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Development of a robotic system for the bed-ridden

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ABSTRACT

The ability to live without the help of a caretaker enhances the quality of life of those who are bed-ridden or confined to a wheel-chair. A lot of systems have been proposed to support the daily life of bed-ridden. A smart home, especially a bed-type robot system, can help the movement and action of patients.

This paper discusses the development of an intelligent bed robot system (IBRS), which can help the elderly and the disabled have independent life in bed. The IBRS is a special bed equipped with two robot arms and an array of pressure sensors attached to the mattress. The pressure distribution on the mattress is used to estimate the pose of the patient, and an appropriate assistance is provided by the robot arms. The proposed system has been tested experimentally for its effectiveness while maximizing the therapeutic outcome.

1. Introduction

The increase in the life span of many elderly people means that there is more demand for support in their normal life. It is increasingly important that robots assist humans at home because of the forthcoming aging problem in society. Ever-progressing scientific technology should lead to safer and more comfortable lives through care-giving aids that allow people with disabilities to live well independently and conveniently. In particular, the elderly and the handicapped have serious problems in performing certain activities in daily life so that some assistive devices or systems are needed to endow them with as much independence as possible so as to improve their quality of life. A smart house for assisting the elderly and the handicapped may be an alternative to solve daily living problems since it integrates systems for movement assistance, devices for continuously monitoring health status, and interfaces for controlling home-installed devices in a human-friendly manner.

In several European countries, a number of demonstration projects and smart houses have been developed. Arrangement of different devices for home automation and their control by the user has become a central topic in many projects, such as the AID (Assisted Interactive Dwelling) project [1], the Smart House project (developed at Social Housing SPRU, University of Sussex, UK), HS-ADEPT [2], HERMES, the Smart Home project (Brandenburg Technical University, Cottbus, Germany), the Gloucester Smart House in the UK (oriented to the specific needs of people with dementia), and the Aware Home (at Georgia Institute of Technology, USA). The SmartBo project [3] started in Sweden in 1998. Developed structures of a technical home environment integrate systems for temperature and humidity control; automatic systems for window closure in the rain; remote control of entrance doors, kitchen appliances, lights, TV, video, phone, and computers; and the measurement of the concentration of gas, carbon dioxide, chemicals, etc. The problems and needs of the elderly and the handicapped vary greatly from person to person, which add lots of major requirements. In contrast to existing automated homes that can be programmed to perform previously defined functions, a team at Colorado University proposed the idea of the smart home, where the home controller can essentially program itself by observing the lifestyle and desires of the inhabitants and learning to anticipate their needs [4]. Fifteen demonstration and research houses, known as Welfare Techno Houses, have been built across Japan. These innovative demonstration projects aim to identify and promote the idea of independence for older people and people with disabilities by creating accessible environments and maximizing the use of assistive technologies. The Robotic Room is a project developed at the Research Center for Advanced Science and Technology at the University of Tokyo [5]. The environment of the Robotic Room consists of a ceiling-mounted robotic arm (called the long reach manipulator) and an intelligent bed with pressure sensors for patient posture monitoring. Modules are network connected and the room can monitor the sick person's respiration or rolling over without attaching anything to the person's body. The robotic arm can bring objects to the user.

The human welfare robotic system research team in KAIST [6] is aimed at fully supporting essential daily tasks with various functionalities to comply with the needs of the users based on a statistical and questionnaire survey, and based on the idea that the technologies and solutions for such a smart house should be

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