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Customized Wheelchair Navigation System

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Abstract— In India, the amount of disabled persons is growing per annum. For persons with disability, special developed aids for mobility are helpful for moving and a substitute for walking particularly within the inside and outside environment also. Wheelchairs and stretchers are generally employed medical equipment for hauling. Especially when a sick person has to shift between beds and wheel chairs, the aiding person will suffers lot due to over-weight, larger height, etc. Realizing the wide-ranging problems within the moving gears and establishing a new design is going to be a benefit for the medical industry for persons with disability. The requirement for a wheelchair based stretcher to help the persons with disability to move and also to supply novel gear to be used within the hospitals and houses. The numbers of persons with disability are rising by various sorts of mishaps are monitored. With subsequent studies, the benefit of requirement for wheelchair associated stretcher was permitted for the Indian hospitals. The currently employed wheelchair based stretcher isn't sufficient to satisfy the patients or old age people's requirement. Hence, we prefer a stretcher which could be operated with the help of electric current and also capable of transforming itself between a wheel chair to stretcher and vise-versa.

Index Terms— Wheel chair, ultrasonic sensor, X- Bee Pro, microcontroller.

I. INTRODUCTION

A wheelchair is a transportation gear equipped with wheels modeled specially for persons with disability. The mechanism is moved by self or through automatic means. Wheelchairs are utilized by the persons for those walking are unfeasible because of some physical issues. Many people are with inherited disabilities, greater than the proportion of the sufferer of mishaps. Mobility wheelers for extreme severe disability or long voyages are employed. To mobilize or to shift a patient from the wheelchair into the stretcher or the other way result in discomfortness.
Using this wheelchair based stretcher a sufferers are made to sit on it and operate it by transforming the wheel chair into stretcher. It will also be convenient for hospital personnel to maneuver a sufferer. An electric module is dedicated to regulate the general movement and operation of stretchable wheelchair. Realizing the different issues with respect to the mobile gear, the better development is going to be a boon for the medical sector and a helping hand for a person with disability. This work is to develop a stretchable wheelchair to shift disables through stairs with self controlled electronic module. The demand today is the controllable stretcher which can be used by patients with disability. It also helps them to walk and to steer using stretchable wheelchairs.

Shifting of disabled persons is tedious process underwent by hospital workers and also by any care taker. This work aims at the development of stretchable wheel chair operated pneumatically. This may mitigate the disadvantage of shifting the disables and to reduce manual effort given by the sufferer when transferred. Usually we need pressure not more than 9 bars which could be supplied by a normal compressor. An arm rest portion is provided with two push buttons. By pressing a button, the chair can be elevated and by switching another push button the wheelchair to stretcher conversion is done. This model is often employed by aged people at houses and also for the disabled persons to shift them in hospitals (Arun Kumar et al. 2017).

Hospital beds are mainly designed to carry a static load of patients and to provide more comfort to them using their ergonomic design. As a result, in the case of bedridden patients, bystanders will have to put in a lot of effort to move the patients to various positions, which are essential for their quick recovery. Patients will also have to be moved to various positions to prevent further complications in their existing medical conditions. There will the side guards in stretchers will hinder during the movement of disabled patients. Power screw mechanism was provided which is operated by an induction motor (single phase) by which the side panel movement was done. With the rising number of patients confined to bed due to various diseases, escalating accidents and aging, the product finds a wide range of usage ever (Akil Sivadas et al. 2016).

Carrying, transferring the sick, injured, disabled persons, etc., are the problem that was not taken care off since olden days. Formerly these patients were carried by persons with the help of woods, steels, cloths, etc. But now with the introduction of wheels the transportation made easy. The field of healthcare and technology has been evolved to address problems efficiently. But transferring of patients between stretchers, wheel chairs etc. are still an area where new design has to be implemented and needs further innovation to improve the shifting effectively. There is a rebellion of wheelers existing nowadays based on the needs of the beneficiaries. Therefore, it is planned to develop a wheeler based stretcher to fortunate medical field. It can be operated and maintained effortlessly both by the patient or by the helper. It works to ease of the patient (Ninand Borkar et al. 2017).

To deal with persons confined to bed a helper is needed throughout the day and night. To trim down time and work, a review was carried out to spot the necessities of special persons who are confined to bed. A new wheeler based stretcher is developed based on study. The newly designed model has a chiffonier attached to it. Whenever needed the disabled persons can perform voluntary functions by using it. The model can also be converted from a bed to a chair. This helps the person to sit by themselves without transferring them. An opening in the top of the model helps to cover the mattresses during normal position. At the same time, a chiffonier arises through the opening for utilizing it. The mattress is kept back to its original position after being used. The best part of the model is that it is not needed to shift the person as chiffonier without troubling the person. In general the newly developed product is novel in design and mechanism (Atul Andhare et al. 2015).

II. CONVENTIONAL WHEELCHAIR

Conventional wheelchairs are manually operated. Many conventional wheelchairs may be ruffled for compact placement. Even though it is rugged in construction, it can be easily carried in a vehicle. Self - moved wheelers are operated by disabled and old people, using big wheels, with 21-25 inches diameter and similar to bicycle wheels.

The person who drives the wheeler by moving the hand rims, in the form of a round tube kept on the outer region of the big wheels. The dimension of rear wheels greater than the hand rims. Trained operators will manage the fast movement and gyration. They can operate the wheeler steadily using the rear wheels.

The two rims are moved by hands, are fixed on either side of the system. In general, the outer wheel is coupled to the other wheel by an axle. When the wheels are pushed together, the chair may be driven back and forth linearly. When one of the wheel is pushed separate, the chair turns left / right.

The wheeler can also be moved using a lever in backward and forward. Few modles are organized to allow the patient to drive using one or both feet instead of the rims. Hand controlled wheelchairs are not comfortable for blind people. No specific provision for obstacle detection. Some devices need separate remote controls.

III. AUTOMATED WHEELCHAIR

A wheeling system is developed to assist the individuals with disability. Devices such as stretchers and wheel chairs are used in medical centers for moving the disable persons.

The automated wheelchair helps the patient to manage the device either by self or with the help of others. It comprises of a handgrip with soft shield in upholstery. During emergency, the route way of the motion plays significant role. The right choice of the wheels helps to mitigate the problem. A smart wheelchair is designed by Mr. Richard Simpson. He stated that only 10% of are blind and also have the disability to move. A special manually operated wheelchair is designed named SPAM (Smart Power Assistance Module) for disabled and old people to move by themselves.

The electronic controlled wheeler includes hurdle identification and prevention for the people with little vision. The controls are carried out with the help of microprocessor. Advanced control of a wheeler is provided by the SPAM. Dr. Daniel E. Jolly specially designed a module for shifting the patients. It includes

amenities for lifting the disabled people from the mattresses to wheeler or the other way around. The sliding boards help the quadriplegic patients for their movement. The best sliding board is formed using a flat wood which is narrowed at its ends. The usual shipment devices available in the medical sector are bassinet, wheeler so as to hold a disable person unable to move or walk without the help of the others. This effortless module with tube like frame attached with pivoted ring. There is also a metal podium on the highest side for the patient to lie down. The objective of this work, is to develop a wheeler module with a stretcher. This helps to urge more accessibility and usefulness to the merchandise.

The wheel chairs that have been using now a day were of X shaped frame, a mechanism that holds more weights. Some of the features of it such as arm rest, foot rest, dual braking and head-rest can be adjusted according to our needs. These features are very much helpful in reducing space and weight. The rotary movement is from the y axis (vertical) of the suspension of a steered wheel in the x-direction (longitudinal). We may see during the F1 racing, the caster angle shall be adjusted by the racers to optimize the stability during various driving situations. θ is the caster angle or the pivot line is in red, the tire area is grey.

In hospitals, the commonly used equipment for the shifting of patents is wheelchair. Due to the various needs, the wheel chairs has specific design with necessary quality of materials such as stainless steel and now a days we can also see the composite one.

A. Input module

In this section the working of the proposed wheelchair based stretcher system is explained. It consists of smart phone, bluetooth transceiver and LCD display. It works according to the user input.

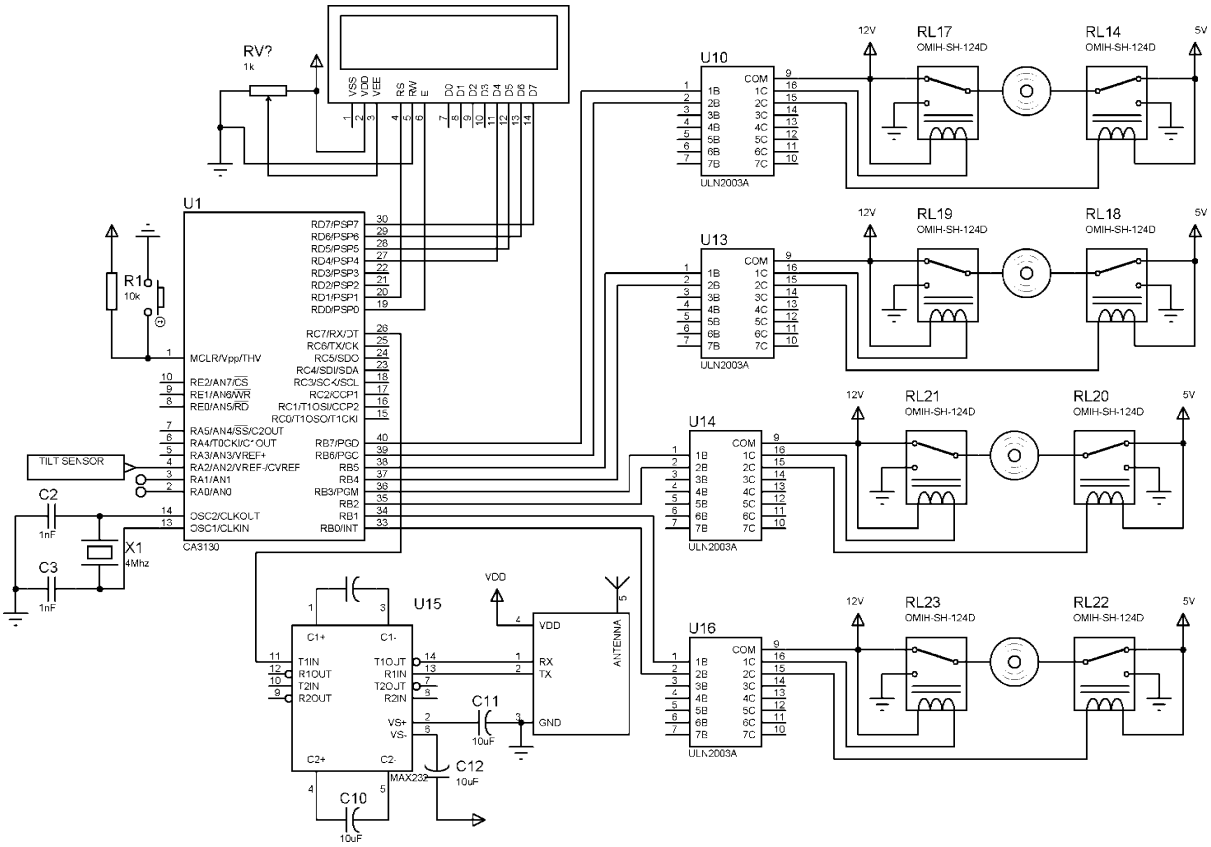

Fig. 1. **Block diagram of input module**

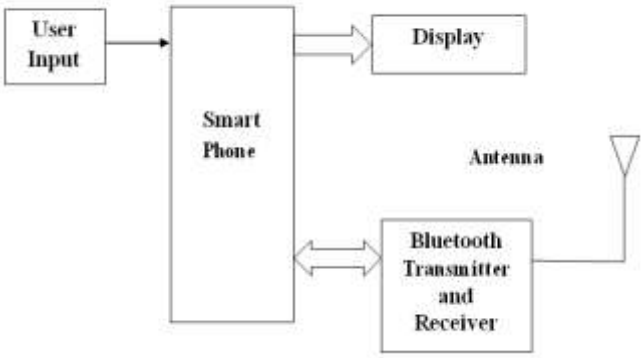

Fig. 2. **Block diagram of output module**

The proposed work is shown in fig.1. The input is received from the operator through the mobile phone. The display shows the operating function of the motor. The input is given to the controller through the Bluetooth transceiver. The message is received by the smart phone and the given input is displayed in the LCD screen.

B. Output module

The fig. 2 shows the output module. Bluetooth transceiver receives the input from the object through the mobile phone.

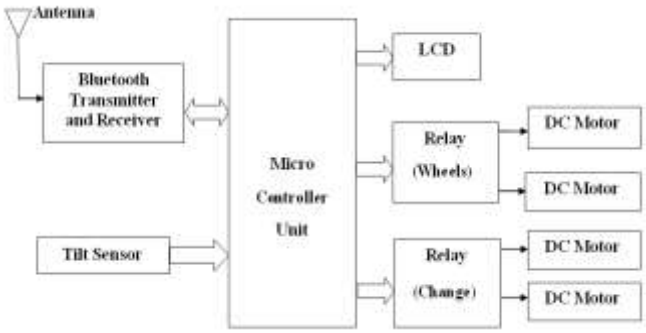

Fig. 3. **Functional diagram of the proposed technique**

The microcontroller controls the overall operation of the working unit. LCD indicates the process. The relay controls the switching process. It gives the motor rotational limits for the wheelchair head, foot, up and down process. DC motors helps to move the wheelchair front, back, right and left.

IV. CIRCUIT DESCRIPTION

With the help of power transformer, we can step down or up DC voltage when an AC is switched ON. The operational circuit is shown in fig. 3.

Circuit shown in fig. 3, a step down transformer of 230V/15V is to reduce the voltage from 230V AC to 15V AC. The 15 V Ac supply is rectified using a power diode. Diode has the ability to allow the current flow in one direction during forward bias condition. Reversing the polarity blocks the electron flow.
Less than 90% of the input AC rms voltage is rectified into DC voltage. Capacitor filters are used to remove the ripples in the output. Our requirement is constant DC voltage and to meet this we have introduced a voltage regulator which assist the filter and rectifier in the circuit.
Without regulator power supply there may be an inbuilt problem of varying DC voltage due to changes in the load or due to instability in the AC line voltage.
Therefore due to the introduction of regulator, the output voltage (DC) was maintained.

The regulators IC7812 and IC7805 provides the +12V and +5V to the circuit. PIC16F877A - 40 Pin DIP pack IC with 33 I/O pins.

C. Hardware Description

In this section the hardware components used for the work is discussed. The following are the hardware modules involved in the methodology.

1) Ultrasonic sensor:

This particular sensor consists of transmitters which convert the electrical signal to ultrasound, receivers that transforms ultrasound to acceptable and measurable electric signal and transceivers acts the dual role of transmitter and receiver. For estimating targets, ultrasonic transducers were used which works under reflection of soundwaves/signals. Passive ultrasonic sensors are microphone that detects the ultrasonic noise that can occur during the working/operation. Ultra sounds were used in wide range of materials in order to predict the target size, shape, location, etc. with more accuracy.

Ultrasound has wide applications such as detecting the speed and direction of the blowing wind, fluid channel levels, and the velocity and direction of fluids through pipes, channels, ducts, etc. Ultra-sonography, Burglar Alarms, humidifiers, etc. are some of the other applications of ultrasound. It consists of a single transducer capable to produce sound waves above 18kHz with the consumption of electric power. The sound waves after reflecting from other end were received by the micro-phone and then it converts it into measurable electric signal. The values of the reflected sound waves were displayed by the system. Some of the de-merits of using ultrasound are, it cannot be used in complex shapes, denser materials and non-homogenous/composite materials. Ultrasound technique was used when one has to detect the approaching velocities and positioning of the objects. By sending and receiving distinct bursts of ultrasound amid transducers, it can measures distance between any two objects. In order to describe the velocity of the approaching object at situation, the system records the transmitting of ultrasound and receiving time of echo and compares with the velocity of sound (mathematically). This technique is accurate in temporal and spatial resolution because the time-of-flight estimation is derived by tracking the same received waveform either by reference signal or zero crossing. This allows the measurement of resolution to go beyond the wavelength of the sound produced by the transducers.

2) Relay:

An electromagnetic relay is a coil consisting of wires which wound on an iron core. The other components of an electromagnetic relay are an iron yoke to provide least reluctance for magnetic flux, portable iron armature, and one or more sets of contacts. The armature is linked with yoke and it is attached to moving contacts. The spring force was used to detained the armature, when the relay de-energized there exists air gap. During the situation, first set of contacts is closed, and the second set is open. The armature and yoke of the relay are connected by means of a wire provided.

The circuit continuity is therefore confirmed between armature (moving contact) and the circuit trailed on the Printed Circuit Board (PCB) over the yoke.

When the coil energized by passing current through it, magnetic field is produces initiates the rotation of armature. The subsequent displacement of the moving contact may make/ break a connection with the fixed contact. If the contacts are closed when the relay is un-energized, then the displacement opens them and breaks the connection. The reverse happens if they are opened when the relay is energized. When there is no current flow through the coil, the armature is resumed by force which approximates to half of the magnetic force that it has during its relaxed position. This force is offered either by a spring or gravity. Due to the quicker operation of relay, it can be applied at both low-voltage and high-voltage or current. During deactivation, a diode is connected in parallel to the coil as an assisting in magnetic energy dissipation when the coil is energized with DC supply. If it is not cared, then voltage spike will be generated which is hazardous for semi-conductor circuit. If a large reactive load was driven by relay, there arises the problem of arising huge current at the output leads of relay. To avoid or to absorb surge current, a snubber circuit is connected across the contacts which include both a capacitor and a resistor in series. An appropriate choice of capacitor and associated resistor is required for a good design.

If AC is supplied to the coil, the flux is split into two components which are added together to, increase the minimum force on the armature. This is achieved by a small copper "shading ring" folded around the core. It creates a delayed, out-of-phase component that holds the contacts during the zero crossing of the control voltage. According to the selected applications, contact material may vary for the relay. Materials with least contact resistance are oxidized in air. Contact material is optimized to have little resistance, high immunity to withstand in subsequent operations and high capacity in tolerating the heat of an arc. Gold-plated contacts with palladium and other non- oxidizing, semi-precious metals where very low resistance is required, or low thermally-induced voltages are desired, silver / silver-plated contacts are chosen for signal switching. For power relays in motor circuit with high current rating, the contacts are modified with

combination of Ag (silver) and (Cd_2O_3)cadmium oxide. It provides low resistance during contacts and high resistance during arcing.
Contacts also have additional assemblies to dissipate heat and to control the arc produced during circuit interruption. Machine tool relays may have replaceable field contacts. They can be replaced during NO (Normally Open) and NC (Normally Closed) state, to permit the variations in the control circuit. As we know, relays are equipment which are used to switch high voltage with low voltage in the circuit with the pilot switches and/or wirings. In this, microprocessors (low voltage devices) also used to drive the relays for controlling loads in the circuits. A simple example is the starter in automobile which operates the crank initially for starting with small wiring contacts in ignition key

3) X- Bee pro:
X-Bee is the brand name from Digi International. The X-Bee radios were introduced in 2005 under the name Max-stream. Their standard design was set according to the IEEE 802.15.4-2003 for point-to-point and parallel communications with a baud rate of 250 bit/s. Two designs were introduced at least cost of 1 Mw X-Bee and the heavy power 100 Mw X-Bee-PRO. After the invention of X-Bee, ecofriendly modules such as gateways, adapters, wireless and other software are introduced. With least connections along with 3.3V X-Bee has UART (separate date in and out) along with lines for Sleep and Reset. X-Bee mounting was made easy and done with our convenient. They have flow control, I/O lines, ADC and separate lines for display. A surface mounted programmable X-Bee a version was introduced in 2010. X-Bee modules may be hole or surface mount. The exception of the X-Bee 868LP is available in the popular 20-pin through hole form factor. Some X-Bee modules are available in pad mount design, which are suitable for high volume applications. The X-Bees can operate either in a transparent data mode or in a packet-based Application Programming Interface (API) mode. In transparent mode, the input data from the Data IN (DIN) pin is directly transmitted through air to the receiving radios without any changes. Input packets may be directly addressed to one target or broadcast to multiple targets. In API mode the input data are enveloped in a packet structure. Then it is sent for addressing,
parameter setting and packet delivery feedback, comprising of remote sensing and control of digital I/O and analog input pins.

4) Microcontroller:
In this section the architecture of Microcontroller PIC16F Microcontroller is discussed. Some of the features of PIC16F Microcontroller are, Lead-free RoHS, Operating at a speed of 20MHz, rate of instruction cycle200ns, Operating range of voltage from 4.0 to 5.5volts. Working Range is from -40 to +85 degrees. With 15 interrupt sources and 35 single word instructions features it provides single-cycle instructions are used except for program branches. There are five I/O ports (port A-port E) in this PIC16F877A microcontroller such as PORT B, PORT C, and PORT D have 8 I/O pins. PORT A and PORT E are 8-bit ports, they do not have eight I/O pins. As peripheral pin is enabled, that pin cannot be used as a general purpose I/O pin. PIC16F877A consists of three sections of memory. They can be listed as flash memory, EEPROM and SRAM. The program used and downloaded by a user is stored in flash memory. PIC16F877A has 8K X 14 words of flash memory it retains the program during power cut off and it is non-erasable along with 256 bytes of Electronically Erasable Programmable Read Only Memory (EEPROM). Also it enhanced with internal SRAM (Static Random Access Memory) of 368 bytes. The PIC16F series has flexible clock options and has an additional feature of having external clock (20 MHz) in series connection. Internal oscillator also provided to these controllers which provides needed frequency options from 31 to 4 MHz. PIC16F877A has equipped with 8 ADC (Analog to Digital Converter) resolution channels of 10-bits. ADC reads the analog input and converts digitally. For example, sensor input and converts it into a digital value that can be understood by the microcontroller..

V. CONCLUSION

Stretchers are not applicable in the existing system. Wheelchairs cannot be used to get the patients into bed. Hand controlled wheelchairs are not comfortable for blind people. No specific provision for obstacle detection. Some devices need separate remote controls. The work has been evaluated by simulation and tested by hardware tools. In this work, LCD, PIC16F877A microcontroller, Bluetooth and relay driver are chosen smartly to do the definite application. The customized wheel chair proposed in this work is a model that satisfies all the essential needs. Further improvement can be implemented for real time applications. The voice recognition is a modern and smarter method than the today's method. The cost of the automated wheelchair price is lesser. The hospitals can provide this to their patients easily. Thus the work contributes to a significant advancement in technology and automation. The work can be further extended by using simple inverter structure. It can be modified to operate even using Maximum Power Point Tracking

(MPPT). Efforts will be taken to reduce the number of switches and conversion stages in DC-AC inverter. Voice recognition feature will be added to the enhanced version of this model.

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