TecTags: An Automated Object Counting Mobile Application Using Object Detection Algorithms

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ABSTRACT
Traditional hardware stores rely heavily on manual labor and processes, which can result in inaccuracies and inefficiencies in [7][8] inventory management. This study presents TecTags: An Automated Object Counting Mobile Application Utilizing Object Detection Algorithms. The primary aim of the study is to develop and evaluate a mobile application that automates inventory tracking by detecting and counting objects from images captured through smartphones. This research helps in advancing mobile object detection applications and offers a streamlined solution for inventory management in construction-related business. TecTags utilizes advanced object detection techniques implemented in PyTorch, supplemented by [14] data augmentation through Roboflow, and was developed using Flutter to ensure cross-platform compatibility. The application was rigorously tested on Android devices, with evaluations conducted in accordance with ISO 25010 standards, focusing on functionality, usability, reliability, and efficiency. Results indicate that TecTags significantly enhances inventory accuracy and improves operational workflow compared to traditional manual methods. This study contributes to the literature by illustrating how mobile-based object detection can modernize inventory practices within the construction sector. TecTags provides hardware store managers with a powerful tool to minimize errors, optimize inventory processes, and ultimately improve overall business performance.

Keywords
PyTorch, Flutter, construction industry, object detection, mobile application

1. INTRODUCTION
As we move towards technology and digitalization, it is concerning to see construction companies using outdated systems such as complicated log sheets and spreadsheets to track inventories. An outdated inventory system can waste a significant amount of time and company physical resources that could affect the productivity of the hardware stores, particularly in the Construction Industry.

Technology has become a tool for productivity, particularly in the construction industry. Construction workers and staff can now check their data and lower their errors in the hardware stores. According to [5], over 90% of construction workers use cell phones daily for their tasks; mobile applications assist with every stage of a construction project, particularly back-office activities of hardware stores.

The use of mobile technology in the Philippines construction has improved project management and communication among industry professionals. A study presented at the IEOM Conference [6] Alviar et al., 2024 shows that mobile platforms play a crucial role in enhancing collaboration through live communication and social networks. The findings suggest that these digital tools are particularly valuable in ensuring efficient project delivery, especially during times of crisis, where seamless coordination is essential.

The researchers of our project, Tetags, want to enhance inventory management for construction companies in the Philippines by developing a counting and number-tagging application that uses object detection. The Tectags application makes the counting process of construction materials easier. Image data can be stored on the user's device and accessible by cloud storage. The system allows live updates, data synchronization, and inventory tracking.

2. SYSTEM ARCHITECTURE

We use the algorithm to detect images, classifying them by location, and labeling them automatically. This process involves using a camera to picture a certain item/living thing to be detected regardless of their numbers and angles. To do this process, you need lots of [17] images to be annotated and trained to be able to identify and tag how many are inside the images.

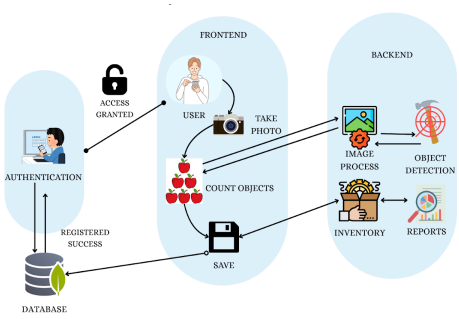

Figure 1. System Architecture

Figure 1 illustrates the overall system architecture of the TecTags mobile application, showcasing the flow of processes across the Authentication, Frontend, and Backend components.

Authentication - The system begins with a secure login process. Users must enter their credentials to access the application. If authenticated successfully, access is granted and the user can proceed. New users are stored in the **MongoDB database** upon successful registration.

Frontend (User Side) - Once logged in, the user can either take a photo using the device camera or select an existing image from the gallery. This image typically contains hardware items (e.g., nuts, bolts, screws) to be counted.

Counting and Saving - After an image is captured or chosen, it is sent for [9][10] object detection and processing. The system counts the objects in the image and allows the user to **save** the count and detection data locally or sync it with the backend.

Backend (Processing and Storage) - The backend handles the core functionalities:

- **Image Processing**: The image is analyzed and passed through the trained object detection model (e.g., PyTorch model) to identify and count objects.
- **Object Detection**: The model detects and classifies individual hardware items in the image.
- **Inventory Management**: The counted objects are added to the inventory database.
- **Reports Generation**: The system stores and visualizes data such as item counts and detection history, providing actionable insights for warehouse staff.

Database Integration - All user credentials, detection results, inventory data, and reports are stored and retrieved from a **MongoDB database**, ensuring data persistence and synchronization between the frontend and backend.

3. METHODOLOGY

The study used the Agile Methodology in developing the application which consists of four major phases:

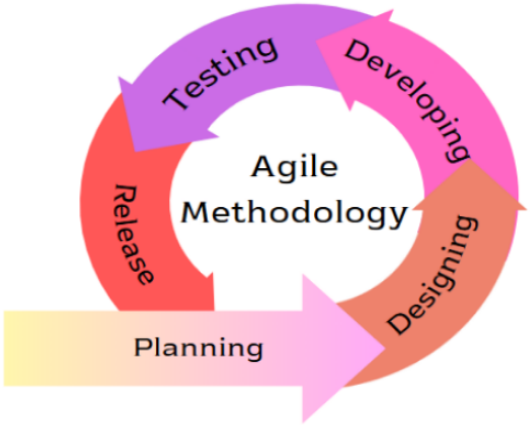

Figure 2. Agile Methodology

3.1 Planning Phase

In this phase, the problems, potential solutions, aims, relevance, target user, features, and application functioning were discussed. It is where the developers decide the software's foundations. It informs the development team of accomplishments and the project's final destination.

3.2 Design Phase

In this phase, Figma and Visual Studio Code were used to create the UI design of the application, which should be readable, adequate, and user-friendly. It is where the developers begin designing the software and systems throughout the design phase to meet each requirement. The architectural design defines all of the development's components, as well as communications with third-party services, user flows, database communications, and front-end representations and behavior of each component.

3.3 Development Phase

In this phase, we implemented the application's features and functionalities based on the specifications outlined during the requirements gathering stage. The development focused on integrating the [11][13] object detection model into the mobile environment to support real-time object detection and number tagging. To achieve this, we will utilize [1][2] PyTorch to enable on-device machine learning capabilities. PyTorch will be used specifically for object detection and computer vision tasks, allowing the application to process images efficiently on mobile devices. This integration ensures fast, reliable performance without relying on external APIs, which is crucial for offline functionality and responsiveness.

3.4 Testing Phase

The team tested the system's functionality and performance during this phase.

4. RESULTS AND DISCUSSIONS

In this chapter, the study's results are discussed based on data collected and analyzed. This study aimed to develop TecTags, a mobile application that automates object counting using object detection algorithms. The evaluation focused on accuracy, processing speed, and usability in hardware industry applications.

4.1 Application of Object Detection

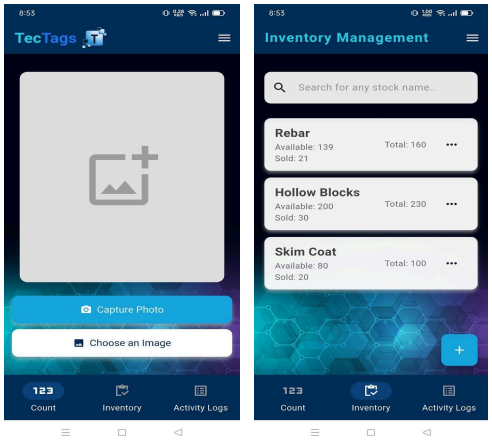

Figure 3: Main Screen and Inventory Screen

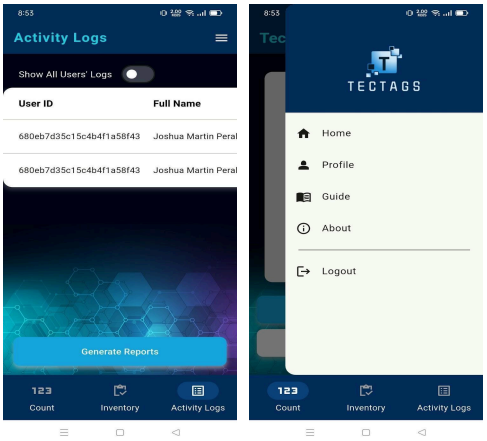

Figure 4: Activity Logs Screen and Sidebar Menu

5. PROJECT EVALUATION RESULTS

The study will be evaluated based on ISO 25010, a standard for software quality assessment. This standard makes sure that the software meets quality attributes. The results found that IT professionals evaluated TecTags online via Google Forms, focusing on its functionality, efficiency, object detection, counting, tagging, and device compatibility, while CGG Marketing staff used paper questionnaires to assess its usability, reliability, and impact on simplifying manual inventory counting.

Table 1. Frequency Distribution of Respondents

Respondents	No. of Respondents	Percentage
IT Professionals	5	10%
CCS Students	10	20%
Construction Professionals	10	20%
CGG Marketing Staff	25	50%
Total	50	100%

Table 2. Likert Scale

Score	Rating	Interpretation
6	5.51 – 6.00	Strongly Agree
5	4.51 – 5.50	Agree
4	3.51 – 4.50	Slightly Agree
3	2.51 – 3.50	Slightly Disagree
2	1.51 – 2.50	Disagree
1	1.00 – 1.50	Strongly Disagree

Statistical Treatment of Data will calculate the result and average of the responses collected via the evaluation form using the weighted mean formula:

Weighted Mean = $T(R6\times6)+(R5\times5)+(R4\times4)+(R3\times3)+(R2\times2)+(R1\times1)$

Where:

R6 to R1 = Number of respondents selecting ratings from 6 (highest) to 1 (lowest)

T = Total number of respondents

Table 3. Summary of Evaluation Results

Respondents	Standards	Results	Interpretation
CGG Marketing Staff	Functionality	5.6	Strongly Agree
	Usability	5.4	Strongly Agree
	Reliability	5.5	Strongly Agree
	Efficiency	5.3	Strongly Agree
	Average	5.45	Strongly Agree
IT Professionals	Functionality	4.2	Agree
	Usability	4.5	Agree
	Reliability	4.6	Agree
	Efficiency	4.4	Agree
	Average	4.43	Agree
Construction Professionals	Functionality	5.1	Strongly Agree
	Usability	5	Strongly Agree
	Reliability	4.8	Agree
	Efficiency	5.2	Strongly Agree
	Average	5.03	Strongly Agree
CCS Students	Functionality	4.3	Agree
	Usability	4	Agree
	Reliability	4.4	Agree
	Efficiency	4.1	Agree
	Average	4.2	Agree

Table 3 shows the evaluation results were derived from the feedback of four respondent groups: CGG Marketing Staff, IT Professionals, Construction Professionals, and CCS Students. Each group rated the TecTags mobile application based on the ISO/IEC 25010 software quality

characteristics: Functionality, Usability, Reliability, and Efficiency, using a 6-point Likert scale.

6. SUMMARY, CONCLUSION. AND RECOMMENDATION

6.1 SUMMARY

The study developed TecTags, a mobile app for automated object counting and inventory management in the [16] hardware industry. Using [3][4] PyTorch-based object detection, the app allows users to capture images of materials and automatically generate accurate inventory records, reducing errors and improving efficiency. Key development steps included image preprocessing, data augmentation, and [12] model training to ensure high accuracy. TecTags features a user-friendly interface and cloud storage for easy data access. Evaluation showed strong performance in functionality, reliability, and usability, with positive user feedback. The app offers a scalable solution for construction firms and meets international software quality standards. Future improvements may include cross-platform support, enhanced recognition, and real-time collaboration.

6.2 CONCLUSION

The study successfully developed TecTags, an Android app that automates object counting and number tagging from images for the construction industry. Using advanced object detection algorithms, it streamlines inventory management by reducing manual errors and improving efficiency. The app met key objectives, including ISO 25010-based evaluation, confirming high standards in functionality, usability, reliability, and efficiency. Feedback from 50 users including IT professionals, students, and construction staff was largely positive, especially from non-technical users. TecTags features mobile accessibility and cloud storage, with future potential for cross-platform support, improved recognition, and real-time collaboration. It showcases how AI can modernize and optimize inventory processes in construction and beyond.

6.3 RECOMMENDATION

Future researchers can use this study as a foundation for developing AI-powered mobile apps for object detection and inventory management across various industries. [15] Recommended areas for further research include improving object detection accuracy with diverse datasets, optimizing performance for different mobile devices, and expanding features such as cross-platform support, real-time collaboration, and cloud-based data sharing. These enhancements can strengthen the impact and scalability of AI-driven inventory solutions.

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