

CHAPTER 6

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HANDCYCLE

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INTRODUCTION

A device to enhance mobility was requested for 66-year-old woman. As a child, she had fallen into a cooking fire and burned off much of her left foot; only the heel remains. She had been walking in this condition ever since. She lives without paved roads or electricity in rural Malawi, Africa. She was walking one mile uphill in rough terrain daily to get to the market. Walking without proper structural support caused her severe back problems. A handcycle was deemed the most effective solution given the timeframe. All components used to create the device were to be readily available in Malawi. The design was to be easily reproducible and take into account the environmental conditions of the client's residential area: rough terrain, a severe monsoon season, high temperatures during the summer, and steep hills.

SUMMARY OF IMPACT

The design (Figures 6.1, 6.2 and 6.3) takes into consideration not only the client's mobility, but also her physical capabilities and environmental factors. The handcycle has crank handles set for maximum efficiency. The client can easily move the handles forward, moving the cycle forward, stop them to stop the device, or move the handles backwards to reverse. The client's lower back problems should



Fig. 6.1. Handcycle.

diminish as her mobility increases. Her travel to and from the local market is likely to be far less painful.

TECHNICAL DESCRIPTION

The final prototype is adjustable so that it can accommodate users of different sizes. For example, the length of the crank, distance from crank to seat, seat position, and handle positions are all adjustable. In addition, the wheels can be removed by the touch of a button in the center. This serves two purposes: avoiding the problem of theft and making the handcycle easier to transport or ship.

MALAWI REHABILITATION ENGINEERING
HAND CYCLE CONCEPT

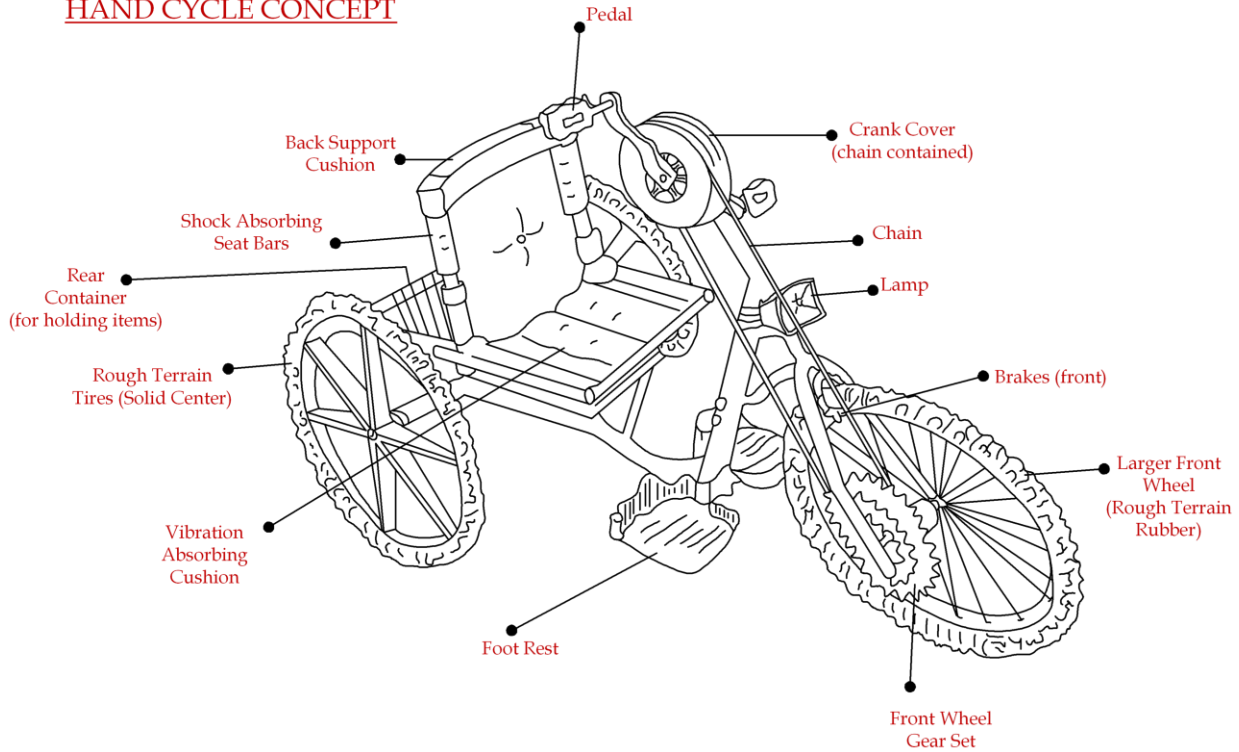


Fig. 6.2. Handcycle Schematic.



Fig. 6.3. Finished Product.

EEG-ACTIVATED ALARM FOR AN ALS PATIENT

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INTRODUCTION

A device was designed to enhance an ALS patient's ability to communicate a need. The patient's existing communication system relied upon detectable eye movements, requiring clear vision to purposefully control cursor navigation on a computer monitor. Also, the eye-tracking system required that his head be stabilized, causing him discomfort and sore spots along the face when used for long periods of time. An alternative to his eye-tracking system was requested. The new design uses biofeedback to detect the patient's need for help. The motivation to choose this approach instead of creating an electrical stimulator for the patient's eyelids were twofold: the client needed a solution that would allow his eyeglasses to be worn or removed, and he needed a simple alternative to his current system. The existing eye-tracking system involves an on-screen keyboard with which he can type.

SUMMARY OF IMPACT

The system (Fig. 6.4) enhanced the client's comfort and provided an alternative means to communicate a need. By extension, this project could be made useful for people with ALS who have lost the ability to communicate. The system design is compact, easy to handle, and portable.

TECHNICAL DESCRIPTION

The system (Fig. 6.5 and 6.6) works through the combination of biofeedback and computing systems, the latter of which runs a help detection method. Once electrodes are applied, the user may sit or lie down. The system works with a PC. Comfort and efficiency were top priorities. A mobile USB-powered system functions with 64-bit PC tablets and laptops and includes a driver CD. The stand-alone software is a mental distress alert algorithm that triggers an audible alarm at a predetermined value related to the alpha and beta bands. The system DAQ is lightweight and portable, weighing only 5.40 oz with dimensions of 4" (L) x 3" (W) x 1.6" (H).



Fig. 6.4. Patient Wearing the EEG-Activated Alarm System.

Attached to the DAQ are five EEG gold cup electrodes with 48" long wires. As the amygdala is the center for panic and fear, four EEG gold-cup electrodes were situated along the mid-brain line to capture distress. Functionality was demonstrated through test results. The mental distress alert program is an EEG processor, specified to measure amplitudes and sum them in specific alpha and beta bands.

The budget for this project was \$700, of which \$300 was used for supplies.

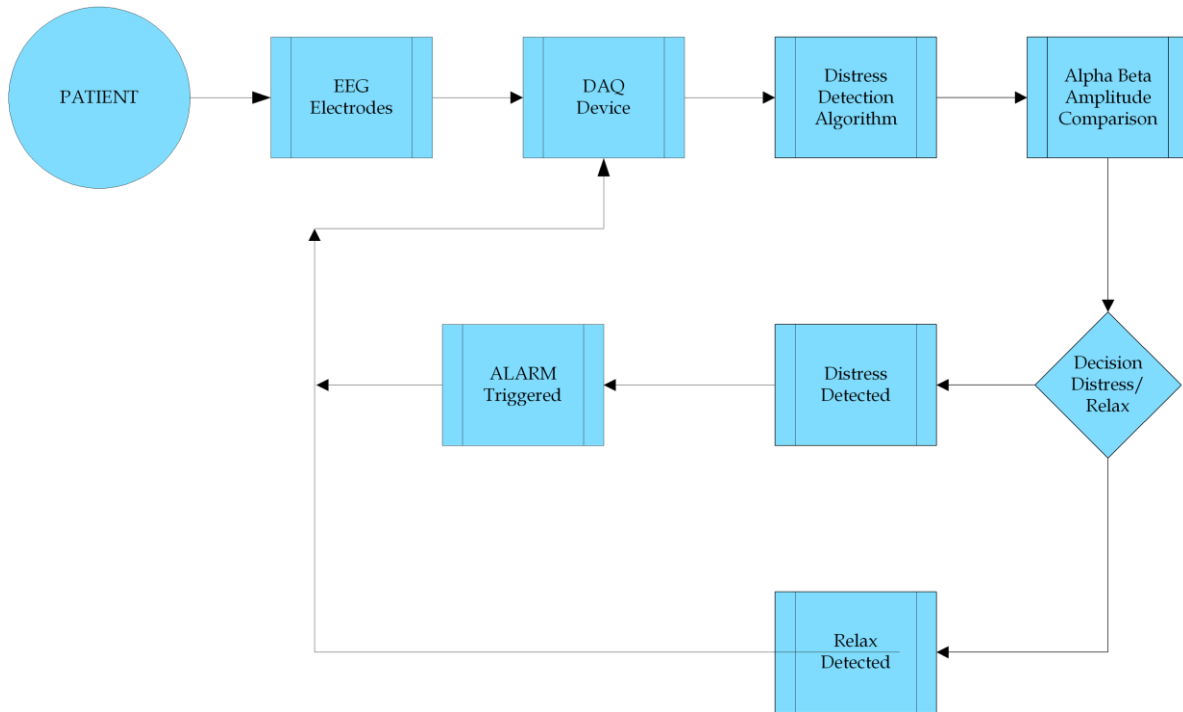


Fig. 6.5. Block Diagram of EEG-Activated Alarm System.

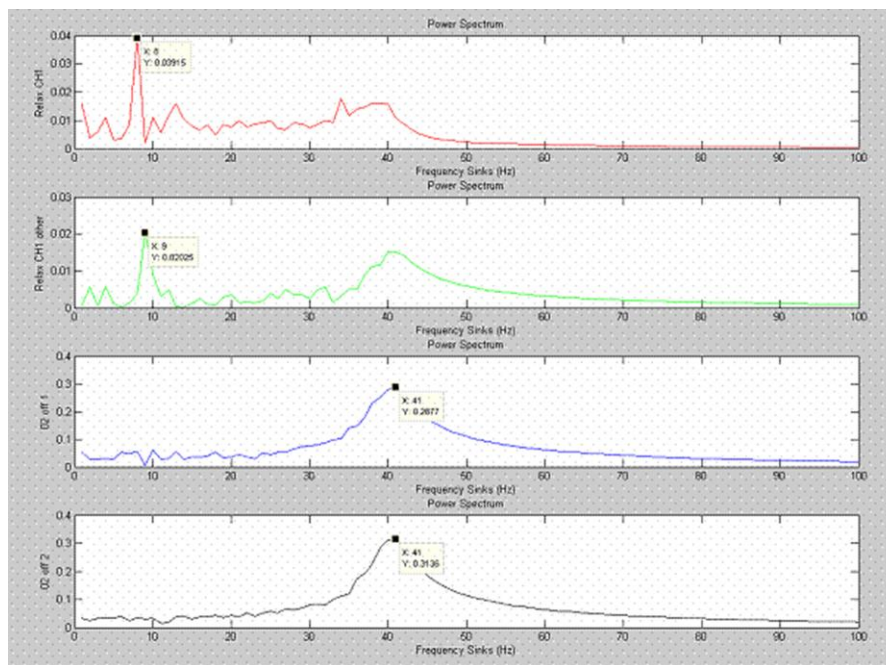


Fig. 6.6. Power Spectrum for Filtered Rest State Biofeedback (Top Two Frames) and Power Spectra for Filtered Distress State Biofeedback (Bottom Two Frames).

FOUR-TIP CRUTCH

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INTRODUCTION

A specialized crutch was designed to assist a 79-year-old man born with legs of unequal length. The client's left leg is about half the length of his right. He lives in a small mountain village far from modern technology and medical care and has recently experienced cardiac problems and declining health. The client's job requires a great amount of mobility. Also, he walks four miles from his house to a nearby market daily. As most of the roads in his village are pitted with holes and covered with rocks, a wheelchair is not of practical use.

SUMMARY OF IMPACT

The prototype (Fig. 6.7) was tested by two adults aged 54 and 59. After some additional modifications, the final form of the product was completed and shipped to the client in Vietnam.

The device will improve the client's daily mobility.

TECHNICAL DESCRIPTION

The goals of the design were to enhance stability, increase walking speed, and provide better support at the wrists and elbows. The crutch has four tips at the base for extra stability, with springs added for comfort. The crutch can be folded in half, along its length, for easy storage (Fig. 6.8). The arm rest is designed to have an upward curve of about 2 inches from the back to the front.



Fig. 6.7. Photo of the Device.



Fig. 6.8. Photo of the Device When Folded Into Half.

MULTI-USE NECK AND HEAD DEVICE

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INTRODUCTION

A device was designed to combine pressure techniques with modern technology, helping alleviate migraine pain. The device (Fig. 6.9) applies gentle pressure to specific points on the head and neck, thereby diminishing pain with no drugs or side effects.

SUMMARY OF IMPACT

The device has the potential to diminish migraine pain without drugs or side effects.

TECHNICAL DESCRIPTION

A Gantt chart is shown in Fig. 6.10. Even though much of the appropriate hardware and materials have been identified, the device is still a work in progress. In an experimental test the device functioned successfully, but there is still progress to be made. If the fully functional device becomes a success, the product can be marketed to hospitals, doctors, and eventually directly to users who suffer from minor neck injuries, stress, and other factors



Fig. 6.9. Multi-Use Neck and Head Device.

associated with muscle tension. Reliability and affordability are important requirements for this design.

The cost was approximately \$135.

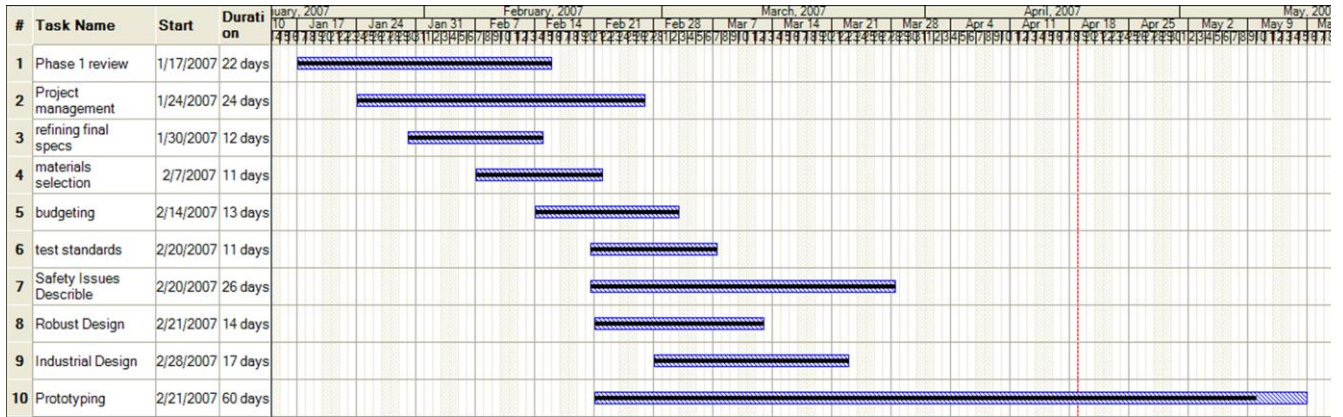


Fig. 6.10. Gantt Chart of Project Progress.

