Improvement of Fire Alarm Systems: With a Focus on Apartment

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Abstract

This research proposed new fire alarm systems to solve the drawbacks: false alarms about current fire alarm systems in apartments, increased prices on manufacturing and installation of the alarm systems which developed recently. Although the new alarm systems are more expensive than the current ones which consists of 4 steps, their strengths are that they cost less than the one recently developed for manufacturing and installation, and also reduce false alarms efficiently. The new fire alarm systems consist of 5 steps. If fire detector detects a fire, a receiver receives it and warns to safety center, send a fire signal. In the case of a false alarm, you can stop the alarm and recover the signal by handling the smartphone application or pressing the switch on the receiver. Otherwise, it is regarded actual and the system sends an alarm to fire automatically to let concerned people know about it. Another feature of the alarm systems is that the monitoring is possible all the time. Even if the fire safety supervisor is absent for a while, he or she can monitor the fire-related information frequently with the smartphone application.

Keywords: Fire Alarm Systems, Alarm System, Home Alarm Bell, Smartphone Applications, False Alarm

1. Introduction

Fire alarm systems are of an important fire detection system to inform the early fire information to the fire-related person and prevent fire spread to minimize the fire damage. Fire alarm systems are comprised of fire detector for fire detection, processing the signal through the code-transmitter or passing through fire indicating equipment to alarm the fire.

Meanwhile, fire alarm systems have reliability problems due to the false alarm and have been studied to improve the reliability. When reviewing previous studies about fire alarm systems, there is the foreign literature which includes H. S. Kong (2016); The Method of Improvement for Automatic Fire Detection Alarm System, Pashkevich·Rasschekina·Lytyagin (2012); The Study about False Alarm of Fire Alarm Systems, Fedorov (2012); The Study about Standardization of Integrated Security Systems, Antonenko·Butsynskaya (2010); The Study about Operating Systems of Integrated Security Systems, Jilin (2007); The Study about Fire Alarm Systems, and Adams (2003); The Study about Application of Intelligent Fire Alarm Systems [1-6].

When reviewing previous studies in Korea, H. S. Kong, J. S. Yang and K. S. Kang(2016); Development of Smart Phone Applications Linked with Fire Alarm Control Panel in Automatic Fire Detection System, J. M. Jung, B. C. Kong and S. H. Lee(2013); Design and Implementation of a Multifunction Fire Detector , G. J. Lee, H. G. Kim, B. U. Lee, T. O. Kim and D. I. Sin(2012); Test Bed Design of Fire Detection System Based on Multi-Sensor Information for Reduction of False Alarms, B. G. Seo and M. O.

Yun(2010); A Study on the adaptability of Carbon monoxide Detector, J. C. Lee, D. H. Kim, S. H. Hong and Y. B. Park(2002); Temperature index dependent smoke detectors and its improvement [7-11].

Despite of continuous research for the false alarm, the false alarm still continued. Therefore, it is necessary to try to do some other research direction. Especially, the false alarm is mainly caused by fire detector and could be caused by environmental condition in many cases. Therefore, it is necessary to study for the false alarm system such as the fire information is transferred to the fire-related person to identify the real fire situation or not.

2. Theoretical Considerations about Apartment Houses

An apartment house is defined as "a type of multi-unit dwelling in which form of housing a building with 5 floors or more is divided into each of several houses on each floor for a separate household to live in" and classified together with a dormitory as one of multi-unit dwellings by 'Installation, Maintenance, and Safety Control of Fire-fighting Systems Act,' based on which, an apartment house is housing with 5 floors or more used as dwellings and a dormitory is used for students or employees etc. of a school or a factory etc. and equipped with a communal kitchen *etc.,* in the structure that allows cooking *etc.*, but not in any form that allows separate dwellings.

Fire alarm systems which are installed in an apartment house are to be installed in the gross floor area of 1,000m² or more. The circuit of fire alarm systems of a general apartment house is configured in the way that signal input of the fire indicating equipment immediately triggers field bells to go off once a fire detector is activated even by the cooking smoke in a kitchen of a home. In this case, a resident of the home might report the false alarm but there are not any other suitable measures in this state.

As these situations frequently take place, false alarms in the front line of fire safety lead to situations where fire alarms such as field bells go off and cause civil complaints of residents. For this reason, there are instances where a fire safety manager shuts the fire indicating equipment off or leaves the field bells off.

Despite this situation a continuous increase in fire casualties of certain fire-fighting objects used for sleeping or lodging such as apartment houses among others brought about the amendment of the fire safety standards (NFSC 103) of fire alarm systems and visual alarm systems, according to the notification of which, smoke detectors should be installed in the living rooms used for sleeping or lodging such as multi-unit dwellings, studio apartments or lodging facilities to be built in the future. It is expected that this will increase the incidence of false alarms caused by cooking at the kitchen, smoking or dust etc. in multi-unit dwellings.

3. The Current Automatic Fire Detection System

Figure 1, shows the current automatic fire detection system used in apartment houses. The current system has four fire alarming steps and is comprised of fire detector, code-transmitter, fire indicating equipment, and fire safety manager and fire alarm at the same time. However, when the false alarm occurs, the fire safety manager does not have enough time to check the false alarm or not and operates the alarm switch in many cases.

There are also cases where dereliction of fire safety manager's duties causes the fire indicating equipment to be left inactive.

Figure 1. Block Diagram of the Current 4-Step Automatic Fire Detection System

Based on the review of the flow chart shown in Figure 2, for the detailed fire alarm system of the current fire alarm systems for apartment houses, if the fire detector with the role of a fire signal generator sends a signal, the signal is passed to the code-transmitter installed between the fire detector and the fire indicating equipment, which receives the signal and transmits it to the fire indicating equipment. At soon as the signal is received, the fire indicating equipment with the signal transmitted triggers the main bell and the field bells and immediately warn the fire safety manager and the residents living in the home. Only when judging the situation not as an actual fire but as a false alarm while the main bell and the field bells are ringing does the fire safety manager presses the reset button of the fire indicating equipment in order to reset the fire indicating equipment to the initial state before the fire.

However, this system of first warning the fire safety manager and the residents living in the home at once without time to determine the fire even when allowing for the fire safety manager's acting of judging the situation as a false alarm and pressing the reset button to reset the fire indicating equipment to the initial state, might cause confusion as the alarm bells have already been activated to warn the residents living in the home.
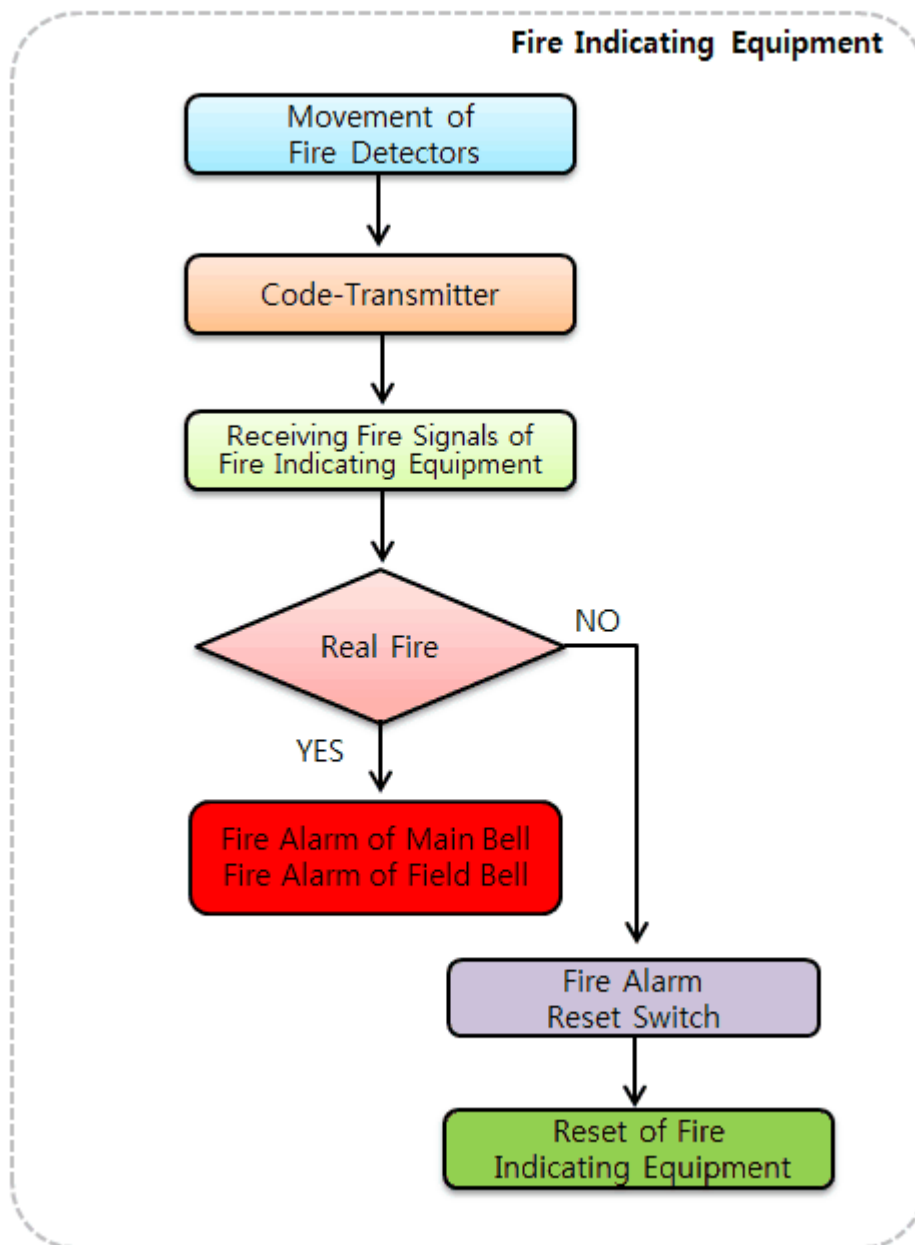
Figure 2. Flow Chart of the Current 4-step Fire Alarm System

4. Recently Developed Automatic Fire Detection System

False alarms occurring in apartment houses have structural characteristics of not allowing the fire safety managers' quick entry to the inside of the house for reasons such as personal safety, make it difficult to manage the fire safety efficiently.

In order to solve this difficulty, home alarm bells are developed. These systems are designed with home alarm bells installed in each home in addition to the fire indicating equipment in order to allow the residents to take primary action against false alarms of the fire detectors.

In the alarm system recently developed in order to prevent false alarms of fire alarm systems for apartment houses as shown in Figure 3, when the fire detector detects a fire, the fire signal is passed to the code-transmitter which simultaneously transmits to home alarm bells and the fire indicating equipment only. As of this step it is a preliminary

warning state in which a voice message is sent to the residents living in the home via the home alarm bells and the fire safety manager is warned against a fire by the main bell in order to allow both the residents and the fire safety manager to judge the situation and only when it is judged as an actual fire do the home alarm bells automatically go off to warn the residents, comprising a total of 5 steps [12].
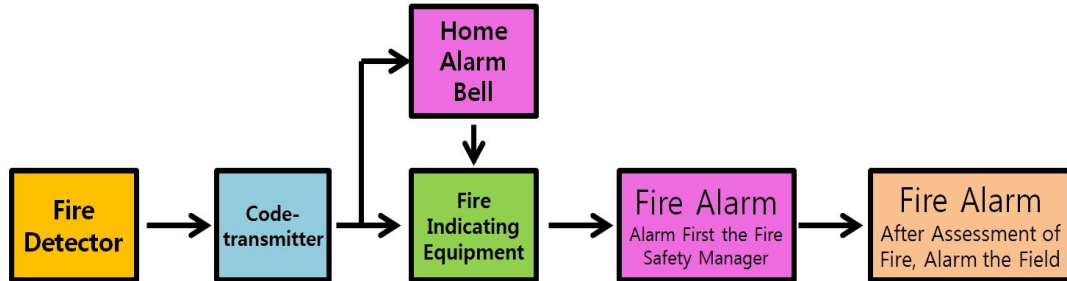

Figure 3. Block Diagram of the Recently-Developed 5-step Fire Alarm System

Based on the review of the flow chart shown in Figure 3, for the detailed fire alarm system of the recently-developed fire alarm systems for apartment houses, if the fire detector sends a signal, the signal is passed to the code-transmitter, which receives and transmits the signal and then the signal is received simultaneously by home alarm bells and fire indicating equipment. The fire indicating equipment first informs the fire safety manager of the fire by means of the main bell and the home alarm bells first reports on the activation of the fire detector to the corresponding home and the fire indicating equipment not by means of the alarm bells but by means of a voice message. If it is not a fire, the residents can press the reset button of the home alarm bells installed in the home to reset the false alarm. If there are not any residents in the home or it is an actual fire, the field bells go off after a certain waiting time, which finally warn the entire residents against the fire signal. On the contrary to the current fire alarm systems where 1 fire safety manager reacts to false alarms, these recently-developed systems feature in provision of double safety systems.

These alarm systems have advantages in decreasing false alarms but generate the problem of increasing the manufacture and installation costs because the home alarm bells should be installed in each home.
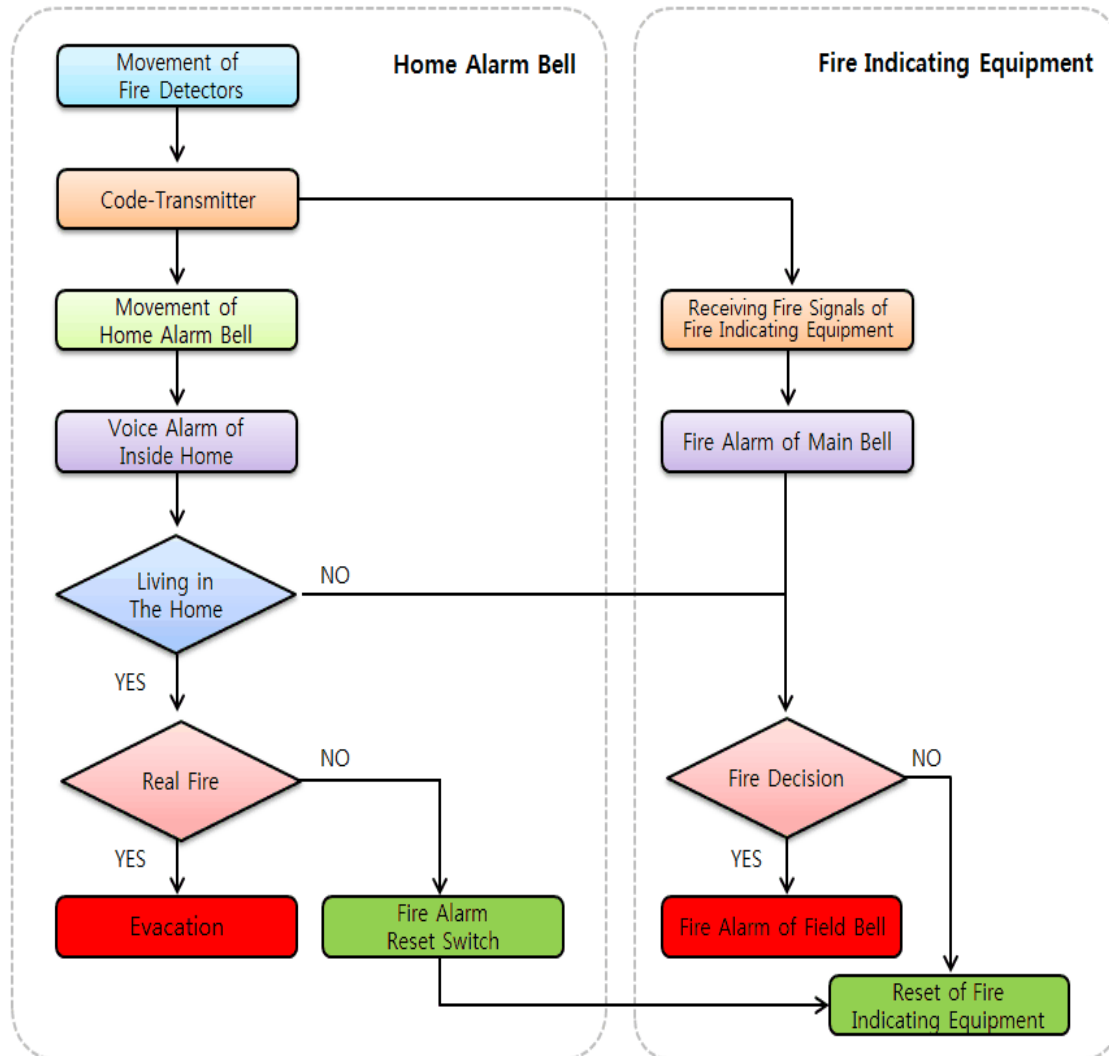
Figure 4. Flow Chart of the Recently-Developed 5-Step Fire Alarm System

5. The Method of Improvement for Automatic Fire Alarm System

There are fire alarm systems which can solve the problem of increasing the manufacture and installation costs as known as the disadvantage of the recently-developed fire alarm systems and prevent false alarms. These systems use smartphones in order to receive various kinds of information of fire indicating equipment of fire alarm and implement the observation system. These systems are shown in Figure 5. When the fire detector detects a fire, the fire signal is passed to the code-transmitter. The code transmitter transmits the signal to the fire indicating equipment. Then the fire indicating equipment warns the building safety center against the fire. At the same time, the fire indicating equipment sends the fire signal to the fire safety manager via a smartphone application. In the case of a false alarm, the fire safety manager can control the smartphone application to stop the fire alarms of the fire indicating equipment. At the same time the fire signal is reset. The fire safety manager can also press the reset switch to stop the fire alarms. Also at the same time the fire signal is reset. On the other hand, there are instances where the fire safety manager might not control the smartphone application responsively even after a certain time passes. In these instances, the fire safety manager might not press the reset switch of the fire indicating equipment either even after a certain time passes. If neither of these is done by the fire safety manager, it is deemed as an actual fire. Then the alarm

bells automatically go off to inform the people related to the fire outbreak that the fire has broken out. These 5-step processes comprise the fire alarm systems using smartphone applications.

These fire alarm systems increase the costs if comparing them to the costs of the current 4-step fire alarm systems. On the other hand, when compared to the recently-developed fire alarm systems, the manufacture and installation costs of these systems are cheaper and these fire systems have advantages in reducing false alarms effectively. In addition, the smartphone applications can be utilized efficiently. Even when stepping out of office for a while, the fire safety manager can monitor fire-related information frequently. It is considered to facilitate a constant observation system at any place and at any time.
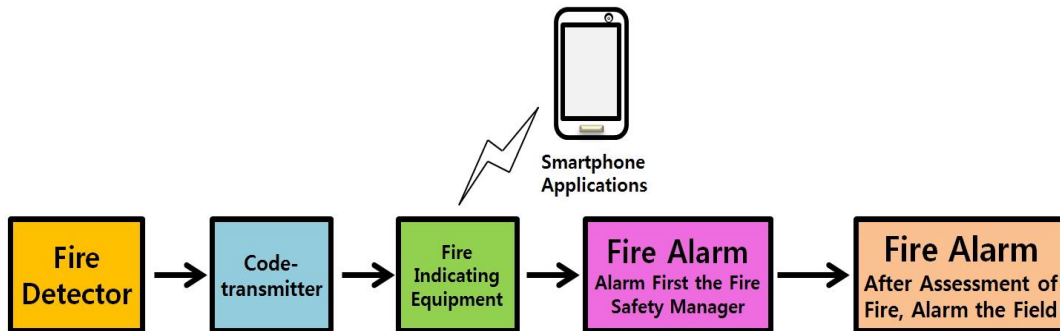

Figure 5. Block Diagram of the New 5-step Fire Alarm System

When looking deep into the fire alarm systems using smartphone applications through the flow chart of the fire alarm systems using the smartphone applications, the fire alarm systems are as shown in Figure 6. If the fire detector detects a fire, the code-transmitter receives the fire signal and transmits it to the fire indicating equipment. Then the fire indicating equipment triggers the main bell to inform the building safety center. At the same time, the fire indicating equipment equipped with an MPU (Micro Processor Unit) board to send the fire signal via smartphone applications runs the dedicated smartphone application to send the fire observation information to the fire safety manager. The fire safety manager can control the smartphone application to check the fire indicating equipment's state, whether a fire has broken out or where the fire has broken out and reset the fire indicating equipment. After controlling the smartphone application, if an actual fire has broken out, the fire safety manager calls 119, reports on the fire and takes all necessary measures such as evacuating the residents. If it is a false alarm, the fire manager presses the fire alarm reset switch of the smartphone application to reset the fire indicating equipment. If an actual fire has broken out and the fire safety manager does not press the reset switch of either the smartphone application or the fire indicating equipment, it triggers the field alarms to go off after a set time and inform the residents that a fire has broken out.
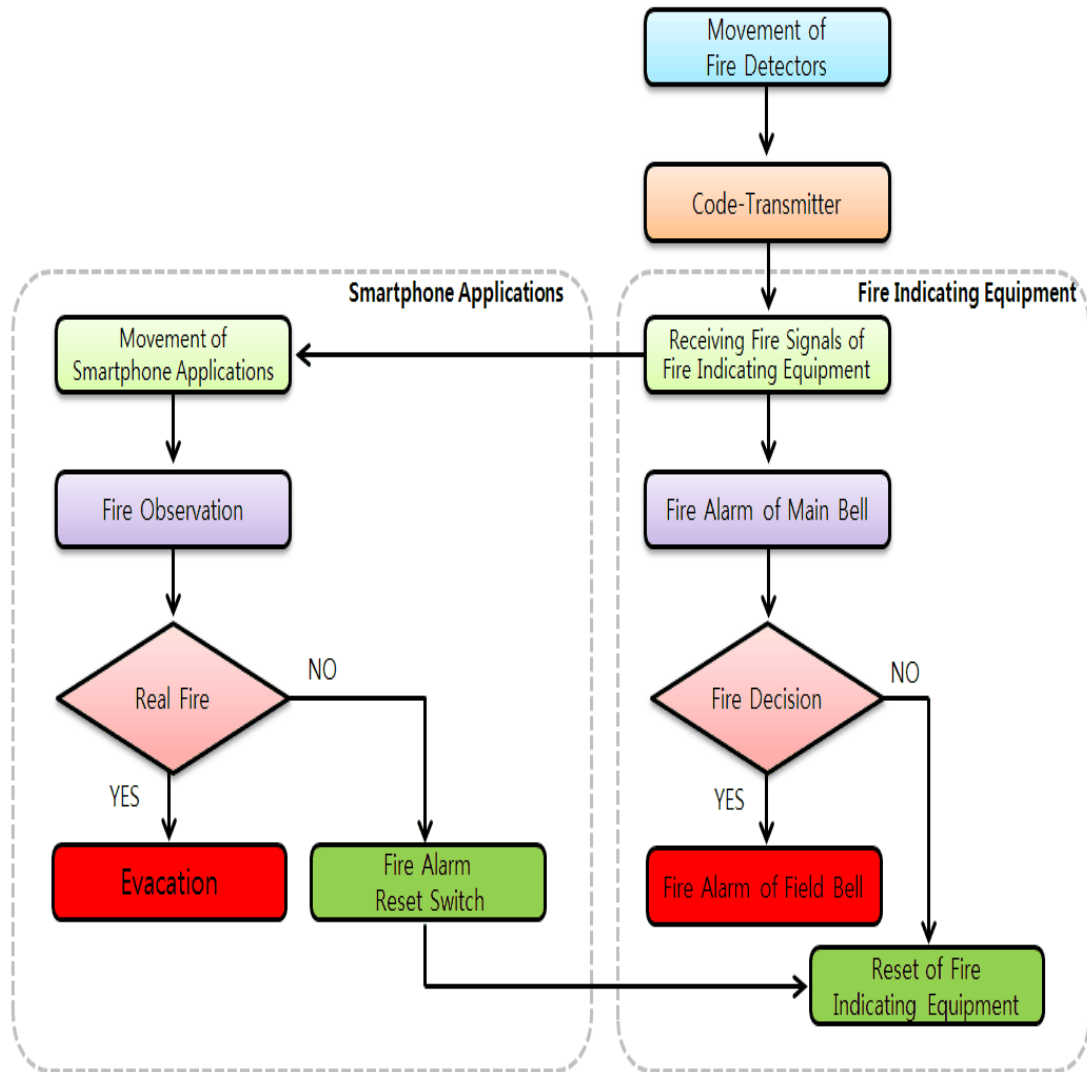
Figure 6. Flow Chart of the New 5-Step Fire Alarm System

6. Conclusions

Fire alarm systems detect fires in apartment houses at an early stage. Accordingly, they play an important role of helping extinguish fires and evacuate residents. On the other hand, false alarms of fire alarm systems have caused the reliability problem of fire alarm systems continuously.

This study attempted to solve the problem of false alarms in the current fire alarm systems at apartment houses and the problem of the recently-developed fire alarm systems such as the increased manufacture and installation costs. In order to solve these problems, this study suggested new fire alarm systems. These new fire alarm systems would not solve false alarms of fire alarm systems. However, we believe that if these attempts continue, it will not be long before false alarms of fire alarm systems are solved and fire alarm systems provide people related to fire safety with reliability.

As the subject matters for future studies, it is necessary to design smartphone applications that interoperate with the fire indicating equipment and consist of the received information unit, the state unit, the control unit and the equipment history search unit in order to implement the functions such as observing fire outbreaks, activating fire alarm

systems, restoring short circuits, resetting the state of fire indicating equipment and fire alarm control panels.

In addition to these studies, we hope the reliability of fire alarm systems is insured by continuous studies about new fire alarm systems which can reduce false alarms.

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