Smart Home Control Design Using EEG Technology

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Abstract:

This project discussed about a brain controlled robot based on Brain–computer interfaces (BCI). BCIs are systems that can bypass conventional channels of communication (i.e., muscles and thoughts) to provide direct communication and control between the human brain and physical devices by translating different patterns of brain activity into commands in real time. With these commands a home devices can be controlled. The intention of the project work is to develop a robot that can assist the disabled people in their daily life to do some work independent on others.

Keywords: EEG, Robot movement.

INTRODUCTION:

Here, we are analyzing the brain wave signals. Human brain consists of millions of interconnected neurons. The patterns of interaction between these neurons are represented as thoughts and emotional states. According to the human thoughts, this pattern will be changing which in turn produce different electrical waves.

A muscle contraction will also generate a unique electrical signal. All these electrical waves will be sensed by the brain wave sensor and it will convert the data into packets and transmit through Bluetooth medium.

Level analyzer unit (LAU) will receive the brain wave raw data and it will extract and process the signal using MATLAB platform. Then the control commands will be transmitted to the robotic module to process. With this entire system, we can move a robot according to the human thoughts and it can be turned by blink muscle contraction.
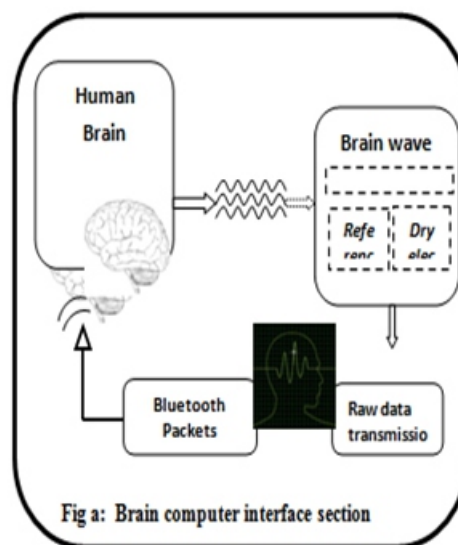
BLOCK DIAGRAM:

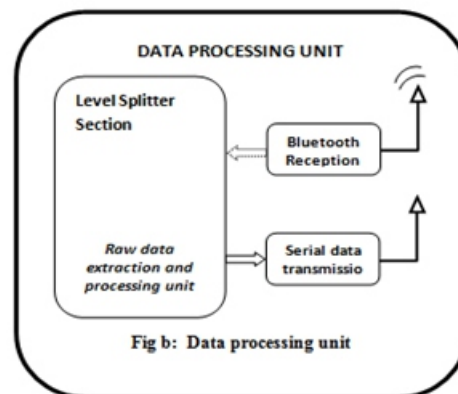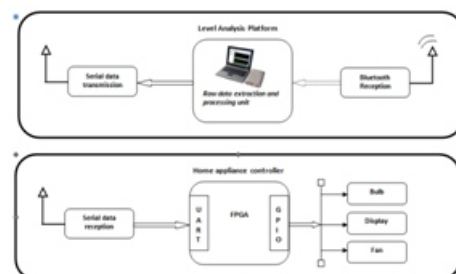Fig a: Brain computer interface section

Fig b: Data processing unit

This project work consists of a FPGA, brain wave sensor and alert unit obstacle detection unit as hardware parts and an effective brain signal system using Mat lab platform. In this project initially the person's attention level or else the driver's drowsy level should be found out by the brain wave sensor.

Whenever a person is controlling the home, the brain wave sensor unit will calculate the blinking level and it will compare with the minimum attention levels of human when ever not sleeping. The blinking levels will equal the set point then automatically vehicle will move without any problem. In case if the blinking levels will cross the set point, then the if he blink cursor moves from FAN to BLUB and double blink means FAN or Blub will be on.

II.DESIGN AND IMPLEMENTATION:

This project uses two important platforms. 1. Coding Platform and 2. Execution Platform. These platforms are discussed below:

Coding Platform:

In this project a brain computer interface system is used which will do the key role in the entire operation. For the BCI system, we are using the MATLAB and for brain wave sensor and Processor communication neurosky is used.. The BCI will process in the following way.For calculating the blinking levels we need to use a brain wave sensor support a neuro sky product which is called min-do4 Initially we have to take the data from the brain by using neurons postion and should store in the brain wave sensor. The supportable sensor in the MATLAB is given in the form of the following data function.

connectionId1 =calllib('Thinkgear','TG_Get-NewConnectionId');

Initially we need to check that sensor is connected or not. The mind wave sensor software will provide the information about the sensor connection. If the sensor is connected we are entering in to the MATLAB section for checking the blinking levels of person.
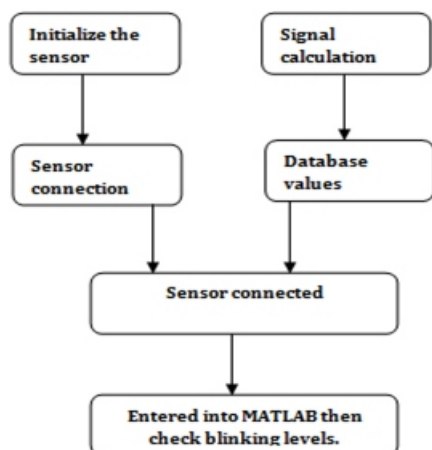
Fig b: BCI Software architecture

Once the blinking levels will calculated it will be send to MATLAB. Whenever MATLAB reads an blinking values it will convert into digital values because for micro controller understanding purpose the values should be in digital format. After calculating the blinking values ,we need to check whether it will cross the set point in the database . As an acknowledgement we will get the following help dialogue.Then pre-processing will be done within the blinking levels and the database values which involves , Similarity checking and probability finding. Here similarity checking is nothing but the comparison between two blinking values by calculating the change between the input and data base values. Then the result will be shown on the MATLAB.Drowsiness, eyes open and eyes closed are closely connected to alpha activity. once sleepiness forces the eyes to shut, alpha waves are strongest encephalogram brain signals have reported that in sleepiness state alpha activity mainly seems in os space and particularly magnitude of alpha2 wave like a better alpha band (11~13Hz) increases. However, supposing traditional adults have their eyes open notwithstanding they drowse, alpha changes of can't be explain one thing logically.

Fig c : BCI running image

Execution Platform:

This half consists of FPGA as a main unit, Brain wave device system, Ignition unit, PC , alert section and a show unit. This modules with coming up with and implementation technique is given below.FPGA is employed for dominant the system. Depends upon the blink level of the person. Depends upon blink levels through uart we transfer the commands for On and OFF of the devices. FPGA was programmed with VHDL coding depends upon the received data it ON and OFF the devices.

Wireless Platform:
a)BCI system:
The main purpose of the current chapter is to review recent advances within the EEG field.

to grasp these developments it'll initial be necessary to detail the physiological basis of the EEG signal. after, vital problems related to knowledge acquisition, signal process, and quantitative analyses are going to be mentioned . the most important portion of the chapter are going to be dedicated to reviewing rising supply localization techniques that are shown to localize EEG activity while not postulating a priori assumptions concerning the amount of underlying sources.

As we are going to discuss, maybe the best advancements within the EEG field within the last 5-10 years are achieved within the development of those localization techniques, especially once utilized in concert with high-density EEG recording, realistic head models, and different purposeful neuroimaging techniques.

The time unit temporal resolution of electroencephalogram permits scientists to analyze not solely fluctuations of electroencephalogram activity (i.e., increases/decreases) as a operate of task demand or subject samples however conjointly to differentiate between practical repressive and excitant activities.low frequencies (e.g., delta and theta) show massive synchronal amplitudes, whereas electroencephalogram frequencies (e.g. beta and gamma) show tiny amplitude owing to high degree of asynchrony within the underlying somatic cell activity.

In adults, the amplitude of normative electroencephalogram oscillations lies between ten and a hundred (more ordinarily between ten and fifty; Niedermeyer, 1993). within the following section, a quick review of varied electroencephalogram bands and their supposed practical roles are going to be given. The review of the muscular and physiological basis underlying the generation of varied electroencephalogram oscillations

Fig d: Sensor status indicator

III.Conclusion:

This project work uses a brain wave sensor which can collect EEG based brain signals of different frequency and amplitude and it will convert these signals into packets and transmit through Bluetooth medium in to the level splitter section to check the attention level. Level splitter section (LSS) analyses the level and gives the robot movement for the person who is sitting in the wheel chair..

IV.REFERENCE:

[1] X. Perrin, "Semi-autonomous navigation of an assistive robot using low throughput interfaces," Ph.D. dissertation, ETHZ, Zurich, Switzerland, 2009.

[2] B. Rebsamen, C. Guan, H. Zhang, C. Wang, C. Teo, M. H. Ang, Jr., and E. Burdet, "A brain controlled wheelchair to navigate in familiar environments," IEEE Trans. Neural Syst. Rehabil. Eng., vol. 18, no. 6, pp. 590–598, Dec. 2010.

[3] J. d. R. Mill´an, R. Rupp, G. R. M¨uller-Putz, R. Murray-Smith, C. Giugliemma, M. Tangermann, C. Vidaurre, F. Cincotti, A. K¨ubler, R. Leeb, C. Neuper, K.-R. M¨uller, and D. Mattia, "Combining brain– computer interfaces and assistive technologies state-of-the-art and challenges," Frontiers Neurosci., vol. 4, pp. 1–15, 2010.

[4] A. Nijholt, D. Tan, G. Pfurtscheller, C. Brunner, J. del R. Mill´an, B. Allison, B. Graimann, F. Popescu, B. Blankertz, and K.-R. M¨uller, "Brain–computer interfacing for intelligent systems," IEEE Intell. Syst., vol. 23, no. 3, pp. 72–79, May/Jun. 2008.

[5] J. R. Wolpaw, D. J. McFarland, G. W. Neat, and C. A. Forneris, "An EEG-based brain–computer interface for cursor control," Electroencephalogr. Clin. Neurophysiol., vol. 78, no. 3, pp. 252–259, Mar.1991.

[6] Y. Li, C.Wang, H. Zhang, and C. Guan, "An EEG-based BCI system for 2D cursor control," in Proc. IEEE Int. Joint Conf. Neural Netw., 2008, pp. 2214–2219.

[7] E. Donchin, K. M. Spencer, and R. Wijesinghe, "The mental prosthesis: assessing the speed of a P300-based brain–computer interface," IEEE Trans. Neural Syst. Rehabil. Eng., vol. 8, no. 2, pp. 174–179, Jun. 2000.

[8] N. Birbaumer, N. Ghanayim, T. Hinterberger, I. Iversen, B. Kotchoubey, A. Kubler, J. Perelmouter, E. Taub, and H. Flor, "A spelling device for the paralyzed," Nature, vol. 398, pp. 297–298, Mar. 1999.

[9] K.-R. M¨uller and B. Blankertz, "Toward noninvasive brain–computer interfaces," IEEE Signal Process. Mag., vol. 23, no. 5, pp. 125–128, Sep.2006.

[10] J. Williamson, R. Murray-Smith, B. Blankertz, M. Krauledat, and K.-R. M¨uller, "Designing for uncertain, asymmetric control: Interaction design for brain–computer interfaces," Int. J. Human-Comput. Stud., vol. 67, no. 10, pp. 827–841, Oct. 2009.

[11] Y. Li, H. Li, and C. Guan, "A self-training semi-supervised SVM algorithm and its application in an EEG-based brain computer interface speller system," Pattern Recognit. Lett., vol. 29, no. 9, pp. 1285–1294, 2008.

[12] Y. Su, B. Wu, W. Chen, J. Zhang, J. Jiang, Y. Zhuang, and X. Zheng, "P300-based brain computer interface: Prototype of a Chinese speller," J. Comput. Inf. Syst., vol. 4, no. 4, pp. 1515–1522, 2008.

[13] B. Hong, F. Guo, T. Liu, X. Gao, and S.Gao, "N200-speller using motiononset visual response," Clin. Neurophysiol., vol. 120, no. 9, pp. 1658– 1666, Sep. 2009.

[14] A. A. Karim, T. Hinterberger, and J. Richter, "Neural internet: Web surfing with brain potentials for the completely paralyzed," Neurorehabil. Neural Repair, vol. 20, no. 4, pp. 508–515, 2006.

[15] E. Mugler, M. Bensch, S. Halder, W. Rosenstiel, M. Bogdan, N. Birbaumer, and A. Kubler, "Control of an Internet browser using the P300 event-related potential," Int. J. ioelectromagnetic, vol. 10.

[16] M. Bensch, A. A. Karim, J. Mellinger, T. Hinterberger, M. Tangermann, M. Bogdan,W. Rosenstiel, and N. Nessi Birbaumer, "An EEG controlled web browser for severely paralyzed patients," Comput. Intell. Neurosci., vol. 2007, pp. 1–5, 2007.

[17] R. Krepki, B. Blankertz, G. Curio, and K.-R. M¨uller, "The Berlin brain– computer interface (BBCI): Towards a new communication channel for online control in gaming applications," J. Multimedia ToolsAppl., vol. 33, no. 1, pp. 73–90, Apr. 2007