Embedded System for Coin Recognition

TECHNICAL SPECIFICATIONS

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1 Objective

The objective of this project is to develop a coin recognition system based on the ESP32 board that will allow blind or visually impaired people to recognize the sum of a set of banknotes and/or coins. This system must be accurate and quick to recognize coins and must provide voice feedback to guide the user in identifying the amount possessed.

2 Functional Specifications

- Image Capture: The system must be able to capture high quality images.
- Image processing: The system must be able to process the captured images to identify the different coins.
- Audible Notification: The system must provide an audible output to help the blind identify the proposed sum value through the Bluetooth speaker or earpiece.
- Activation button: The system must be activated using an activation button.
- Power: The system must be powered by a portable, rechargeable battery.

3 Non-functional specifications

- Portability: The system should be portable to allow easy and convenient use by the blind.
- Software Update: The system should be easily updated with new features and software enhancements.
- Battery life: The battery life should be long enough to allow prolonged use of the system.

4 Technical description

The project requires an ESP32 board, an ESP32-CAM camera, a Bluetooth speaker or earphone, an activation button and a battery to provide a portable and convenient solution to help blind people identify the total sum of different banknotes and /or coins.

4.1 The ESP32 card

Provides a versatile microcontroller that offers data processing, connectivity, and data storage functionality. It is programmed to drive the system using signals from the camera and the activation button.

The board can be configured to communicate with different types of sensors, such as camera and speaker, to provide a smooth user experience.

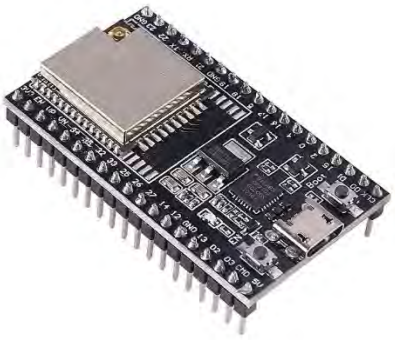

Figure 1: ESP32-WROOM-32U WIFI + Bluetooth, IoT Development Board

4.2 The ESP32-CAM camera

Is a crucial system component that captures coin images. It can be configured to take high resolution photos and take photos automatically when the activation button is pressed.

Figure 2: ESP32-CAM

4.3 Bluetooth speaker or earphone

Is used to provide sound output to help the blind identify the value of the amount of currency owned. Although the Bluetooth earpiece can be used to provide a more discreet and personalized experience, it would likely be more distracting than the speakerphone.

4.4 The activation button

Is used to trigger camera shooting and image processing. When pressed, it sends a signal to the ESP32 board to trigger image capture and banknote and/or coin identification.

4.5 Battery

Is a critical system component that provides a portable, self-contained power source for the system.

5 Choice of technologies allowing image analysis and object recognition

5.1 Library choice

For coin recognition for the blind, several technologies for image analysis and object recognition can be used. Three possible options are OpenCV, Detecto and TensorFlow.

5.1.1 OpenCV

Is an open source image analysis and digital processing library that provides algorithms for object detection and pattern recognition.

5.1.2 Detecto

Is an open source Python library for object detection based on PyTorch. It provides pre-trained models for object recognition and also allows the creation of custom models for other object recognition.

5.1.3 Tensor Flow

Is an open-source machine learning library developed by Google for object recognition, natural language processing, machine translation, etc. It provides pre-trained models for object recognition, as well as tools to create custom models.

The chosen technology must be able to provide reliable and accurate results in real time to allow practical and efficient use by visually impaired or blind people.

5.2 Choice of programming language

The choice of language goes hand in hand with that of the chosen technology, because it is a question of choosing a language which is adapted and compatible with the latter. In our case, Python was chosen because it is the simplest and most suitable language for working with Detecto, OpenCV or TensorFlow.

Figure 3: Possible technologies

6 Potential

The system described in this document can possibly be integrated in a more practical form and improved with more functionalities.

6.1 Form

A camera (1) and a pair of discreet headphones (2), mounted on glasses with an integrated activation button (3), and connected by wire or wireless to a compact device (4) comprising the microcard (Microcontroller + necessary components) and a rechargeable battery.

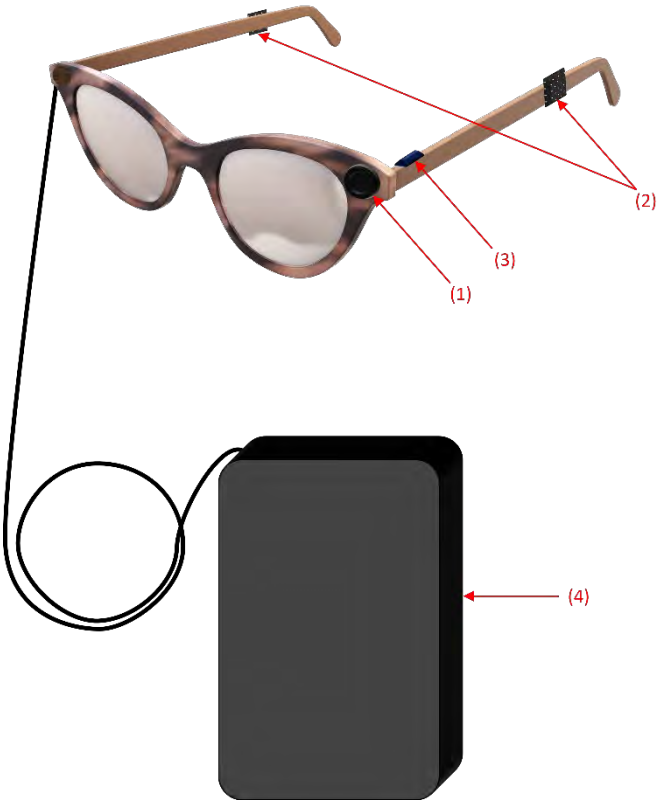

Figure 4: Idea for the final product

6.2 Additional features

6.2.1 Obstacle detection

An ultrasonic or radar distance sensor would allow the detection of obstacles in front, and therefore. It could be mounted in the same way as the camera.

6.2.2 People detection

This could be accomplished using the already integrated camera by implementing an AI model, or alternatively using a dedicated infra-red camera.

6.2.3 Reading text

Thanks to an optical character recognition (OCR) model and a text-to-speech program (TTS), the system could capture a photo of the text in front of the user and read it to him. It could help him identify danger or safety labels, for example.

6.2.4 Vibrate mode

In order to ensure user privacy, it is possible to integrate a vibration motor into the device, which substitutes some of the sound alerts. In addition, it would reduce the impact on the wearer's sense of hearing.