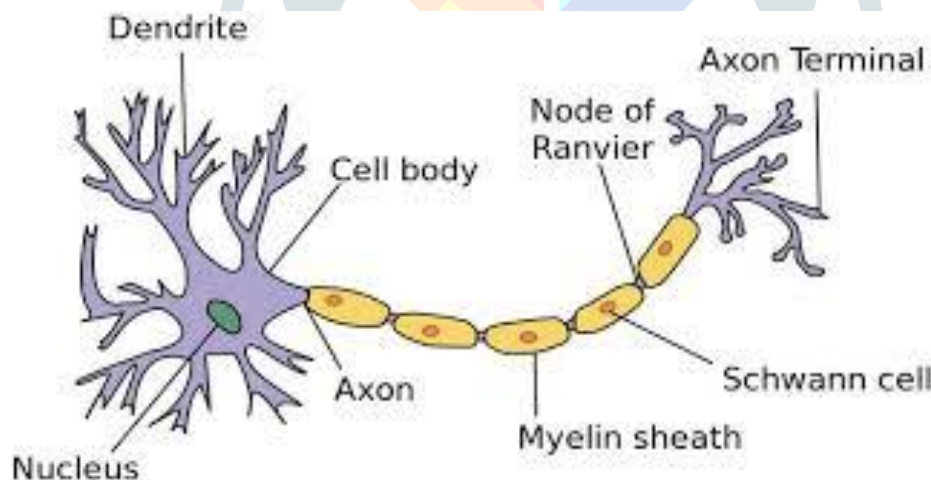# Using EEG based self-controlled Wheelchair for a tetraplegic person.

(RESEARCHER HARSH PATEL)

Abstract:- In this research paper, an EEG based brain controlled wheel chair used for Quadriplegic patients

This wheelchair has a specific purpose using brain computer interface (BCI) with the helping of the NeuroSky mind wave EEG sensor. Tetraplegic patients can not move because the loss of muscle moves in a part of their body. Success achievement of this device will help the paralysis patients to move one place to another place without any other help. The motion of the wheel chair is controlled by different brain activity like attention and meditation level of patients. An added sensor for patients security in front and back side of the wheelchair ultrasonic sensor is used because patients are not in control of their mind in emergency situations then this sensor is detected front and back wall and patients Do not hit with the wall.

Introduction:- The human brain is most typically part of the body. Approximately 86 billion neurons in the human brain. Most neurons receive signals via the dendrites and soma(central cell body) and send out signals down the axon.

 Neurons are created amplitude and frequencies like delta=1-3hz, theta=4-7hz, alpha=8-13hz, beta=14-30hz, gamma=>40hz EEG device is used to detect a different brain activity EEG based BCI(brain computer interface) is used to convert the paralysis patients different waves in mind.

The most paralysis patients are damaged lower of the neck and many more like hemiplegia which affects one arm and one leg on the same side of their body. paraplegia which affects only legs. quadriplegia or tetraplegia which affects both leg and arm. Monoplegia which affects only one arm and leg of side of the body.

Tetraplegic is most caused by road accident **monoplegia** is often caused by cerebral palsy. It can also be caused by an injury or trauma to the brain, spinal cord. Every year more than 1.50 million people die in road traffic accidents. Most two and four wheel accidents for 50% of the spinal cord is damaged. In some situations some older people walk in a sleepy area and they balance their body. That is the reason they fall in the back side and the spinal cord is damaged and cracked. In the current ratio estimated 40 to 80 cases **per** million population are paralyzed.

A number of previous learning brain waves signals are different applications using BCI EEg based BCi have been used to check their brain activity in different waves.

In this research only the attention level is needed to drive a wheelchair. According to patients are paralayzed but upper neck part is working completely than a patient, try to concentrate on mind than obviously change in attention level and a patients are gone from one place to another place without any help. Tetraplegic patients are shown a one problem which is if any person mind is not control yourself and a front side of wheelchair any object or wall is come than a wheelchair is not stop and patients are collide with wall than a patients are not safe fully. Patients are off or on their devices then they close their eyes (for EX: 2 second).
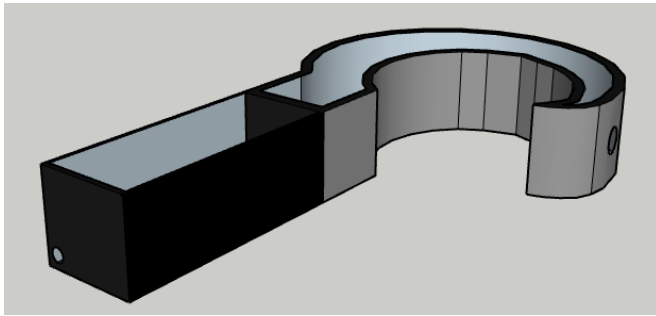
This type of problem shows a patient this reason one sensor is added in the front and back side of the wheelchair.

The sensor is working a distance to measure and object and wall. Ultrasonics sensor is working a distance is an electronic device that measures the distance of a target the object by emitting ultrasonic sound waves. These waves convert reflected sound into an electrical signal. This sensor detects the object and immediately stops the wheelchair in any waves. This sensor is useful for stopping a wheelchair in any situation.
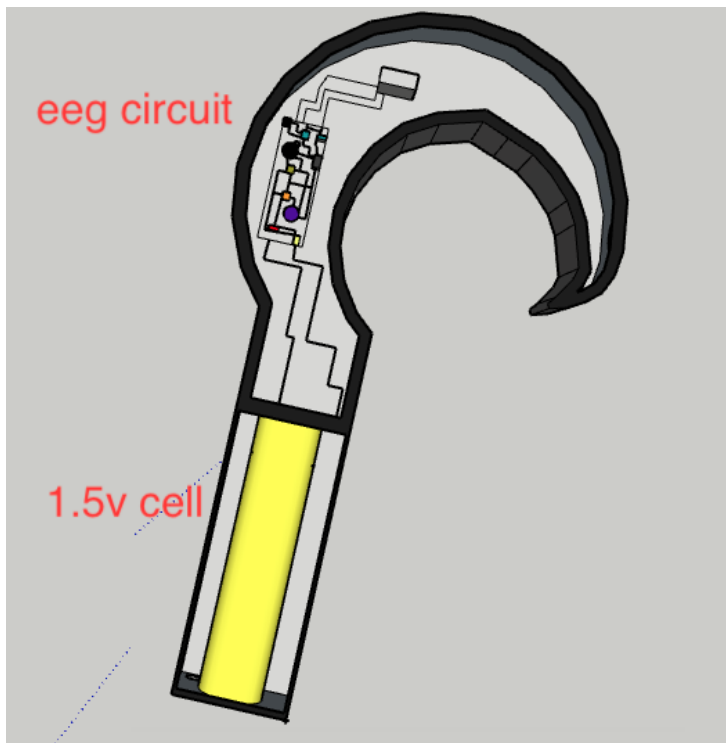
In this paper EEG based brain controlled wheelchair is intended for tetraplegic patients to be used in daily life and then to move on their own will. Directional movement of the wheelchair is controlled by the attention level of patients. This wheelchair is controlled very easy and also secure for patients.

A. mindwave neurosky headset

The neurosky headset is safe to use and measure different waves like(delta,theta,alpha,beta,gamma).
The head set information the ground electrodes are on the ear clip,while the EEG dry electrode is the main electrode
this sensor places on the forehead above the eye.

This design of mini-mind waves headset (mmhs) is very small and easy to wear. A small circuit of bci is placed on the left ear of the back side.

B. attention level calculation

With a sample rate of 512 Hz, EEG(electroencephalogram) data were recorded at 16-bit quantise level using NeuroExperimenter. For simplification of the data processing method, EEG data were processed through a low-pass filter, whereas the cut-off frequency is 50 Hz. An algorithm, Fast Fourier transform (FFT) was working, which is used to sample a signal over a period of time and then part it into its frequency parts. Here, FFT transforms a segment with 512 sampling points to the frequency domain. Overlapping with the previous segment, the samples were segmented with 256 points. Assuming F(n) is the FFT result of a sample segment, where, n = 1, 2, 3, ..., 512. So, the associated Power Spectral Density (PSD) is calculated using Eqn.1.

$$E(n) = \frac{f(n)\, f*(n)}{N}$$

Where, F*(n) is the conjugate function of F(n) and N is the

number of samples which is 512.

There are five types of brainwaves, which exist in EEG signals, they are α, β, δ θ and γ. But testing of those waves that output the brain is α, β, δ, and θ are related to human's different mental states. According to the brain waveband issue of the EEG the simplified energy is the summed value calculating from raw EEG signal amplitudes to produce those four different features. If E is the energy value of different frequency levels, the four features can be defined from Eqn.2 to 5 respectively.

Eα=$\Sigma 13$freq=8 E freq

Eβ =$\Sigma 40$freq=14 E freq

Eθ =$\Sigma 8$freq=4 E freq

Eδ =3freq=0.5 E freq

In additional information the activity of the brain is indicate α and β waves.the relaxation of the patients is continuous changes in mental state the ratio of the waves is α and β activity is calculated
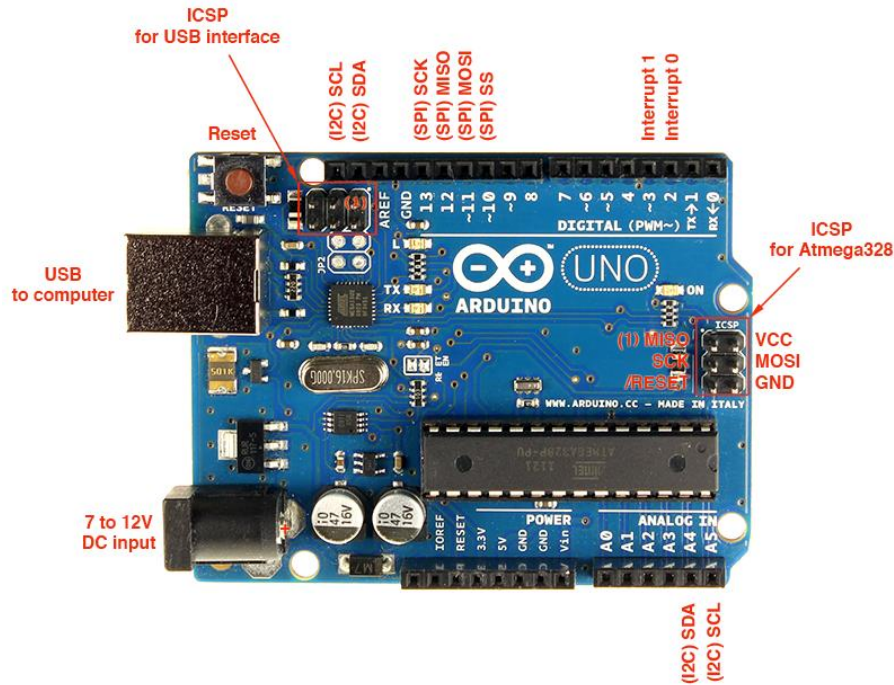
$$R = \frac{E\alpha}{E\beta}$$

The R is the measure of attention level.

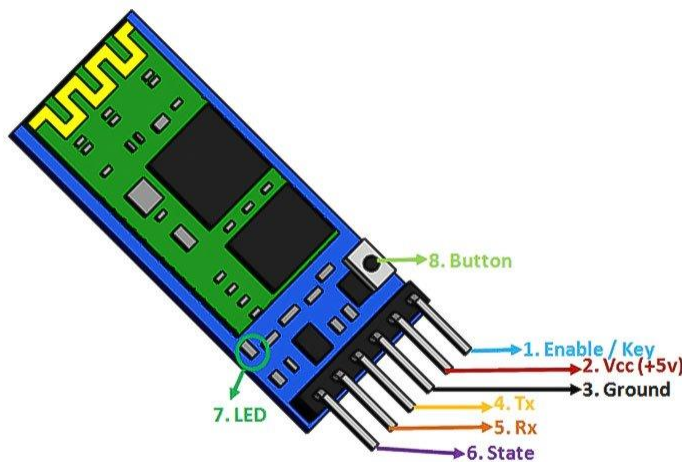## C. bluetooth with mindwave and sensor use

The data of the headset is shown in arduino software in serial monitor alpha and beta waves is obtained from neurosky and sent into the bluetooth module .The bluetooth module has received the data and processing data in arduino and sent it to the command for wheelchair.
In this wheelchair development arduino uno,bluetooth module(HC-05),mind waves(neurosky) and ultrasonic sensor.

Arduino uno:- Arduino is an open source hardware and its use for multiple projects. arduino are able to read input light on a sensor and a finger on a button . In this hardware basically c and c++ language are used. I am using Arduino uno.

Bluetooth module(HC-05):- bluetooth module is an easy to use spp (serial port protocol) module designed for transparent wireless connection This module is easy to use and pair with other devices ex:(neurosky). This module is master and slave both which means it is able to use neither receiving nor transmitting data.

Mind waves(neuro sky):- the neuro sky mindwave is an EEG headset and it's used to measure their brain activity in different waves.headset ear clip is used to ground.

Ultrasonic sensor:- this sensor is used to measure distance. It works by one sensor a waves transmit and the second sensor receives the waves then an ultrasonic sensor measures the object and distance.

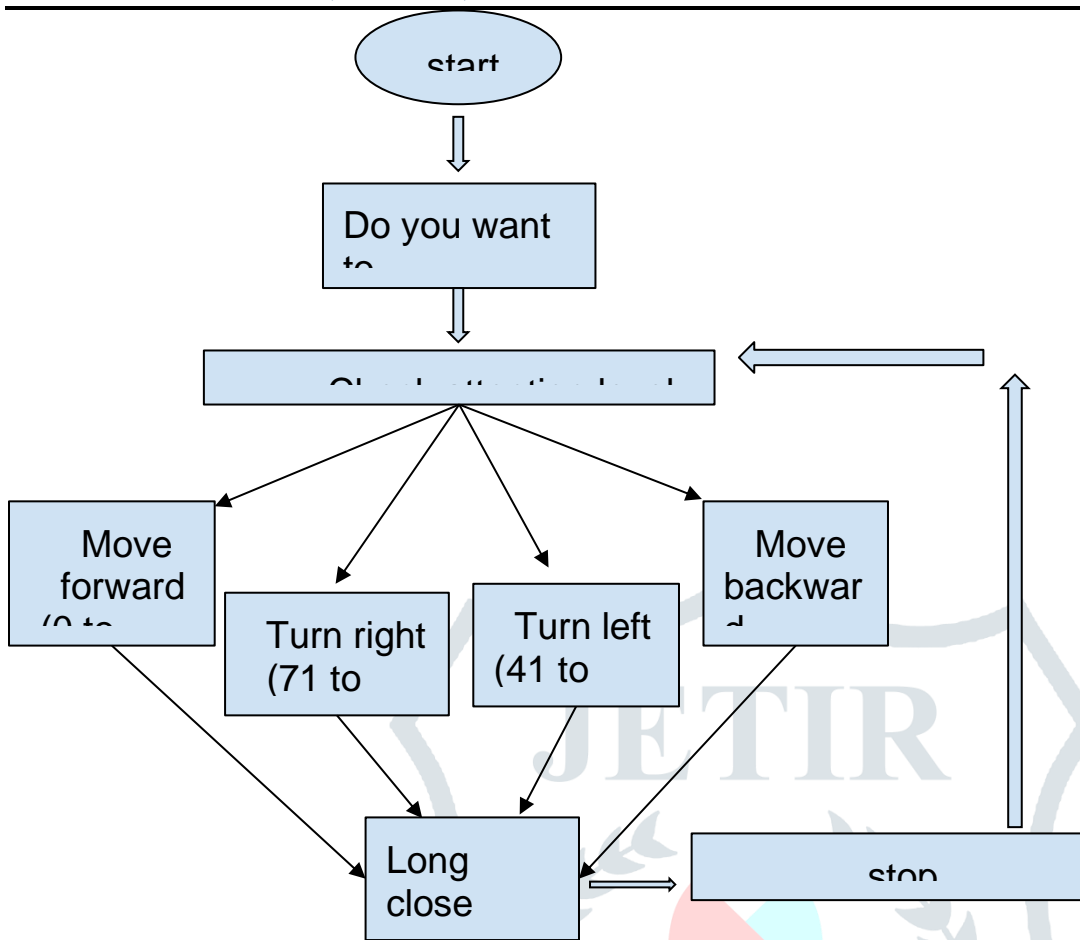## D. motor with arduino and sensor connection.

Two 12v dv (2500rpm) motors use a back wheel of the wheelchair .2000 mah lithium polymer (lipo) battery for whole power supply .

(add all connection power supply design)

Data result and discussion:- The diagram of attention level for wheelchair is shown in figure1.3 . if the patient wants to move from place to place the patients try to pay attention to his mind then they are gone . In emergency situations patients try to stop the wheel chair but the attention level is high and in front of the wheelchair wall is shown and a sensor is detected and immediately stops the wheelchair.

image of start to stop of wheelchair diagram

start

Do you want to

Check attention level

Move forward (0 to

Turn right (71 to

Turn left (41 to

Move backward

Long close

stop

When the patients wants to move the arduino uno on the wheel chair check the attention level and send it to signal through mindwaves and receive the signal from bluetooth wireless communication if the attention level of patients from 0% to 40% wheelchair move forward 41% to 60% will turn right 61% to 90% turn left and value greater than 90 %wheelchair will move backward.

(different waves frequency recording)

Frequency band	Speed (Hz)	Mental state	Electroencephalography (EEG) recording
Delta	1-4	Deep sleep	Slow
Theta	4-8	Drowsy	
Alpha	8-12	Relaxed	
Beta	12-30	Focused	Fast

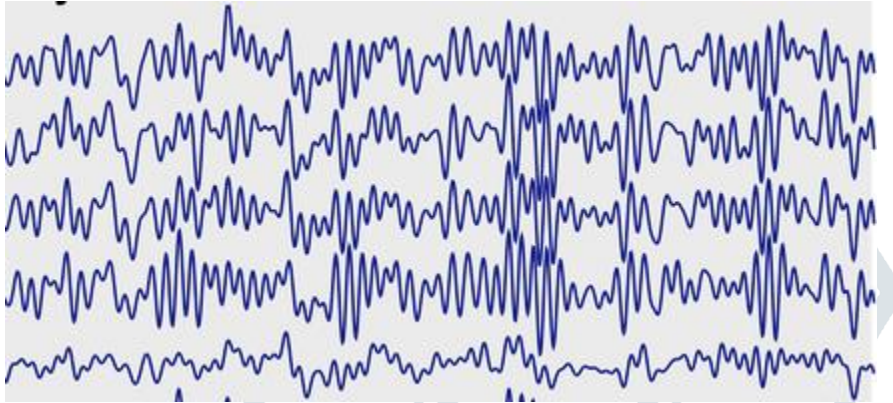1 second

Result of long eye blink and discussion

The waves are produced from the left lobe of the brain which is alpha 1, beta 1 and right lobe alpha 2, beta 2.
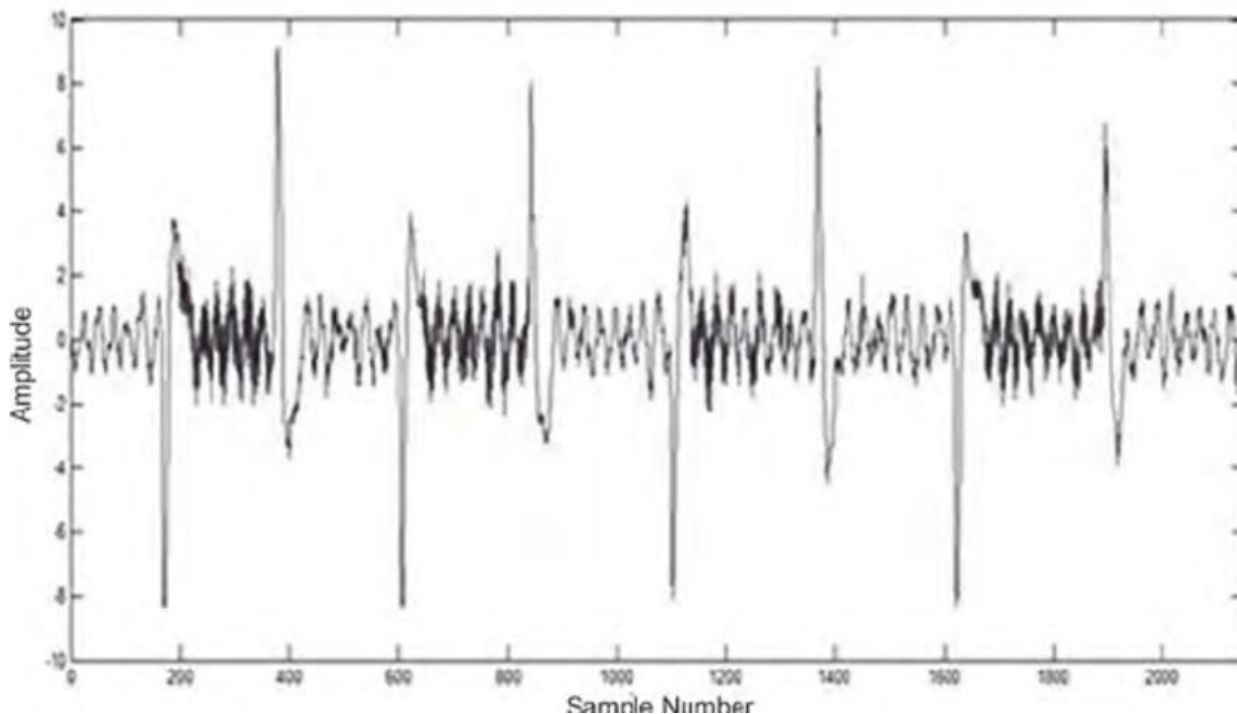
The data of alpha 1 and 2 waves and beta 1 and 2 waves are taken from patients to check attention level.

image of long close eye

Patients want to start the device and they want to go then they close their eyes for a long time and close it like a device depending on the previous condition.

image of normal eye blink

Check attention of patients is shown in arduino software in serial moniter the value of attention level is seen in this image .the patients are close for long their eyes than a poor quality is change 0 to 50 or 40. If the patients open the eye the poor quality is normal which is 0.

serial monitor image

```
PoorQuality: 0 Attention: 4 Time since last packet: 277
PoorQuality: 0 Attention: 8 Time since last packet: 988
PoorQuality: 0 Attention: 13 Time since last packet: 995
PoorQuality: 0 Attention: 17 Time since last packet: 993
PoorQuality: 0 Attention: 57 Time since last packet: 992
PoorQuality: 0 Attention: 67 Time since last packet: 998
PoorQuality: 0 Attention: 93 Time since last packet: 994
PoorQuality: 0 Attention: 100 Time since last packet: 991
PoorQuality: 0 Attention: 83 Time since last packet: 993
PoorQuality: 0 Attention: 97 Time since last packet: 993
PoorQuality: 0 Attention: 96 Time since last packet: 993
PoorQuality: 0 Attention: 90 Time since last packet: 998
PoorQuality: 0 Attention: 100 Time since last packet: 991
PoorQuality: 0 Attention: 100 Time since last packet: 1001
PoorQuality: 0 Attention: 93 Time since last packet: 987
PoorQuality: 0 Attention: 84 Time since last packet: 994
PoorQuality: 0 Attention: 75 Time since last packet: 993
PoorQuality: 0 Attention: 77 Time since last packet: 995
PoorQuality: 0 Attention: 87 Time since last packet: 991
PoorQuality: 0 Attention: 96 Time since last packet: 994
PoorQuality: 0 Attention: 100 Time since last packet: 996
PoorQuality: 0 Attention: 100 Time since last packet: 990
PoorQuality: 0 Attention: 97 Time since last packet: 1000
PoorQuality: 0 Attention: 88 Time since last packet: 989
PoorQuality: 0 Attention: 63 Time since last packet: 1002
PoorQuality: 0 Attention: 53 Time since last packet: 986
PoorQuality: 0 Attention: 63 Time since last packet: 997
PoorQuality: 0 Attention: 70 Time since last packet: 990
PoorQuality: 0 Attention: 69 Time since last packet: 1016
PoorQuality: 0 Attention: 75 Time since last packet: 970
PoorQuality: 0 Attention: 74 Time since last packet: 997
PoorQuality: 0 Attention: 75 Time since last packet: 993
PoorQuality: 0 Attention: 90 Time since last packet: 995
PoorQuality: 0 Attention: 74 Time since last packet: 998
PoorQuality: 0 Attention: 51 Time since last packet: 989
PoorQuality: 0 Attention: 24 Time since last packet: 1003
PoorQuality: 0 Attention: 11 Time since last packet: 985
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conclusion

The tetraplegic patients are increasing day by day and they are suffering from moving one place to another place. This is the reason we are helping through technology.The wheelchair is implemented for tetraplegic patients they can easily move without any help. The patients will able to move four direction with help of attention level.one issue and problem can face the patients which is the battery of the wheelchair is re-charge use of daily with helping other but my upcoming future plan is the battery is charge automatic with help of G.P.S(global positioning system) is find near plug and re-charge battery automatically.