

Stages of Facial Recognition Prediction using Artificial Intelligence Teachable Machine Learning Approach

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Abstract

Artificial Intelligence (AI) plays an important role in everyday life, particularly in how humans work and interact. This study analyzes teachable AI-based facial recognition using a machine learning approach with two test scenarios: training images and webcam-based images, using accuracy as the evaluation metric. The dataset consists of five age groups: 18–20, 21–30, 31–40, 41–50, and 51–60. The results show that the model achieved 89% accuracy for ages 18–20, indicating good performance on real data. Accuracy for ages 21–30 was 47%, while ages 31–40 reached 54%. The 41–50 age group achieved 88% accuracy, and those aged 51–60 achieved 66%. In webcam testing, the model achieved 86% accuracy for ages 21–30 using 50 epochs, a batch size of 16, and a learning rate of 0.001. Overall, the highest accuracy was achieved for ages 18–20 (89%) and 51–60 (66%), while other age groups showed lower accuracy and misclassification. These results indicate that teachable machines can serve as effective experimental tools for early-stage AI model development before implementation in software or hardware.

Keywords: Artificial Intelligence, Face Recognition, Teachable Machine, Machine Learning

1. Introduction

According to a McKinsey report entitled "The State of AI in 2022," the average use of AI in industry will double from 20% in 2017 to 78% in 2024 [1]. Indonesia has 212 million internet users with a penetration rate of 77%, 167 million social media users, and 353 million active mobile connections [2]. With this data, Indonesia is a huge market for the technology industry [3], including artificial intelligence (AI).

Artificial Intelligence (AI) has become an integral part of everyday life [4], significantly changing various aspects of how we live, work, and interact. From increasing productivity to improving healthcare and revolutionizing entertainment, AI's influence is vast and continues to grow [5]. One of the most widely used applications of AI is facial recognition. This AI-powered tool helps record attendance directly using your face or palm. This application utilizes deep learning to understand and respond to user requests, making daily attendance easier, more efficient, and easier to manage [6]. In addition, this AI application continues to be used and developed in industry, namely with the IoT (Internet of Things) System.

IoT is a system that continuously collects device data over time and generates large amounts of data with diverse content. Therefore, IoT systems require big data services to accommodate this data. This is due to the ability of big data services to store large amounts of varied data and analyze it more efficiently [7]. Currently, big data services are evolving into more complex architectures for various needs, such as the real-time analysis process frequently used by IoT system developers [8]. This process utilizes Artificial Intelligence architecture in data analysis. This journal was written to provide a simple and explanatory overview of the stages of AI for machine learning technology trends in solving everyday problems, especially in AI applications.

AI is a crucial factor in the Industrial Revolutions 4.0 and 5.0. It has the potential to empower intelligent production systems, which are essential for Industry 4.0 and help position the well-being of workers and the planet in a contrasting position with Industry 5.0 processes. However, little research has considered the different roles of AI in Industry 5.0. Further insights are presented and discussed, followed by a future research agenda [9].

So In the development of IoT applications integrated with big data, the implementation of machine learning services which are part of artificial intelligence [10], [11], is increasing, so experts are needed to understand how it works and the stages of the process carried out to make predictions. Therefore, in this study we use machine learning to look further at the processes applied in AI, namely how AI service providers apply machine learning as an analytical service both in real-time and offline (batch) forms. This includes the types of algorithms that can be used such as unsupervised learning, supervised learning and reinforced learning [12]. Apart from the previous discussion, in

this study we conducted a facial recognition prediction test using the teachable machine artificial intelligence approach with a description of the stages of the machine learning algorithm to make it easier to understand the process as a reference in data processing

2. Research Methods

Gartner Hype Cycle is a graphical representation of the maturity and adoption of technologies and applications, of how a technology or application will evolve over time, providing a powerful source of insight for managing its adoption in the context of research and business objectives, [13], [14].

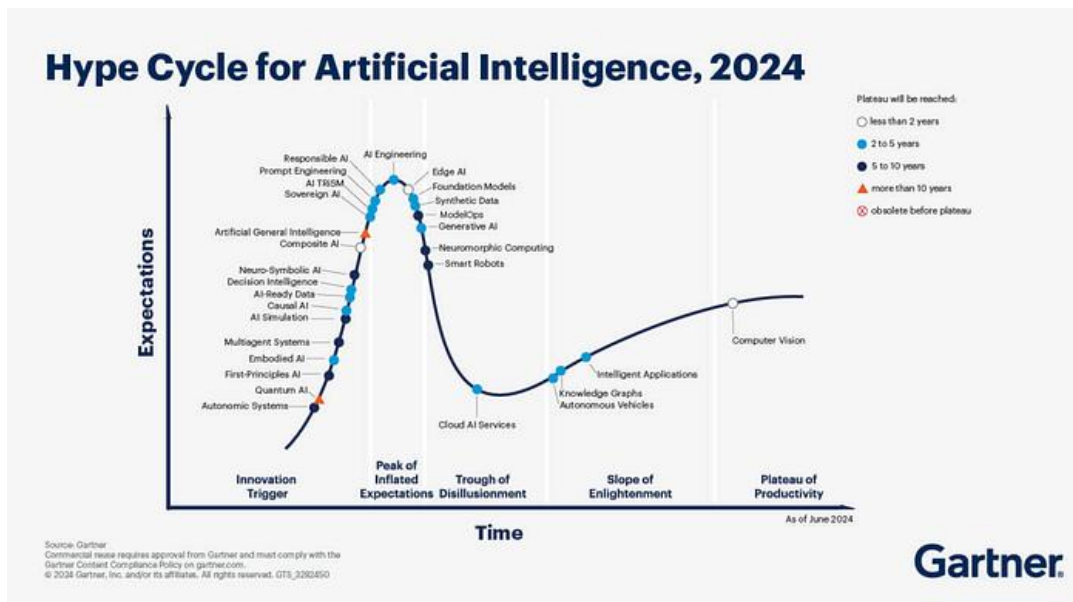


Fig. 1: Hype Cycle AI 2024

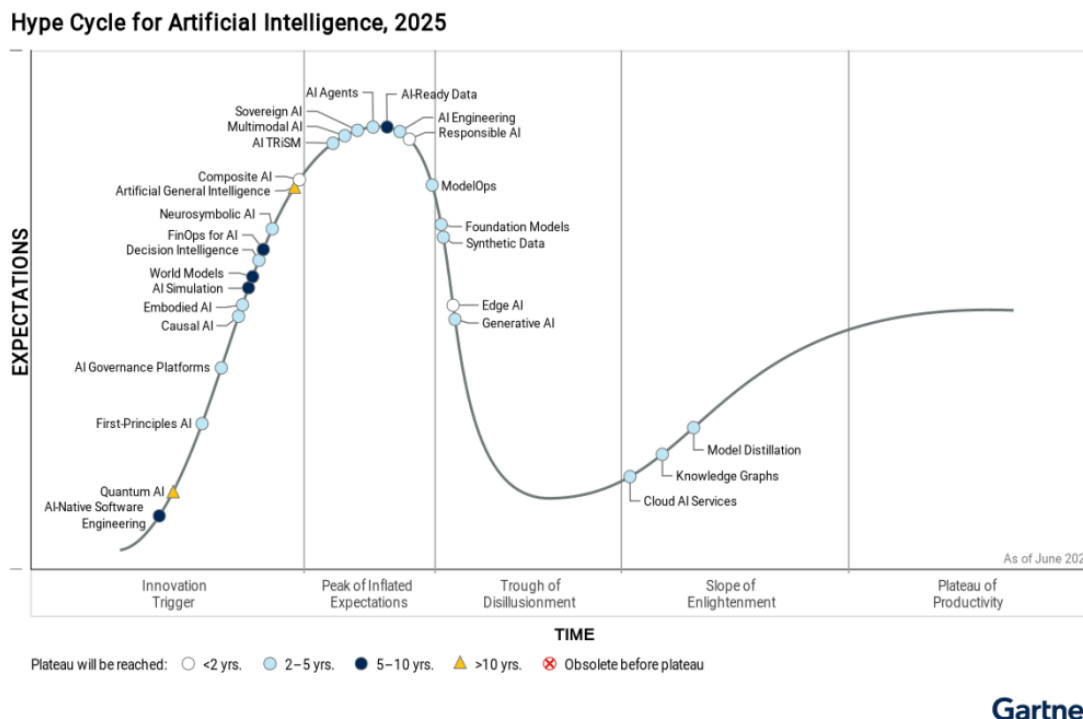


Fig. 2: Hype Cycle AI 2025

In Fig. 2 the 2024 AI hype cycle shows the peak technology adoption, AI engineering, with a 2- to 5-year development cycle. Meanwhile, in the 2025 hype cycle, the peak technology adoption shifts to AI Ready Data, with a 5- to 10-year development cycle. Interestingly, however, 2024 and 2025 share similarities in Quantum AI and Artificial General Intelligence technologies, which remain unchanged with a development cycle of more than 10 years. This graphical representation provides a glimpse into the widespread application of AI across industries.

Artificial Intelligence is a technology that provides the ability to think and learn with computers [15]. In other words, Artificial Intelligence is a part of technology that uses computers to complete tasks automatically with little or no human intervention at all [16], [17]. AI has experienced rapid development in recent years. The advantages of AI are providing efficient services and processing data with a statistical approach in prediction [18], [19] with an illustration of the stages of AI in Figure 2.

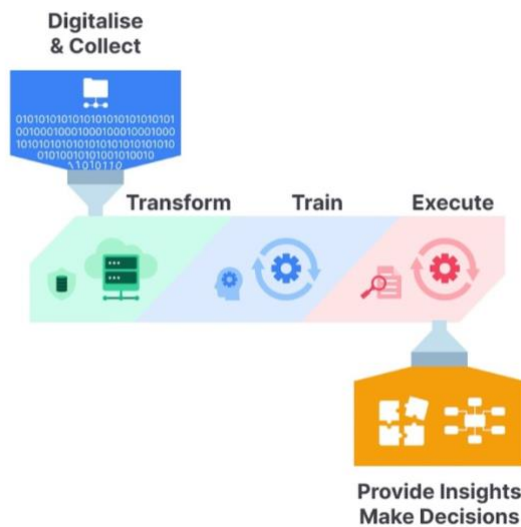


Fig. 3: Stages Research

The AI Stages Research are explained in Figure 3, Digitize & Collect, which is the stage of collecting and storing data that will be used in the AI development process. Transform here can be interpreted as the process of change, converting data into the required format, to evaluating data by identifying unnecessary data. Train is determining the appropriate algorithm for AI development. "The book by Jie Ding et al. entitled "Model Selection Techniques - An Overview" states that no algorithm is universally suitable for any data and purpose." Execution/Running is the AI model that has been trained and refined can be used to perform human tasks. The accuracy of the model is continuously evaluated to ensure that the system meets expectations and provides feedback for improvement. Provide Insights Make Decisions is the extraction of the knowledge it has. This process helps decision-making and improves our understanding in further AI development.

This testing involves AI and machine learning in the process of discovering models and results. The workflow is iterative, meaning the process can be repeated as needed. The machine learning workflow has four continuous stages, as seen in Figure 4.

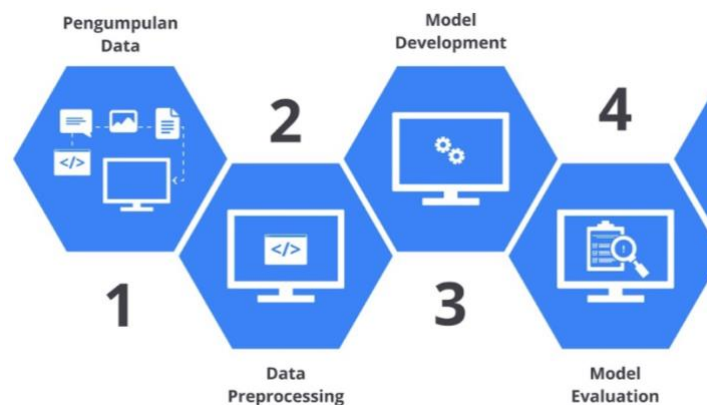


Fig. 4: Research Flow Diagram

The machine learning stages are explained in Figure 4. The data collection process can be carried out by obtaining datasets from pre-established sources; here, we use data from Kaggle. Data preprocessing is the stage of further data processing to prepare the data for developing machine learning models. Data preprocessing has several parts: data cleaning, data transformation, and data integration. Data cleaning stages include: Data imbalance, and so on. Furthermore, several steps can be taken during the data transformation process, such as scaling or changing the data scale to fit a specific scale, standardization, and other steps that can be performed during the data integration stage. Merging datasets, formatting, and so on. Model development can involve two things: selecting a learning method or ML algorithm and selecting the best hyperparameters for the chosen machine learning method. Hyperparameters are variables used to control the model training process, such as epochs, optimizer, and so on. Changing hyperparameter values while running an ML algorithm will produce different results or model performance. This process of finding the best model performance with different hyperparameter settings is also called model development. The model evaluation steps can be described as follows: Predict labels from the test data. Calculate the number of predicted results based on the test data. This stage calculates all existing conditions, such as the number of predicted conditions that have a true or false status. Compare the predicted results with the labeled data we have. From this comparison data, we can calculate the

model's accuracy or performance. In this testing, we examined four stages: data collection, data reprocessing, model development, and model evaluation.

3. Results and Discussion

The application of AI across all industrial sectors is growing rapidly, both in terms of product and service quality. This demonstrates the increasingly intense connection between industry and AI. This stage presents the results of testing, which did not use Jupyter Notebook or Collab, but focused on using an AI teachable machine approach with machine learning algorithm stages as the process reference. The results then confirmed the experimental response, whether the model was able to recognize input according to the learned categories, and then concluded the output/results. The testing used two different scenarios. The first scenario used image files, and the second scenario used a webcam/live camera. This testing provides an overview of the application of facial recognition in industry, such as facial recognition systems for automated attendance. This experiment used an AI teachable machine approach as a testing tool, along with the results and discussion.

Face recognition is a technology that allows for the identification or verification of faces in the form of live image or video files/webcam data. This technology uses biometrics to identify or verify a person's identity by comparing facial features captured by a camera or input as testing data. Teachable Machine is a web-based tool that can create machine learning models quickly, easily, and accessible to everyone. This tool is designed for anyone from any background. Creating a model doesn't require in-depth machine learning knowledge, even a novice can master it.

This study uses data obtained from the Kaggle site consisting of 125 training data images and 25 testing data with 5 class categories, the Age 18-20 class, indicating age in the range of 20 years, the Age 21-30 class, indicating age in the range of 30 years, the Age 31-40 class, indicating age in the range of 40 years, the Age 41-50 class, indicating age in the range of 50 years, the Age 51-60 class, indicating age in the range of 60 years. The dashboard on the teachable machine can be seen in Figure 5 below.

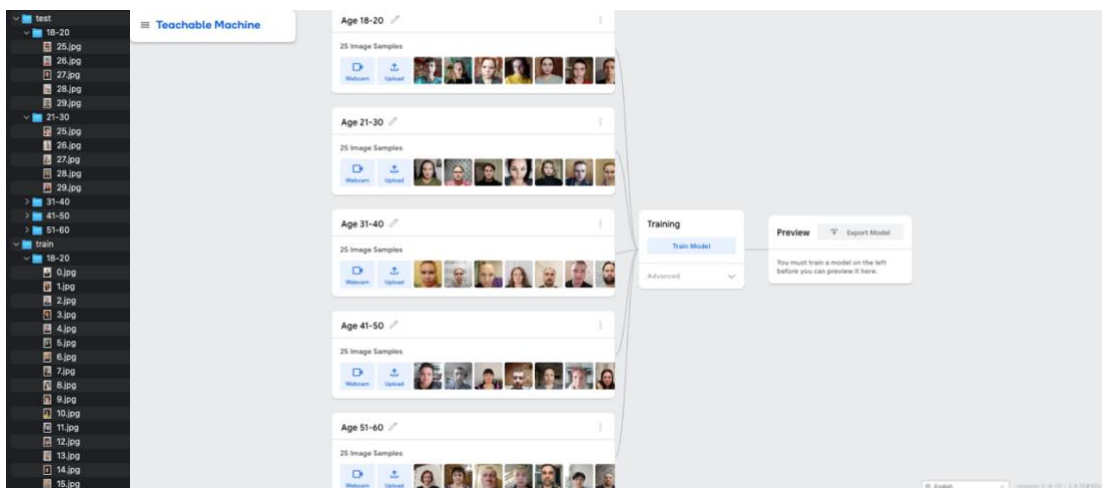


Fig. 6: Data Training and Data Testing

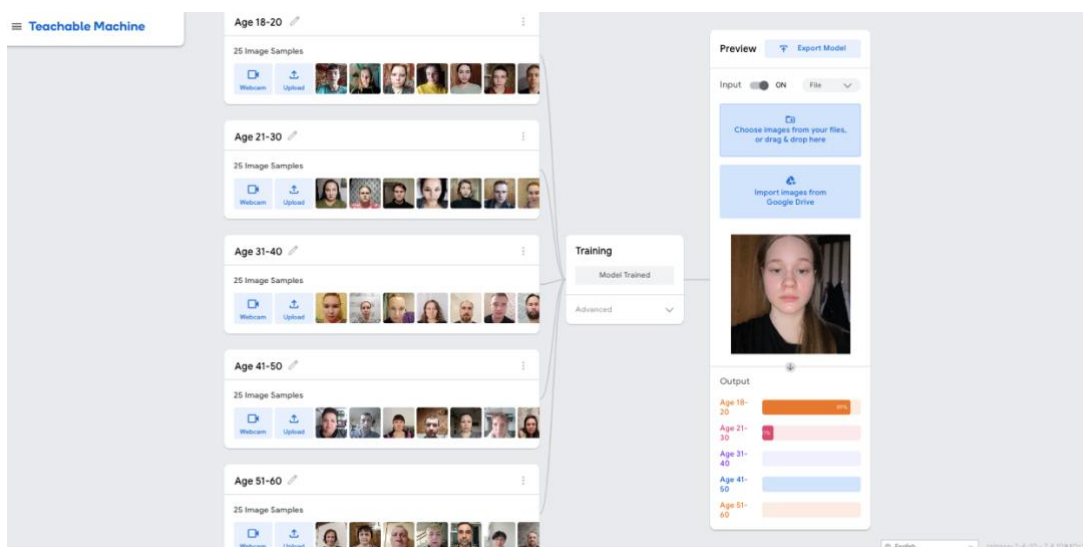


Fig. 6: Data Reading Testing class age 18-20

Figure 6 is the output of the application of the training model to the testing data, the results of facial recognition, the model reads 89% of the images in the 18-20 age category and 11% in the 21-30 age category, with the epochs parameter setting 50x, batch size 16, learning rate 0.001 resulting in accurate facial recognition with the age data class.

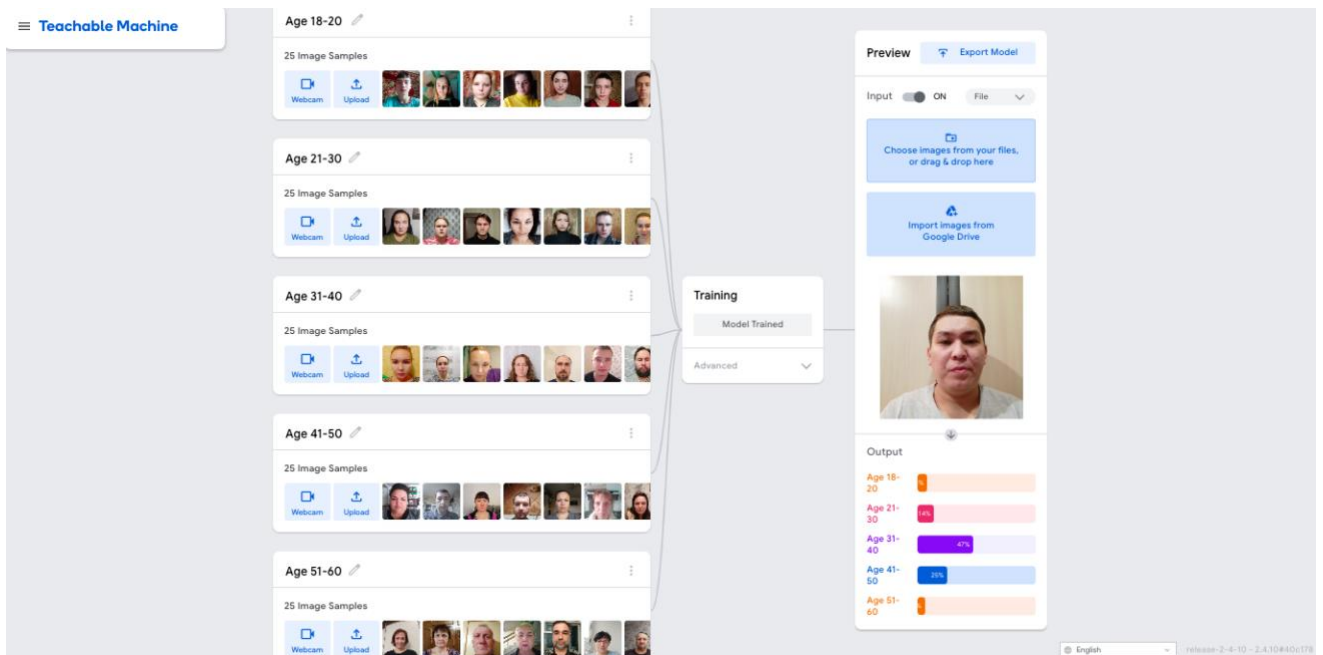


Fig. 7: Data Reading Testing class age 21-30

Figure 7 is the result of facial recognition, the model reads 47% of the image in the 31-40 age category, 25% in the 41-50 age category, 14% in the 21-30 age category, 1% in the 51-60 category and 1% in the 18-20 age category, with parameter settings of epochs 50x, batch size 16, learning rate 0.001 resulting in less accurate facial recognition with age data classes that should be in the 21-30 age range.

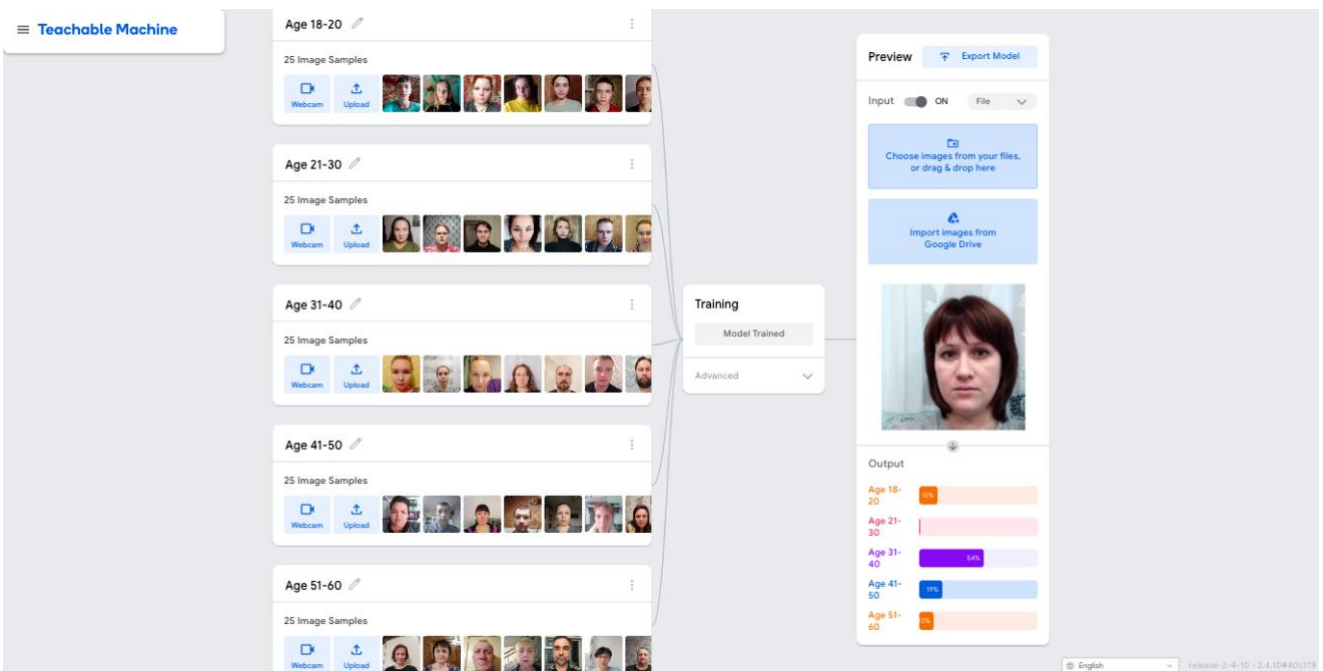


Fig. 8: Data Reading Testing class age 31-40

Figure 8 is the result of facial recognition, the model reads 54% of the image in the 31-40 age category, 19% in the 41-50 age category, 14% in the 21-30 age category, 12% in the 51-60 category and 15% in the 18-20 age category, with parameter settings of epochs 50x, batch size 16, learning rate 0.001 resulting in less accurate facial recognition with the actual age data class.

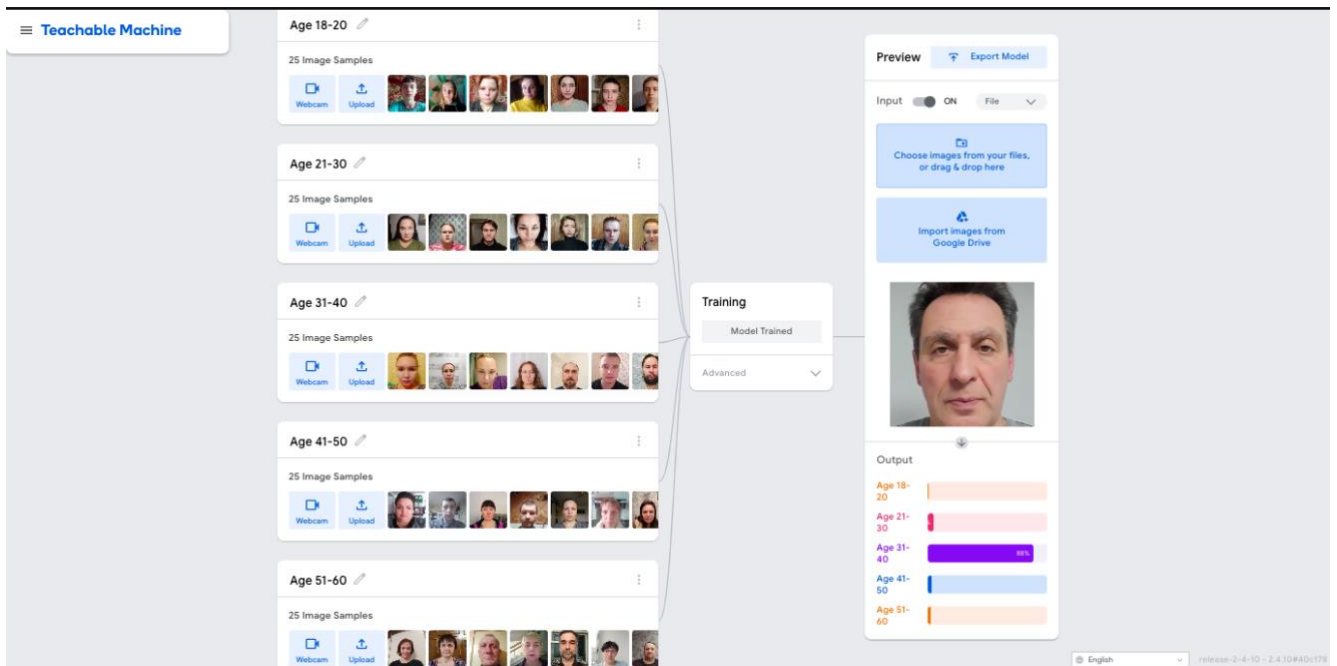


Fig. 9: Data Reading Testing class age 41- 50

Figure 9, the image reading model for 88% of the 31-40 age category, 5% of the 21-30 age category, 4% of the 41-50 age category, 2% of the 51-60 category and 1% of the 18-20 age category, with parameter settings of epochs 50x, batch size 16, learning rate 0.001 produces less accurate facial recognition with the actual age data class, namely in the 41-50 age range.

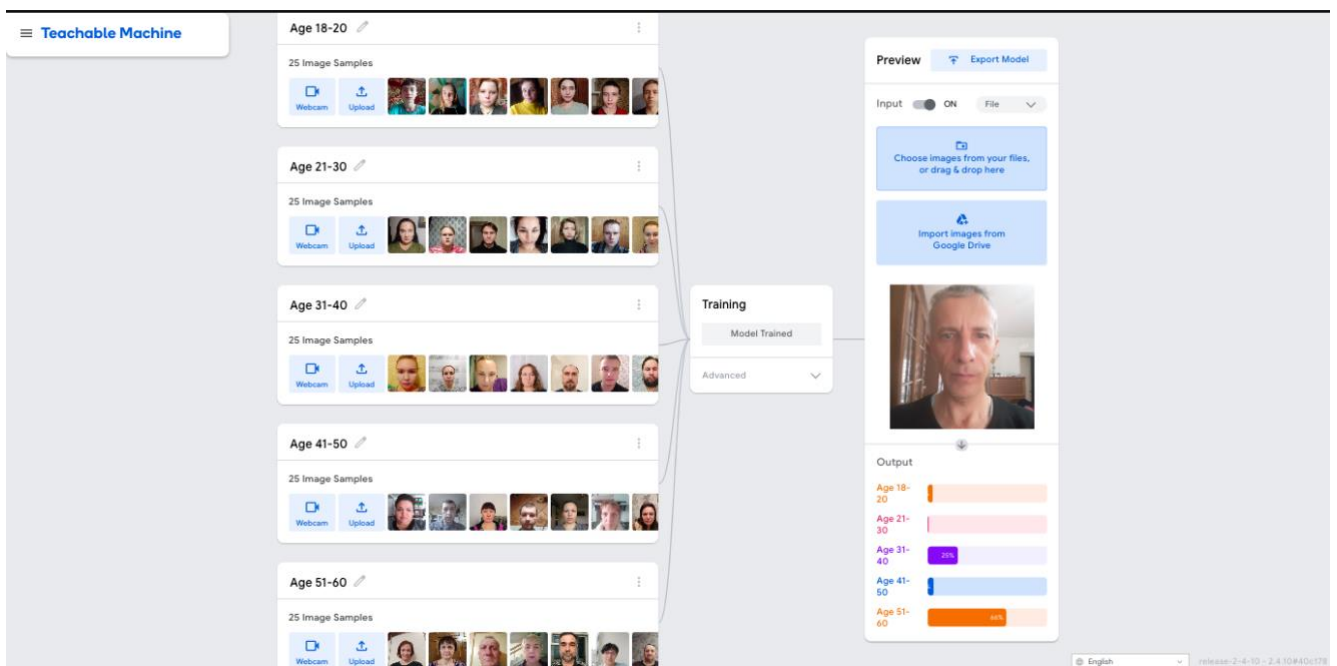


Fig. 10: Data Reading Testing class age 51- 60

Figure 10, the image reading model for 66% of the 51-60 age category, 25% of the 31-40 age category, 4% of the 41-50 age category, 4% of the 18-20 category and 1% of the 21-30 age category, with parameter settings of epochs 50x, batch size 16, learning rate 0.001 produces accurate facial recognition with the actual age data class.

Teachable machine learning predictive classification can be performed in two ways: 1. uploading an image, and 2. activating a webcam. This test uses uploaded images for training and testing, as well as webcam testing as a benchmark, as seen in Figure 11.

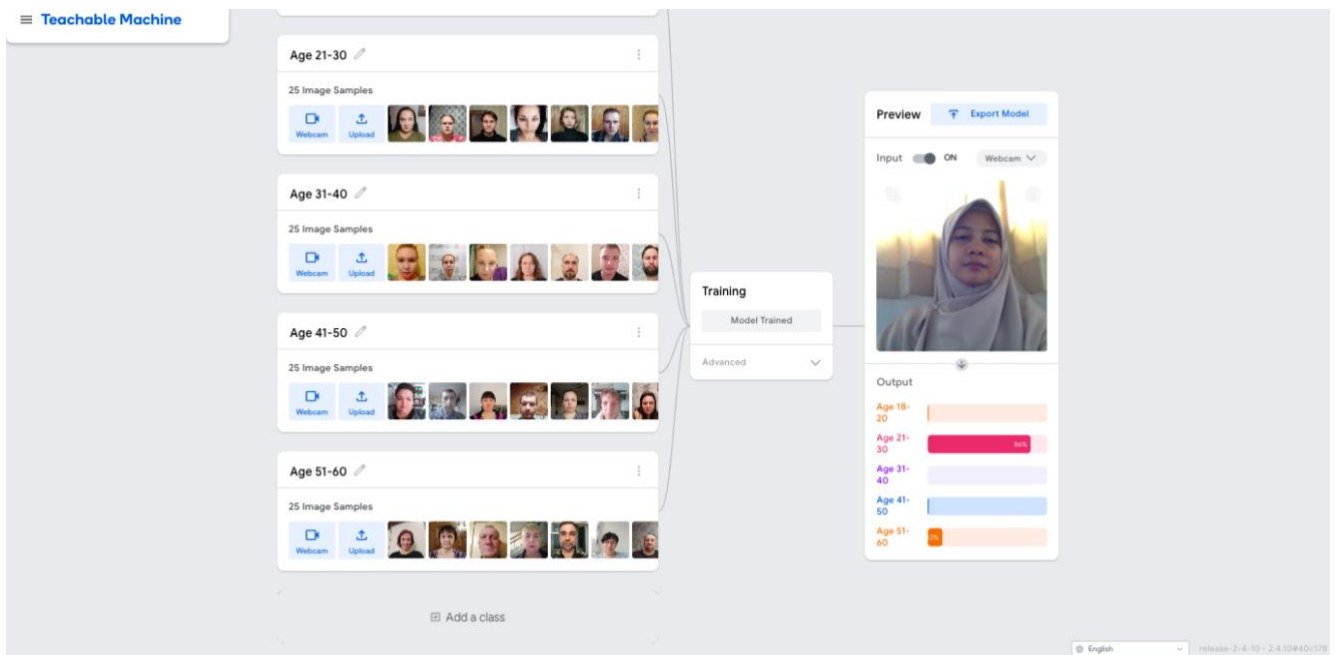


Fig. 11: Data Reading Webcam class age 21- 30

In Figure 11, the image reading model for 86% of the 21-30 year age category, 12% of the 51-60 year age category, 1% of the 41-50 year age category and 1% of the 18-20 year age category with epoch parameter settings of 50x, batch size of 16, and learning rate of 0.001 produces accurate facial recognition with the actual age data class.

Testing was conducted using an AI teachable machine with facial recognition. Two different scenarios were tested: the first using training and testing image files, and the second using live webcam images. The following is a compilation of the test results, which can be seen in Table 1. Compilation Performance Test Specifications.

Table 1: Compilation Performance Test Specifications

Skenario	Testing Age	Epoch	Batch size	Learning rate	Accuracy	Output Age
Data Testing	Age 18-20	50	16	0,0001	89%	Age 18-20
Data Testing	Age 21-30	50	16	0,0001	47%	Age 31-40
Data Testing	Age 31-40	50	16	0,0001	54%	Age 31-40
Data Testing	Age 41-50	50	16	0,0001	88%	Age 31-40
Data Testing	Age 51-60	50	16	0,0001	66%	Age 51-60
Webcame	Age 21-30	65	16	0,0001	86%	Age 21-30

4. Conclusion

Testing was conducted using an AI teachable machine learning machine (AI) with facial recognition in two scenarios. The first scenario used training and testing image files, and the second used live webcam images, with the model's accuracy performance as a benchmark. The first scenario used five test images, covering the age categories 18-20, 21-30, 31-40, 41-50, and 51-60, with default parameters. Results showed the model was still inaccurate in reading images in experiment 2, covering the age category 21-30, and experiment 4, covering the age category 51-60.

The second scenario used live webcam testing images for the age category 21-30, with default parameter settings. The model read 86% of the images in the 21-30 age group, demonstrating accuracy in reading the test data. Based on the results of 2 scenarios carried out with Epochs 50x, batch size 16, learning rate 0.0001, it shows that the facial recognition results need to be improved again, namely by setting the parameters epochs 65x, batch size 16, and learning rate 0.01, so that these results show that the test requires parameter settings to get accurate facial recognition prediction results.

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