Monitoring system of physical behavior for dementia patient

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Abstract: In this paper we propose a system to forecast the dangerous behavior of the dementia patients. Basic idea of our approach is to measure the body movements of the dementia patients using the acceleration sensor. Based on the data measured, warning the care-givers about   possible dangerous actions like falling down from the bed and slipping down onto the floor to some extent. The signals measured by the acceleration sensor are processed by a one-chip computer. Based on the diagnosis of the one-chip computer , alert signal is generated to the care-giver by a wire-less signal. The sensor is implemented in a compact body . Applicability of the system is now being examined at a nursing home.

Keywords: dementia patient, monitoring system, nursing home, elderly, alert signal, wireless signal

1. INTRODUCTION

Increase of the aged people is becoming a serious social problem. In a care house a few care workers are working for many aged people. Typically in the nighttime care workers are too busy to cope with various kinds of tasks, since only two or three care workers are staying at night. Many of the care workers are doing their best but are tired. One serious problem at care-houses is the injury of the aged caused by slipping and falling down on the floor. Once they broke their legs and feet, it is not easy for them to recover sooner. Typically in the case of dementia patient, they easily forget and neglect the request not to leave the bed alone by the caregiver. One simple answer to protect such cases is to fasten the patient onto the bed. But such kind of treatment means neglect ion of the human right of the patient. Touch sensors and pressure sensor is proposed to detect the wake up of patient from the bed. But requirement of the care givers is to develop a technique to detect the fine body movement of the patient on the bed and forecast the risky movements of the patients. Image processing is one technique to obtain such movements, but it may affect privacy of the patient. Furthermore, the image processing costs a lot.

In this paper a monitoring system is proposed which monitor fine movement of the patient and forecast the occurring of the risky. There exists many kinds of physical movements like deep sleeping, a light sleeping, walking, standing up, slipping, falling down and jumping up. These action can be classified each other from the data obtained by acceleration sensor. Therefore, the proposed system employed an acceleration sensor. A one-chip computer processes the sensor signal. Based on the diagnosis of the one-chip computer, alert signal is generated to the care-giver by a wire-less signal.

2. SYSTEM CINFIGURATION

A system configuration is shown in Fig.1 where a patient is wearing a sensor on his chest. The content of the sensor is shown Fig.2. In the sensor an acceleration sensor (ADXL202) , one-chip CPU(PIC16F84A) and wireless signal transmitter (AM-KT5-315:RF Solution Co.Ltd) are implemented in a compact body. The acceleration sensor detects two-dimensional acceleration. Of course, the sensor detects the acceleration due to the gravity. Therefore, if a patient wears the sensor on his chest, the physical behavior of the patient can be readily recognized from the data obtained. A

compact wireless signal transmitter enables to transmit the results to the main computer. The main computer decides to generate alert signal to the care-giver or not.
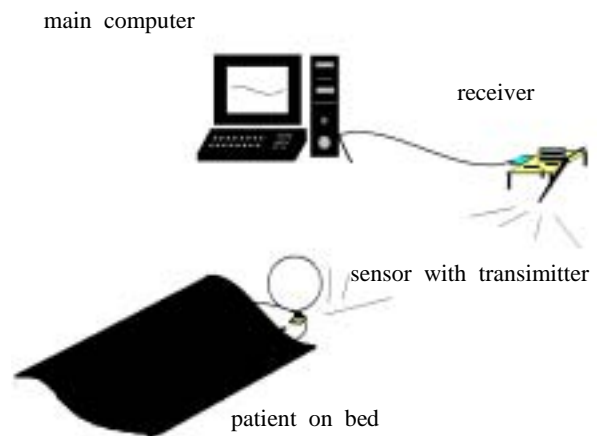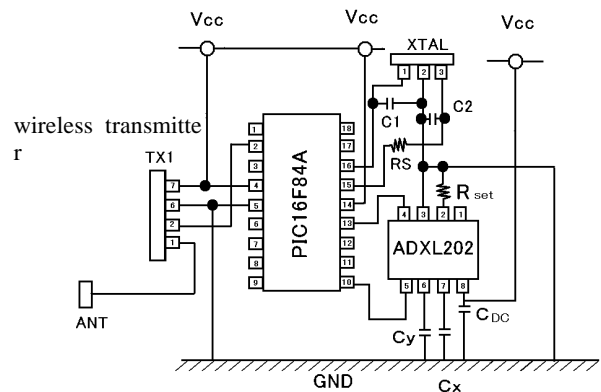

Fig.1 System configuration

Fig.2 Sensor with one-chip computer

3. EXPERIMENT

Sensors could be realized in a compact body as shown in Fig.3. The applicability of the senor was recognized by the experiment at a care house of the aged people. The reachable range of the wireless transmitter was less than 30m. Every three minutes, the behavior sensors are programmed to emit identification signals to the nurse office. Due to the function, the caregiver and nurses could confirm the patient is inside 30 m range. In addition, if the patient fell down onto the floor inside the toilet or washing room, the accident could be readily recognized.
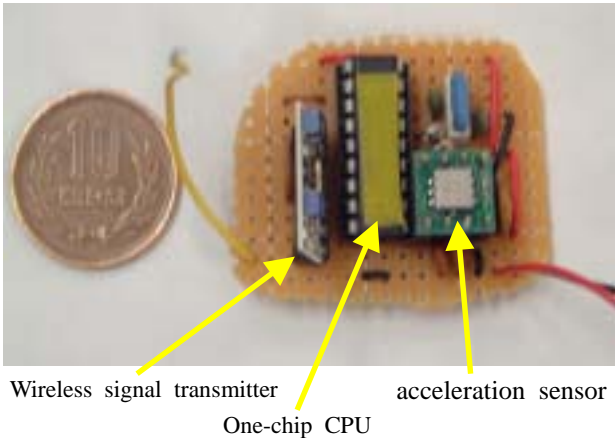

Wireless signal transmitter   acceleration sensor

One-chip CPU

Fig.3 Arrangement of elements in the sensor

This sensor is attached to an examinee to check the feasibility. An examinee wearing the sensor is requested to (1)sleep in the bed, (2)roll over , (3)wake up and (4)walk around the bed. During the above movements, the sensor detected the acceleration signal. Fig.4 shows the acceleration signal toward foot direction. Fig.5 shows the acceleration signal toward leftward.
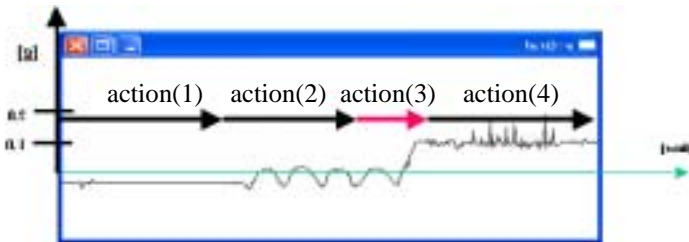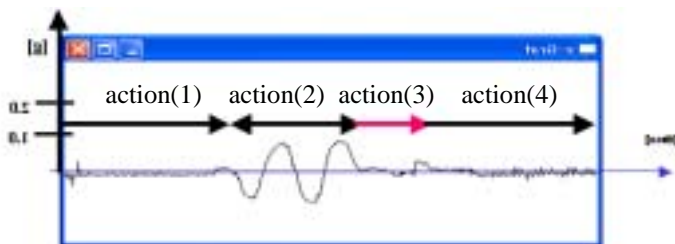

Fig.4   Sensor signal toward foot direction

Fig.5 Sensor signal toward leftward

(1) Sleep in the bed

(2) Roll over

(3) Wake up

(4) Walk

Fig.6 Sequences of actions

Form Fig.4 and Fig.5 sinusoidal waves caused by rolling over on the bed can be recognized. In Fig.4 increase of acceleration data can be recognized caused by standing up action. It is important that during walking actions, fine vibration signal can be recognized in Fig.4.

Considering the feature of the acceleration signals at every action, it is easy to separate each action from the others.

4. CONCLUSION

We developed a monitoring system of physical behavior of aged patients. The sensor can be effectively applied to suppress the number of the accidents caused by the slipping and falling down on the floor. The system can be readily connected to the Internet system. Due to the miracle power of Internet, our system can be expanded to more advanced system like remote care of the patients in the far place. Furthermore, patients could be cared safely in the care house even if the caregivers are busy.

We are now testing a prototype system at a hospital in Nagasaki city. The results of the test will be demonstrated.

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