Design and Fabrication of Automated Bed Control System for Patients
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Abstract— Hospital beds are manufactured around the world, with each nation providing its own unique qualities and traits to the hospital beds. In researching the beds, we classified into two main types: medical and surgical hospital beds as well as intensive care unit beds. Each personality has developed a various mechanism for lifting the backrest. We have studied various hospitals bed and to develop a good quality bed. Mostly hospital bed are operated manually by means of health care workers, from this both the patients and health care workers feel uncomfortable. To overcome the difficulty manual method is replaced by automatic method. Various bed lifting methods used at present such as screw jack, spring lifting, hydraulic and worm gear mechanism using threaded joints are evolved. From our area of concept is an incorporated new mechanism for swiping motion. An automatic bed control system is particularly adapted for the care of patients at hospitals, and comprises a stationary frame, and a mattress support having a head section, a center section, and foot section, which are in hinging type is interconnected. A lift arm has opposing ends thereof pivotally connected with the frame and the mattress support center section respectively.

Key words: Fabrication, ABCS, Automated Bed Control System

I. INTRODUCTION

Hospitals, rehabilitation homes, nursing homes and retirement homes around the world are dependent upon a quality medical staff to maximize safety of individuals Staff professionalism, facility quality and the condition of equipment are all key components in medical care which must be taken into account when designing hospitals. Particularly hospital beds are of recent concern around the world. In the United States, there have been a number of FDA (Food and Drug Associations) regulations adjusted in recent years while all around Europe recent modifications to reduce the risk of patient entrapping were introduced. In areas such as Africa, Eastern Europe, Asia and other developing nations there is a particular need for improving and modernizing hospital beds. The domestic manufacturing of modern hospital beds in India will also allow the facilities to gear their focus toward other research and Pinion (to and fro) along with links for lifting which is highly a mechanical based and to analyze the components and functions of each. We have protested various literature review and develop a new hospital bed according to our own design, and strive for developing the product. Actually Hospital bed and others furniture should be designed considering ergonomics. The word "Ergonomics" comes from two Greek words ergon," meaning work, and "nomos" meaning laws (Bridge 1995). It is the interaction among man, machine and environment which focuses on the interactions between the works demand and worker capabilities. Anthropometry is one of the basic parts of ergonomics that refers to the measurement of human body. It is derived from the Greek words “anthropos” means man and “metron” means measure (Bridge 1995). Anthropometric data are used in ergonomics to specify the physical dimensions of workspaces. Our plan is to study major existing models and we have to indulge a new mechanism (ie) Rack task to the man” (Grandjean 1980) and to ensure that the physical mistakes between the dimensions of equipment and products and the corresponding user dimensions are avoided. In certain countries, poor and middle class people generally go to government hospital which is more or less charge free. Here, the use of ergonomics in hospital and other work stations is very poor. This study will help this regional people to design hospital bed according to anthropometric data of this regional people considering patients physical demand. The paper is being organized as follows; after discussing the introduction section a detailed review on the different literature are being depicted in the following section, then in section 3 some outlines of research methodologies are discussed which is followed by result and result analysis. At the end portion of this paper a suitable conclusion.

II. ADJUSTABLE BED

As long as people have slept in beds there have been continual attempts to revise their construction in order to better accommodate the individual's particular needs for sleeping and lounging in comfort. One major initiative, which is used extensively in the health sector, was the development of the adjustable bed. Adjustable beds were originally designed with the principal purpose to accommodate the patient in a variety of positions. A growing number of people place television and other media based entertainment devices in their bedrooms, and spend more time lounging in bed. For this to be enjoyable issues of posture are important. Consequently companies are taking a scientific approach to bed design with these needs in mind and with the intention of solving the inadequacies in regard to such things as comfort when sleeping or reading. The result has been the development of adjustable beds for use in residential environments by those who have no health or physical impairment. The adjustable bed is now considered by many to be an alternative piece of leisure furniture (Stroud 2000). An example of a modern adjustable bed for the home is shown in Figure 1.1.

Fig. 1: Adjustable hospital beds

A. Design Model

Design Model is adopted as per own design, they pride themselves on using state of the art technology and innovative production methods. This is reflected in the
broad base of skills present in the design team, from graphic
design, architecture, textiles, CAD/CAM to industrial
design. The general brief presented by Design Model
incorporated the design of a simple and affordable
adjustable mechanism to integrate into the frame of their
latest bed range. Design model were aware that the
mechanism required to produce the adjustment was
available through third party suppliers and could be
retrofitted to their bed. However, these mechanisms did not
have the desired styling, and integration into their frame
would have required extensive modifications to the bed.
Therefore, Design Model made the decision to design our
own mechanism.

B. Design Techniques

Design techniques are tools or aids used for bringing a
rational approach into the design process and a designer may
combine a number of these methods during the course of the
design process (Cross 1994). More often than not these
design techniques appear to be too systematic and are not
useful in the chaotic world of the design office.

French (1971) suggests that they increase the size
and range of the projects the designer can undertake and
improve the quality and speed of their work. Some of these
techniques are common sense methods yet by formalizing
them into the design process they are not over looked. At
times by following a design Background to a Systematic
Approach to Design technique it may appear that the focus
of the design process has been diverted from the central task
designing. While this is true, this diversion is important
as it sometimes allows the designer to view a broader
picture rather than viewing an immediate problem at hands.

Formalization of the design method widens the
approach to the problem, externalizes design thinking and
encourages the designer to look beyond the first solution
that enters their head. Factors that otherwise may have been
over looked with informal methods are not neglected in a
more structured approach. Externalization is the process of
transferring thoughts onto paper which is done in a number
of ways such as creating charts and diagrams.

Cross (1994) suggests that all of this frees the
designers mind from the complexities of the design to allow
more intuitive and imaginative thinking. Using design
techniques also reduces the size of mental steps, prompts
inventive steps, reduces the chances of overlooking them,
and generates design philosophies for the problem in
question (French 1971).

Perspective of J.L. Peterson investigated in hospital
beds of the type to which this invention relates, the bed
spring is adjustable in two ways. First, the head of the bed
spring may be raised upwardly so the whole head end
portion of the bed is raised to lift the upper part of the
patient’s body above a horizontal position and there is
shown an arrangement in which a hydraulic pump supplies
hydraulic fluid pressure to two separate hydraulic cylinders
for individually operating the bed spring. In the control of
these hydraulic cylinders, it is necessary, first, that all
controls be conveniently accessible to a patient in the bed
and, secondly, that the movements of the bed be effected
only when the patient desires them in its two above-described
movements.

Perspective of Catalano Coolidge developed
automated bed control system using screw jack mechanism
along with slider crank lifting device. Here the form of motor
get actuated and transmitted through the screw jack. Both
the motor and screw jack are coupled so that the power is
equally transmitted, henceforth power is generated to the
back rest by a means of slider lift mechanism this forces the
swiping motion.

Perspective of Stryker Medical’s Stryker Medical
has been producing beds for intensive care units for over
sixty years. Stryker’s first major design was known as the
Wedge Turning Frame and was developed in 1939. This bed
allowed nurses to easily turn their patients and help elevate
bed sores caused by long periods of immobility. Stryker
continues to design beds based on ease of use to allow
nurses to focus less on the beds and more on patient care.
The current design by Stryker for Intensive Care Units is the
Epic II.

Perspective of Hill-Rom the Total Care ICU bed
provides not only stability and easy to use controls for the
patient but is also built to satisfy the needs of patient
caregivers. The bed reduces the amount of stress on the
caregivers’ backs when transferring patients from the bed.
The bed provides other capabilities such as an overriding
feature for CPR which, by the press of a button, overrides all
manual and automatic controls to immediately put the bed
into a position convenient for resuscitation in case of
emergency.

C. Problem Statement

When using a hydraulic system Abnormal noise in hydraulic
systems is often caused by aeration or cavitation. Aeration
occurs when air contaminates the hydraulic fluid. Air in the
hydraulic fluid makes an alarming banging or knocking
noise when it compresses and decompresses, as it circulates
through the system. Other symptoms include foaming of the
fluid and erratic actuator movement. Aeration accelerates
degradation of the fluid and causes damage to system
components through loss of lubrication, overheating and
burning of seals. When using spring system it possess
certain vibration while the back rest is exerted. If in turn
occurs any fault while compression and expansion it
evaluates large disaster. (ie) when the sudden load applied on
the motor rpm of the motor rises this in turn produces
certain vibration in spring thereby undergo certain
dislocation in bed arrangement.

III. Objectives

The overall aim of our project was to:

- To analyze all existing bed products and to determine
  the highest quality in relationship to price.
- To produce the highest quality beds -Fabricate our own
design.
- Instead of using existing mechanism we have
determined Rack and Pinion to generate to and fro
motion. From this to and fro motion the swiping
motion is adopted using a form of linkage mechanism.
- To manufacture a prototype of our bed alterations.
- To create standard quality bed.
- To manufacture a prototype of our bed alterations.
- To produce the highest quality beds -Fabricate our own
design not in exist.
- To promote future scope by undergoing certain alteration.
- To increase the comforts of patients.
- To reduce the usage of electronic circuits and also to indulge the mechanism by using the form of mechanical components.
- To reduce the certain slippages whereas the component accelerated.

IV. EXPERIMENTAL DETAILS

A. Rack and Pinion

![Fig. 2: Rack and pinion](image)

B. Wheel

![Fig. 3: Wheel](image)

Circular component indented to rotate. Used For transportation of bed and other components from one place to another thereby the wheels are connected by a means of wheel axle so that equal speed and weight are transferred throughout the system.

C. Structure Wheel

![Fig. 4: Structure wheel](image)

Main Constituent of structure wheel is that it can rotate full revolution upto 360 degree this wheels are hard and made of certain form of composites. In the structure wheel at the top end they are actuated by a means of ball assembly so that capability to move free inside the system.

D. Frame set

![Fig. 5: Frame set](image)

It is the component which bears the entire body weight. It occupies and they are joined by means of welding.

E. Slotter along with roller

![Fig. 6: Slotter long with roller](image)

This enact the links to actuate, they are just kept behind the back rest of the frame to balance the weight. They promotes the way of undergoing swiping motion.

F. Link Actuation

![Fig. 7: Link actuation](image)

Linkages are generally a collection of interconnected components Based on the specification they are used for actuating the system. 4R links are used for performing the actuation such as compression and rarefaction which is connected to rack.

V. DESIGN AND FABRICATION

From our area of project we have adopted Design and fabricated the product according to the design and certain gear ratio calculations are made. Design aspects are done by using auto cad and solid works.
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(IJSRD/Vol. 4/Issue 02/2016/169)

Fig. 8: Isometric view automatic bed control system

Fig. 9: Side view of automatic bed control system

Fig. 10: Lifting section by back rest

Fig. 11: Wire frame model of automated bed control system

It shows schematic diagram of the automatic bed control system is represented in the mechanism of mechanical dynamic motion. This hospital bed was designed based on the comfort of patient in which attain the motion for elsewhere. The bed system is adopted for patient to move one place to another place without any human being help to anywhere. It is simply designed in the system is fully based on mechanical linking mechanism. Many authors were found the hospital bed system such as electronically based to produce and selling in the market. But as per our authors concern maximum contribution of actuation movement is relevant to mechanical.

The bed system is newly developed by adopted in linkage mechanism with help of movement to the bed control system. This system is automatically movement in each component with help of motor power. The power will transmitted to rack and pinion in addition to that transmitting power controlled from compound gear mechanism. The rack and pinion is to transverse motion to action on the roller over the slotter. Mainly, the linkages should move on slottor, the back rest portion will adjust based on the transverse motion.

Many hospital beds actuating system movement with help of hydraulic system is discovered from hospitals for used in patient. Now, the current authors determined the problem from exiting system such as noise, quick action etc. Based on the problem the authors replaced hydraulic to linkage mechanism were used to bed system for improving the efficiency of the bed system. The summary of our project is at first the selection of materials as required and then appropriate frame for the construction of hospital bed is manipulated. Motor is adjusted by imparting slots so that it can be adjusted thereby followed by rack and pinion, next to compound gear mechanism, so that speed can be reduced by the form of gear ratio. The motor is actuated by means of control switch (ie)both the clockwise and anticlockwise movement is occurred so that movement is transferred to the rack and pinion which in turn posses rotational motion into a form of to and fro motion. Rack and pinion is coupled by means of universal joint from this system followed by means of linkage along with channel slots, the frame is mainly split into two parts the main part is backrest the power is transferred to the backrest to evaluate swiping motion. It is accompanied by means of linkage actuation, (ie)when the motor is in forward rotation rack forces to move front it forces the linkage to produce up thrust force this provide the backrest to force upward the same system is accompanied when motor is reversed rack get retarded this forces the compressive force in links thereby backrest brought it original position is obtained. Back flow is arrested by means of a stopper.

VI. CONCLUSION

The project is concluded that mostly the hospital beds manufactured in modern traits are using 60-70% of electronic circuits usually in the form of boards. The authors have surveyed various hospital beds and also evolved a certain mechanisms which are already in exist. The developing a new mechanism and also to produce cheaper quality bed that going to produce there by selected rack and pinion to produce to and fro and thereby channel along with slottor accompanied by links to manipulate swiping motion. we experimented in implementing a new mechanism and made it as a prototype while implementing the product is captivate some flaws but finally at exist has been developed Automated bed control for patients (product) into a grant success according to the patient convenience, and also gathered some experience and knowledge in working certain machines and formulated certain innovative ideas and deliberate the ideas into an action.
REFERENCES


[16] JL Peterson in (2001) have invented automated bed control by using hydraulic system