Title of the Seminar Paper

Neural Network Learning

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***Abstract*— Text of the abstract**
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I. Introduction

With software infusing more and more of our daily lives, software developers are trying to keep up with the rising expectations of end-users. With IoT in the rise, we collect more data in a single day, than we could have ever imagined and have digital interfaces to nearly all parts of our lives.

Software development has grown to a point, where we have a giant base of great algorithms, that enable us to solve many problems quickly and efficiently. In todays software development it often comes down to having an idea and implementing it on the basis of these existing algorithms. Still there is a limit to what they can do and it is often reached at tasks that seam pretty simple to us humans. Algorithms are great in using big amounts of data, accumulating it to models and trends, showing it in smart graphs and in general making it visual and easier to analyse and interpret. Still the final interpretation is a skill where humans are unmatched in.

The following paper follows the entire process of creating a so called ”artificial intelligence” that is able to take an image, grabbed from a file or a video and determine, if showing a person, which kind of mask this person is wearing or whether he/she is wearing any at all. First the project and its goals will be layed out in detail with a short introduction of each team member and their role in this project. This is followed by a description of the used dataset and how it was created. Then there will be an outline of the process including used methodologies and encountered difficulties and finally a summarization of the obtained results and their interpretation.

II. Project - Description

This project was conducted in context of a university course at Université Côte d'Azur in Nice, France. The main goal of the project was a first experimentation with the concept of machine learning with neural networks. It's purpose was to gain a deeper understanding of what influences the decisions of such a model and using the gained knowledge to create a simple, but fully functioning face-mask-detector.
The project was split into two parts, the data collection and preparation and the machine learning (ML) model creation and training. In the following both parts will be outlined with a introduction of the team members and their roles in both parts.

A. Part I - Data Collection and Preparation

The data collection is already a big part of the project, as there are a lot of things that can go wrong here. The data is the main thing that influences the final model in the decision it makes. A ML model is in this context not different than humans, as it can only act on its own experience. Therefore making sure the data is chosen in conjunction with the final goals is essential. As the scale of this project is fairly small and its purpose is a first experimentation with the concept, it was sufficient to expect the the model to recognize the three members of this project.
The collected data will most likely not be in a format, that is easily readable for our model. The next step therefore needs to manually interpret the data, label it for the model and standardize it. The level of the data preprocessing again is determined by the goal one wants to achieve. In the scale of this project, our preprocessing will go as far as already identifying the face on the image, cutting it to a good fitting square and giving it a label according to its context. To achieve all that in a streamlined, standardized and user friendly way, the development of an image annotation software was necessary. In addition to the manual annotation we some automation tricks to help us with easy classifiable data.

B. Part II - Machine Learning Model

This of course is the center of the project. Setting up and compiling a ML model, that is capable of taking an image of a face and determining whether the person shown is wearing a mask and what kind if yes.
As mentioned before, we limited our goal to being able to detect mask on the faces of our team members, as we would have needed a much larger and more diverse dataset to achieve more than that. ...

C. Team Members and Roles

The team consists of three members, Michael Cegielka, Julien Schulz and Leonhard Zirus. The roles in this project where distributed equally in a way where everyone was still involved in every part of it. In the first part of the project, Leonhard took charge of the annotation software, being responsible for the organization and collaboration. He created the framework and interfaces. Julien as our ML expert was responsible for making sure that the software was usable in the second part of the project and created a streamlined process

for the creation of the dataset, augmentation and later labeling. Micheal was mainly in charge of the UI (User Interface) and UE (User Experience) of the annotation software. In the TODO: Part II TODO: Who coded TODO: Who wrote the paper

III. Dataset

The used dataset was created by taking pictures of our team members wearing different kinds of masks. For the ML model to use the images they need to be preprocessed and labeled to enable the learning process.

A. Image Creation

The images taken will influence greatly what kind of images the model will later be able to recognize. This means, that lighting, orientation of the face, background, clothing or other kinds of patterns are very important to be aware of when creating taking the pictures.
Imagine a person choses to never wear a bonnet when walking inside, but because of corona, that is exactly when he/she always wears a mask. As it is winter, the opposite is true for being outside, he/she wears a bonnet, as it is cold, but no mask, because it is outside and not required. Now using pictures from these situations, the model might turn to identifying whether the person is wearing a bonnet instead, as the dataset reflects such an implication. This is just one of many examples, of unwilling implications that might turn up in a dataset.
In order to make sure to not have any such implications the images were tried to create, using equal distributions of different backgrounds, with no lighting differences correlating to the wearing or not wearing of a mask and different clothing styles not related to the mask. The later one was limited to wearing a bonnet or not.
The limitation of time and equipment will surely create a few problems with the dataset. As an example, the creation started in the evening, which in turn changed the lighting between changing to a different mask. As this problem became aware, the fotoshoot was moved inside to at least have similar lighting throughout all the pictures.
The improvements to the creation are countless, but would have all not been justified by the dimension of this project. To create a proper one, the diversity of the people, lighting, backgrounds, clothing, camera-lenses, etc. would all have to be greatly increased. Also the number of images created is still very small for the model to accurately recognize anyone, anywhere we put them in front of the camera. In the end the created dataset should have sufficient diversity to serve the purpose of this project.

B. Scaling, Labeling and Formatting

With the base for the dataset created, it is time to pre-process the images into a format that can be used for the model. The final images should have a square format with 240 x 240 pixels saved in a folder specifying it's label. There are four labels: "no_mask", "ffp2", "op_mask" and "other_mask". In this case "other_mask" will be different kinds of cloth-masks.
The image annotator ... As the dataset started out with over 500 images,

IV. Implementation and Methodologies

This project had two major implementations, the annotator and the ML model, which will be detailed in this chapter. The following will explain used methodologies and choices made in the implementation process as well as overcome difficulties.

A. Image-Annotator

B. Machine Learning Model

V. Testing and Results

VI. Summary and Outlook