

# A Preferable Brain Computer Interface for Paralyzed/Disabled People

Md. Mahmud-Or-Rashid

Lecturer, Department of Mechanical Engineering  
Shahjalal University of Science and Technology,  
Sylhet-3114 Bangladesh

Mr. Saddam Hossen

Lecturer, Department of Mechanical Engineering  
Dhaka University of Engineering and Technology,  
Gazipur Bangladesh

**Abstract**— A significant portion of the population throughout the world is physically disabled to perform the basic activities of life and needs to depend upon others. After a certain age, people become disabled and feel themselves as a burden for society. Inspired by observing the sufferings of physically disabled (paralyzed) people this project is done to reduce their miseries by making them self-dependent with the help of this device. This device is composed of simply a webcam integrated with a computer. A brain computer interface (BCI) is a system of direct communication between a human brain and an external device. This device has an interface that receives commands from the disabled persons by the movement of eyes & face only and is capable of performing some functions automatically according to the given signal from the eyes of the user. Serving neurological patients in future is an expectation of this work also.

**Keywords**— Brain computer interface(BCI), MATLAB, Microcontroller, Eye detection method,

## I. INTRODUCTION

A brain computer interface is called by people as mind-machine interface. Signal is transferred from brain to the computer directly. No physically input device is used here to develop communication between brain and computer. From 1970, research on BCI started and being modified day by day [1]. BCI research on different animals especially on monkey has been done at many times [2]. Invasive BCIs, partially invasive BCIs and non-invasive BCIs are introduced with time. Different simulation models have been also established by using MATLAB [3] Human brain acts as natural sensors. So, it can communicate with external devices easily. Many research groups are focusing on image processing [4]. With signal of eyes those problems are solved mechanically and electronically. Many research groups are focusing on electrical activities of brain. Combine technologies of electrical and electronic engineering, computer science and biomedical engineering are used here. With a view to improve the facilities for the disabled person and to improve the condition of medical system in Bangladesh application of BCI is suggested.

This BCI device can be used in the hospitals for the paralyzed patient to reduce their full-time dependency on other people (like nurses) [5]. To improve the facilities in hotel for the disabled tourists this device can be integrated in hotel room. As it having simple working principle, this device can be used in household for the disabled. Time has come to serve neurological patient [6]. Improving accuracy and speed of the technology is a most important research

nowadays. Wireless BCIs is a breakthrough for recent research.

## II. SORTED OUT COMMON ACTIVITIES

After discussing with some disabled people about their daily performance, some common activities are selected as follows.

- Serving foods,
- Playing music,
- Switching of light,
- Switching of fan,
- Moving wheelchair at any direction.

## III. INSTRUMENTS USED

### A. MECHANICAL COMPONENTS

- Acrylic sheet
- Wheel Castor
- Wheels

These components are used to develop a movable object.

### B. ELECTRICAL COMPONENTS

- Two relays (switch)
- Boost Module
- Li Po battery(12V) with three cells
- Jumper wire
- Arduino Uno(Microcontroller)
- Bread-board

## IV. METHODOLOGY

Using MATLAB, the eyes of the paralyzed people are detected by image processing [4]. With signal of eyes those problems are solved mechanically and electronically.

### A. DEVICE INTERFACE

The interface is the screen of a computer which contains a webcam. The user can control some devices (such as wheelchair, light, fan etc.) with this interface through the movement of eye and face. The interface is capable of taking video input of the user's movement and sending signal to the desired output devices continuously [7]. The interface is made user-friendly by showing images of desired output system such as images of foods, wheel-chair, light, fan, headphone to listen music instead of written instructions.

**B. INPUT METHODS**

The input command is taken from the intention of the user by detecting eyes of the user. MATLAB program is capable of taking image of users and detecting the eyes of the users and sending some fixed characters as command for fixed output functions [8]. The image of the options like moving wheelchair, switching of light and fan, playing music, opening a door appear in the interface one by one continuously. If the user wants to perform options, he/she needs to look at the webcam just after the appearance of the option in the interface [9]. Then this interface can detect user eyes, take the signal 'yes' and send the signal to the desired output device.

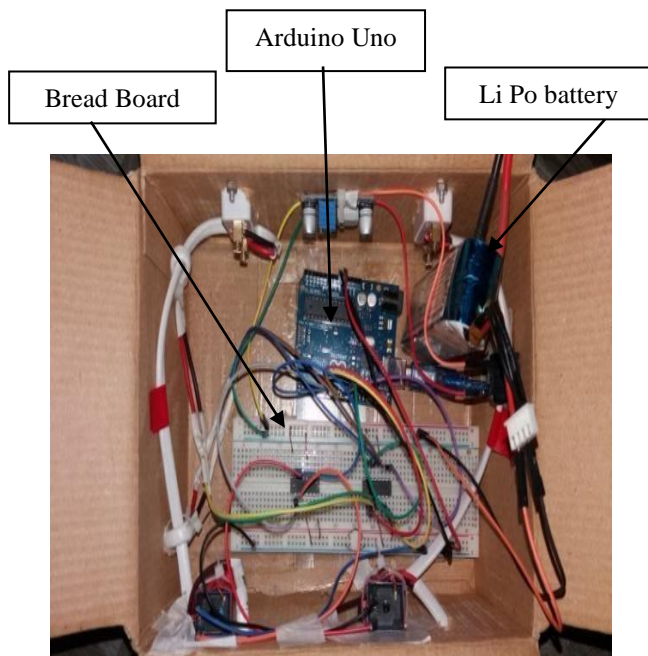


Fig 01: Wire Connection between input and output

**C. OUTPUT FUNCTIONS**

The output system of this device provides the facilities to perform desired function by receiving the signal 'yes' from

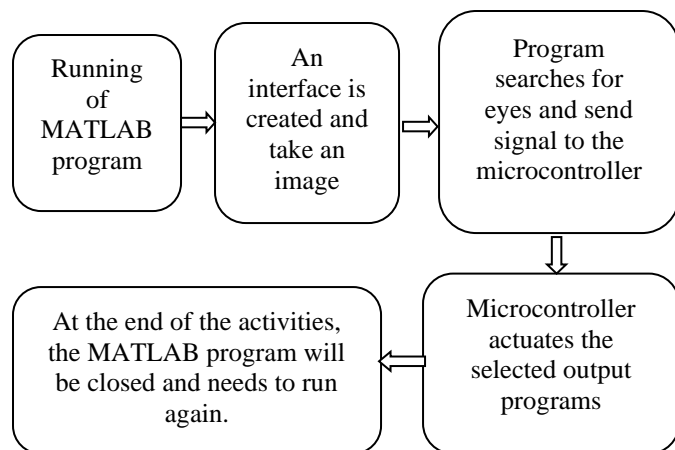


Fig. 02: Block diagram of working principle the input system in the form of some fixed characters. Arduino Uno is used here as a microcontroller and needs battery to run.

To move wheelchair forward, the user needs to look at the camera after the appearance of the image of wheelchair with forward moving signal (like a forward indicating arrow). Then a character (like 'F') is sent to the output system which turns on the two motors of the wheel-chair with the help of Microcontroller and Motor driver and thus the wheelchair moves forward [10].

An automated wheel chair is only the mechanical part of the project. Only for experiment, a prototype of the wheelchair was produced which contains an acrylic sheet having two wheels and a castor wheel. This prototype can meet other objectives as serving of foods or other necessary things. Two DC motors are attached to the wheels individually. The individual movements of the wheels are needed to rotate the sheet at left/right direction. When the two motors rotate at same speed and direction, the sheet will move in the forward or backward direction. In this system switching of light, fan is performed with the help of Relay [11]. Playing music and sending email is done by MATLAB program using automatic cursor control.

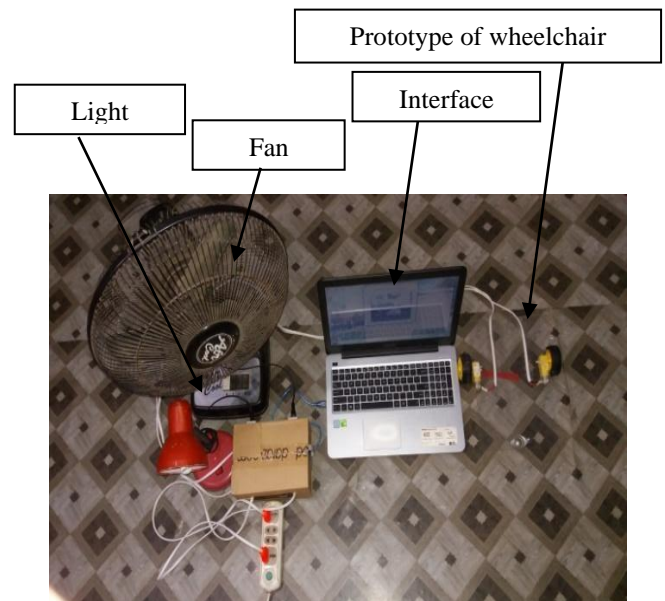


Fig 03: Experimental setup

**V. RESULTS AND DISCUSSIONS**

The successful completion of output function is totally dependent on taking image and finding eyes from the image by MATLAB. A study is performed that the effect of light on eye detection method.

This project was run at three different times of the day. To analyse under sunlight condition, the test procedure was done on rooftop at 3.00PM. The response was excellent at sun light condition. The experiment was run again at 6.00PM to check the accuracy at dark condition. At this time, the detection of eyes was tough enough by image processing and so the response was not good. Fluorescent light was used at

10PM, which gave better response compared to dark light. So, it suggests that light and a good webcam helps to run every individual performance. As at low light level the response is not so good, an extra features like flash may be introduced along with the webcam. The experiment has shown difficulties for those users who use glasses in front of their eyes. At this case the used program fails to detect eyes form image at sometimes.

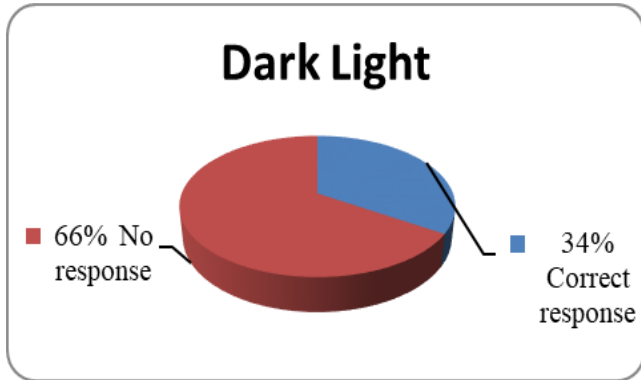


Fig 4(a)

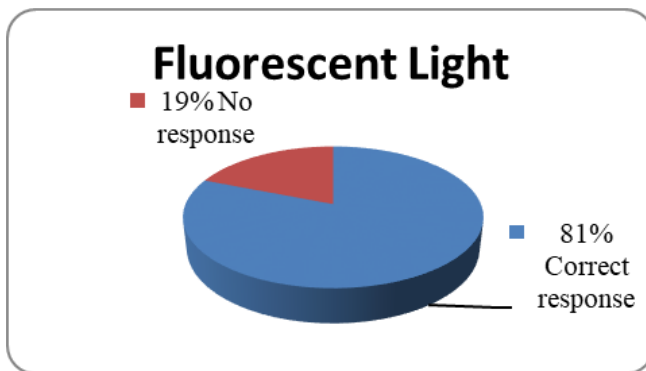


Fig 4(b)

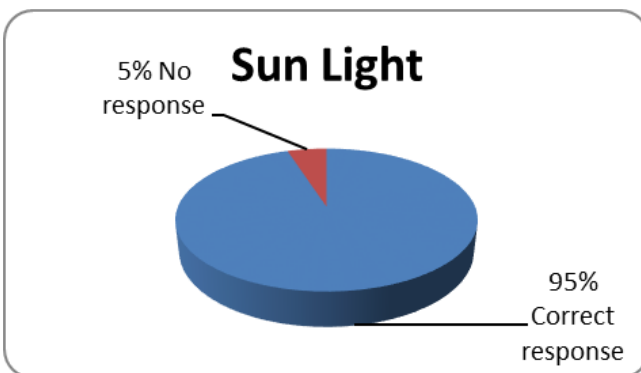


Fig 4(c)

Fig 04: Response of the program at (a) dark light, (b) fluorescent light, (c) sun light

The project was run very well according to the instruction of the users. It has taken less than one second to switch light, rotate fan, move wheels, play music and send emails. Automatic cursor controlling was done using program. For

that a music was placed at a fixed position in the memory of the computer. A good suggestion is that the music file should be located at desktop so that it is easy to be found out.

**COST ANALYSIS**

Every equipment's here is collected from local market. That's why the cost of project is much. Users having personal computer need to pay a low amount of money for instalment.

TABLE 01: Calculation of total cost for a unit project

No.	Name of the parts	Quantity	Price (BDT)
1	Bread board	1	200
2	Arduino Uno	1	500
3	Relay	2	100
4	Boost module	1	150
5	AVR programmer	1	500
6	Acrylic sheet	2	200
7	Battery	1	1200
8	DC motor with wheels	2	300
9	Jumper wire	2 sets	20
10	Switch and plug	2 sets	80
11	Computer	1	40000
Total			43250 (BDT)

**LIMITATIONS**

Considering the socio-economic aspects of Bangladesh this BCI system is very expensive for the rural people of our country, because of the full-time dependency on electricity and Laptop. If any smartphone can be used as interface that will be more feasible [12]. Besides the installation and maintenance of this device require the skillful knowledge of computer programming language and operation of microcontroller device which is not available in our rural area. Webcam is not so good at maximum computer that requires further iterations.

**VI. CONCLUSION**

The consequences of BCI are spectacular and almost unbelievable. It can help paralyzed people to move by controlling their wheel-chairs, to communicate by using e-mail and to be independent. Conclusively, BCI has proved to be a blessing for paralyzed people. In future an Android version BCI system may be introduced, which may be more economical. This work may be introduced with wireless connection in future and should be combined with more functions helpful for the paralyzed. With time, this technology will be available throughout the world. Using this, paralyzed people may be interested in joining many jobs like banking sectors. Users will perform every action using eye signal in office. Then paralyzed people will bring an economic impact on both society and country and will become an asset for a country.

## VII. REFERENCES

- [1] Vidal, J.J., "Toward direct brain-computer communication", *Annual Review of Biophysics and Bioengineering*, pp 157–180, 1973.
- [2] Schmidt, E.M., McIntosh, J.S., Durelli, L., Bak, M.J., "Fine control of operantly conditioned firing patterns of cortical neurons", *Experimental Neurology*, pp 349–69, 1978.
- [3] Zhao, H., Wang, H., Li, C., and Li, Y., "Brain-computer interface design based on slow cortical potentials using matlab/Simulink", *International Conference on Mechatronics and Automation*, pp 1044-1048, 2009
- [4] Rani, M.S., Chitransh, Shubham., Tyagi, Priyam., Varshney, Prashant., "Eye Controlled Wheel Chair", *International Journal of Scientific Research & Engineering Trends*, 2020.
- [5] Fehr, L., Langbein, W. Edwin., Skaar, Steven B., "Adequacy of power wheelchair control interfaces for persons with severe disabilities: A clinical survey", *Journal of rehabilitation research and development*, pp 353-360, 2000
- [6] Santhanam, G., Ryu, S., Yu, B., Afshar, Afsheen., Shenoy, Krishna., "A high-performance brain-computer interface", *Nature*, pp 195–198, 2006.
- [7] Nicolas-Alonso, L.F., Gomez-Gil, J., "Brain computer interfaces, a review", *Sensors*, pp 1211-1279, 2012.
- [8] McAndrew, A., "An introduction to digital image processing with matlab notes for scm2511 image processing, School of Computer Science and Mathematics", Victoria University of Technology, pp 1-264, 2004.
- [9] Mortazavi, A., Somers, C., Hwang, Y., Radermacher, R., Rodgers, P., Hashimi, S., "Performance enhancement of propane pre-cooled mixed refrigerant LNG plant", *Applied energy*, pp 125-131, 2012.
- [10] Mirza, I.A., Tripathy, Amiya., Chopra, Sejal., et al., "Mind-controlled wheelchair using an EEG headset and arduino microcontroller", *International Conference on Technologies for Sustainable Development (ICTSD)*, pp. 1-5, 2015.
- [11] Lin, C.-T., Ko, L.-W., Chang, M.-H., "Review of wireless and wearable electroencephalogram systems and brain-computer interfaces—a mini-review", *Gerontology*, pp 112-119, 2010.
- [12] Blum, S., Debener, Stefan., Emkes, Reiner., Volkening, Nils., "EEG recording and online signal processing on android: A multiapp framework for brain-computer interfaces on smartphone", *BioMed research international*, 2017.