Design and Fabrication of IoT Enabled Wheelchair cum Stretcher with Home Automation and Patient Monitoring System

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ABSTRACT

The proposed project was aimed at designing and fabricating a wheelchair cum stretcher that can overcome the shortcomings of a conventional wheelchair, with focus on cost effectiveness and utility. This project will eliminate the use of a separate wheelchair and stretcher in hospitals. The proposed idea describes the wheelchair, which can transform itself into a semi- chair and stretcher and the mobility of the wheelchair positions are made with the help of knob without any assistance. In addition to it, the proposed project has the IoT enabled home automation to control the household devices and patient monitoring system for regularly monitoring the health of patients at home.

KEYWORDS: Hospital, Motor, Patient, Stretcher, Wheelchair, Worm gear

Abbriviations – DC, Direct current; Wi-Fi, Wireless fidelity; NodeMCU, Node MicroController Unit; MB, Megabyte; KB, Kilobyte.

I. INTRODUCTION

In India the number of disabled populations had a tremendous augment in the past few years. According to the survey conducted by government of India, it has been calculated that 6,105,477 of the total population of 1,028,610,328 people [1] are disabled with movement impairment which account for about 0.6% of the total. Enormous amount of people has congenital disabilities, another few percentage are the victim of accidents and various kind of mobility devices are inevitable part of their life. [1] The problem of transferring patients exists from ancient times. In hospitals, for the treatment of patients they have to be shifted from wheelchair to stretcher, stretcher to bed, and bed to wheel chair and vice versa which creates unsafe conditions for patients. Another major problem is that it causes unsafe conditions not only to the patients but also to the people who help them. Though we have evolved in the field of healthcare and technology we are not yet able to address the problem efficiently.

Studies also showed that more than 40% of the helpers who helped physically challenged people for transferring them for treatment are suffering from problems like Disc herniation, IT Band Syndrome, Achilles tendonitis; SLAP tear which even risks the life of few people

In addition to this the growing old age population coupled with various ailments, increases the requirement for these movement assisted devices. Besides these the problems faced by various bed ridden patients while resting on these devices may lead to various disease conditions such as pressure ulcer or otherwise known as decubitus ulcer in medical field [2].

Studies have also shown that prolonged sitting in a wheelchair can cause lower body swelling, venous pressure, abnormal spinal curvature as well as in vital organ damage.

II. PURPOSE OF THE PROJECT

The Wheel chair cum stretcher with patient monitoring and home automation has been proposed mainly to eliminate the medical complications that are caused while transferring the patient from wheel chair to stretcher, stretcher to bed and vice versa.

The proposed project has three main purposes:
1. Used for elderly and disabled people in home.
2. Used in hospitals for transferring patients.
3. Used in ambulances for the movement of the patients in a convenient manner and to send a vital detail of the patient before the patient reach the hospital.

A. Used for Elderly and Disabled People in Home

The wheel chair cum stretcher is developed in such a way that it can operate in three positions which will be a greatest asset to the elderly and disabled people in home. It can be operated by the patients without any assistance and it also plays a major role in monitoring their medical parameters and also used to access the home appliances independently by using patient monitoring and home automation.

According to the analysis more than 50 million adults and 300,000 children have many types of arthritis. It is most common among women and occurs more frequently as people get older.

[3] The severe arthritis can result inability to daily activities and make it difficult to walk. To reduce the difficulties faced by the people affected by arthritis, wheelchair with three positions is developed.

The proposed project is also useful for the people affected by the diseases and disorders like
1. Guillain-Barre syndrome.
2. Non traumatic spinal cord compression.
3. Mentally disabled people.

The main advantages are it will monitor the vital details of the patient for every second and the data will be collected from their respective homes and stored for the references of the doctor to analyze the health condition of the patient.

B. Used in hospitals for transferring patients

The developed model will play an impeccable position in hospitals hence it is used for shifting the patient from wheelchair to stretcher, stretcher to bed, bed to wheelchair and vice versa without any assistance. The shifting process will be easier and it will provide an injury free transportation of the patients. The attenders who are helping the patient for shifting from one ward to another, i.e. those who help in the mobility of the patients are affected by some physical problems like disc herniation, IT band syndrome, Achilles tendonitis. To overcome these issues, we can use the proposed project.

C. Used in ambulances for the movement of the patients in a convinient manner and to send vital details of the patients before the patient reach hospital

In this, mechanical operation of the proposed project plays a major role, the people who met with an accident may get fractured or may get injured severely, when the injured person is in unconscious state, the person who is handling the injured one, don't know where they are injured and fractured, so their handling towards the affected person may cause more injury over an affected part, it will leads to a breakage of bones. To overcome these risk factors, the proposed project is developed with three locked positions chair, semi chair and stretcher. The three positions are controlled by knob will avoid the transferring or shifting of the patient from one position to other.

The advantage of the proposed project is that the patient monitoring fixed in the wheel chair will collect the vital details of the injured person and will send the collected data to the hospitals before the ambulance reaches the hospital.

This will enable the doctors to analyze about the health conditions of the injured person or patient in advance, so the doctors with the help of the details obtained, they will set up all the necessary requirements for the treatment process before the patients reach the hospitals. Due to this feature, the death rates can be exponentially reduced.

III. PRINCIPAL OF WORKING

The proposed project consists of both hardware and software implementations.

3.1. Hardware Implementation:

The basic model of the wheelchairs which are used in the Indian hospitals is the base of the proposed model. The wheelchairs can be restructured in a way that it could operate in the following three positions.
➤ Wheelchair Position
➤ Semi-chair Position
➤ Stretcher Position

3.1.1. Worm Gear

Figure 1 shows the worm gear interfaced with DC motor is attached in the construction plays a key role in maintaining the three fixed position. The patients can control the positions of the designed wheelchair with the help of a knob fitted at their arm rest position. The speed controller with the specification 24V and 60Amps is used in the hardware to control and regulate the speed of the motor.

Figure 1: Worm Gear

3.1.2. DC Motor

Figure 2 shows the DC motor is used to make the prototype more cost efficient and it is interfaced with the worm gear to lift a person initially up to 60Kg weight. It can be increased by using a motor with higher torque. The specification of the DC motor is 1000rpm, 50kg Torque and 30Amps.

Figure 2: DC Motor

The supply to the motors is given by two 12V batteries. The mechanism works in such a way that when the knob is rotated, it automatically instructs the speed controller and the motor to change the desired positions.

3.1.3. Speed Controller

Figure 3 shows the DC motor speed controller of specifications 24V and 60Amps is used to control the speed of the motor. In the proposed project requires high torque but while changing the positions from chair to semi-chair or semi-chair to stretcher, it requires slow movement. In order to vary the required positions, the speed of the motor is controlled.

Figure 3: Speed Controller

3.2. Software Implementation

Node-MCU (ESP8266) microcontroller is used for both Patient monitoring and Home automations system. The specification of the Node-MCU is 128KB memory, 4MB storage and XTOS operating system.

3.2.1. Patient Monitoring System:

Figure 4 shows the patient monitoring system is attached with the wheelchair which is used to update the vital parameters of the patients such as the glucose level, Blood pressure, heart rate and temperature to the doctors regularly by storing all the vital data's in the server of the hospital.

Figure 4: Patient monitoring system

The sensors used in the patient monitoring system sends the vital parameters of the patients to the Node-MCU. Those parameters are finally stored in a server with the help of the inbuilt Wi-Fi module in the Node-MCU. If any problem arises with the patients' health, the system will give an alert to the doctors.

3.2.2. Home Automation System

Figure 5 shows the Home automation system is specifically designed for the wheelchair cum stretcher which will be used for the patient and also for the elderly people to operate the electronic appliances at their home without any assistance.

Figure 5: Home Automation System

The Blynk app installed in the smart phone acts as the platform to establish a connection between the home appliances and mobiles. This results in eliminating the need for asking help from other people to operate the home appliances.

IV. OUTPUT

1. Wheel Chair Position

2. Semi-Chair Position

3. Stretcher Position

V. CONCLUSION

In this paper, the proposed model of wheelchair cum stretcher is operated smoothly with the DC motor and the worm gear exactly fixes the required position with the use of knob in the speed controller. Thus, the proposed project is cost efficiency and the home automation and patient monitoring system works effectively in both hospitals and the home of the patients.

VI. FUTURE SCOPE

A. The Solar panel roof can be used as alternative power source and also it can be a protective layer from rain and sun.

B. The wheelchair movement is controlled by combination of head and voice control system.

C. The wheelchair is controlled by electric signal coming from brain, there is a certain potential difference between each neuron such that the neuron emits 0 to 50 HZ electric signal. By interpreting the signal by modulation and demodulation, the wheelchair is controlled.

D. The wheelchair will move to the destination given by the patient by using GPS technology, this technology is currently used in driverless cars in various countries.

Conflict of Interest: The authors confirm that there are no known conflicts of interest associated with this publication of this paper.

VII. REFERENCES

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