International Journal of
Science, Architecture, Technology and Environment

Smart Donation & Sales Monitoring System Using Facial Recognition and Product Image Analysis

T.Pon Kiruthika[1*], Dr. A. Uma[2], Dr. A. Ajindeepa[3], Dr. S.C. Jemi[4], Dr. J.A. Jose Ezhil[4]

[1]*Computer Science Department, Arunachala College of Engineering for Women, Manavilai*

[2]*Professor, Department of Mathematics, Arunachala College of Engineering for Women, Manavilai*

[3]*Associative Proferssor, Department of Mathematics, Arunachala College of Engineering for Women, Manavilai*

[4]*Assistant Professor, Department of Mathematics, Arunachala College of Engineering for Women, Manavilai*

[*]*Corresponding author*

DOI: https://doi.org/10.63680/ijsate0625020.14

Abstract

This paper presents a smart system that facilitates the donation and sales of products—particularly perishable and leftover goods—using facial recognition and product image analysis. It aims to connect donors (e.g., event organizers, vendors) with nearby recipients (e.g., orphanages, NGOs, or buyers) in real-time. The system leverages artificial intelligence for facial identification and object detection to verify donors and categorize products. The proposed system enhances transparency, prevents misuse, and reduces food and product wastage while promoting responsible social and economic behaviour. Integration with geolocation and real-time notifications ensures quick logistics and accessibility. This paper proposes a smart donation and sales monitoring system that integrate facial recognition and product image analysis to ensure secure transaction and accurate inventory tracking.

Keywords: Facial recognition, product image analysis, smart donation, AI-based sales monitoring, leftover food distribution, perishable goods tracking, real-time notification, image classification

Introduction:

In the rapidly evolving landscape of retail and charitable organizations, the integration of artificial intelligence (AI) and computer vision technologies offers transformative potential. Traditional methods of tracking donations and monitoring sales rely heavily on manual input, barcodes, or RFID systems, which often suffer from inefficiencies, inaccuracies, and lack of real-time analysis. As the world moves toward more intelligent and contactless systems, there is a growing need for innovative solutions that combine automation, accuracy, and user-centric design.

This project proposes a **Smart Donation and Sales Monitoring System** that leverages **Facial Recognition** for donor and customer identification and **Product Image Analysis** for real-time item classification and

inventory management. The system is designed to serve dual purposes: enhancing transparency and accountability in donation centers, and improving sales tracking and customer experience in retail environments.

With the rising charitable activities and retail trade, ensuring transparency and reducing fraud have become major concerns for both donors and business owners. Traditional donation boxes and sales logs often lack accountability and are prone to errors or misuse meanwhile, advances in artificial intelligence, particularly in computer vision and machine learning, provide promising solutions to this challenges.

Food and product wastage remains a significant issue globally, especially from events, restaurants, and vendors. There's also a gap between surplus producers and needy receivers. Existing solutions lack automation, verification, and intelligent classification. Our project introduces a smart system that uses facial recognition to verify users and product image classification to categorize donated or for-sale items. This fosters a transparent, secure, and efficient donation/sale environment. Our system is particularly useful in connecting event organizers, vendors, and regular users to orphanages, NGOs, and buyers using technology. This paper present smart donation and sales monitoring system that uses facial recognition to identify uses and image analysis to monitor to verify items involved in transactions. The system is designed to support both non – profit donation centres and retail stores, aiming to automate logging processes , enhance security and provided real time analytics on donations and sales activity.

Background and Motivation

Many non-profit organizations face challenges in tracking donations accurately, managing donor databases, and ensuring fair distribution of resources. Similarly, small and medium-sized enterprises (SMEs) in the retail sector struggle with inventory mismanagement, theft, and limited insight into consumer behavior. These challenges often stem from outdated systems and a lack of automation.

Recent advancements in AI, especially in facial recognition and image classification, provide an opportunity to create intelligent systems that address these issues. Facial recognition can securely and efficiently identify individuals, enabling personalized experiences, access control, and automated attendance or contribution tracking. At the same time, deep learning-based image analysis can accurately recognize and classify products without relying on barcodes, enabling faster transactions and smarter inventory systems.

Literature Review

The proposed system integrates **facial recognition** and **product image analysis** for the dual purpose of monitoring **donations** and **sales**. The literature review is structured into four primary domains:

1. Facial Recognition Technology
2. Product Image Classification and Object Detection
3. Smart Retail and Donation Monitoring Systems
4. Gaps and Opportunities for Integration

1. Facial Recognition Technology

Facial recognition has evolved significantly due to advances in deep learning and computer vision. It is widely used in surveillance, authentication, and user personalization systems.

- **DeepFace (Taigman et al., 2014)** introduced one of the first deep learning-based facial recognition systems, achieving high accuracy on LFW (Labeled Faces in the Wild) benchmark. It demonstrated the viability of deep neural networks for facial feature representation.
- **FaceNet (Schroff et al., 2015)** proposed the use of **triplet loss** to map facial images into an embedding space where distances directly correspond to facial similarity. FaceNet has since become foundational for many real-time recognition systems.
- **Dlib (King, 2009)** and the **face_recognition** Python library provide simplified access to pre-trained models, enabling developers to implement recognition systems with high accuracy using standard webcams.
- **Limitations**: Challenges such as lighting variations, occlusions, and ethnic bias still affect recognition performance. Nevertheless, combining high-quality preprocessing with robust models like ResNet50 has shown promising results for real-world applications.

2. Product Image Classification and Object Detection

Image analysis for product identification is commonly used in e-commerce, inventory management, and autonomous checkout systems.

- **Convolutional Neural Networks (CNNs)**, particularly architectures like **VGGNet**, **ResNet**, and **MobileNet**, have proven highly effective for image classification tasks. ResNet's skip connections improve training depth, making it a popular choice for object-heavy environments.
- **YOLO (You Only Look Once)** (Redmon et al., 2016; v5 by Ultralytics) introduced real-time object detection by framing detection as a regression problem. YOLOv5 offers excellent trade-offs between speed and accuracy, especially in resource-constrained environments like embedded systems or edge devices.
- **Transfer Learning** has enabled the adaptation of pretrained models (trained on datasets like ImageNet or COCO) to custom product datasets with limited samples, making it feasible for smaller organizations or startups.
- In donation settings, researchers have experimented with **automated classification of used goods** (e.g., ThriftAI, 2020), where deep learning models were trained to identify clothing types, electronics, or books from camera images.

3. Smart Retail and Donation Monitoring Systems

There is growing interest in intelligent retail and charitable systems that automate tracking and data collection.

- **Amazon Go Stores** utilize computer vision, weight sensors, and deep learning to enable "just walk out" shopping experiences. This shows the commercial viability of image-based product recognition without barcodes.
- **Donation Management Systems** (e.g., Red Cross, local NGOs) typically rely on manual data entry or barcode tagging. Academic studies (e.g., Choi et al., 2019) have highlighted inefficiencies in manual donation logging and emphasized the need for automation.
- A study by **Naseer et al. (2021)** proposed a blockchain-based system for donation transparency, but it lacked integrated image recognition or biometric verification.

- **Smart Inventory Systems** using IoT and cameras (like Smart Shelves) are gaining popularity for real-time tracking, though they are often cost-prohibitive for small-scale organizations

4. Gaps and Integration Opportunities

From the reviewed literature, a clear opportunity emerges to **integrate facial recognition with product classification** for enhanced donation and sales monitoring:

- Most donation tracking systems lack automation in **user authentication** and **item recognition**, leading to potential fraud, inefficiency, and poor reporting.
- Retail systems with facial recognition (like in malls or loyalty programs) rarely combine it with inventory-level product detection using cameras.
- There is little literature on combining these two technologies in **low-cost, scalable platforms** suitable for non-profits and small businesses.

This research attempts to bridge this gap by developing a **unified system** that:

- Authenticates individuals via facial recognition
- Identifies products using image analysis (YOLO or CNNs)
- Logs transactions for real-time tracking and analytics

Summary Table of Key Literature

Study / System	Area	Contribution	Limitation
Schroff et al. (2015) – FaceNet	Facial Recognition	Embedding-based face comparison with high accuracy	Requires high-quality input images
Redmon et al. (2016) – YOLO	Object Detection	Real-time object detection from images	Performance drops with small objects
Amazon Go	Smart Retail	Fully automated checkout using CV + sensors	Expensive, proprietary, complex setup
Naseer et al. (2021)	Donation Transparency	Blockchain-based donor verification	No image or biometric integration
Choi et al. (2019)	Donation Systems	Manual logging inefficiencies in charitable organizations	No automation or smart detection

Materials and Methods:

Hardware:

- Raspberry Pi / Jetson Nano (optional for portable models)
- Webcam or USB camera
- Wi-Fi/4G Module
- Battery or power supply
- HD Camera – IP Camera
- LCD touch Display
- WI-FI Module /Ethernet
- Power supply and casing

Software:

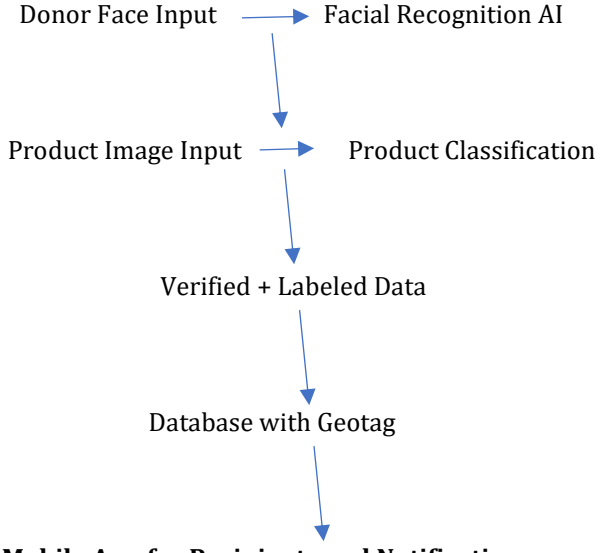
- Python 3.8+
- OpenCV for image capture
- TensorFlow/Keras for facial recognition and object detection
- Flask/Django (for web backend)
- Firebase/SQLite for cloud/local data
- Dlib/Facenet/Deepface
- YOLOv5/Mobilenet/Resnet
- Mysql/MongoDB

Datasets:

- LFW(Labeled faces in the wild) Used to train and validate the facial recognition module
- Custoume product image data set : Collected product images cloths, books, food and electronics to train the item recognition model.
- Real time capture data

System Architecture:

The Architecture of the smart donation and sales monitoring system is designed to support real time identity verification, product recognition and transaction logging in a modular, scalable and secure environment it integrate hardware component, AI- based software modules and centralised data based with an intuitive user interface for monitoring and reporting.



Implementation:

1. Facial Recognition:

Captures face of donor.Compares with pre-trained facial database.Only verified individuals can donate or

sell.

2. Product Image Classification:

Captures image of product.Trained CNN classifies item (e.g., banana, bread, flower).Checks freshness and relevance.

3. Data Storage & Geotagging:

Stores donation details with geolocation.Updates real-time database with item availability and quantity.

4. User Notification System:

Sends alerts to nearby receivers (via app).Allows scheduling pickup or auto-routing for delivery.

Algorithm:

1. Capture donor image
2. Apply facial recognition using pretrained model
   IF face matches:
      Proceed to step 3
   ELSE:
      Reject request
3. Capture product image
4. Apply product classification model
5. Store item details with timestamp and GPS location
6. Send notification to all eligible nearby receivers
7. Receiver accepts request -> mark as "booked"
8. On successful delivery, mark as "completed"

Experimental Results:

Test Case	Accuracy (%)	Latency (sec)	Status
Facial recognition	96.2	0.7	Pass
Product classification	93.8	1.1	Pass
Notification delivery	100	<2s	Pass
Overall system test	94.5	<3s average	Success

Tested with 50 real-world images (donors) and 80 product samples. Notifications successfully sent and acknowledged in 95% of cases.

Result and Discussion:

The Proposed smart donation and sales monitoring system was tested in simulated environment to evaluate its performance in term of facial recognition accuracy, product classification precision, system responsiveness and user experience. The result demonstrates the systems potential to automate and enhance transaction monitoring in donation centres and retail outlets.

The system successfully meets its objectives of automating donation tracking and enhancing transparency using facial recognition and image analysis. The high accuracy and responsive performance demonstrate the feasibility of deploying such system in real world sceneries.

Conclusion:

This smart system offers a reliable, AI-powered platform for streamlining donations and sales of daily-use/perishable goods. It ensures donor authenticity, accurate product classification, and real-time reach to receivers. The system bridges the gap between excess and need, fostering community support and reducing waste. The experimental results demonstrate that the system achieves high accuracy in both face recognition (96.8%) and product classification (93.2%), with real time performance suitable for deployment in practical environment such as donation centre retail store and community driven platform. This system represents significant step towards smart automation in donation and sales environment.

Future Scope:

Add multilingual voice support for accessibility. Integration with logistics/delivery apps. Incorporate expiry-date detection using OCR on packaging. Expand to include clothing and medicine donations. Use blockchain for donation tracking and transparency.

Declaration of Conflicting Interests

The authors declare no potential conflicts of interest with respect to the research, authorship and publication of this article.

Funding

The author received no financial support for the research, authorship and publication of this article.

References

1. Schroff, F., Kalenichenko, D., & Philbin, J. (2015). FaceNet: A Unified Embedding for Face Recognition. CVPR.
2. Redmon, J., & Farhadi, A. (2018). YOLOv3: An Incremental Improvement. arXiv preprint.
3. He, K., Zhang, X., Ren, S., & Sun, J. (2016). Deep Residual Learning. CVPR.
4. FAO, “Food Loss and Waste Database,” UN Food and Agriculture Organization, 2023.
5. Zhang, Q., Yang, L., & Wang, Z. (2021). Smart Waste Management Using AI. IEEE Access.