# Real-time Convolutional Neural Networks for Emotion Classification

## Project Specification

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# 1    Work overview

I intend to implement a deep learning real time facial recognition and emotion classification program. To achieve this, I will use Convolution Neural Networks (CNNs) for training from a dataset and real-time computer vision from a webcam. The proposal of this project is a facial emotion analysis, in real time, on participants presented with a dataset of videos, and subsequent accurate categorising of the emotions produced by each element in the dataset. The sequential process will be delineated in three distinct phases; the first phase, where a human face is detected through the webcam, the second phase where the input is examined on the features with support of a CNN model and the third phase where the human face is classified as an emotion such as anger, disgust, happiness, fear, neutral, sadness or surprise.

This program will aim at achieving an effectiveness of at least 66%, in line with similar studies [1] on facial emotion classification which will translate into data visualization on the impact of audio-visual input in human emotions. Through the analysis of the data visualization, a comparation and evaluation study will be produced.

To accomplish the finest results I will use Python, CNNs classifiers, open-source deep learning libraries and open-source datasets.

## 2 Technologies and Materials

This project will use deep learning as main technique to be implemented. In order to execute this technique, I will use Convolutional Neural Networks (CNN's) for their superior performance with image compared to other neural networks. Through the use of CNN's main five layers Input, Convolutional, Pooling, Fully-connected and Output, I will increase CNN's complexity by accumulating larger number of layers of each type. As direct result, I expect superior identification of portions of the image within each layer, ultimately resulting in an accurate emotion identification.

As library I will use TensorFlow, a deep learning library that "*clusters together machine learning and deep learning models*" [2]. The decision of using TensorFlow (TF) rather than other solutions, such as Keras, is based on some exclusive TensorFlow features such as the ability to be used for high-performance models and large datasets. Although TF speed being slower, is still the best solution for my project needs. TensorFlow link: https://www.tensorflow.org/ .

This project will require the use of a computer equipped with a webcam which will be sourced by me in the prototype phase and later sourced by each of the participants of the study.

# 3    Motivation and research

My motivation for this project lays in two main points: firstly, learn and implement a program capable of recognizing and categorize human emotions; secondly, use said program to try to understand if there is a correlation on how overloaded each age group is by social media platforms and the level of desensitization present in each age group. Although have been well reported that exposure to violent games would produce more violent individuals and behaviours, some studies find the opposite [3], making the counterpoint with the desensitization claim. With this project I plan to study a group of 20 people, analyse their emotions to a specific set of videos and evaluate if the age groups traditionally more online connected are more desensitized than the ones with less online presence.

The world in 2021 is more connected than ever. We are bombarded by information everywhere, in the shape of images, video and sound. The once novelty 24/7 news TV channels became ordinary. The quick development of better and cheaper technology, alongside the ascension of the internet, made the old-style news TV channels lose their throne as the pinnacle of information. That position was claimed by social media platforms, available virtually everywhere and now an integral part of society where users share news, media, and personal opinions. In the vast list of social media platforms, the second biggest is YouTube, a video platform, with 2.17 billion users worldwide and where 694,000 hours has been streamed per minute in August 2021 [4]. This usage penetration has no boundaries of gender, social class, religion believe, political view or age with the most popular children-themed YouTube channel reaching 51.6 million subscribers. Along with YouTube, platforms such as Facebook, Instagram and TikTok congregate access to images and videos. This perpetual and infinite exposure inflates the extremes: the happy media creates bridges between communities; the hate media destroy them. This effects were more visible throughout the COVID-19 pandemic with reports of 2.5 hours of daily social media usage worldwide [5].

This project can also be used in the psychological field as a tool to analyse the emotional aspect of online media exposure and its role in the mental health in the different age groups. Additionally, it may enable an extrapolation about the role that environment plays in such different levels of emotional content exposure and desensitization.

So, by using a dataset with more than 30,000 facial RGB images of different expressions, I will train a Convolutional Neural Network (CNN), the state-of-art method for analysing multidimensional signals such as images, and by the end of this project I expect to be able to study and evaluate this issue through the use of a computational solution to categorise a participant emotion to a specific set of videos. My personal accuracy target is a minimum of 67%, in line with similar projects [1].

## 3.1 Existing knowledge

For this project I will use all my knowledge gathered from past and present modules.

From last year Algorithms and Data Structures, I will use such knowledge in the creation of an algorithm. Additionally, I will use my Java knowledge from second year in order to accelerate my Python learning for both languages share many base aspects.

Currently I am studying Artificial Intelligent and Neural Networks. The first is providing me experience on Python and the second provides me the necessary knowledge to learn and use the deep learning techniques and libraries.

## 3.2 New knowledge

With the purpose of accomplish the best outcome possible, I need to acquire new skills.

First, I need expand my knowledge in Python. For that I am doing two Udemy courses: "Python Programming Beyond The Basics & Intermediate Training" and "Complete Python Bootcamp | Deep Learning Into Python Coding". This two courses with provide me Python experience and then experience in deep learning coding.

Then, I need to learn how to use the CNNs classifiers, open-source deep learning libraries, open-source datasets and TensorFlow. All this will be covered by my current modules Artificial Intelligence and Neural Networks, therefore realisable by completing both modules successfully. I will have two as support to the current modules: "Deep Learning with Python" by François Chollet and "Neural Networks and Learning Machines" by Simon Haykin.

# 4    Timeline and milestones

| Period of time | Milestone | Task | Deadline |
|---|---|---|---|
| **11/10/21 - 22/10/21** | Research | Decide which idea to pursue. Complete idea. Research academic support to the idea. Choose technologies and materials. | Project Specification |
| **23/10/21 - 31/10/21** | Additional Research | Research more about CNN's classifiers. | |
| **01/11/21 - 19/11/21** | Prototyping | Develop prototype of program. | Prototype/proof of concept |
| **20/11/21 - 28/11/21** | New skills | Complete Udemy courses about Python and Deep Learning coding. | |
| **29/11/21 - 21/12/21** | Implementation | Program development. | |
| **27/12/21 - 09/01/21** | Report | Measure project development. Produce interim report. | Interim Report |
| **10/01/21 - 26/01/21** | Implementation | Conclude program development. Test the program on the data set. Amend what necessary. | |
| **29/01/21 - 11/02/22** | Presentation | Decide a presentation structure and program key points. Produce presentation slide. | Presentation |
| **15/02/22 - 01/03/21** | Testing | Perform all the necessary testing. Amend what necessary for MVP. | |
| **02/03/21 - 16/03/21** | Group test | Test the program with participants. | |
| **17/03/21-03/04/21** | Report | Write report. Amend according to supervisor feedback. | |
| **04/04/21-06/05/22** | Final phase | Conclude report and get final supervisor feedback. | Final hand-in |

I have reserved 32 days for the last phase of the project as my contingency plan. This great number of days can be used to fix or minimize any unexpected situations that may occur. Possible delays may arise on the second implementation period and/or at the group test, assuming that the program will be capable of it.

## 4.1 Minimum viable product

The intended final program requires more time than the available. Given the constrains inherent to this type of project, my main focus will be on developing a program capable of recognize, analyse, and classify an emotion with at least 67% accuracy when tested against the dataset.

## 4.2 Project repository

Link: https://github.com/dosodrac/real_time_emotion_project

# 5    References

[1]    Arriaga, O., Valdenegro-Toro, M. and Plöger, P., 2017. Papers with Code - Real-time Convolutional Neural Networks for Emotion and Gender Classification. [online] Paperswithcode.com. Available at: https://paperswithcode.com/paper/real-time-convolutional-neural-networks-for [Accessed 23 October 2021].

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[5]    DataReportal – Global Digital Insights. 2021. Digital 2021: Global Overview Report — DataReportal – Global Digital Insights. [online] Available at: https://datareportal.com/reports/digital-2021-global-overview-report [Accessed 27 October 2021].