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AE 457

Project Proposal

Abstract:

My proposed project is to create a machine learning model that is based on feature recognition to detect meteors within spectrographs. This would be done by using color salience and meteor shape detection to allow for a machine learning model to identify and mark a meteor within a provided spectrograph. I am proposing this approach because Zooniverse and their Radio Meteor Zoo along with BRAMS (Belgian RAdio Meteor Stations) currently require human based meteor identification, this is an extremely time consuming processes. Additionally, there is an OpenCV based approach that already exists, created by Calders on GitHub. While this approach may provide a solid start for an algorithm based approach, it leaves a gap in implementation method as it does not utilize machine learning, an extremely relevant technology.

Purpose/Benefit:

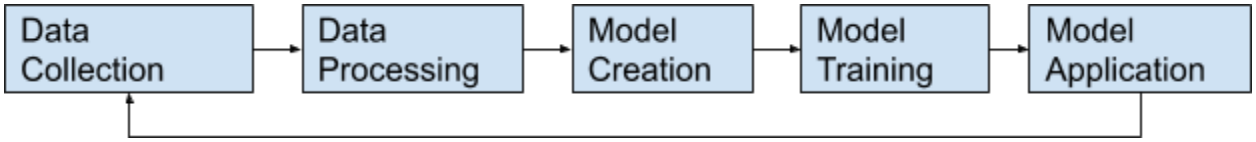
The purpose of this project is to create a new machine learning model that can detect meteors within spectrographs. This will be beneficial to BRAMS (Belgian RAdio Meteor Stations), who specialize in tracking meteors throughout Belgium. By creating a machine learning model, multiple benefits are provided to both BRAMS and myself. The first is that I get to advance my knowledge of the field and look cool while doing it. Alongside this, a machine learning model will be able to detect and optimize for finding only relevant features for detecting meteors within spectrographs, resulting in a highly optimized and efficient solution. This can be further build upon itself through continuous training to allow for new data points to be used to train a model, thus resulting in a model that is always increasing in accuracy.

Measurable Objectives:

1. Okay
    a. Create a process that can obtain dataset from BRAMS and save it for later usage.
    b. Have a refined way of processing data to mark areas of interest.
        i. Ideally this will already be done before data collection but this may not be possible if Zooniverse does not allow for this data to be obtained.
    c. Have a machine learning model that utilizes feature detection to learn how to detect meteors within spectrographs.
        i. Able to detect rough shapes and/or number of meteors per data point.
2. Decent
    a. All of Okay.
    b. Have a machine learning model that utilizes feature detection to learn how to detect meteors within spectrographs.
        i. Able to identify rough shapes of meteors with decent accuracy and/or number of meteors per data point.
        ii. Ignore airplane interference.

3. Better
    a. All of Decent.
    b. Have a machine learning model that utilizes feature detection to learn how to detect meteors within spectrographs.
        i. Good accuracy when detecting shape and number of meteors per data point.
4. Best
    a. All of Better.
    b. Have a refined way of processing data to mark areas of interest.
        i. Have a simple and streamlined solution for creating new data points with OpenCV or other image processing library to ensure that model can be continually trained and improved.
5. Ideal
    a. All of Best.
    b. Have a machine learning model that utilizes feature detection to learn how to detect meteors within spectrographs.
        i. Model has 100% accuracy when detecting shape and number of meteors per data point.

Diagrams:



The diagram above shows the basic process that will be involved with creating a machine learning model for use detecting meteors within spectrographs.

- Data Collection
    - Gathering spectrographs
- Data Processing
    - Converting spectrographs into images
        - Unsure if this will be the final approach as it will require additional processing to be done before spectrographs can be analyzed by the model
    - Marking areas of interest
- Model Creation
    - Writing code for model
- Model Training
    - Allow model to be trained with processed data
- Model Application
    - Use trained model on new data

Required Resources:

- Large dataset
    - Preferably already marked with areas of interest
    - Will also need data to validate performance of the trained model

- Machine (cloud or physical) to train model on
- Knowledge of Keras/Tensorflow
    - Currently lacking this, this will be learned throughout the course of the project

Short Professional Biography:

- Work Experience
    - Google
        - At Google I was apart of the Kubeflow Pipelines which focus on creating and delivering a seamless, robust, and repeatable solution for machine learning pipelines (a pipeline being the initial, intermediate, and final steps for creating a machine learning model). While I did not directly work with machine learning models, I became familiar with the interface, Kubeflow Pipelines, as well as basic concepts around machine learning.
    - RAINN
        - At RAINN I managed and developed mobile and web solutions that help survivors of sexual assault recieve any help and resources that they may need. Alongside this work, I am a full time student at Capitol Technology University, this allows me to get valuable time management and communication skills as I have to properly allocate time for work and school while also communicating with superiors about outcomes and expectations.
- Personal Experience
    - Gwitter
        - Gwitter was a side project that a friend and I worked on to identify Twitter user's gender based on their tweets. While this only had a 50% accuracy, it introduced me to the world of CNNs (Convolutional Neural Network) and Tensorflow.