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Raspberry Pi Based Smart Navigation System for the Visually Challenged

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ABSTRACT:

Self-determination is the foundational mechanism for realising one's dreams and goals in life. Unsighted people are justified in going out on their own. There are millions of visually challenged persons in the globe who are always in need of assistance. They must rely entirely on others for every minor work, not only devices. To replace the aforementioned gaps in the lives of visually challenged people, we offered a gadget loaded with modern technology that would allow the individual to conduct their own job rather than rely on others. In this project, we will use a Raspberry Pi to create a navigation system for visually challenged people, the system would contain a pi cam module to detect the objects further that will be implanted with a moisture and ultrasonic sensor to detect real-time obstacles while walking and will be linked to the Google Maps cloud for optimal navigation. This will result in a smart system that will be incredibly beneficial for blind people while also being more precise and safe. Blind individuals use voice to engage with the system. Using 4G technology, the cloud platform communicates with the smart phone. The suggested system may give more plentiful surrounding information and more accurate navigation, as well as validate the system's practicability.

Keywords — Raspberry Pi, Pi camera module, Deep Learning, Ultrasonic sensor, Moisture sensor.

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I. INTRODUCTION

The clever device for blinds is a contraption that assists blind people in navigating with speed and confidence by recognising adjacent objects and obstacles using a pi camera, ultrasonic waves, and notifying them with a buzzer sound and voice alarm. The present technological expertise is evolving on a daily basis in several aspects in order to give individuals with flexible and safe movement. The white stick is currently the most common

and widely utilised means by visually impaired individuals, however it has limits. With the newest technology, it is conceivable to expand the assistance provided to persons with visual impairment throughout their mobility; this project offers an inexpensive object detection-based ”Third Eye for the Visually Challenged” in order to obtain a personal assistant.

II. SYSTEM CONTENTS

A. RASPBERRY PI

The Raspberry Pi, a credit card-sized device powered by an ARM processor, is capable of running Linux. With one GB of RAM, the Raspberry Pi 3 Model B+ includes multiple features such as dual-band Wi-Fi, Bluetooth 4.2, Bluetooth Low Energy (BLE), HDMI output, Ethernet port, audio output, and RCA composite video output (accessible via the 3.5 mm jack). It also has Bluetooth 4.1, dual-band Wi-Fi, and four USB ports (GPIO). To operate the Raspberry Pi, an operating system must be loaded onto a microSD card as shown in figure 1.

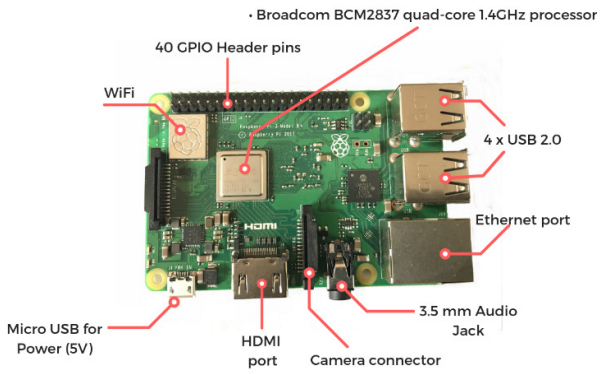


FIGURE 1 (RASPBERRY PI)

FEATURES:

- BCM2837B0, Cortex-A53 (ARMv8) 64-bit SoC @ 1.4GHz
- 1GB LPDDR2 SDRAM
- 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2, BLE
- Gigabit Ethernet over USB 2.0 (maximum throughput 300 Mbps)
- Extended 40-pin GPIO headerBroadcom
- Full-size HDMI
- 4 USB 2.0 ports
- CSI camera port for connecting a Raspberry Pi camera
- DSI display port for connecting a Raspberry Pi touchscreen display
- 4-pole stereo output and composite video port
- Micro SD port for loading your operating system and storing data
- 5V/2.5A DC power input
- Power-over-Ethernet (PoE) support (requires separate PoE HAT)

B. PI CAM MODULE

This 5 megapixel camera module with OV5647 sensor can capture still photos and 1080p video and connects directly to your Raspberry Pi. The most recent Raspbian operating system is plug-and-play compatible, making it ideal for time-lapse photography, video recording, motion detection, and security applications. You may get started byconnecting the provided ribbon cable to the Raspberry Pi's CSI (Camera Serial Interface) port.

With dimensions of roughly 25 x 23 x 9 mm and a weight of little over 3 g, the board itself is incredibly small, making it ideal for mobile devices or other applications where size and weight are critical. The camera provides static photos up to 2592 x 1944 pixels and video up to 1080p30, 720p60, and 640x480p90 as shown in figure 2.

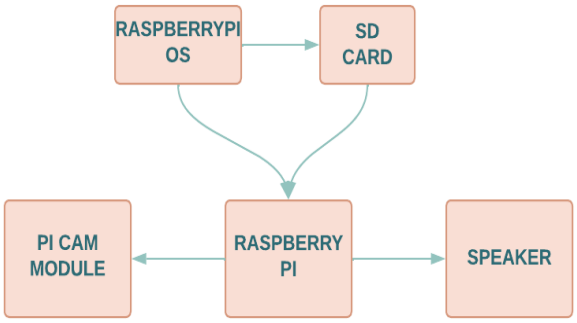
FIGURE 2: PI CAM MODULE

C. MICRO SD CARD

Most frequently, microSD cards are utilised to increase the storage capacity of smartphones, drones, gaming systems, and cameras. Like full-sized SD cards, microSD cards are backwards compatible with hardware devices. For microSD cards, the same guidelines that apply to SD cards also apply as shown in figure 3.

FIGURE 3: MICRO SD CARD

III. BLOCK DIAGRAM



IV. METHODOLOGY

A. *RASPBERRY PI OS*

Before doing anything else with the Raspberry Pi, an operating system (OS) must be installed on it. The Raspberry Pi Foundation provides an easy-to-use OS installer called BUSTER, which can be downloaded from their official website and extracted onto a blank SD card. When the SD card containing Buster is inserted into the Raspberry Pi, a list of available operating systems that can be installed on the device is displayed. In this case, the Raspbian desktop version without any additional applications was selected as the operating system when the Raspberry Pi was powered on using BUSTER. Raspbian, a Linux-based OS, is the official operating system for the Raspberry Pi. Which is shown in the figure.

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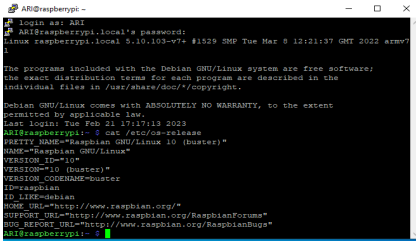

FIGURE 4: BUSTER OS DESKTOP

B. *PREPARATION OF THONNY IN RASPBERY PI*

Thonny is a Python Integrated Development Environment (IDE) that caters to novice Python users. It offers a range of useful features, including a built-in debugger to help you tackle complex problems, as well as step-by-step expression evaluation. Thonny is also incredibly user-friendly and comes pre-installed on Raspbian. Simply click on the Raspberry Pi icon and select Programming > Thonny Python IDE to launch it and start working in an interactive environment that's focused on Python.

Write your program in the top pane, click File > Save as... *to* save it, and click Run > Run current script to execute the program. Output will appear in the bottom interpreter pane, which is shown in the figure.5

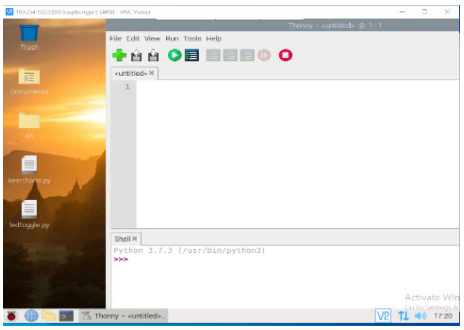

FIGURE 5: THONNY SOFTWARE

C. *INTERFACING PI CAM MODULE*

A Raspberry Pi-based navigation system for the visually challenged can be built by connecting a Pi camera module and GPS module to the Raspberry Pi using GPIO pins, installing Raspbian or any other suitable operating system, OpenCV, Python libraries, and a text-to-speech library to process images and convert directions to speech. Mounting the camera module on a suitable location such as the user's head, image processing techniques can be used to detect obstacles, and hazards to provide feedback to the user through TTS. The GPS module can determine the user's location and provide real-time directions to the user using Google Maps API. A reliable power supply, clear audio output, obstacle detection, voice recognition, localization, and real-time feedback can be included in the system for better performance. Building a Raspberry Pi-based navigation system for the visually challenged requires a combination of hardware and software skills and can improve the quality of life for people with visual impairments.

D. *OPEN CV*

OpenCV is an open-source computer vision and machine learning library. It provides algorithms for image and video processing, object detection, feature detection and matching, and more. OpenCV supports C++, Python, and Java, and can run on multiple platforms. It is widely used in robotics, augmented reality, medical imaging, and other fields. OpenCV has a

large and active community of developers and users. Overall, OpenCV is a powerful tool for unlocking the potential of visual data. Which is shown in figure.6

FIGURE 6 Open CV

V. RESULT

Raspberry Pi-based navigation systems for the visually impaired use sensors, software, and positioning technologies to detect obstacles, provide feedback, and improve mobility and independence for individuals with visual impairments.

VI.CONCLUSION

This project provides a means of active interaction and navigation between the system and the blind person. Its features like interaction or commands over voice, precise navigation, and reliable obstacle detections make its future scope huge. With the advancement in technology and our dependency on it, this project would be proved to be high in demand in the recent future. The test results prove that this system is more reliable than any other existing system, however, some more improvements can make it even more faithful and accurate. Also, the cost of this project is optimum and proves to be the best aid for blind people.

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