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Automated Medical Bed Chair

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Abstract*—The very concept of Engineering is to simplify processes in life thereby improving human life standards and even more, when a person becomes physically challenged. This Project is centered on enabling a patient's (elderly person a deformed person) mobility like sitting, reclining and sleeping, when seated on the perform basic Convertible Chair Bed, without relying on another person or without giving any stress to the patient. The Convertible Chair Bed is specifically designed keeping in mind the patient who is unable to even move around, within his own residence. The product is dimensioned in such a way that he can have access to any part of his/her place of stay with the minimum help of another person. The added special feature of the Convertible Chair Bed is that it can be easily stackable one into another thereby occupying very less space when compared to any other traditional Chair Beds. Because of this facility, old age homes, hospitals and service organizations can store more Convertible Chair Beds and provide better amenities to the needy. The Convertible Chair Beds are mounted on castor wheels with braking facility keeping in mind the safety of the patient. The mobility of the Convertible Chair Bed is facilitated using electric linear actuators because of their silent and smooth movements. The control system in the unit makes it possible to operate these actuators wirelessly using any sort of handheld or portable remote.*
Keywords*: physically challenged, convertible, stackable, linear actuators, portable, remote.*

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I. INTRODUCTION

With time comes senescence, and as more number of people go into old age, better medical facilities need to be available at regular times. A multiutility hospital bed is one of vital importance for people suffering from immobility and lack of posture. This multi-utility bed consists of multiple features, the two most essential features being the ability to adjust the backrest and the ability to inhibit mobility. Both go side-by-side, as these are common movements that old people are incapable of performing at an average age of 60.Any person with grandparents may have noticed that once they recline (or) lie down, it's a cumbersome task to get up once again. This bed is a solution to that problem. The second feature stated, is the lack of mobility (or) immobility among old people. To tend to this feature, this bed can be converted to a chair and since wheels are provided it takes up the work of a wheel chair (i.e) the person can be moved around. All these features in the present day might sound expensive. This is mainly where the multi-utility hospitality bed differs from other beds i.e. in terms of being cheap. The multi-utility bed has been fabricated from the most cheap and sustainable material as possible, such that any person whether geriatric or not can use it.

1.1 Background work

Todd RH [1] in his reference guide we could derive and extract the various forms of welding techniques that were carried on our project which helped in the manufacturing process.Arc welding was greatly used for the joints of different parts in the project.

Colvin F H [2] helped in assembling the jig and fixture placement which was set as a foundation and clamp hold for the manufacturing process.

The design and development of conceptual wheelchair cum stretcher from SASTECH volume 10 written by CS Gopinath [3] made us understand and gave an impact on the need of a convertible wheelchair cum bed which would serve as a dual purpose medical chair.

In the International Journal of Engineering and Innovative Technology, Tokishiro [4] Yukawa highlights the ideas on how to reduce manual control of wheel chairs by implementing electric drives and power systems.

Various other books and journals helped in minimalizing the cost and enabled in implementing automizing techniques which would bring in lot simpler control.Also certain references helped us on implementing stackability and good portability to the chair.

II. Proposed System

The course of our work begins with the planning phase involving initial research, literature survey and background study. It is followed by concept generation phase that includes evaluating existing wheel chair, customer requirements and concept designs. Prototyping the wheelchair into complete bed using actuator system by means of 2-5 bar pressure and we progress towards testing a feasible model. Collection of all the equipment's and materials required for overall wheel chair cum bed enhancement setup.Forming of a light weight wheel chair cum bed structure which would carry up to 100- 150 kg. Successfully coding of a specific program, which would run the device directionally by using mobile control application, and head motion. Implementation and connection of all the equipments like linear actuators, micro-controller, relay switch, and other sensors together. Implementation of Linear actuators, would convert the Wheel chair into Bed and lifts the wheel chair into adjustable height. The device consists of an embedded microcontroller which acts as a brain of thesystem and controls the actuator through wireless means. It processes the commands based on how it is pre-programmed and the whole system drives power from a rechargeable battery of 12V with a current rating of 7 Ampere-hour. The system contains relays which will control the motion of the actuators through which the wheel chair will be controlled as well makes appropriate decisions.

III. Construction and testing of the bed chair

3.1 Construction of Bed chair

1. Designing the skeleton of the project by implementing cost effectiveness, stackability, and portability (knock down).
2. Fabricating the designed framework in a dismantlable way using the required machinery and tools.
3. Positioning and fixing the Actuators, Microcontroller and battery to the fabricated and assembled framework.
4. Checking for project failures or further improvements needed by running test trials.
5. Spray painting for the fabricated part and any fine tuning and arrangements if required
6. Applying the furniture and final physical testing with human subject.

Fig 3.1: Construction

3.2Testing of Bed chair

Different forms of testing were made with the patient on the bed chair and also certain forms of testing were made using the Ansys software with which we could find the stress test and deformation test.

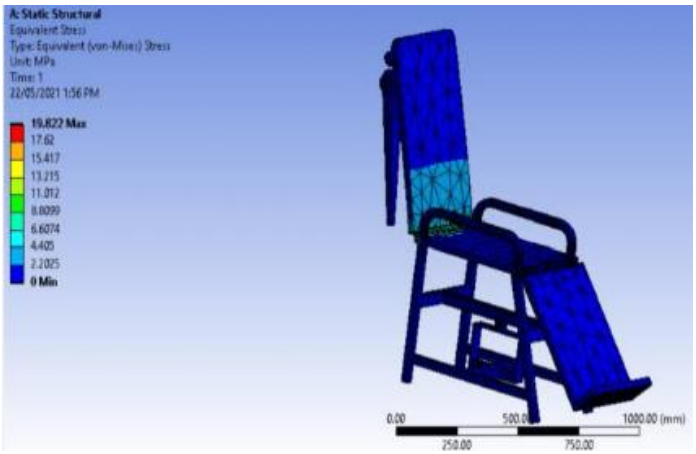

Fig 3.2: Stress Test

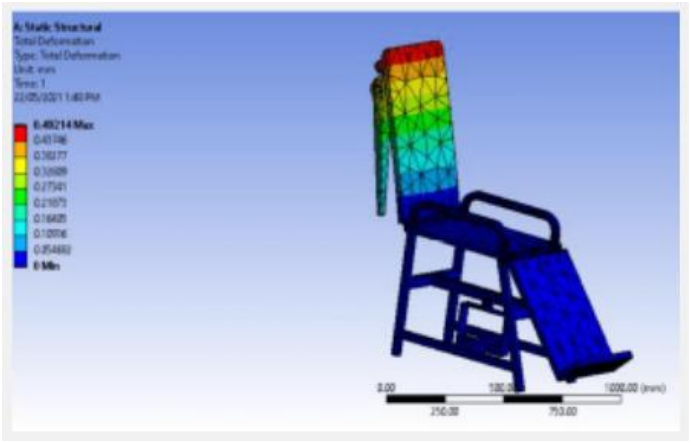

Fig 3.3: Deformation Test

IV. AUTOMIZING THE BED CHAIR

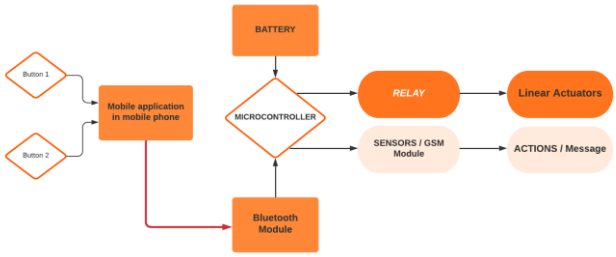

Fig 4.1: Block diagram of proposed automation

4.1 Application Used

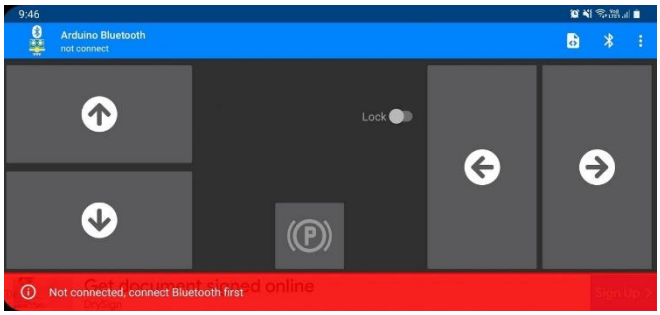

Fig 4.2: Application used

We needed an application that could communicate via bluetooth transmission after pairing with the bluetoothreciever (HC-05 Bluetooth module). The application required 4 buttons basically to control the actuators of the head part and the actuators of the leg part. Hence the command characters were assigned according to the need. The button features could be altered with a gyro control, voice control or any other control methods once the command characters are assigned to each button or action of the control.

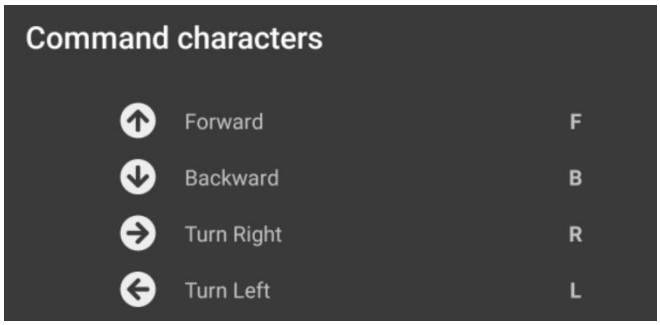

Fig 4.3: Command characters

4.2 Coding

Since the base microcontroller used for the project was Arduino, we had created the program using C language.It first included a bluetooth module file to detect the bluetooth. Then we introdced the pins for the microcontroller to be powerd. Then the command characters were assigned based on the action key and finally the delay was set.

```
l298N §
char t;

void setup() {
pinMode(13,OUTPUT);
pinMode(12,OUTPUT);
pinMode(11,OUTPUT);
pinMode(10,OUTPUT);
Serial.begin(9600);

}

void loop() {
if(Serial.available()){
  t = Serial.read();
  Serial.println(t);
}

if(t == 'F'){            //Actuator 1 up
  digitalWrite(13,HIGH);
}

else if(t == 'B'){      //Actuator 1 down
  digitalWrite(12,HIGH);
}

else if(t == 'L'){      //Actuator 2 down
  digitalWrite(11,HIGH);
}

else if(t == 'R'){      //Actuator 2 up
  digitalWrite(10,HIGH);
}

else if(t == 'S'){      //STOP (all motors stop)
  digitalWrite(13,LOW);
  digitalWrite(12,LOW);
  digitalWrite(11,LOW);
  digitalWrite(10,LOW);
}
delay(100);
}
```

Fig 4.4: C coding for Arduino

4.3 Wiring and Connections

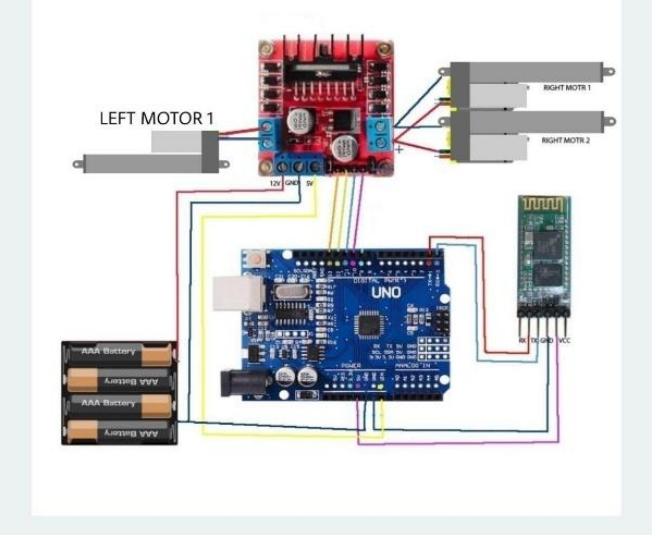

Fig 4.4: Wiring Diagram

The above diagram shows how the connections are made for the working of the chair. The battery requires enough power to run a 24v dc actuator and at the same time provide the required power for the H bridge and the arduino. The battery can also be replaced with a direct power supply.

V. CONCLUSION AND FUTURE SCOPE

This journal deals with the design, fabrication and automation of multiple utility hospital beds. The project is carried out by us in collaboration with a company. It is very useful in hospitals and at homes. For the further development of the project, few sensors and a hub motor connected to the wheels can be included on the project which allows to monitor the patient and also to control the movement of the bed chair around its path.

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