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A Mind Controlled Wheel Chair with Patient Monitoring and Indoor Positioning System

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General Note

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ABSTRACT

This paper describes a Mind controlled wheel chair with patient monitoring system based on Brain Computer Interface (BCI). BCIs are systems that may bypass typical channels of communication (i.e., muscles and thoughts) to supply direct communication and management between the human brain and physical devices by translating different patterns of brain activity into commands in real time. With these commands a wheel chair can be controlled. This wheel chair allows Doctors or relatives of patient to check the status of patient health remotely. With an Indoor Positioning System (IPS) patient inside the building is located to provide home automation.

Index Terms: Embedded System, Brain Computer Interface (BCI), Indoor Positioning System (IPS)

1. INTRODUCTION

Independent mobility is core to being able to perform activities of daily living by oneself. However, powered wheelchairs are not an option for a large number of people Who are unable to use conventional interfaces, due to severe Motor–disabilities. For some of these people, non–invasive brain–Computer interfaces (BCIs) offer a promising solution to this Interaction problem and in this article we present a shared control architecture that couples the intelligence and desires of the user with the precision of a powered wheelchair. Envision technologies that increase training or rehabilitation effectiveness by integrating real-time brain activity assessment into individualized, adaptive training, and rehabilitation regimens; technologies that help you focus or even overcome a bad day by adjusting your environment to help you achieve desired brain states; technologies that help your doctor identify brain-based diseases or disorders before they interfere with life by assessing neural activity before behavioral symptoms appear; or even technologies that help you communicate better by assessing the neural activity of your audience and providing suggestions for increased clarity and interest. These are examples of potential brain–computer interface (BCI) technologies, a class of neuro technologies originally developed for medical assistive applications.

Figure 1 Brainsense Headband

In figure 1, the Brainsense Headband and those signals will be transferred by using Bluetooth which is there in the Brainsense headband, for this Brainsense headband need to give power using an AAA battery. The Brainsense headband comes with Power switch, a sensor tip, flexible ear arm and a ground connection Ear clip. In this Headband they use Non-invasive sensor that won't cause any pain to the User who were the headband. After inserting an AAA battery switch on the Brainsense head band.

2. SYSTEM DESIGN

While having clear in mind the big futuristic goal a smaller and reachable intermediate step must be chosen; it would become the goal in the mind of everyone. Such a simpler problem has been addressed by substituting the wheelchair with a cart based on an Arduino board Moreover it is important to insist once more that one of the Engineering approaches to problem solving is the "divide and Conquer" paradigm, solving smaller problems to solve the complete problem. The movement problem has been simplified to optically centering the cart on a painted line on ground. Scaling the problem to a wheelchair will also require attention to any misinterpretation of brain signals and software that recognizes them as non-commands, blocking dangerous response. This exercises students' mind to take into account more aspects that just the one on which they are working (the cart), so to not miss the big goal of the problem, making it always alive.

Data processing Unit

Data transmitted by the Brainsense headband will be received by the Computer's Bluetooth receiver. And then all these data will be analyzed by the Level Analysis platform, the data will be received from the port pin which they are giving the same port number for the Bluetooth receiver in the back panel.

EEG signals

EEG signals will be collected with electrodes that area unit placed on the surface of the scalp. The foremost wide used electrodes area unit silver/silver chloride (Ag/AgCl) as a result of they need low price, low contact electric resistance, and comparatively sensible stability. What is more, there are unit rather mature commercial acquisition systems together with the electronic equipment and graphical record cap with integrated Ag/AgCl electrodes that are with success applied in research and clinical diagnosing. However,

exploitation Ag/AgCl electrodes need removing outer skin layer and filling gel between electrodes and scalp (and so, this sort of electrodes is additionally known as "wet" electrodes). These operations take lasting and area unit uncomfortable to users. To deal with these limitations of "wet" electrodes, some researchers are exploring "dry" electrodes that ought not to use gel and skin cleanup. The most disadvantages of existing dry electrodes is that the no heritable graphical record signals area unit worse than those uninhabitable with standard electrodes as a result of the rise of contact electric resistance . Some firms are commercializing acquisition systems supported dry electrodes.

Patient Monitoring System

The wearable sensors provide four functionalities: vital signs monitoring, location tracking, medical record storage, and triage status tracking. We integrated two types of non-invasive vital signs sensors – a pulse oximeter and a blood pressure sensor. The pulse oximeter attaches to the patient's finger and measures heart rate (HR) and Body temperature. A cuff pressure sensor on the patient's upper arm measures systolic and diastolic blood pressure.
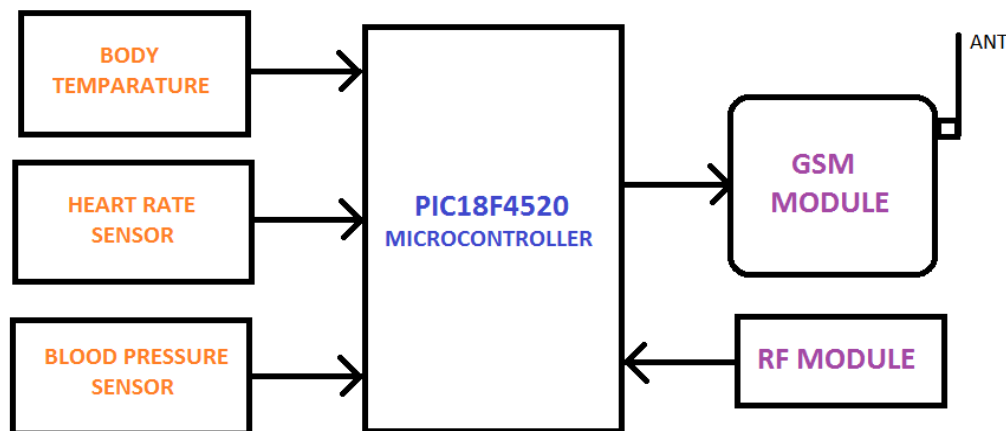
Figure 2 Patient Monitoring System architecture

Indoor Position System

We also integrated a type of location sensing capabilities a indoor location detection system to provide location where the GPS signal cannot be reached. After an initial determination of the position, the system can keep track of its location by using its previous location and the advances from that position. An IPS normally uses accelerometers and gyroscopes for accurately determining the advances from the previous location.
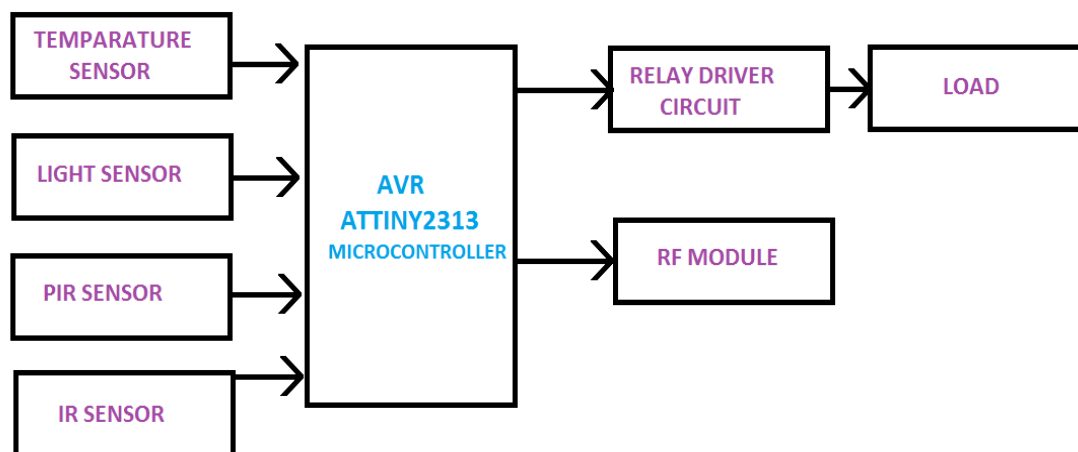
Figure 3 IPS and home automation design

The IPS should provide the room where a patient is. Thus location-based applications in hospital can monitor whether a patient enters a correct room for diagnoses or operation to provide home automation for patient.

3. IMPLEMENTATION AND TESTING

A.BRAIN SENSE

Each type of brain wave has a range of values and is typical of a brain state, for example Lower frequency (Alpha waves, 8-12 Hz) is associated with calm while higher frequency (Beta waves, 12-30 Hz) with concentration. Lower frequency waves (0.1-7 Hz) are associated to mental images down to unconsciousness (non-REM sleep). Brainsense can sense frequencies from 0.5 to 50 Hz and transmit data by a Bluetooth connection every second using a proprietary protocol. Muscular contraction produces unique wave patterns (EMG), they often shadow other brainwaves and are a recognizable way to identify eye blinking (used by the *eSense* algorithms).The *eSense meters* are used to provide a measure of general brain status based on 2 values:

1. *Attention*: the eSense Attention meter indicates the intensity of a user's level of mental "focus" or "attention", such as that which occurs during intense concentration and directed (but stable) mental activity. Its value ranges from 0 to 100. Distractions, wandering thoughts, lack of focus, or anxiety may lower the Attention meter level.

2. *Meditation*: the eSense Meditation meter indicates the level of a user's mental "calmness" or "relaxation". Its value ranges from 0 to 100. Note that Meditation is a measure of a person's mental states, not physical levels, so simply relaxing all the muscles of the body may not immediately result in a heightened Meditation level. However, for most people in most normal circumstances, relaxing the body often helps the mind to relax as well. Meditation is related to reduce activity by the active mental processes in the brain. Ithas long been an observed effect that closing one's eyes turns off the mental activities which process images from the eyes. So closing the eyes is often an effective method for increasing the Meditation meter level. Distractions, wandering thoughts, anxiety, agitation, and sensory stimuli may lower the Meditation meter levels. Values of Attention and Meditation are divided into classes,40-60 is considered average value, 60-80 slightly elevated, and80-100 elevated, where the eSense evaluated is significant. On the opposite side, 20-40 indicate a reduced value while 1-20 is significant of mind states as distraction or agitation. The ranges are wide in order to allow slow adaptive algorithms to actually learn without giving too much importance to fluctuations. Moreover this allows enough tolerance against varying environmental conditions and different people .The figure shows the signals as output after Think Gear processing as well as the three eSense meters. Going in deeper detail, the *eSense Attention meter* measures the level of attention or focus of the subject. A general lack of focus as distractions or anxiety may lower it. The other *eSense, Meditation meter*, measures the level of mental (as opposed to just physical) calmness. Closing eyes and distractions, wandering thoughts, anxiety, agitation, and sensory stimuli may lower the level. All these mental states can and must be trained in order to modify the levels on purpose.
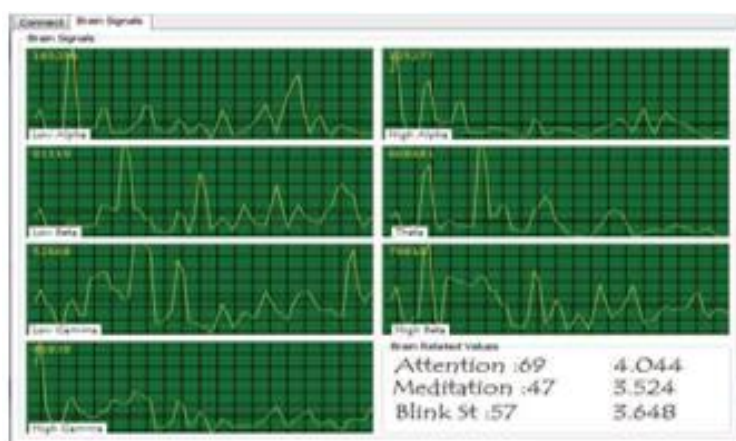
Figure 4 The interface of the brain signals and attention ratio

B.ARDUINO BOARD

Arduino is a 8-bit single-board microcontroller programmable in C or C++ by using a library called Wiring. The C and C++ languages are primary choices in every Computer Science programming language course, so students can apply theoretical programming to something real; moreover these are the ones usually required for embedded system programming. Moreover Arduino is a multiplatform environment (it can run on Windows, Linux, Macintosh), make use of an interface based on the Processing Programming IDE, an easy-to-use development environment used by designers, programming is done via a USB cable (not a slow serial port), and benefits from open source hardware and software, so any modifications allowed without paying any royalty to the makers of Arduino.

Figure 5 Arduino board with Brainsense

A laptop lies between Brainsense headband and Arduino controlled wheelchair. Data exchange is over a Bluetooth connection. Drivers for many platforms have been developed and made available to download and install. In the laptop, data from the band are received by a Bluetooth connection, stored in proprietary Think Gear packets. These are 4-173 byte long, protected by a 1 byte simple (and fast) checksum, and are transmitted as an asynchronous stream of bytes. The wheelchair is simulated by a traditional rover robot. To allow for the simplification of not requiring steering, two light sensor have been mounted on the front of the cart. The cart follows a white line painted on the ground and differences on the reflected light received from the two sensor are used toslow down the wheels in the correct side of the cart, toreposition the cart in the center of the line. The 4 independent wheels of the cart are moved by four continuous rotation DC motors chosen for their compatibility with Arduino hardware. These motors have external potentiometers adjustment screws to set an identical response of all the motors to the same input The goal was to move the wheelchair in a deterministic way. This resulted in another unexpected outcome: the fatigue of concentration was not even supposed, but showed up as an important factor.

4. CONCLUSION

The analysis and development of Mind-controlled wheel chair have received an excellent deal of attention as a result of they'll facilitate bring quality back to folks with devastating contractile organ disorders and therefore improve their quality of life. During this paper, they tend to confer a comprehensive up-to-date review of the whole systems, key techniques, and analysis problems with Mind-controlled wheel chair It is important to address issues related to brain-only driving, for example further experimentation must be conducted in order to discover what happens when the driver gets tired or loses concentration, gets agitated, or even so tired to have micro-naps. Many studies have demonstrated the valuable accuracy of BCIs and provided acceptable information bit rate, despite the inherent major difficulties in brain signal processing. Accordingly, user training time has been significantly reduced,

which has led to more widespread BCI applications in the daily life of disabled people, such as word processing, browsers, email, simple environmental control or neuro prostheses among others.

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