28th ECSS Anniversary Congress, Paris/France, 4-7 July 2023

Smart Truck: Classifying skateboard tricks with a convolutional neural network based on motion data

Westenberger, E., Hollaus, B., Freitas, G., Fresen, L.

MCI

INTRODUCTION:
In the fitness community, quantifying activities with apps and wearables rose in popularity throughout the last decade. In sports like running or cycling, these digital technologies are ubiquitous while fun sports are not yet as present. The Smart Truck project aims to change that for skateboarding by enabling the classification of tricks. Studies on motivation behind fitness app usage show that achievement oriented members of the running community benefit most from the tracking features of such apps [1]. Skaters could use this technology to keep track of their skill progression or to compete in challenges.
METHODS:
In an experiment, motion data of the rear axis of a skateboard was recorded with an IMU at a sample rate of 120Hz while skaters were performing the following tricks: “Ollie”, “180 Front-side”, “180 Back-side”, “360-flip”, and “Kick-flip”. While performing the tricks, orientation, angular velocity and magnetic flux density were recorded. In the post-processing phase, the relevant data around the pop was extracted to an array with the dimensions of 9x120 elements. The 9 rows represent orientation, acceleration and magnetic flux density for all axis. The 20 data-points prior and the 100 data-points after the pop are saved to a .csv file. The dataset was split into parts containing 80% and 20% of the samples for training and testing respectively. To classify each trick, the neural network was designed with a combination of linear, max pooling, and one dimensional convolution layers. For optimization, the Adam optimizer was used [2].
RESULTS:
The accuracy score of the model created for this project amounts to 96.84%. With a batch size of 10 samples per step and 80 steps per epoch, 5 subsequent loss values of lower than 0.2 were achieved after 6 epochs. The tricks with the lowest and highest mean confidence scores respectively are the “360-flip” with 77% and the “Kick-flip” with 95%. The tricks “180 front-side” and “180 back-side” ranked lowest in precision both with a score of 94% compared to the tricks “Ollie” and “Kick-flip”, both with a score of 100%.
CONCLUSION:
The results show that it is possible to create a model that is capable of classifying skateboarding tricks based on motion data. Although the model performs classification with sufficient accuracy, the results have limitations. The major limitation is the dataset, as it was unbalanced and of limited variety. In the future the dataset could be improved by including more recordings from a broader demography of skaters. As the project was intended as a proof of concept, the results achieved with the current dataset were able to demonstrate the feasibility of a digital gamification platform for skateboarding. This outcome could inspire similar products, leading to a stronger representation of funsports in the digital market.

References:
1. Stragier J., et al., DOI: 10.1080/0144929X.2018.1484516
2. Adam J., et al., arXiv:1412.6980

Topic: Training and Testing

Presentation Oral