

Product Design Specification

Hospital Bed

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Problem Statement

Existing bed back angle control systems do not allow the operator to control the velocity of motion. A more intuitive control system, which gives the user better control over the velocity, is desired. The user would be able to grasp a handle which operates according to a force-assist concept, and the velocity would vary with the amount of force applied. The bed back still needs to support the weight of a heavy patient, and be stable if power is lost.

Client Requirements

- Ability to control velocity
- Accessible for patients with specific disabilities
- Intuitive and ergonomically designed controller
- Support a maximum load of 180 lbs on the bed-back
- Bed-back brake system during power loss
- Maximum operator force should not exceed 20 lbs on the controller
- Budget less than \$2,000

Design Requirements

1. Physical and Operational Characteristics

- Performance requirements:* The controller needs to be mechanically and electrically compatible with an existing bed. The device may be used several times a day. Repeatable and consistent behavior is expected. The bed back should be able to support a load of up to 180lb. User interface must be durable and easy to use.

- b. *Safety*: The device will be in close contact with the patient. Therefore, it must be completely insulated and should not present an electrocution hazard. Also, one patient's grandson is a hemophiliac. Therefore, the device must be free of sharp edges.
- c. *Accuracy and reliability*: The angle and speed need not be fully accurate, and an error of 10% is tolerable. However, the user must have full control over the angle and speed, and should be able to adjust those as needed.
- d. *Life in service*: The device should sustain reasonable usage, which may be several times a day, with about a minute of usage at a time. The device should be in service for several years.
- e. *Operating environment*: The device will be operated primarily in an indoor setting at a fairly constant room temperature. Fluid may be spilled on the device (patient's medication, for instance). The device should be resistant to reasonable conditions, such as moderate humidity and temperature fluctuations.
- f. *Ergonomics*: The controller must be accessible to patients with carpal tunnel syndrome, partial paralysis, Parkinson's disease and blindness. The device should be fully operable with a small amount of force.
- g. *Size*: The controller should not be too bulky as to hinder the normal functioning of the bed.
- h. *Weight*: If free to move, the controller should be easy to carry for patients with impaired muscle and bone function.
- i. *Aesthetics*: The device should fit into the aesthetics of the existing bed, as some patients do not wish to be seen as sick.

2. Production characteristics

- a. Quantity:* For prototyping and RERC competition purposes, only one device will be produced.

- b. Target product cost:* The production cost should not exceed \$2000.

3. Miscellaneous

- a. Standards and specifications:* The bed and device must satisfy the requirements and recommendations of the Hospital Bed Safety Workgroup (HBSW)

- b. Patient-related concerns:* The design must be done with the patient in mind at all times. The patient must be comfortable enough with the bed to be able to sleep in it.

- c. Competition:* The main competition arises from other participants in the RERC National Design Competition. Our device needs to exceed the others in functionality and originality. A preliminary patent search did not yield any significantly similar products on the market.