True Detect Smart Doorbell

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Introduction

TrueDetect is an ***IoT-based*** doorbell camera with embedded machine learning modules which can detect people and non-people alike. The system has facial recognition features allowing you to list the owners and residents of the house as known individuals.

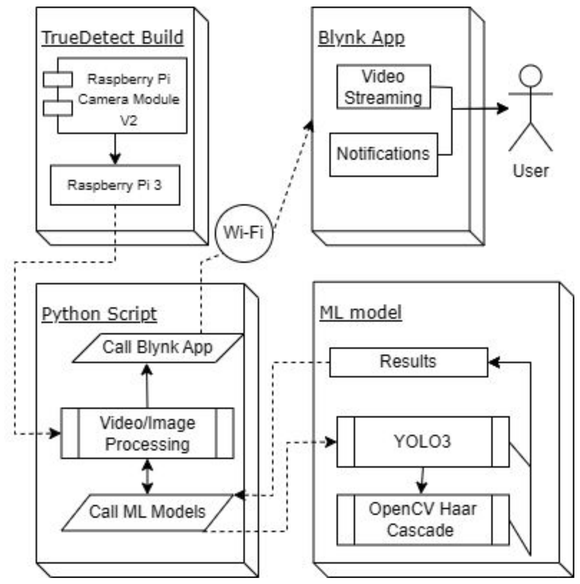
The system consists of ***Raspberry Pi 3*** as it's main functional hub, a ***Raspberry Pi Camera Module 2***, this is used because of ease of compatibility with built-in features. Finally the software of the system uses ***Python*** as the main coding language, ***YOLO3*** and ***OpenCV Haar Cascade*** as ML modules, and ***Blynk*** as the user interface to stream and send notifications.

The project website: Github
Full Report: Link to the final report on GitHub

The Objectives

1. **Smart Object Recognition** to eliminate false alarms as a result of basic motion detection.
2. **ML-based Facial recognition** Save known people and alert in case of unknown people.
3. **Sends notifications** to detect and alert in case people are at the door, especially if unknown.
4. **View live feed** streaming through the doorbell camera and viewed on the mobile application.

System Architecture



System architecture showing the communication between our different devices and modules

Key Aspects

Motion detections: Device functionality is based on motion detection, the recognitions and ML functionalities only work when motion is detected and this rate of update is in 5 second intervals

Facial recognition suppression: The user can suppress/whitelist known faces meaning the application won't notify when a familiar face is detected.

Performance Analysis/Results

1. **Object Recognition Accuracy:**
   TrueDetect uses YOLO3 for object detection, effectively distinguishing between people and non-people. While factors like lighting and background clutter can reduce accuracy, increasing image contrast in low light significantly improves performance. The system achieves 90% accuracy in various environments, based on multiple tests.
2. **Facial Recognition Accuracy:**
   Using OpenCV's Haar Cascade, identifying known individuals with about 85% accuracy. Recognition accuracy drops in angled light, or low-light scenarios but can be improved with better lighting around the camera.
3. **Streaming Latency and Quality:**
   Streaming latency is low, ranging from 200ms-800ms, with video quality up to 720p at 60 fps, ensuring smooth monitoring. However, the Raspberry Pi 3's hardware and network conditions may cause occasional buffering and reduced performance in poor network environments.
4. **Notification Timing:**
   Sends notifications within 1-3 seconds of detection, ensuring timely alerts for unknown visitors. Users can enable a whitelisting feature to prevent notifications when known individuals are detected, streamlining the experience.

Conclusion

In conclusion, the TrueDetect doorbell combines advanced motion detection and image recognition to improve home security by accurately identifying people and objects while reducing false alarms. Using YOLO for object detection and OpenCV for facial recognition, the system provides real-time alerts and smooth streaming. With a focus on privacy, reliable performance, and an easy-to-use interface, TrueDetect offers a practical and effective solution for modern home security.