Full Automatic Fire Extinguish System for Residential Use

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Abstract

We are continuing to improve followed previous from three years ago. It fires detected automatically, and improvement of residential systems for fire-fighters remotely. The system, it is possible to build an automatic fire extinguishing system for residential only attached to the fire extinguisher is an off- the-shelf. It is also characterized by performing image processing using OpenCV for fire detection. System detects the fire by processing images of an infrared camera in Python programs using OpenCV. When detecting, after moving the nozzle automatically in a position detects the fire, we have successfully developed a system for performing initial fire extinguishing. Workings of this system are controlled by the Raspberry Pi.

Keywords: Raspberry Pi, image processing, infrared camera, initial fire fighting, OpenCV

1. Introduction

2015, the total number of fires that occurred in Japan^[1] is a review 39,046. Has declined review 4695 compared to fire the total number of case of the 2014 fiscal year^[2]. In addition, it has decreased 9049 review compared to fire the total number of the 2013 fiscal year^[3]. Equivalent to about 57 percent of the total number, 22,149 of the issues are a building fire, accounting for more than half of the total number fire. Of this building fire, it shows what was the number of applications the breakdown and the dead in the graph in Fig.1. This figure, view residential and co-housing, a combination housing as housing. Number of fires is 54.3 percent the number of deaths is 83.1 percent. According to this figure, the occurrence and damage of the fire in the house

it can be seen that very large. As mentioned earlier, the total number of fires has decreased. However, the number of fires and the death toll of the housing is beyond the half of the total. Therefore, the threat of the building fire is considered to be very serious. The most effective and efficient means to prevent the damage caused by this house fire is the initial fire. Initial fire fighting is that of fire fighting carried out in the time since the fire until two minutes before and after. By applying the fire before spreading burning fire, leaving it possible to reduce greater damage to the fire place. In addition, for fire fighting activities carried out by the fire also that can be minimized, it can be said to be a very efficient fire fighting. The presence or absence of the initial fire fighting, leaving a large difference in the scale of the human and material damage. The numerical value as the reference is shown in Fig.2. From this, the importance of the initial fire is seen.

However, in most cases, the initial fire extinguishing is not performed. Factors that initial fire fighting is not done, if the calm is also aware of the case and the fire that does not notice the fire would give priority to flee to not be able to deal with can be considered. Factors that do not notice is a variety. For example, fire during sleep, such as the fire from the location without a fire and people at the time of absence is considered. In addition, it is difficult to fire that occurred in the elderly housing also subjected to a fire. In fact it is the elderly about 60 percent of the dead in house fire is the elderly. For the elderly, even in situations where the initial fire fighting can be carried out, or did not know how the proper fire fighting, it is difficult. Such as the development of universal design fire extinguisher^[5], it has also been carried out. However, it is difficult for fire-fighters while ensuring safety.

Fig.1.Building fire detail view

Fig.2.Presence of fire fighting and fire damage^[4]

Currently, the system there are many subjected to a fire. For example, home fire alarm is possible to install in any home inexpensive. However, no fire alarm fire extinguishing feature to the alarm itself is past the initial fire of the stage at the time of the actuation. Besides, there is a sprinkler. It has a high fire extinguishing capacity, it does not begin to extinguish until sprinkler body is heated to about 70 degrees. Therefore, it can't be said that carried out the initial fire fight. In addition, sprinklers for fire-fighters sprayed a larger amount for water. For this reason, electronic equipment and precision equipment is to be put out a lot of damage for wet with water.

Besides, it has been widely development of fire extinguishing robot. For example, There is also such as remote-operated fire extinguisher jet fighter the Tokyo Department owns^[6] and intelligent Afekkusu^[7]. However, not for general household. Also, such as early fire discovery system^[8] it has been developed by the burnt of the detection using a semiconductor gas sensor. The advantage of the initial extinguishing in order to maximize detects the fire at an early stage, there must be a system for applying a properly extinguish fire source.

Therefore, we aim to construct a system for performing initial fire extinguishing for general household. Previous studies^[10] is the development of a fire extinguishing system which can perform an initial extinguishing by remote control the road. In addition, expanding the fire range of the initial fire, improvement of fire fighting accuracy, by the improvement of the fire detection, we have been successful in building a better system. However, in previous studies, the user initial fire fighting can not be to be remote operation immediately after the fire. In this study, when a fire extinguisher has detected the fire, we have successfully developed a system to extinguish automatically when the remote operation is not performed.

2. Structure

2.1 Structure of Body

The systems is mounted on fire extinguisher body. Then, the fire detection using an infrared camera that is built into the system. If a fire is detected, the system performs a fire fighting with automatic by controlling the fire extinguisher by a motor. This system is intended to perform the installed fixed point extinguished home. An operation outline diagram of the system at the time of fire is shown in Fig.3. First, it is detected by the fire detection system when a fire occurs. If a fire is detected, the email address has been registered in advance, notification of a fire is sent. Users, to access the web site for carrying out fire fighting from a mobile phone or personal computer. The fire was confirmed on the web site, it is possible to perform fire extinguishing remotely.

The body, fire extinguisher, video camera, infrared camera, and a small computer Raspberry Pi. Centers of the present system is the Raspberry Pi. It is equipped with an I/O pins that can be used to control. This using the Raspberry Pi, fire detection, notification to the user, creating a fire fighting for the web site, such as automatic fire fighting, have done all of the control. When performing the fire is operating a fire extinguisher of the trigger and hose by controlling the motors by the Raspberry Pi.

The system user to check the fire on the website performs the remote operation. However, if a user is to be carried out remote control, carry out the fire extinguisher automatically.

2.2 Structure of System

This system is mainly classified into two. One is, the user performs a fire using a web site, fire fighting by remote control. Another, fire extinguisher for fire-fighters in the automatic, an automatic fire extinguishing. Fire

Fig.3.Operation schematic diagram.

Fig.4.remote control system block diagram.

Fig.5. automatic fire extinguishing system diagram.

extinguishing system by remote control are shown in Fig.4. The automatic fire extinguishing system is shown in Fig.5. Automatic fire extinguishing system that moves only when the extinguishing by remote control has not been performed.

Fire and automatic fire by remote control, both the mechanism of fire detection is the same. Image of the infrared camera mounted on the fire extinguisher, performs image processing by Raspberry Pi. At this time, it is determined whether the fire by the size of the flame. If the

Raspberry Pi is determined to fire, a notification e-mail addresses that are registered in advance are sent.

In the case of fire by remote control, the user who received the e-mail access to the URL written in the e-mail. Then the user performs the fire fighting to move the hose with each command while watching the fire of the video.

Automatic fire extinguishing operates in the case where the reaction of the user who sent the e-mail was not. Raspberry Pi is to identify the fire place in the Python program using OpenCV the image of the infrared camera, for fire-fightings to move the hose automatically. Thus, any chance user Even in circumstances that can not be remotely operated, fire extinguishers to operate without the need for remote operation. Therefore, it is possible to reliably perform initial fire fighting.

2.3 Advantages of The System

The advantage of this system is that the fire can be early detection, there is also that carried out the initial fire fighting. By infrared and Raspberry Pi can be monitored at all times or a fire in a room does not occur. Also, if a fire occurs, it is possible to notify the fire will receive a user to be notified by e-mail at an early stage. Even in a situation where the user is unable to remote operation, it is possible to perform an initial extinguishing. Therefore, in the previous study, it was possible to further extend the advantages that make the initial fire fighting.

3. Automatic Fire Extinguish System

Currently, fire detection, residential fire alarm is utilized. The residential fire alarm, there are two types of Smoke-type and thermal. Smoke-type is determined that the fire by sensing the smoke. Thermal to determine where the temperature of the surrounding residential fire alarm rises to above a certain temperature and fire. It is possible to fire detection By using this residential fire alarm. However, it can not be detected until the occurrence location of the fire. In contrast, in the present system, just not only to the fire detection, up to the size of the fire of the location and the fire, it is possible to detect. For extinguisher performs extinguish automatically, it is necessary to identify the fire place. Therefore, the fire detection by the image processing is essential.

Automatic fire extinguishing is carried out by the image processing and motor driving program which is inside the infrared camera and Raspberry Pi. Uses a OpenCV as an image processing library, used language is Python. As automatic fire extinguishing was mentioned in the previous

section, to determine the fire away from the infrared camera of the image, to extinguish move the hose. The process from a particular fire place until the fire described below.

First, the program for detection a fire, there is an image obtained by binarizing the Raspberry Pi. At this time, it appears white only portion reflects the fire source, the other is black. Each keep numbered in this image are divided into 10×10 pieces of area. Divided image. An image when the divided region of 10×10 , shown in Fig.6. There are fire white display portion in the image. There may be best by pointing a fire extinguisher of the house to the squares of the corresponding number. Whether a fire occurs, whether white portion in the image is displayed, in is determined. In advance, registering the location of the fire, such as a stove or cooking stove. It is determined that the fire occurs when the fire has expanded. Each square, and is stored the angle of the house in advance. Move the house to an angle that has been stored in the square there is a white part of the image. Then, it is possible to aim the fire. For example, it is assumed that there is a white projected part in squares of number 22. In this case. It is possible to extinguish and move the hose at an angle to aim the number 22. Further, it is possible to be a significant fire across multiple grid to extinguish. For example, the fire has spread to number 20, 21, 22, 30, 31, 32,

Regions										
0	10	20	30	40	50	60	70	80	90	
1	11	21	31	41	51	61	71	81	91	
2	12	22	32	42	52	62	72	82	92	
3	13	23	33	43	53	63	73	83	93	
4	14	24	34	44	54	64	74	84	94	
5	15	25	35	45	55	65	75	85	95	
6	16	26	36	46	56	66	76	86	96	
7	17	27	37	47	57	67	77	87	97	
8	18	28	38	48	58	68	78	88	98	
9	19	29	39	49	59	69	79	89	99	

Fig.6. Image obtained by dividing the area

Fig.7.State of the experimental

40, 41, 42, 3×3 trout. In this case, it is possible to extinguish by directing the hose at an angle that nine of the squares of the number 31 of the center. This system can be used in up to eight tatami room. Such was programming a series of operations to fire fighting from the detection of the fire of the place of occurrence. Then, it has become possible to perform automatic fire extinguishing.

4. Experiment

As mentioned in the previous section, in order to carry out initial fire extinguishing extinguisher is automatically must know the angle of the hose corresponding to the respective grid of Fig.6. Therefore, to measure the angle of the hose fire extinguishers corresponding to each square. The contents of the experiments are shown blow. One mater from. Infrared camera is in this experiment caused the infrared at a position familiar. Infrared is the seat of the fire. Generating infrared radiation one hundred squares each position. At that time, it was recorded angle of the hose when directing the hose. I was using an electric stove as infrared sources. In addition, it began to record one by one to make sure that there is a fire origin on a straight line of hose. Based on this record, and stores the angle corresponding to each of the squares in Raspberry Pi. Or actually aim the fire source, an experiment was conducted. Fig.7 shows the state of the experiment. With this experiment, it was confirmed that the aim of the fire source.

5. Conclusion

In this study, we made improvements to the previous studies. Then, it was confirmed that added a new function to the extinguishers, it was confirmed that it is possible to extinguish that do not require remote operation. Further, whereby it was possible to improve the effectiveness of the automatic initial fire extinguishing system.

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