

# THE HARDHAT OF FUTURE, AI-HARDHAT

## Development of an Artificial Intelligent System

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**Note:** This project, requires Ethic approval. Your team needs to apply through UBC to obtain the approval, at the early stage of the project (guidance will be provided).

[Video Description of the project](#)



### Introduction:

It may sound a bit scary to think of a safety hardhat capable of spying on you! Ostensibly, it seems like a futuristic, *Star Trek*, and Science fiction project. Would it be possible to add something to a regular safety hardhat, and make it smart enough to give us some information on the state of a person brain? In particular, the hardhat provides warning if a worker is mentally sleeping (i.e. eyes are open and blinking, but the person brain is in a sleeping state, or it is not keen, due to sleep deprivation, drinking alcohol, using drug,



or smoking marijuana). In fact, this is what we are envisioning in this project. We want to add a gizmo to a standard/regular safety hardhat, then develop an AI (Artificial Intelligent) system, to give the hardhat the power to start learning and detecting something (i.e. patterns which give us a clue on a state of a person's brain) from a person's brain; and provides warning if the person is not sharp/keen enough to conduct a task, to prevent an imminent crash.

## Background

*(Here is a brief description of a different projects which provides you with a background on the current project)*

I have been conducting some research to develop an AI system, based on signals from a portable EEG (electroencephalogram) for detecting a driver who is mentally distracted (i.e. sleepy, high on marijuana or other drugs). The main objective of this research is to analyze the feasibility of developing a system to detect a driver who is mentally sleeping (i.e. the eyes are open but the functional and orientation parts of brain are sleeping) which can happen if the person is very tired or she used drugs, or marijuana. The aim of this project is to develop signal processing algorithms capable to extract the distraction level of a car driver or a worker based on one-channel EEG data.



Finding a robust measure of driver sleepiness or brain distraction is difficult. The classic approach is to monitor the eye blink. Unfortunately, this method doesn't work very well. There are problems with the current system based on blinking: 1- difficult to detect a

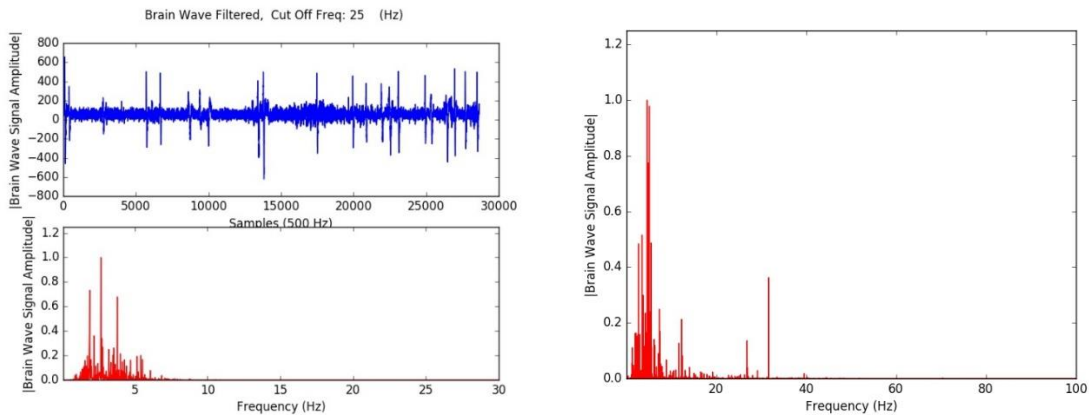
person blink who wears glasses 2- A person who is high, her eyes blink but her brain mentally is sleeping mislead the system.

To solve these issues, I used an EEG based device with a focus to detect drivers who is high (the brain is sleeping, while the eyes are blinking and the person seems to be acting normal). In preliminary tests, two individuals were asked to get high by smoking marijuana, and eating some eatable infused marijuana cookies. After we were sure that the person under the test is high, she was asked to drive a virtual reality driving game. The EEG data was collected for several minutes. The same test was also repeated the next day, when the person is in a normal condition. As an example, the following figures, shows the dominant frequencies of the brain for one person when she was high and when she was normal. The data indicates that when she is high the dominant frequencies are below 7 Hz, which suggest a deep sleeping or day dreaming state of mind (usually is referred to Delta Wave) state of the brain (while the eyes are open and the person blinks); while in a normal situation, when the person was conducting a virtual driving game, the data indicates a range of frequencies up to 40Hz which is the active and keen state of a brain.

These preliminary tests, indicates that the developed device can detected a distracted driver who is high, while the eye blink detecting system cannot realize this situation. While this research is at its early stage it shows a high potential for its application in future.



**Application of EEG Device with One Channel for Measuring the Brain Wave, When the Driver is Sleepy, or Mentally Distracted, for example Used Drugs, or High by Using Cannabis**



**Brain wave frequencies while a person is running a virtual reality driving game, left figure: the person is high, right figure: brain is keen**

While this method seems to be working, it is still very premature. Currently, I have been conducting research to develop the system based on Machine Learning technique.

## **Brief Project Description:**

The project aims to build an AI-hardhat, capable of obtaining brain wave, using an EEG, inside the hardhat, sending the data wirelessly to a computer, and apply machine learning technique to detect some patterns in brain wave, pertaining to active or sleepy state of a brain.

This project has two independent tasks:

### **Part I. Hardware development:**

This part involves pure mechanical design and prototyping. Your task is to design and build a mechanism to securely install an EEG inside a standard hardhat. You will be using a developed portable EEG. At the early stage of the project, you will be using a one channel EEG, then as the project proceeds, the project would advance with a 8-channel EEG.



An 8-channel EEG

## Part II. AI development

Here is the main task, where you collect as much as possible data (brain wave data), and conduct special data analyses, and Machine learning technique (*guidance will be provided to your team*), to develop the artificial intelligent system. Here, you are adding a brain to the EEG, by using its data wirelessly in a computer and detect patterns. It requires some brain muscle for coding (*preferably, Python*)

## Expected Outcomes:

- Design and prototyping of the mechanical parts, for installing the EEG inside the hardhat.
- Development of the AI.

## Resources Available from Customer:

I am available to meet with students bi-weekly to answer any questions and provide design feedback. I also provide essential information regarding the Machine learning and AI development. In addition of the department budget for each project (\$750), you will be given the one-channel EEG to start working, plus its software. Then either, you will be given (\$1500) to purchase the 8-channel EEG or we purchase it and give it to you.

**Contact for more details:** If you have any question or concerns regarding this project, you can send me an email directly at: [mpanah@mail.ubc.ca](mailto:mpanah@mail.ubc.ca) or I am available for a ZOOM meeting to discuss the project and answer your questions.

Ahmad