TEKNOFEST

AEROSPACE AND TECHNOLOGY FESTIVAL

TECHNOLOGY FOR HUMANİTY COMPETITION

PROJECT DETAIL REPORT

PROJECT CATEGORY : Disabled Friendly

PROJECT NAME :CONTROL AND AUTOMATION OF ELECTRIC HEELCHAIR USING EEG AND IMAGE PROCESSING/AI ALGORITHMS

TEAM NAME : Byte optimizers

TEAM ID :#49540

TEAM LEVEL : High School

TEAM MEMBERS : Rubab, Afshan

ADVISOR NAME : Muhammad Aijaz khan

Project Detail Report

1. Project Summary:

In this modernized era with leading mechanization, which can perform intricate tasks, there is a deprivation of adjunct in the locomotion of impaired population. To overcome this problem there are multiple proffers presented, such as brain-controlled wheelchair. There has been commodious research over this, many archetypes and approaches have been done to dispatch the arduous situations in the disabled people's life. But however, the various techniques applied are either expensive or hellacious to use. Our prototype aspiration is to build a wheelchair which is user friendly to use and less stressful over the user.We accomplish this from EEG **electroencephalogram**, which is non-invasive and portable. This hands-off wheelchair provides the disabled people to control their locomotion according to their necessarily with no use of hands as long as they are mentally sound. The tactics used are productive, and the outcomes show that the wheelchair can be moved with a user grade low-expenses EEG devices, and alongside the AI is shown to be both fast responsive.

AIM

The aims of our archetype is that we aim to build a wheelchair that a disabled person doesn't need to specify direction, only a general one and the AI will decide the path to the destination.

OBJECTIVES

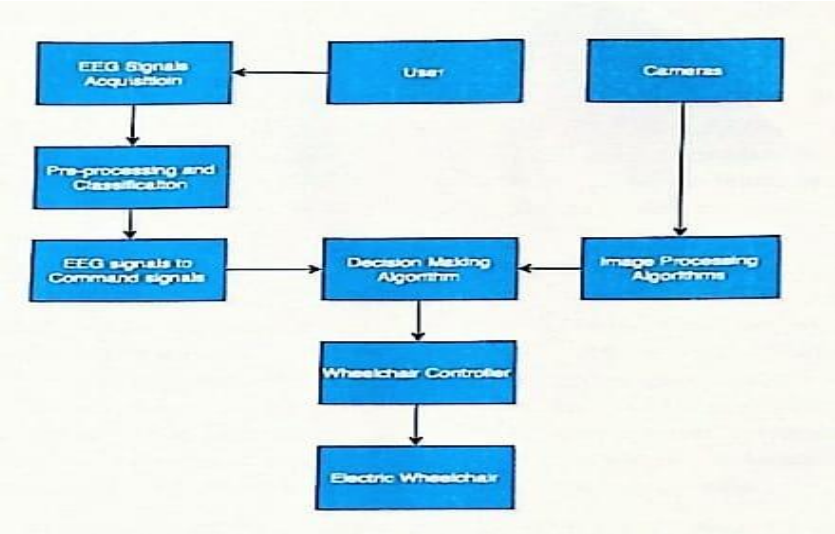
- Our objectives are to design a cost-effective automatic electric wheelchair.
- To control the wheelchair directly using EEG waves.
- To use AI/image processing for assistance in control.
- To have an integrated control system which is flexible and can be optimized easily.

It is programmed with intelligence through the use of cameras and powerful SBC **single board computer.** The cameras help in detecting obstacles and avoiding them in real time using stereo vision through depth perception. While SBC is responsible for processing the signals and images, while simultaneously controlling the wheelchair. The wheelchair in our project is custom built, along with the control circuitry.

To provide some automation, some intelligence is required to be added to the system, there have been several methods proposed and implemented in the field for the past few decades, one of which is computer vision along with artificial intelligence. In a controlled environment a computer-vision based feature extraction system can detect objects as demonstrated in [25], they used a haar-like feature based cascade classifier to detect regular objects. In the field of computer vision one of the most popular libraries is OpenCV [26], it is based on C and a wrapper can be used in python. The systematic applications used are Cortex API **application program interface** version 2.0. the JSON **java script object notation** gives the power to the application to communicate with severs in a defined way by removing the ad-hoc code. It is basically the encoding scheme that follows the web socket protocol.

The design is based on the user interface. This wheelchair design is based on two things the controller and the cameras. Further they are divided to be based on building it the command to move towards the object would be achieved through EEG signals acquired from the user, such signals include but are not limited to general directions. Moreover, we will be able to toggle between the manual and autonomous control, it would be worked as the user passing out the EEG signal acquisition by pre-processing and classification and turn the EEG signals to command signals and on other hand with the user would work the cameras that would be based upon the image processing algorithms and when both will have the connection, so there would be decision making algorithms that make the wheelchair controller and the electric wheelchair accomplish. due to less hardware requirement the expenses will also decrease and so will the hardware complexity. Thus reducing the risks of hardware failure, which can make it more accessible to middle class people.

High level flow chart of design



2. Problem/ Issue:

Essentiality and complications

According to the statistical data provided by the department of social welfare there are total of 1 billion people with disabilities which is about 15% of the world population. The percentage of physically disabled persons among all disabled persons is 33% which is second majority of disabled persons worldwide. Most of the physically disabled people are facing the difficulties to move around freely. Since the physically disabled people are one of the contributions to the total number of disabled persons, it indicated that the number of physically disabled people that have lost their mobility are substantial. An electric wheelchair is the common device that is used to provide mobility to the physically disabled persons. The input methods that are made for these kind of people includes sip-and-pff method, single switches, and eye tracking systems. The problem is that these methods are not suitable for the people with severe physical disability and for people with ALS **amyotrophic lateral sclerosis**, MS **multiple sclerosis**, or strokes. These people are not capable of communicating their thoughts with the electric wheelchair using the methods defined above. Another solution is autonomous robot but due to the fact the safety is very important when we are dealing with a disabled person, this is not a good choice and also people want to be charge of their locomotion so the decisions that a fully autonomous wheelchair makes can give rise to stress to the person. BCIs **braincomputerinterfaces** solves these problems which does not involve any kind of physical movement to give input to the wheelchair and control it. BCIs are way of interfacing human mind with computer that is, it is a direct communication interface between human mind and computer and nowadays a most commonly used input methods for severely disabled personals. There are two commonly used methods for developing BCI

1. Invasive methods
2. Noninvasive methods

Invasive methods require surgery to put into a person's heard and is not commonly used for this reason.

Noninvasive method on the other hand does not require any surgery the sensors just rest on the person's head and take the signals. Noninvasive methods can take the input from the human subject in different ways such as EEG, BOLD **blood-oxygen-level-dependent** signals, MEG **magneto encephalograms**, de **oxyhemoglobin concentration**. Because of come benefits like low expenses and easiness to use the EEG is commonly used methods when it comes to develop BCIs. Conventional EEG based control systems are usually very stressful for the user. A lot of the time it requires substantial training and too much time, and at best it is possible and at worst clumsy. However, if we remove some of the active control and instead opt for automation by the way of image processing/AI, may of the redundant tasks which user usually had to perform actively can be performed automatically.

Objectives

The main objective of our project is to construct a wheelchair which can be directly controlled by the brain without requirements of any physical feedback as controlling input from the user. The method employed in this project is the BCIS using EEG. EEG signal is also known as brainwaves signal. The EEG signals from artificial intelligence will be in providing object detection and obstacle avoidance using only cameras with the computer visions

3. **Solution**

Clarification of solutions

Signal accession from brain activity using BCI can be done through either invasive or noninvasive means, where people almost always prefer noninvasive. In BCI we used EEG due to its low cost and convenient use. The endeavored strategy since it used cameras, is of low expenditure and less bulky as comparison to other such archetype. The use of only cameras as opposed to an array of other sensors, can reduce the cost of repairs as well. Cameras also tender the high ground of authorizing the machine to apprehend thee objects and construct it more interactive. Using object recognition, we can also expand the safety of the user as it can also detect short abrupt changes in elevations (small pit falls etc.) as opposed to using ultra-sonic sensors to achieve the same effect. Due to its software heavy design, it can also be upgraded quite easily, as a quick firmware upgrade can add new features and remove any existing bugs. We can also apply facial detection to recognize familiar people. It also decreases the anxiety and stress over the user due to its semi-automatic nature. The user will also have the option of both fully manual and autonomous control. The manual control will provide more precise control.

Final hardware figure

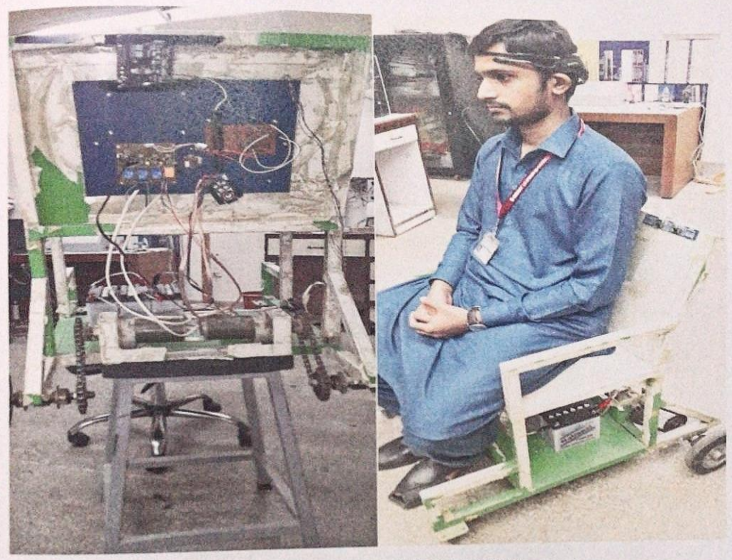


Figure 4.1: Finalized Hardware Build

4. **Method**

Innovation and originality based on your solutions and problems

The overall methodology used is parallel processing of two signals one of which is an EEG signal and other is image signal. First human will perceive the environment and at the same time the cameras will perform the task of image acquisition. The human subject will take decision based on the perceived environment in which direction to give the wheelchair the motion. The live feed of environment is taken through two cameras in order to measure the distance from the different objects. These will be two processes running out in behind. First is the process of EEG signals, EEG signals processing means extracting the commands from the signal that will be needed to determine in which direction the human subject want to go. The EEG command before being implemented will be pre-processed and classified according to a linear classifier, and then using ERD/ERS **event related desynchronization/synchronization**, we will assign proper commands to corresponding control signals.

Overall design methodology

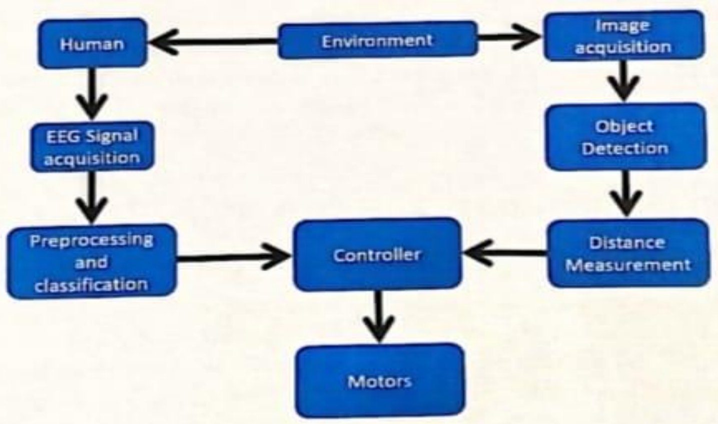


Figure 3.1: Overall Design Methodology

The strategy used for image processing is based on machine learning and depth mapping using stereo cameras. Stereo camera setup was used as opposed to an ultra-sonic sensor because of inherent advantages of light-based vision. With a stereo camera setup not only we create depth map from disparities, but we can also apply machine learning to images. An ultra-sonic sensor while being more accurate cannot provide accurate information about geometry of the object alongside strict boundaries for objects, and it also cannot be used for long range applications. The image processing section of the equidistant processing will deracinate the images from the environment and determine the object present in those images after detecting those object our image processing algorithms will measure the distance from each of the object existing a frame and also the object detection algorithms will give us the boundaries of object from which we have to keep our wheelchair away. If there is no object near the wheelchair and the wheelchair can move freely the main controller will decide to move the wheelchair in the direction and if there is an object instant whose expanse less than the threshold values, then the main controller will find a way to avoid that object and make a move in the direction decided by the human subject using EEG signals. If the wheelchair cannot be moved in the direction decided by human subject due to some objects present then the wheelchair will not move hence giving the feedback to human subject that going to this direction is not safe for any reason like there are stairs in this direction, there is a suspended object in this direction, there is wall in very near to your wheelchair etc. bases on both the image captured from cameras and the commands extracted from EEG signal our controller will decide in which direction the wheelchair should move and will send the signal to motor controller to move motors accordingly.

Components selection/use

The selection of the components is specified following:

1. JETSON NANO DEVELOPER KIT

   For processing of the image based information ie. Computer vision, we went with Nvidia's Jetson Nano Developer Kit. We compared many SBXs and in last concluded that Jetson Nano developer kit has the best performance for image intensive tasks GPU.

   Following are the significant technical specifications of this device

   - The Jetson Nano has 1228-core Maxwell based GPU, the main reason it is so good at image processing.
   - One of the other main reasons to choose this device was the provisions of two MIPI CSI-2 DPHY lines, which means we do not need an extra multiplexer for connecting two CSI cameras to the device. Furthermore, without the need for multiplexing we can work around the issue of camera synchronization as well, as the lanes are independent from one another while being driven from the same back clock signals. A time-division multiplexer wouldn't have been sufficient for that. However, only the b01 revision of board has two CSI-2 DPHY lanes, while the previous revisions only had one lane.
   - It has the same CPU as the raspberry pi4, Quad-core ARM A57 with 1.43Ghz clock speed providing it with a decently fast processor.
   - The amount of system memory is 4GB at 64bit memory bus LPDDR4 giving it read/write speed of 25.6GB/s which is more than enough for our particular work.
   - For networking it has a gigabit Ethernet port, and a M.2 key E slot underneath the main processing module, which can be used to attach a wireless access card to the device.

Jetson Nano Developer Kit

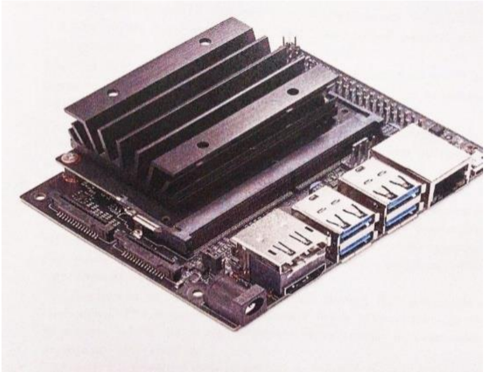


Figure 3.2: Jetson Nano Developer Kit

2. EMOTIVE INSIGHT

   One of the central devices in our project is the EEG headset. For this we looked up for several options, based on their specifications and their prices, we settled on Emotive Insight for our EEG processing.

   Following are the significant technical specification of this device

   - It has five electrodes with five channels for the acquisition of EEG data, there are two reference points on the lest mastoid process. The electrodes are fitted with three prong gummy sensor for the better hair penetration, with a hydrophilic semi-dry polymer as the material used in its construction for the better reception of signals.
   - The EEG signals are sampled at a sampling rate of 128 samples/second for each channel. The ADC is 15 bits with the LSB resolution of 0.51μV.
   - The frequency response characteristics is given in the range of 0.5-43Hz with a digital notch filter at 50Hz and 60Hz to remove ambient electrical noise from electricity supply lines.
   - The device can be connected to the computer both wired and wireless connection. The wireless communication mode is done through low energy Bluetooth, while the wired communication mode is done with 2.5GHz proprietary USB receiver.
   - Emotiv provides software support for the device as well, which includes Cortex API, which can be used for the interpretation and classification of acquired EEG signal. It can also be used to train models suited for different individuals.
   - Mental commands, which can be a neutral plus four pretrained items per training profile.

Emotiv Insight

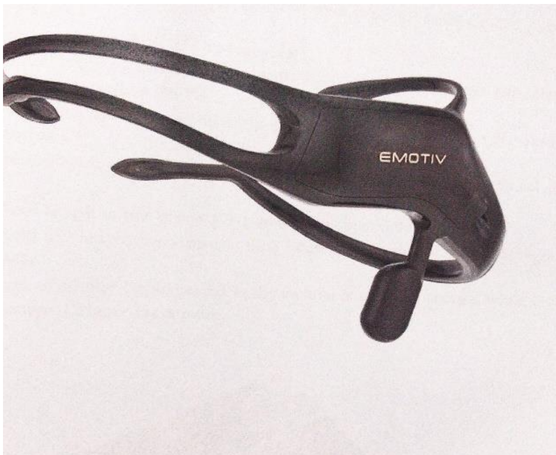


Figure 3.3: Emotiv Insight

3. PICAM V2.1

The stereo vision system work of our project depends upon the cameras attached to the system. To get better performance and results, we tested the CSI-2 cameras instead of USB based RGB cameras, but the problem was of response of time lanes. Secondly we verified the USB but it even cannot properly synchronize among them, then the RGB cameras were often bulky, hoping for the last we tested the Picam V2.0 cameras however, they can't have direct connection with Jetson Nano kit but by modifying the kernel of jetpack OS for Jetson Nano, however even through that we didn't received our good result but at last the only thing that worked was the picam V2.0 based on Sony sensors, which have open drivers available for almost all devices. It is a bit more expensive but a very useful component to make the signals and the object detection more accurate.

Following are some of the significant reasons of the technical specification of this device

- The camera sensor is the Sony IMX219 with a sensor resolution of 3280×2464 pixels.
- The still image resolution is 6 Megapixels.
- The video modes include, 1080p at 30FPS. 750p at 60FPS and 649×480 at both 60FPS as well as 90FPS.
- For linux integration the camera supports V4L2 drivers which are provided in Jetpack OS.
- The size of each pixel on the sensor is 1.12µm×1.12µm, with an optical size of ¼".
- The focal length of lens is 3.04mm and focal ratio is 2.0.
- The field of view of sensor is 62.2 degrees horizontally and 48.8 degrees vertically.
- The type of shutter implemented in the camera is rolling shutter, while there is no external trigger for capture.

Picam V2.0

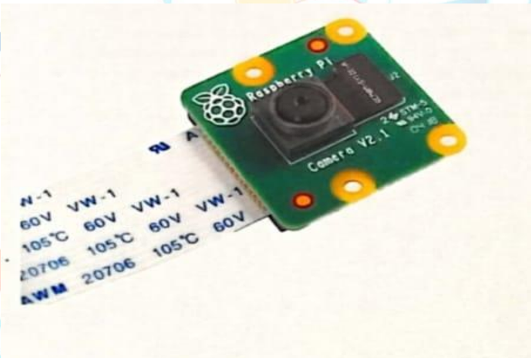


Figure 3.4: PiCAM Version 2.1

4. MAXON DC MOTOR

For the wheelchair setup we are using motors in the wheelchair are Maxon's F2260 Φ60mm, 40 watts, 36V DC motors, they provide a sufficient torque to handle a human body and work with reverse polarity to drive them backwards.

Following are the significant technical specification of this device

- They have nominal voltage of 36V at 266mA at no load.
- They have no load speed of 4550rpm.
- The nominal speed is 4150rpm.
- The maximum continuous torque of motors is 74.5mNm and with two motors they can handle a payload of 60Kg.
- The motor has maximum efficiency of 72% in ideal low temperature and moisture

conditions.

Maxon DC motor

Figure 3.5: Maxon DC Motor 2260.815-51.216-200

5. **Innovative Aspect**

Innovation and originality based on your solutions and problems

With the advent of EEG, a lot of BCI became easy and affordable. This approach has been studied many times, and in the last decade there have been more than 100 research articles on EEG based wheelchair control alone.

On the wheelchair the first EEG verification was done with Rabsamen et al.[1],this method was however, very stressful on the user and the method itself suffers from low response time. So while accurate it is not as fast as easy to use. Another approach was done by using first EEG control robot, put forth by Millian et al[2]. It use FSM **finite state machine**, this strategy while providing good time response but was not robust enough for real time application. Another method was uses recursive training and nearest neighbor classification to control wheelchair[3], however while this method had an acceptable response of time and is not error prone, the method was only utilized in an indoor controlled environment.

Criteria of EEG devices

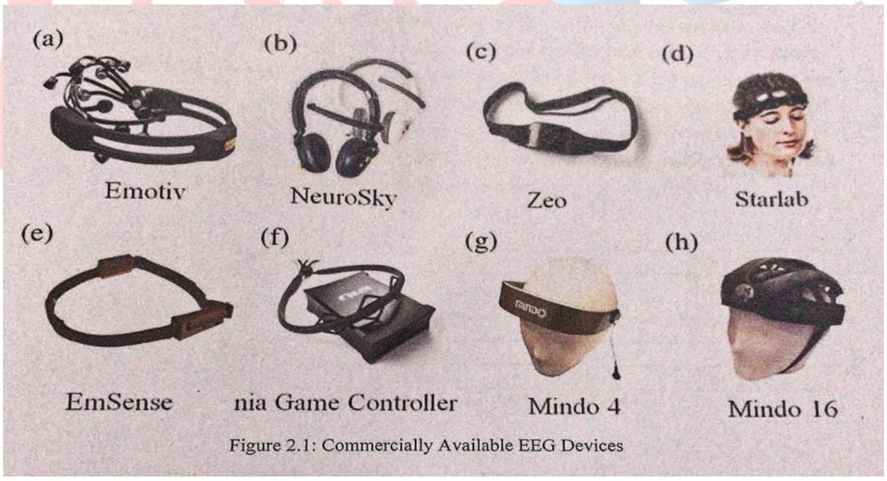


Figure 2.1: Commercially Available EEG Devices

The above figures show some common consumer grade EEG devices. The devices selection is critical for any EEG based system, if the device is inadequate the system may not work properly, this is demonstrated in [20], and shown in following figures for device comparisons, their proportion for artifacts such as how many false positives it acquired and SNR signal noise ration in dB.

Range comparisons

Device	EPOC	Trilobite	Jellyfish	BR8+	g.SAHARA	g.LADYbird
Proportion of artifacts[%]	25.11	41.14	22.36	51.22	16.21	3.19
SNR [dB]	-13.66	-11.55	-14.31	-3.78	-0.50	5.09
Berger effect	.		-	...	...	...
Increase in fontal theta			..			.
Decrease in parietal alpha				..	..	...

Viable EEG devices

Device name	MindWave	EPOC	Insight	BrainAmp
Available channels	1	14	5	32
Used channels	1	14	5	12
Sampling rate	512Hz	128Hz	128Hz	1kHz
Price	100$	849$	300$	60,000€

Development board devices

SBC	Rock Pi N10 (model A/B/C)	Raspberry Pi 4B	
CPU	Dual Cortex-A72@1.8GHz and quad Cortex-A53 1.4GHz	Quad-core ARM Cortex-A72 64-bit@1.5GHz	Quad-core ARM Cortex-A57 64-bit@1.42GHz
GPU	Mali T860MP4	Broadcom video-Core VI (32-bit)	NVIDIA Maxwell w/128 CUDA cores@921MHz
NPU	3.0 TOPS computing power	N/a	N/a
System memory	4/6/8GB LPDDR3	4GB LPDDR4	$GB LPDDR4
GPIO	40-pin GPIO	40-pin GPIO	40-pin GPIO
Prize	99$/129$/169$	55$	99$

The all above shows the past work done over the EEG wheelchairs, and their merits in real-life environment, however there are still researchers working over this EEG wheelchair. Our work strives to explore this approach alongside reducing cost of the whole system. This along with software-based automation affords the system flexibility.

FUTURE WORK OF THE PROJECT

This project can be improved in the future by taking the following steps

- A better camera system could be used to get even a clearer depth map.
- A mobile app can be developed to monitor the battery of the wheelchair and share the live location of the disabled people with trusted people.
- Could base computing could be used to process all the information rather than an on-site microcontroller which could save battery power and space.
- A wheelchair could be used with better motor drivers with speed control features in it.

- Emotiv headset does not provide the raw EEG data hence we are stuck with their algorithm for extracting command so different headset can be used which is open source or emotive pro subscription can be done to get raw EEG data using which a better command extraction algorithm can be made with less command can time and better accuracy.
- Emotive has more power headset like EPOC X specially designed for BCIs if the cost is not a problem then a better headset can be very helpful in reducing the stress in calling the command and accuracy.
- Image processing algorithm can could can could be improved upon by using more more GPU accelerated functions.

6. **Applicability**

Software and design (detailed)

As software we use the Emotiv cortex services.

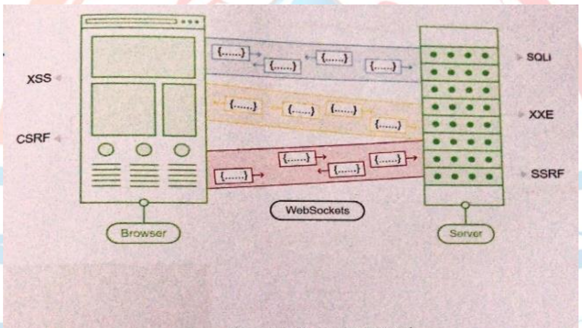


Figure 3.6: Websocket Protocol

Here we will discribe the hardware coding of the system that starts with setting up the emotiv. Now to extract the commands from the emotiv insight headset with used Cortex API version 2.0 as the support for version 1.0 was ending in december 2020. In order to make it easily accessible from commonly used programming languages the cortex API was basee on JSON and webstock. For now, the cortex is not available for Linux or Respbian operating system. So we need to use windowsor Mac based computer in order to access it. The Beta versions of cortex for ubuntu and respbian will be released in soon in fall 2020 so we will not need to use any windows computer ti extract the commands from EEG signals.

JSON gives the applications the power to communicate with severs in a defined way by removing the ad-hoc code. It is basically an encoding scheme. Websocket is basically a protocol for the intercommunication of cimputers and gives them ability to do two-way communication using a single TCP connection as shown above.

❖ **Hardware coding of emotive**

To use the emotiv cortex services one must create emotiv account. The all onr has to do is create an application ID. Then next setep is to generate client ID and client secret to be able to take data from cortex API. Following are the steps to communicate with the emotiv headset using cortex API.

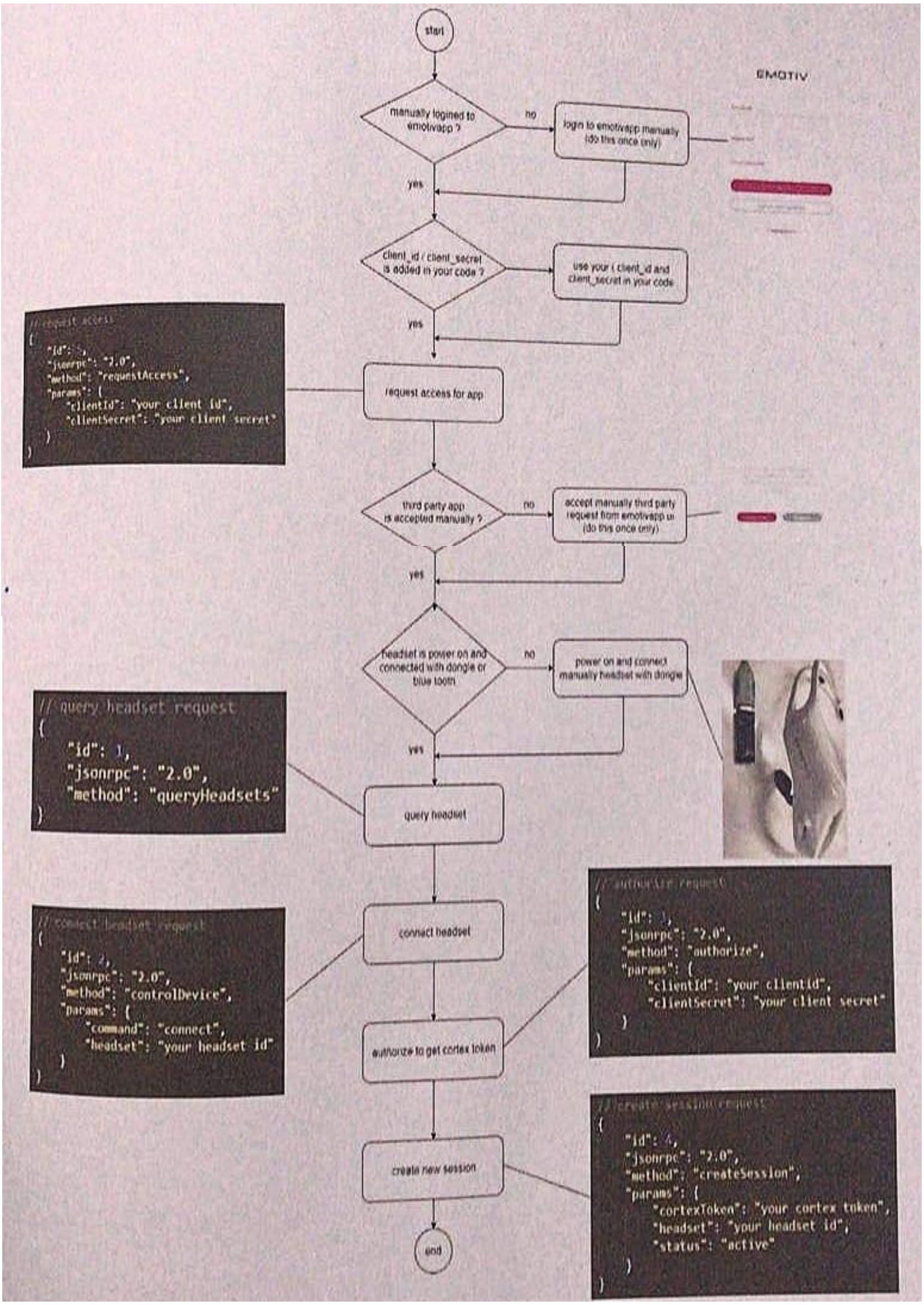
- Use the wss protocol to connect with websocket client to the localhost on port 6868. Anyone of the available websocket client in any programming language can be used.

- When the websocket connection has been opened now one can communicate and call methids including or excluding paramteters to take back the results or any error messeges using JSON-RPC 2.0 protocol.

The next step is to get the cortex information. That is its version and build number etc. This can be done by oassing a request

{“id”:1.
“jsonrpc”:”2.0”.
“method”:”getCortexInfo”
}

In the responce the server will return the version, built number, and built date of the cortex API. As shown in image below


start
EMOTIV
manually logined to emotivapp ?
no
login to emotivapp manually (do this once only)
yes
client_id / client_secret is added in your code ?
use your (client_id and client_secret in your code
yes
// request access
{
"id":
"jsonrpc": "2.0",
"method": "requestAccess",
"params": {
"clientId": "your client id",
"clientSecret": "your client secret"
}
}
request access for app
third party app is accepted manually ?
no
accept manually third party request from emotivapp ui (do this once only)
yes
headset is power on and connected with dongle or blue tooth
no
power on and connect manually headset with dongle
yes
// query headset request
{
"id": 1,
"jsonrpc": "2.0",
"method": "queryHeadsets"
}
query headset
// connect headset request
{
"id": 2,
"jsonrpc": "2.0",
"method": "controlDevice",
"params": {
"command": "connect",
"headset": "your headset id"
}
}
connect headset
// authorize request
{
"id": 1,
"jsonrpc": "2.0",
"method": "authorize",
"params": {
"clientId": "your clientid",
"clientSecret": "your client secret"
}
}
authorize to get cortex token
// create session request
{
"id": 4,
"jsonrpc": "2.0",
"method": "createSession",
"params": {
"cortexToken": "your cortex token",
"headset": "your headset id",
"status": "active"
}
}
create new session
end

1. Login to Emotiv Cortex apps using Emotiv ID.
2. Use correct applications and client ID and also the client secret.
3. Then call the method “request Access” API from computer To Cortex and accept the access request from Emotiv app.
4. After that connect the Emotiv insight usging UDB dongle or bluetooth.
5. Then call the method “queryheadset”API in order to get list of all the nearby available headset.
6. Then call the method “controldevice” API to make connection with the desired headset.
7. To find token for subsequence request one has to call “authorize” API .
8. next step is the creation of a session by calling "createsession"API.

- **GetUserLogin**

The coding scheme method for the user login

```
{
"id":1,
"jsonrpc":"2.0",
"method":"getUserLogin"
}
```

- **RequestAccess**

The coding scheme method for the request for the access

```
{
"id":1,
"jsonrpc":"2.0",
"method":"requestAccess",
"params":{
"clientId":"xxx",
"clientSecret":"xxx"
}
}
```

- **Authorize**

The coding for authrizing the generating cortex

```
{
"id":1,
"jsonrpc":"2.0",
"method":"suthorize",
"params":{
"clientId":"xxx",
"clientSecret":"xxx"
}
}
```

- **Headsets**

queryHeadset

the method coding to call out and setup the queryheadset

```
{
"id":1,
"jsonrpc":"2.0",
"method":"queryHeadsets"
}
```

- **ControlDevice**

  the method to connect or diconnect to a particular heatset codings are following

```
{
"id":1,
"jsonrpc":"2.0",
"method":"controlDevice",
"params":{
"command":"connect"
"heatset":"INSIGHT-AID20463"
}
}
```

- **Sessions**

  createSession

```
{
"jsonrpc":"2.0",
"method":"createSession",
"params":{
"cortexToken":"xxx",
"heatset":"INSIGHT-AID20463",
"status":"open"
}
}
```

- **Brain computer interface**

  queryProfile

```
{
"jsonrpc":"2.0",
"method":"queryProfile",
"params":{
"cortexToken":"xxx",
}
}
```

- **GetCurrentProfile**

```
{
"id":1,
"jsonrpc":"2.0",
"method":"getCurrentProfile",
"params":{
"command":"connect"
"heatset":"INSIGHT-AID20463"
}
}
```

- **setupProfile**

```
{
"id":1,
"jsonrpc":"2.0",
"method":"setupProfile",
"params":{
"cortexToken":"xxx",
"profile":"cortex-v2-example",
"status":"create"
}
}
```

- **training**

```
"id":1,
"jsonrpc":"2.0",
"method":"setupProfile",
"params":{
"action":"push",
"cortexToken":"xxx",
"detection":"mentalCommand",
"session":"f3a35fd0-9163-4cc4-ab30-4cd224369f91",
"status":"start"
}}
```

- **data subscription**

```
"id":1,
"jsonrpc":"2.0",
"method":"setupProfile",
"params":{
"cortexToken":"xxx",
 "session":"f8cb7289-9a92-438b-8281-e5fdffe8166e",
"streams":["met","mot"]
}
}
```

- **unsubscribe**

```
"id":1,
"jsonrpc":"2.0",
"method":"unsubscribe",
"params":{
"cortexToken":"xxx",
 "session":"c6b52ab2-8828-412c-b1b9-9cc48842dc0c2",
"streams":["met","mot"]
}
}
```

7. **Estimated Cost and Project Scheduling**

T-WORD EXPENSES AND PROJECT SCHEDULING

Calendaring

Project evolution report	3/4/2021
Project detailed report	6/13/2021
Components and algorithms	6/29/2021
Device selection	7/10/2021
EEG design draft	7/10/2021
EEG design and construction	7/12/2021
Image processing construction	7/18/2021
Draft testing	7/20/2021
Final testing	7/25/2021

Product estimation and prizes

Jatson nano developer kit	1 in quantity	Rs.24,899
Emotiv insight	1 in quantity	Rs. 46,898
PiCAM version 2.1	1	Rs. 13,018
Maxon DC motor	1	Rs. 13,489
Screw	800	Rs. 15,00
Wheelchair	1	Rs. 20,483
Connecting wires	17	Rs. 3,094
System developing	Entire	Rs. 45,879
Consrtuction hardware	Entire	Rs. 50,000
Testing and draft total work amount	- Maximum amount	Rs. 219,260 Rs.30,0000

8. **Target Group of the Project Idea (Users):**

User

People suffering from severe disability and the one facing problem with their locomotion are going to be served from our EEG based and image processing AI wheelchair. We will take a live stream video from the cameras and using a tiny YOLO- implemented in AI image library.

9. **Risks**

According to our complete drafts and testing result we have no risks in our prototype project because the selection of software,hardware,components,assembly and entire work is identified with specific criteria and with a complete determination and looked forwarded with entire surety.

Now comes the explanation for what is our plan B, so according to our entire work and risk there is a complete confirmation of a work and progress been done but as there is no risk or any problem in all parts so our archetype doesn't has any of the plan B work done because all the testing and justifying is already done to confirm it working and helpful for the people suffuring from the locomotion. so as we have make our entire project to make our project riskless and completely safe for our users.

10. **Resources**

1. M. A. Oskei And H. Hu," My electric Control System-A Survey", In Biomed. Signal Process. Control, Oct 2007. Vol.2 ,No.4. Pp.275-94.
2. World Report on Disability © World Health Organization, report- 2011.
3. Kobayashi, N.; Nakagawa, M. BCI-based control of electric wheelchair. In Proceedings of the 4th Global Conference on Consumer Electronics (GCCE 2015), Osaka, Japan, 27–30 October 2015; pp. 429–430.
4. Dabosmita, P.; Moumita, P. Automation of wheelchair using brain computer interface (BCI) technique. In Proceedings of the American Institute of Physics (AIP 2019), Mangalore, India, 19–21 September 2019; pp. 1–6.
5. Moon, M. Lee, J. Chu, and M. Mun, "Wearable EMG-based HCI for Electric-Powered Wheelchair Users with Motor Disabilities," Proc. of the 2005 IEEE Int. Conf. on Robotics and Automation, pp. 2649-2654, 2005.
6. T. Taha, J.V. Miro, and G. Dissanayake. Wheelchair driver assistance and intention prediction using POMDPs. In Intelligent Sensors, Sensor Networks and Information, pages 449–454, 2007.

NOTE ON REPORT DRAFTS:
- There will be up to 10 pages including cover, description and visual. - The competitors should support their reports with visuals (prototype, test results, etc.), which will provide an advantage in terms of evaluation. - All reports should be written in accordance with academic report standards. - Each report should include a cover page. - Font: Times New Roman, point: 12, Line Spacing: 1.15 , leaning on two sides, page margins should be top-bottom-right-left 2.5 cm. - The sentences in the report should not be identical and should not be repeated. -In their report, the teams that have benefited from the previous year's reports on our website should indicate the quotation on the related page. You must state the explanation after the quoted sentence. QUOTE FORMAT: "Cited Phrase(s)" (Year, Competition Name, Category,Team Name) SAMPLE QUOTE: "The most important problem is that cannot detect location of earthquake victim because of slowing down search and rescue operations and removal of debris" (2020, Technology for Humanity Competition, Disaster Management, Team X)