Development of Monitoring System of Lock-Key Using Photo Reflector

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Abstract

Most of the damages made by the burglaries are due to the people that forget to lock their house. Even if the door was locked, damage of illegal invasion by picking is not few. In this study, we developed monitoring system of the lock-key using photo reflector. The system judges the locked state of doors in house by using a photo reflector. The user can confirm the locked state of doors by smartphone from anywhere. The system provides a device that trigger the alarm when user is about to go out without locking the door.

Keywords: damage of illegal invasion, monitoring system of lock-key, photo reflector.

1. Introduction

Victim of burglary has decreased year by year, but it still has about 58000 cases every year⁽¹⁾. On average, it is happen about 160 cases per a day. In those cases, thief damage accounts for about 40%. Here, "thief" means invading the house and stealing things during the absence of the house owner. The most common method of thief is glass breaking. Surprisingly, the second most common method of thief is invading for unlock houses, and it account for 25% of thief cases. People consciously closed the entrance, but the key of a veranda and windows tend to remain open especially in summer⁽²⁾.

Currently, as a measure to prevent thief, there are some ways that can be followed, such as

- (1) Introduction of intrusion detection device by trader⁽³⁾.
- (2) Put a lot of auxiliary lock in addition to the main lock⁽⁴⁾.
- (3) Strengthening the patrol at the place⁽⁵⁾.

"Introduction of intrusion detection device by trader" is very expensive for general household. It has been introduced in many offices and shops, but there are only few houses that have been introduced in the general household. "In addition to the main lock, we put a lot of auxiliary lock" does not make any effect if we forgot to close the door. "The patrol strengthening by region" requires a lot of labor. Therefore, we thought the system that is capable of eliminating the unlocking of door, and can be easily introduced to many houses can lead to a significant reduction of housing invasion damage. So we worked on this study.

Fig. 1. Configuration of a circuit.

(a) inside

(b)outside

Fig. 2. Installation location of the photo-reflector.

Fig. 3. Installation location of the pyroelectric sensor.

2. Monitoring System of Lock-Key

2.1 Configuration of the entire

Fig.1 shows the configuration of a circuit that was created. This system has the following functions.

- (1) To determine the locked state of the door by using the photo-reflector.
- (2) To sense the presence of people by using the pyroelectric sensor.
- (3) When we are going to go out is made without locking the door, the buzzer will alert the owner of the door.
- (4) To check the locked state of the door from the smartphone.

STATE OF KEYS

CURRENT THE STATE OF KEY

Location: State

Entrance :
:::/LOCK/:::2014/ 8/ 9 11:55:18 /// [Recent state](#)

Veranda:
:::/LOCK/:::2014/ 8/12 16:40:20 /// [Recent state](#)

Window1 :
:::UNLOCK:::2014/ 8/ 9 11:55:22 /// [Recent state](#)

Window2 :
:::UNLOCK:::2014/ 8/ 9 11:55:19 /// [Recent state](#)

Fig. 4. Example of the main page screen.

STATE OF KEYS

KEY STATE OF ENTRANCE RECORDED

:::UNLOCK:::2014/ 8/ 9 11:55:16

:::/LOCK/:::2014/ 8/ 9 11:55:18

:::UNLOCK:::2014/ 8/ 9 11:58:45

:::/LOCK/:::2014/ 8/ 9 11:58:59

:::UNLOCK:::2014/ 8/ 9 11:59:15

:::/LOCK/:::2014/ 8/ 9 12:10:00

Fig. 5. Example of the subpage screen.

2.2 Determining the state of key by the photo-reflector

First, we install a photo-reflector as shown in Fig. 2. Sensor can judge the state of the lock because the output of the sensor varies with the state of the lock-key. Therefore, it is possible to know the state of the lock by comparing the threshold of this feature that set with the output that done A/D converting, thus, it will save the output that was obtained to a text file.

2.3 Sensing the presence of people by the pyroelectric sensor and sounding the buzzer when an attempt to go out is made without locking the door

Circuit is attached to the door as shown in Fig. 3. This sensor senses the movement of people. This function is used mainly at the entrance. It is thought that when the sensor is activated it would indicate that going out or entering the house. Then, the system will judge the resident left the door without locking when the sensor become unresponsive. If this state stays for a long time, potential of thief damage is large. So it will trigger the buzzer to sound the alarm to inform of the unlock door.

2.4 Checking the locked state from the smartphone

In this feature, we can check the state of key using smartphone apps. On the main page, you see latest state of the all keys, and on the sub-page, you see the time that each lock-key was operated. The information of the state of lock-keys are used the data that have been saved to a text file in section 2.2. Fig. 4 and 5 shows the example of the display screen.

3. Experimental Methodology

Section 3.1 and 3.2 show the experimental methodology of the two sensors.

3.1 Performance of the photo-reflector

We test the performance of the photo reflector. We do two types of experiment which are to put the sensor inside such as at the entrance, and another type is to attach it to the outside part such as a window. We try each type for 10 times. Then we determine the threshold from the average output of each type. Finally, we confirm if the threshold goes well or not.

3.2 Performance of the pyroelectric sensor

We test the performance of the pyroelectric sensor. It is necessary to test the accuracy of the sensor with various distances and brightness of surrounding. Therefore we do the experiment in four ways by combining four conditions. The four ways are as below;

- (1) Case of that the experimenter is at a distance of 10cm from the sensor in dark
- (2) Case of that the experimenter is at a distance of 1m from the sensor in dark
- (3) Case of that the experimenter is at a distance of 10cm from the sensor in bright
- (4) Case of that the experimenter is at a distance of 1m from the sensor in bright

4. Experimental Result

Section 4.1 and 4.2 show the experimental result of the two sensors.

4.1 Experimental result of the photo-reflector

Table 1 shows the experimental result of the photo-reflector. When we were allowed to work with this threshold, it could accurately judge the state of the lock-key

Table 1. Experimental result of the photo-reflector.

	Average(locked)	Average(unlocked)	Threshold
Inside	4.23 V	3.10 V	3.70 V
Outside	3.20 V	2.22 V	2.70 V

Table 2. Experimental result of the pyroelectric sensor.

	Dark	Bright
10cm	○	○
1m	○	○

4.2 Experimental result of the pyroelectric sensor

Table 2 shows the experimental result of the pyroelectric sensor. As a result, irrespective of brightness, the case of that the experimenter is at a distance of 10cm is better than the case of that the experimenter is at a distance of 1m. But, the case of that the experimenter is at a distance of 1m is no problem for sensing the movement of people.

5. Conclusion

We have proposed a new burglary prevention system in this study. It will be able to greatly reduce the damage burglaries. This is because we won't go out of have without locking the door if this system is use. On the other hand, this system still has many challenges. For example, it is enabling wireless communication, eliminating contact failures or to make easier of threshold setting. We consider that this system become easier to use at home by improving them. Therefore if this system becomes more common it would be a significant contribution to crime prevention.

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