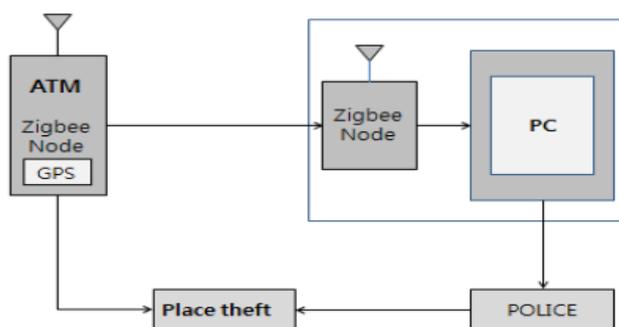
Figure 4. Location Monitoring System Configuration

2. Output of Location Information

GPS Node sends location information with type of MNEA-0183 in KBE16, and Location information monitoring system receives in the master road. Once the information is received, the location information of latitude/longitude is calculated and displayed on the map.

IV. EXAMPLE OF ATM DEVICE THEFT AND APPLICATIONS

As the external installation of ATM device has been increased, the loosen reaction for the ATM device theft case can make huge damage by the loss of cash and device. To protect that kind of things, we are to suppose the method to minimize the damage with rapid reaction for the ATM theft by applying location monitoring system in installed GPS on ZigBee network.

TABLE I.   SUMMARY OF ATM DEVICE THEFT CASES

Date	Description
17th Sept. 2006	ATM device theft of Convenience Changwon-si, Gyeongsangnam-do.
28th Aug. 2007	ATM device theft of Convenience Siheung, Gyeonggi.
2nd Jun. 2009	ATM device theft of Convenience Yangyang, Gangwon-do.
7th Jul. 2009	ATM device theft of Convenience Wolseong-dong, Dalseo-gu, Daegu

4.1 Application for ATM device theft

Basically, external ATM device has its signal lamp as a 1st security system, opening detection sensor installed on the body, and impact detection sensor to send signal immediately if it senses impact from outside. The impact detection sensor sends abnormal signal to the control center immediately when outside impact is detected. However unfortunately if the ATM device is stolen with the reason of lack of responsibility of the ordered person, lack of personnel and devices. GPS node sends the information data which received from GPS node installed on ATM to the PC which handles monitoring software through master Node (Node 0) and then send signal to the patrolling agent and the police again. As you see the example in the table above, there are cases that theft ATM device thoroughly and taking the same cases afterward, and the thief is caught after destroying the ATM device and use out of all the cash inside of ATM. At this point, if the location tracing monitoring system were applied on that ATM device, the damage could be minimized. In this case, if the location of the stolen ATM device is monitored and informed rapidly to the control center, patrol agent and the police can be moved to the location immediately and react rapidly so that the damage of ATM and cash can be minimized by early caught of the thief.

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V. CONCLUSION

The ATM device which is always exposed to the crime, is gradually increased every year, and in this trend, the crime for the ATM is increased accordingly. The location tracing monitoring system is a system which is able to monitor the location real-time when ATM is stolen by installing GPS module on ZigBee in ATM. Due to the security system of external ATM device is down when the power of ATM turns off, installing GPS on the ZigBee which has self-power so that if the ATM device is stolen, the control center can react immediately using location tracing monitoring system. Even though the application of location tracing monitoring system is not the perfect solution for the ATM device theft, we hope that the study is able to help to develop the system. Also, the development and application which is optimized to the external ATM device regarding to the characteristics is needed in the future.

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