Research on monitoring technology using induced voltage generated by charged human body

Tetsuya Kawamoto, Masahiro Watanabe*, Junichi Arai, Norimitsu Ichikawa
Dept. of Electrical Engineering
Kogakuin University
phone: +81-(0)42-628-4692
e-mail: ichikawa@cc.kogakuin.ac.jp

***Abstract*—Security cameras are currently used for a monitoring technology in buildings. We cannot say the monitoring technology with the cameras is suitable for the guard of privacy. Some monitoring technology capable of the guard of privacy is needed without the cameras. The paper presents a monitoring technology using induced voltages generated by the movement of a charged human body. The monitoring technology using the induced voltages will be useful for discriminating the movement of the body without cameras.**

I. INTRODUCTION

Security cameras are currently used for a monitoring technology in buildings. However, we cannot say the monitoring technology with the cameras is suitable for the guard of privacy. The watching with the cameras is unwilling for us to determine the movement of a human body.

A monitoring technology with *e.g*. sensors is used for sensing the movement of a human body *etc*. in the buildings. Such technology is difficult to determination of the movement of the body. Some monitoring technology capable of the guard of privacy is needed without the cameras.

The paper proposes a monitoring technology using an induced voltage generated by a charged human body. In the experimental study, the induced voltage of an ungrounded copper plate of floating potential can be measured when human body walks and take a seat or stand up. Thus, we succeed in the determination of the movements of a human body. The proposed monitoring technology capable of the guard of privacy will useful for determining the movements of a human body.

II. EXPERIMENTAL SETUP AND METHOD

Figure 1 shows an arrangement of an experimental setup. The experimental setup

represents a measuring system for measuring induced voltage with non-contact when a charged human body in the building is walking. The experimental setup consists of a human body, an experimental floor, and measuring devices. The experimental floor consists of a grounded copper plate, a styrenform, a copper plated of floating potential, and an acrylic plate (see Figure 2). The dimensions of a grounded copper plate are 1 m in length, 2 m in width, and 1 mm in thickness. The dimensions of the styrofoam are 1 m in length, 2 m in width, 19.6 cm in thickness. The styrofoam puts on the the grounded copper plate. The copper plate of floating potential puts on the top of the styrofoam. The dimensions of the copper plate of floating potential are 1 m in length, 2 m in width, 1 mm in thickness. The acrylic plate puts on the copper plate of floating potential. The dimensions of the acrylic plate are 1 m in length, 2 m in width, 2 mm in thickness. We use 3 types of footwear in the experiments.

When a charged human body walks on the experimental floor, induced voltage is generated electrostatically in the copper plate of floating potential. The induced voltage generated in the copper plate is measured by a measuring instrument of model 711 of 3M Co. The measuring instrument connects to an insulated oscilloscope of Agilent Co. and a notebook computer. Thus, we can save the measurement data on the computer.

We can explain the experimental procedure of walking as follows. The height between soles of these shoes and acrylic plate of the experimental floor is almost constant of 15 cm. The induced voltage of the copper plate of the floating potential is measured when the human body walks for 15 sec.

Room conditions of the experiment are 67% R. H. and temperature of 12 degree.

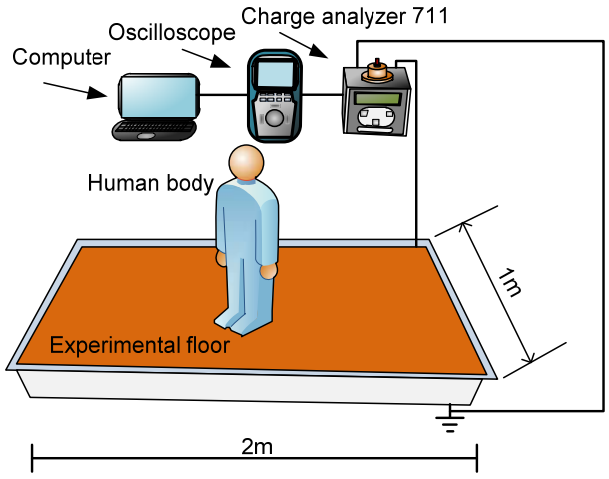

Figure 1 Arrangement of experimental setup

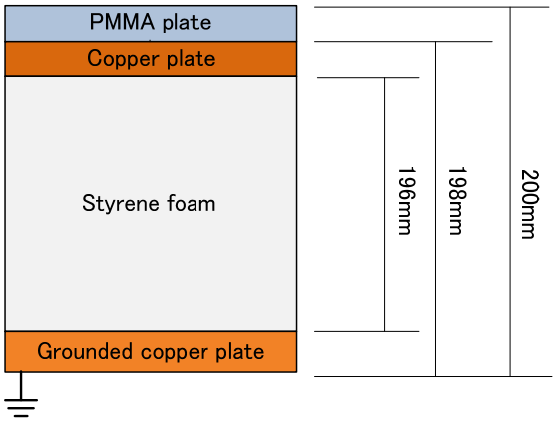

Figure 2 Experimental floor

III. EXPERIMENTAL METHOD

Figure 3 shows the result of an induced voltage generated in the copper plate of floating potential, while a human body walks on slippers. The material of slippers is the polyvinyl chloride (PVC). The value of the induced voltage is approximately 300 V when one leg is raised at the height of 15 cm. The induced voltage decreases while the height of the one leg lowers. The induced voltage becomes the value of approximately 50 V in the height of 0 cm. The change of the induced voltage is repeated while the human body walks. The induced voltage decreases down to 10V after a working of human body at 17 sec. finishes.

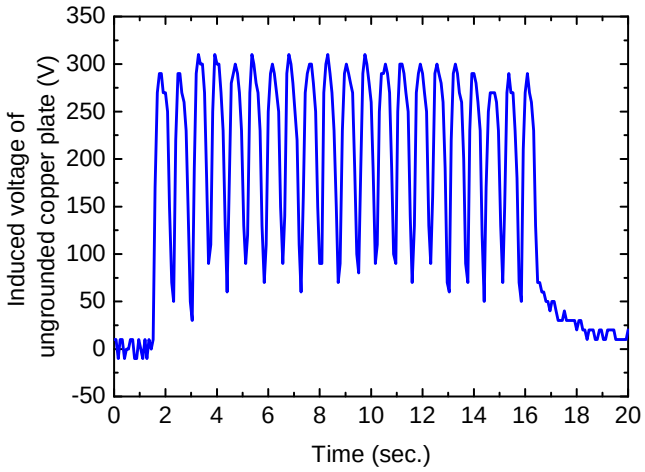

Figure 3 The induced voltage of an ungrounded copper plate while a human body walks

on slippers.

Figure 4 shows the result of an induced voltage generated in the copper plate of floating potential, while a human body walks on sneakers (synthetic rubber) on the experimental floor. The value of the induced voltage is approximately 450 V when one leg is raised at the height of 15 cm. The induced voltage decreases while the height of the one leg lowers. The induced voltage becomes approximately 90 V in the height of 0 cm. The peak value of the induced voltage increases gradually as the walking of human body is repeated. The induced voltage decreases down to 10V after the walking of human body at 17 sec. finishes.

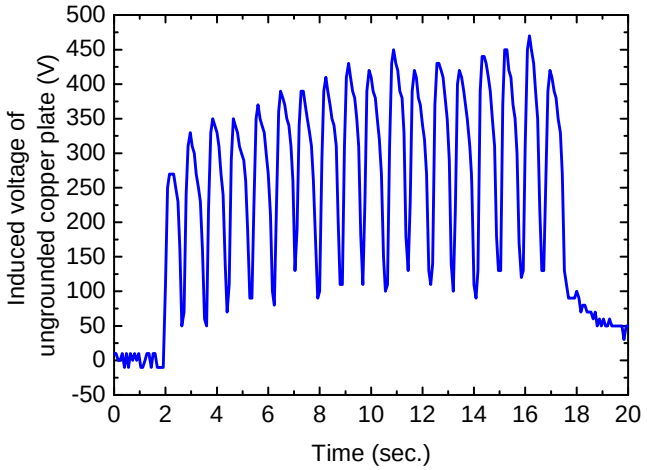

Figure 4 The induced voltage of an ungrounded copper plate when a human body walks on sneakers (synthetic rubber).

Figure 5 shows the result of the induced voltage generated in an ungrounded copper plate of floating potential, while a human body walks on shoes. The sole of shoes is a wooden sole. The induced voltage is the value of approximately 120 V when one leg is raised in the height of 15 cm. The induced voltage decreases while the height of the one leg lowers. The induced voltage becomes approximately 90 V in the height of 0 cm. The peak value of the induced voltage decreases gradually as the walking of human body is repeated. The induced voltage decreases down to -20V after a working of human body for 17 sec. finishes.

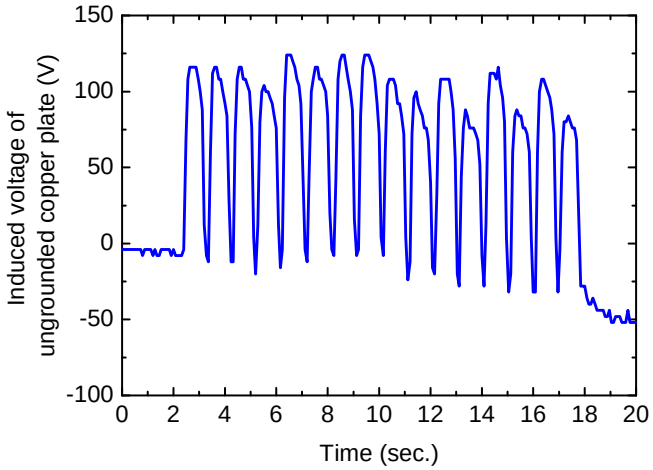

Figure 5 The induced voltage of an ungrounded copper plate when a human body walks on shoes. The sole of shoes is a wooden sole.

IV. Discussions and conclusions

We can measure the induced voltage generated in an ungrounded copper plate of floating potential when a human body walks on the experimental floor. The induced voltage changes by the movement of the human body. The reason is that the value of the induced voltage changes by changing capacitance between the human body and the copper plate. The principle represents just like the voltage divider. Thus, we succeed in the distinction of walking of a human body with non-contact.

We measure the induced voltage generated in an ungrounded copper plate of floating potential when a human body stands up from a chair and takes a seat. Figure 6 shows the measured result of the induced voltage. The human body moves on slipper (PVC). We can discriminate the movement of a human body in the figure.

The monitoring technology will be useful to us for discriminate the movement of a human body in buildings.

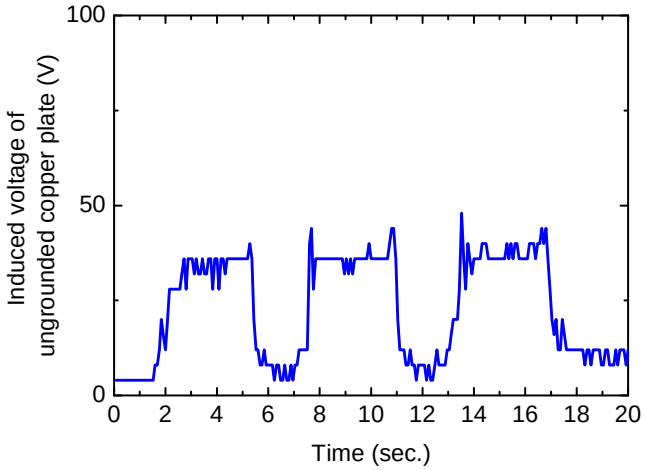

Figure 6 The induced voltage of a copper plate when a human body stands up and takes a seat.

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