

CHAPTER 18

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Smart Hospital Room Project

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INTRODUCTION

A system for controlling a hospital room's environment by a person with limited mobility is the focus of this project. The key attributes of the system is the restoration of the ability of a limited mobility patient to control the hospital room environment using basic body movements. Additionally, alternative communication is provided with care providers as well as their friends and family through the use of a virtual phone, the internet, and an instant messaging service to the nurses' station. This communication can be automated through scripts or customized messages can be created.

SUMMARY OF IMPACT

The target audiences for this system are patients who have recently experienced an accident and are therefore in a highly frustrating and vulnerable phase of their new disability or injury. For the implementation a quadriplegic patient is selected as the user. These patients are paralyzed in all four limbs (arms and legs) for the initial stage of recovery which can be for up to three months. The symptom is usually caused by damage to the brain or spinal cord which causes the person to lose partial or total mobility of all four limbs. Quadriplegic patients initially experience increased anxiety due to unexpected or anticipated lack of control in their surrounding environment. For example, they cannot walk to the TV and turn it on. They cannot control the temperature of the room. In some cases, it is difficult for them to call for help (i.e. the nurse) due to temporary loss of speech.

TECHNICAL DESCRIPTION

A graphical user interface is controlled with a wearable mouse. Interface to the mouse is performed with a reflector placed on the patient's forehead or on the tip of a ball cap.



Fig. 18.1. Smart Hospital Room Graphical Display

Motion of the head or face is detected to move the mouse on the screen. A click is performed by resting the position of the mouse for a few seconds. The patient selects the device to control by inspection of the graphical interface; for instance the call button, lights, fan, bed, TV, or internet. The graphical interface is generated by the processor. The user communicates with the processor via the user input device. The processor transforms the input command into an output command usable by the selected transceiver and device controller. The processor directly controls the access to the internet. The output commands for the external devices are sent through the processor transceiver. The selected device transceiver executes the action needed to adjust the chosen device via the controller.

The computing platform is placed on a stand as shown in Fig. 18.2. This stand has an adjustable arm so the monitor can be placed at a comfortable location for patient use. Lockable wheels are placed on the base so the device remains in place under the bed. As shown in Fig. 18.1, the receiver for the mouse is on top of

the display but this can be moved based on the needs of the user.

The cost of parts/material was about \$1,000.

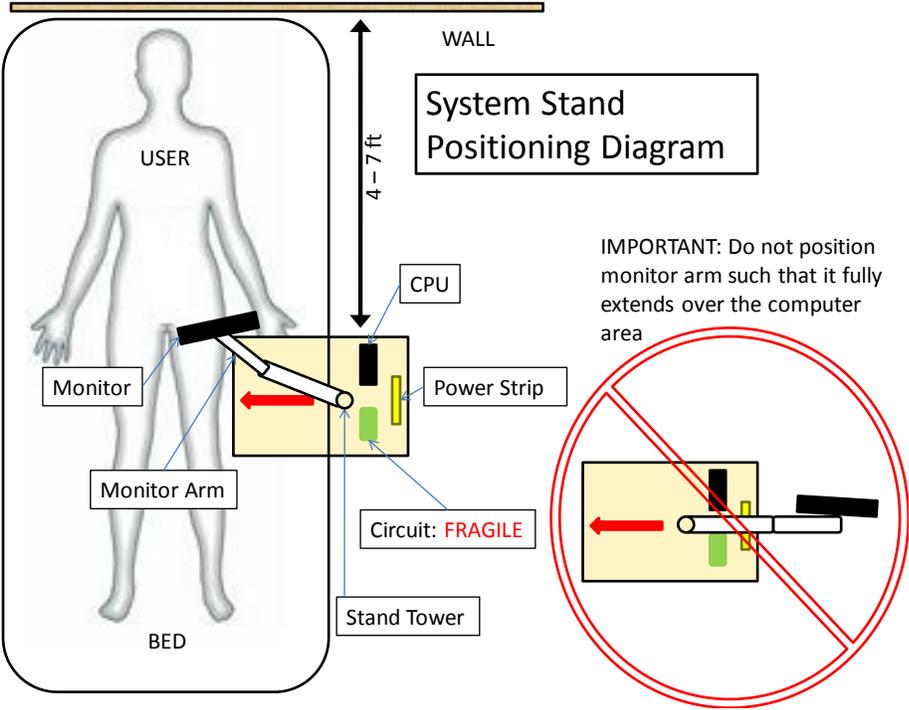


Fig. 18.2. Positioning Diagram for Bedside Stand.

Low Impact Exercise Bike Redesign

Designers: Adrian Lucero

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INTRODUCTION

The intended scope of this project is to create an aesthetically pleasing machine that is of a lower cost, weight and bulk, that can help a wide range of people without going extensively into market research and testing. The modeling for the machine is mostly focused on the general needs of a particular patient. The original patient was recovering from knee surgery and wanted to regain the mobility to go on fishing trips. Light to moderate exercise was believed to allow her to complete this goal. After two years, the initial design was becoming rusty and the flywheel design was both wobbly and did not offer enough resistance, and thus a redesign will focus on better longevity and stability while addressing weight and bulk concerns.

SUMMARY OF IMPACT

The proposed exercise machine is a redesign from a 2007 project which was intended for people who are unable to perform common physical activities, however, are able to perform mild exercise routines. The machine design is to help people who may be overweight or unable to exercise by common means. This device may be of use to persons with medical problems, health problems, leg surgery recoveries or any other ailments that do not allow for common exercise routines or regular outdoor activities.

TECHNICAL DESCRIPTION

The base frame is constructed from 2 inch by 2 inch by 14 GA wall A500 rectangular tube steel. All pieces are welded together. Powder coating of all steel pieces is done in order to have a protective weather coating. Adjustable feet, which can be cut from rubber tubing, are placed on the bottom of the structure so the device can be leveled. The 31.5" support bar for the sliding seat is welded to the frame and is constructed of 2"x2" by 14 GA wall A500 rectangular tube steel. The support bar has 1-1/2" spaced holes for maximum seat adjustment. The seat is a prefabricated 'Koolback' recumbent seat. The handlebar and connection arm are comprised of two components. The handlebars are standard design off the shelf with an adjustable connection arm and the connection arm. The straight neck design is fabricated from the standard 2"x2" 14 GA steel with a grooved 5" cut to allow for the flywheel clearance of 4" and allowing the hole cut for the drive shaft to secure the straight neck to the assembly. The arm also has resting pins on the aluminum outer frame cover assembly.

The cost of parts/material was about \$1,478.

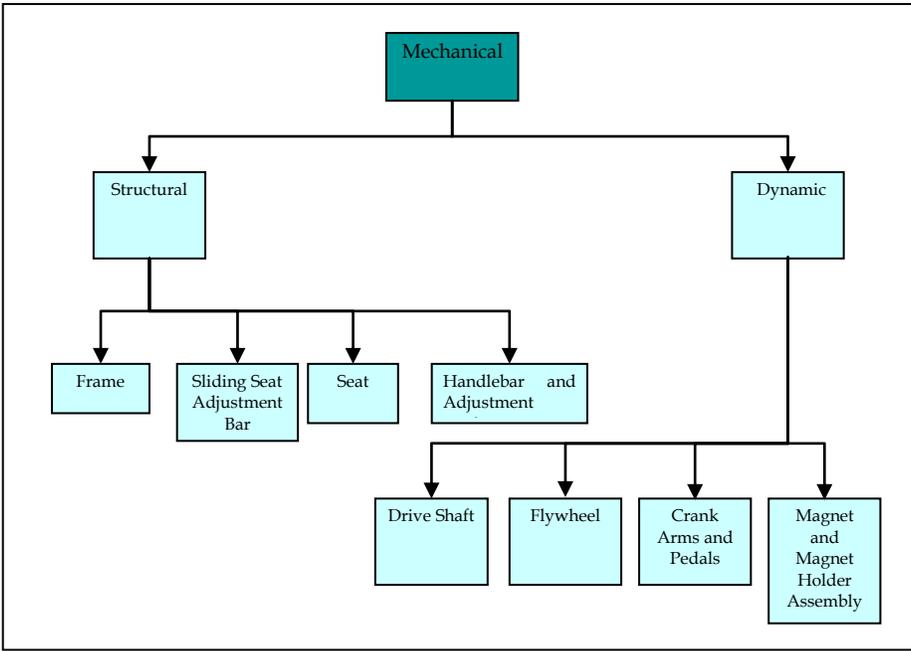


Figure 18.3. Exercise Bike System Level Diagram.

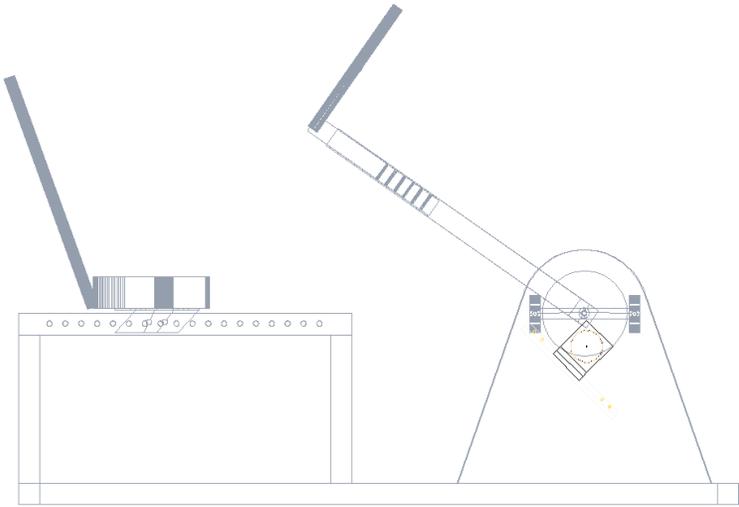


Fig. 18.4. CAD drawing of Exercise Bike.

Knee Rehabilitation Goniometer

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INTRODUCTION

On a national level, as of 2007, 27% of people aged 18 and older reported some form of joint pain, and 16% reported knee pain. A study in the American Journal of Orthopedics suggests that in-home mechanical therapy may increase the range of motion (ROM) of those afflicted with loss of knee flexion. In-home mechanical therapy is a potential solution to those who a rigorous and costly physical therapy regimen is not available or those wishing to regain flexion without surgery. Therefore, this study indicates that an increase in in-home mechanical therapy among certain patients could stimulate demand for range of motion monitoring and data transmission. Of the approximately 4 million orthopedic procedures performed in the US last year, 555,800 were total knee replacements (TKRs). The number of total or partial knee replacement procedures performed in hospitals in Colorado, between August 2007 and July 2008 was over 10,600.

SUMMARY OF IMPACT

At-home physical therapy is substantially more cost effective to the physician, the insurance company and saves the patient a lot of time. A wearable product enables the patient to rehabilitate his/her joint at home and provide the physician with the necessary information regarding the ROM progress. This will free up the caregivers time in the office as well.

TECHNICAL DESCRIPTION

The contributions this year are improved sensing and communication capability of the device for remote monitoring of progress after total knee replacement surgery. Students used an angular rotation sensor mounted in a knee brace and interfaced this with a Bluetooth module for communication with a smart phone to a remote server. The allows a physician to monitor progress during the critical 10-14 day window after surgery to ensure full ROM is achieved before the tendons stiffen and additional surgical intervention is required.

The cost of parts/material was about \$600.



Fig. 18.5. Wearable Sensor and Phone Interface.

