REVIEW OF FIRE DETECTION PROBLEM

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ABSTRACT

In order to protect life and property, a good fire and smoke detection system is necessary. However, with existing automatic fire and smoke detection system design, the major concern is false problem. In the present review, factors leading to false alarm problems are identified and remedial methods are suggested. Based from current literature survey, a number of research results for reducing false alarms such as multi-sensor technique, the use of neural networks are identified. This formed the basis for developing new fire and smoke detection techniques and would be useful for future fire protection.

1. INTRODUCTION

Fire and smoke spread within the building can be affected by various factors such as the geometry, dimension, layout and usage of the building. In order to provide fire protection in the building, it is very important to detect fire at its early stage. The most common fire and smoke detection methods include the use of point type detectors (i.e. ionization smoke detectors, photoelectric detectors, heat detectors), line type detectors etc. These detection methods based on the use of fire signatures such smoke, heat. However, these detection methods have some significant drawbacks including the false alarm problem and delay in smoke detection. False alarm will dilute and discredit the valid fire intelligence. If the detection system is connected to other fire services installations such as fire shutters and smoke control systems, this may also lead to business interruption. These false alarms will also lead to the waste of fire brigade resources and reduction of the effectiveness of the system in the case of real fire. The worst of all is cry wolf syndrome. Occupants will tend to ignore the fire alarm until the fire has becoming highly destructive and life threatening.

2. LITERATURE SURVEY ON FALSE ALARM STUDIES

Various countries have conducted studies attempted to identify the causes of false alarm problem and suggested remedial solutions. In U.K., a BRE information paper was published to address to this problem. Based on the BRE information paper (IP13/92) June 92, the false calls to real fires in U.K. reported in 1970 is 11:1 and the false calls to real fires in U.K. reported in 1980 is 20:1. In year 2002, British Standard 5839-1 was published to provide guideline for the design of fire detection and fire detection system in buildings. Based on BS 5839-1:2002, the no. of false alarms attended by the fire services in U.K. was over 250,000.

Besides U.K., U.S. also conducted similar study. In a 1980 survey of health care facilities in the U.S., Bukowski et al. reported nuisance alarm ratios for smoke detectors at 14:1.

Similar records can be found in H.K. Statistical records of fire alarms have been collected from FSD 1975 to 1995. The number of fire alarms rose from 6238 in 1975 to 31014 in 1995. The frequency of unwanted fire alarms rose from 1471 in 1975 to 18277 in 1995 and the no. of fire calls in 1997 is 35543. The number of fire calls increased to ~44000 in year 2000. The number of unwanted fire alarms per day increased from 4.03 in 1975 to 50.07 in 1995.

The number of unwanted calls for 2001 to 2003 is listed as follows:

- 44564 fire calls were received in 2001 and ~29412 were unwanted alarm calls.
- 41204 fire calls were received in 2002 and ~27565 were unwanted alarm calls.
- 37774 fire calls were received in 2003 and ~24439 were unwanted alarm calls.

In order to tackle the false problem, an exercise was conducted by the British Fire Protection Systems Association and the Suffork Fire Services in 1988. They classified the fire signals into genuine fire signal, unwanted fire signal, accidental fire signal, malicious fire signal, malfunction fire signal, unidentified fire signal

Based on the records of the Hertfordshire Fire and Rescue Services, FRS analysed 4000 false alarm report. The nature of false alarm was highlighted as follows:

- Human factor – 22 % caused by human
  24% of these calls - actuation by manual call points
  13% - accidental operation

12% - malicious operation

- System generated false alarm
  14% - unknown
  26% - fault
- Reliability
  48% out 2000 reports - smoke detection system
  2.7% out 2000 reports - heat detection systems
- Obscure sources of false alarms
  thrips
  lightning - 0.4% of all false alarms, increasing trend

Similar work was conducted in Hong Kong. It was found that the false alarm problem is site dependent. In a study of false alarm problem, 765 alarm records from 17 sites (railway stations) were collected from mid 1994 to 1996 and statistical analysis of the data was performed. The results are listed as follows:

- True fire alarms: 1.44%
- True trouble alarms: 27.84%
- True ground fault alarms: 4.7%
- False fire alarms: 48.24%
- False ground fault alarms: 3.92%
- False trouble alarms: 13.86%

The causes of false fire alarms:

- Detector faults: 24.66%
- Fire services faults: 4.61%
- Human errors: 14.9% (break glass broken)
- Construction work in progress: 23.85%
- Cable faults: 2.71%
- Monitor modules: 3.25%
- Others: 2.71%
- Unknown :23.31%

3. CAUSES OF FALSE ALARM

In the above survey, it was found that the causes of false alarms can be grouped as follows:

- mechanical and electrical faults
- vibration, impact or corrosion
- ambient conditions such as Heat, smoke flame from cooking
- work processes, fumes from engine etc, or high velocity
- work being carried out in a protected area without knowledge of precaution
- communication faults arising from servicing or testing work
- electrical transients or radio interference
- inadequate serving
- the build-up of dust or dirt within a detector
- change of use or changes within the building
- accidental operation of manual call points or detector

4. MEASURES TO REDUCE FALSE ALARMS

Based on the BRE information paper (IP13/92) June 92, it is very important to enhance the education and training for designers and installers on fire detection equipment. This paper also suggested that regular system maintenance can help to reduce the false alarm problem. In order motivate the building owners to provide better fire safety management, it also suggested that penalty for false calls should be imposed and the cost for false alarms should be publicized.

In the recent version of BS 5839-1:2002, the following measures for reducing false alarms are suggested.

- sitting and selection of manual call points
- selection and sitting of automatic fire detectors
- selection of system type
- protection against electromagnetic interference
- performance monitoring of newly commissioned systems
- filtering measures
- system management
- regular servicing and maintenance

5. RESEARCH AND FUTURE DEVELOPMENT FOR REDUCING FALSE ALARM

In order to reduce the false alarm problems, other techniques area suggested by different researchers such as [2-10]:

- Time of day adjustments
- Time delays
- Multi-sensor
- Use of multi-signature
- Fuzzy Logic and Neural Networks

6. CONCLUSION

From the current review, it can be concluded that false alarm problem is very serious in H.K. and other developed countries. It is very important to develop new fire and smoke detection techniques to reduce the no. of false alarm. At the same time, it is

also necessary to educate the public concerning measures related to the reduction of false alarm. This will be very useful in providing better fire safety in buildings.

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