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| RESEARCH ARTICLE

Detection of Product Cost for Blind People Based on Android Application

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| ABSTRACT
Blindness refers to a condition in which a person suffers from disturbance or interruption in the sense of vision. Blind individuals are generally classified into two major groups: complete blindness and visual impairment. There have been numerous initiatives and aids developed to support individuals with disabilities, including those with vision impairments. One such aid that could be implemented is an application designed to make shopping easier for the blind. It is widely acknowledged that individuals with disabilities often require assistance from others, and the development of assistive technologies presents an opportunity for blind individuals to become more self-sufficient. The primary objective of this research is to develop an Android application called “See in Me” that can aid blind individuals in shopping more easily, particularly in Bangladesh, where such facilities are currently unavailable. The “See in Me” application will listen to the user's voice instructions, after which the camera within the app will be activated. The user is able to scan any packaged product, which will be recognized by the Android application. The app will provide the user with information such as the product's name and price via voice mode. If the user wants to buy the scanned product, they can add it to the cart by shaking the phone or using the “OK” voice instruction. This process allows users to add more products to their cart. After completing the purchase, the user can use the “OK” instruction to see the total price and list of products added to the cart and can invoke the “Delete” instruction to remove the product from the cart. To ensure that the “See in Me” application is effective, it is crucial to develop accurate and reliable voice recognition technology that can interpret the user's voice instructions without errors. The application should also have a user-friendly interface with clear instructions and feedback to guide the user through the shopping process. It is also important to ensure that the application is compatible with different devices and operating systems, making it accessible to a larger number of users. Testing the application with a diverse group of users, including individuals with varying degrees of visual impairment, can help to identify any usability issues and ensure that the application meets the needs of its target audience.

| KEYWORDS
Blindness, Assistive technology, Voice recognition, Android application, Visual impairment, Shopping accessibility

| ARTICLE INFORMATION
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1. Introduction
Advances in technology have made smartphones one of the most widely used devices. They have become our daily necessities. We need to call or write someone anytime, anywhere. The problem is more obvious to blind people. "See in Me" is an Android app that supports voice instructions, voice, and touch feedback. This app is designed for blind people. It helps visually impaired people to shop easily without relying on others. A voice instruction opens the app, and the camera detects the object and voices the actual product and price to the user. This application can be easily accessed from anywhere with your mobile phone.

2. Literature Review
A camera-based system helps visually impaired individuals read product information through barcodes in stores, enabling them to make informed purchases. The system uses a camera to recognize barcodes, retrieves object details through ECLIPSETM

software and converts the information into speech using text-to-speech technology. It is cost-effective, easily deployable, and does not require store modifications, as explained in [Hilal et al. 2019]. In [Neelaveni et al. 2022], The on-demand service system connects service providers and users, utilizing service-oriented architecture and location-based services, providing job opportunities and efficient service utilization for both parties, accessible through web and mobile interfaces. The study surveys the design aspects of travel aids, addresses the relationship between wearability and device features, and identifies limitations, gaps in provision, and future research directions. A visually impaired person can identify and distinguish banknotes using an Android-based money detection app called Eyessential, which utilizes image processing techniques and a Convolutional Neural Network algorithm for accurate recognition with high accuracy and efficiency, as discussed in [Vivien et al. 2022]. Real-time banknote detection and recognition is very important for people with visual impairments, which shows how important this technology is for accessibility requirements [Sree et al. 2022]. Recent advances in navigation and navigation technology have improved accessibility by allowing blind people to identify and match scanned items to predefined lists, such as banknotes, provides audio feedback for angles and distances to people, bottles, and detected objects. The camera is explained in [Reddy et al. 2022]. Blind Assist is a voice-based mobile application designed to help visually impaired and elderly individuals overcome daily challenges and perform essential tasks using features like SMS reading, email sending, text scanning, currency recognition, and diary maintenance discussed in [Shreya et al. 2021]. Aid people who are blind or visually impaired using a smartphone application that uses artificial intelligence, machine learning, image recognition, and text recognition to let them communicate with the outside world on their own and make use of technology explained in [Abhishek et al. 2022]. In [Gagandeep et al. 2020], An Android Application leveraging computer science, voice recognition, and image recognition assists visually impaired individuals to interact with their environment using their smartphone. The latest assistive technologies for the visually impaired, with a focus on computer vision, automotive systems and mobile platforms, can generate sound and vibration signals to detect obstacles in home and outdoor environments and incorporate them into daily life. Providing function keys for future leaders and helping researchers develop walking aids for blind people discussed in [Milon et al. 2019].

3. Similar Works

There exist several applications worldwide that share similar features with “See in Me”, such as utilizing a camera to identify objects for visually impaired individuals. Some examples of comparable applications include Be My Eyes, Seeing AI, and TapTapSee. However, there are no any other apps like “See in Me” currently available in Bangladesh.

3.1 Exploring Contrasts

Typically, an application is developed to achieve a specific goal. Below are some comparable applications, such as “See in Me”, that shown in table 1:

TABLE 1: EXPLORING CONTRASTS ANALYSIS

Name	Their Working Procedures	Our Working Procedures
Be My Eyes	The service enables visually impaired individuals to connect with volunteers via live video conference, providing them with visual assistance.	See in Me is a product identification apps that utilizes the camera to recognize items and provide users with their corresponding names and prices.
Seeing AI	The ability to read text, distinguish between different products, recognize familiar faces, identify different types of currency, etc.	Identify products.
TapTapSee	Identify objects.	Detect products, add them to the cart and calculate price.

4. Requirement Analysis And Modeling

Our process involves gathering images, refining them, training a model, and exporting it as TensorFlow Lite for use in an Android application. When the user opens the app and points the camera at a targeted object, the app takes the input and tries to match it to the trained model specified in the app. If the app finds a match with greater than 90% accuracy, it responds with a voice prompt. A block diagram of requirements analysis is shown in Fig. 1.

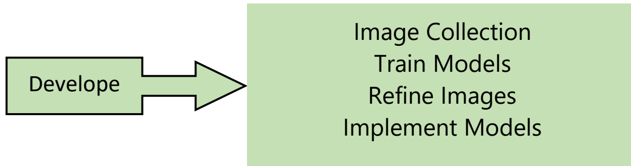

Fig. 1 Requirement Analysis

The basic communication structure of the "See in Me" application using an internal process model to describe the application's workflow, as shown in Fig. 2.

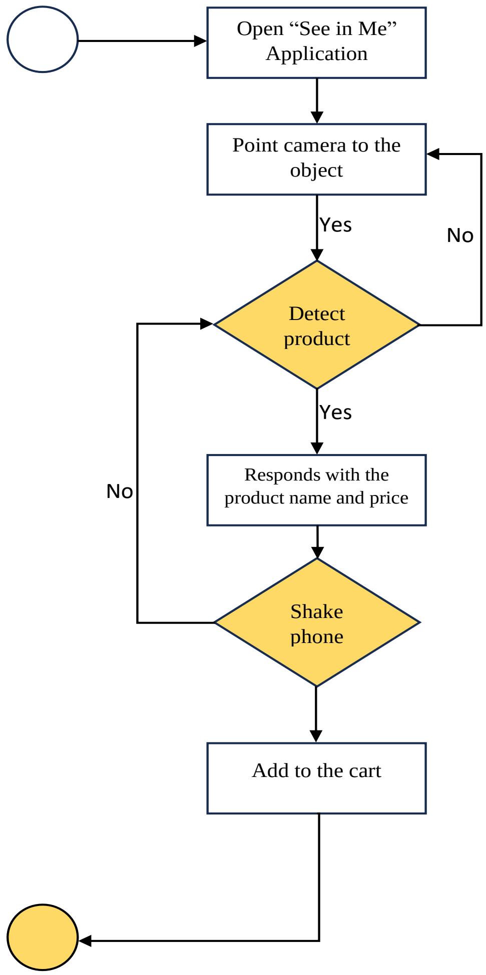

Fig. 2 Internal Processes Modeling

5. Training Model Process

The TensorFlow Lite Model Maker package speeds up the process of modifying and tuning TensorFlow neural network models for machine learning applications on devices with specific data sets. as Fig. 3. logical data model.

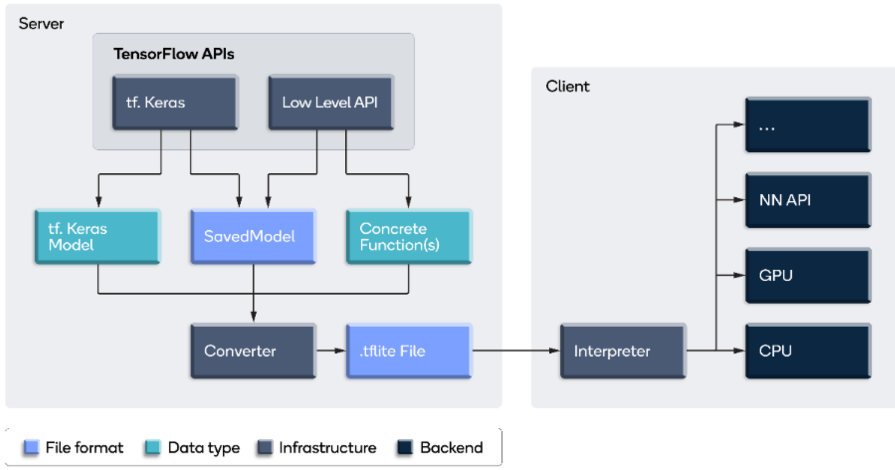

Fig. 3 Training Model Process

6. Model Design

To conduct our testing, we carefully chose five specific items: Pepsodent, Pespodent Tooth Powder, Lux, Vim & Harpic. To ensure the best possible accuracy, we captured numerous photos of each item from various angles, ultimately selecting between 130-200 images per product. Subsequently, we refined these images and utilized TensorFlow to train our model. We then exported the model as TensorFlow Lite, using a Quantized conversion type. As a result, we were able to obtain both the model file and the class names text file with great success. Here we attached some Fig. s that shows including model training, model exporting and class leveling as well as Fig. 4, Fig. 5 and Fig. 6 are given below.

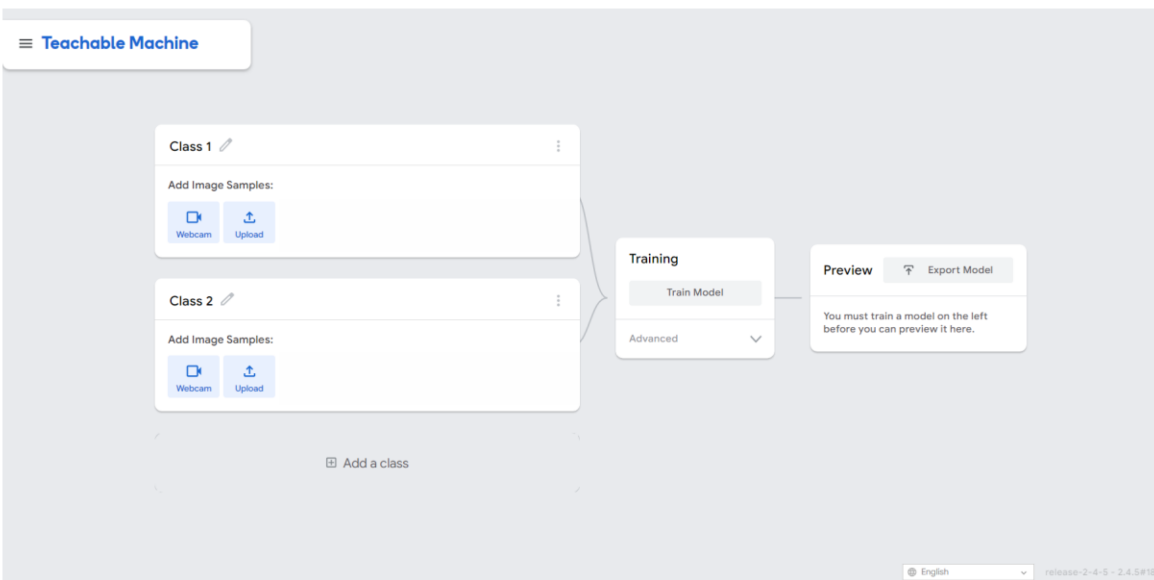

Fig. 4 Model Training

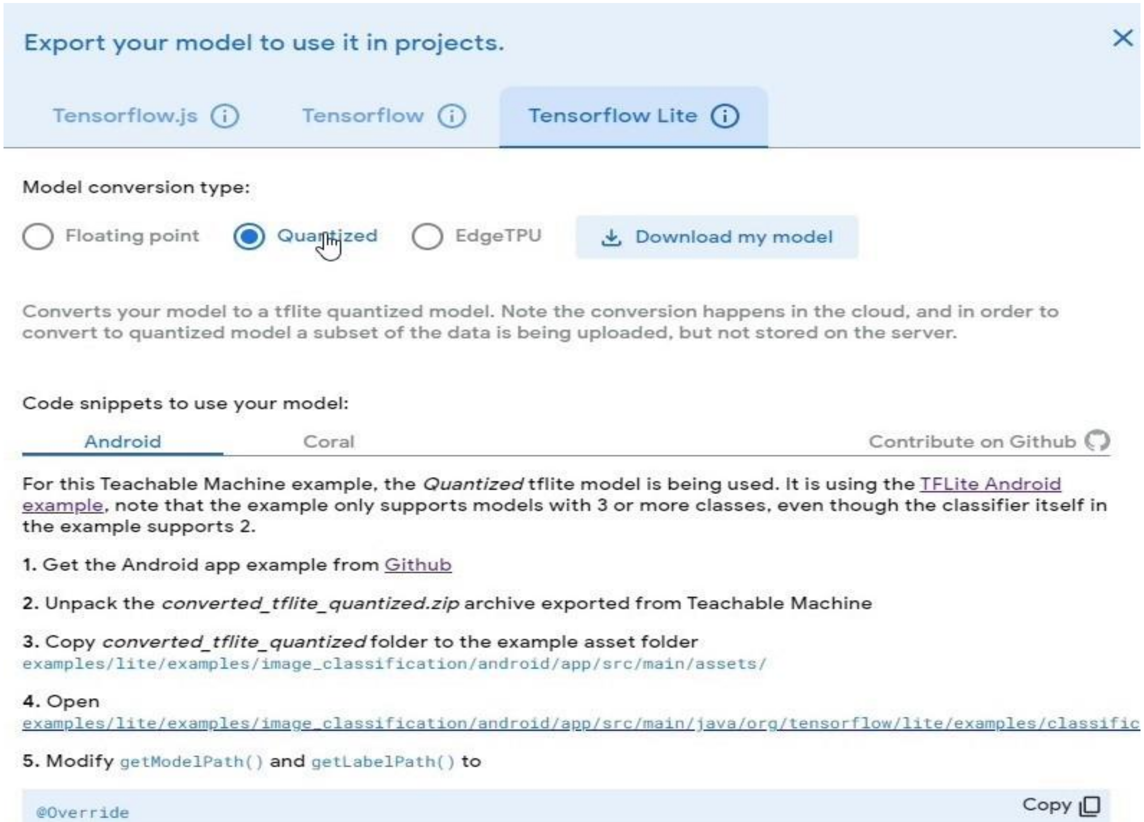

Fig. 5 Model Exporting

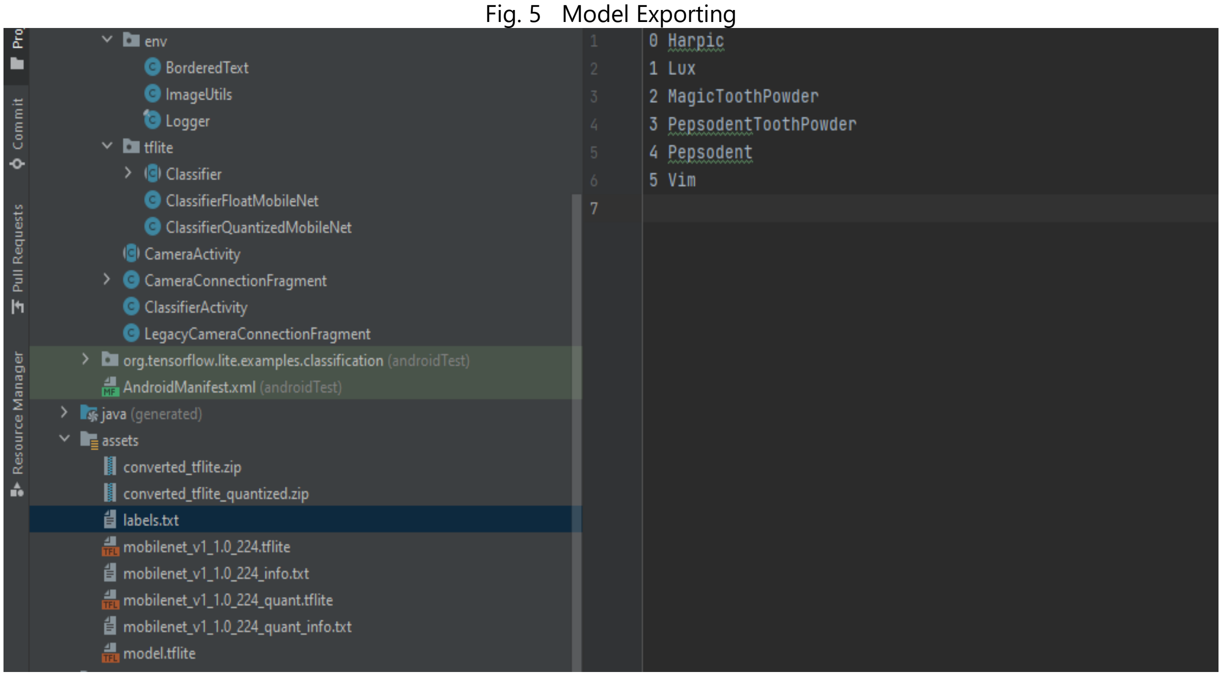

Fig. 6 Class Label

7. Deployment Process of Trained Model

The creation and use of the model serve as the fundamental building blocks of ML-based software applications. To get the requisite models and classes for this project, we used a quantized TensorFlow Lite model, which we exported as TensorFlow Lite. We created the project using Android Studio and added XML files, Java classes and dependencies during development. We have also provided a text file and a model trained with the TensorFlow Lite file extension. We used the TensorFlow Lite package to bring TensorFlow

Lite into our Android app. To collect and compare photos with trained models, we used image acquisition, which is an Android multimedia action, and an outward-facing lens**.**

8. Testing Implementation of Selected Products

Testing the implementation of selected products is a crucial step to ensure their quality and functionality. By thoroughly testing the implementation, we can identify and address any bugs, errors, or performance issues that may arise. It helps in validating that the products meet the desired specifications and requirements. In this section, we are discussing five selected products testing and their implementation. If the application identifies the targeted product through the camera (95% match according to the trained model), the application audibly announces its recognition, providing information on the product's name price, and displaying as well as captured screenshot given below in Fig. 7, Fig. 8, Fig. 9, Fig. 10 and Fig. 11.

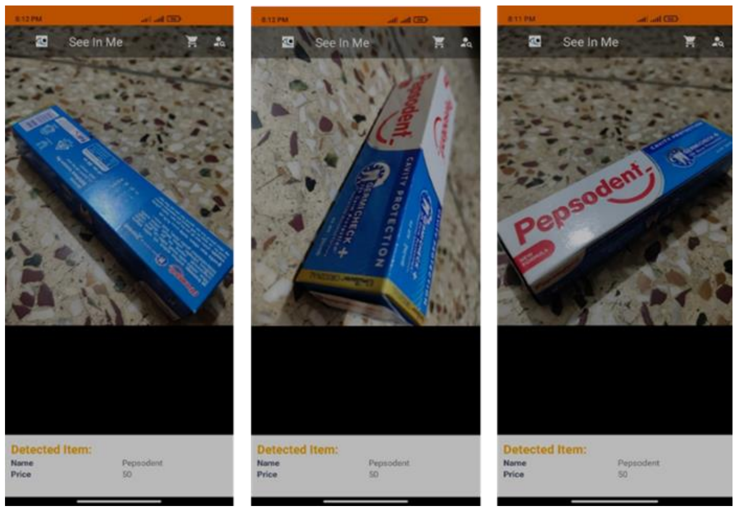

Fig. 7 Pepsodent recognition from several angles

Fig. 8 Pepsodent recognition from several angles

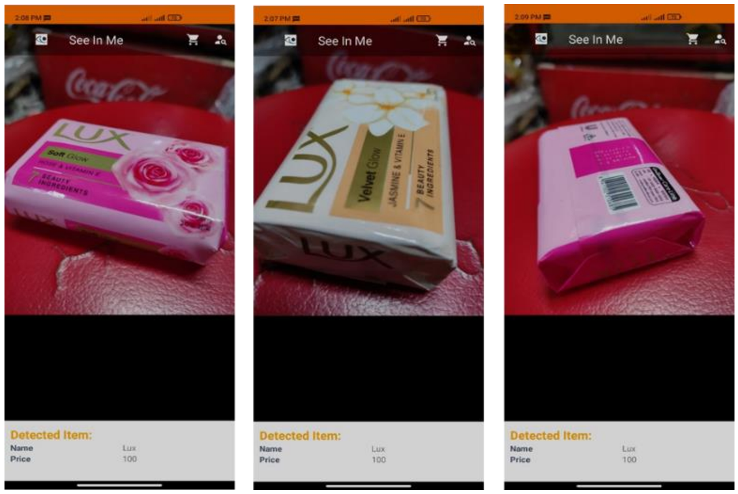

Fig. 9 Lux recognition from several angles

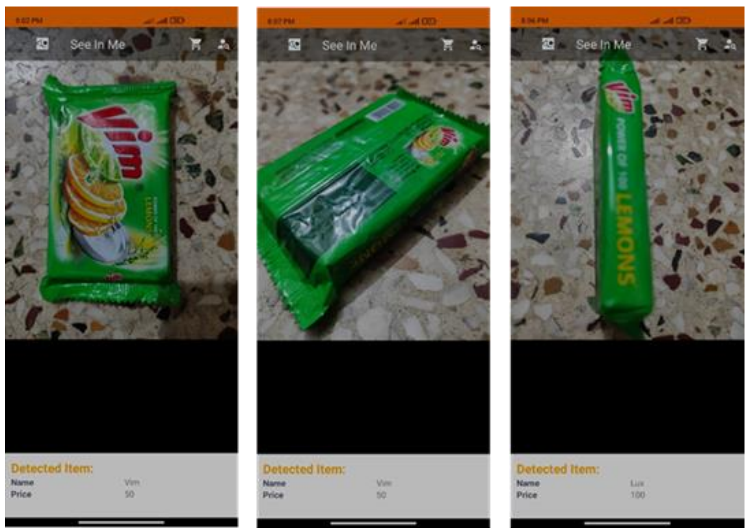

Fig. 10 Vim recognition from several angles

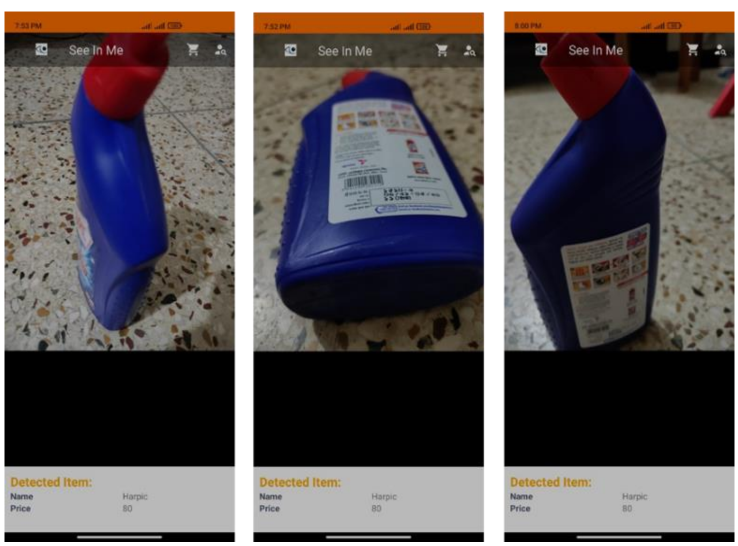

Fig. 11 Harpic recognition from several angles

9. Testing Implementation of Selected Products

In order to train the models, we collected a substantial number of images, meticulously refined them, and proceeded with the training process. The specific count of photos utilized for model training is detailed below in Table 2.

Table 2: Total Collected Data

Product Name	Collected Data
Pepsodent	214
Pepsodent Tooth Powder	184
Lux	192
Vim	189
Harpic	118

Ultimately, we assessed the effectiveness of our application by capturing various angles of products using the android application through the camera; then, we got the following outcome given in Table No. 2.

TABLE 3: TESTED ACCURACY

Product Name	Total Attempt	Positive	Negative	Accuracy
Pepsodent	15	15	0	100 %
Pepsodent Tooth Powder	14	14	0	100 %
Lux	24	22	2	94.72 %
Vim	15	14	1	97.9 %
Harpic	13	13	0	100 %
Total =	**81**	**78**	**3**	**98.524 %**

10. Result Analysis

In the evaluation phase, a total of 81 attempts were made to test the system's performance. Out of these attempts, an impressive 78 were classified as positive, while only 3 were identified as negative. As a result, the overall accuracy of the system reached an impressive 98.524 %. This high accuracy rate demonstrates the system's robustness and effectiveness in accurately classifying the given inputs. Here is a data chart table in Fig. 12 that is able to describe the summary of the result.

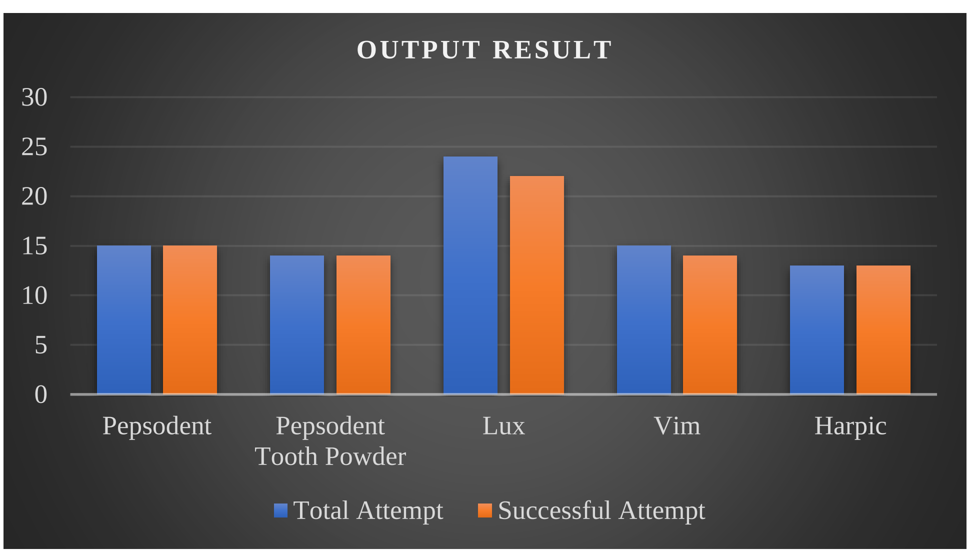

Fig. 12 Data chart table of the output result

11. Conclusion

The "See in Me" application has the potential to make a significant positive impact on the lives of visually impaired individuals. Our society often neglects and fails to provide adequate support for people with disabilities, but this project showcases the compassion and dedication of individuals who are committed to empowering those in need. By utilizing a camera to detect objects and provide voice-based responses, including product names and prices, the application offers a revolutionary hands-free and eyes-free experience. This technology enables independent shopping, reducing the users' reliance on others and granting them a newfound level of convenience and empowerment.

The combination of compassionate individuals stepping forward to support people with disabilities and the impressive performance of the "See in Me" application demonstrates a bright future for enhancing the lives of visually impaired individuals. By leveraging technology and innovative solutions, we can bridge the gap in support and provide the necessary tools for independence and empowerment. This research-based project serves as a beacon of hope and a reminder of the positive impact we can make when we come together to address the needs of marginalized communities.

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