Automated Mouse Grimace Scale Scoring

Degree programme : BSc in Computer Science
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To reduce suffering caused to lab animals during experiments, researchers are looking for ways to reliably detect and measure pain in animals. One promising way for this is the detection of pain signs in the animal's facial expressions. This thesis focuses on automating the extraction of face images from footage of mice for automated pain detection using the mouse grimace scale.

Introduction

The Mouse Grimace Scale (MGS) is a method for assessing pain in mice by looking at details in their facial expressions. MGS scores have the potential to reduce suffering of laboratory animals. By allowing researchers to detect signs of pain after animal experiments, measures for easing the pain can be applied more quickly and efficiently. However, doing MGS scoring requires a lot of manual effort and can only be done by trained experts. Researchers from the Bohacek lab for molecular and behavioural neuroscience at the ETH Zurich developed a standardized recording system to produce high quality footage for behavior analysis and MGS scoring. They provided the recordings as well as a list of manually annotated MGS scores that were used in this project.

Goals

The goal of this thesis was the creation of an automated machine learning pipeline for extracting high quality images of mouse faces from videos and generating MGS scores.

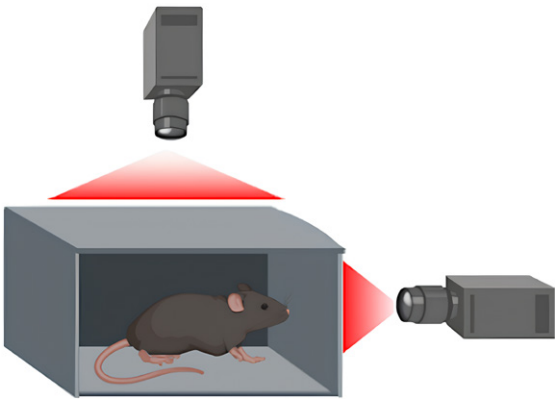
Results

Two computer vision models were trained for extracting the face images. One model scores the frames based on image quality and the position of the mouse to determine if a frame is usable. The second model then finds and crops the face of the mouse. The system is able to reliably extract high quality face images in real time from 30 fps video footage.

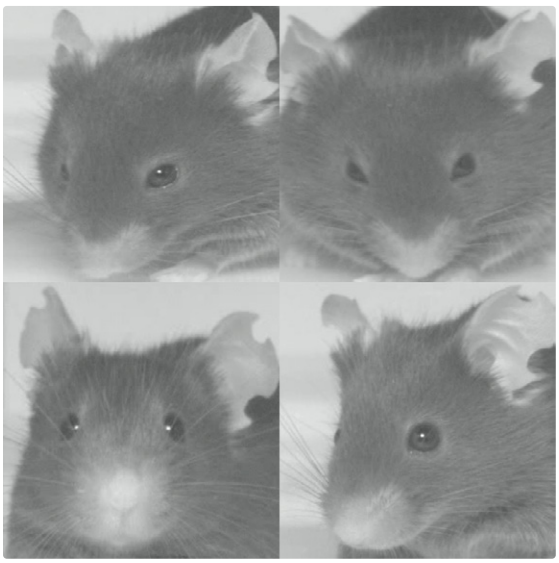
A third model to detect signs of pain in these images was trained using MGS scores labelled by experts. However, due to the low number of manually labelled training images as well as bias in the ground truth data, the model was not yet able to achieve a sufficiently high accuracy in detecting pain.

Outlook

To improve the accuracy of the pain scoring model, it is necessary to get more and higher quality data. The recording setup will be sent to collaborators from other labs to collect more footage. Using a higher number of annotated images and more varied data, the model will be continuously improved until it is ready for widespread adoption in biological and pharmaceutical research.



Overview of the recording setup. Two infrared cameras record the mouse inside a box transparent only to infrared light.



Examples of extracted face images

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