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## **ภาคผนวก**

### **ผลงานที่ได้รับการตีพิมพ์**

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## The Integration of Security Systems Using WBSC

Sanchai Rattananon

Department of Telecommunication Engineering  
University of the Thai Chamber of Commerce  
Bangkok, 10400 Thailand  
sanchai\_rat@utcc.ac.th

Suparerk Manitpornsut

Department of Computer Engineering  
University of the Thai Chamber of Commerce  
Bangkok, 10400 Thailand  
suparerk\_man@utcc.ac.th

**Abstract**—Presently, the aggravated economy and society in many countries can critically lead to various forms of crimes, especially building robbery. Therefore, one of the best ways to prevent the properties' owners from such crime is to install a security system. Basically, the designed building security systems consist of two installation systems, the Monitoring system such as Closed-Circuit Television (CCTV) and the Alarm system. Each system has its own control equipments such as Digital Video Recorder for the CCTV system and Control Panel for the Alarm system, which might constitute high cost and difficulties to control and manage those equipments. In this paper, we introduce new controlled equipment for the both building security systems. It integrates and extends the functions to control both Monitoring and Alarm systems, which is called WBSC (Wireless Building Security Control). In addition, we also propose an incorporation of the wireless network, mobile network, and PSTN (Public Switching Telephone Network) into the use of the building security systems. Finally, the result of this paper presents a functional success of the WBSC equipment that meets the requirements to control the building security systems and to perform the alarming system very efficiently for the properties' owner at anywhere and anytime.

**Keywords** - WBSC; GSM; Wireless Network; IEEE802.11; Mobile Network

### I. INTRODUCTION

The economic crisis all around the world in the present day imposes on not only the financial difficulties but also the social problems to the society. Financial difficulties come to the attention of the government in every country due to its scale, required the macro perspectives to alleviate the financial situation. On the other hand, the social problems need the special attention from everyone in the community to sincerely improve the circumstances. The social problems include conflict, drinking and drugs, physical and mental health, racial, crime, etc.

One of the most critical social problems is the robbery and burglary. In Fig. 1, the number of robbery and burglary in the USA during the last five years [1] has constantly occurred more than two and half million times each year. Approximately 83% of such crimes occurred in the building of both residential and non-residential (e.g. store, office, etc) areas.

In order to alleviate the aforementioned crime, a building security system is usually deployed. The building security

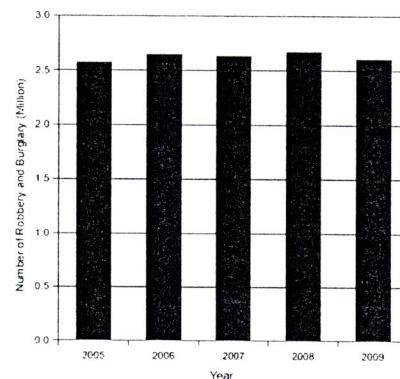


Figure 1. Number of robbery and burglary in USA during 2005 – 2009

system can be categorized into two major types, depending on its purposes: Monitoring and Alarming systems.

Conventional building security monitoring system is Closed-Circuit Television (CCTV). CCTV typically consists of camera, video recorder, and monitor. CCTV provides real-time monitoring as well as video playback features. However, it requires security officers in charge for all time to monitor the possible threats and/or identify the problem after someone breaches into the building.

On the contrary, alarming system provides alerts by informing the user via notification so that no need to monitor the building in person. The notification could be in the forms of voices, messages, etc. Alarming system basically consists of sensors (e.g. motion detector, smoke detector, etc.), alarm notification unit (e.g. siren), control unit, and user access unit. However, unlike monitoring system, alarming system generally offers only instantaneous notification without playback feature.

In order to enforce the security in the building, both monitoring and alarming systems are required. However, these systems have their own core technologies and consequently interoperability is hardly possible. This issue introduces high cost of ownership and maintenance drawback.

We, therefore, propose the solution to prevent the robbery and burglary by using the Wireless Building Security Control System (WBSC), which combines the advantages of both monitoring and alarming systems. The proposed system offers 'anywhere and anytime' access. We explain our design in more details in the next sections. This paper is organized as follows:



The related work is explained in section II. Then, the proposed WBSC system is delineated in section III. In section IV, the experimental results are discussed. Finally, we conclude our study and future work in section V.

## II. RELATED WORK

In this section, we provide the reviews of available products of monitoring and alarming systems. In addition, we also show a number of proposals for building security service system.

### A. Monitoring System

Conventional monitoring system is CCTV (Closed-Circuit Television). CCTV consists of camera, video recorder, and monitor. CCTV provides real-time monitoring as well as video playback features.

Camera in CCTV could be as simple as analog camera or as advanced as wireless high-definition (HD) video camera. In the same manner, video recorder ranges from analog video recorder (e.g. VHS) to HD digital video recorder. The connectivity between camera and video recorder could be done through cable, radio connection, or IP network.

No matter what technologies are used it requires security officers in charge for all time to monitor the possible threats and/or identify the problem after someone breaches into the building.

### B. Alarming System

Alarming system provides the alert by informing the user via notification. The notification could be in the forms of voice, message, etc. Alarming system basically consists of sensors (e.g. motion detector, smoke detector, etc.), alarm notification unit (e.g. siren), control unit, and user access unit.

A variety of sensors could be used in the system, depending on the purpose of the alert system, such as motion detector, smoke detector, touch sensor, etc.

Unlike monitoring system, alarming system usually offers instantaneous notification without playback feature.

### C. Building Security Service System

Jiang et al [2] proposed a framework that uses the wireless home alarm system. Therefore, we can make the use of GSM network by adding GSM module [3] which has simple structure and easy to control.

Liting et al [4] proposed to distribute security system for intelligent building, especially the alarm devices. They provided the mechanisms to develop the detect sensors based on wireless communication technology and embedded system which could be applied the intelligent building [5].

## III. WBSC SYSTEM ARCHITECTURE

The main objective of WBSC is to support service integration that provides the monitoring capabilities as well as alarming features. It consists of hardware architecture and controller software stack, as explained below.

As shown in Fig. 2, the hardware architecture composes of three main components as follows:

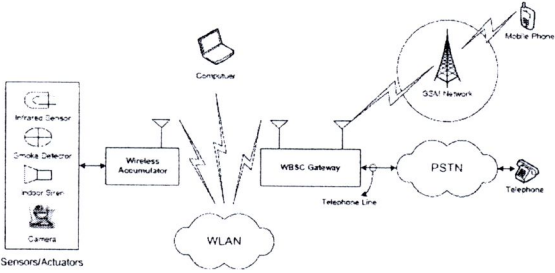


Figure 2. WBSC System Architecture

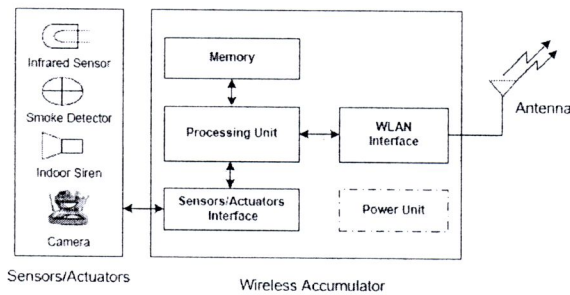


Figure 3. Architecture of Wireless Accumulator (WA)

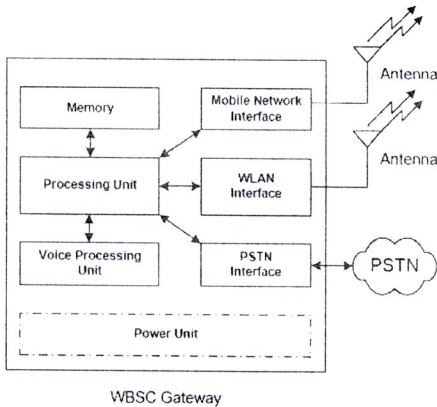


Figure 4. Architecture of WBSC Gateway (WG)

### A. Sensors/Actuators

In order to be aware of the environment, sensors are used to detect the conditions of their surroundings, e.g. heat, motion, smoke, etc. Actuators are installed so that they can react to the environment upon the preset actions. An example of actuators is a siren, used to produce alert voices.

### B. Wireless Accumulator (WA)

WA acts as an interface between sensors/actuators and WBSC Gateway (WG), as illustrated in Fig. 3. It comprises four subsystems:

- 1) *WLAN Interface*: IEEE 802.11b WLAN interface module enables WA to communicate to WG via wireless network.
- 2) *Power Unit*: Rechargeable battery, regulator and power switching circuits are used to supply uninterrupted power to all units.
- 3) *Processing Unit*: Empowered by PIC Microcontroller from Microchip [6], the processing unit is designed for low power consumption and support a large number of sensors/actuators.
- 4) *Sensors/Actuators Interface*: This module is used to convert data from sensors to useful information and pass it to the processing unit. Another functionality of this module

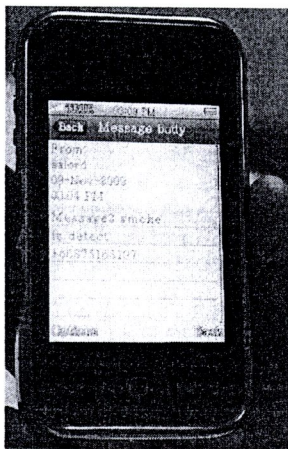


Figure 5. SMS Alert from Smoke Detector

is to deliver the commands from processing unit to the actuator.

C. *WBSC Gateway (WG)*

WG is an important component that allows authorized users to connect to the system remotely through PSTN, mobile network, or wireless LAN. As depicted in Fig. 4, there are six main subsystems but only three of which differ from WA are described here:

- 1) *Mobile Network Interface*: This module supports GSM network with GPRS, allowing the video monitoring on mobile phones or portable devices through mobile network.
- 2) *PSTN Interface*: PSTN interface offers a reliable communication channel required in emergency situation, e.g. to inform fire and police stations.
- 3) *Voice Processing Unit*: This unit is used to process voice message, allowing the system to automatically send pre-recorded voice message to the relevant authorities via PSTN interface.

IV. EXPERIMENTAL RESULTS

The experiments are set up in laboratory environment with the following scenarios:

A. *Binary sensor and SMS alert*

This scenario is to test the simplest functionality of the system – alarming system. Binary or on/off sensor is the simplest kind of sensors, which can provide only two output values: on or off. We use smoke detector as a sample of binary sensor and SMS (Short Message Services) as an alert message via mobile network. The result in Fig. 5 shows the SMS alert with sensor information.

B. *Video Monitoring and MMS alert*

In order to illustrate the integration of monitoring and alarming systems, video camera is deployed in WBSC, as shown in Fig. 6. During the video recording, WBSC can



Figure 6. Video Monitoring and MMS Alert Experiment Setup

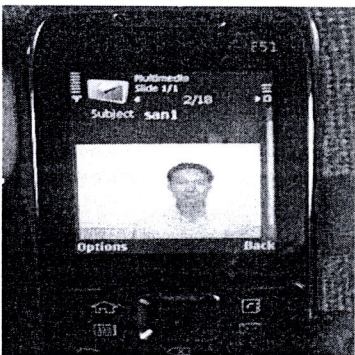


Figure 7. MMS Alert via Mobile Network

send the MMS (Multimedia Message Services) alert to the associated mobile phone as shown in Fig. 7.

C. *Binary sensor and voice alert through PSTN network*

Some alert needs an immediate attention, e.g. fire alarm. It is better if this type of alert is sent to the relevant authority when the building owner is not available to monitor the alarm or fail to reset the alarming system within the predefined alert delay.



During the test, the recorded voice message is triggered to send to a preset phone number through PSTN network when the alert delay is run out.

## V. DISCUSSION AND CONCLUSION

WBSC offers integration of monitoring and alarming system as a single point of services. Wireless accumulator (WA) is a wireless platform that can be interconnected to a variety of sensors and actuators. It decouples the presentation of the sensed data from the WBSC Gateway (WG). This decoupling allows authors to emphasize on the access control on WG. In WBSC architecture, WG support multiple access technologies, including WLAN, PSTN network, and GSM mobile network. Access through WLAN can provide a high quality video monitoring while access via GSM mobile network enables monitoring and alarming to mobile users and access through PSTN network provides alarming function for emergency cases.

From the experiment, the WBSC system can achieve reasonable results. As a monitoring system, it can capture and record video streaming as well as playback the videos. As an alarming system, WBSC is also able to provide the alert message in terms of SMS, MMS, and voice message.

However, the WBSC system itself still has some limitations. The connection between WA and WG is a point-

to-point connection. Multicasting connection is required to support multiple WAs associated to the same WG, which we have left it for future work.

## ACKNOWLEDGMENT

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