I J C T A, 9(16), 2016, pp. 7871-7877

Cursor Control Using Eye Ball Tracking System

P. Uday Vardhan[1], R. Monika[2], Saiteja G.[3] and A. Nikhileswar[4]

ABSTRACT

Computers have become a basic requirement for any individual. But some people cannot operate computers on their own because of the disabilities, and they have to depend on others for computer usage. To overcome such problem an eye gear is designed, which can be used as input device for computers. The idea of eye gear is of great use to not only the handicapped or disabled but also for the future of natural input. We can replace normal input devices of a computer like keyboard and mouse with an eye gear and an on-screen keyboard. To build an eye gear mouse IR sensors and MEMS sensor are used to capture the gestures. Raspberry Pi is used to process the variations generated by this sensors and an arm processor is used to interface this system with computer. The raspberry pi generates the cursor movements based on the voltage variations generated by the sensors implemented.

Key words: IR sensor, Raspberry pi, ARM, ADC.

1. INTRODUCTION

Eye gear mouse is to enable complexly paralyzed patient to make their life more accessible to computers. However, there were some previous models which were operated using USB cameras [1], EOG based method, eye ball sensing method [2]. But in those models, the user will have a very strict seating position which is not possible to maintain for long hours and very annoying at work space. The idea of eye gear is of great use to not only the handicapped or disabled but also for the future of natural input. People who are unable to operate computers with their hands can use eye movements to give input to the computer. To design a system which detects the eye movement, a wearable eye glass with an IR sensor and a MEMS sensor is used. Raspberry Pi is used to process the signal received from the sensors and ARM processor is used to move the cursor on screen. The voltage variation generated by the IR sensor with respect to the eye ball movement is used to control the movement of cursor. The IR sensor output is given to an analog to digital converter. The output of the analog to digital convertor is given to the GPIO pins of the Raspberry Pi.

2. LITERATURE SURVEY

[1] Roshani.D.Ninama, Rutu.P.Nayak, designed a system in which eye controls are used for wheel chair movement. For tracking eye movement they used an USB camera and the output of these is given to motors of the wheelchair.

[2] Hari Singh and Dr. Jaswinder Singh discussed about eye physical structure and different methods that can be used for eye movements tracking and their pros and cons.

[3] Rafael Barea, Luciano Boquete, Manuel Mazo, Elena Lopez, L.M.Bergasa designed a system, In this system they presented a new method to control and guide mobile robots. In this case, to send different commands they have used electrooculography (EOG) techniques, so that, control is made by means of

[1,2,3,4] ECE Department SRM UNIVERSITY Chennai, Tamil Nadu, India, *Emails: uday.ktr@gmail.com, moni.rajendran@gmail.com, teja.jss@gmail.com, nikhil2eswar@gmail.com*

the ocular position (eye displacement into its orbit). A neural network is used to identify the inverse eye model, therefore the saccadic eye movements can be detected and know where user is looking. This control technique can be useful in multiple applications, but in this work, it is used to guide an autonomous robot (wheelchair) as a system to help to people with severe disabilities. The system consists of a standard electric wheelchair with an on-board computer, sensors and graphical user interface running on a computer.

3. SYSTEM IMPLEMENTATION

In this prototype (Fig.1a), two pairs of IR sensors and one MEMS sensor is used. All these sensors are connected to raspberry pi. Raspberry pi will process these signals, and these signals are given to ARM processor to produce output on a display screen. IR sensors are used because, they can generate different voltages for black & white colors and this logic can be used for eye movement tracking. And, IR sensors are very cheap so the overall system cost can be reduced. MEMS sensor is used for vertical eye movement detection. To process this sensor signals Raspberry Pi B+ is used. The Raspberry Pi is of ultra-low-cost, whose output is given to ARM7. It has 4 USB ports and HDMI out and an Ethernet cable slot through which it is connected to computer.

Python programming language is used for coding purposes. Python is more readable and convenient language for people from non-programming background. All the sensors implemented are connected to an analog to digital convertor, to convert the analog voltage value generated into digital signal. These ADC outputs are given the GPIO pins of raspberry pi. The power supply to the sensors and convertors is driven from the 5V pins of raspberry pi. The data pins of raspberry pi are connected to data pins of Arm, to drive this system using an USB support. ARM processor serves as a bridge between the raspberry pi and display unit.

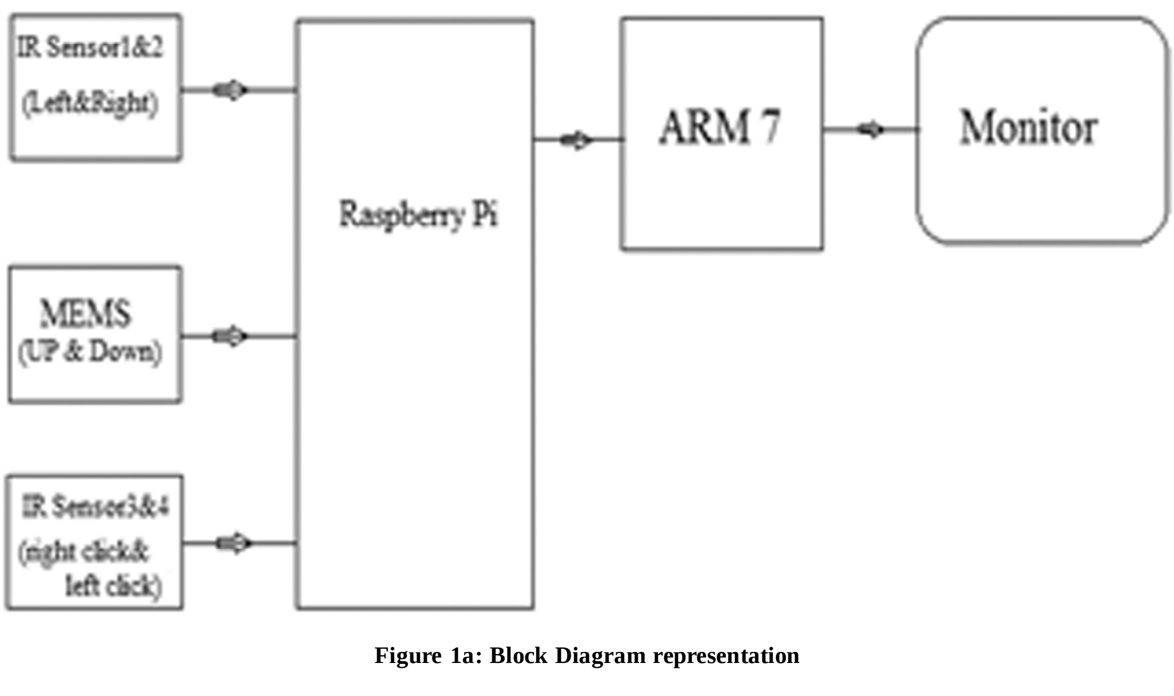

Figure 1a: Block Diagram representation

Working conditions:

(1) **IR sensor (1 & 2)**: The output of these sensors relates to the right and left movement of the cursor.

Condition: If IR sensor 1&2 is equal to 1, the cursor will be stable. If IR sensor 2 is equal to 0, the cursor will move towards right. If IR sensor 1 is equal to 0, the cursor will move towards left.

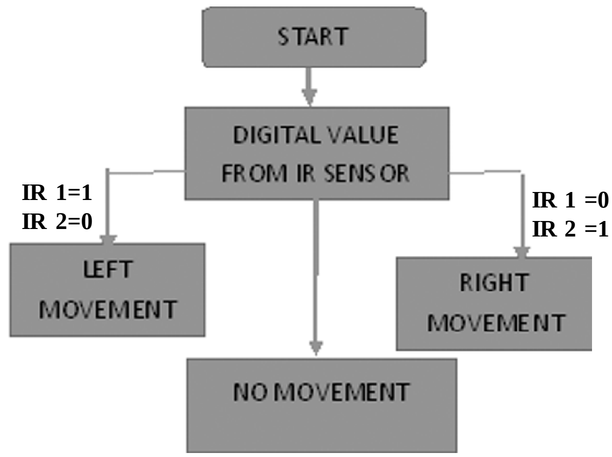

Figure 1b: Flowchart for left and right movement

(2) **IR sensor (3&4)**: The output of these sensors relates to right and left click of the cursor.

Condition: If IR sensor 1&2 is equal to 1, the cursor will be stable. If IR sensor 2 is equal to 0, right click will be done, If IR sensor 1 is equal to 0, left click will be done.

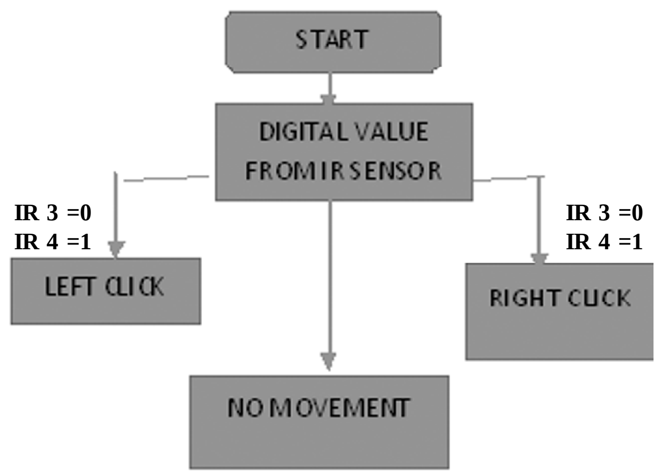

Figure 1c: Flowchart for left and right click

(3) **MEMS sensor**: The output of this sensor relates to up and down movement of the cursor.

Condition: If the angel of the sensor is between o and 90, cursor will be moved upward. If the angel of the sensor is between 0 and 270, the cursor will be moved downwards.

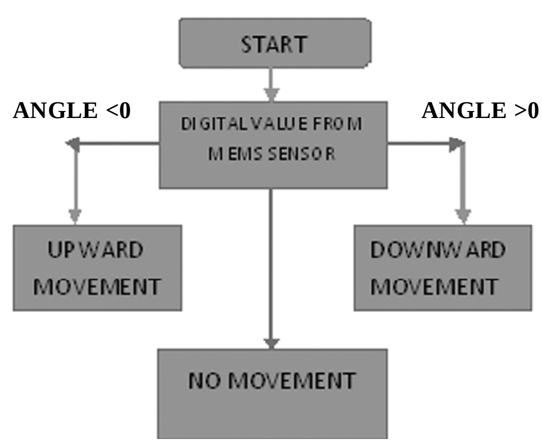

Figure 1d: Flowchart for up and down movement

4. DESIGN ALGORITHM

IR sensors are placed in the eye gear on either side. One side IR pair is used for right and left movement and the other pair is used for right and left click. MEMS sensor is placed on the frame for up and down movement Based on the eye ball position IR sensors generate different voltage values. This voltages are converted into digital values by using an Analog to digital convertor.

Color	*Voltage*	*Digital value*
Black	Greater than 3.3	1
White	Less than 3.3	0

-ADC outputs based on eye position.

(1) For eye ball center position

-When the eye ball is in its central position the ADC will transmit digital value “1” for both the sensors. ADC will be given a threshold value. If the voltage value generated by IR is larger than threshold value “1” is transmitted and if the voltage value is less than the threshold value than value “0” is transmitted. Based on these variations generated by the ADC raspberry pi will process the values and generates mouse movements in coordination with the ARM processor.

(2) For right movement of the eye ball

If the eye ball is moved to the right side, IR sensor 1 will transmit value “1” and IR sensor 2 will transmit value “0”. This values of IR sensor will be recognized as right side movement by the raspberry pi with the help of the python

(3) For left movement of the eye ball

If the eye ball is moved to the left side, IR sensor 1 will transmit value “0” and IR sensor 2 will transmit value “1”. This values of IR sensor will be recognized as left side movement by the raspberry pi with the help of the python code given to it.

Figure 2: ADC output 1

Figure 3: ADC output 2

5. EXPERIMENTAL SETUP & RESULTS

The digital values from ADC are processed by the python program in the Raspberry Pi. Based on the values, Pi will accordingly give command to ARM processor for movement of cursor on screen. Initially the cursor will be in the center position of the screen. Final results are as follows

1. For eye ball center position
   When the eye ball is in center position the cursor will be at the center of the screen.
2. For right movement of the eye ball
   When the eye ball is moved to the right side, the cursor will move towards right. There will not be any delay during the cursor movement.

Figure 4: ADC output 3

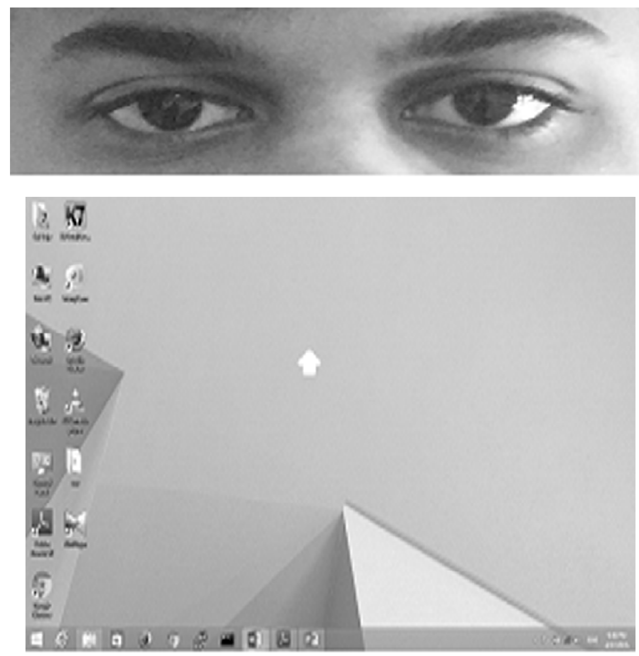

Figure 5: Output 1

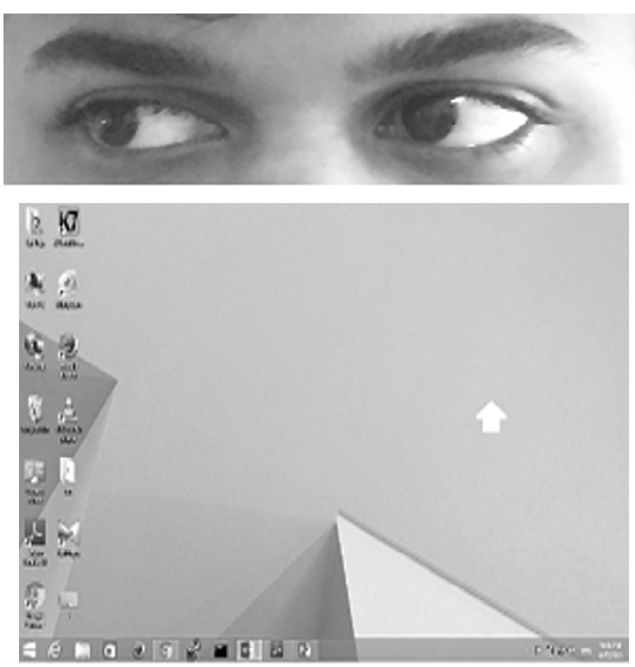

Figure 6: Output 2

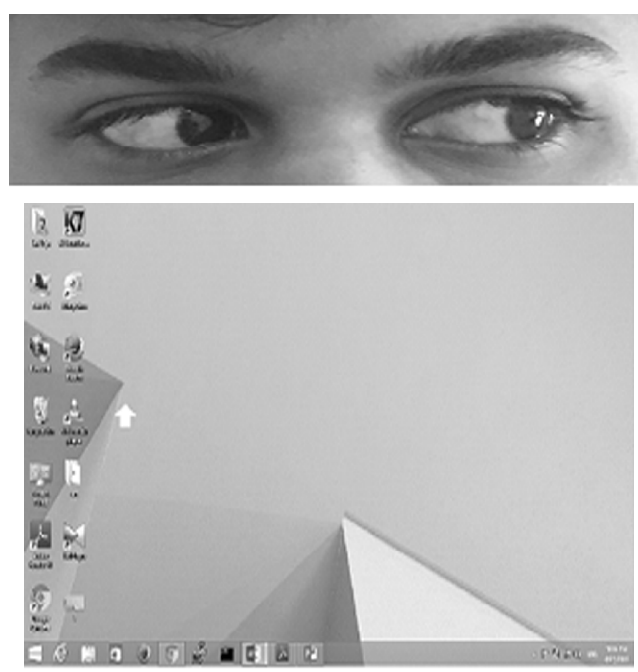

Figure 7: Output 3

3. For left movement of the eye ball
   From the initial position , the curosr will move towards to the left if the eye ball is moved to the left.
4. MEMS sensor initial position
   When the MEMS sensor is in neutral position the cursor will be in the center of the vertical axis of the screen.
5. MEMS sensor upward movement.
   When the sensor is tilted upward the cursor will move upward from the central position of the screen in vertical axis.
6. MEMS sensor downward movement.
   When the sensor is tilted downward the cursor will move downward from its position.

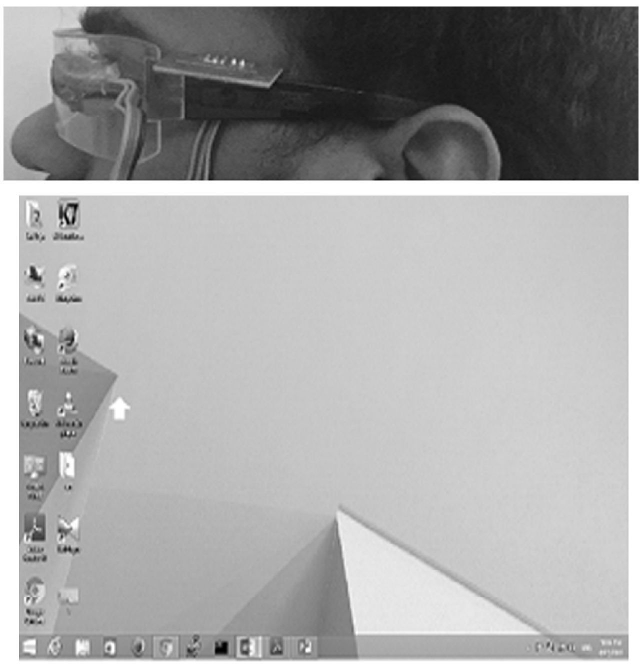

Figure 8: Output 4

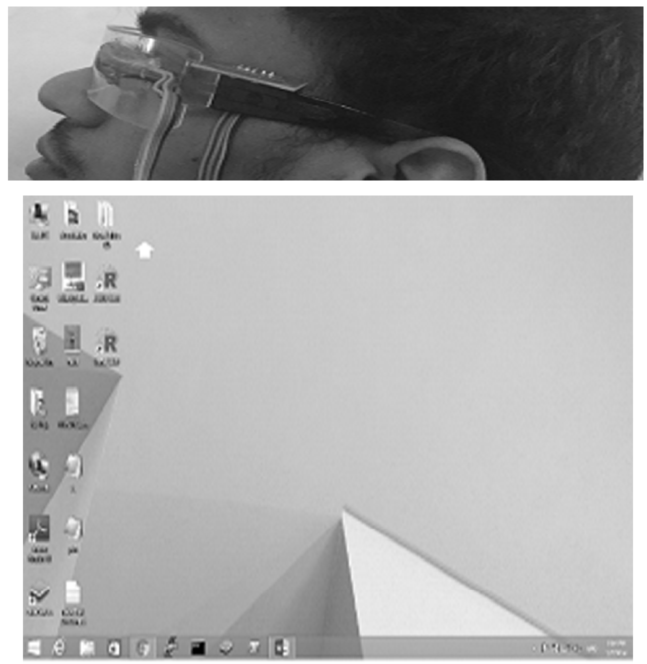

Figure 9: Output 5

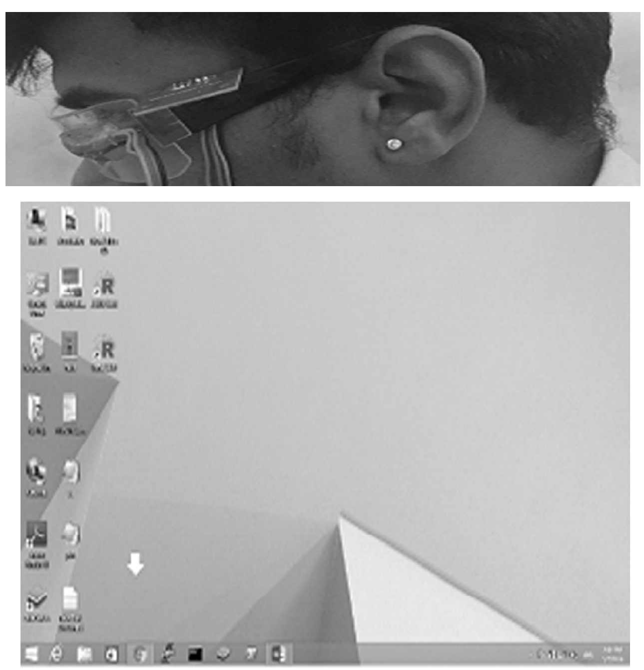

Figure 10: Output 6

6. CONCLUSION AND FUTURE WORKS

As discussed an eye controlled mouse for disabled person is designed in this project. There were few previous models using USB camera or EOG systems, which are not convenient for daily usage. And, in those models the user should maintain a strict seating position which is not possible for long hours. With this system we can overcome all these problems. This system can be implemented in the form of normal USB mouse. The response time is very fast in this system compared to others, which implemented different processors. If this system is designed in real-time, it can be implemented in a wireless form which will be more convenient for the user.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude and thanks to our Head of the Department, Dr.T.RAMA RAO, Department of Electronics and communication for his moral support encouragement throughout the development of our project work. We would like to express our heartful gratitude and thanks to our project coordinator Mrs.S.Kayalvizhi, Assistant Professor (O.G), Department of Electronics and Communication. We are indebted to our guide Ms.R.Monika, Assistant Professor (O.G), Department of Electronics and Communication for providing moral support, motivation and for her valuable guidance, encouragement and timely help throughout our project work. We extend our sincere thanks to all other faculty of our department for their kind co-operation and help in completing our project. Finally we would like to thank our parents and our friends whose kind encouragement and moral support have helped us to complete the work successfully.

REFERENCES

[1] Alex Dev, Horizon C Chacko and Roshan Varghese, "Eye Controlled Wheel Chair Using EOG", International Conference on Computing and Control Engineering (ICCCE 2012), 12 & 13 April, 2012

[2] Rafael Barea, Luciano Boquete, Manuel Mazo, Elena López, L.M. Bergasa. "E.O.G. guidance of a wheelchair using neural networks" Madrid. Spain.

[3] Nurul Muthmainnah Mohd Noor, Salmiah Ahmad, "Analysis of Different Level of EOG Signal from Eye Movement for Wheelchair Control," Department of Mechatronics, Kuliyyah of Engineering, IIUM, Gombak, Malaysia.

[4] Preethika Britto, Indumathi. J, Sudesh Sivarasu, Lazar Mathew, "Automation of wheelchair using ultrasonic and body kinematics", CSIO Chandigarh, INDIA, 19-20 March 2010

[5] A. kamaraj, "Implementation of Wheelchair Controller using Eyeball Movement for Paralytic People", April -2013.

[6] Poonam S. Gajwani1 & Sharda A. Chhabria, "Eye motion tracking for wheelchair control" July-December 2010.

[7] Sandesh Pai, Sagar Ayare, Romil Kapadia, "Eye Controlled Wheelchair" October-2012.

[8] Yash Pathak, Samir Akhare, Vishal Lambe, "Iris Movement Tracking by Morphological Operations for Direction Control" September – 2012.

[9] K.S. Sabarish, A.M. Suman, "Eyeball and Blink Controlled Robot with Fuzzy Logic Based Obstacle Avoidance System for Disabled" (ICEEE'2012) June 16-17, 2012, Bangkok.

[10] Wei-Chung Cheng 'An Electro-Oculography Circuit for Detecting Eye Movements for Low-Powerv Displays'

[11] Poonam S. Gajwani & Sharda A. Chhabria, "Eye Motion Tracking for Wheelchair Control", International journal of information technology and knowledge management, July-Dec. 2010.

[12] Matt Bailey, et. al, "Development of Vision Based Navigation for a Robotic Wheelchair", in proceedings of 2007 IEEE 10th International conference on rehabilitation robotics.

[13] Michal Ciesla*, Przemyslaw Koziol, "Eye Pupil Location Using Webcam" Department of Physics, Astronomy and Applied Computer Science, Jagiellonian University, Reymonta 4, 30— 059 Kraków, Poland

[14] David Wild, "Gaze tracking using a regular Web camera" Departement of computer Science, Rhodes University, Graharnstown, South Africa

[15] Hari Singh, Dr. Jaswinder Singh, "Human eye tracking and related issues: a review", Department of electronics and communication DAV Institute of engineering and technology, Jalandhar, India.

[16] Roshani D. Ninama, Rutu P. Nayak, "Eye movement controlled Wheel chair" Biomedical engineering department, G.E.C, Gandinagar, Gujarat, India.