Assistance System for People with Visual Impairments Using IoT

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***Abstract*--The "Assistance System for People with Visual Impairments Using IoT" presents an innovative assistive technology solution aimed at enhancing accessibility and Self-sufficiency for those with visual impairments which consists of two main components: Smart spectacles and Smart cane. Leveraging Raspberry Pi, Arduino, and Camera technology, the system integrates sophisticated algorithms for computer vision, for currency note recognition, person detection, and obstacle detection. Key components include the Raspberry Pi single-board computer, Pi Camera module, speaker module for voice output, Arduino, Ultrasonic sensor to detect obstacles, Buzzer, and specialized image processing software. In real-time, the system analyzes the live camera feed to detect individuals, detect obstacles, and identify currency notes, providing crucial auditory feedback and buzzer sounds to people with low vision. This seamless integration of components empowers People have visual problems to navigate their environment safely and independently while facilitating confident financial transactions through voice-based feedback.**

***Keywords*—Raspberry Pi, Image processing, currency notes recognition and person detection, obstacle detection.**

I. INTRODUCTION

The "Assistance System for People with Visual Impairments Using IoT" - is a revolutionary assistive technology designed to boost visually impaired individual's standards of living. This innovation combines cutting-edge technology with wearable devices like innovative optical items. One of its standout features is detecting currency and providing audible feedback regarding its denomination.

With the power of artificial intelligence and computer vision, this equipment offers newfound independence and confidence to those who are visually impaired when handling money in their day-to-day lives. In this article, we will delve into the incredible features and benefits of the Assistance System for People with Visual Impairments Using IoT, showcasing how it's reshaping how people with vision impairments engage with currency.

II. RELATED WORK

This section describes the existing IoT-based methods for the visually challenged. R. Radhika et al [1] If someone is visually handicapped, a smart stick featuring infrared, ultrasonic, and water sensors have been developed to assist in obstacle detection.

M.H. Mahmud et al [4] reduce the effects of blindness by building automated technology based on microcontrollers that can confirm a blind person's ability to notice impediments in front of them instantaneously. The hardware is a proximity sensor, wet detector, ping sonar sensor, micro pager motor, and other components.

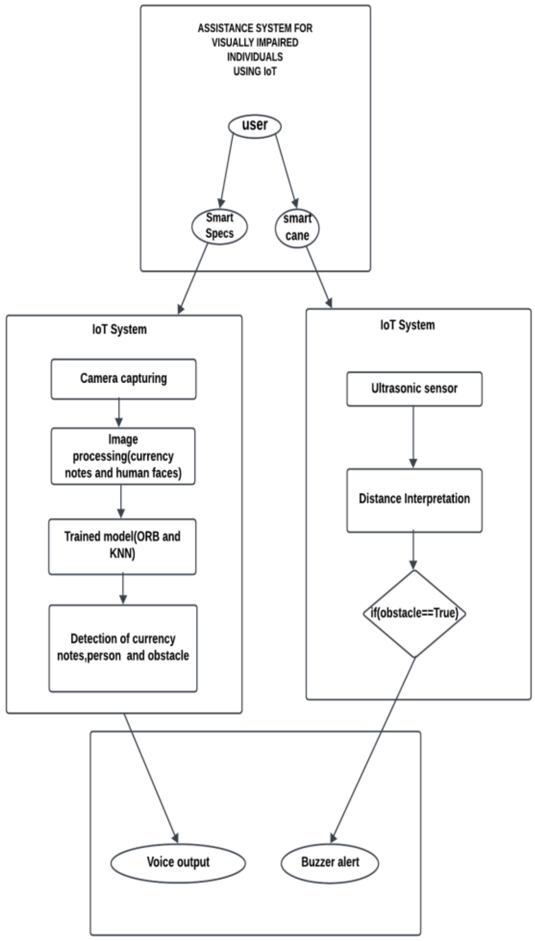
R. Sheth et al [19] designed the stick to keep it structurally similar i.e. thin, lightweight, and easy to handle, yet give active feedback to the operator regarding hazards in his walking path.

C.S. Kher et al [20] the ultrasonic detectors mounted on the smart white cane are situated in a way that can detect potholes and pits. Android handsets, RFID, and infrared sensors are utilized, they present a system of navigating for the visually handicapped that focuses on giving speech output for preventing obstacles and navigation. There are infrared proximity sensors on the device. Both public buildings and the walking sticks employed by the visually impaired are equipped with RFID tags. Through Bluetooth, This gadget is linked to an Android mobile device. barriers at low lying and knee level and those above the waist, including staircases and downslopes. Pre-recorded sound cues and haptic feedback in vibrations alert the operator to the same.

Ahmed et al [8] created the using an ORB algorithm. Binary descriptors can be obtained by applying ORB. The improved performance of this new algorithm The accuracy and outcomes of the prior ROI extraction and template matching is superior.

Imad et al.'s proposed study [5] uses deep neural networks (DNNs). The primary features of the Pakistani dollar notes are extracted via live input after the system has been trained using the Alex-net architecture. The master features are classified using the Support Vector Machine (SVM) methodology.

III. PROPOSED SYSTEM



Reading Images

This Step contains reading images from the camera. There are various methods to obtain an image, such as using a scanner or a digital camera. All features must take part in the final image, which will be converted to RGB. We have used opencv-python(cv2) for reading images.

Image preprocessing

Pre-processing is done to boost an image's visual expression and enhance the impact of a dataset. Pre-processing images is typically the first step needed to extract relevant information and data. Image pre-processing, also known as image restoration, comprises the introduction of noise, degradation, and distortion during the imaging process. Pre-processing images can improve optical inspection accuracy.

Feature Extraction

Reads the captured image using OpenCV.Uses the ORB(Oriented FAST and Rotated BRIEF) feature detector and descriptor to extract key points and descriptors from the image. It is anticipated that When the features that are extracted are appropriately chosen, the collection of these features will carry out the intended function by substituting the input data's associated information for the total input. Here KNN is used in person detection.

Data for testing

Gather high-quality images of various currency denominations that you want the code to recognize and persons to detect. Ensure the images are clear, well-lit, and representative of typical conditions. The data is selected from the real-time users using the camera module of the IoT.

Algorithm for matching

In light of the many attributes extracted, this phase detects or classifies the currencies of dissimilar denominations. The text-to-audio conversion will be sent to the visually impaired individual based on their classification.

Training and Evaluation

Compares the descriptors of the captured image with a set of predefined training images using a brute-force matcher (cv2.BFMatcher).Determines the best match depending on the quantity of good matches and identifies The value of the cash denomination note. Using the metric score the accuracy will be found out.

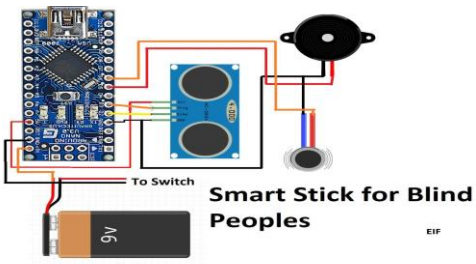
IV. METHODOLOGY

The Assistance System for People with Visual Impairments utilizes a combination of hardware, software, and machine learning to achieve its functionalities. Here's a breakdown of the potential implementation methods:

Hardware:

Smart Glasses: The core wearable device equipped with a camera for capturing visual data, a processor for on-device processing, a speaker for audio

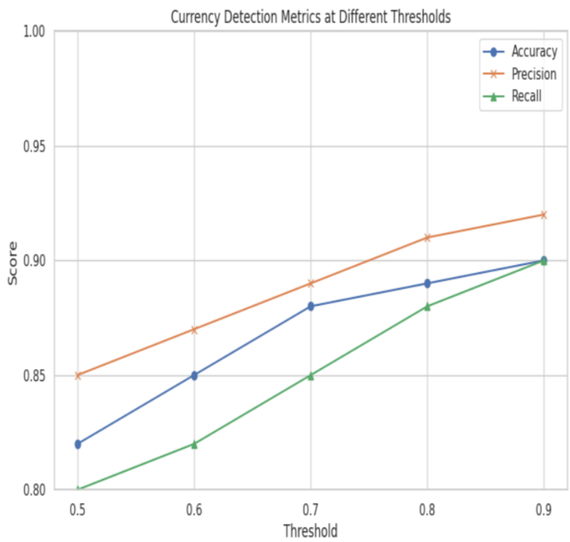
feedback, and potentially additional sensors like an ultrasonic sensor for obstacle detection.
Smart Cane: An additional wearable device equipped with an ultrasonic or other sensor for obstacle detection, and potentially haptic feedback features for vibration alerts.

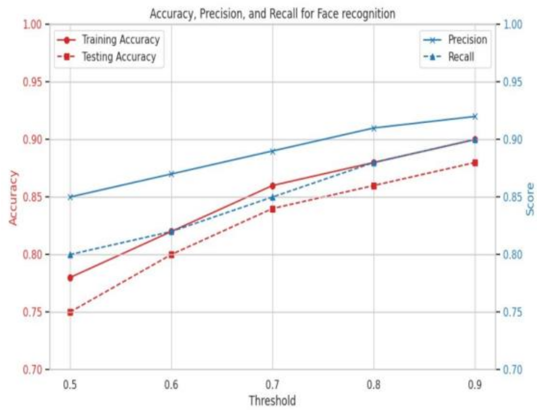


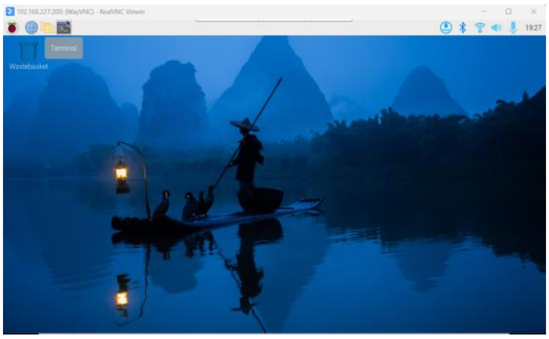
Software:
Operating System: A lightweight operating system for the smart glasses to manage resources and facilitate communication with other components.
Computer Vision Software: This software module running on the smart glasses or a connected device utilizes ML to analyze the camera feed for tasks like:Object detection (including obstacle detection and currency recognition)
Image classification (identifying the denomination of a currency note)
Audio Feedback Software: This software module generates voice alerts based on the processed data for functionalities like:
Obstacle detection (announcing location and severity)
Currency denomination identification (announcing the value of the detected note)
Implementation Steps:
Selection of Hardware: Choosing appropriate hardware components like cameras, processors, and sensors based on performance, power consumption, and cost constraints.
Software Development: Developing the core functionalities like computer vision algorithms for object detection and currency recognition, and audio feedback generation for real-time user interaction.
System Integration: Integrating the hardware components, software modules, and communication protocols for seamless data flow and system operation.
ML Model Training: Training the computer vision models using a large dataset of images for object and currency recognition. This might involve deep learning techniques depending on the complexity of the system.
Testing and Refinement: Rigorously testing the system in various scenarios and user environments to ensure accuracy, reliability, and user-friendliness. Refining the system based on test results and user feedback.
Additional Considerations:
Security: Implementing security measures to protect user privacy and data security, especially when dealing with financial transactions.
Life time of battery: Optimizing power consumption through efficient hardware and software design to ensure extended usage time.
User Interface: Designing a user-friendly interface for calibration, settings, and interaction with the system (if a mobile device is included). By following these steps and addressing the considerations, the Assistance System for People with Visual Impairments can be implemented as a valuable assistive technology tool.

V. RESULTS

To parse script files, a text-to-speech converter is used. It recognizes known textual codes and speaks them out for audio output. Utilizing the assistance of speech output, this application seeks to make textual material more obtainable by those with visual impairments by making it easier for them to understand and navigate the content. By carefully crafting parsing algorithms, integrating with a dependable TTS engine, and creating an intuitive user interface, the converter aims to improve accessibility and enable visually impaired users to interact with textual content efficiently.







VI. DISCUSSIONS

Surely, there is still more to learn and explore in both person detection and currency recognition in terms of research and perspective. There might be more currency categorization, through the computer vision OpenCV, and a few ORB approaches. OpenCV is indeed a popular open-source computer vision library, while the ORB is a feature detection process that can detect meaningful points in an image. It can use this method's ORB to obtain features from currency photos, and then OpenCV will be used for further processing and categorization. On the other hand, machine learning KNN method for person detection means training on labeled data, a model capable of identifying patterns that are related to human figures.

A simple and efficient method of making an item classified by a vote of most of its neighbors referred to as KNN, the Object is then assigned to that class level which has most of the common class among its k nearest neighbors:Though money identification has levels of technique, it is hard to modify a solid backdrop model to manage the metric variances from various settings. Altered recognition systems are capable of making various variables, including illumination, image quality, and inter-money design variability. Finally, no model can manage such kinds of metrics fluctuations, and scientists are still investigating to construct such a model, probably using cutting-edge techniques such as deep learning and CNNs. The ORB algorithm is suitable for a job such as cash recognition for real-time applications in that it can rapidly and accurately identify and explain significant characteristics in pictures. On the other hand, KNN is a versatile algorithm that may be trained to identify many different patterns, such as human forms, hence it is ideal for positions that entail the detection of people. In brief, while enormous advances have been made in person spotter and currency identifier, there is still a fantastic deal to be achieved, notably in modeling in several circumstances. Most such advancements in these areas will likely result from more analysis and innovation in algorithms, models, and techniques such as ORB and KNN.

VII. CONCLUSION

In summary, Helpful technology for individuals with visual impairments has advanced significantly with the introduction of the Assistance System for People with Visual Impairments Using IoT. This inventive kit gives those with vision impairment the ability to traverse the world with more confidence and freedom by including state-of-the-art capabilities like cash recognition, obstacle detection, and person detection help that is amendable in the future by adding GPS Navigation. Not only does it improve their financial management and obstacle-detection skills, but it also provides vital assistance with daily movement. The Assistance System for People with Visual Impairments Using IoT is a great illustration of how advances in wearable technology and ML have the potential to greatly enhance the lives of people who depend on these tools for a fuller, more fulfilling life.

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