Design of a Neurally-Controlled Audio System

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Introduction

The goal of the project is to develop a wireless music-producing device that can be controlled by thoughts and actions. Wireless technology is rapidly branching out to every facet of our lives, including communications, entertainment, and household technology. However, there are many other potential uses that have yet to be explored.

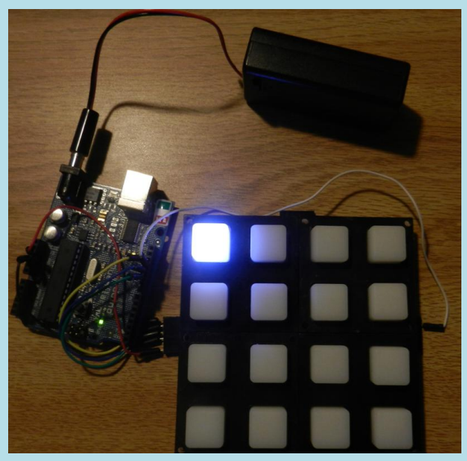
This project serves as an example of mind-controlled device applications in entertainment, electronic music, wireless technology, and music composition.

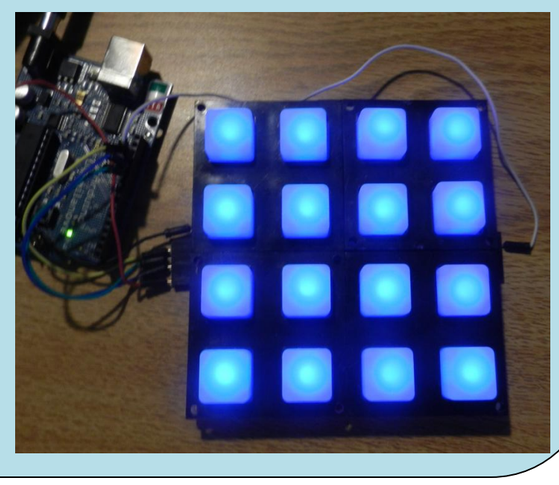
MIDI Controller

The MIDI Controller uses SparkFun's ButtonPad board. Data is transmitted through SPI MOSI (serial data in a "master output, slave input" format) to an ATMEGA328P chip interfaced through an Arduino.

The speed of the music is controlled on the computer through a GUI, in units of beats per minute (bpm).

Sixteen common beats were selected and mapped to each button. When a button is on, its beat plays continuously. All sounds are played through the computer speakers by using Processing.





EEG Brain Wave Reader

The Emotiv EPOC Neuroheadset is used to read the user's brain waves. The device can be trained to recognize unique thoughts and actions because each one produces a different set of electroencephalography (EEG) brain waves. For example, the headset can distinguish between pushing left, pushing right, pulling up, and pulling down.

OSCP5 (Open Sound Control), an open source library for communication between computers and devices, is used so that the ATMEGA chip can process the captured data.

Within the microcontroller code, each thought/action is mapped to a button-on press. The opposite thought is toggle-able as a button-off press. Only thoughts/actions with distinct opposites are used.

Difficulties and Future Work

The most difficult part about using this device is the brain wave profiling required for each user. Because every person produces different waves for a specific thought, individual training must be done before any use. At its current stage, EEG technology will have a hard time finding one-size-fits-all training data.

Future work primarily consists of finding a way to more accurately map button presses. User feedback in conjunction with machine learning techniques could be applied to the brain wave mapping algorithms in order to learn what the user intends and correct for it.

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