Brain wave control of household appliances

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Abstract

The technology that we surround ourselves with in our homes is expanding everyday. With so many buttons, switches, and dials to interact with, it may become a challenge for individuals limited by physical disability, or simply someone with their hands full, to use household appliances effectively. In an attempt to streamline and simplify these interactions, it is the focus of this research to explore what is necessary to design and build a system that allows for the hands-free control of common household appliances. This may be done by employing electroencephalography (EEG) and Bluetooth technology to wirelessly manipulate electrical devices with the human mind. Imagine a room in the near future that is devoid of light switches, or touch screens, and simply responds to your thoughts.

Objective

Figure 1. Transmitting brainwave activity to a computer that will interpret the signals and convert them to electronic commands.

The objective is to assemble a database of indexed brain wave “commands” that can be readily identified and programmed to correlate with particular functions of designated electronics in a person’s home. This could be beneficial for toggling lights, environmental control, and adjusting the settings or functions of other connected appliances.

Method and Materials

Cells within the body, like neurons or muscle cells, communicate through electrical activity by the result of “action potentials” where an influx of potassium, or sodium, is moved across the cell membrane. When this happens, ions, atoms lacking neutral charge, are exchanged, and the electrical potentials associated within the cell and its outside environment begin to fluctuate. In the case of brain cells, electrodes can be placed in contact with the scalp that measure the rise and fall of electrical potentials within the brain due to mental activity and can be depicted as waves. This method of collection is called electroencephalography (EEG). These brain waves are crucial to all activity in the body including involuntary muscle contractions and motor control. As such, brainwaves are complex data transmissions that are unique to the type of action being performed. Knowing this, it should be possible to log particular brain activity and then create a computer program that will recognize and execute commands upon detection of certain neural activity.

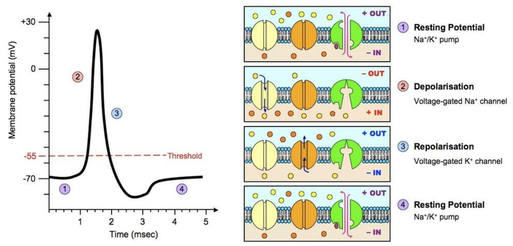

Figure 2. This shows the process by which the electrical potential of the cell is raised and lowered by ion transfer.

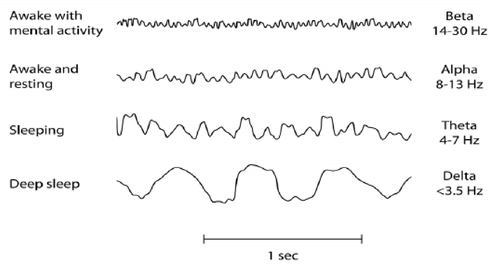

Figure 3. Shown is the range of frequencies for the different types of brainwave activity and their associated states.

For this project, brain wave activity is measured using a NeuroSky MindWave headset, and the collected data is transmitted via Bluetooth to an Arduino Uno microcontroller. When a particular brain wave pattern is detected, a command is given that switches a power control relay connected to a light bulb on or off.

Results

Once the NeuroSky MindWave headset was calibrated, a suitable software program had to be found that would allow for the display and recording of the incoming raw data from the headset. Following a sequence of mental phrases like; “bedroom light” or “kitchen light”, their associated wave patterns would be recorded that would then allow for the naming and selection of particular device to be powered. Wave patterns were also identified for commands such as “on” and “off”. Through this technique, a device could be queued and subsequently given a command such as “bedroom light on” or “kitchen light off”.

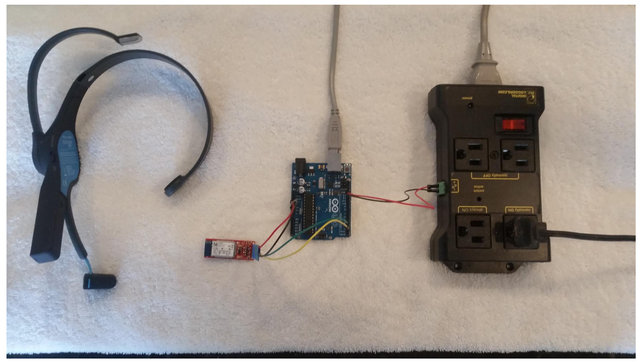

Figure 4. The NeuroSky MindWave headset (left) communicates with the Arduino Uno microcontroller (blue card) via a BlueSMiRF Bluetooth device (red card). The Arduino then sends a voltage which switches the power relay on and off. The gray wires on the top of the photo supply power to the respective components, and the black cord is a lamp power cord.

Conclusion

Although this experiment was conducted only with the construction of a simple bench rig containing a single power control relay, it is feasible that this technology is completely scalable to a much larger array of home appliances simply by building a collection of named objects and commands. If a medical grade EEG, one consisting of many more electrodes on the scalp, were used instead, then higher resolution data could be acquired and used for error reduction and finer control.

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