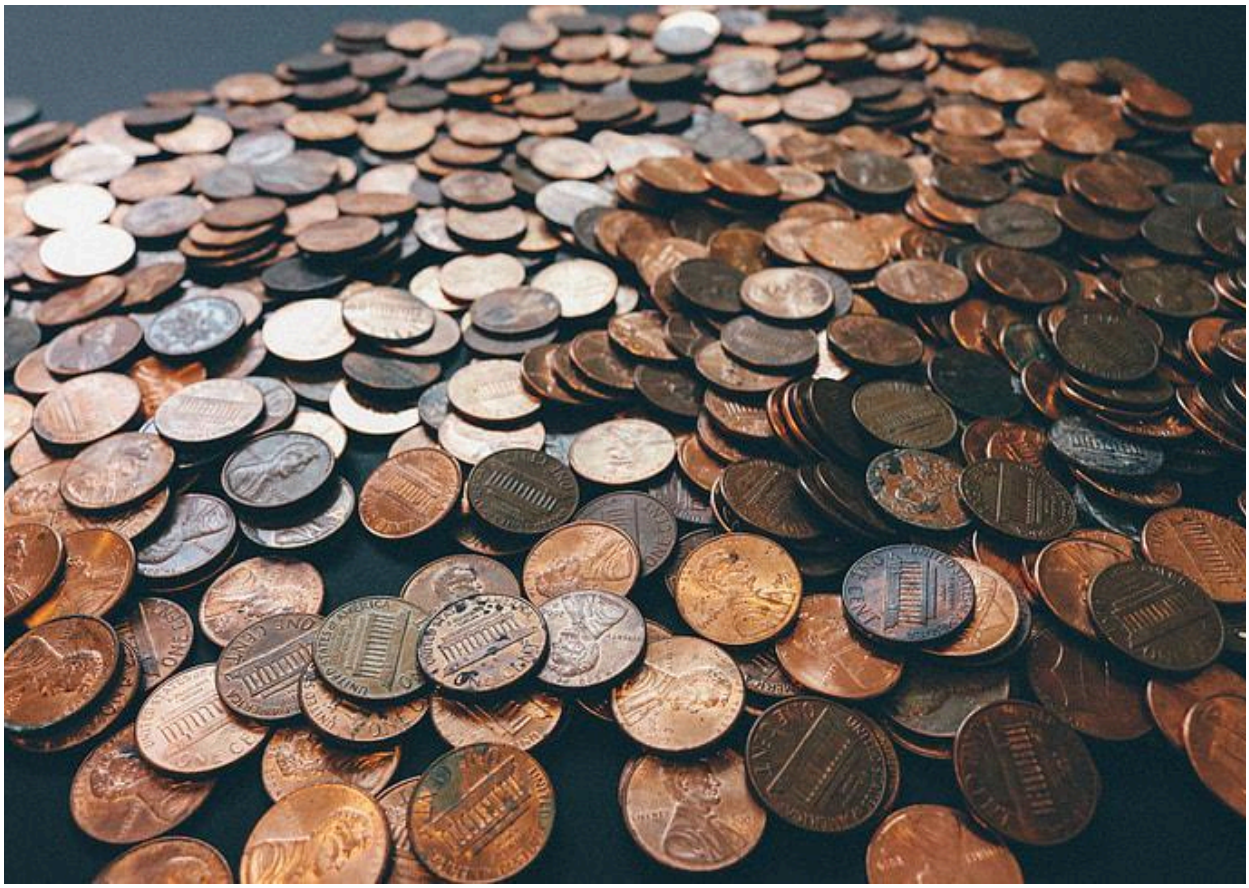
Philippine Peso Coin Detector and Counter

ITE 153 - Intro to AI and Expert Systems



Aminola , Baylon, Cañete, Jose, Tomindug

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PROJECT OVERVIEW

INTRODUCTION

In the expanding field of artificial intelligence (AI), the creation of accessible, real-world applications demonstrates the rapid growth and incorporation of AI technology into our daily lives. The project presented herein uses Google's Teachable Machine (GTM), an innovative tool aimed at promoting machine learning skills, to create a web application that functions as a coin detector and counter. This program focuses on detecting and counting Philippine Peso coins in denominations of 1, 5, 10, and 20 Pesos, as well as the 25 centavo coin. Using GTM-facilitated image recognition technology, this project aims to provide a practical solution for quickly identifying and summing the total value of a collection of coins, thereby simplifying financial transactions and educational purposes related to currency recognition and management.

The new series of Philippine peso coins are designed to be more identical to each other, which can be challenging for people with visual impairments to distinguish. An AI coin detection system can help these individuals by accurately identifying the value of coins through images or video samples, thereby enhancing their accessibility and convenience in daily transactions (Alon et al., 2021).

The significance of this project lies not only in its practical application but also in its educational value. It provides a realistic example of how machine learning algorithms may be taught and deployed to deal with specific, daily problems. The usage of Philippine Peso coins as the subject matter gives the project specific context, making it more relevant to users in the Philippines. Through this project, we aim to demonstrate Teachable Machine's potential for closing the gap between complex AI technologies and end-users, allowing individuals without significant technical understanding in AI to develop powerful, machine learning-based apps. This documentation will go over the whole development process, from concept to implementation, showcasing the creative approach and technology utilized to create an AI-powered tool that improves human connection with the digital world.

RATIONALE

The rationale behind developing a Philippine coin detection AI lies in its potential to improve efficiency, accuracy, accessibility, security, and innovation in various financial applications. In addition, It aims to solve the issue of time efficiency in coin counting by

utilizing camera sensors while maintaining high accuracy. Moreover, a key use case in the industry involves integrating coin detection AI into self-service kiosks or vending machines.

DATA COLLECTION AND PREPARATION

DATASET COLLECTION

The dataset used for the AI coin detection system, specifically for the Philippine peso, consists of legal tender coins that are accepted as payment for goods and services. This dataset is composed of close-up photos of the coins, taken by the group, and includes both the front and back faces of each coin.

The use of close-up photos is particularly important as it allows for detailed analysis of the coin's features, which are crucial for accurate detection and classification. This method is supported by research and development in the field of computer vision, where object detection models have been successfully applied to identify and track various coin types in real-time, even under challenging lighting conditions and diverse orientations (*Detect & Classify Coins Using Computer Vision*, 2023)

The inclusion of both front and back faces of the coins in the dataset is a strategic decision that addresses a common challenge in coin detection systems. By training the model on images of both sides of the coins, the system can better recognize and classify coins regardless of their orientation. This is a critical aspect of the coin detection process, as coins can be presented in various orientations during transactions.

Right below are the classification of the coins used as dataset:

1. 25-Cents Coin Photos
2. 1-Peso Coin Photos
3. 5-Peso Coin Photos
4. 10-Peso Coin Photos
5. 20-Peso Coin Photos

TRAINING AND TESTING

The training set was composed of coins numbering at least a 100 of samples as long as it is possible for the group to collect. Moreover, the number of sample data is still varying due to the lack of resources. Nevertheless, it is made sure that the training set coin samples were not used in the testing set, the testing set was made sure to be composed of

coins that are not in the testing set or were taken in a different angle or lighting. Lastly, after the testing, the testing set is also added to the training set.

MODEL DEVELOPMENT

ARCHITECTURE AND SETUP

The setup used for training Teachable Model was the default setup of teachable model. The classes in the image model were 10 and will be discussed in Table 1. Model Classes. In addition, the setup will be displayed in Table 2. Model Setup.

Table 1. MODEL CLASSES

Class Name	Value
1 PESO - Front	1
1 PESO - Back	1
5 PESO - Front	5
5 PESO - Back	5
10 PESO - Front	10
10 PESO - Back	10
20 PESO - Front	20
20 PESO - Back	20
25 CENTS - Front	0.25
25 CENTS- Back	0.25

The setup for training for the model was default as tweaking the setup can be detrimental to the result of the model as small changes to numbers can impact the accuracy of the model. With that in mind, the group has decided to keep on default. In addition, By comparing the performance of more sophisticated models against the

default model, it becomes possible to assess whether the efforts are truly improving the predictive power or just adding unnecessary complexity (How, 2024).

Table 2. Model Setup

Options	Value
Epochs	80
Batch Size	16
Learning Rate	0.00102

TRAINING AND EVALUATION

TRAINING PROCESS AND CHALLENGES

The training process started after the collection of the 50 sample sets of each coin in the model classes. In addition, the testing lasts for 3 months and is still currently on-going. Amidst the testing, the group encountered challenges such as lack of resources for specific classes of coin such as the 20-Peso Coin, 10-Peso Coin and 25-centavos. In addition, there is a lot of sample data for 1-peso and 5-peso coin casting to split and adjust the sample data for these classes of coins.

Another challenge is the low accuracy in the detection rate, the model seems to detect almost every silver coin or if the lighting is bright to be a 1-Peso coin with a very high confidence level ranging from 90-100% of confidence value. In addition, the factors that seemed to affect the accuracy were the large amount of sample which was then splitted, the lighting of the image, and the AI seems to detect the silver-colored coins as 1-Peso Coin.

To address the challenges with low accuracy in detecting silver coins as 1-Peso coins, especially in bright lighting conditions, consider capturing close-up shots of the coins with a clear background. This approach can help the model focus on the specific features of each coin, potentially improving its ability to differentiate between different types of coins. Additionally, ensure that the lighting conditions are consistent across all images to reduce the impact of lighting on the model's performance.

EVALUATION

For testing the model, we used past data of the first model test to compare to the current model testing but only by remembering what were the challenges and problems. If the problem is solved it will be checked. Nevertheless, this causes confusion in the long term and the group has decided to use test plans to record the results which are displayed in Appendix A, Test Plans.

In these test plans, the group used sample data and counted how many the model can detect correctly with a confidence level of at least 60 or 70%. If the model couldn't reach 60%, it will be counted as a failure. In addition, the confidence level and also the decision if pass or fail is included in Appendix A. Test Plans.

The group didn't use any baseline or benchmark model from the internet but nonetheless used the previous model as the benchmark model for improving the current performance of the model.

DEPLOYMENT AND USE CASES

REAL WORLD DEPLOYMENT

The "Philippine Peso Coin Detector and Counter" AI application has a potential for creation into a variety of real-world settings to improve currency handling operations. For example, banks and financial organizations can use this technology in their branches or self-service coin counting devices to improve customer experience and ensure precise and efficient coin processing during deposits. Furthermore, in vending machines, the detector and counter can prevent fraud and assure correct crediting by properly counting and confirming coins, which benefits both operators and users by making transactions more convenient (Steinberg et al., 2021).

Furthermore, the incorporation of this technology can help government agencies, nonprofit organizations, and large retailers enhance their cash management procedures, saving time, lowering expenses, and improving overall operational efficiency. Overall, the use of the "Philippine Peso Coin Detector and Counter" AI application in these real-world scenarios has the potential to transform coin handling procedures, providing benefits in terms of speed, accuracy, and cost-effectiveness (Humanness in the Age of AI, 2023).

POTENTIAL USE CASE OR APPLICATION FOR THE DEVELOPED AI APPLICATION

The development of an AI-powered Philippine peso coin detection and counter marks an important advancement in automated financial instruments. This program uses machine learning technology to reliably detect and count coins in various denominations, including 1, 5, 10, and 20 pesos, as well as 25 centavos. Such skills may be used across numerous industries to improve efficiency, accuracy, and ease in financial transactions and management.

Retail and Consumer Services

The incorporation of an AI-based coin detector in retail environments, particularly in high-volume settings such as supermarkets, convenience shops, and vending machines, can help to simplify the cash transaction processing. It can cut down on the amount of time customers spend at checkout counters while also improving cash handling accuracy by reducing human mistakes in issuing change and counting daily receipts.

This technology leverages artificial intelligence and computer vision to automate the checkout process, eliminating the need for traditional cashiers and providing a seamless shopping experience for customers. Moreover, AI vision checkout technology can automatically detect items through visual recognition, calculate the total cost, and process payments without manual scanning or waiting in line, thereby reducing wait times and improving overall efficiency (admin, 2024).

Banking and Financial Institutions

Banks and other financial organizations can use this technology to increase the efficiency of coin counting services they provide to consumers. This is especially useful in branches where firms or individuals make frequent coin deposits. The AI program guarantees that coins are counted quickly and precisely, which improves customer service and operational efficiency.

Moreover, AI in banking has been revolutionary, automating processes, improving customer experience, mitigating risks, boosting efficiency, and transforming overall operations (*AI's Role in Banking: Benefits and Risks*, 2023). In addition, The operational efficiency gained through AI is crucial, as it allows for the automation of routine tasks such as data entry, account reconciliation, and document processing, leading to cost savings and greater operational efficiency

Charitable Organizations

Charitable groups that collect coins can use this AI application to better efficiently count and categorize donations. By automating the counting process, these organizations may devote more resources to their main goal and activities, increasing the impact of the contributions they receive.

Furthermore, the AI-powered Philippine peso coin detector and counter has a wide range of applications that can help industries with a high volume of coin transactions. By implementing this technology, businesses may increase operational efficiency, financial transaction accuracy, and customer happiness. As we continue to embrace digital advancements in numerous aspects of business and society, tools like this AI application highlight the power of innovative technology to improve everyday operations and services (Dorota Jasińska, 2024).

ETHICAL & SOCIETAL IMPLICATION

It's important to understand the implications of artificial intelligence in terms of ethics and society at large, in addition to its application in innovations pertaining to daily life. Accuracy and reliability, security threats, employment displacement, and a decrease in errors and frauds.

Reliability and Accuracy

Regarding the accuracy and reliability of the AI model as it is being developed, there is a chance that improper training, inaccurate datasets, or poorly calibrated datasets could lead to unreliable results, causing errors in coin detection that could impact user trust and result in financial losses. Additionally, security risks associated with manipulable dataset collection, such as identifying false or mimicked coins as legitimate, pose threats of financial losses or security breaches.

In an article by Baker (2023), he stated that “The development and deployment of AI models, including those for coin detection, face significant challenges related to accuracy, reliability, and security. Improper training, inaccurate datasets, or poorly calibrated datasets can lead to unreliable results, potentially causing errors in coin detection that could impact user trust and result in financial losses.”

Job Displacement

One additional aspect to take into account regarding the possible ethical and societal implications is the possibility of job displacement. Specifically, the automation of coin detection tasks via AI technology may result in the loss of employment for those involved in manual coin counting and sorting, which could potentially worsen inequality in society.

Moreover, the adoption of AI in various sectors, including hiring, presents both challenges and opportunities. While AI can increase efficiency and reduce costs associated with HR, it also poses the risk of job displacement. This is particularly relevant in the context of coin detection, where automation could lead to the loss of jobs in manual coin counting and sorting. The transition to AI-driven systems could require workers to acquire new skills or adapt to different roles, potentially worsening inequality if not managed carefully (The White House, 2022).

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