Executive Summary: Facial Recognition for Verification

Carter Grant A02298650

**Project Goal:** The main objective of this project was to develop a facial recognition model specifically designed for verification purposes. This model will use simple images to verify without the need for specialized sensors like infrared.

**Methodology:**

The project followed a structured approach, beginning with the Data Collection phase. Images of myself were collected to serve as positive samples(roughly 300 images). Simultaneously, images of other individuals were gathered from a Kaggle dataset to make up the negative samples(also roughly 300 images). This dataset was intended to be expanded upon as the project progressed.

**Model Development:**

This step involved the use of a Convolutional Neural Network (CNN) architecture, a powerful deep learning technique well-suited for image recognition tasks. The TensorFlow and Keras libraries were chosen for their flexibility and wide adoption in the machine learning community. To enhance the model's ability to generalize to unseen data, various data augmentation and hyper parameter tuning techniques were employed. This ensured that the model wouldn’t be overfit to the specific characteristics of the training images and could handle variations in real-world scenarios.

**Model Training and Evaluation:**

The collected dataset was split into training, test and validation sets. The model was trained on the training data (mentioned earlier), and its performance was continuously monitored using metrics like accuracy and loss. Early stopping, a technique that halts training when the model's performance on the validation set plateaus, was implemented to prevent overfitting. Additionally, model checkpointing was employed to save the best-performing model during the training process, ensuring that the most accurate model was retained for future use. The prediction was then interpreted based on a pre-defined confidence threshold, determining whether the image contained my face or someone else.

**Key Observations and Challenges:**

Throughout the project, several noteworthy observations and challenges were encountered. Firstly, the model demonstrated an overall capability to differentiate between the target face and others, indicating the success of the training process. However, during testing, it became clear that the model occasionally exhibited a tendency to predict "Other" with a higher frequency than desired. This behavior could potentially be because of the relatively limited size of the dataset and the lack of diversity in the images used for training.

The impact of external factors like lighting conditions, facial accessories, and the angle of the face on model accuracy was observed. These factors can introduce variations in the appearance of a face, making it more challenging for the model to consistently identify the target individual.

**Next Steps:**

To improve the facial recognition model, we first need to expand the Dataset. Increasing the number and diversity of images used for training will equip the model with a broader understanding of facial variations, enhancing its ability to handle different scenarios. This includes using images with varying lighting conditions, facial accessories, and angles to expose the model to a wider range of real-world situations.

More Fine-tuning of the model is also essential. This involves experimenting with different model architectures, adjusting hyperparameters, and optimizing the training process to achieve better performance.

Finally, conducting additional real-world testing is an important next step to validate the model's performance in realistic scenarios. Deploying the model on a cell phone camera and evaluating its accuracy in real-time usage will provide valuable insights into its practical usability and identify any remaining challenges that need to be addressed.

**Conclusion:**

In conclusion, this project has successfully demonstrated the feasibility of using images in facial recognition verification. Despite the limitations encountered, the model achieved a reasonable level of accuracy (over 95%) in distinguishing between my face and others. By addressing the identified challenges and implementing the proposed next steps, the model can be further refined and optimized for real-world deployment. This technology has the potential to serve as a reliable and secure verification tool, enhancing the security and user experience of my devices!

Dataset: [..\Pictures\Data 5610 images.zip](../Pictures/Data%205610%20images.zip)