Design of Automatic Multipurpose Bed for Paralytic attacked, differently – abled and elderly persons

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ABSTRACT:

An automatic bed has been developed for specially cared persons, including elders, differently-abled and paralytic attacked individuals, that can be converted into wheel chair and vise versa. This help them to improve their mobility and activities like sitting, moving to different places across the bed room autonomously and retiring at bed without anyone's assistance. The automatic bed cum wheel chair also ensures safety and gives a new meaning of their survival to lead an autonomous routine life, by increasing confidence level within them to act independently. This device is designed not only to facilitate the displacement of enabling cared people at ease, but also to make them feel confident of operating at ease enabling their self confidence to be in place.

Keywords: *Automatic bed, wheel chair, Arduino UNO, physically abled, elderly persons*

1. INTRODUCTION:

Many a times, the specially cared persons including paralytic affected, differently-abled and elderly persons struggle to be mobile like others, which case they would require a secondary attendant assistance every time. It is a challenging task for them to get relocated from the wheel chair to the bed, every time when they want to retire. It would be better if these specially cared persons have been privileged to operate at ease the wheel chair and also the bed, without expecting or feel like disturbing others to help them.

This invention accomplishes the task of providing such patients with mobility by the use of a bed cum wheel chair which is inter-convert able between its two transformation states-bed and a mobile wheel chair with the help of a switch provided.

The Wheel Chair can be used for locomotion independently by the patients since it is powered by electric motors and the direction of motion can be controlled by the help of joy-stick provided.

Since the invention is intended basically for paralytic attacked differently-abled and elderly patients, it also compromises of various health monitoring systems such as Heart Rate Monitoring and Body Temperature Monitoring facilities. When any abnormal conditions are observed by these monitoring systems, the care taker(s) is/are intimated or notified via SMS (Short Message Service) who can rush to the patients for aid.

The invention also incorporates pressure sore prevention mechanism which prevents any sores that could prevail because of continuous usage of this invention. Hence the invention can be used 24/7 without any sores/injuries.

Thus this invention provides maximum comfort to the patients and provides the means through which the patient can independently carry out their daily tasks without the need for any special care taker(s).

Piazza [1] has invented mechanically operated bed-chair device such as may be readily adapted alternatively to either bed or wheelchair use while being occupied by the patient. A convertible bed-chair structure comprising three bed frame-mattress units dimensioned to be disposed in end-to-end relation to provide a single bed with the center unit of said structure disposed under the pelvic portion of a recumbent patient, means for detachably interconnecting said units' in rigid bed form, said center unit having a two-piece mattress cooperating to provide a seat cushion and a back rest for the patient when seated upon said seat cushion. With his legs hanging over the side thereof, hinged frame will be movable to support said back rest in patient sitting position, arm-rest will be normally hanging below said frame and swingable into upright standing positions at opposite sides of unit to provide arm-rest. Latch devices carried by arm-rests and detachably engageable with back-rest support to maintain arm-rest and back-rest in patient sitting attitudes, and positionally adjustable foot-rest devices suspending from said frame to support the patient’s feet when in seated position.

Hiroshi [2] has designed multifunctional bed in which a variable bed that can be changed into a wheelchair form is fitted in a U-shaped fixed bed, when a seat back portion of the variable bed is laid or raised, the variable bed may assume an unstable position, thus hindering a smooth form change. The present multifunctional bed

comprising a variable bed that can be changed into a wheelchair form and a fixed bed in which the variable bed can be removably fitted, wherein a holding member is provided between the fixed bed and the variable bed, for holding a vertical position of the variable bed relative to the fixed bed, and the holding member comprises a vertical pair of guide rails, disposed on a left and right inner side surfaces of a notched recess portion of the fixed bed formed so as to appear substantially U-shaped, and guide rollers, disposed on both sides of a seat back portion of the variable bed.

Bed and mattress having a retractable foot section [3] invention relates generally to adjustable beds and more specifically to a bed having an improved adjustable foot section. There are many known bed designs that have adjustable foot sections. On beds that convert from a planar bed configuration to an upright chair configuration, the foot section is generally shortened as the foot section rotates from a horizontal to a vertical position. There are also beds having adjustable lengths wherein an attendant physically repositions the head or foot section of the bed to the desired length. These designs include a sliding telescopic foot section as well as a folding foot section equivalent to a “lazy boy” design. It is also known to deflate the foot section of the mattress when converting from a bed to a chair. For short occupants, there exists a need for adjustment of the foot prop or board in the chair position shorter than that attended by adjusting the length of the foot section.

Cleveland [4] has invented the convertible wheelchair includes a seat and a plurality of chair legs extending downward from the seat. Each leg includes a wheel to permit movement of the convertible wheelchair. A reclining backrest is pivotally mounted to the back of the wheelchair, which provides a flat, horizontal surface for a user to rest thereon. Both the seat and the back rest include a pair of panels selectively extendable towards the lateral side in order to form a bed. In this configuration, a caregiver can easily maneuver the user into any position required for ablutions and lavatory functions. Each panel and the handlebars on the backrest may include extendable legs to stabilize the bed.

Karwal [5] has developed a versatile patient care and transport assembly having a patient support frame constructed of multiple sections, each including pluralities of individual patient sensors, and which can be cooperatively tilted or otherwise inter-articulated to a variety of support positions. Pull-out/expandable side and end railings are provided for patient safety. Power and drive components are incorporated into a base module upon which the patient support module is mounted in multiple elevation

and/or articulating fashion. Also provided is paired side-by side docking of two identical assemblies such as for facilitating patient transfer and in order to drastically reduce the risks associated with handling of patients by caregivers.

Prassler et al [6] developed a robotics wheelchair for elderly and disabled persons, to support and transport people with limited motion skills. It is based on a commercial wheelchair that has been equipped with an intelligent control and navigation system. Conversations with disabled and elderly people and with their physicians indicate that the automatic functions desired in a robotic wheelchair do not include following walls or passing doorways, but do include navigation in narrow, cluttered environments and through wide, crowded areas.

João Fernandes and Costa Branco [7] developed a shell-like spherical induction motor for low-speed traction in wheel chair. Electromechanical characteristics of a novel shell-like spherical induction machine with multiple degrees-of-freedom (DOF), formed by a shell stator and a spherical hollow rotor. The shell-like induction machine is evaluated using n-harmonic analytical models for its electromechanical characteristics. The electromechanical model includes the distribution of the copper windings in the stator slots, incorporating the currents harmonic content to describe its spatial distribution. The distribution of the magnetic potential vector and the components of the magnetic flux density are computed using the real source-current distribution. The authors have developed small prototype was built to validate the analytical model. Experimental tests were done to the magnetic flux density and the torque. The shell-like induction motor is concretized as traction motor in an electric wheel-chair.

Jiajun Shen et al [8] developed a low-cost tele-presence wheelchair system based on tele-presence robot, intelligent wheelchair, and touch screen technologies. The tele-presence wheelchair system consists of a commercial electric wheelchair, an add-on tele-presence interaction module, and a touchable live video image based user interface (called TIUI). The tele-presence interaction module is used to provide video-chatting for an elderly or disabled person with the family members or caregivers, and also captures the live video of an environment for tele-operation and semi-autonomous navigation. The user interface developed in lab allows an operator to access the system anywhere and directly touch the live video image of the wheelchair to push it as if he/she did it in the presence.

Jin-Woo Jung and Jun-Hyeong [9] developed an advanced robotic residence for the elderly/the handicapped people. This work focuses on human-friendly technical solutions for motion/mobility assistance, health monitoring, and advanced human-machine interfaces that provide easy control of both assistive devices and home-installed appliances. Mechatronic transfer robot was developed to improve the inhabitant's comfort, an intelligent bed, and intelligent wheelchair. Various interfaces based on hand gestures and voice, and health monitoring system.

Kalpana and Madhe [10] proposed an automatic bed position control system for disabled patients in which added two more movements to the existing electronic bed systems (Left and Right) movement of the bed based on different hand gestures. A particular gesture input is given by the patient to the system, and then this gesture is given to the micro-controller via RS-232 communication cable. The micro-controller further processes this input from the system and changes the position of the bed automatically with the help of DC motors and the accelerometer is used as a sensor to detect and display the patient fall.

Siddharth and Deshpande [11] designed a Smart Wheel-Chair (SWC) controlled by RTOS as its core operating system. It consists of a touch-screen based navigation system along with accident prevention and fall detection. A semi-automatic vision function, heart rate sensors and physiological stress sensors have been integrated. GPRS system is used for location determination and GSM is used to communicate in those cases where certain abnormal events like falling, accident or health issues are trigged. The real-time interaction functions are designed with the motive to make the user operating the wheel-chair completely self-dependent and his interaction with the environment can be like of a normal person.

Avutu et al [12] designed a low-cost manual cum electric-powered wheelchair for disabled person's to use in indoor. Mechanical lever and gear box system were used in this wheel chair. The lever was used to change mode of operation and the gear box system is used, to establish the contact between wheels of the wheel chair and two DC motors. The calculated result shows the robustness of the manual cum powered wheelchair design. The proposed wheelchair improved the quality of the life of the elderly people and those with disabilities.

Megalingam et al [13] designed an automated voice based home navigation system for the elderly and the physically challenged person. The voice of the person was detected by voice capture module which will be compared by voice recognition

module with predefined voices loaded in to the system. According to the received voice, the destination is automatically understood and the wheelchair moves according to the route which is predefined. It is also equipped with obstacle avoidance technique, where the person may not be able to provide proper voices at the right time. The wheel chair can automatically navigate from one point to the other in the home as per predefined route based on the voice received. Thus the above proposed system can be used by elderly and physically challenged people in day to day life even if they are alone at home.

Rathore et al [14] designed an intelligent wheelchair which can assist physically handicapped, visually impaired as well as elderly people. It consists of a navigation system which makes use of accelerometer and magnetometer, the system contains a navigation pad which can be held in hand or tied to the head for navigating the chair. It also has obstacle avoidance system comprising of four ultrasonic sensors, real time location tracking system which makes use of RFID for tracking the chair inside a building and voice guidance system to assist the visually impaired.

2. OBJECTIVES

- To develop an automatic bed cum wheel chair that can be easily dismantled from the fixed structure of bed and move anywhere.
- To model the wheel chair that can be folded, expanded, moved and fit to bed.
- To design the control system to take care of the mobility, wheeling positions, seating positions.
- To develop an indigenous product for the specially cared persons, which could be operated at ease.

3. DESIGN OF MULTIPURPOSE BED CUM WHEEL CHAIR:

The Frame used in wheel chair is shown in Fig.1 which is made up of mild steel. It is designed to carry a pay load of 120 kg.

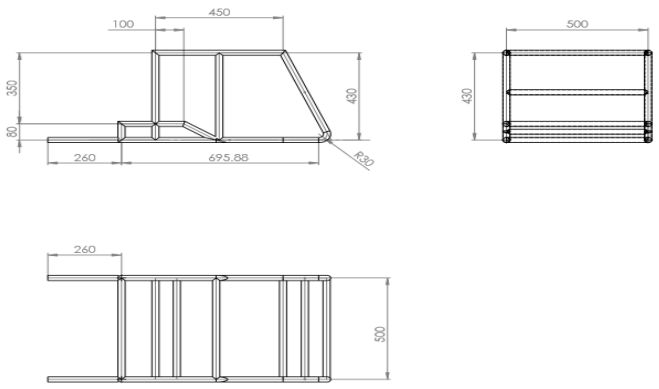

Fig.1 Orthographic view of frame

The back rest is used to provide comfort to the patients when the bed is converted into wheel chair. The orthographic view of back rest is shown in Fig.2.

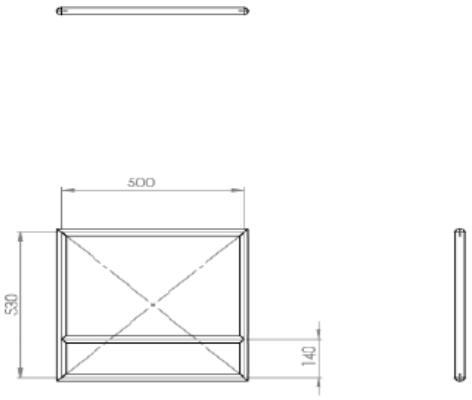

Fig.2 Orthographic view of back rest

Fig.3 shows the orthographic view of leg rest used in wheel chair. It is used to connect the seating part and foot rest of the wheel chair.

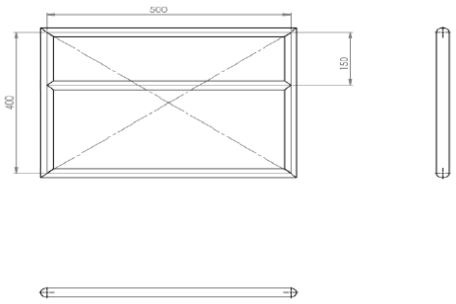

Fig.3 Orthographic view of leg rest

Foot rest is used in wheel chair to provide comfort to the users. Fig.4 shows the orthographic view of foot rest used in wheel chair.

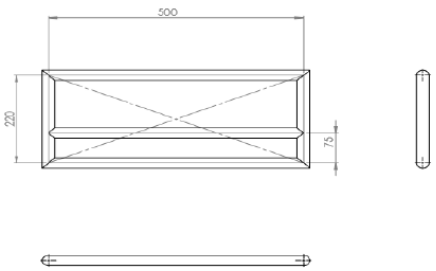

Fig.4 Orthographic view of foot rest

Fig.5 shows the assembly of automated wheel chair used in multipurpose bed for paralytic attacked and elderly persons.

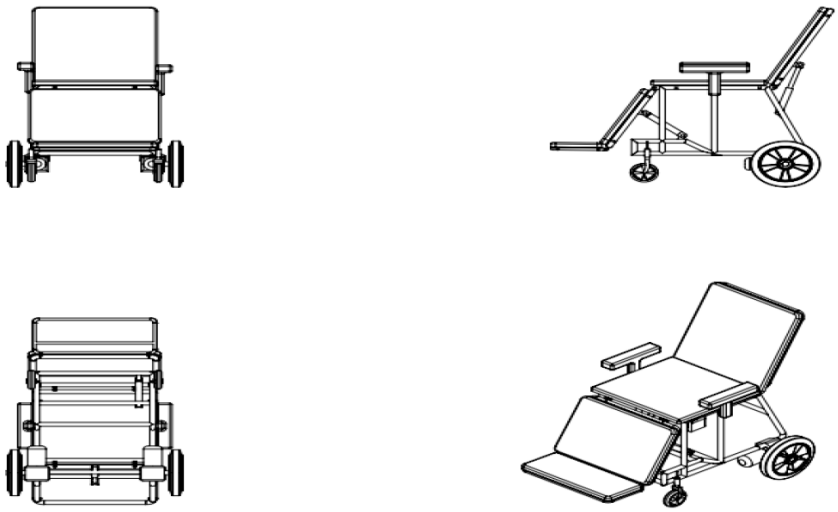

Fig.5 Assembly of automated multipurpose wheel chair

4. ELECTRICAL CIRCUIT:

Fig.6 shows the electrical block diagram used in multipurpose bed for paralytic attacked and elderly persons. It consists of an Arduino UNO development board used to control the movement of wheel chair. It also used to send SMS to the care taker in case of an emergency. It is also connected to temperature sensor and pulse rate monitoring sensor in order to monitor the health of patients.

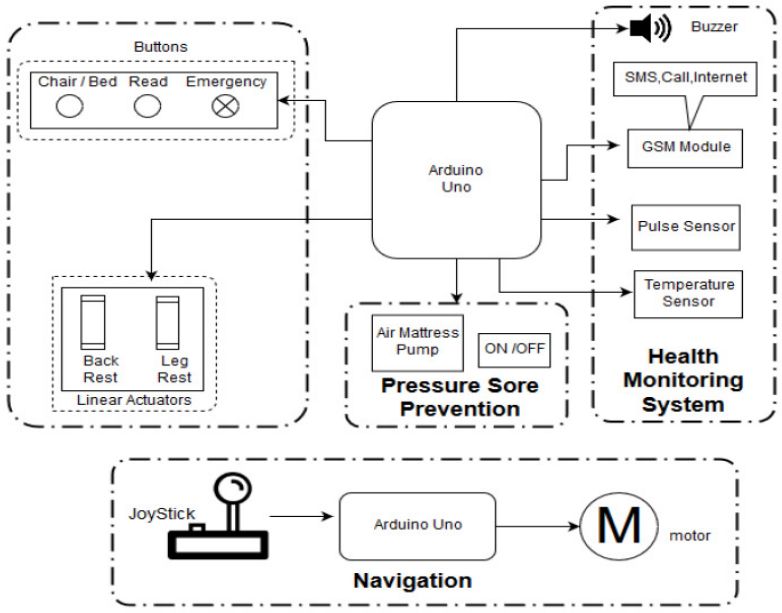

Fig.6 Electrical circuit for automatic multipurpose bed cum wheel chair

5. WORKING PRINCIPLE:

The multipurpose bed cum wheel chair is shown in Fig.7. The invention provides best comfort to the specially cared persons through its ergonomic design. The unique design provides better stability even when used in abnormal paths. Mild Steel has been used for the fabrication of the frame because of its optimum tensile strength, low cost and customizable properties. The pressurized sore prevention system enables the user to be seated with optimum comforts even upon continuous usage. The inter conversion between a chair and a bed is controlled by a simple electronic switch which provides signal to the development board (Arduino UNO) which in turn actuates the linear actuators through a relay system. The locomotion of the whole system is provided by two permanent magnet DC motors of each 180W power which are powered by a 24V battery system. Moreover, the speed at which the system moves is 5 – 6 km/hr which is the average walking speed of humans. The direction of locomotion is provided by the signals from the joystick which is easily accessible on the right hand side of the system.

When the system is used as a chair there may be in need of a hand rest and when used as a bed the hand rest is no longer needed as it has a fixed part which can be combined with the moving system which provides a better and efficient way for hibernation.

The hand rest can be triggered by the use of another switch which again sends a different signal to the development board (Arduino UNO) which in turn actuates a stepper motor whose clockwise motion pulls the hand rest down with the help of helical threading in its extended shaft and vice versa. The stepper motor is driven by a stepper motor driver (Model: TB6600w) which receives signals from the development board (Arduino UNO) and drives the stepper motor either clockwise or anti-clockwise.

There is also an emergency switch which when triggered sends a Short Message Service (SMS) to one or more of the care takers of the specially cared persons. This is facilitated by a GSM modem (SIM900A) which in turn is controlled by the development board (Arduino UNO).

The presence of health monitoring systems such as temperature and pulse monitoring sensors provides live health monitoring values which may be viewed by the caretaker anytime. The system also triggers alert notifications to the care taker when any of these monitored values becomes abnormal.

6. CONCLUSION:

This Invention is cost effective compared to other existing models. It helps the specially cared persons, including elders, differently-abled and paralytic attacked individuals to move independently without the help of others. The mechanism used here makes the person so comfort without causing any problems to the individuals such as blood sore. It makes the person to feel like living more independently without the help of others. As it is a bed cum wheel chair, it can be converted into bed as well as chair and all these process are automatic which can be controlled using buttons in the hand rest of the wheel chair. So it does not require the help of other person to convert it into bed as well as chair. The fixed bed offers an extra space to the specially cared persons while sleeping as the space in the wheel chair may not be sufficient. This invention bridges the gap between the work done by a differently abled and a normal Human with no disabilities.Thus this invention helps the differently abled feel in such a way that of Normal Human and helps them carry out various daily activities.

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Conflict of Interest: The authors declare that they have no conflict of interest.

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