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Persuading the Wheel chair by relevanting the brainwork

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Abstract - Amyotrophic lateral sclerosis, or ALS, is a chronic disease of the nerves cells that conveys impulses from the central nervous system to a muscle, gland, or other effect or tissue that at last leads to complete paralysis. We are developing a wheelchair system that can help ALS patients, and others who can't use physical combinations such as joysticks or gaze follower, regain some autonomy. The method must be usable in hospital and home with marginal infrastructure changes. It must be safe and nearly low cost and must give best contact between the user and the wheelchair within the necessity of the brain computer interface. we have prepared the first working model of a brain-controlled wheel chair that can operate inside a habitual office or hospital surroundings. This unit defines the BCW, our control approach, and the system's performance in a habitual building surroundings

Index-Terms- Brain Computer Interface; P300; EEG and epochs

1. BRAIN COMPUTER INTERFACE

Research on brain composed interfaces has grown in past few years. For instant, BCI researches have arranged neural fix in the brain of animals and humans to control easy mechanisms. Because such intrusive methods are even so dangerous, human BCI research has focused mainly on nonintrusive methods as for observing the brain activity, such as EEG (electroencephalography), magneto encephalography near spectroscopic analysis, and functional magnetic resonance vision**.** Our wheelchair uses an EEG-based BCI—a simple, movable system charge endless reading of brain process. BCIs are usually built using EEG, and researchers have found different techniques to use EEG for communication between a human and a computer. As with other BCIs, low information transfer rate is produced by EEG: either the waiting time between sequentially commands is long, typically various seconds, or uncertainty about the command is high. The problem is to find how to control the wheelchair using weak signal. . One explanation is to present the structure with some independence, such that the user must afford the wheelchair with instructions only from time to time.

Fig. 1. Brain controlled wheelchair based on computer monitoring

The scheme we used in our controlling system is P300EEG which is safe and fast and helps the user to select a required command on the display. The wheelchair then moves to the related target on a predefined way. This scheme requires marginal effort from the user. The paths are computer code defined and not hard coded, so they can easily be varied if the surroundings changes

1.1. Properties of the P300 BCI

An EEG-based BCI is predominantly well appropriated for wheel chair system since it can distribute a continuous time signal in addition to the essential hardware is movable. A set of electrodes on a cap are wired to an amplifier, filter and digitizing. It transfers the signal for analysis to a computer. The related electronic device weighs under one kilogram and have the size less than a laptop.The P300 induced impending is a well-studied fixed brain signal. This normal, instinctive response of the brain to irregular stimuli can offer a BCI with an eccentric pattern. In this pattern, an arbitrary sequence of stimuli is existed, the one which is concerns the theme. There is a positive potential peak in EEG signal when approximately 0.3 seconds after the goal flares. It determines that the goal stimulus arise 300milliseconds earlier when the system identifies a P300 signal (P means +ve and 300 means 300milliseconds).

The raw EEG signal from 10 electrodes is shown in fig 2a. The vertical red lines represent the times of goal and green lines represent the non-goal stimuli. The system cannot differentiate the P300 signal from backdrop activity, but on average several samples eases the uncorrelated activity, noise in addition to signal variability.

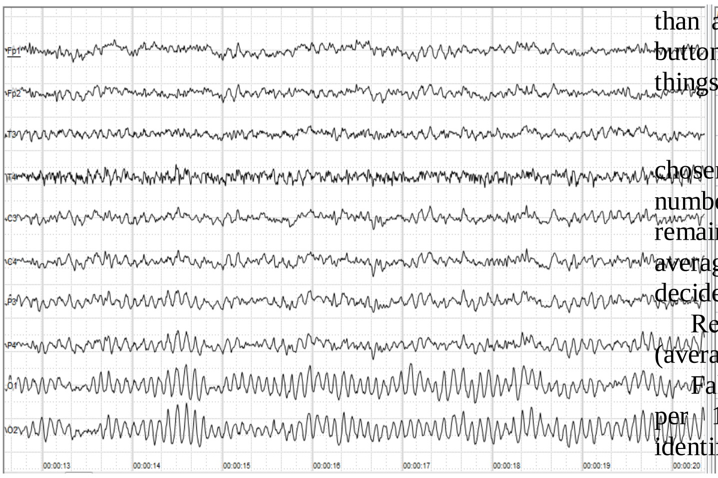

Fig. 2(a). EEG for 10 electrodes

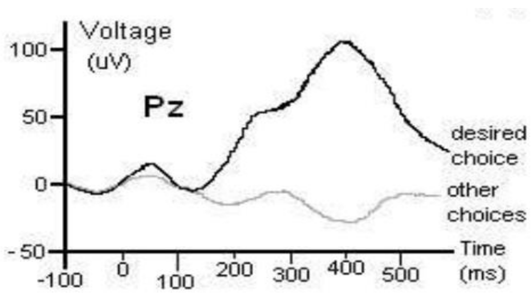

Fig. 2(b). Averaging epochs cancels out uncorrelated noise

Figure 2b shows the signal that comes from averaging hundreds of samples core sponging for goal events (red curves) and non-goal events (green curves). The P300 supported BCI needs no user training and only a few minutes to regulate the detection algorithm's constraints. This is important since other BCI techniques need a long preparation stage, up to numerous months in the case of sluggish cortical-potential tools.

2. MAIN FEATURES

Our BCW utilize the asynchronous P300 system. The scheme must be asynchronous so that the user can interfere at any desired time. Firstly, the scheme filters and cleans the signals from 15EEG electrodes positioned on the top of the head. It is then slices the signals to correlate every button on the GUI with an appetizer related to statistics 150 to 500 ms after that button flares. These appetizers are nourished carry vector tool, which calculates a score articulating the possibility that the appetizers contain a P300. After every epoch (the time during which all buttons are sparked once), the nourished carry vector tool results new scores for all buttons. When one or more scores are higher than a verdict threshold, the system delegates the button with the highest score as the goal. Three things are significant for the P300 BCI:

Error rate (Err): the ratio of incorrectly chosen goals (substitution) divided by the total number of selections throughout research. We remain this error rate low by using the moving average of scores above the last eight epochs to decide the goal.

Response time (RT): the time prior to a button's (averaged) score attains the verdict threshold.

False-acceptance rate (FA): the number of times per 100 seconds that the system incorrectly identifies the P300.

Selecting a decision threshold

To decide an appropriate threshold for our purpose, we calculate RT, FA, and Err as a function of the threshold. We traced the EEG signals for five young, healthy subjects while they were choosing buttons on the boundary and while they executed other metal missions such as reading or relaxing.

Research results are shown in fig3. For every subject, both the P300 and non-P300 scores are nearly usually allocated and the mean of the P300 scores is superior to the non-P300 mean. The RT curve is better than 8, the averaging window's thickness. RT enlarges with the threshold because lesser amount models have a high score. Equally, FA is near to 100% for threshold values minor than the score division's center and leads to zero for high threshold values. Err is below 10% and reduces for huge threshold values. Based on the requirement and desired performance the threshold value should be chosen. To manage wheelchair, we focus extra on consistency and thus select a moderately high threshold value, springy a low Err. Our outcomes show that for a threshold that keeps FA around 2.5%, RT is around 20seconds, which is totally suitable. For example, the waiting instance in elevators or for a green light on the street is on the order of tens of seconds or minutes.

2.1. Simple collaborative control

Normal wheel chair control requires manual operation like remote or an assistant to control it. While the chair is controlling by the physically disabled person then there will be some cases of occurring accidents and it is hard for the person who unable to control his hand to control chair. To avoid such cases brain computer interface is required where we collect the EEG data and analyze it with the help of processor to control the wheelchair. For analysis we use p300 interfacing for controlling wheel chair. In standard wheelchair control requires the user to provide commands continuously, and even slight errors can cause accidents, however for continuous brain control isn't possible because the current BCIs (Brain Computer Interface) aren't fast or reliable enough. So we need to provide sufficient automation to the wheel chair to reduce manual errors. Here we use some navigating techniques to the wheelchair. A best approach for automating the wheelchair with the help of sensors to perform obstacle detection and localization (with reference to particular coordinate system). The robot must have some artificial intelligence in it to generate suitable trajectory for reaching a destination with safety during motion. But this strategy requires a heavy cost and power. For example some autonomous vehicles refuse to move forward even for small disturbances and obstacles' which a human can understand and take certain action on it.

In case of robotic wheelchair it assists a person, who will decide to change the command at any time – for example to stop the way to kitchen, or to go to toilet. The quality of interaction between robotic wheelchair and human will be determined whether a person adopts it or not. For all this reasons, we decided to develop a safe motion-control strategy by using simple sensors, capable with the users to solve complex situations that will occur from time to time.

2.2. Motion guidance

The wheelchair user cannot issue commands continuously, so we simplify motion control with the help of set of predefined paths between two locations in the user's daily environment. when the user selects the path, then the system drives the wheelchair along to the desired path with the help of controller.

Fig. 3(a) Sample map with a guiding path in a home environment

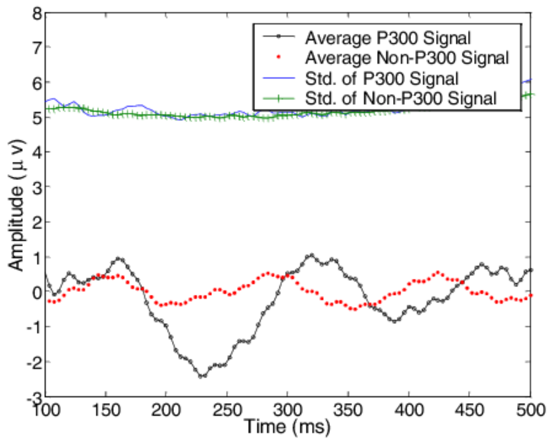

Fig. 3(b) Distribution of a typical subject's scores for the samples that contain a P300 (corresponding to the highest score) and those that don't.

If the plan of the building is available then the wheelchair system will create a collection of guided paths automatically or alternatively we can create a map using manual programming: the inbuilt computer records the trajectory while a helper pushes the wheelchair between two locations. Hear we use a cubic Basis-spline mathematical equation to serve as a guide as a guide for subsequent movements. We can easily extend the map to nearby locations or spaces. We develop a tool for path editing map that helps the user to easily modify the path in case of environmental modifications like obstacles and furniture location.

2.3. Context-dependent menus

The computer scans the locations linked by the guiding paths. It displays the list on the P300 interface, as shown in figure .when the user choose the desired destination then the wheelchair moves towards it, following the particular guided path. The menu in the interface is context dependent. When BCW detects the obstacle then it stops in front of the obstacle then it displays an option to the user to solve particular situation. When he is in a lift then the GUI displays the list of floors. If it is a smart lift which can communicate wirelessly with surroundings then the processor controls the lifts entrance and exit. The P300 BCI we using can handle 20 or even more buttons , so that the user can select the floor directly in one step.

2.4. *Adapted control hierarchy*

Here we use P300 paradigm which recognizes a stop command with in a less duration. Because the commonly used command in motion is "stop", the GUI will consists of one stop button along with 8 dummy buttons. Still the respond time is on the order of several seconds, and will provide best safety, to stop the wheelchair we used stop reflex with the help of simple sensors in front of the wheelchair. For this we used three IR sensors with a range of 40 to 60 cm's and an angular range of 180 degrees. When the wheel chair stops in front of the object / obstacle then the GUI asks the user which action to perform:

- Continue moving if the obstacle is removed in the path(example: a human blocks the path)
- To avoid the path by moving left or right of the object

3. IMPLEMENTATION

We assembled the BCW model on a Yamaha Navione power wheelchair. The real-time control program is written in C and runs on a Dell Inspiron 15 5000 with a 8th Gen Intel Quad Core i5-8250U Processor run by Ubuntu Linux 17.10 with a Linux kernel 4.13 with Real Time Application Interface v3.3 for real-time abilities. We limited the sensors to two Mask encoders which are attached to specially designed glide wheels to collect the use of data from motion sensors to estimate change in position over time and a GPS for global positioning. This GPS, similar to GPS used in mobiles to read location, is mounted below the seat. The physically disabled person can move to any place with the help of GPS, without the help or care of another person. Combining information from these two simple sensors, the system provides sufficiently accurate wheelchair positions and orientations at speeds up to 0.8 meters per second. For the EEG acquisition, we use Neuroscan's SynAmps RT, a high-quality, low cost 64 channel digital EEG amplifier that's capable of 24-bit sampling at 20,000 per channel all channels driven, measuring signals from DC to 3500 Hz.

3.1. Locking scheme for greater reliability

The user operating the wheelchair should stay in a particular location and perform any command. To prevent false commands which may move the wheelchair, we applied an interface –locking strategy. The user should select any one command from the given options in the display. Once the required option is selected the user can't give another command to the system.Here, the number of false selections for unselecting the key is FA/9.

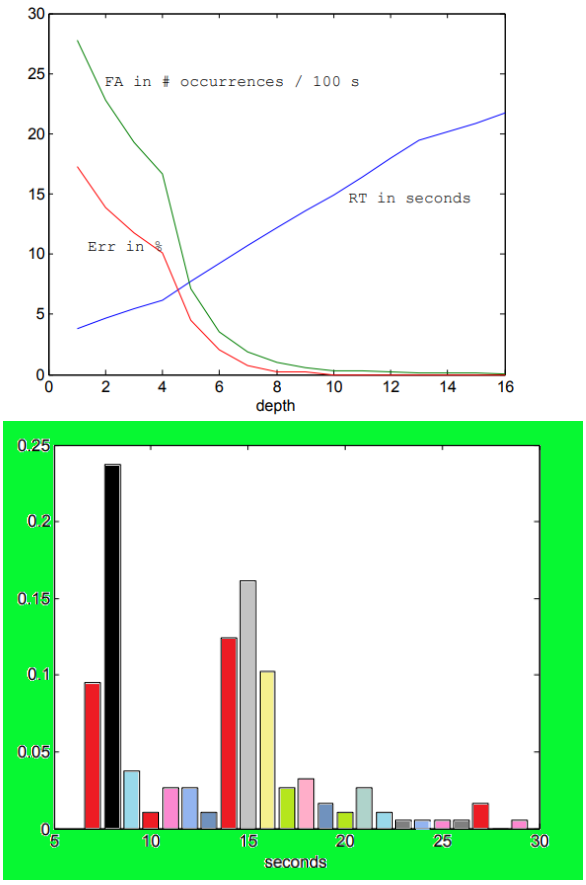

Fig. 4. (a) Features of BCI with some Threshold Value (b) Samples that consists of P300.

3.2. *A quick interface for stopping*

By using one button to stop the wheel chair at the time of movement has two uses. By using the low threshold the response can be reduced.

3.3. *Navigation with the wheelchair*

The GPS we provided in the chair is very user friendly and it does not require any environmental modifications. The GPS uses Google maps, so there is no need of other maps for guiding paths or weather condition check up. By the help of GPS the chair can be driven even on the roads, the GPS also provides the traffic conditions by which the user can take the safest road without the help of other person. Here the user only has to select the destination in his mobile. The whole system is easy to set up and it doesn't require environmental modifications.

4. CONCLUSION

The experiments we conducted showed the best results and also very easy to use. The human-system collaboration built-in in our system was designed to use, both the wheelchair system and the user to their full potential. The commands provided to the user in the computer allow both the user and the computer to communicate, enabling the user to select the required commands corresponding to the current situation. This will let the user decide the next step, depending on his or her superior training, while the BCW is responsible for executing them safely, thus paying back for the user's disability. GPS provides effective control while needing little input, so it's an updated version to that of BCI's model. This is also cost friendly and is a safety provider. If the user wants to perform another task on the way he or she can stop the chair within a little span of time using p300 stop command. The IR sensors used in the chair can detect any physical object and respond on the users command sharply.

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