big Air
VIRTUAL SNOWBOARD COACH

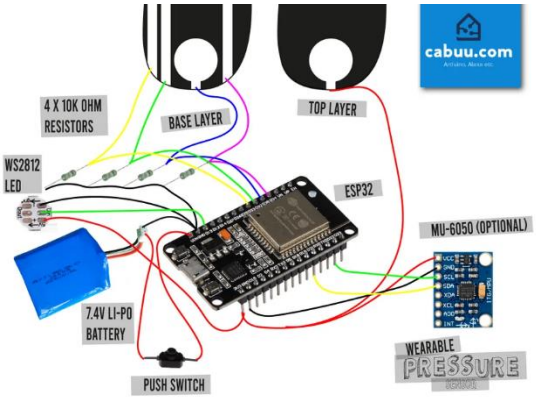
Project Idea

This project aims to create a virtual snowboard coach for intermediate users. The inspiration is to combine the mountain lifestyle with robotics engineering to help riders get coaching easily and for a low cost. There will be a hardware pack sold to the user, and a ML model to take the sensor data, determine what trick is being attempted, and inform the rider what they are doing wrong.

Process

Hardware:

The hardware package will consist of 3 elements. 2 insole foot sensors, 2 accelerometers (one on boot and one on wrist) and 1 gyroscope, all feeding into a itsy-bitsy microcontroller connected to a LiPo battery. The insole foot sensors will be made with 6 small pieces of Velostat pressure sensitive material [1] and copper tape, on top of a 3D printed insole. The copper tape will be placed on either side of the Velostat material, one terminal with a 5V charge, and the other feeding into the itsy-bitsy. Pressure can be detected depending on the resistance of the material, and therefore the charge coming into the itsy-bitsy, which changes as pressure is applied. The Gyroscope and accelerometers will be used to detect the orientation and acceleration of the rider in air. The project manager's experience in Mechatronics and Robotics gives him confidence this hardware package will work.



Data:

Data will be collected by the team and supporting friends (already have 5 volunteers) and will only consist of 4 or 5 tricks. We will explore the use of chat GPT or GAN to create more data based off our smaller dataset. In each training trial we will record the sensor data as the trick is executed, along with the trick being attempted. Accelerometer data on the landing will determine if the trick was successful or not (fast deceleration upon landing will result in a fail). Foot pressure data will be used to determine when the rider takes off the jump (significant reduction in pressure) and when they land.

Models:

There will be multiple models for this project. Firstly, we will make a model to predict the trick being attempted. This is predicted to be a very accurate model as the gyroscope will provide the orientation of the rider in the air, and what axis they are rotating around. Currently, the project manager thinks a 1D-CNN (1-Dimenional Convolutional Neural Network) will be appropriate for

this task because it is efficient at capturing local patterns in sequences of time steps to detect what trick is being attempted. Secondly, we will have an individual model for each trick. This model will learn the essential pieces that make up a successful trick based on the training data. For this task the project manager thinks a RNN (Recuring Neural Network) will be appropriate as it can take in time steps with a longer range, allowing all parts of the trick attempt to be analyzed for improvement to then be given to the rider. The full scale implementation of this project will include an app then allows the rider to accept if a trick guess is correct or not, and then give them our suggestions. The models will continue to learn like this and get smarter as more riders use our technology.

References

[1] https://www.amazon.ca/Adafruit-Pressure-Sensitive-Conductive-Velostat-Linqstat/dp/B00SK8LYK4/ref=sr_1_fkmr1_1?crid=1Z8MQMKBC5SUT&keywords=Sheet+of+Velostat+conductive+sensing+material&qid=1680206885&sprefix=sheet+of+velostat+conductive+sensing+material%2Caps%2C222&sr=8-1-fkmr1