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AI-based TTS Support for People with Visual Impairments (text to speech)

Aziz, Syeda, Mohammed Junaid, Abdul Wadood
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I. ABSTRACT

Today, everyone has to be able to make their own way in the world, yet this independence may be difficult for persons who are blind or visually impaired. The individual is unable to detect or feel the surrounding environment due of visual impairment. People in this situation would benefit greatly from having access to various equipment designed to help them carry out their tasks without assistance. Improvements in areas like as mobile communication and AI have made it easier to provide assistance in their everyday lives. The combination of AI, picture recognition, and geolocation makes our technology a viable aid for the visually impaired community. In order to execute our concept, we built a pi camera on a raspberry pi that uses TTS to tell users about their immediate surroundings, a GPS module to let users explore the area using their mobile devices, and an obstacle detection sensor. To better communicate with its surroundings, it can also analyse photos and translate them into words.

II. INTRODUCTION

People who are visually challenged report a wide range of issues while trying to read printed text with the available technology, including accuracy, portability, and efficiency. To help the vision challenged, we've developed a smart gadget that can quickly and accurately read printed text. To read Text documents, the suggested approach employs a camera-based auxiliary aid. A Raspberry Pi board, a built-in camera, and an ultrasonic rangefinder are the building blocks of this framework for implementing image capture techniques in an embedded system.

III. PROBLEM DEFINITION & WORK PLAN

Next, we'll be working on a system to gather data from the pi camera worn by a vision challenged individual on his or her shoulder. The visual information is sent to a microcontroller based on the Raspberry Pi, which, with the aid of artificial intelligence, converts the textual information into an audible format. Shoulder-height obstructions are detected using an Ultrasonic sensor with a detection range of 8-10 cm. The user is aided by proximity detection in avoiding potential dangers. The user's position is sent to the API managed by the caretaker using a GPS system mounted on the raspberry pi board. When the carer sends a text message asking for the position, the vehicle's built-in Wi-Fi transmits the coordinates to its server on the internet.

IV. METHODOLOGY:

The strategy relied on breaking the system into modules, with each module standing in for a particular goal. The goal of this method is to simplify the system's debugging process early in its creation. In addition to ensuring the longevity and dependability of the system as a whole, the modules must be integrated to provide a fully operational system. Specifications are defined, simulations are run, components are chosen, Python code is written, tested, integrated, and verified.

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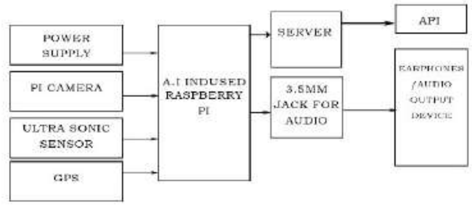

Figure 1: Block Diagram

V. EXPERIMENTAL SETUP

The system's block diagram is seen in Figure 1. We've constructed an experimental platform with the help of a number of different pieces of hardware. This system uses artificial intelligence to detect nearby objects and generates an auditory signal. Next, we'll take a high-level look at each of the hardware modules included in the system.

Hardware Modules

A. RASPBERRY PI 3 MODEL B+:

The Broadcom BCM2837B0, Cortex-A53 (ARMv8) CPU running on a 64-bit SoC at 1.4GHz is found in the Raspberry Pi 3 model B+, the latest and greatest edition in the Raspberry Pi 3 line. Wi-Fi LAN supporting IEEE 802.11a/b/g/n/ac at 2.4 and 5 GHz. This device is compatible with Bluetooth 4.2 and BLE (Bluetooth low energy). Onboard Wi-Fi conforms to the IEEE 802.11.b/g/n/ac standard for wireless LAN access to the internet. The GPIO input/output pins have been expanded to a 40-pin header. Full-size HDMI, the audio/video output standard of today, is present. In order to connect to the outside world, there are four USB 2.0 connections available. Raspberry Pi camera connection CSI camera port. Raspberry Pi touchscreen support through DSI display port. Component video in/out and a 4-pole stereo jack are also included. Support for installing operating systems and transferring data through Micro SD card. The input DC voltage is 5V, and the current is 2.5A. Provides power over Ethernet (PoE) (requires separate PoE HAT).

Reason to choose ARDUINO UNO:

-Low cost (~35$)

-Huge processing power in a compact board

-Many interfaces (HDMI, multiple USB, Ethernet, onboard Wi-Fi and Bluetooth, many GPIOs, USB powered, etc.)

-Supports Linux, Python (making it easy to build applications)

-Readily available examples with community support

-Developing such an embedded board is going to cost a lot of money and effort

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Figure 2: Raspberry Pi 3 Model B+

Microprocessor	Broadcom BCM2837 64bit Quad Core Processor
Processor Operating Voltage	3.3V
Raw Voltage input	5V, 2A power source
Maximum current through each I/O pin	16mA
Maximum total current drawn from all I/O pins	54mA
Flash Memory (Operating System)	16Gbytes SSD memory card
Internal RAM	1Gbytes DDR2
Clock Frequency	1.2GHz

Table 1: RASPBERY PI 3 TECHNICAL SPECIFICATION

B. POWER SUPPLY:

In electrical systems, the term "power supply" refers to the component that transfers energy from an electrical source to the load.

A power supply is a device that takes electric current from a generator and adjusts it so that it has the proper voltage, current, and frequency to power the load.

A power supply's input connection is where it takes energy in the form of electric current from its source, and its output connection(s) are where it sends that current to the load.

Figure 3: Power supply

C. PI CAMERA:

As the official camera board for the Raspberry Pi, the Raspberry Pi Camera v2 is the latest product to be produced by the Raspberry Pi Foundation.

The Raspberry Pi Camera Module v2 has a fixed focus lens and an 8-megapixel Sony IMX219 image sensor, making it a high-quality add-on board for the Raspberry Pi.

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You can record HD video and still images with the Raspberry Pi camera module. It's simple enough for newcomers to pick up, yet rich with features for those with more experience. Many videos demonstrating its use for time-lapse, slow-motion, and other creative purposes can be found online. You may also make use of the included libraries for the camera to generate your own effects.

Those who care about such things should know that the module is equipped with a five-megapixel fixed-focus camera that can record in 1080p30, 720p60, and VGA90 video formats and take still images. A 15-centimeter ribbon cable connects it to the Raspberry Pi's CSI port. The Pi-camera Python library is only one of several third-party libraries available for it, along with the MMAL and V4L APIs.

The camera module is often used for monitoring private properties and capturing animals.

Figure 4: Pi camera

D. HC-SR04 ULTRASONIC SENSOR:

An acoustic sensor, ultrasonic transducers may be broken down into three categories: transmitters, receivers, and transceivers. One may use a transceiver, which can both send and receive ultrasound, or a transmitter, which can convert electrical impulses into ultrasound, or a receiver, which can convert ultrasound into electrical signals. Ultrasonic transducers are used in systems that assess targets by deciphering reflected signals, much like radar and sonar. The distance to an item may be determined, for instance, by timing how long it takes from when a signal is sent until an echo is received. To detect ultrasonic sounds, passive ultrasonic sensors essentially function as microphones. Diagnostic transducers, such as those used in range-finding applications, often have lower power requirements than those employed to alter the chemical, biological, or physical (e.g., erosive) features of the liquid medium or objects submerged in the liquid media.

Figure 5: HC-SR04 ULTRASONIC SENSOR

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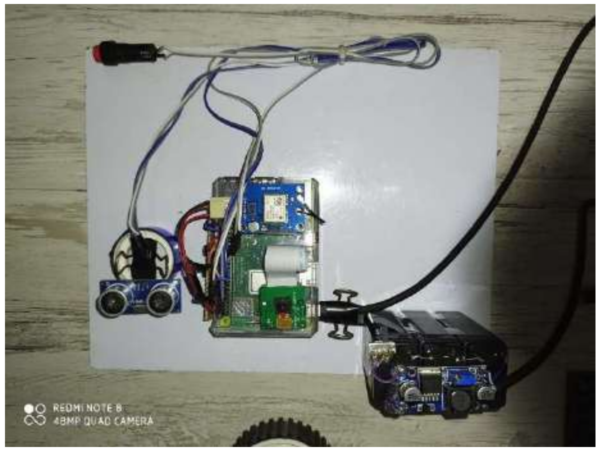
I. VI. HARDWARE SETUP

The below figure shows the full hardware setup of the system.

Figure 7: Implementation of Hardware Setup



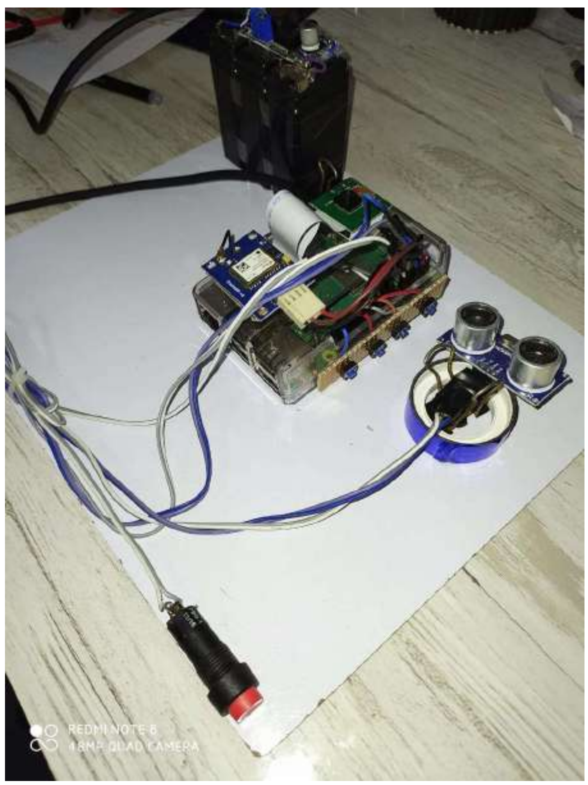


Figure 8: Hardware Setup

VII. ALGORITHM AND FLOWCHART

A. Algorithm:

• The raspberry pi initialises the libraries of the pi camera, ultrasonic sensor, GPS module, and Espeak when power is applied.

• Once all the necessary libraries have been loaded, the ultrasonic sensor may begin its rangefinding duties. Unless stopped, this procedure will continue to repeat indefinitely.

A distance reading is taken by Espeak and stored when the ultrasonic sensor detects an item within range.

There are two potential outcomes to this procedure. If you don't click the button, the ultrasonic sensor will revert to its original distance-checking mode.

• When the button is pushed, the AI-enhanced raspberry pi activates its camera and processes the resulting picture.

•In order to update the server on where it is, the GPS device transmits that information.

• The camera's.jpg file has been processed, and it's now being converted into a text file for the Espeak.

• Espeak takes this text file and transforms it to its corresponding audio format, then plays it back to the user in speech form.

B. Flowchart:

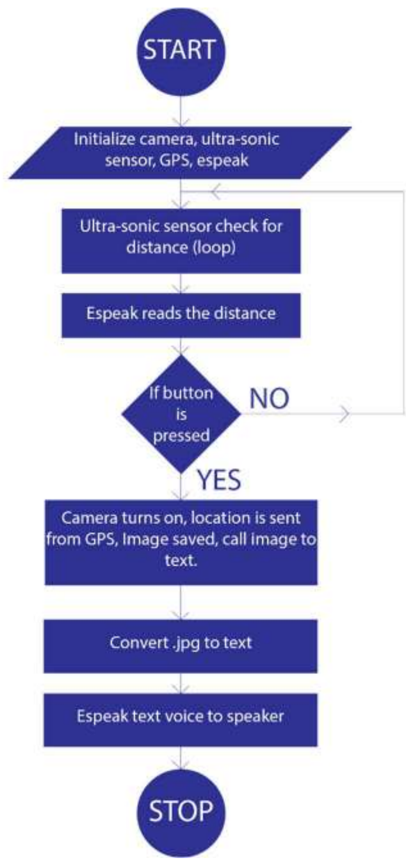


Figure 9: Flow Chart

X. ADVANTAGES AND LIMITATIONS

A. ADVANTAGES:

1. The primary benefit is that it can read aloud detected text for the visually handicapped.
2. It aids the visually handicapped in seeing potential dangers in their environment before they become serious.

3. The device's built-in GPS technology makes it simpler to determine the user's current position in real time via the use of an application programming interface (API) on a mobile device.
4. The use of A.I. in this project has greatly improved the speed and accuracy with which data is computed.

B. LIMITATIONS:

1. The only way visually impaired persons can read material is via a screen reader, thus they often miss out on opportunities to learn the precise spelling of words, particularly when they pertain to technical or specialized fields like medicine.

XI. FUTURE SCOPE

According to our current proposal, our designed system functions perfectly in private homes. Compared to similar systems developed by other groups, my suggested system incorporates a few minor enhancements and the addition of new functionality. There are plans to modify this system in the future to a web-based monitoring system utilising the GPRS method, allowing users more convenience in gaining remote access to the system over the Internet. A system update would also be implemented to allow for the surveillance of a greater region. In addition to measuring temperature and humidity, the system would also evaluate data from other sensors, such as a barometric pressure sensor, a gas detector for checking air quality, and a web interface.

XII.CONCLUSION:

People with low vision have the greatest need for this. Those who are blind or have low vision may use it to read the text without assistance. They may utilise it to decipher notes, memos, and other written materials. This technology enables the vision handicapped to read text in the same way sighted people do.

Some individuals find screen readers uninteresting because the speech they employ sounds like it came from a machine. Companies are working hard to develop voice synthesisers that can accurately imitate human reading, down to the appropriate intonation, but although they have made great strides in recent years, they are still a long way from their ultimate aim.

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