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ALL FOR TRAINS

MEASURING THE ACCELERATION OF MONTREAL'S METRO

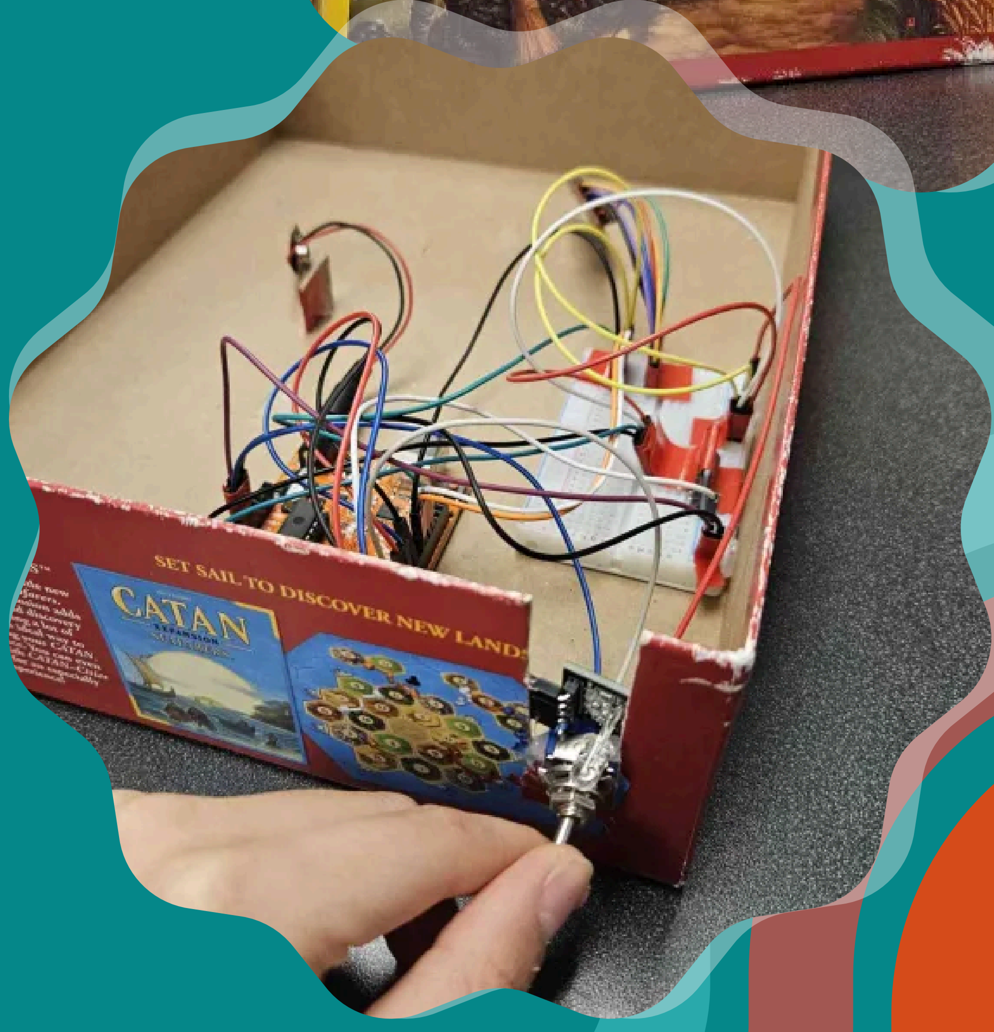
Ever wondered what is *scientifically* the most comfortable metro line on your way to school?

GOAL

We want to measure the acceleration experienced in the Montreal metro to answer a multitude of questions. For example, which line is the most comfortable in terms of vibration? Is there a measurable difference between the two types of trains currently in use (MR-73 and Azur)? What are the maximum values the acceleration and deceleration reach, and do they match the official values provided by the STM? We also hope to be able to use integration to find the velocity at which the trains travel.

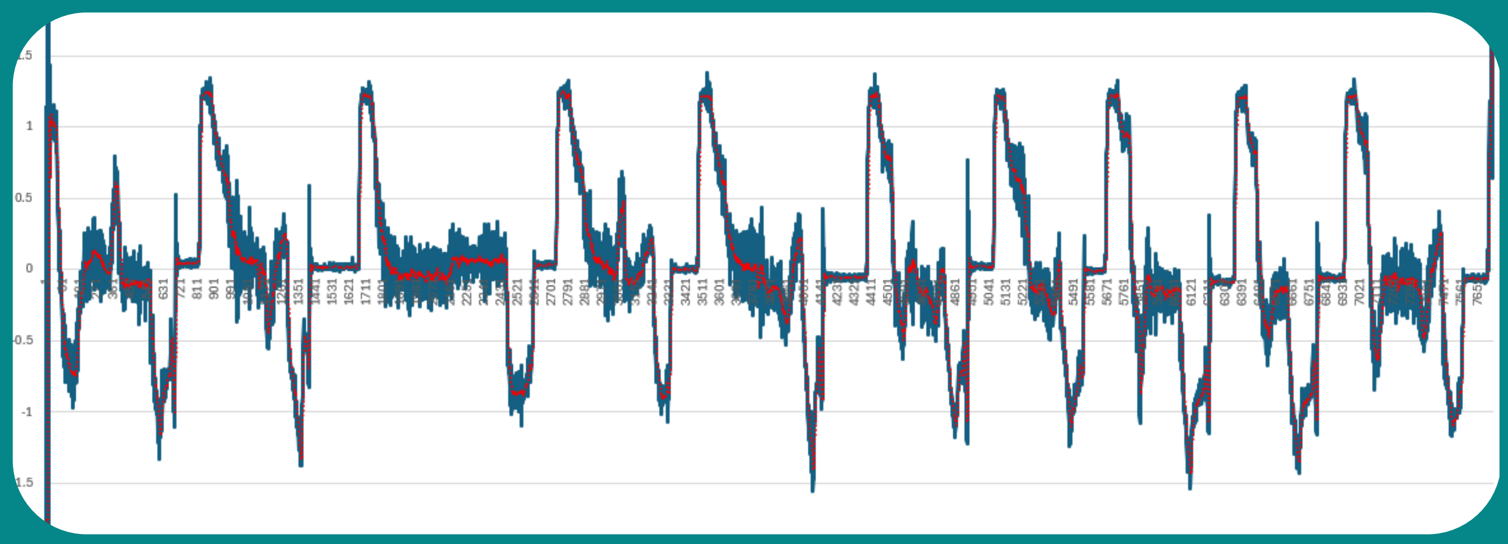
CATA

Our first prototype of the Creative Arduino Train Accelerometer (CATA) included two sensors: the accelerometer and a vibration switch, which we were hoping to use by measuring the proportion of each run it spent registering vibrations. However, after testing its sensitivity, we discovered it would not respond unless we hit it directly. We decided to only keep the accelerometer for our second prototype. Once we confirmed Cata worked as we expected, we assembled the device. We have since collected over 60 000 datapoints!



DATA

Each axis of acceleration can be represented on a separate graph, where we will analyse a number of features. First, because the accelerometer has uncertainty, and also because the metro vibrates, we plot the average value over 10 datapoints. This provides us with an easier picture of how the acceleration evolves over time. Second, we can use the standard deviation on the lateral and vertical axes to evaluate how far the values deviate from the mean, which will serve as our measure for the level of vibration of the train.



This is a graph of the acceleration in the direction of motion between stations Cartier and Berri-UQAM in an Azur train. We can see that between any two stations, it sharply rises to a maximum value for a short time, returns around zero, then the train decelerates bfeore stopping.

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