

BCI-IOT

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Abstract — With the advancement in technology, the mode of interaction with the electrical devices has also advanced. This paper proposes a brain computer interface BCI for regulating everyday house hold appliances ranging from a simple mechanical switch based control of electrical devices to IoT based wireless control facility. This technology includes an EEG device to acquire signals associated to the brain activity and communication protocol. The integration of BCI and IoT for “CONTROLLING THE THINGS REMOTELY” is a promising and emerging technique to make home environment comfortable by easy access, automation and optimization of home appliances such as television sets, ac light bulbs and so on. In addition to this, monitoring brain activity in real time through cloud server a major role in education and medical fields to monitor the concentration and attention levels of students and to monitor brain activity of patients in coma respectively. [12][7][1]

Keywords— BrainComputerInterface (BCI), Internet of things (IoT), Eelectroencephalography (EEG)

I. INTRODUCTION

According to survey, a human brain consists of infinite interconnections of neurons. They communicate with each other by sending some electrical pulses, which consist of electrical charge. These charges create some amount of force to generate electric field with varying electrical potential. Our scalp which is about (micro volts). This micro voltage can be sensed by the sensor and electrodes. The sensor or electrode is placed on the forehead of our scalp based on the standard configuration (10 or 20 electrode system). These measureremints are known as electroencephalography (EEG) [1][6].

Electroencephalographic, Neuro sky mind wave mobile is an EEG device to capture the activity of brain (attention and medication levels). All electrical activity of brain is recorded from the scalp surface at a particular position [1], The captured Brainwaves pattern by EEG normally range from 0.5 to 100µV, has a sinusoidal shapes and they are measured from peak to peak [2].

TABLE 1. EEG [2]

Name	Frequency	Activity
Delta	0.5 - 4 Hz	Deep, dream sleep
Theta	4 - 7 Hz	Mediation, mental imagery
Alpha	7 - 13 Hz	Relaxed ,calm, not thinking
Beta	Above 13 Hz	Alert, normal, awake

Here mainly concentrating on the brain activity (attention and meditation values) of children (brain activity), patients, and also controlling the things remotely through cloud, this make easy to controlling the remote devices.

Internet of Things (IoT) is a one of the best technologies in the world which as has wide range of applications. IoT includes a vast range of systems, sensors and networking products, which works by exchange of data through cloud using wireless sensors and controllers. Advancement is applied in the field of computational power and network interconnections to provide for everyone and every required product [3] like brain activity of patients, children in hospitals and for quadriplegic people. (Controlling the things remotely) We are analyzing the data for above applications. Data is generated from EEG device it gets uploaded to cloud through MQTT

Here we are using things speak or Ubidots (cloud platform) for analyzing brain data and also controlling the things [1] [3].

II. EQUIPMENTS

A. Hardware

- Arduino Nano
- EEG mind wave mobile
- ESP Node MCU
- Breadboard
- Jumper wires
- Battery

B. Software

- things speak or Ubidots
- Arduino IDE 1.8.5

III. PROPOSED METHODOLOGY

Here we use non-invasive methods for acquisition of EEG signals, it is done by using the NeuroSky Mind Wave Mobile device. This device uses a single electrode which sits on the forehead of a person, and records the electrical activity from the frontal lobe of the human brain. Mind wave mobile has a fp1 electrode which is standard configuration given by 10/20 system Figure 1 and a reference electrode is used which is the A1 electrode. Two states of mind namely attention and meditation can be recorded using this device, also the blink strength of the eye is recorded. Corresponding to each attention and meditation signal, the device outputs other nine types of wave signals [11]

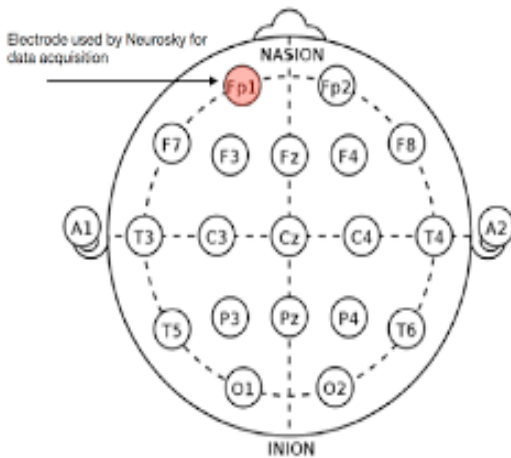


Fig. 1. Schematic of the 10-20 electrode system



Fig 2: attention and mediation levels

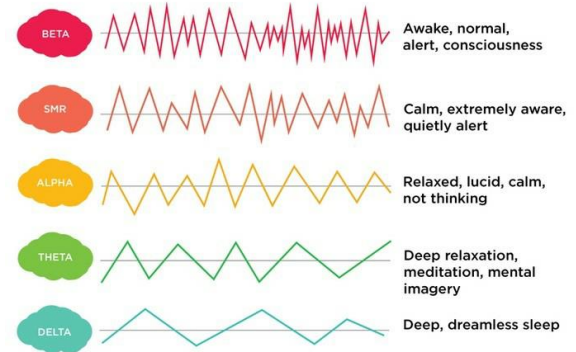


Fig. 3: EEG Wave Frequency Ranges

Data acquisition is done by EEG device called NeuroSky Mind wave Mobile. The process raw data is obtained from the front part of the scalp where we get different signals like alpha beta gamma theta and delta and This will be preprocessed by microchip in mind wave mobile and these signals represent the concentration and mediation level of mind Figure2. Different signals have different range of frequencies. Figure 3, for each different frequency range is having different behavior in human body, mainly we are focusing on concentration and meditation levels of mind .Alpha waves and Beta waves has a frequency range of 8-14 Hz and 13-30 Hz respectively take place while relaxing or reflecting and the user is concentrating. [5][12].

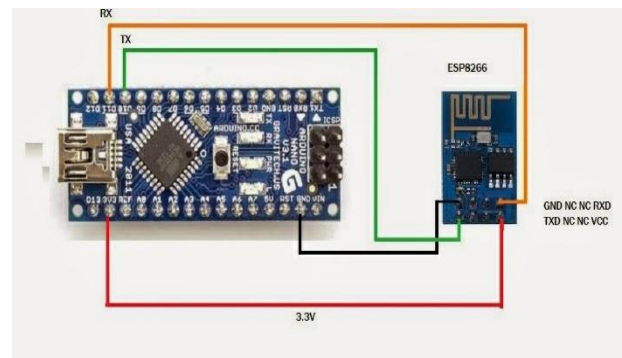


Fig. 3. Arduino Nano connection with node MCU module.

Arduino Nano is a micro controller used for computing EGG signals using Bluetooth protocol, the processed data is digitalized while coming from mind wave mobile EEG device through Bluetooth and thus the computation takes place. Esp8266 or esp32 is a Wi-Fi module, where Nano and ESP are connected via SPI protocol, ESP is connected to local wireless LAN and the data is publish form EEG device to cloud through MQTT and also sending command to control.

The signal with distortion causes many issues because Some brain waves are very low frequencies. There are slight disturbance this will leads to weak data, so once signals are processed it publish into cloud to achieve better results. [12] MQTT is define as Message Queuing Telemetry Transport, one of the most commonly used protocols in IoT projects, Figure 5 that uses publish/subscribe operations to exchange data between clients and the serve here we are sending NeuroSky Mind wave mobile data to cloud so the we can analyze the brain waves or monitoring, It works on top of the TCP/IP protocol, and is designed for connections with remote locations. [12][7]

Publish/ Subscribe:

MQTT is a publish and subscribe system where we can send or receiving 'message'. It is a simple communication system where we connect multiple communication devices. The main advantage of this protocol is low bandwidth. Data will be published in cloud via MQTT. To monitoring the data graphically we use cloud platform and this process is called Publishing the data or reading the sensor values to cloud. For controlling things remotely. Sending a command or high signal to cloud from EEG device to act like switch. By considering this we control the things.

Note: message refer to exchange of data or command to control the devices. [12][7]

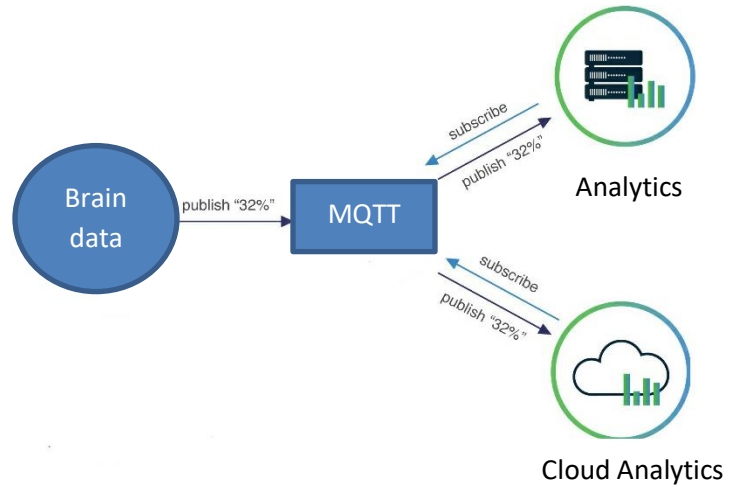


Fig 5: MQTT working

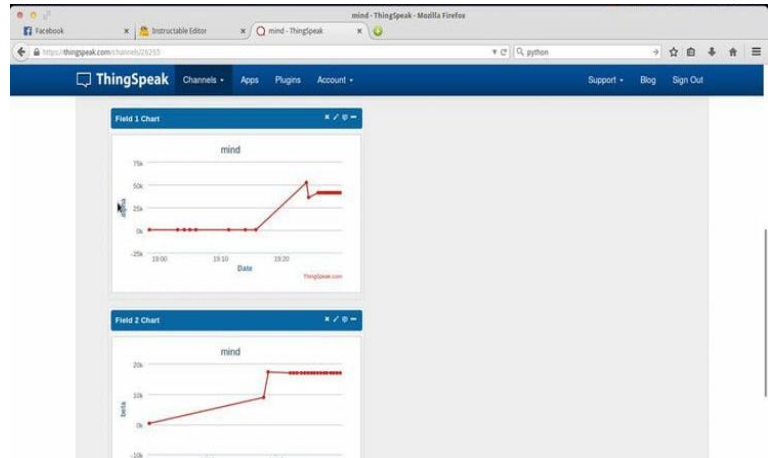


Fig 6: graphical representation of brain wave data

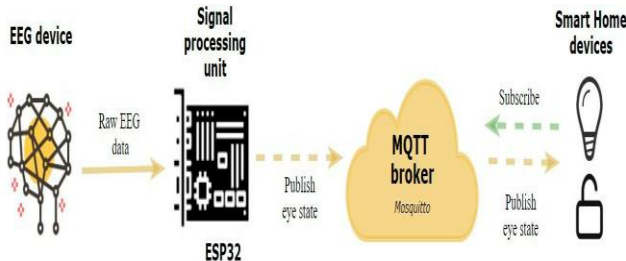


Fig. 4: Brainwaves Data is publishing to cloud [6]

IV. CONCLUSIONS AND FUTURE SCOPE

The main purpose of this paper is to analyzing brain activity of humans using cloud based technology and also for testing the children's attention level and concentration levels. By using these signals we can control the daily electronics devices like television mobile etc. The proposed system for the integration of BCI and IoT is formed by a single channel EEG device, a signal processing module to determine the user's brain activity and also for testing the children's

attention level and concentration levels.

The MQTT protocol for the distribution of the extracted knowledge among the connected devices. The results show that the proposed system achieves high accuracy. In future, we aim to build processing cloud server which would be able to predict epileptic seizure (Epileptic seizures are caused by a disturbance in the electrical activity of the brain) based on the signals received from the headset

The application can be made simpler for usage and headset design could be changed to make it easier for everyday wearing. Moreover, employment of event driven data acquisition and transmission will add system resources utilization and power efficiency. As the technology advances prediction of brain disease will become easy day by day. Future scope will be analyzing the stress and mental strength of a person by brain wave levels using cloud based technology.

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