"BRAIN CONTROLLED CAR FOR DISABLED USING ARTIFICIAL INTELLIGENCE"

Mr. Ajay B. Gadicha*

Prof. Vijay. B. Gadicha*

Prof. A.S.Alvi**

ABSTRACT:

This paper considers the development of a brain driven car, which would be of great help to the physically disabled people. Since these cars will rely only on what the individual is thinking they will hence not require any physical movement on the part of the individual.

The car integrates signals from a variety of sensors like video, weather monitor, anti-collision etc. it also has an automatic navigation system in case of emergency. The car works on the asynchronous mechanism of artificial intelligence. It's a great advance of technology which will make the disabled, abled. In the 40s and 50s, a number of researchers explored the connection between neurology, information theory, and cybernetics. Some of them built machines that used electronic networks to exhibit rudimentary intelligence, such as **W. Grey Walter's** turtles and the **Johns Hopkins** Beast. Many of these researchers gathered for meetings of the Teleological Society at Princeton and the Ratio Club in England.

* P. R. POTE (PATIL) College of Engineering and Technology. Amravati, India.

** Department of Information Technology, PRMIT &R, Badnera, Amravati.

INTRODUCTION:

The brain is the major organ of the central nervous system and the control centre for all the body's voluntary and involuntary activities. One of the major parts of the brain is cerebellum whose main functions are the maintenance of posture and the coordination of body movements.

In the human body there are several parts and all having its separate motion. Each area of the cerebellum has its separate significance in the body movements .To control movement the brain has several parallel systems of muscle control.

The motor system controls voluntary muscle movement, aided by the motor cortex cerebellum, and the basal ganglia. The picture below shows the cerebellum with clear labelelling showing at which part, signals are generated for controlling, which body parts.

In brain machine interface technology the electrical signals from the brain are extracted and processed to run various applications. The video and thermo gram analyzer continuously monitor activities outside the car. A brain-computer interface (BCI), sometimes called a direct neural interface or a brain-machine interface, is a direct communication pathway between a human or animal brain (or brain cell culture) and an external device.

In one-way BCIs, computers either accept commands from the brain or send signals to it (for example, to restore vision) but not both. Two-way BCIs would allow brains and external devices to exchange information in both directions but have yet to be successfully implanted in animals or humans. In this definition, the word brain means the brain or nervous system of an organic life form rather than the mind. Computer means any processing or computational device, from simple circuits to silicon chips (including hypothetical future technologies such as quantum computing).

Once the driver (disabled) nears the car. The security system of the car is activated. Images as well as thermo graphic results of the driver are previously fed into the database of the computer. If the video images match with the database entries then the security system advances to the next stage. Here the thermo graphic image verification is done with the database. Once the driver passes this stage the door slides to the sides and a ramp is lowered from its floor. The ramp has flip actuators in its lower end. Once the driver enters the ramp, the flip actuates the ramp to be lifted horizontally. Then robotic arms assist the driver to his seat. As soon as the driver is seated the EEG (electroencephalogram) helmet, attached to the top of the seat, is lowered and suitably placed on the driver's head. A wide screen of the computer is placed at an angle aesthetically suitable to the driver. Each program can be controlled either directly by a mouse or by a shortcut. For starting the car, the start button is clicked. Accordingly the computer switches ON the circuit from the battery to the **A.C.Series** Induction motors.

1. WHAT IS EEG..?

Electroencephalography is a routine method of medical diagnostics for assessing human brain activity. The electrical signals, induced by activity of the cranial nerves, are measured on the scalp. Thinking consists of a complex interaction of electrical signal processing and chemical signal storage in the brain.

Certain parts of the brain are clearly related to activities of the body, e.g. the processing of eye signals used here which takes place in the visual cortex in the back of the human brain. Such electrical processes occur in all parts of the brain and they interfere with each other.

They can be measured by accompanying voltage on the skin. With the electroencephalography, caps are usually used for applying electrodes which can measure the voltage of a few millionth volts. The signals of normal vision are too complicated and too weak to be used in the EEG. But if a large part of the field of view is occupied by a blinking pattern with a frequency between 8 and 15 Hz, stronger electrical signals of the visual centre are induced in the brain.

They can be recorded by the EEG, filtered by the computer and processed. Such signals induced by external, defined stimuli are called visually evoked potentials (VEP).The signals are represented as a map (see figure). In medical applications, the doctor makes a diagnosis by comparing the brain activity of the ill person with that of healthy ones.

2. BIOCONTROL SYSTEM:

The biocontrol system integrates signals from various other systems and compares them with originals in the database. It comprises of the following systems:

- Brain-computer interface
- Automatic security system
- Automatic navigation system

Now let us discuss each system in detail.

2.1. Brain Computer Interface:

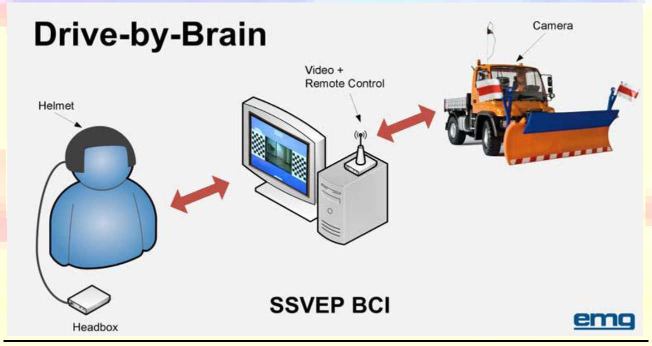
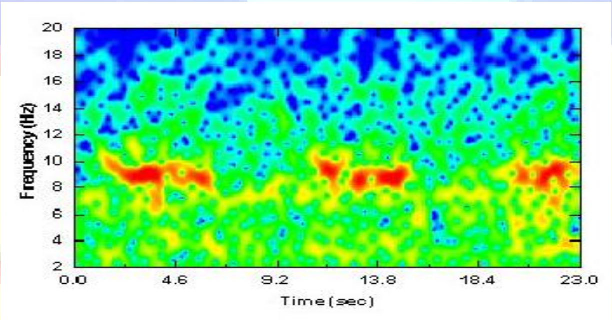


Fig.1: The control of machines by means of steady-state visually evoked potentials is done via the helmet, which records the brain signals and transmits them to the computer. It evaluates the signals and controls the vehicle via remote control**.**

A brain computer interface is meant to allow the direct information flow between brain and computer. For the technical implementation, signals from the brain have to be recorded. There are several methods which can be considered for this purpose. The method we use is the relatively cost-effective and simple recording of electrical brain signals (EEG) by means of capacitive electrodes. In our system, the signals of the visual region of the brain are induced by looking at two blinking chequerboard patterns on the computer screen. If the controlling person concentrates on the blinking pattern on the left side, the vehicle is supposed to drive to the left and accordingly to the right if looking at the pattern on the right side. If none of the chequerboard patterns is looked at, the vehicle drives straight ahead. The signals for left and right differ in terms of blinking frequency **. (Martin Oehler, Peter Neumann, Matthias Becker,Gabriel Curio, Meinhard Schilling,** "Extraction of SSVEP Signals of a Capacitive EEG Helmet for Human Machine Interface", Proceedings of the 30th Annual International Conference IEEE EMBS, Vancouver, Canada, 2008).

The recorded signals are amplified and disturbances are filtered. The signals are then transmitted to the computer (wireless or via cable) and evaluated. The intention of the controlling person can only be determined from the various signals and converted into control signals for a machine by means of a computer program. The control commands are then transmitted to a vehicle model via radio.



2.2. Automatic Security System :

The EEG of the driver is monitored continually. When it drops less than 4 Hz then the driver is in an unstable state. A message is given to the driver for confirmation and waits for some time, to continue the drive. A confirmed reply activates the program for automatic drive. If the driver is doesn't give reply then the computer prompts the driver for the destination before the drive.

2.3. **Automatic Navigation System:**

As the computer is based on artificial intelligence it automatically monitors every route the car travels and stores it in its map database for future use. The map database is analyzed and the shortest route to the destination is chosen. With traffic monitoring system provided by xm satellite radio the computer drives the car automatically.

Video and anti-collision sensors mainly assist this drive by providing continuous live feed of the environment up to 180 m, which is sufficient for the purpose.

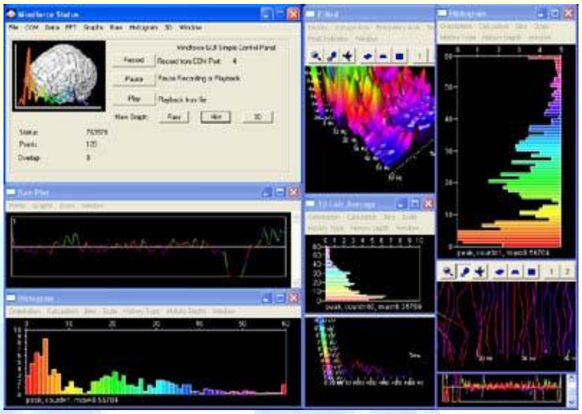


Fig.8: EEG Analysis Window

3. IMPLEMENTATION: TEST RESULTS COMPARING DRIVER ACCURACY WITH/WITHOUT BCI :

1. Able-bodied subjects using imaginary movements could attain equal or better control accuracies than able-bodied subjects using real movements.

2. Subjects demonstrated activation accuracies in the range of 70-82% with false activations below 2%.

3. Accuracies using actual finger movements were observed in the range 36-83%.

4. The average classification accuracy of imaginary movements was over 99%.

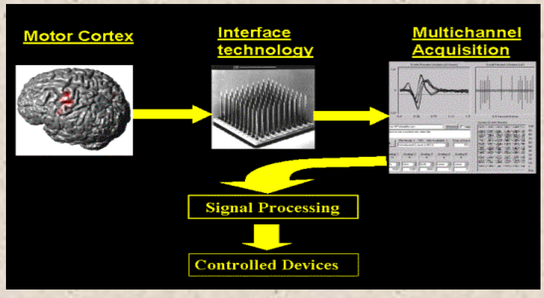


Fig.4 Brain-to- Machine Mechanism

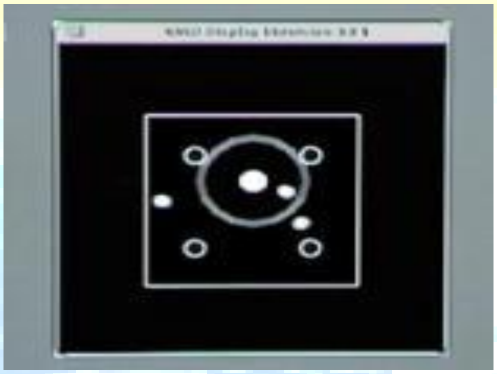


Fig.5 Eyeball Tracking

The principle behind the whole mechanism is that the impulse of the human brain can be tracked and even decoded. The Low-Frequency Asynchronous Switch Design traces the motor neurons in the brain. When the driver attempts for a physical movement, he/she sends an impulse to the motor neuron. These motor neurons carry the signal to he physical components such as hands or legs. Hence we decode the message at the motor neuron to obtain maximum accuracy. By observing the sensory neurons we can monitor the eye movement of the driver. As the eye moves, the cursor on the screen also moves and is also brightened when the driver concentrates on one particular point in his environment. The sensors, which are placed at the front and rear ends of the car, send a live feedback of the environment to the computer. The steering wheel is turned through a specific angle by electromechanical actuators. The angle of turn is calibrated from the distance moved by the dot on the screen.

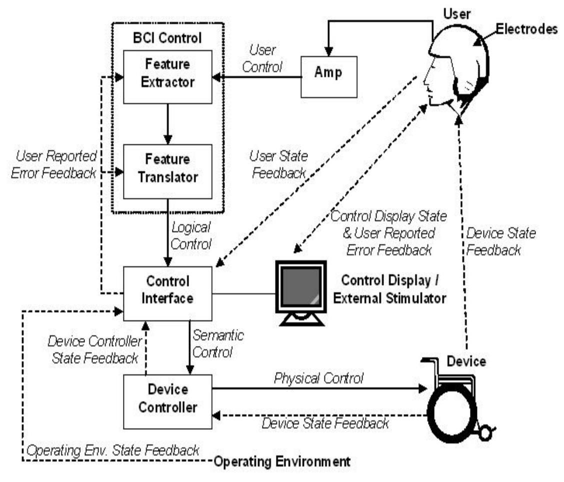


Fig.6: Electromechanical Control Unit

4. SOFTWARE & HARDWARE SPECIFICATION :

Brain-computer interfaces will increase acceptance by offering customized, intelligent help and training, especially for the non-expert user. Development of such a flexible interface paradigm raises several challenges in the areas of machine perception and automatic explanation.

The teams doing research in this field have developed a single-position, brain-controlled switch that responds to specific patterns detected in spatiotemporal electroencephalograms (EEG) measured from the human scalp. We refer to this initial design as the Low- Frequency Asynchronous Switch Design (LF-ASD) (Fig.1).

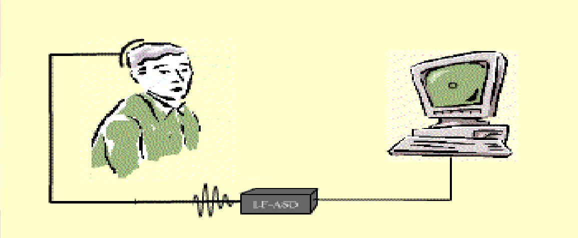


Fig.1 LF-ASD

The EEG is then filtered and run through a fast Fourier transform before being displayed as a three dimensional graphic. The data can then be piped into MIDI compatible music programs. Furthermore, MIDI can be adjusted to control other external processes, such as robotics. The experimental control system is configured for the particular task being used in the evaluation. Real Time Workshop generates all the control programs from Simulink models and C/C++ using MS Visual C++ 6.0. Analysis of data is mostly done within Mat lab environment.

5. FEATURES OF EEG BAND :

Remote analysis data can be sent and analyzed in real-time over a network or modem connect. Data can be fully exported in raw data, FFT & average formats. Ultra low noise balanced DC coupling amplifier.max input 100microV p-p, minimum digital resolution is 100 micro p-p / 256 = 0.390625 micro V p-p. FFT point can select from 128 (0.9375 Hz), 256 (0.46875 Hz), 512 (0.234375 Hz resolution). Support for additional serial ports via plug-in boar; allows extensive serial input & output control. Infinite real-time data acquisition (dependent upon hard drive size).Real-time 3-D & 2-D FFT with peak indicator, Raw Data, and Horizontal Bar displays with Quick Draw mode. Full 24 bit color support; data can be analyzed with any standard or user.

Customized color palettes; color cycling available in 8 bit mode with quick Draw mode. Interactive real-time FFT filtering with Quick Draw mode . Real-time 3-D FFT (left, right, coherence and relative coherence), raw wave, sphere frequency and six brain wave switch in one OpenGL display. Full Brainwave driven Quick Time Movie , Quick Time MIDI control; user configurable Full Brain wave driven sound control, support for 16 bit sound; user configurable. Full image capture a n d playback control; user configurable.

6. CONCLUSION:

When the above requirements are satisfied and if this car becomes cost effective then we shall witness a revolutionary change in the society where the demarcation between the abler and the disabled vanishes. Thus the integration of bioelectronics with automotive systems is essential to develop efficient and futuristic vehicles, which shall be witnessed soon helping the disabled in every manner in the field of transportation.

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