ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
pp. 84-97

Article Title: **Solar Powered Wheel Chair with Voice Controller for Physically Challenged Persons**

Solar Powered Wheel Chair with Voice Controller for Physically Challenged Persons

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Abstract

Peoples who involved in physical injuries and disabilities with good mental strength struggling to get through places using the ordinary hand powered wheelchair. This paper enables an economic assembly in any existing wheelchair that enables a smart system for self-operating motion which can be controllable by any smartphone. Here the main concept involved is Smartphone which has an operating system as Android which have Bluetooth Wireless technology. The purpose of the project can be adjustable to other mobile devices which has Android mobile phone by sharing the application that we have developed. An Arduino microcontroller processes the voice command from the speech recognition to control the motor movement of the chair. The main second part of our system architecture has a microcontroller ARDUINO which drives in the various directions of the dc motor for targeted motion of wheelchair and powers the DC motor for straight forward of the wheelchair. The DC motor can controls the front wheels for turning the wheelchair while the pair of DC motor are connected to the rear wheels can be easily enable linear motion.

Key words: solar- power, Bluetooth, voice- controller, wheel-chair.

1. Introduction

It is challenging for people with arm and hand limitations to use a regular wheelchair since their hands are not able to operate it or move it in any direction. Consequently, a voice-activated wheelchair is made to help these individuals get over their challenges and be able to use the wheelchair. Voice commands will be used with the supplied input to operate the wheelchair. All commands that the user wants to give will be fulfilled by the Arduino. The Arduino itself has programs written in the form of instructions for each direction.

Spoken orders will be given to the wheelchair by the unilateral microphone, which will be positioned based on the user's comfort level. Speech recognition is handled by the HC05 Bluetooth module. After that, Arduino gets the output from this module.The wheelchair will move as intended thanks to the pre-written algorithms on the Arduino, which help the device translate these spoken commands into meaningful output. Using a wheelchair control system

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will help people become more independent. Speech recognition technology is used by the wheelchair control system to initiate and regulate all of its movements.

With the help of technology, wheelchair users can operate the device simply by speaking into the Bluetooth app called Arduino Bluetooth control. Therefore, a trained voice is all that is needed to operate the wheelchair. Apart from that, it might not much cost to create this project. To improve this system's dependability, a few adjustments are necessary. It could improve the wheelchair's design to incorporate wireless connectivity. We can instantly make a positive impact on the lives of the community's disabled residents. The four basic motion operations are hold, turn left or right, and travel forward or backward. A flexible that may be shaped to the user's specifications is used to transmit the spoken words to the speech recognition system.

In this instance, the programming device we used was Arduino. Where C has improved the project by using programming. The Wheel Chair System Project's primary objective is to develop a smart system so that we can get several benefits from a single endeavor. Therefore, a trained voice is all that is needed to operate the wheelchair. Apart from that, it might not be much cost to create this project. To improve this system's dependability, a few adjustments are necessary. It could improve the wheelchair's design to incorporate wireless connectivity. We can directly make a difference in the lives of those with disabilities in our community.

2. Literature Survey

A.B. Haque, S. Shurid, A. T. Juha proposed that disable individuals are disregarded more often than not. Nothey need human help 24/7 to proceed onward. They need a wheelchair to move from one place to another as per their need. It would be much easier if the wheelchair needed for their task be automated and controllable by the person himself rather another constant human engagement. In this paper, a design has been proposed considering these facts. The wheelchair will be controlled by voice and gesture. To make the system energy efficient solar power will be used. Along these lines, while moving around all around the battery can be revived effectively. This keen wheelchair is additionally fit for hindrance recognition.

S. N. Sakib, S. P. Mouri, This paper presents a study on a low-cost solar-powered wheelchair for the disabled in Bangladesh. The maincomponents are: wheelchair structure, solar panels, DC motors, control circuits, microcontroller andjoystick. The proposed model is very useful forphysically challenged people from rural areas. Thisproposed model is available to low income people incountries like Bangladesh. The wheelchair is costeffective and user friendly. The proposed model isself-contained and independent. A life-cycle costanalysis is performed for the proposed model andcompared with an electric wheelchair that drawspower from the grid for charging, and the proposedmodel is shown to have a lower cost. A solar-poweredwheelchair will significantly help physicallychallenged people in their daily movements. Theproposed model will be very effective in rural areas aswell as in urban areas.

M.R. Hans, K.K. Sandeep [6] Solar system gets pure and clean energy from the sun. Solar panels are able to generate energy from the sun's rays and convert it into electricity using the

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photovoltaic effect. During this process, the panel creates no pollution and is less expensive. We designed the solar wheelchair for disabled people. This wheelchair consists of solar panel, battery, charge controller, brushless DC motor. This report contains all the information about the components related to the solar wheelchair. The designed wheelchair system is self-propelled, making it very useful for the physically challenged. This is the best invention in the field of medicine. Earlier wheelchairs use mains power to charge the batteries. Also, the price of these vehicles was not affordable for the common man. In this case, an attempt is made to design a solar wheelchair at an affordable price so that it can be accessible to the common man.

K. Vijayakumar, T. R. Vikram, This project designs an automated wheelchair to help physically challenged people and will serve as a complete form of automatic system (mobility aid). This paper presents the design and fabrication of a smarter solar-powered wheelchair with two control interface modes. A prototype of the smarter features of the solar powered wheelchair system was built based on a manually operated wheelchair that is commonly available in the market, with the addition of related work done in electrical and mechanical advancements.The mechanical design of a wheelchair, the electrical and control system of a smarter wheelchair are introduced. The wheelchair is solar powered for indoor/outdoor use. A high torque DC motor is used in our project. Other features include fingerprint, panic alarm and liquid crystal display. The fingerprint emergency button setting is located in the joystick itself and the buzzer is also used to release a sound when the emergency button is pressed.

System Design

The Existing work system design consisting of various components such as: i) wheel, iii) battery and its operations, iv) Microcontrollers, vi) power management, vii) circuit design, viii) DC motor forward reverse control, ix) I/O ports and functions. We have also equipped our chair with infrared sensors which will help to avoid accidents happening due to obstacles.Sensors will respond to the nearing obstacle and eventually commands will be forwarded to the microcontroller(ATMega328) enabling desired further motion.This system also includes a health monitoring system which monitors health of the user and forward that to the application**.**

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2.1 Existing Block Diagram

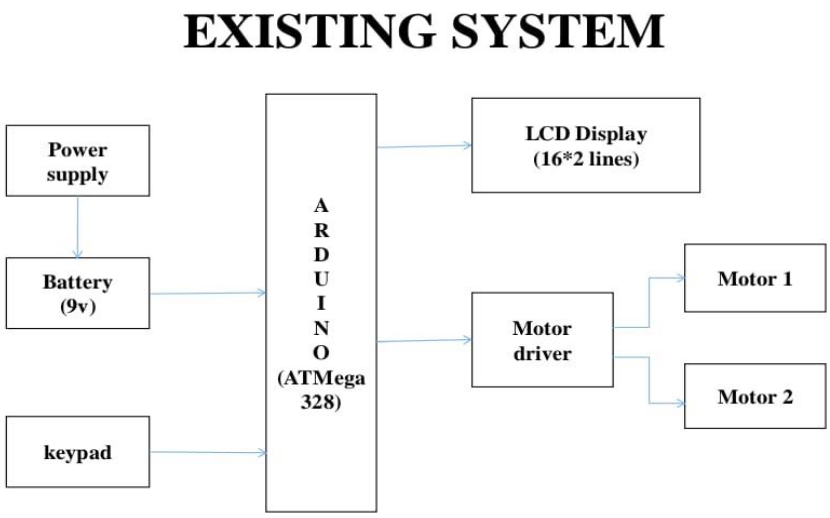

Figure 1: *Block diagram of Wheel chair for physically challenged persons.*

3. Proposed Work Explanation

The design and use of the user interface for the solar wheelchair system is done on an Android smartphone. An Android app is also built with voice interface. The user can choose directions and access an SOS help section through the graphical user interface. Upon opening the application, a notification appears to activate the mobile device's Bluetooth. At that moment, a string is passed from the transmission unit to the receiving portion via the mobile phone's Bluetooth when the user hits the virtual button. The algorithm to be followed is given as below:

First the battery should be switch on. Android application should be opened and using the user interface design, select the type of control either we can select as voice controller or button controller. Before selection of the controller, Bluetooth should be enabled for chair and the Android phone. When the Bluetooth is on, the application scans the input when the user touches the virtual button. If the requirement is forward, then all the dc motors are supplied with 5V and moved in forward directions for linear movement. If the requirement is reverse, then all the dc motors are supplied with 5V and moved in backward directions for linear movement. If the requirement is to turn left then the left dc motors are stopped and the right dc motors are supplied with 5V and the wheel chair moves in left direction. If the requirement is to turn right then the right dc motors are stopped and the left dc motors are supplied with 5V and the wheel chair moves in right direction. If the stop virtual button is touched then all the dc motors are stopped. The proposed work system design consisting of various components such as: i)wheel, ii) solar cell, iii) battery and its operations, iv)Microcontrollers, v) Bluetooth usage, vi) power management, vii) circuit design, viii) DC motor forward reverse control, ix) I/O ports and functions. A solar cell, or photovoltaic cell is a semiconductor device consisting of presence of sunlight is capable of generating usable electrical energy. This conversion is called the

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photovoltaic effect. The field of research related to solar cells is called as photovoltaic. Solar cells are appearing on building roofs where they are connected through an inverter to the electricity grid in a net metering arrangement.

4. System Design

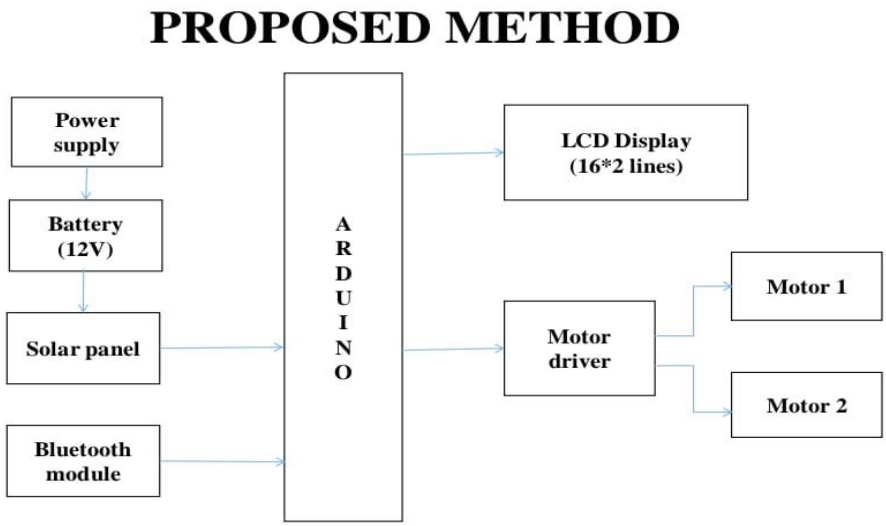

Figure 2: *Proposed project block diagram of Solar powered wheel chair with Voice Controller for physically challenged persons*

5. System Description

Proposed system consists of various blocks for different methodologies that is discussed below.

5.1 Solar Cell

The solar cell is made from a polycrystalline silicon wafer. Electron-hole pairs are produced when photons are absorbed. These pairs diffuse to their electrical contacts and can be retrieved to power electrical devices. One of two things can occur when a photon of light strikes a silicon fragment. The photon can flow through silicon directly in the first place. This occurs when the photon's energy is less than the silicon semiconductor's band gap energy. The photon may be absorbed by the silicon, which is the second possibility. This occurs when the photon energy surpasses the silicon bandgap energy.

An electron in the crystal lattice receives the energy from a photon that is absorbed. This electron is typically in the valence bond, where it is firmly bonded to nearby atoms in covalent bonds, preventing it from moving too far. It is excited into the conduction band, by the energy that the photon gives it. There is now a hole—a single electron missing from the covalent link that the electron was formerly a part of.

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Figure a: *Solar panel*

A hole can pass through the lattice when a covalent link is absent, which permits the bound electrons of nearby atoms to migrate into the "hole" and leave another hole behind. Consequently, it can be claimed that mobile electron-hole pairs are produced by photons absorbed in the semiconductor

5.2 Wheels

High quality plastic wheel for motors with 6 mm diameter can be used. These wheels are perfect for robots and micro mice. These robust wheels have a premium rubber grip and are constructed of nylon. These wheels are perfect for robots and micro mice. These robust wheels have a premium rubber grip and are constructed of nylon. i) Hole diameter 6.1 mm with metal bush inner rod, ii) Screw for fastening on motor shaft, iii) Made from virgin plastic, iv) Easy fit with motors, v) Side screw to tight fix.

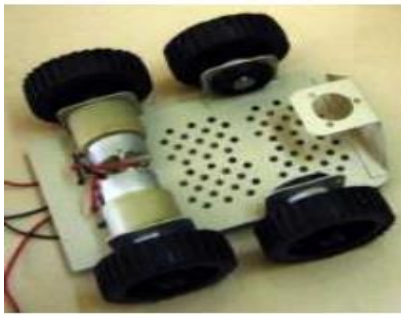

Figure b: *Wheels*

5.3 Battery and its Operations

A battery is a device that converts chemical energy directly to electrical energy. It is composed of several voltaic cells, each of which is made up of two half-cells joined in series by a conductive electrolyte that has both cations and anions in it. Electrolyte and the electrode that anions migrate to make up one half-cell. i.e., the anode or negative electrode, the other half-cell includes electrolyte and the electrode to which cations migrate. i.e. the cathode or positive

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electrode. A separator between half-cells allows ions to flow, but prevents mixing of the electrolytes.

Figure c: *Battery*

5.4 DC Motor Forward and Reverse Control

The circuit design given in figure is to control the motor in the forward and reverse direction. It consists of two relays named as relay1, relay2. The relay ON and OFF is controlled by the pair of switching transistors. A relay is nothing but electromagnetic switching device which consists of three pins. They are Common, Normally Close (NC) and Normally Open (NO).

The common pin of two relay is connected to positive and negative terminal of motor through snubber circuit. The relays are connected in the collector terminal of the transistors T2 and T4. When high pulse signal is given to either base of the T1 or T3 transistors, the transistor is conducting and shorts the collector and emitter terminal and zero signals is given to base of the T2 or T4 transistor. The relay is therefore in the OFF state. The transistors T1 and T3 are switched off when a low pulse is applied to their bases. The T2 or T4 transistor's base is now receiving 12 volts, which causes the transistor to conduct and the relay to switch on.

Only one relay can be operated at a time due to the interconnection of the NO and NC pins of two relays. A snubber circuit is a series arrangement comprising a resistor and capacitor. The rear emf of the relays may malfunction if they are turned on and off repeatedly. Thus, the snubber circuit grounds the back emf. The motor is operating forward when relay 1 is in the ON state and relay 2 is in the OFF state. When the relay 2 is in the ON state and relay 1 is in the OFF state, the motor is running in the reverse direction.

Figure d: *DC Motor*

5.5 Bluetooth Usage

In a short amount of time, Bluetooth developed into a system that lets individuals connect and

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interact with one another through a range of primarily portable devices without the users' involvement. Bluetooth devices will be able to talk to each other as they come into range, which is about 10 meters, although this can be extended to more than 100 meters by increasing the transmit power from a nominal 1mW to as much as 100mW.Cell phones and Palm-style PDAs are anticipated to be the first devices to incorporate Bluetooth technology; however, it will spread swiftly to notebook and laptop computers, printers, scanners, digital cameras, household appliances, games, toys, and more. Although some features span multiple layers, the Bluetooth protocol stack is specified as a collection of layers.

A module that implements the lower layers of the protocol stack and a host that implements the upper tiers can make up a Bluetooth device. There are various reasons why this layer separation can be beneficial. For example, hosts such as PCs have spare capacity to handle higher layers, allowing the Bluetooth device to have less memory and a less powerful processor, which leads to cost reduction. Also, the host device can sleep and be awoken by an incoming Bluetooth connection. Naturally, an interface is required between the higher and lower layers, and Bluetooth defines the Host Controller Interface (HCI) in order to do this. However, it is still feasible for some tiny, straightforward devices to execute every layer of the protocol stack on a single CPU. A headset is one instance of such a system.

5.6 Power Management

Since many Bluetooth devices are battery-operated, the design has taken extra care to minimize power consumption. Bluetooth gadgets don't have enough power to be dangerous to people's health. In order to extend battery life, there are three established low-power modes that reduce activity on a connection. These modes go by the titles Sniff, Hold, and Park. The nominal transmit power used by most Bluetooth applications for short-range connectivity is 0 dBm. This restricts current consumption and keeps interference to other systems to a minimum. Since many Bluetooth devices are battery-operated, the design has taken extra care to minimize power consumption. Bluetooth gadgets don't have enough power to be dangerous to people's health. In order to extend battery life, there are three established low-power modes that reduce activity on a connection. These modes go by the titles Sniff, Hold, and Park.

5.7 LCD Display

LCD is an abbreviation for liquid crystal display. It is one type of electronic display module that is utilizedin many different circuits and gadgets, such as TV sets, computers, calculators, mobile phones, and so on.

Seven segments and multi-segment light-emitting diodes are the major applications for these displays. The primary advantages of utilizing this module are its low cost, ease of programming, animations, and unrestrictedcharacter, special, and animation display options.

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Figure e: *LCD Display*

5.8 Arduino Microcontroller

Based on the ATmega328P, the Arduino UNO is a full microcontroller board that is suitable for use on a breadboard. Just use a USB cord to connect it to a PC. six analog inputs, a reset button, an ICSP header, a power jacket, a USB port, and a ceramic resonator operating at 16MHz. Everything required to sustain the microcontroller is contained in it.

Figure f: *Arduino Uno*

5.9 Bluetooth APP HC-05

HC-05 Bluetooth module and perform Bluetooth communication between two separate Arduino boards as a master and slave device Before starting the first example, controlling the Arduino with a smartphone, let's take a closer look at the HC-05 Bluetooth module. Compared to the HC-06 module, which can only be set as a Slave, the HC-05 can also be set as a Master, allowing communication between two separate Arduino boards. There are several different versions ofthis module, but I recommend the one that comes on a breakout board because it's much easier to connect that way. The HC-05 module is a Bluetooth SPP (Serial Port Protocol) module, which means it communicates with the Arduino via serial communication. HC-05 has two operating modes, one is Data mode, in which it can send and receive data. From other Bluetooth devices and another is the AT Command mode where the device's default settings can be changed. They can control the device in either of these two modes using the key pin as explained in the pin description.

5.10 Arduino IDE

The Arduino Integrated Development Environment –or Arduino Software (IDE) – includes a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a number of menus. Connects to Arduino and Genuine hardware to upload and communicate with programs. Programs written using the Arduino software (IDE) are called

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sketches. These sketches are written in a text editor and saved with a file extension. The editor has cut/paste and text search/replace functions. The message area provides feedback during saving and exporting, and also displays errors. The console displays text output from the Arduino software (IDE), including complete error messages and other information. The configured board and serial port are displayed in the lower right corner of the window.

5.11 I/O Ports and Functions

A different purpose for the device's peripheral features is multiplexed onto some pins of PIC I/O ports. Generally speaking, a peripheral pin that is enabled cannot be utilized as a general-purpose I/O pin.

5.12 Working Process of Solar Panel

The solar panel power system is one of the main focal points of the wheelchair. Make the system consume less electricity. When a person moves outside with a wheelchair, the solar panel starts working automatically. So, when the solar panel hits the sunlight, it starts charging the battery. Photovoltaics is the main thing in a solar panel system that converts the sun's energy into electricity. Photovoltaic cells produce direct current or direct current energy, but a single photovoltaic cell is not enough to produce a large amount of electricity for a wheelchair. For this reason, the photovoltaic cell module to get enough energy. At the stage when the light reaches the p -n junction, light photons can pass through the thin p-type layer without much stretching in the junction. Like photons, the light vitality of the penetration provides sufficient vitality to create different sets of electron gaps. The light of the episode will disturb the hot equilibrium state of the junction. Free electrons in the depletion region can quickly move to the n-type side of the junction. The taps can thus quickly switch to the p-type side of the junction.

Flowchart of Wheel Chair

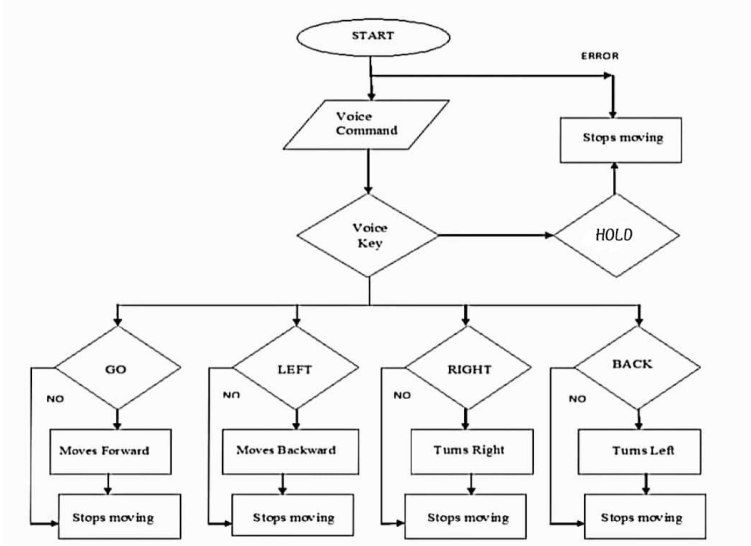

Figure 2: *System Flowchart*

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6. Experimental Results

The design of a wheelchair that runs on solar power is the proposed project. Two distinct situations are examined for the accuracy of the wheelchair: (i) in the presence of sunshine, (ii) in the absence of sunlight, and (iii) employing classifications such voice controller and button controller.

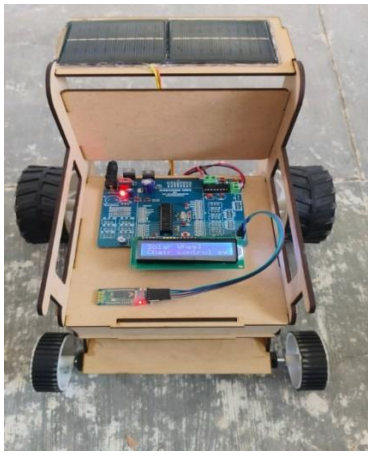

Figure 3: *Solar powered wheel chair with Voice Controller for physically challenged persons*

TABLE I
WHEEL CHAIR MOVEMENT USING VOICE CONTROL IN THE PRESENCE OI SUNLIGHT

Voice command	Experimental trials					
	1	2	3	4	5	Total response
Forward	1	1	1	1	1	5
Backward	1	1	1	1	1	5
Left	1	1	1	1	1	5
Right	1	1	1	1	1	5
Stop	1	1	1	1	1	5

TABLE III
WHEEL CHAIR MOVEMENT USING BUTTON CONTROL IN THE PRESENCE OF SUNLIGHT

Button control	Experimental trials					
	1	2	3	4	5	Total response
Forward	1	1	1	1	1	5
Backward	1	1	1	1	1	5
Left	1	1	1	1	1	5
Right	1	1	1	1	1	5
Stop	1	1	1	1	1	5

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TABLE IIIII
WHEEL CHAIR MOVEMENT USING VOICE CONTROL IN THE ABSENCE OF SUNLIGHT

Voice command	Experimental trials					
	1	2	3	4	5	Total response
Forward	1	1	1	1	1	5
Backward	1	1	1	1	1	5
Left	1	1	1	1	1	5
Right	1	1	1	1	1	5
Stop	1	1	1	1	1	5

TABLE IVV
WHEEL CHAIR MOVEMENT USING BUTTON CONTROL IN THE ABSENCE OF SUNLIGHT

Button control	Experimental trials					
	1	2	3	4	5	Total response
Forward	1	1	1	1	1	5
Backward	1	1	1	1	1	5
Left	1	1	1	1	1	5
Right	1	1	1	1	1	5
Stop	1	1	1	1	1	5

System Implementation

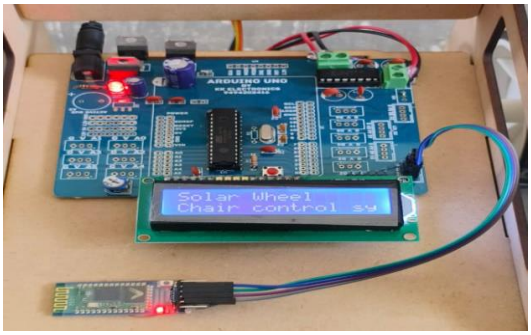

Figure 4: *Hardware kit*

Results displayed in LCD

Figure 5: *LCD display*

Input process for voice commands through arduino Bluetooth control application.

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Figure 6: *input process through voice command using keywords*

The system is examined to ensure appropriate operation. As a result, 100% accuracy is shown both in the presence and absence of sunshine, and when utilizing both voice and button controllers.

7. Conclusion

The desired completion of this project will enable a great ease in movement and socializing of disabled people with negligible human efforts. The design and assembly of the wheelchair using a Bluetooth module are further explained in this paper. This study elaborates on the wheelchair's design and assembly using a Bluetooth module. When the user gives a command, the circuit moves appropriately. Following the circuit's design, which has been verified and tested, physically impaired people can now operate their wheels with an Android application on their cellphones. The microcontroller successfully controls the detection of any impediment. Any barrier that is anticipated to be within a 4-meter radius will be recognized by the sensor as soon as the person turns on the circuit and begins moving. This proposed approach helps older and differently abled people become more self-reliant.

If the distance between android mobile phone and wheel chair exceeds 10 meters, the controller cannot be reached since the device is not in the range of bluetooth module to perform connectivity to the chair with the user interface present in the android phone. The Recharging capacity of the panels is satisfactory. Thus the attempt made in fabricating the Solar Powered Wheel chair is successful.The recharging time can be minimized by increasing the capacity of the Solar Panels.Also, it is easy to use and operate as the movement are just one touch away. The module is compact and economical; the various sensors present in the prototype which is very reliable and helpful.

8. Future Scope

Further implementation of voice controlling system or IR sensor glasses for the movement of wheelchair can be installed in the existing prototype. These two will increase the mobility level

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of chair to a very high standard, which will be highly efficient and less dependent on other sources to move. Also, the implementation of gear box will increase the speed of chair and handling as well. We can also install solar power panel for promoting the eco-friendly charging of this chair. A detachable metallic stair-case can be attached to climb slopes and small hurdles. Hence, all these changes on a whole will prove to be a boon in medical field.

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