A Fundamental Study to Develop a New Interface System for Elderly People in Home

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Abstract

This report describes a new support system that makes the elderly people able to live with a sense of relief without the help of other people. In this system, using sensors, it is possible to watch closely the condition of the elderly people from a distant public institution. Furthermore, the valuable information how to be well off is presented by this system. Then, according an experiment using this system, the possibility is made clear that this system would be useful for the support of elderly people.

1. Introduction

The number of the elderly people is rapidly increasing in both developing and developed countries. It is necessary to establish a method for taking care of many elderly people through a social system. There are many reports for characteristics of human motions in daily life [1-3]. However, there are only few reports for measurement of elderly people's behavior in the daily life situation [4-7]. For establishment of more adaptable care system for elderly people, it is important to attempt measuring and analyzing human behaviors and motions in daily life.

In our laboratory we study the development of an elderly support system. This present paper proposes a new support system that analyzes human behaviors and motions and detects a change for the physical condition of an elderly human in the house. There are many reports for characteristic functions of elderly people. However, there are few reports for a measurement of elderly people's behavior in the daily life situation. For developing and establishing a support system, it is important to research elderly people's behavior and investigate it thoroughly. Accordingly, we made inquiries about the behavior of four elderly people and experimentally measured their behavior using the proposed system system.

2. Monitoring System of Living Situations

The new support system is a Monitoring System of Living Situation. The concept diagram of this system is illustrated in Figure.1. The system is fundamentally composed from sensor units, a controller unit and a supervisor unit. Several sensor units and a controller unit with two antennas are placed in the house of solitary elderly people.

The sensor units are of four sensor types that are a pyroelectric infrared sensor, a magnetic door sensor, an electric current sensor and a light sensor. A pyroelectric infrared sensor is able to find out any human motion by detecting the IR emission from a human body. Also using an electric current sensor, it is possible to record some actions in a human life like turning on/off the switch of a television, an electric heater, and so on.

Using these sensor units, human behavior can be detected. These data are transmitted to the controller unit using a wireless telecommunication method.

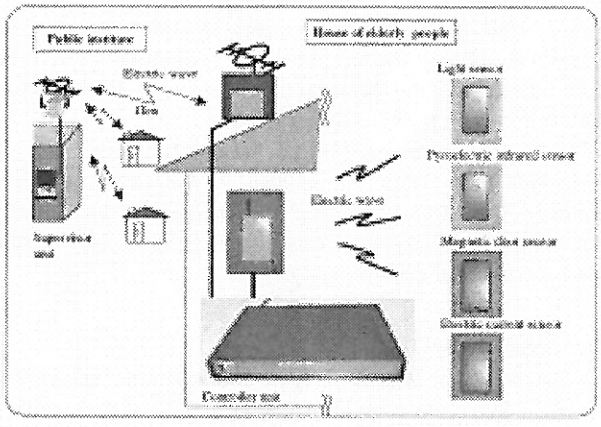

Figure 1. Concept of the Monitoring System of Living Situation

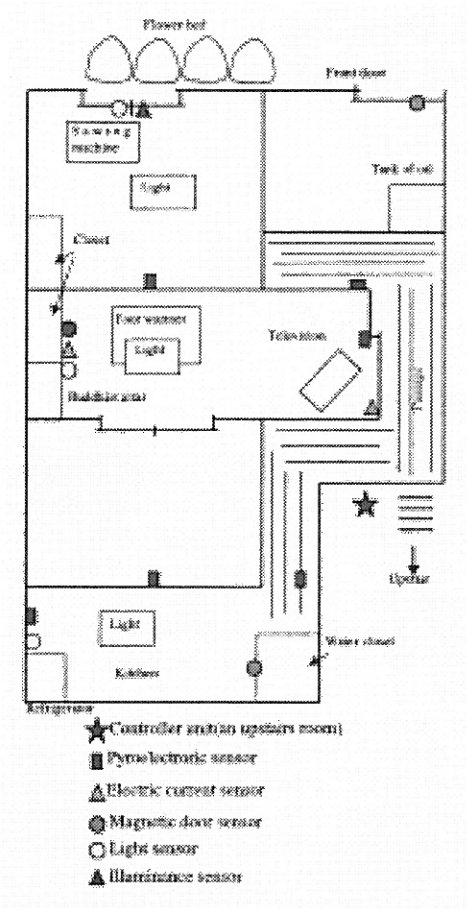

Figure 2. Disposition of Sensor Units

In the controller unit, these data are analyzed in order to check the physical condition of an elderly human in the house. Furthermore, all data in the controller unit are sent to the supervisor unit. In the supervisor unit, the data are classified into each person's database and are accumulated. Using each person's data, a characteristic pattern for each person is extracted.

The characteristic pattern is transmitted back to the controller unit. With the pattern in the controller, it is possible that, by comparing the measured data by the sensor units, the physical condition of the elderly people can be estimated continuously.

3. Questionnaires

A questionnaire was developed to understand the elderly people's life style. The subjects were four elderly people who live in solitude in separate homes. In the questionnaire, there are about 70 questions about one's behavior. From the questionnaire results, the characteristic pattern is influenced by a change of the elderly individuals life environment. So, corresponding to the change of environmental, it is necessary that several characteristic patterns be extracted and kept in memory in the supervisor unit. Also, the characteristic pattern is influenced by the change of an elderly individual's weekly life style. Most of the elderly have rules that particular behaviors should be carried out on a specifically selected day of the week. For example, elderly people periodically go to the bath of a public institution on a specifically selected day of the week.

4. Experiments

Three experiments were performed, including the

- Transmission of Measured Data, and
- Analysis of Measured Data

4.1 Transmission of Measured Data

In the experiments, several sensor units and a controller unit with two antennas were disposed in the houses of solitary elderly people. The number of sensor units is about 15 in the house of elderly people. Figure 2 shows an illustration of the disposition of sensor units. The number of sensor increases or decreases following the number of rooms and the layout of the house. The subjects were eight elderly people. The experiment was carried out in two areas. For the areas, the center of Takaoka city and Oyama town were chosen, in order to examine whether the environmental situation around the house was significant. At each area, there were four subjects and one supervisor unit. A supervisor unit was located at a public institution within 1 km away from the subjects' houses in each area.

4.2 Analysis of Measured Data

The analysis was carried out using both the measured data and the results of the questionnaire. Then, using the results of the analysis, the system conjectures one elderly individual's behavior of a day that was not part of the analysis.

5. Experimental results

5.1 Transmission of Measured Data

All subject lived their usual daily life. In order to get the subject' senses accustomed to the existence of the system, the daily measurements started one month after the sensor units and the controller unit were set up.

As a result, it was possible that the sensors detected human motions like moving from a room to another one, and actions like turning on/off the switch of a television.

5.2 Analysis of Measured Data

Figure 3 shows a result for the probability that a subject has gotten up in one day. In the questionnaire of the same

day, the subject got up at AM7:10 and went to bed at PM10:00. The probabilities are about 0.003 at AM7:00, 1.000 at AM7:10, 9.999 at PM10:00, and 0.009 at PM10:10. But the probability at PM10:20 is 0.289.

Figure 4 shows a result for the probability that a subject has gone out in one day. In the questionnaire of same day, the subject went out from AM9:50 to AM10:10, from PM0:20 to PM0:30, from PM4:30 to PM5:50, and from PM6:30 to PM6:50. The probabilities are beyond 0.5 from AM9:50 to AM10:10, from PM0:20 to PM0:30, from PM4:30 to PM5:50, and at PM6:50.

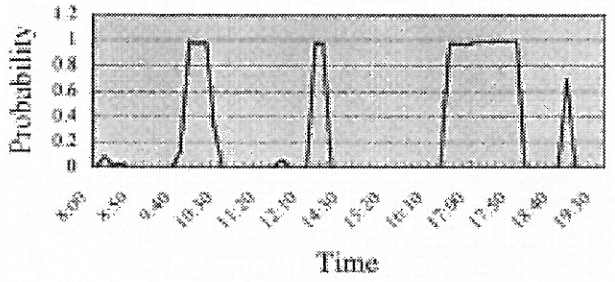

Figure3 The Probability that a Subject has gotten up in one day

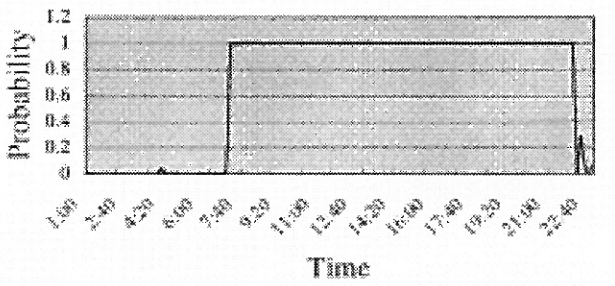

Figure4 The Probability that a Subject has gone out in one day

6. Conclusion

For the purpose of practically applying the new system for elderly people, questionnaires and two experiments was carried out. From the results of the questionnaires, the characteristic pattern is influenced by a change of the elderly individuals's life environment. So, corresponding to the environmental change, it is necessary that several characteristic patterns be extracted and kept in the memory of the supervisor unit. In addition, from the experimental results, it was ascertained that this support system could measure and analyze elderly people's behaviors. So, using this system, it is possible to watch closely the condition of the elderly people at a distant public institution. These results indicate that the system was useful for an elderly support.

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