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PROPOSAL FOR AN EMERGENCY EVACUATION METHOD IN HOTEL FIRES

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Abstract: This report has discussed emergency evacuation in hotel fires and proposed an integrated system of emergency evacuation. By using "A New Type of the Computerized Emergency Evacuation System" all guests will be able to quickly and safety escapes the fire.

Introduction

Hotels may be classified into two types; i.e., city hotels and resort hotels. City hotels include multi purpose big hotels and business hotels. The former have banquet rooms, conference rooms, shops and wedding halls in addition to of course sleeping accomodations, and the latter center on providing lodging for traveling business men. Resort hotels aim to serve guests visiting for sightseeing and recreation. Those who stay at stay at city or business hotels mainly just want sleeping accomodations. However the layout of a big hotel varies so widely because of the multitude of uses they must serve, that fires are more likely to happen, and when they do occur, guiding people to safety is more difficult than in other types of hotels. For this reason fires in big hotels almost never occur without deaths or injuries among the overnight guests. This is obviously due to the fact that fires in big hotel buildings can be as large scale and complex as the buildings themselves[1,2].

Nowadays the control and monitoring systems which aim to prevent disasters are computerized and have improved so much that detecting the origin and magnitude of the fire and activating fire extinguishing equipment and smoke suction equipment along with taped emergency information on a public address system can be done immediately. However, no improvement has been made in securing safe paths for evacuation and guiding the evacuees to exits.

This report proposes a new type of the emergency evacuation method developed with improvements made by studying problems in emergency evacuation experienced during past hotel fires.

Current Status and Problems in Disaster Prevention Systems

In the total hotel control system, a disaster control /monitor system is integrated with a central control/monitor system in order to improve functions and for ease of operation[3], as shown in Table 1. What the disaster pre-

Table 1 Configuration of the integrated control system.

CENTRAL MONITORING SYSTEM	CENTRAL MONITORING AND CONTROL UNIT MONITOR RECORDER
DISASTER PREVENTION MONITORING SYSTEM	RECEIVER FROM HEAT/SMOKE SENSOR SMOKE EJECTING FACILITY CONTROL UNIT MONITOR

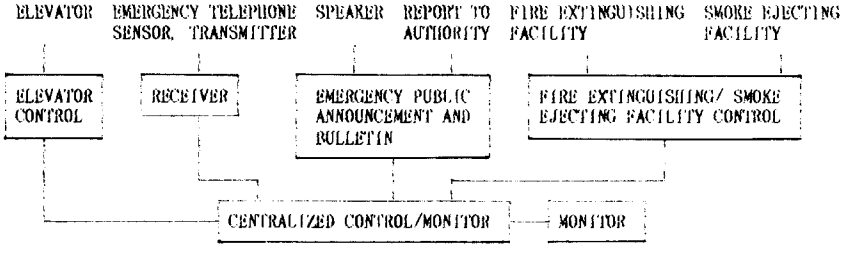

Fig. 1 Example of a disaster prevention system.

vention center ought to do when heat/smoke sensors detect a fire is to locate the origin of the fire, assess its magnitude, provice the guests with emergency information by public address system, secure safe paths for evacuation, guide guests to emergency exits, activate fire extinguishing and smoke removal equipment, and to report the occurrence of the fire to the authorities"[1]. Such a disaster control/monitor system is exemplified in Fig. 1. Such systems however almost never operate successfully without delays.

At the site of the fires the evacuating people cannot expect the disastrous manager, to make the right decisions needed for evacuating people because judgement of the disastrous manager deteriorates quickly due to a lack of oxygen in rooms and halls full of smoke. Another difficulty in securing evacuation routes is that a panic tends to happen when many people including the overnight guests rush to emergency stairways and elevators. It is also difficult to guide the evacuees to exits because the chaos and cries of the people make it difficult for them to hear the public address system.

In order to save lives and property it is necessary to reconsider both the hardware and software needed in a disaster prevention control/monitor system. Therefore we decided to develop a computerized emergency evacuation system that does not depend on the judgement of the person who is responsible for safety in the vicinity of the fire and that can hotel fires in all their complex forms.

A New Type of Emergency Evacuation Method

Based on the discussion given in "Current Status and Problems in Disaster Prevention Systems"[2], A new type of the emergency evacuation method and a computerized emergency evacuation system are proposed by the present work which lets us to know how many guests remain in each room, the conditions of each room, perform emergency public address announcements, secure evacuation routes and guide the evacuees to exits, all without delay.

Monitoring Guests Remaining in Room

Present disaster prevention control systems do not allow us accurately know the correct number of guests still remaining in their rooms in the event of a fire. This problem can be solved with the devices shown in Fig. 2. These devices include a light source and a CdS photoconductive cell which is a photosensor. A self focusing micro lens creates a beam of parallel light rays using the light emitted from the light source. Two sets of light sources and CdS photoconductive cells are installed near the door inside the room, in parallel at about 70 centimeters above the floor. Each set is installed so that the CdS photoconductive cell receives the light emitted from the light source. These CdS photoconductive cells are connected to the computer.

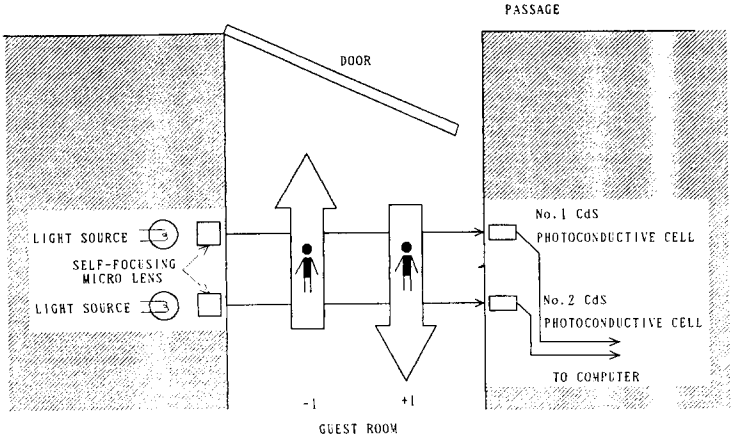

Fig. 2 Counting guests entering or leaving the room.

When a person enters the room, the overnight guest intercepts two beams of light. First the overnight guest intercepts the beam nearest the door (No. 1), and second, that farthest from the door (No. 2). At that time the computer adds one to the number of people recorded as being in the room. When a person leaves the room, the overnight guest intercepts these light beams in reverse order (the No. 2 beam first and the No. 1 beam second). The computer then subtracts one from the number of people recorded as being in the room. When the count of people entering and leaving tends to overlap. The counts made by the No. 2 beam when entering and that made by the No. 1 beam when leaving differ from each other. In such a case the larger count will be used. The devices however do not always suffice to give an accurate count of people remaining in the room. So in case of a fire, video cameras must be used in addition to the CdS photoconductive cells in order to ensure the additional safety of the guests. The video camera operation is described next.

In this system video cameras are used for monitoring the rooms as follows. Ordinarily these video cameras must not be used, in order to ensure the privacy of the guests. However once a fire occurs, the shutter of the video camera installed in the ceiling at the center of the room opens, so that the computer can check on the room status and whether any people are remaining in the room (see Fig. 3). Information obtained with the video camera in all the rooms, enters the computer via optical fiber cables and the computer keeps watch only of the rooms where people still remain. The person responsible for safety thus knows the current status of all guests and can guide them to exits or send a rescue team to the appropriate room as needed.

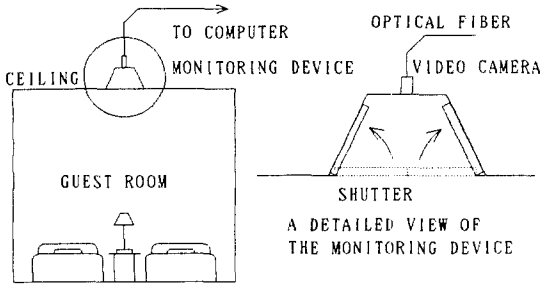

Fig. 3 Monitoring with a video camera.

Casualties occuring in hotel fires are said to be mostly due to carbon monoxide poisoning rather than due to burns. It is therefore certain that injuries and deaths can be reduced a great deal by guiding remaining guests to safety or sending a rescue team as needed if the conditions of the guests in the remaining rooms are known.

Emergency "Synthesized Speech" Public Address Systems

Emergency public address systems aim to offer all persons staying at the hotel, information on the location of the fire, its magnitude and evacuation information.

Fig. 4 Speech synthesizer.

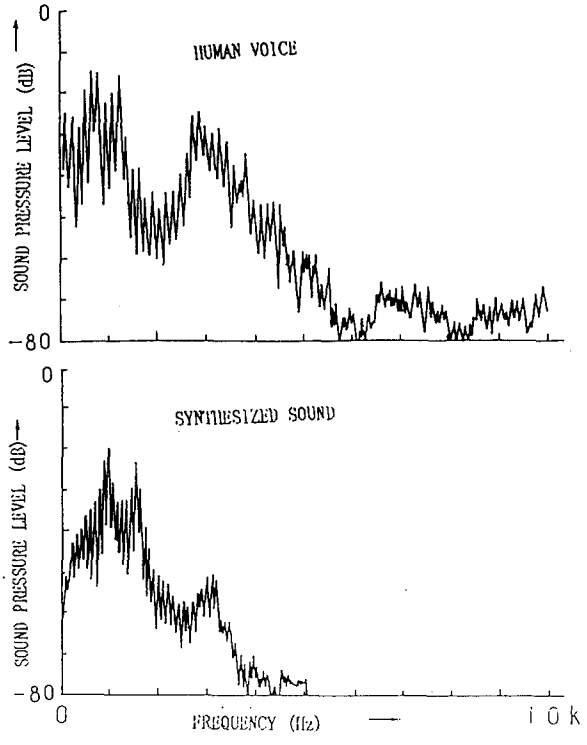

Fig. 5 Relationship of the Spectral Characteristics and Frequency with the Japanese syllabic sound "a".

Such emergency information is normally offered with an ordinary human speech on a pre recorded tape and played over the public address system in the event of a fire. The noise created by people in a panic tends to drown out safety messages given over the public address system which makes guiding the evacuees more difficult. After considering this problem, the use of a speech synthesizer was adopted (see Fig. 4).

Use of the speech synthesizer has the merit that the computer may be programmed to let the synthesizer LSI generate messages in any language such as English, Japanese, German and others. As shown in Fig. 5, the frequency band of the synthesized speech is narrower than that of a human speech with high frequency speech components removed. This kind of synthesized sound is less likely to be drowned out than an ordinary human speech. Moreover the computer can be programmed so that the doors of all guest rooms which the computer controls are automatically unlocked when emergency messages are announced.

Method for Guiding the Evacuees to Exits

It is not always a good idea for the person responsible for safety to guide the evacuees to emergency exits during a fires. The reason being that his judgement deteriorates a great deal from a lack of oxygen to the brain, caused by the smoke filled rooms and halls. Thus a new type of the quick and safe evacuation method as shown Fig. 6 was proposed by the present work. This new evacu

ation method is characterized by synthesized speech announcement and colored carpets laid at strategic routes on the floor of hallways. As illustrated, a carpet is colored in red, for example towards one end of a hallway and in blue towards the other end of the hallay. Emergency elevators or staircase are provided at both ends of the hallways. Speakers are installed in the ceilings at eight meter intervals and announcements tell evacuees to follow the red carpet or the blue one. Sound pressure levels in the speakers are varied so that people can know which way to go.

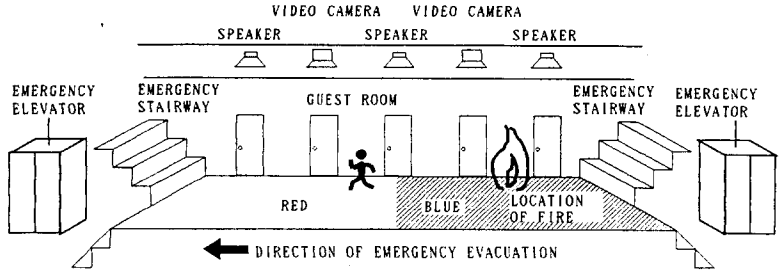

Fig. 6 Method for guiding the evacuees.

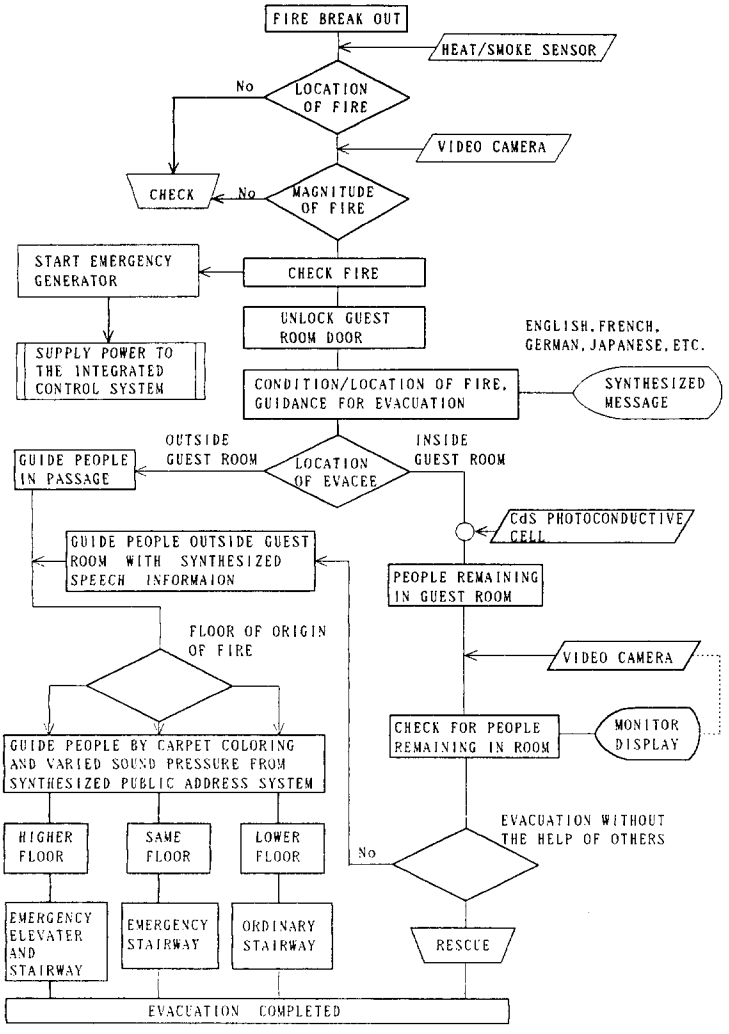

Fig. 7 New method for emergency evacuation.

A new type of the quick and safe evacuation method is carried out in the following manner.

(1) Peoples on the same floor as the fire are guided to safety via the emergency stairway.

(2) Peoples on floors higher than the fire are guided to safety via either the emergency elevator or the emergency stairways.

(3) Peoples on floors lower than the fire are guided to safety via the ordinary stairway.

Proposal for a New Emergency Evacuation Method

With the systematic and correct application of the items as listed in "A New Type of Emergency Evacuation Method", the lives and property of the hotel guests can be adequately safeguarded. Fig. 7 shows the flow diagram of the new type method for emergency evacuation during hotel fires using the items as described in "A New Type of Emergency Evacuation Method". By using this system all guests will be able to quickly escape the fire when they are guided by the flowchart procedure described below.

(1) Heat/smoke sensors detect the location of the fires and video cameras give information on its magnitude. The doors of the guest rooms are immediately automatically unlocked and the public address system announces emergency information with synthesized speech messages. The emergency generator then starts supplying power to the integrated hotel control system equipment.

(2) The presence of guests still remaining in their rooms is checked by CdS photoconductive cells, video cameras and computer.

(3) The evacuees are guided by the synthesized speech messages and the colors of the carpets so that those on floors higher than the fire can escape via either the emergency elevator and the emergency stairway, those on the same floor as the fire can escape via the emergency stairway and those on the lower floors can escape via the ordinary stairway.

To make the integrated hotel control system more reliable the new type of the computerized emergency evacuation system as shown in Fig. 8 was used. This new emergency evacuation system utilizes a completely automated system for guiding the evacuees. The computer should be programmed so that the emergency generator supplies power automatically to the integrated hotel control system upon the occurrence of a fire.

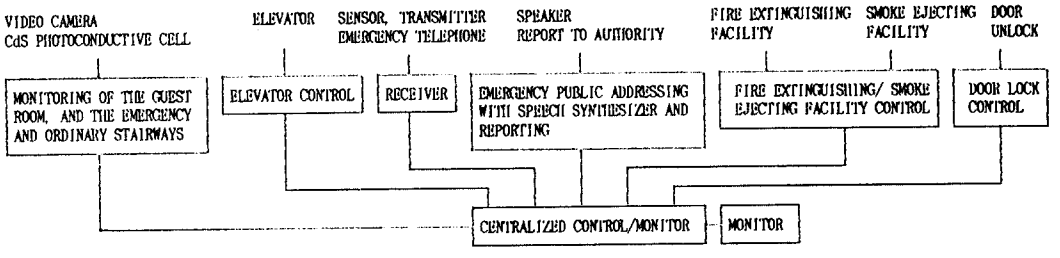

Fig. 8 New disaster prevention system.

Conclusion

This report has discussed emergency evacuation in hotel fires and proposed an integrated system of emergency evacuation which, using CdS photoconductive cells and video cameras, enables the system to know the status of each guest room and how many guests still remain there; perform emergency public address announcements with synthesized speech messages; and secure three routes for evacuation passages depending on the location of the fire. Introducing this system into hotels rather than presently used disaster prevention control systems which are complicated and unreliable, will prove effective for total control of building activities and save lives and property not only in fires but in any other disasters.

References

(1) Erena Marcheso Moreno: Computerized Control Systems, Architecture, vol. 78, no. 3, pp. 129-130, 1989

(2) T. W. Ashton: The London District Surveyors' Association Fire Safety Guide No. 1 Fire Safety in Section 20 Buildings, Structural Survey, vol. 8, no. 3, pp. 278-279, 1990