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SMART ROTA CATHEDRA

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Abstract: **"SMART ROTA CATHEDRA" Is the Latin Name for smart wheelchair. "Rota" Means "Wheel" and "Cathedra" means "chair". A device and a method for controlling the movements of a smart motorized wheel-chair with different methods are disclosed in this innovation. User can operate wheeled-chair very easily with the four different methods. This smart-wheelchair can be controlled by Touchpad, Smartphone, Hand movement and Push buttons. The user can control the direction of the wheelchair while moving simply by a small movement of the finger on the touchpad. Smart Wheelchair movement can also be controlled by accelerometer present in most Smart phones and Bluetooth wireless technology enabling users to move their wheelchairs by just tilting their Smartphone. By using the flex sensors the movement will be detected and the controller will process the signal and will transmit to the wheel chair for its navigation. And has also a provision for push button for simpler and easy movement. This Smart Wheelchair makes use of a motor driver for driving the motors attached to the wheel chair for the movement of wheel chair and Micro controller.**

Keywords: **"SMART ROTA CATHEDRA", Touchpad, Flex sensors, Smartphone, Push Buttons.**

I. INTRODUCTION

The goal of this smart wheelchair project is to enhance an ordinary wheelchair using different technologies and method to perceive the wheelchair's surroundings. Smart wheelchair will play an important role into the future welfare society. The use of smart wheelchair encourages the view of the machine as a partner rather than as a tool. Driving a wheelchair in domestic environments is a difficult task even for a normal person and becomes even more difficult for people with arms or hands impairments. Some patients who cannot manipulate the direction of the wheelchair with their arms due to a lack of force face major problems such as orientation, mobility etc. Therefore the smart wheel Chair is developed to overcome the above problems allowing the end-user to just perform safe movements and accomplish some daily life important tasks.

Several studies have shown that both children and adults benefit substantially from access to a means of independent mobility. While the needs of many individuals with disabilities can be satisfied with traditional manual or, a segment of the disabled community finds it difficult or impossible to use wheelchairs independently. To accommodate this population, researchers have used technologies originally developed for mobile robots to create "smart wheelchairs." This is a Quadra type operated wheel chair that is made to work based on touch screen, smart phone & flex sensors. The user can control the direction of the wheelchair while moving simply by a small movement of the finger on the touchpad. Smart Wheelchair movement can also be controlled by accelerometer present in most Smart phones and Bluetooth wireless technology enabling users to move their wheelchairs by just tilting their Smartphone. This Smart Wheelchair can also be controlled by the simple movement of head and by pushing push buttons.

The number of people, who need to move around with the help of some artificial means, whether through an illness or accident, is continuously increasing. This means have to be increasingly sophisticated, taking advantage of technology evolution, in order to increase the quality of life for these people and facilitate their integration into their working world. In this way a contribution may be made to facilitating movement and to making this increasingly simple and vigorous, so that it becomes similar to that of people who do not suffer deficiencies.

II. BACKGROUND OF THE INVENTION AND PRIOR ART

This invention mainly focused on enhancing an ordinary wheelchair using different technologies and method to perceive the wheelchair's surroundings. Smart wheelchair will play an important role into the future welfare society. The use of smart wheelchair encourages the view of the machine as a partner rather than as a tool. Driving a wheelchair in domestic environments is a difficult task even for a normal person and becomes even more difficult for people with arms or hands impairments.

Some patients who cannot manipulate the direction of the wheelchair with their arms due to a lack of force face major problems such as orientation, mobility etc. Therefore the smart wheel Chair is developed to overcome the above problems allowing the end-user to just perform safe movements and accomplish some daily life important tasks. The evidences shows that two of earliest invention of man wheels and chair were assembled together to be an invention

"THE WHEELCHAIR". Wheelchair is a chair fitted with wheels.

Wheelchairs are, of course, well known in the art and numerous modifications and improvements therefor have been described over the years. The contribution of many inventors leads the Journey of development of the wheelchair from a self-propelled wheelchair to a smart automated wheelchair.

The contribution of the inventors goes as…………………………

In year 1981 the inventors John H. Loveless and Woodrow Seamone patented Chin controller system for powered wheelchair patent no. US4260035 A, which was A chin controller system, for controlling a motor-driven wheelchair, comprised of an elongated control arm which extended to a location adjacent to occupant's chin and there supported an actuator mechanism. The actuator enabled the user to select the desired direction to travel on the wheelchair. But the parlayed person can't use the proposed solution of inventor. So to ease the parlayed persons the idea of invention of Smart Rota Cathedra is proposed.

In year 2000 the inventors Jerome M. Kurtz erg and John Stephen Lew patented Voice-controlled motorized wheelchair with sensors and displays patent no. US6108592 A, which was a motorized wheel-chair, equipped with one or more sensors for detecting obstacles and one or more microphones pick up the sounds of the user's voice and transmit them to a computer. The computer decodes commands and transmits these commands to the wheelchair to affect the desired motion. This invention can't be used in noisy surrounding. Hence to overcome this problem our idea is proposed which has different methods to ease the people.

In year 2005 the inventors B. Richey II Joseph, Bruce A. Jaenke patented Wheelchair having speed and direction control touchpad patent no. US6926106 B2, which was a wheelchair having a speed and direction control touchpad and when pressure is applied to the layers bringing them into contact with each other, an X, Y coordinate location is produced and the wheelchair is moved in different directions. The proposed idea is not sufficient to ease all the patients it should have alternate method.

In year 2008 the inventor Linda Fehr, Steven B. Skaar, Guillermo Del Castillo patented Computer-controlled power wheelchair navigation system patent no. US7383107 B2, which wheelchair navigation system for a motorized wheelchair includes dual cameras, proximity sensors, microphones, and rotation sensors for the wheels The navigation system uses the proximity sensors, rotation sensors and cameras in conjunction with the specialized software to determine where objects or impediments are located in the room and thereby redirect the path of the wheelchair so as to avoid such objects. The proposed idea is not sufficient to ease all the patients it should have alternate method.

The number of people, who need to move around with the help of some artificial means, whether through an illness or accident, is continuously increasing. This means have to be increasingly sophisticated, taking advantage of technology evolution, in order to increase the quality of life for these people and facilitate their integration into their working world. In this way a contribution may be made to facilitating movement and to making this increasingly simple and vigorous, so that it becomes similar to that of people who do not suffer deficiencies. So to ease and serve the humanity this idea of "SMART ROTA CATHEDRA"Is proposed.

III. DETAILED DESCRIPTION OF THE INVENTION

The device can be operated in four modes, viz., Mode-1 controlling by TOUCHPAD Mode-2 controlling motorized wheel chair by SMART-PHONE, Mode-3 controlling by HAND-MOVEMENT and Mode-4 controlling by PUSH BUTTONS. In Mode-1, the user can control the direction of the wheelchair while moving simply by a small movement of the finger on the touchpad.

In Mode-2, The Wheelchair movement can also be controlled by accelerometer present in most Smart phones and Bluetooth wireless technology enabling users to move their wheelchairs by just tilting their Smartphone. In Mode-3 The

Flex sensor which Will detect the simple movement of head and the controller will process the signal and will transmit to the wheel chair for its navigation and In Mode-4 The Smart Wheelchair contains the push buttons which on pressing them the controller will process the signal and will transmit to the wheel chair for its navigation.

III.A) Micro-controller:

A microcontroller is the heart of the automated wheelchair. A microcontroller is a programmable device that can be used to perform any arithmetic and logic operations. . The difference between a microcontroller and a microprocessor is the availability of internal memory to store the programme code and it can function as a standalone controller. There are several self-sufficient microcontroller boards available of which Arduino is the best suited for the following functions.

Arduino is an open-source single-board microcontroller, descendant of the open-source Wiring platform, designed to make the process of using electronics in multidisciplinary projects more accessible. The hardware consists of a simple open hardware design for the Arduino board with an Atmel AVR processor and on-board input/output support. The software consists of a standard programming language compiler and the boot loader that runs on the board. Arduino hardware is programmed using a Wiring-based language (syntax and libraries), similar to C++ with some slight simplifications and modifications, and a Processing-based integrated development environment.

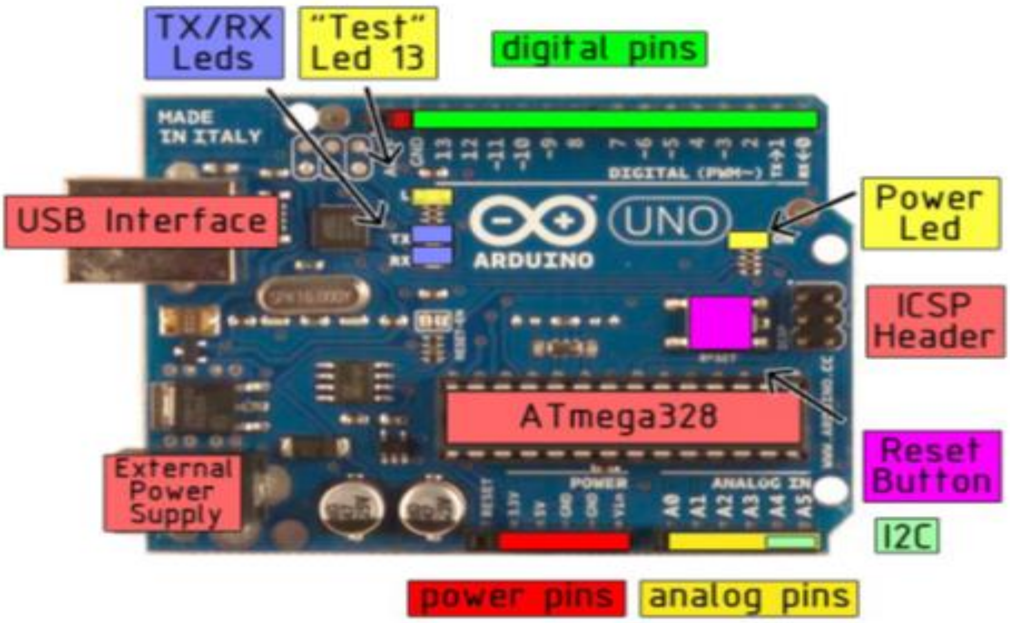

Fig.1 Audrino uno

III.B) Touchpad:

A touch screen is an electronic visual display that the user can control through simple or multi-touch gestures by touching the screen with one or more fingers. There are a variety of touch screen technologies that have different methods of sensing touch.

Resistive Touchpad:-

A resistive touch screen panel comprises several layers, the most important of which are two thin, transparent electrically-resistive layers separated by a thin space. These layers face each other with a thin gap between. The top screen (the screen that is touched) has a coating on the underside surface of the screen. Just beneath it is a similar resistive layer on top of its substrate. One layer has conductive connections along its sides, the other along top and bottom. A voltage is applied to one layer, and sensed by the other. When an object, such as a fingertip or stylus tip, presses down onto the outer surface, the two layers touch to become connected at that point: The panel then behaves as a pair of voltage dividers, one axis at a time. By rapidly switching between each layer, the position of a pressure on the screen can be read.

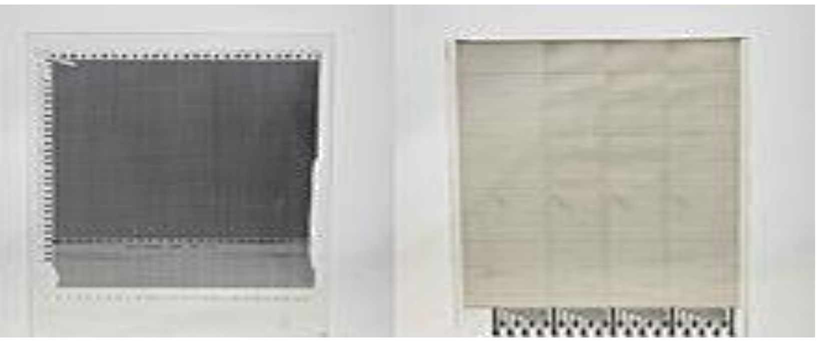

Fig.2 Resistive touchpad

Capacitive Touchpad:

A capacitive touch screen panel consists of an insulator such as glass, coated with a transparent conductor such as indium tin oxide (ITO). As the human body is also an electrical conductor, touching the surface of the screen results in a distortion of the screen's electrostatic field, measurable as a change in capacitance. Different technologies may be used to determine the location of the touch. The location is then sent to the controller for processing.

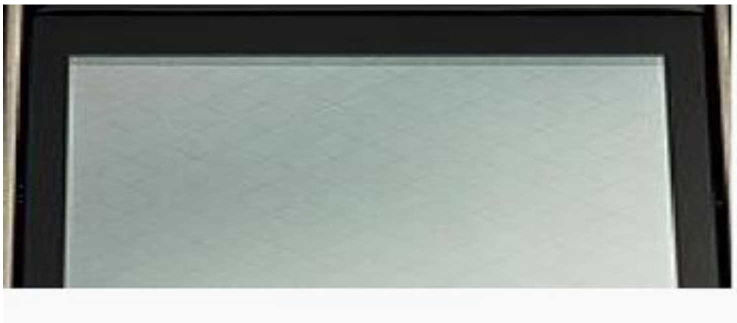

Fig.3 Capacitive touchpad

III.C) Flex Sensor:

Flex sensors are analog resistors. They are usually in the form of strip 5‖ long that vary in resistance. They work as variable voltage analog dividers. Inside the flex sensor are carbon resistive elements within a thin flexible substrate More carbon means less resistance. When the substrate is bent it produces a resistance output relative to bend.

Type of Flex Sensor:

Bidirectional flex sensor

Unidirectional flex sensor

Bi-Directional Flex Sensor:

Changes resistance when bent or flexed in either direction. Resistance of sensor varies from ohms to kilo ohms. The flexible bend sensor operating temperature is -30 to 80 degree Celsius.

Fig.4 Bidirectional Flex Sensor

Uni-Directional Flex Sensor:

When the flex sensor is bent, the resistance gradually increases. Resistance vary between few ohms and kilo ohms. The flex sensor's operating temperature is -30 to 80 degree Celsius.

Fig.5 unidirectional Flex Sensor

III.D) Bluetooth Module:

EGBT-045MS is a generic Bluetooth Modules loaded with SPP firmware for UART wireless cable replacement functions. The EGBT-045MS can be configured by the user to work either as a master or slave Bluetooth device using a set of AT commands.

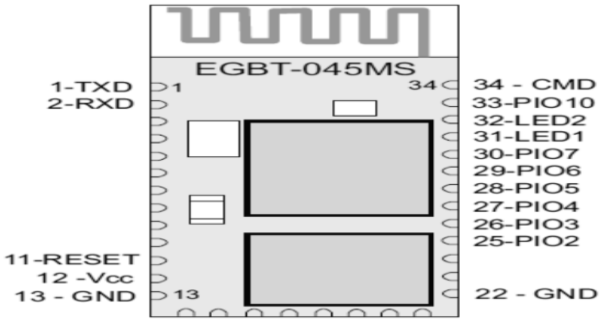

Fig.5 Bluetooth module

SPECIFICATIONS EGBT-046S:

Radio Chip: CSR BC417

Memory: External 8Mbit Flash

Output Power: -4 to +6dbm Class 2

Sensitivity: -80dbm Typical

Bit Rate: EDR, up to 3Mbps

Interface: UART

Antenna: Built-in

Dimension: 27W x 13H mm

III.E) Johnson Dc Geared Motor

10RPM 12V DC geared motors for robotics applications. It gives a massive torque of 10Kgcm. The motor comes with metal gearbox and off-centered shaft. Shaft has a metal bushing for wear reissuance.

Fig.6 jhonson Dc Motor

Formulas for Operating Patters of dc Johnson Motor:

First the relationship between time and speed for each item that is being controlled is determined and then is converted to the operating pattern for these items into a motor shaft operating pattern .

1) Triangular Operating Pattern

Maximum Speed:

$$v0 = \frac{X\,0}{tA} \quad (1)$$

Acceleration/Deceleration Time:

$$tA = \frac{X\,o}{vo} \quad (2)$$

Travel Distance:

$$X0 = tA * v0 \quad (3)$$

Where v0 is the maximum speed in ms-1

X0 is the maximum displacement in m

tA is the acceleration/deceleration time in s.

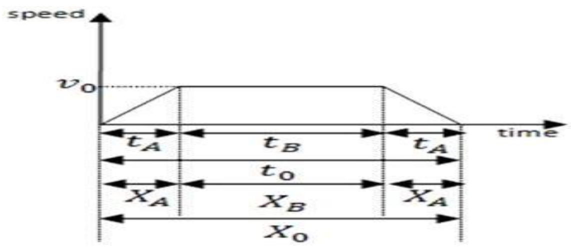

Fig.7 Triangular Operating Pattern of dc Motor

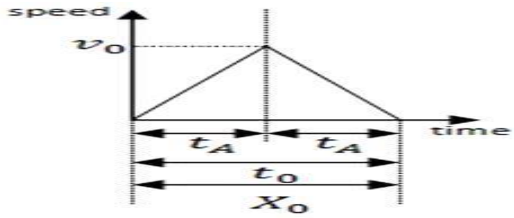

Fig.8 Trapezoidal Operating Pattern

Maximum Speed:

$$v0 = \frac{X\,0}{t0 - tA} \quad (4)$$

Acceleration/Deceleration Time:

$$tA = to - \frac{X\,0}{vo} \quad (5)$$

Total Travel Time:

$$t0 = tA + \frac{X\,0}{vo} \quad (6)$$

Constant-Velocity travel time:

$$tB = to - 2*tA \quad (7)$$

Total Travel Distance:

$$X\,o = V0\,(t0 - tA) \quad (8)$$

Acceleration/Deceleration Travel Distance:

$$X_A = \frac{(v_0 - t_A)}{2} \quad (9)$$

Constant-Velocity Travel Distance:

$$X_B = v_0 * t_B \quad (10)$$

Where v0 is the maximum speed in ms-1

X0 is the maximum displacement in mXA is the acceleration/deceleration distance in m X B is the constant velocity travel distance in m t0 is the total travel time in stA is the acceleration/deceleration time in s tB is the constant-Velocity travel time.

Speed – Slope Relationship

Ascending Time:

$$t_A = \frac{v_o - v_1}{\alpha} \quad (11)$$

Distance moved including Ascending time (tA):

$$X_A = 0.5\alpha * t_A^2 + v_1 * t_A \quad (12)$$

Speed after ascending:

$$v_0 = v_1 + \alpha * t_A \quad (13)$$

Speed Gradient:

$$\alpha = \frac{v_g}{t_g} \quad (14)$$

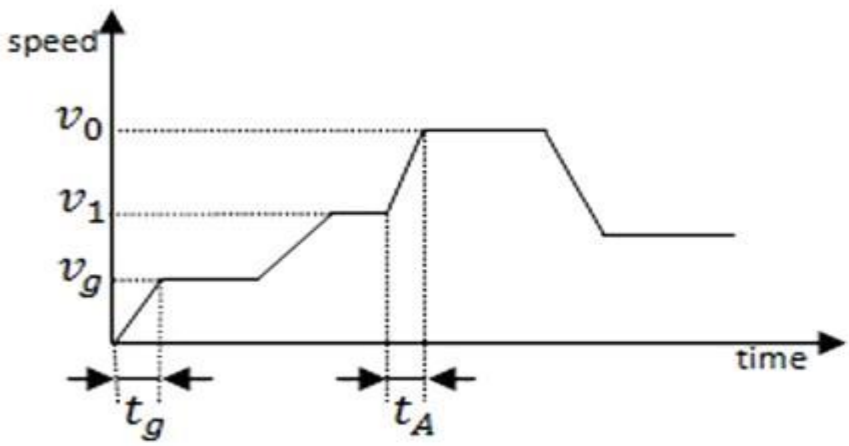

Fig. 9 Speed and Slope When Ascending Operating Pattern

DC Motor for Driving Linear Motion:

The DC motor is employed to help in the linear motion of the wheelchair. This motor is in turn controlled by the microcontroller. The type of motor generally employed is DC motors with higher RPM, torque and the one which can withstand higher capacity (weight). Any motor with higher performance can be used for this purpose.

IV. TECHNICAL DESCRIPTION

Fig 10 gives the brief idea about the process of working of Smart Rota Cathedra. It shows that there is a power supply in which there are batteries used which are of 12v each. They are connected to the 4 different operating modes that are Touchpad, Smart-phone, Flex Sensors and Push buttons. Touchpad, Flex Sensors and Push Buttons are further connected via wired system to Arduino and it is programmed. Whereas the Smart Phone is connected via a Bluetooth module and it is programmed with Arduino Uno. This Programmed Arduino will gives signal to the motor drive circuit and this motor drive circuit will command the motors to go in respective directions.

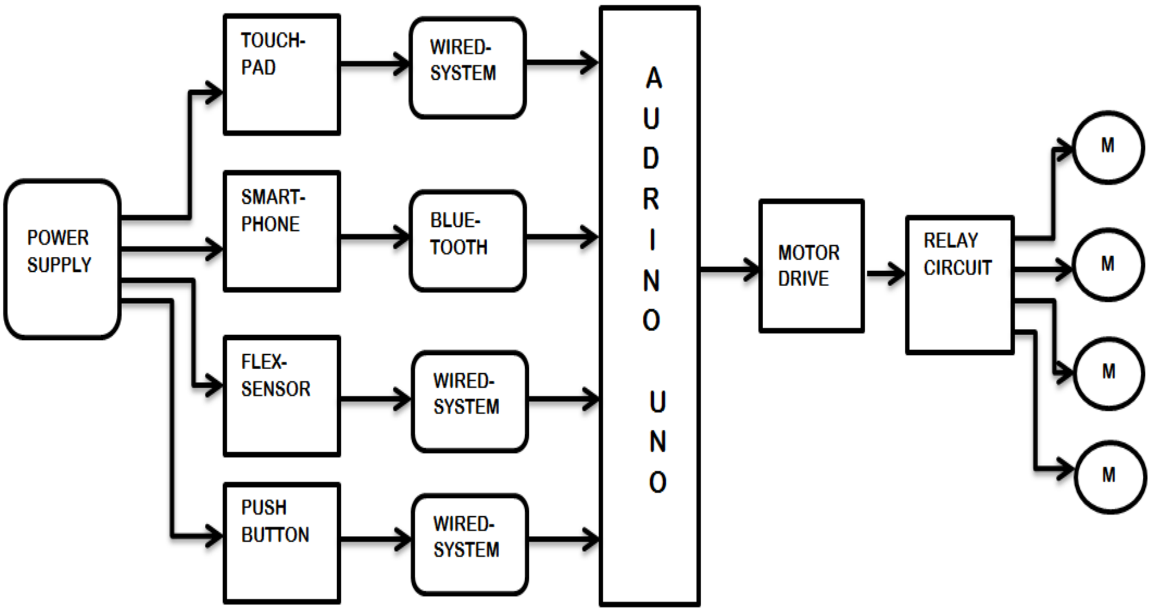

Fig. 10 Block Diagram

Controlling By Touchscreen:

The Construction of the proposed idea of Smart Rota Cathedra is having a direction controlled 4 wire Resistive touchpad. "Touch Pad"2 wires are connected to Microcontroller which is a reliable circuit. Another 2 wires 1 is given to ground and 1 are given to power supply. This Microcontroller will take over the task of controlling the motion of wheel chair by rotating the dc motors in desired direction. The user can control the direction of the wheelchair while moving simply by a small movement of the finger on the touchscreen.

Controlling By Hand Movement:

This Smart Wheelchair is to be developed to control the motor rotation of wheel chair based on head/hand movement. A flex sensor is fixed on the cap/glove which is to be wear by the person.

Based on the head/hand movement the accelerometer and the flex sensor will drive the motor fitted to the wheel chair. The wheel chair can be driven in any of the four directions.

Controlling By Smart phone:

This Smart wheelchair takes advantage of the application available on play store in smart phone and Bluetooth wireless technology enabling patients to move their wheelchairs by just tilting their Smartphone. This Microcontroller will take over the task of controlling the motion of wheel chair by rotating the dc motors in desired direction.

Controlling By Push Button:

The pushbuttons are place on the handle of the wheelchair which on pressing enables patients to move their wheelchairs by just pressing the buttons. This Microcontroller will take over the task of controlling the motion of wheel chair by rotating the dc motors in desired direction.

V. APPLICATIONS

1. Mainly helpful for the physically handicapped persons.
2. Useful for the aged persons who do not have ability to walk.

3. User can determine and control the direction of the wheelchair while moving simply by Small movement of the finger on Touch screen.
4. Tilting the Smartphone.
5. By simple movement of the head.
6. Provides easy movement for physically challenged people.
7. Easy to implement on any existing wheelchair and does not require sophisticated components.
8. Less expensive that completely built electric wheelchairs and many existing systems.

VI. FUTURE EXPANSION

1. By modifying this circuit we can use it in making the brain controlled wheel chairs. By capturing the small signals from the brain and amplifying it we can control the chair.
2. This can be modified to make gesture controlled wheelchair.
3. This smart wheelchair circuit can also extended to control it through thoughts of user.
4. This circuit can be also extended and controlled by breath of the user.

VII. LIMITATIONS

1. The limitations of this smart wheelchair is that its implementation is difficult compared to the normal manually operated wheelchair.
2. The cost is more than manually operated wheelchair but less than electrical wheelchair & eye and tong based wheelchairs

VIII. CONCLUSION

Controlling technique in the proposed system is unique and it is quite simple. Any type of disabled person wills able to operate this wheelchair with help of some new techniques this proposed system could be a boon for disables. This wheelchair can be made more flexible in future by upgrading the technologies used. User can give only 6 command signal to the wheel chair, which are start, stop, left, right, forward &backward. This system can be controlled by using touchscreen; flex sensors and smart phone further advancements can be done through more research. The interface and software can be modified and redeveloped according to the level of disability of the patient.

IX. SNAP SHOTS OF HARDWARE AND TESTED PROJECT

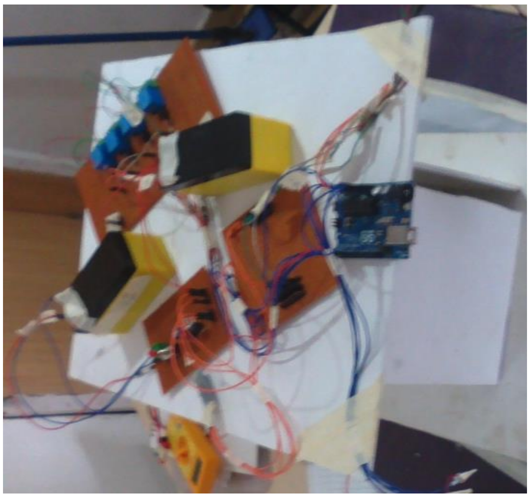

Fig. 11 Hardware of the Project

Fig. 12 Testing of Project

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