Determination in operation by the frequency analyzing induced voltage generated by the movement of the charged human body

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***Abstract*— 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. Therefore, some monitoring technology capable of the guard of privacy is needed without the cameras. There is a sensor as an example of the monitoring technology without the surveillance camera. The determination in a distance between a target and a sensor is possible using the sensor. The use of these technologies is not suitable for determining the motion of a human body. Therefore, the induced voltage generated by the motion of the human body is measured and the determination of the motion becomes possible by a frequency analysis of the measured induced voltage. The paper presents a study of monitoring technology for performing the motion determined by frequency analysis of the induced voltage. The induced voltage is generated by the movement of the charged human body. It is conceivable that using the induced voltage monitoring technology is useful for identifying the movement of the body without the camera. Also, it is considered to be a detailed motion determines possible by frequency analysis.**

I. INTRODUCTION

Currently, as a general monitoring technology is used with a surveillance camera in the building. However, we cannot say surveillance camera is suitable in terms of privacy protection. Therefore, it is necessary to monitor the human body in protecting privacy. For example, there is a sensor sensing a human body in a kind of monitoring technology. This is used to sense the motion of the human body in the building. However, the determination of the motion of the body is difficult in such techniques. In this study, it is considered the monitoring technology [1] for motion discrimination by the frequency analysis of the induced voltage generated in the conductor of the floating potential by the motion of a charged human body [2,3].

II. EXPERIMENTAL METHODS

Figure 1 shows the arrangement of the experimental apparatus. The experimental apparatus represents a system with noncontact for measuring the induced voltage when a human body motions in the buildings. When the object has been charged such as a human body in the building is walking, the experimental apparatus represents a system for non-contact detection the voltage. The experimental apparatus consists of a floor a copper plate which is grounded, a copper plate of floating potential, the styrene foam, and an acrylic plate. A human body performs a motion on it. The dimensions of the cooper plates are length 1 m, side 2 m, thickness 1 mm. The dimensions of the styrene foam are length 1 m, side 2 m, thickness 196 mm. The dimensions of the acrylic plates are length 1 m, side 2 m, thickness 1 mm. The induced voltages are generated on the copper plate when a human body motions. The electrostatic measuring device of charge analyzer 711, 3M Co. is connected to the copper plate for measuring the induced voltage. The monitor output voltages of the charge analyzer are recorded by an oscilloscope of Agilent Co. and a personal computer.

The experimental procedure can be explained as follows. The induced voltage is measured generated in the copper plate of the floating potential when a human body walks 10 seconds. The distance between the acrylic plate and the sole of shoe is almost constant of 15 cm. The slipper of polyvinyl chloride as footwear is used in the experiment. The plastic chair is used at the time of the seating and standing motion. Laboratory conditions are 55 % R.H., the temperature is 21 °C.

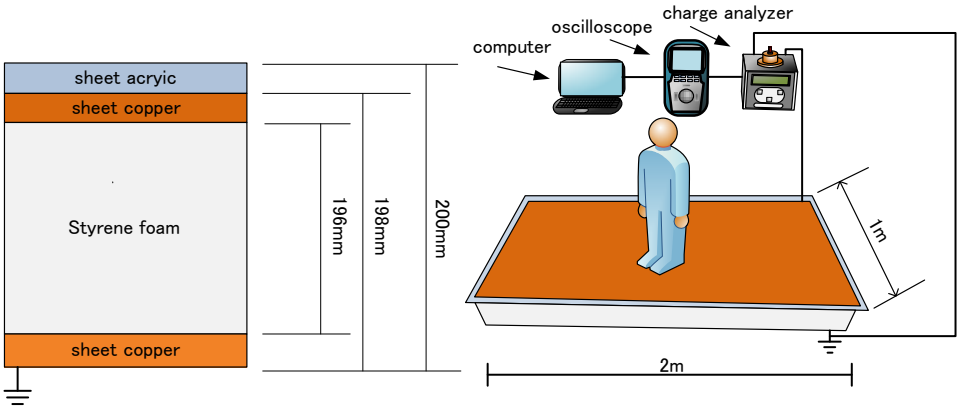

Fig.1. Experiment layout drawing

III. EXPERIMENTAL RESULTS

The induced voltage generated for each motion and its FFT are explained in this section.

Fig.2 shows the induced voltage generated by walking a human body. The induced voltage increases as a distance between the acrylic plate and the sole of shoe increases. Maximum induced voltage is 150 V. The induced voltage decreases as the distance de-

creases. Thus, the induced voltage is changed while a human body walks. The induced voltage approaches to 0 V when the motion of the human body stops.

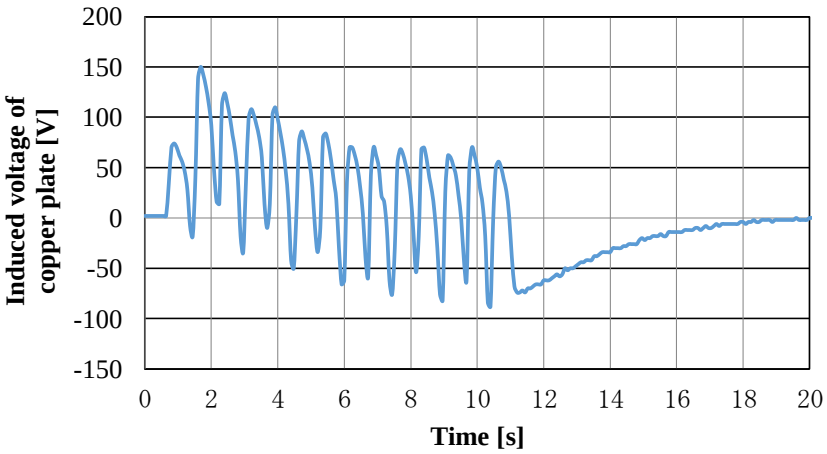

Fig.2. Induced voltage of walking motion

Fig. 3 shows the results of the FFT of the induced voltage in Fig. 2. Spectrum that can be recognized as characteristic of walking are present in a total of five bands about 0.05 Hz, about 0.7 Hz, about 1.3 Hz, about 2.7 Hz, of about 4 Hz. The amplitude of these spectrums are 44.5 V for 0.05 Hz, 8.1 V for 0.7 Hz, 28 V for 1.3 Hz, 11.8 V for 2.7 Hz, and 3.5 V for 4 Hz.

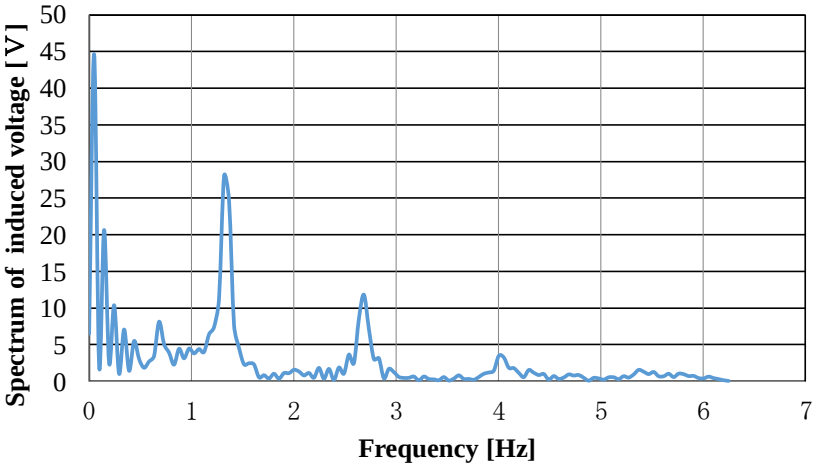

Fig.3. Frequency spectrum of walking motion

Fig. 4 shows the induced voltage caused by standing. Induced voltage was increased at the time standing up from a chair. The induced voltage approaches to 0 V after the standing up. Maximum induced voltage is 22 V.

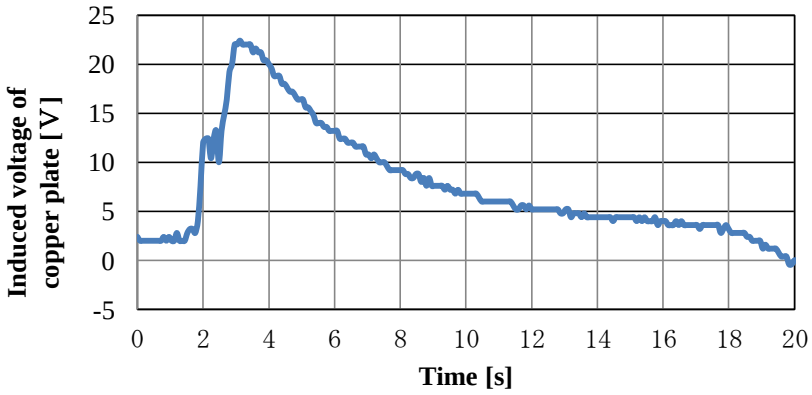

Fig.4. Induced voltage of standing motion

Fig.5 shows the results of the FFT the induced voltage in Fig. 4. It was not possible to find spectrum that can be recognized as a feature of the standing motion.

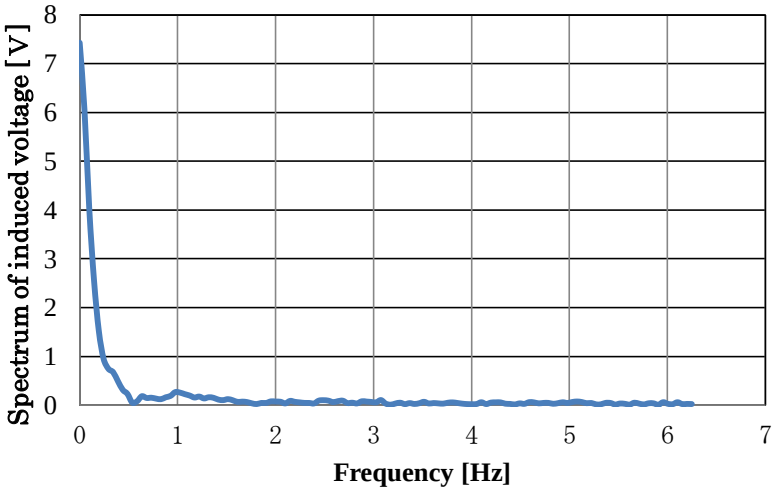

Fig.5. Frequency spectrum of standing motion

Fig. 6 shows the induced voltage caused by seating. Induced voltage is decreased at the time seating on a chair. The induced voltage approaches to 0 V after the seating. Maximum induced voltage is -15.6V.

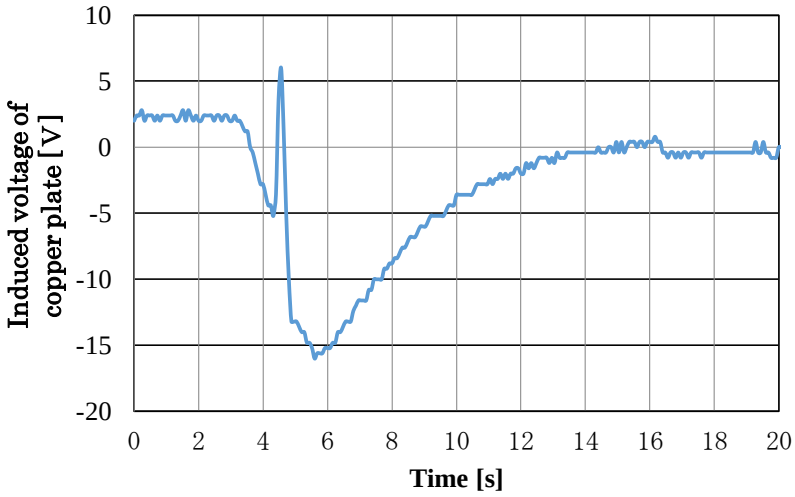

Fig.6. Induced voltage of seating motion

Fig. 7 shows the results of the FFT of the induced voltage. Spectrum can be recognized as a characteristic of the seating is present at about 0.04 Hz. The amplitude of this spectrum is 5.1 V for 0.05 Hz.

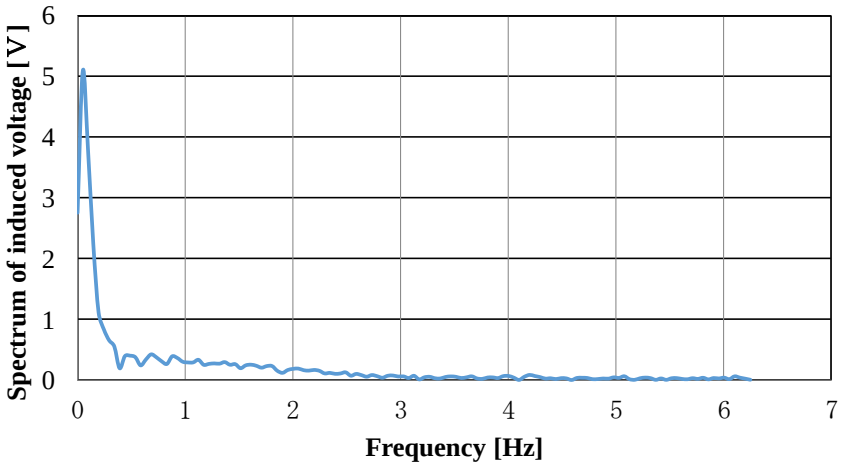

Fig.7. Frequency spectrum of seating motion

IV. DISCUSSION

It finds that there is a difference in such as frequency bands and the size of the spectrum in each motion. It was possible to check five induced voltage spectrum characteristic of walking motion. This is a feature not found in other motions. We considered discrimination of walking motion is possible from the feature.

There is a difference between seating and standing motion. However, we considered the determination of the seating and standing motion is difficult in this case. Therefore, motion determination as walking motion, standing motion and seating motion is possible in this experiment.

V. CONCLUSION

It was found that motion determination of the human body is possible by applying the monitoring technology of a charged human body. It is believed this technology can be used as a new monitoring technology on locations that do not have a surveillance camera such as a hospital. It is also considered to be able to perform also the motion determination a certain extent by this method.

REFERENCES

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