# Brainwave Controlled Wheelchair for the disabled using Microcontroller

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***Abstract - Designing a wheelchair for the patients with severe loco motor disorder such as poliomyelitis, motor neuron disease is a challenge because it should provide easy mobility without the involvement of limbs. Such patients are in a condition of being not able to move any limb below their neck. An attempt has been made to propose a brain controlled wheelchair, which extracts the brain signals and processes it to control the wheelchair. The method of extracting brain signals is known as Electroencephalography (EEG). Electrodes are placed on the user's head which extracts the brain signals and converts it into movement commands by the arduino microcontroller which in turn moves the wheelchair.***

***Key Words: Electroencephalography, Neurosky headset and brainwaves***

## *I.* INTRODUCTION

According to the statistical data, the percentage of physically disabled persons among the entire disabled person is 33%, which is the second majority of the disabled person. Since the physically disabled person is one of the major contributions to total number of disabled people, this indicates that the amount of disabled persons who lost their mobility are substantial. Wheelchair is the most common device that is used to provide mobility for the physically disabled and sometimes elderly people.

EEG is the most suitable method to be utilized for retrieving the signal of brain activity in order to implement the Brain-computer interface system. This is because the EEG device is portable and non invasive. EEG is a method that captures electrical waveform from the brain. These signals are captured and will be transmitted to the computer for further processing. The patterns of the electrical waves that produced by the brain is distinctive due to different kind of thoughts. There are two methods of obtaining brain waves, Invasive method and Non-invasive method[1].

It is very expensive and sometimes dangerous too. Non-invasive method involves capturing brain signals from outside the brain that is by placing electrodes on the scalp or on the forehead. During the EEG signal processing the raw EEG signals are processed in a manner to differentiate the mental commands that are thinking by the user. After obtaining the mental command, it is used to produce the electrical control signals for controlling the movement of the wheelchair[3].

## II. BLOCK DIAGRAM OF PROPOSED SYSTEM

The system mainly includes Mind wave Headset (signal acquisition), mobile app (Brain controlled wheelchair), Bluetooth module (HC-06), Arduino Uno microcontroller, motor driver and the Wheelchair. The headset is used to capture the brain signal as shown in fig 1.

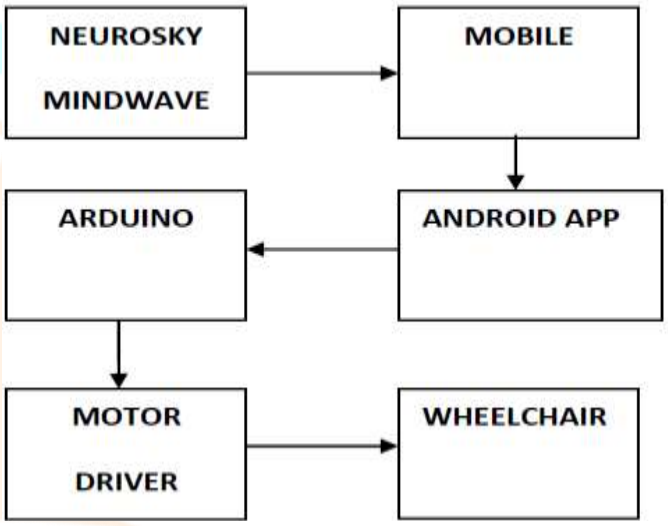



**Fig 1: Block Diagram of Proposed system**

The signal is sent to the mobile app which recognizes the commands sent by the user. The app sends this command to the arduino microcontroller via the Bluetooth module. The arduino sends command signals to the motors in the wheelchair according to the output of the headset. Now the disabled person on the wheelchair can move accordingly.

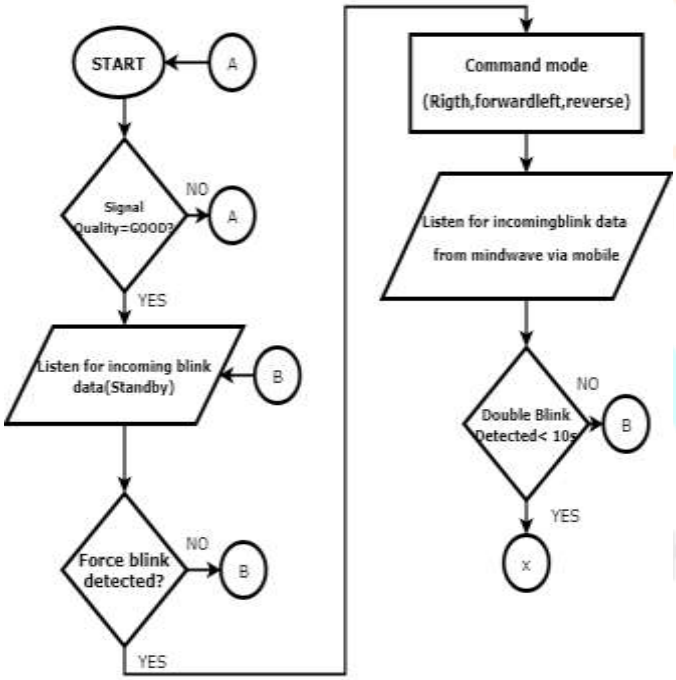
- **ANDROID APP**

Android application GUI is shown below Figure.2. The application has two buttons: one to connect the app to the HC-06 Bluetooth module and the other to connect the app to the mind wave Mobile. On startup, the connect button for the Mind wave Mobile is disabled - it will only be enabled once connection with the HC-06 Bluetooth module is established [4].


**Fig 2: Android App**

The app displays six text values relevant to the operation of the wheelchair. Signal quality indicates whether the connection to the Mind wave Mobile is not detected, poor, medium, or good; attention level displays the users current attention level; state displays whether the wheelchair is currently in standby, command, focus or running mode; direction will only be activated when the current state is command and will cycle between the forward, backward, left, and right directions; normal blink strength will display blink strength values below the threshold value of 90; last, forced blink will display blink strength above the 90 threshold value.

## III. METHODOLOGY



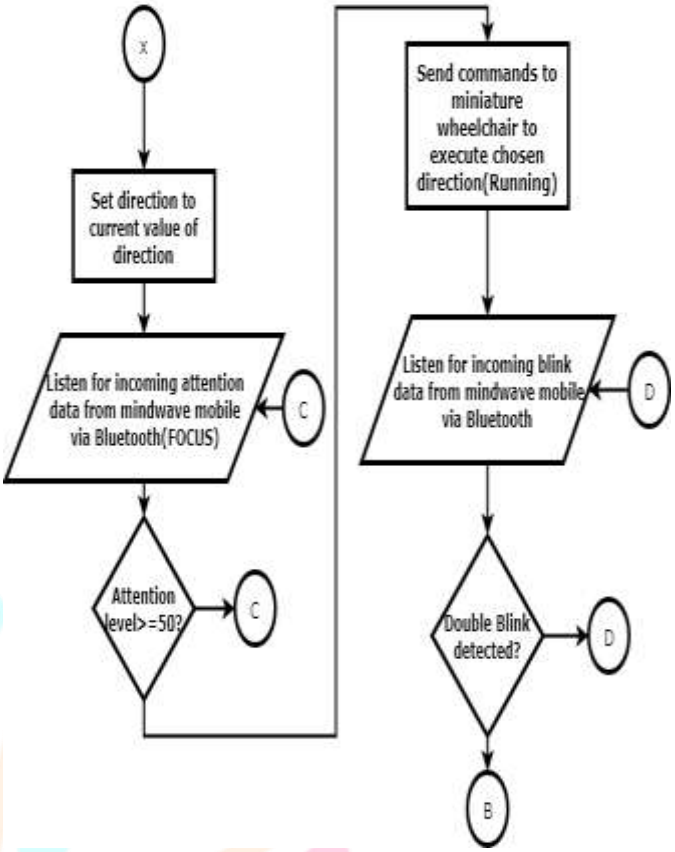




**Fig 3: Android App working methodology**

Step1: Analyze the brain signals and check if the signal quality is good.
Step 2: If the signal quality is poor or fair check again on a continuous loop
Step 3: If the signal quality is good, then check for blink signals. The app will be in standby mode.
Step 4: If force blink is detected, select the command mode (left, right, forward, reverse) as shown in Fig 3.
Step 5: If not, then check again for blink values.
Step 6: Check for incoming data coming from the mind wave headset via mobile.
Step 7: If double blink is detected then, set direction of the wheelchair to the current value of direction selected.
Step 8: If not, repeatedly check for double blink values.
Step 9: Check for attention values from the mind wave app via Bluetooth.
Step 10: If the attention value is greater than 50 then, send commands to the wheelchair to execute wheelchair to the chosen direction. The wheelchair starts moving.
Step 10: If not, keep checking for attention values greater than 50.
Step 11: Check for any blink values from the mind wave mobile via Bluetooth
Step 12: if double blink is detected, repeat from step 3.
Step 13: If not, then keep checking for blink values.

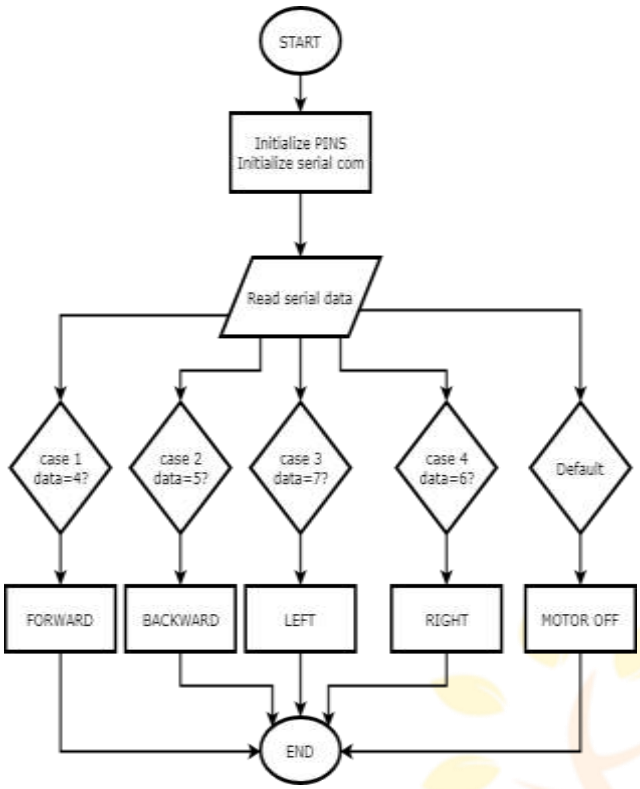



**Fig 4: Arduino Control**

Above Fig 4 explains the conditional step by step execution of the wheelchair using brainwave controlled mobile application.
Step 1: initialize the arduino pins and the serial communication
Step 2: read the serial data sent by the mindwave app
Step 3: Case1: if the serial date is 4 then, move the wheelchair in forward direction.
Step 4: Case2: if the serial date is 5 then, move the wheelchair in reverse direction.
Step 5: Case3: if the serial date is 7 then, move the wheelchair to left.
Step 6: Case4: if the serial date is 6 then, move the wheelchair to right.
Step 7: Case5: if the serial date is any other values then, turn the motor off.

## IV. DESIGN AND IMPLEMENTATION

As result, an electrical wheelchair which is able to function as a common electrical wheelchair is developed. Android based Application for this project is developed as shown in Figure.5. This algorithm is able to read and process the EEG data from the Neurosky mind wave headset into mental command. After processing, this program sends out the command signal to the connected HC-06 on the microcontroller board of the wheelchair. In the end, the electrical wheelchair is able to move according to the user's desire [4]. By using this application, the electrical wheelchair can be directly controlled by human brain.

**Fig 5: Proposed wheelchair model**

## V. EXPERIMENTAL RESULTS

The results show that the processed EEG data does not provide 100% accuracy according to the human mental command. However, it can achieve up to 75% of accuracy. The testing results for mental commands are shown in table 1.

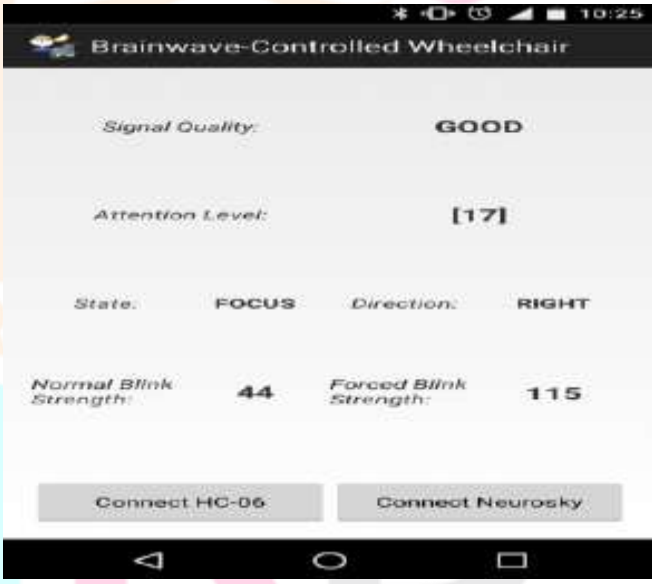



**Fig 6: Running mode of wheelchair using app**

The above Fig 6 shows the running mode of wheelchair using android application which indicates the working status of wheelchair Signal quality, Attention level, State and Direction of movement with respect to the eye blinking strength**.**

**Table -1: Result Summary**

| Directions | No. of attempts | No of attempts successful | No of attempts failed |
|---|---|---|---|
| **Forward** | 10 | 8 | 2 |
| **Reverse** | 10 | 7 | 3 |
| **left** | 10 | 7 | 3 |
| **Right** | 10 | 8 | 2 |

## VI. CONCLUSION AND FUTURE SCOPE

The movement of the wheelchair will be solely configured to the signals generated by the mind thus negating any physical force required. User based or specific modules can be created thus generating a unique footprint. It uses upcoming and ever evolving technology that will enable easy and manageable iterations.

In future many enhancements can be done like an obstacle in the way could be detected automatically by the wheelchair forcing it to stop. The wheelchair could be integrated with head movements to control factors such as speed and brakes.

## REFERENCES

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## BIOGRAPHIES

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