

## RECENT RESEARCH TREND OF THE FIRE DETECTION SYSTEM

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### ABSTRACT

As structures are higher, large-sized and more complex, we should detect the fire at the beginning and cope with it to reduce the loss of mankind and the physical damage due to fire. So we have investigated and developed various kinds of fire detection system, and do the efforts for minimizing the nonfire alarm.

As there exists a close relationship between the technology development and the market potential, a comparison between the number of fires in special buildings and detection types were made to find out market potential based on the annual statistics on fire products inspection.

In addition, we have discussed the causes of nonfire alarm and the fire detection system and prospect the research trend of the fire detection system.

### I. INTRODUCTION

Along with the development of the scientific technology, industrial structures are reformed and all sorts of constructions become high-storied, crowded, and complicated.

If fire breaks out, we'll have great damages. So it is very important to find a fire in the beginning and to cope with the such situation. Unless we find a fire in the beginning, we cannot help large disaster. Therefore, when fire breaks out, there is an equipment for rapid responses fire alarm system, if it is used and managed by fundamental object, fire alarm system is possibly the best equipment.

However, although quality should be guaranteed the prompt fire alarm system is the most important of all.

Construction's owner or user misunderstands this system as required equipment simply according to the law.

He thinks that other equipments are more productive but fire alarm system

is unproductive, so it isn't managed properly.

Also, each country has installation rules about technical aspect of fire alarm system, but they have a lot of difficulties to fix installment as laws about, noise of construction, its kind and structure, open area square and ventilator's installation. They are afraid of examination itself because of the effect of the malfunction.

Detector's fire detection and ratio of the reception aren't exactly investigated, so the persons concerned don't believe the detector itself of fire alarm system.

Fire Alarm System is composed of control panel, repeater, push button switch, detector, speaker and other belongings:

According to the relationship of the each compositions, it's performance and fire detection can be changeable.

Detector finds heat, smoke, or flame and transform these into transmission signal. There are many kinds and characteristics of detector, so common user except professional engineer has difficulties to manage detector's inside components or outside quality of the lumber.

Although detectors of many kinds and characteristics are installed in accordance with the installation rules, we cannot guarantee satisfied function in case of other installation environment.

Therefore, detector's R&D among fire alarm system is the most important but each country in the world is concentrated in research about various installation environment, phenomena of aging of the components from elapse of a year and malfunction prevention.

Therefore, in this paper I will consider the markets with R&D expense and domestic market of fire detection system, and I'll discuss R&D status of foreign country and our country, and correct our research trend with new technology.

## II. MAIN DISCOURSE

### 1. DEVELOPMENT OF FIRE DETECTION SYSTEM

Fire detection in the beginning was rate-or-rise heat detector, which can identify a fire from common heat and spot-type fixed temperature detector.

In 1960's, smoke detector appeared which can identify smoke when fire breaks out. Also, record type was developed and it can record the control panel which receives a signal sent from detector.

In late 1970's, photo electronic detector was classified into scattering photo

type and sensitization, so we could detect exactly when fire broke out.

Push button switch was developed from the way person check a fire and transmit a signal to T-type push button switch which is connected as soon as transmission signal is blared.

According to the construction's high-rise, over-sized, amount of detector and the distance with control panel were increased, it came to be influenced by the voltage, drop and noise.

As repeater, which deal with signal between detector and control panel, was developed we could connect a control panel with much more detectors.

Therefore, we could easily manage and control signal transmitted to the interlocking system such as fire extinguishing system, antismoke-smoke exhaust system.

In 1980's gas using was rapidly increased. As explosion accident happened by gas leakage, it was added to mark function about the gas leakage on the control panel. Also, generation of the nonfire alarm was decreased the reliance of fire prevention equipment, so the prevention became important factor. While they were trying to prevent that, sensor was developed to detect the flame when fire broke out in 1990's. It was called flame detector which decided existence of fire through wave length of light from the flame.

Self-test function was developed to help observation system at ordinary times and analog type detector was developed to notice the environment of detector, and now we are using these systems.

Besides, Infrared detector was developed to decide existence of fire through detection of Infrared and ultraviolet detector was developed to decide existence of fire through detection of ultraviolet, and now we are using these systems.

Also, Fuzzy detector applied by fuzzy theory and intelligent detector have been researched.

## 2. PRESENT FIRE DETECTION SYSTEM

Detector, which detects the fire, has played a role as a on-off switch when heat or smoke connected with detector so far in fire detection system and it has played a role as a point of contact when fire breaks out.

Sound facilities are operated and fire alarm is noticed by this signal. This signal is used not only operations for fire extinguishing system and antismoke-smoke exhaust system, but also for automatic information into the fire station. Due to development of these system, as microprocess is supplied and high sensitivity sensor is developed, each detector, added address, can

analyze individual signal.

This is owe to analog system which can receive the analog data produced from density of smoke or thermal.

In fire alarm system, an endeavor for nonfire alarm's minimum is influenced by maximum of the equipment's reliance. Also, according to maximization of the constructions, the numbers of detector installation are increased and signal-processing has become as important factor. Therefore, it is closely related with control panel which is factor of core.

In domestic technology about control panel, Input/Output circuits can control about 1000-2000 circuits and now every datum from fire alarm system is divided into alarm, period, present circumstances, etc.

The management of output information and the possibility of printing should enable us to classify data that occur each weekly, monthly, and quarterly, and the nonfire alarm data as well.

Also, when fire breaks out, it is very important to respond rapidly, so system signal processing is to be treated during real-time.

We should represent digital indication on fire display panel and it is to represent many digital indications in the same time. It should have pseudo circuit cut-off function and function detected the open-line of detector automatically.

It has improved performance of the system that test function can test each component of the equipment itself in the system.

Although conventional type detector has a lot of functions, we can find our conventional type detector has much limit, compared with the imported new technology.

Now we are using the control panel which enables us to use both the conventional type detector and the analog detector sensing thermal or smoke density step by step.

Signal, transmitted from analog detector, comes to transmit signals gradually by variable value of environment. According to these detector signals, control panel's reception and operation of alarm system are necessary. Also, when the length of line is long, communication trouble is generated from electric noise.

Therefore, it has function which can eliminate communication trouble and check the situation among repeaters in case of using repeater.

Even when impossibility of communication and connection is generated, it can represent these problems in message display panel of LCD in detail and it can easily check equipment's trouble. There are interlocking functions like fire

extinguishing system, antismoke-smoke exhaust system.

Elevator control panel, and interface circuits, many products, supplementing elevator control panel and interface circuits are researched and developed. However we can't compare ours with a forefront nations.

### 3. USAGE NUMBER AND MARKET OF DETECTION SYSTEM

Fire alarm system was constructed by control panel, detector, repeater, push button switch, bell inclination lamp speaker lamp and so on.

According to these reciprocal signal process, operation is different.

The usage number of F.A.S is not used frequently such as Figure 1.

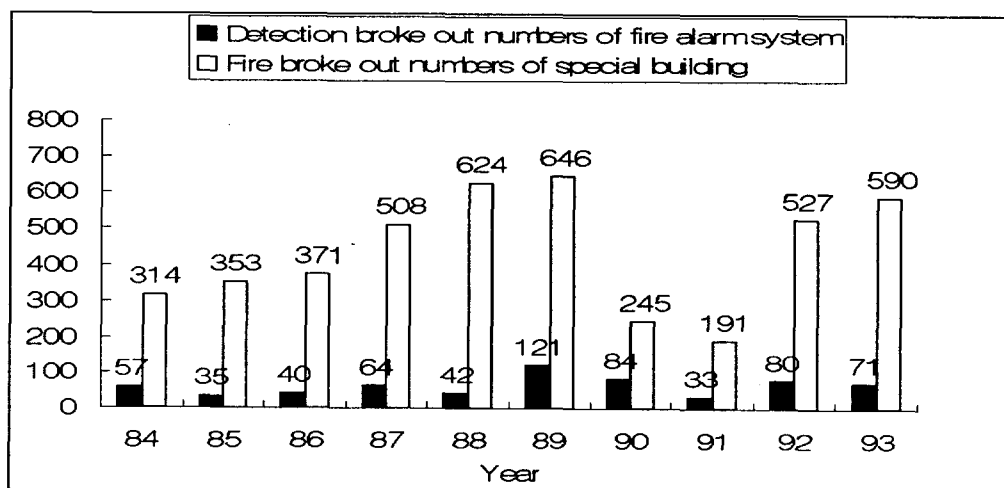


Figure 1. Breakout numbers of a detection and a fire

There are various factors, but the most important factor is a lack of a fire security. So the maintenance such as movement switch off does not be kept properly.

Nevertheless, our fire system industry invests many efforts and expenses in research, and new fire system such as total systemization of fire alarm system are appeared.

The status of domestic production according to each component is shown in Table 1.

Table 1. Production number according to components

Component	Detector	Push Button Switch	Repeater	Control Panel	Bell	Total
Number of Production	28	25	6	26	26	111

Our country has certification standard for each components and only such goods passed this standard are sold in our country.

And we are prepared for ISO standard. Type inspection counts is Figure 2  
A scale of market according to components is Table 2.

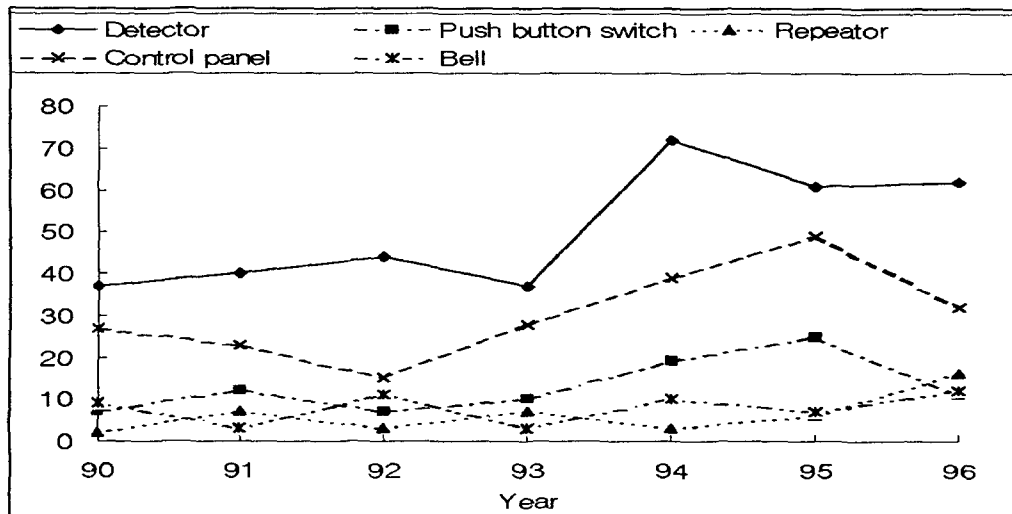


Figure 2. Type inspection counts

Table 2. A scale of market according to components  
(₩1000)

Components	Inspection Counts	Sale Price
Detector	3,973,635	17,594,926
Push button switch	400,862	1,603,448
Repeater	93,348	4,667,400
Control panel	229,390	87,813,800
Bell	465,008	1,860,032

#### 4. FOREIGN FIRE OBSERVATION SYSTEM

The foreign products have characteristics which can be easily installed and maintained.

They have function which can display position, type status and smoke's measure value of detector per second.

Moreover, they can use high voiced system, multiplex serial construction, control system and recording also they can on site.

It contains the large memory chip with the changeable up and down function.

In addition, they have various functions; observation function about every trouble situation which can be operated in control panel, display function which can display operation status until eighth of initial operated detector, and display function about history of status which can notice operation status during a week or certain specific period.

Besides, it heightens the reliability with Network system and it enlarges the changeability with the window system utility.

They've accomplished great development for users, for example, easiness of program exchange.

#### 5. GENERATION OF NONFIRE ALARM

Fire detection systems of the inside and outside of the country, which were mentioned in the preceding pages, are related with the development of detector and the development of every kinds of sensor.

In fire alarm system's reliance, it is the most important to prevent nonfire alarm.

Management and counter plan should be proper with construction characteristics in order that reliance of the equipment can be improved by the prevention of nonfire alarm.

Ultimately detector of fire alarm system takes charge of fire signal, so it is natural that detector should be installed by rules. But we had so complex rules about different environment conditions of various rooms that we should investigate about factors in detail.

Nonfire alarms factors can be classified into artificial factor, functional factor, factor of maintenance, and factor of installation.

Human activity and custom are the most important factor in the artificial

factor, and the change of human conscious is important, too.

We should constantly educate about recognition of the fire danger so that human consciousness can be changed.

Functional factors are different from each detector's class.

Functional factors in heat detector are non-operation of operational part, defects of production, component defects by weather, sensitivities change, and atmospheric pressure change.

In Smoke detector, there are two functional factors; The first is worm protecting net and the second is the situation which we can not distinguish from smoke when dusk or insect raids into the detector.

Also, in flame detector which is recently developed, there are effect of sunlight and the change of flame energy by detective distance.

Factors of maintenance are deeply related with the consciousness of construction owner.

If construction owner invests management cost actively, it is possible to solve the problems about poor cleaning.

Factors of installation lie in the in appropriate construction of installation and they are open to distributing wires, poor insulation, corrosion, and poor environment by the change of environment.

Although human notice cause of these situations, detector is often operated in Nonfire, because detector doesn't have the ability of judgement like human.

Detector has technological motion sensor, so it comes to judge it as a fire whenever the environment has the condition to move the sensor.

## 6. RESEARCH TREND

In the large-sized constructions and underground structures, it is very difficult that people take shelter safely when fire break out.

Judgement about the fire spot and early detection is very important so that many people can take shelter rapidly when fire break out. Therefore, Hightech fire Observation System is constantly researched to increase the function, reliance, and so on, copying with the causes of nonfire alarm

There are Compartment Fire Observation System, Large Space Fire Observation System and Fire Observation System which are applied to intelligent building.

Compartment Fire Observation System is applied to interpret of ramber checked in combust test.

So to speak, this is the system which examines relationship between number



of average movement point and sampling time obtained from sensor and then decide frequency band needed for detection system.

Developments of thermal thermistor, density of smoke, compound sensor and gas sensor are researched and the new sensor which can sense CO<sub>2</sub> radiation created when combustible material is combusted, is researched as well.

The fire judgement method has been conducted on the basis of location vector trajectory in 3D space, which resulted from 3D analysis of data emitted from each sensor.

Furthermore researches go on fire detection by time thermal simulation, fire detection method by fuzzy theory based on combination of complex sensor & Humidity and Neural network.

The Fire Observation system for large space area should be necessary in high and large space such as auditorium, building atrium and dome area. This system adapted projected beam type smoke detector and installed thermal emission type fire detector in order to detect and suppress the fire.

This system is used on fire observation system for thermal size, ignition area and flame detection by computer signal process which can catch transmission signal from the usage of infrared radiation sensors.

In large spaced fire observation system, it is very high for these sensing systems to electro-communicate with office automation system.

Other fire observation system for enclosed area with HAVC system is being developed by using high sensitive particle sensor, super conducting infrared radiation sensor and CO<sub>2</sub> sensor.

In the case of non-fire alarm, eye examinations must be necessary. So a research goes on non-fire distinguishing system and new fire smoke detection system by measuring smoke corpuscular diameter on the basis of TM polarization and mie diffusion theory.

In a near future, other researches must be conducted on determination of alarm level and accumulating time on the basis of essential data about fire detector environmental condition, and time whether people move or not. Also sensors, electronics, microprocessor and telecommunication technology should be combined.

In order to increase operability, user will indicate fire status on CRT. As ten key, touch screen and pen light method are used in system operation, each manufacturing company should standardize the operation system to make users comfortable.

For credibility increase, memorization of CPU and looping technology

between communication line and power supply system are necessary.

Standby power supply capacitance should also be increased for a longer use.

Alternative decentralization of central administration room should be considered on economic base.

Required area should be minimized by compaction, light weighing for installation and maintenance work. It is very inevitable to consider them against maintenance works.

### III. CONCLUSION

Even if there are somewhat small fire detection system markets in Korea, We have developed analog detector, fuzzy detector, air sampling detector and so on.

Signal processing ability is advanced owing to many studies and developments, but there is no detecting fire capacity in fire detectors and fire sensors. Thus it detects fire by sensing a level of physical and chemical development.

Later, it need the study of detecting fire and the development of a complex sensor with various fire detector. Also, it makes a 3D method addressing the location of fire detector and sensor beyond the spot type or line type.

The 3D method will improve the reliance of the installation. In addition, it makes fire detection system having a rapid-speed and high efficiency using a computer. It is possible to make a fire detection system for a computer to apply a fuzzy theory, a artificial intelligence theory, a information processing theory etc.

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