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Mind-Driven Vehicle for Disabled Person using Intelligent System

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Abstract: *In this paper, we presented a car for a disabled person. It is associated with the human brain. It will be of great help to the physically disabled people. These cars will work based on person's thinking thus they will 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 read brain signals and controls a car accordingly. Earlier some researchers had 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. Recently Chinese engineers from Nankai University in Tianjin have developed a system that can read brain signals and control a car accordingly. Most researchers think that their work will eventually be incorporated into a machine with general intelligence, combining all the skills above and exceeding human abilities at most or all of them. According to the researchers, the ultimate plan could be to integrate the technology with driverless cars, so it is more of a complementary service than an alternative to physical driving.*

Keywords: *Brain monitoring, Brain computer interface, bio-control system, ECG, Automatic security System, Neuroprosthetics.*

1. INTRODUCTION

A brain-machine interface (BMI), sometimes called a direct neural interface or a brain-computer interface. It is a direct communication pathway between a human or animal brain 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 BMIs 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 physically challenged driver starts to drive 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 drivers 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. The original premise behind Brain Driver was to build a system that someone with a physical disability can use to manoeuvre through the world

2. RELATED WORK

The self-driving car, for physically challenged drivers and a potential advance in road safety, could also prove to be a life-changing breakthrough for many people with disabilities, granting them a new measure of independence. While much of the necessary technology is well along in development, those awaiting vehicles that can provide unassisted transportation will have to be patient. Self-driving cars have been the stuff of science fiction and experimentation since the early days of the automobile. In 1925, Time magazine carried an article about a car that cruised New York City streets without a driver, guided by radio control. The General Motors Futurama exhibition at the 1939 New York World's Fair depicted a future of self-driving cars by the industrial designer Norman Bel Geddes.

The Bel Geddes vision, with its implications for the disabled try to make car which is mind driven. Automakers have demonstrated cars capable of self-driving operation, and in August the chief executive of Nissan, Carlos Ghosn, said the automaker would offer a car with "autonomous drive technology" by 2020. Mr. Ghosn did not promise a vehicle that could be operated without a driver at the wheel, and a Nissan spokeswoman, Wendy Payne, said the company had not studied the disability issue. Confirming that Nissan's first self-driving car would require an able driver, she said that all automakers were taking that approach: "At this point, the driver has to be able to operate the vehicle." G.M. is among the makers demonstrating self-driving prototypes, and a driver-assistance technology that it calls Super Cruise, to be introduced in 2017 model Cadillacs, makes partly autonomous operation possible on the highway. Still, the company is reserved in its optimism. "We believe that one day there will be fully automated cars that drive themselves under all circumstances," a G.M. spokesman, Dan Flores, said about the potential of driverless vehicles for the handicapped. "A lot of societal benefits are possible, but we're years away from achieving those benefits." Audi recently obtained a permit to test self-driving cars on California roads. But the cars are equipped with manual controls so a driver can take over if necessary. "Present-day tech developed by every automaker and accepted by state laws requires human ability to take over," a company spokesman, Brad Stertz, wrote in an email. "Fully autonomous driving is mostly a human generation away, no matter who is making promises." Google is making promises, or at least offering suggestions. The company, which declined to provide an interview for this article, has developed two prototypes. The first was a standard vehicle fitted with sensors, hardware and computers that enabled self-driving. Equipped with steering wheel and brakes, it could be operated by a backup driver in an emergency. The second-generation Google car is entirely driverless and has no steering wheel or brake pedal. Driver intervention is impossible, even in an emergency, so its design would be appropriate for people physically unable to operate a vehicle [1].

3. BIO-CONTROL SYSTEM

The bio-control system integrates signals from various other systems and compares them with originals in the database. BMI could be helpful especially for safety applications or applications where it is instantaneously difficult to move and the response time is crucial. Besides they can also be used to increase the accuracy of the HCI systems, resulting in BCI contribution in various fields such as industry, educational, advertising, entertainment, and smart transportation. Despite its expected success, Brain computer interfacing needs to overcome technical difficulties as well as challenges posed by user acceptance to deal with such newly discovered technology [1]. It comprises of the following systems:

1. Brain-computer interface
2. Automatic security system
3. Automatic navigation system

Now let us discuss each system in detail.

3.1 Brain-machine Interface

Brain-machine interfaces are also called as brain-computer interface or direct neural interface. It increases 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. It is a direct communication pathway between an enhanced or wired brain and an external device. BCIs are often directed at researching, mapping, assisting, augmenting, or repairing human cognitive or sensory-motor functions. The teams doing research in this field have developed a single-position, brain-controlled switch that responds to specific patterns detected in spatio-temporal electroencephalograms (EEG) measured from the human scalp. We refer to this initial design as the Low- Frequency [3].

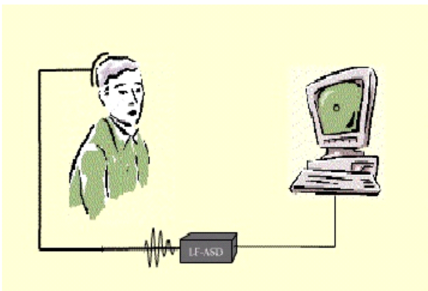

Fig 1: *Asynchronous Switch Design (LF-ASD)*

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 [3].

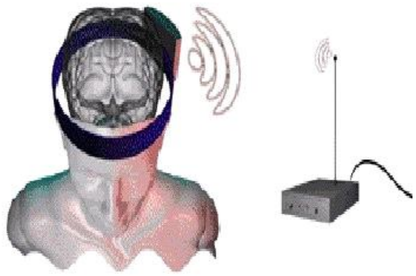

Fig 2: *EEG Transmission*

3.1.1 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%

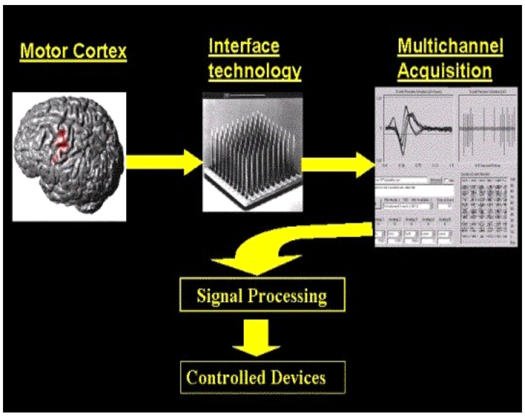

Fig 4: *Eyeball Tracking*

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 [4].

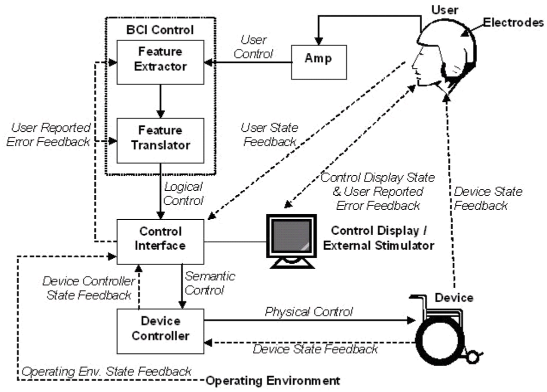

Fig 5: *Electromechanical Control Unit*

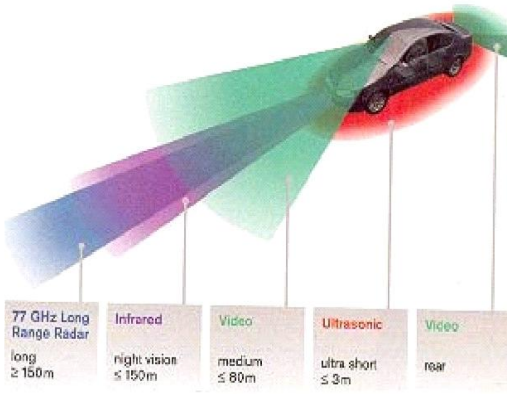

Fig 6: *Sensors and Their Range*

3.2 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 [5].

3.3 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 [6]

An automotive navigation system is part of the automobile controls or a third party add-on used to find direction in an automobile. It typically uses a satellite navigation device to get its position data which is then correlated to a position on a road. When directions are needed routing can be calculated. On the fly traffic information can be used to adjust the route. Dead reckoning using distance data from sensors attached to the drive train, a gyroscope and an accelerometer can be used for greater reliability, as GPS signal loss and/or multipath can occur due to urban canyons or tunnels [7].

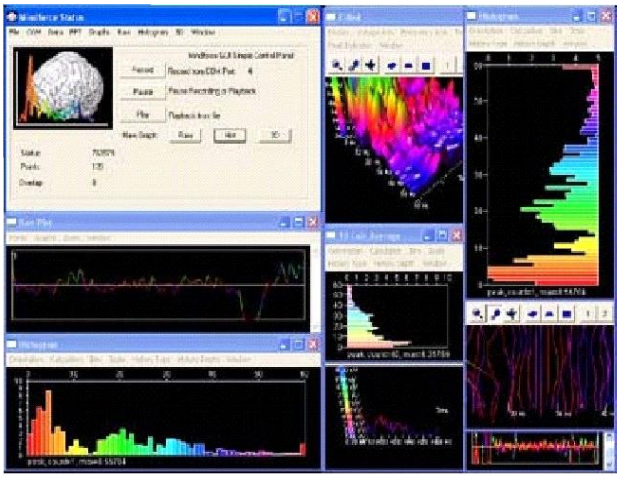

Fig 9: *EEG Analysis Window*

4. VERSUS NEUROPROSTHETICS

Neuroprosthetics is an area of neuroscience concerned with neural prostheses, that are, using artificial devices to replace the function of impaired nervous systems and brain related problems, or of sensory organs. The most widely used neuroprosthetic device is the cochlear implant which, as of December 2010, had been implanted in approximately 220,000 people worldwide.[8] There are also several neuroprosthetic devices that aim to restore vision, including retinal implants [7]

The difference between BCIs and neuroprosthetics is mostly in how the terms are used: neuroprosthetics typically connect the nervous system to a device, whereas BCIs usually connect the brain (or nervous system) with a computer system [8]. Practical neuroprosthetics can be linked to any part of the nervous system—for example, peripheral nerves—while the term "BCI" usually designates a narrower class of systems which interface with the central nervous system [4].

The terms are sometimes, however, used interchangeably. Neuroprosthetics and BCIs seek to achieve the same aims, such as restoring sight, hearing, movement, ability to communicate, and even cognitive function. Both use similar experimental methods and surgical techniques [9].

5. EXPERIMENTAL RESULTS

Henrik Matzke made an attempt to design a car for disabled. The car pulls up to a junction. He concentrates for a moment, willing the car to turn. The steering wheel spins, and the car veers to the right, accelerating away. He's part of a team at the Free Univesity of Berlin working on what they call the Brain Driver – a project that's hoping to bring research into reading and interpreting brain signals into people's cars and homes. What is it like to control a one-and-a-half-tonne vehicle with your mind? The original premise behind Brain Driver was to build a system that someone with a physical disability can use to manoeuvre through the world. Brain Driver would, in theory, allow them to drive by simply thinking "right" and "left" and "forward". But turning that dream into a reality is as hard as it sounds. Adalberto Llarena, a roboticist with the Brain Driver project has faced two main challenges: the hardware and the humans. On the hardware side, they're trying to design a commercially viable piece of equipment that can listen in on the brain's whispers and turn them into meaningful signals that power a machine. On the human side, they've got to develop something that real people can actually learn to use [10].

Fig 10: *Disabled person in Car*

6. CONCLUSION

According to the researchers, the ultimate plan could be to integrate the technology with driverless cars, so it is more of a complementary service than an alternative to physical driving. When the above requirements are satisfied and if brain controlled car for disabled 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. This type of non-invasive brain interface could also allow disabled and paralyzed people to gain more mobility in the future, similarly to what is already happening in applications such as robotic exoskeletons and advanced prosthetics.

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