Micro-Impacts Deriving from Improper Walking

Brain Impact Sensor

NIU Engineering Design: Sponsored by Pizur Financials

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Abstract — The Brain Impact Sensor is to be advertised as a medical accessory device that individuals can purchase and use anywhere. The device is to track the impacts every instant the user’s heel strikes the ground. By installing the appropriate components into a ‘baseball style hat’, the device will now be located in the most fit location to track micro-concussions that are detrimental to brain cells and causing long term health effects such as Alzheimer’s and Insomnia. The Brain Impact Sensor applicational purpose is to aware the user’s improper walking patterns in order to prevent future health complications by displaying their data via graphs and numerical data.

I. INTRODUCTION (PURPOSE)

The project was purposed by an individual named Thomas Pizur who had spent several time studying specific fighting stances and techniques. He came became aware that certain stances transfer energy currents directly through the body depending on how much force the target matter is contacted with, and also the angle at which the force was dealt at. These two factors could knock an individual onto the ground at the moment the move is executed.

Researchers have been noticing an increase in Alzheimer (along similar diagnosis related to these symptoms) cases over the past several years and been relating the causation from micro-concussion. Originally, sports were the main focus due to the amount of hits being taken in per game, but the amount of force that can be constantly impacting the brain even more has been improper walking patterns. With the past recent studies being discovered regarding spinal alignment issues or other lower back incidents, brain damage cases are increasing and micro sized impact forces are becoming a contributing factor.

II. OBJECTIVE

The objective of the designed prototype is to create a device that can record every instant the user takes a step and represent their data visually to inform to them if they are currently obtaining micro sized force impacts. The data being obtained will be visually accessible through smart phone applications that show the user’s real time impacts in a graphical form or quantifiably. Through their results, the individual will know to alter their walking patterns in order to reduce the amount of force being traveling up to the brain.

In order to best derive data by the user while he/she is walking to determine if their walking patterns are detrimental, the equipment needed would be best to fit inside something an individual can place on their head, such as hat, headband, i.e.,. The best solution determined was to utilize the shape of the baseball cap for two specific reasons.

To graphically obtain the most accurate data, fundamentally their should be a sensor located at the highest point, this being the crown of the skull. Another feature that lead the baseball cap selection was its opening on the rear side for adjustable purposes. This space will not only be wide enough to fit the necessary components required to measure the data, but also allows the required pieces to be concealed enough so it isn’t recognizable by simple bystanders walking past.

With the baseball hat being the best option to install the equipment finally concluded, further research needed to be conducted in order to first obtain this degree of data (i.e. which kind of sensors are capability of measuring micro-concussions). The sensors also needed to be small enough to fit in the amount of space that is now established.

III. EXPERIMENTS (INSTALLATION)

A. Electrical Components (Materials)

The amount of components that actually need to be purchased to first start calculating micro sized force impacts are a total of five items:

- Adafruit LIS3DH Triple-Axis Accelerometer
- Arduino mini-PRO Atmega 328P Microcontroller
- Arduino HC-05 Bluetooth Module
- 3.7 V Lithium Ion Battery
- Lithium Ion Battery Charger

These parts are located in two different locations inside the hat which are necessary in order to receive the most accurate data. All of the main component housing is located in Fig. 1, while the accelerometer will get its own housing as
seen in Fig. 2. Fig. 3 shows the lid that can be detached to access the electrical components. The accelerometer is housed at the crown of the skull so the axis are in the up right position and at the highest point of the individual. The four remaining parts are looped all inside the main housing above the adjustable size strap in all universal hats.

The housing has all been printed using a 3-D printer which was accessible any moment necessary. Throughout the process of re-ordering correct parts, the printing solution has lead to many benefits. If the dimensions were even off by a centimeter, the according changes could be made within a several hours, decreasing the third party use of Northern Illinois University’s 3-D printer.

B. Equipment Testing (Program[s])

The program running the experiments in order to send the proper instructions to the certain pins for signal receiving/dispatching was Arduino. Their free online downloadable program allowed for the code to be inputed so that when the circuit is functioning, the signals are being appropriately dispatched to the following pins and thus, receiving a visual output in the form of graphs or numerical charts that are derived from the accelerometer.

The experiments that were required were different walking patterns in order to determine if the data were to be accurate and the graphs were adjusting according to the force of the different impacts. The following tests were normal walking and hard impact walking.

IV. RESULTS (FUNCTIONING PROTOTYPE)

Through installing the necessary sensors into the hat, the device was now able to track daily impacts arising onto the user from daily walking. The micro concussions are representing energy transferring to the brain which have been linked to chronic illnesses which is why this product is to be marketed as a medical device to prevent similar diagnosis. Fig.4 visually represents the prototype functioning as an accessible feature and medical tracking device.

A. Figures

Figure 1: Main Housing (open)

Figure 2: Accelerometer Housing

Figure 3: Main Housing (closed)

Figure 4: Brain Impact Sensor (Prototype)

B. Troubleshooting (Future Development)

The brain impact sensor is functioning fully within the housing that was 3-D printed into an accessible hat, finishing the fundamental features for the project were not able to reach its fullest potential. At the moment, in order to visualize the incoming impact forces either graph or numerical forms of data, the user must connect to a third party application. The realistic goal is to have its own app on the application store for all platforms (IOS, Android, i.e.) which displays all of their records visually appealing to the eye. Unfortunately, none of the following developers are focusing on computer engineering.

Acknowledgment

The following project is something that we see helping a lot of individuals with specific health conditions related to micro-concussions. The project was first sponsored and brought to us and without ever have meeting this individual, our knowledge about this sort of thing was very limited. Everyone from Team 55 are extending are deepest gratitude for Tom Pizur (sponsor) through discovering and teaching us the idea of energy movement from simply walking everyday, into concussions based from our every step. The team would also like to thank Northern Illinois University and Dr. Donald Peterson for without the two, projects elaborated such as this would not have been possible to design. The last two individuals we would like to thank would be German Ibarra and Dr. Venumadav Korampally for not only their wisdom and knowledge about out entire process, but because they wanted us to succeed more then anything. They even implemented daily updates on the project’s status via emails because they were beginning to see our potential being wasted. Through the optimist gestures and tips throughout the entirety of designing, we would like to give them a special thank you.

REFERENCES
