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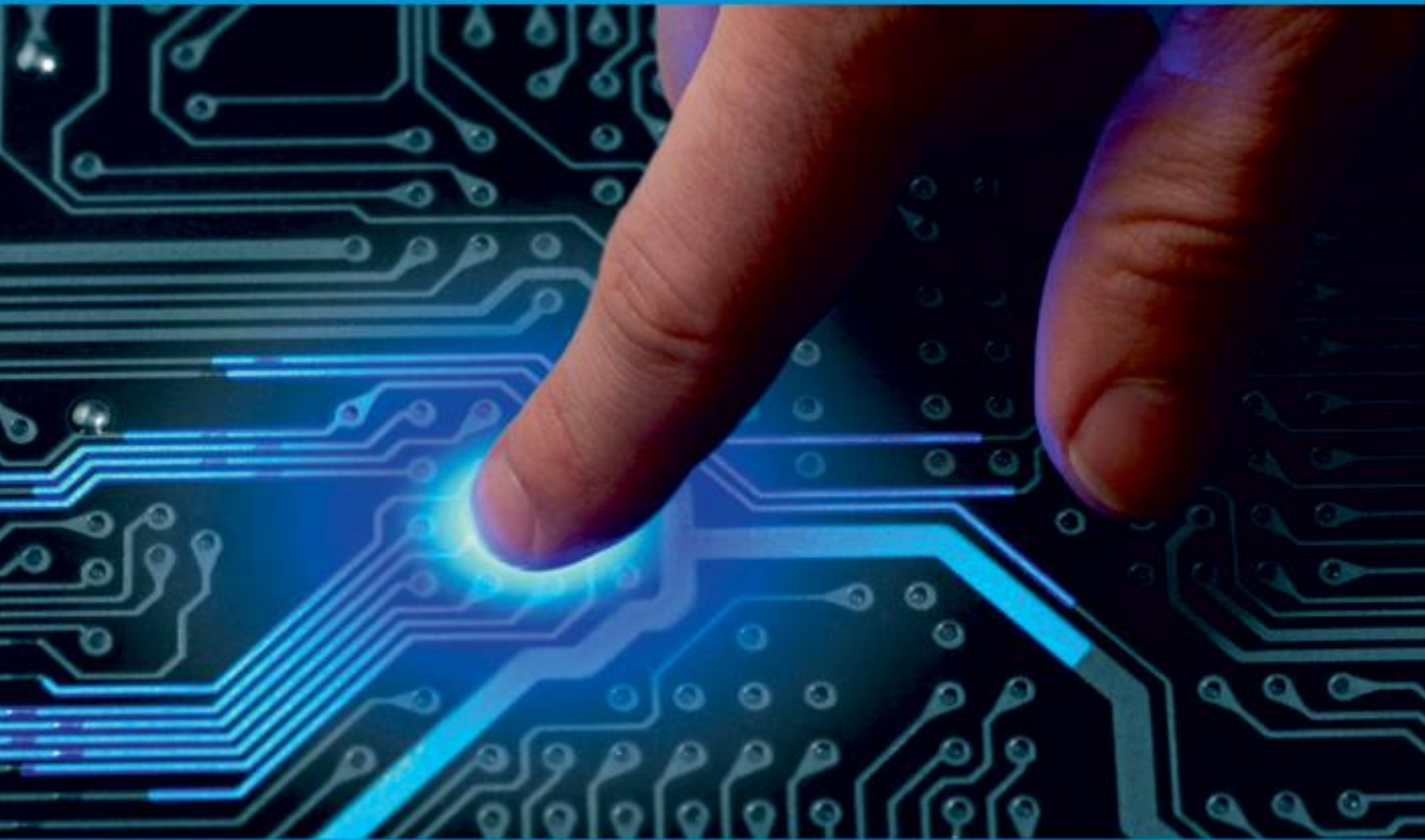

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Enhancing Safety for Visually Impaired Person

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ABSTRACT: When we are unable to use our own eyes to navigate through an unfamiliar situation, it can be extremely difficult. People who are visually impaired deal with this issue daily. Typically, they use a walking stick to guide them. Through basic tactile force input, they use the walking stick to detect static objects on the ground, stairs, holes, and uneven surfaces. Despite being small and lightweight, its range is constrained by its own dimensions, making it unsuitable for use with dynamic components. To help visually impaired persons walk more confidently, this study focuses on designing a Smart Walking Stick that employs the Node MCUESP32 to provide information about their surroundings. By using ultrasonic sensors to identify and notify people of impending hazards such as pits and stairs, walking accidents can be decreased. The stick is configured to automatically establish a Wi-Fi connection with the Android phone to transmit sensor data and provide audio feedback to the user**.**

KEYWORDS: Ultrasonic Sensor, Node MCU (ESP8266), Fire Sensor, Piezoelectric Sensor, ESP32 CAM, Buzzer.

I. INTRODUCTION

Visual debilitation, also known as vision impairment or visual misfortune, is a partially reduced ability to see that results in problems that cannot be resolved with conventional treatments, such as spectacles. Some also include those with reduced vision because they avoid using glasses or making eye contact with objects. The most regrettable corrected visual sharpness of 20/40 or 20/60 is typically used to describe visual weakness. The word "visual deficiency" refers to the misfortune of whole or nearly complete vision. Visual impairment may lead to problems with traditional routines, such as examining and moving around flexible preparation and equipment. Geographical differences in vision deficit are most commonly attributed to uncorrected refractive errors (43%), waterfalls (33%), and glaucoma (2%). Astigmatism, farsightedness, presbyopia, and partial blindness are examples of refractive errors. The most well- known cause of vision impairment is waterfalls. Age-related macular degeneration, diabetic retinopathy, corneal obfuscating disorders, juvenile visual deficiencies, and other conditions are among the many conditions that can result in vision problems. Visual deficiencies can also result from mental health problems brought on by stroke, early pregnancy, trauma, or other conditions. We refer to these situations as cortical visual impedance. Examining young people for visual Problems may help them acquire better vision and information in the future. Adult screening without symptoms has questionable benefits. An eye test is used for examination.

1.1 What Is Visual Impairment

Visual debilitation, also known as vision impairment or vision misfortune, is a partial loss of vision that results in problems that cannot be resolved with standard treatments like spectacles. Some also include those with reduced vision because they avoid using glasses or making eye contact with objects. Typically, visual weakness is defined as having a best corrected visual sharpness of 20/40 or 20/60, which is more disappointing than either one of the other. If you have trouble seeing completely or almost completely, you are said to have a visual deficiency. Visual impairment may lead to problems with traditional routines, such as examining and moving around flexible preparation and equipment. Errors in refractive errors are the most common causes of visual deficiencies between sides of the planet. waterfalls (33%),

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glaucoma (2%), and 43%. Astigmatism, farsightedness, presbyopia, and partial blindness are examples of refractive errors. The most common cause of vision impairment is waterfalls. Age-related macular degeneration, diabetic retinopathy, corneal obfuscating disorders, juvenile visual deficiencies, and other conditions are among the many conditions that can result in vision problems. Like mental impairment, visual deficiencies can also result from stroke, premature birth, trauma, and other mental health conditions. We refer to these situations as cortical visual impedance. Examining young people for visual problems may help them see better and learn more in the future. Adult screening without symptoms has questionable benefits. An eye test is used for examination.

1.2 What Qualifies Someone as "Blind"

An innate and pediatric ocular infection known as expanded pressing factor inside the eye, or intraocular pressure (IOP), is the cause of visual impairment. It is the same thing that impairs the visual field as it does the optic nerve. Patients with glaucoma should be diagnosed and treated as soon as possible since the condition is triggered by ambiguous IOP readings. Moreover, another glaucoma has four causes,
which can be tested for accurate diagnosis:

- Induced by corticosteroids.
- An incongruous element associated with initial alteration and enduring exacerbation.
- Inflammatory Ocular Hypertension Syndrome.

1.3 Common Impairment Scenarios

The challenge of walking from one area to the next independently is one of the main things preventing people with vision impairments from participating in public life and being free. To navigate independently, they must continuously adjust their orientation and location to avoid obstacles and hazards. This can be dangerous and distressing, and it can increase theattentional load, especially.

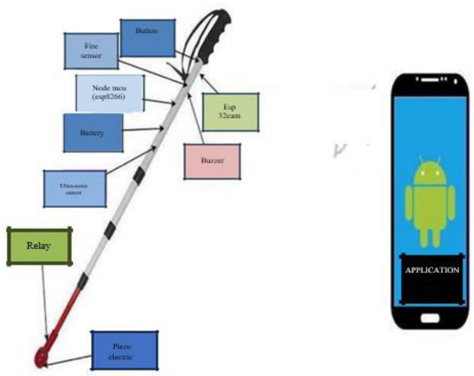

Fig.1: Smart Blind stick

II. LITERATURE REVIEW

A. Mukesh Prasad Agarwal & Atma Ram Gupta developed a smart stick for the blind and visually impaired, which is a cost-effective, simple, and efficient electronic guiding device. It uses advanced sensors to detect the origin and distance of objects, providing 360-degree scanning. The stick features a traffic detector that vibrates to alert the user of approaching vehicles and operates on a rechargeable battery with a 12-hour lifespan.

B. Akshay Salil Arora & Vishaka Gaikwad introduced the Blind ID Stick, a user-friendly and affordable device for the blind. It includes a variable duration buzzer for obstacle detection, and its efficiency can be enhanced with advancements in GPS and mobile technology. The stick also has potential integrations with IoT for features like traffic forecasting and weather updates.

C. Sandesh Chinchilla & Samir Patel created an AI and sensor-based assistive system for the visually impaired. The system uses smartphones and hardware to detect obstacles, recognize images, and provide audible feedback. It includes ultrasonic sensors for obstacle detection and an accelerometer for identifying potholes, enhancing navigation for low-income users.

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D. Reshma Vijay Jawale et al. proposed an ultrasonic navigation system controlled by an Android app with voice commands. The app offers campus and GPS navigation modes. Bluetooth connectivity allows the system to provide audio instructions and translate text warnings into speech for the blind user.

E. Yi-Qing Liu et al. designed an intelligent ultrasonic walking stick with a bracelet for the blind. The stick uses ultrasonic waves to detect obstacles and sends signals to the bracelet, which vibrates to alert the user based on proximity. A stepper motor and angle sensor maintain the detector's forward direction for accurate obstacle detection.

III. DESIGN METHODOLOGY

The inventive Blind Stick was created for those who are blind or visually impaired. Here, we suggest a sophisticated blind stick that enables those with visual impairments to recognize obstacles. The ESP32 wifi camera and ultrasonic sensor are integrated into the blind stick. The image of the books, newspaper, money, bill, etc. is captured by the ESP32 camera and sent to the server for processing. Our suggested idea employs ultrasonic waves and ultrasonic sensors to identify impending obstructions. The sensor transmits this information to the microcontroller when it detects impediments. After processing this information, the microcontroller determines whether the obstruction is sufficiently close. The circuit does nothing if the obstruction is not that close. The vibrator receives a signal from the microcontroller if the impediment is approaching.

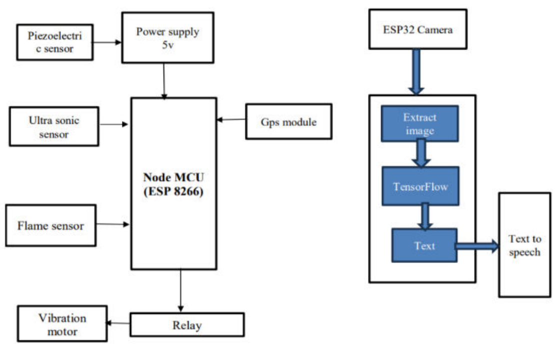

Fig. 2: Overview of enhancing safety for visually impaired person

IV. HARDWARE COMPONENTS

- **A.** ESP8266 Node MCU Board.
- **B.** Ultrasonic Sensor.
- **C.** Piezo electric
- **D.** Vibrator.
- **E.** Flame sensor.
- **F.** 5V Single Channel RELAY Module
- **G.** ESP32 Camera

A. Node MCu ESP 8266

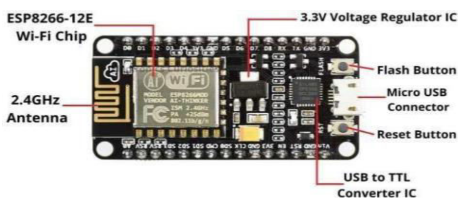

Fig. 3: Node MCU ESP 8266

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The ESP8266 chip on the ESP8266 Node MCU CP2102 board, as depicted in figure 3. it is a highly integrated semiconductor created to meet the demands of an increasingly interconnected society. It provides a full and independent solution for Wi-Fi networking, enabling it to either run the application itself or transfer all Wi-Fi networking duties to another application processor. Through its GPIOs, the ESP8266 may be integrated with sensors and other application-specific devices with minimal coding required up front and minimal loading during runtime because to its robust on-board processing and storage capabilities. Because of its high level of on-chip integration, very little external circuitry is needed, and the whole system including the front-end module is made to take up the least amount of space on the PCB. For low-cost Wi-Fi projects, the ESP8266 Node MCUdevelopment board is a real plug-and-play option. Simply install the USB driver (see below) to get started; the module comes pre-flashed with Node MCU firmware. The ESP-12 Lua Node MCU Wi-Fi Dev Board is an Internet of Things board that comes in a package that is suitable for a breadboard. It includes a complete ESP8266 Wi-Fi module with all of the GPIO broken out, a full USB-serial interface, and a power supply. ("ESP8266 Module ESP-12E NodeMcu LUA WiFi Internet CP2102 New Version ...") You can start the using of this board in a matter of minutes because it comes pre-flashed with Node MCU, a Lua-based firmware for the ESP8266 that enables simple control through the handy scripting language Lua. An all-in-one microcontroller + Wi-Fi platform, the ESP- 12 Lua Node MCU Wi-Fi Dev Board Internet of Things with ESP8266 is incredibly user-friendly for developing projects including Wi-Fi and IoT (Internet of Things) applications. The widely used ESP8266 WIFI Module chip with the ESP- 12 SMD footprint serves as the foundation for the board. The ESP8266 (ESP-12E) development board comes with all the parts needed to write and upload code pre-installed.

Features:

1. 11 b/g/n Wi-Fi Direct (P2P),
2. Integrated TCP/IP protocol stack
3. Use CH340G to replace the CP2102.
4. Arduino-like hardware IO.
5. Integrated low power 32-bit CPU.

B. Ultrasonic Sensor.

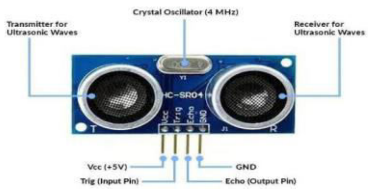

Fig. 4: Ultrasonic Sensor

Figure 4 illustrates how an ultrasonic sensor, like bats, uses the sonar to measure an object's distance. It provides exceptional non-contact range detection from 2 cm to 400 cm, or 1" to 13 feet, with high accuracy and reliable readings in an intuitive packaging. Though soft materials like cloth can be challenging to detect acoustically, the operation is naffected by sunshine or dark materials. An ultrasonic transmitter and the receiver module are included. Sensor Ultrasonic The sensor HC-SR04 has a distance measurement capability. It releases an ultrasonic wave at 40000 Hz (40kHz) that travels through the atmosphere and returns to the module upon encountering an item or obstruction. You may compute the distance by taking the sound's speed and travel time into account. The HC-SR04's configuration pins include GND (4), TRIG (2), ECHO (3), and VCC (1). You can connect the TRIG and ECHO pins to any Digital I/O on your Arduino board, and the VCC supply voltage is +5V. To produce the ultrasound, we must place the Trigger Pin in a High State for ten seconds. That will cause an 8-cycle sound burst to be released, travel at sound speed and land at the Echo Pin. The sound wave's travel time, measured in microseconds, will be output by the Echo Pin.

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C. Piezo electric.

Fig. 5: Piezo electric

In some materials, a phenomenon known as piezoelectricity occurs when mechanical stress results in the generation of an electric charge or vice versa. It was discovered in 1880 by Pierre and Jacques Curie and is used in many different technologies. Piezoelectric materials, such as quartz or some ceramics, undergo internal structural deformation in response to mechanical stress, which results in a potential difference across their surface. Piezoelectric sensors, actuators, and transducers utilize this characteristic. Sensors are used in accelerometers, pressure sensors, microphones, and other devices to detect mechanical impulses and translate them into electrical ones. Inkjet printers, ultrasonic cleaners, and nano positioners may all operate precisely because actuators translate electrical impulses into mechanical motion. Because of their efficiency and adaptability, piezoelectric materials are essential in consumer, medicinal, and industrial applications.

D. ***Vibrator***

Fig. 6: Vibrator

Figure 6 illustrates a vibrator motor that can be utilized for small toys or any do-it-yourself project. These motors have an operational voltage range of 3V–6V, thus two AA batteries or a 5V USB power source can run them.

Features:
Maximum RPM: 10,000.
Shaft Diameter: 2 mm.
Operating Voltage Range: 3 to 6 VDC.
Weight: 15 gm per motor

E. ***Flame sensor***

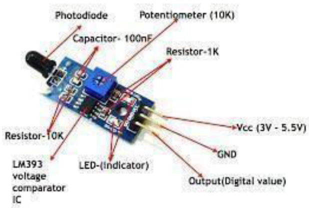

Fig. 7: Flame Sensor

Figure 7 illustrates a flame sensor that has a 700–1000 nm wavelength range for detecting infrared light. The light detected as infrared light is converted into current changes by the far infrared flame probe. The onboard variable resistor, which has a detection angle of 60 degrees, is used to modify sensitivity.

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F. 5V Single Channel RELAY Module

Fig. 8: RELAY Module

This is an Arduino PIC AVR DSP ARM 5V single channel relay board module. It can be controlled by a variety of microcontrollers, including Arduino, AVR, PIC, ARM, and others. The module is triggered; the high trigger current is less than 5 mA; the output capability of 51 single-chip IO ports is partially deficient; pull or improve the circuit's drive capability. It can be utilized to operate home appliances or microcontroller development board modules.

Feature & specifications.

- Power supply indicator lamp.
- Control indicator lamp.
- Relay output status indicator.
- Operating Voltage: 5V.
- The current capacity of the relay contact at AC 250 V is 10 A, and at DC 5 V, it is also 10 A.

G. ESP32 CAMERA

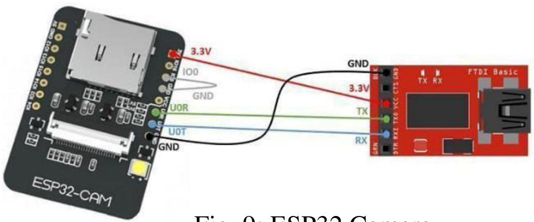

Fig. 9: ESP32 Camera

Based on the ESP32 microcontroller and an OV2640 camera module, the ESP32-CAM is a flexible and reasonably priced development board. It was created by Expressive Systems and is perfect for a range of Internet of Things, security, and image processing applications since it combines the capabilities of a camera with the power of an ESP32 chip. The ESP32-CAM is primarily equipped with the ESP32-S chip, which has dual-core processors, Bluetooth and Wi-Fi connectivity, a large number of GPIO pins, and support for multiple communication protocols. A 2-megapixel CMOS image sensor with video and image capture capabilities is integrated inside the OV2640 camera module. For projects that need embedded image processing and capture, the ESP32-CAM's tiny form factor and low power consumption make it a smart choice. The official development framework from Espresso if, called ESP-IDF, or the Arduino IDE can be used to program the ESP32-CAM may be used for a variety of activities, from straightforward ones like motion detection and remote monitoring to more intricate ones like object tracking and facial recognition. Its integrated Bluetooth and Wi-Fi technologies facilitate wireless communication, enabling data transfer and remote control. The ESP32-CAM is famous for its support of custom code or on-board algorithms for real-time image processing. This creates opportunities for on-device machine learning inference, object detection, and image filtering applications. The ESP32-CAM is a capable microcontroller, but it has drawbacks as well, like less RAM and flash memory than other microcontrollers. Its camera module could also not be appropriate for applications that need to operate in low light or with high resolution.

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V. SOFTWARE COMPONENTS

A. Programming Language: C, Python, Java

B. IDE: Arduino IDE, Python IDLE, Net beans, Android Studio

C. Optical character recognition

A. C Programming

C is a high-level and versatile programming language suitable for creating firmware or portable programs. Dennis Ritchie created C for the Unix Operating System at Bell Labs in the early 1970s, initially for system software development.

B. Arduino IDE

The open-source Arduino Software (IDE) facilitates code creation and uploading to the device. This software is used to program Arduino boards. Sketches refer to programs created with the Arduino IDE. The drawings are created in a text editor and saved with a file extension. The editor supports cutting, pasting, and searching/replacing text. The message box shows error messages and provides feedback while saving and exporting. The console shows text output from the Arduino IDE, including error warnings and other information. The configured board and serial port are displayed in the bottom right corner of the window. ("GSM Based Motor Control System with Water Level Monitoring - IJRASET") ("GSM Based Motor Control System with Water Level Monitoring - IJRASET") The toolbar has buttons for verifying and uploading programs, creating, opening, and saving drawings, and opening the serial monitor.

It initializes variables, input and output pin modes, and other libraries required for the sketch.
• Loop (): After calling setup (), the main program executes the loop () method continuously. It controls the board until it is turned off or reset.

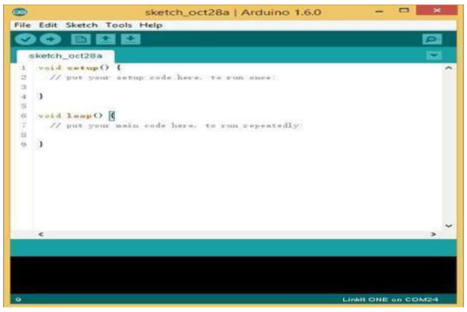

Fig. 10: Arduino IDE sketch

C. Optical character recognition

optical character recognition (OCR) converts a variety of document formats—including scanned paper documents, PDF files, and images—into editable and searchable text. To identify and extract text from pictures or scanned documents, this program uses complex algorithms and machine learning approaches.

The following functions are commonly included in OCR software:

- **Text Recognition:** Regardless of the font's style, size, or orientation, OCR software's primary job is to identify text characters found in pictures or scanned documents.
- **Image Preprocessing:** To increase recognition accuracy, OCR software frequently comes with capabilities for enhancing and preprocessing images, such as skew correction, contrast modification, and noise reduction.

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- **Language Support**: A lot of OCR programs come with support for a wide range of character sets and languages, so users can process documents written in different languages using different writing systems.
- **Formats for Output:** OCR software can produce text that has been recognized in a number of formats, including plain text, searchable PDFs, editable Word and Excel files, and structured data formats like XML and JSON.
- **Batch Processing:** To save time and effort when digitizing huge volumes of content, some OCR software enables users to process many documents or photos at once.
- **Accuracy and Confidence Levels:** To help users evaluate the dependability of the OCR findings, advanced OCR software may include accuracy metrics and confidence levels for the identified.

VI. APPLICATIONS

Makes it easier for blind persons to walk to the necessary location. aids in the identification of obstacles to protect the user. The sensor's attachment aids in warning the user of any obstacles or holds up ahead. OCR helps to detect object and to read text.

VII. IMPLEMENTATION AND RESULT

The experiments were conducted in order to assess the effectiveness of the suggested approach. The findings presented in this study mark the start of our attempts to develop a portable travel assist that enables people with vision impairments to navigate their daily surroundings. The sensor circuits provide information about the surroundings, as was previously explained.

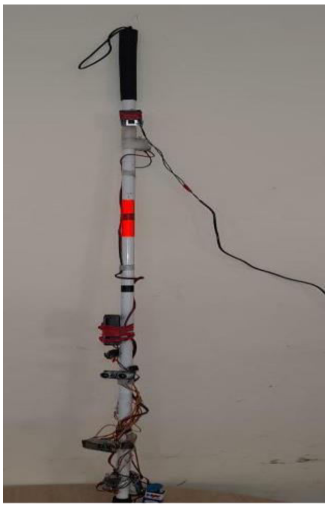

Fig. 11 Working Model

Our suggested technology employs ultrasonic waves and ultrasonic sensors to identify nearby obstructions. The sensor notifies the Node Mcu when it detects obstructions. After processing this information, the Node Mcu determines if the obstruction is sufficiently close. The circuit accomplishes nothing if the obstruction is not that near. The vibrator receives a signal from Node Mcu if the obstruction is nearby. After the impediment is identified, it vibrates. Additionally, it vibrates in order to detect the manholes. As a result, this technique enables vision impaired individuals to sense obstacles. Our project's detection range is adjustable up to 500 cm, with a default value of 20 cm. The blind stick will vibrate if the obstruction is within this range. OCR technology is being utilized to create a gadget that makes text from books, newspapers, or cash audible to blind individuals. An Android application for text-to-speech conversion has been developed. Another special characteristic of the gadget is its ability to detect fires. The ESP32 camera records the digital text, which is subsequently translated into voice and played on the mobile device when the blind stick detects heat higher than usual. This alert sound alerts the user to the fire that is ahead of them. After the designed mobile software is downloaded to an Android phone, it will do all the tasks required for the blind stick.

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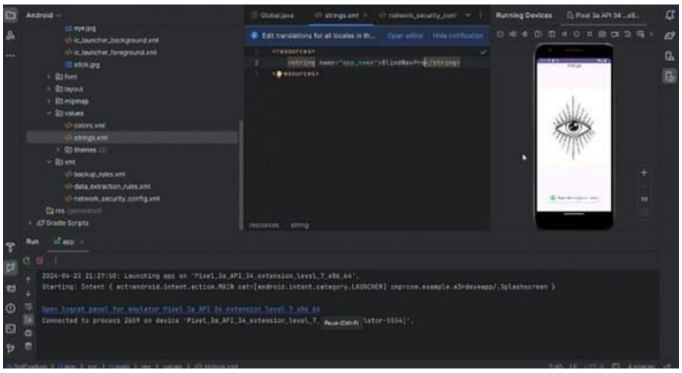

Fig1 12: Screenshot of output

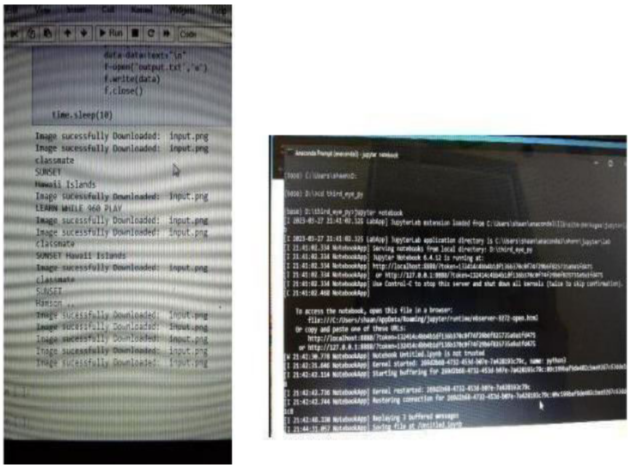

Fig 13: Output of ESP32 Camera

VIII. CONCLUSION AND FUTURE SCOPE

At this point, it's important to note that the study's goal designing and implementing a smart walking stick for the blind has been completely accomplished. The Smart Stick serves as a foundational platform for the next wave of assistive technology, which will enable the blind to securely traverse both interior and outdoor environments. It is both economical and efficient. It produces decent results when it comes to identifying impediments in the user's path up to three meters away. This system provides a strong, affordable, portable, low-power, and dependable navigation solution with a noticeable quick reaction time. Despite having sensors and other components hardwired in, the system is lightweight. Wireless communication between the system's components may be used to enhance the system's functionality in other ways, such as extending the ultrasonic sensor's range and putting in place a technology that measures the speed of impending obstacles. We prioritized the needs of blind individuals in all poor nations when creating such an empowering solution.

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