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AIOI as Vision Aid for Visually Impaired People

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ABSTRACT*:* Internet of Things (IoT) and AI are now becoming the emerging issue in the field of research. IoT is used in home appliances, health monitoring, Industry Internet and many more. Sensors and Actuators play important role in the Internet of Things. AI is already playing a large part in healthcare. It is helping with faster, improved diagnoses, personalized treatment and drug discovery. In day-to-day life, Vision is one of the highly important senses needs to be taken care with utmost care but the people who lost the capability of seeing the world should not be treated pity by others. In such cases, technology has come forward to help the people with visually deficient to travel along with the living environment and disseminating their life smoothly to undergo activities in rapid manner. The proposed system assists the visually impaired to recognize several objects and provides an audio message to aware the user. Four laser sensors are used in the system to detect the objects in the direction of the front, left, right and ground. Deep learning, as a promising technology, is also expected to improve the lives of visually impaired people. The critical challenges faced by visually impaired users in using Assistive systems based on smartphones, IoT devices, sensors, etc have been discussed along with future directions. The device notifies the user of these detections through sound or vibration alerts. The project also includes a survey involving visually impaired individuals from the local community. Open CV and Python are the programming languages used for implementation, and the prototype investigates algorithms for detecting objects, including a warning signal for obstacles.

I. INTODUCTION

The ever increasing number of blind persons attracts the development of many assistive devices around the world with the hope that these will help visually impaired in leading normal lives. One in every 179 people is blind. As per the current statistics, India contributes to 21% of the total blind population all over the world. In India itself, around 8 million people out of around 39 million people are blind. And in a million, 53 thousand people are visually impaired, 46 thousand people have Low Vision and 6800 people have complete vision loss i.e. they are blind. And unfortunately, as per the current statistics only 5% of them have access to any kind of assistive technology.

Given the fast-paced life now-a-days one faces many difficulties due to the congestion of obstacles in the environment, it would be even worse for the visually impaired people. They usually rely on either external assistance which can be provided by humans, trained dogs or other electronic support systems for decision making. Existing systems are able to detect obstacles at the ground level or at the waist level or above but not together. Hence we were motivated to develop a device which intends to guide the human through the obstacles at both ground and waist level. We implemented two modules, one is the Shoe Unit and the other one is Cane Unit. So we wanted to provide an additional feedback to the user before he runs into the obstacle. The IOT is a theory which reflects a connection of any person, anything, anytime, anywhere, any service and any network. IOT is an upcoming trend in next-generation technologies which will affect the whole scope of the heart and can be considered as the interconnection of intelligent objects and devices. The IOT compromises suitable solution for a wide range of applications, such as smart cities, traffic congestion, waste management, structural health, security, emergency services, logistics, retail sales, industrial control and medical attention.

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II. LITERATURE REVIEW

1 PAPER 1
PAPER TITLE: “Smart Glasses for Visually Impaired Person”
AUTHOR NAME: Gaurav Kumar, Seema Nayak, Kishan Kumar, Jwala Prakash
YEAR: 2021
DESCRIPTION:
• Face recognition and distance detection features are enabled by the Raspberry Pi2as the heart of processing. The prototype consists of a Raspberry Pi 2 processor, a Raspberry Pi 2 camera, an ultrasonic sensor, a 5V power supply, and a pairof glasses. Experiment results demonstrate that the prototype is working as intended. • The World Health Organization (WHO) estimates that there are 285 million visually impaired people globally, with 39 million being blind. These individualsface difficulties in interacting with their surroundings, especially those who are unfamiliar with their surroundings. Researchers developed a smart glasses for visually impaired people to provide guidance efficiently and safely.
• The prototype uses a Raspberry Pi 2 processor, a Raspberry Pi camera for facial recognition, an ultrasonic sensor for obstacle detection and avoidance, and a 5V power supply to run the Raspberry Pi. The IoT is an upcoming trend in nextgeneration technologies that affects the whole scope of the heart and can be considered as the interconnection of intelligent objects and devices.
• The proposal of this smart glass mainly depends on the Raspberry Pi 2 processor, which is a Linux-based ARM processor that supports a micro SD card. The Raspberry Pi camera is connected to the Raspberry Pi through a flex cable and is fixed on the top center of the glasses for optimal image capturing.

2 PAPER 2
PAPER NAME: Smart Glass Using IoT and Machine Learning Technologies to aid the blind, dumb and deaf AUTHOR NAME: Siddhant Salvi, Sudipta Pahar, Yuvraj Kadale
YEAR: 2020
DESCRIPTION:
• The researchers propose a solution that provides a new technological eye, ear, and brain for disabled individuals. Machine learning algorithms are used for object detection, speech to text conversion, and text to speech conversion to aid the deaf and dumb while communicating. The amalgamation of these technologies with IoT technologies will help resolve issues related to these differently abled people.
• The hardware requirements for the smart glasses include a transparent OLED panel for viewing speech-to-text conversion displayed over the HUD, a normal OLED panelwith a mirror to reflect text directly to the user's glass, IP cameras for processing rawfootage, and proximity sensors for impact-resistant technology.
• The researchers have modified pre-defined algorithms and designed the implementation according to hardware requirements, including the use of a transparentOLED panel, a normal OLED panel, IP cameras, and proximity sensors.

3 PAPER 3
PAPER NAME: “Smart Glasses for Blind People”
AUTHOR NAME: Dr. Sankit Kassa, Manisha Inchanalkar, Amisha Kamble, Mayuri Inchanalkar
YEAR:2021
DESCRIPTION:
• The device converts an image's text to speech using an embedded system that captures an image, extracts only the region of interest (the part of the image that contains text), and converts that text to speech. The device is implemented using a Raspberry Pi and a Raspberry Pi camera.
• The captured image undergoes a series of image pre-processing steps to locate only the part of the image that contains the text and removes the background. Two tools are used to convert the new image (containing only the text) to speech: OCR softwareand TTS engines. The audio output is heard through the Raspberry Pi's audio jack using speakers or earphones.
• The main goal of "Smart Glasses" is to help blind people and those with vision difficulties by introducing a new technology that makes them able to read typed text. These glasses are provided with technology to scan any written text and convert it into audio text. They effectively help blind people and people with vision difficulties in various life aspects, such as education.

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4 PAPER 4
PAPER NAME: "Blind Assistance Device using AI"
AUTHOR NAME: Safnaz, Nayana Manju Jogi, Shreya Shetty, Rathode, Mrs. Deeksha K
YEAR: 2021
DESCRIPTION:
• The article presents a paper on a project to develop an assistance device for blindand visually impaired people using AI and OCR. The project focuses on person expression detection and classification on pictures captured by the device and alsotext to voice conversion mounted on a device.
• The system uses Tensor Flow and the Raspberry Pi to convert and recognize whatthe visual is about, and then the gadget will vocally help the person
• Facial expression recognition is a crucial component of natural human-machine interfaces and can also be used in behavioral research.
• The paper provides a facial recognition approach based on Convolutional Neural Networks (CNN) and predicts the expression label, which should be one of the following: anger, fear, happiness, neutral, sadness, or surprise.

5 PAPER 5
PAPER NAME: "A Survey on Assistive Technology for theVisually Impaired"
AUTHOR NAME: Shivang Tripathi, Chandrani Halder, D.Vanusha
YEAR:2018
DESCRIPTION:
• This paper discusses recent developments in assistive technologies for the visually impaired, focusing on mobile applications that can detect and differentiate between objects, navigate, recognize text, and provide vibrational and audio feedback.
• The paper provide an overview of these recent advancements, especially in the field of application development for the assistance of the visually impaired.
• Artificial neural networks are major computing systems used for image recognition and classification, and voice recognition requires training data. With the advent of APIs like Google Vision, Google Speech, the task of image and voice recognition is reduced to mere API calls, allowing developers to focus on providing more features and helping the visually impaired with better interactionand ease.

6 PAPER 6
PAPER NAME: "Smart Glass System Using Deep Learning for the Blind and Visually Impaired"
AUTHOR NAME: Mukhriddin Mukhiddinov and Jinsoo Cho
YEAR: 2021
DESCRIPTION:
• The article discusses a smart glass system using deep learning for the blind andvisually impaired to facilitate independent movement in a night-time environment.
• The system includes low-light image enhancement, object recognition and audio feedback, salient object detection, and text-to-speech and tactile graphicsgeneration models. The study evaluates the performance of the system on challenging datasets.
• At least 2.2 billion people worldwide suffer from vision impairment or blindness, of whom at least 1 billion have a vision impairment that could havebeen prevented or is yet to be addressed.

7 PAPER 7
PAPER NAME: "Lightweight Smart Glass System with AudioAid for Visually Impaired People"
AUTHOR NAME: Feng Lan, Guangtao Zhai and Wei Lin
YEAR: 2015
DESCRIPTION:
• The paper presents a lightweight smart glass system with audio aid for visually impaired people. The smart glass system aims to provide greater accessibility to the environment for those with visual disabilities, who rely on other senses such as hearing, touch, and smell to understand their surroundings. The system can seethe world for the blind and provide voice instructions and hints through wireless bone conduction headphones. This will help visually impaired people gain increased independence and freedom in city life.

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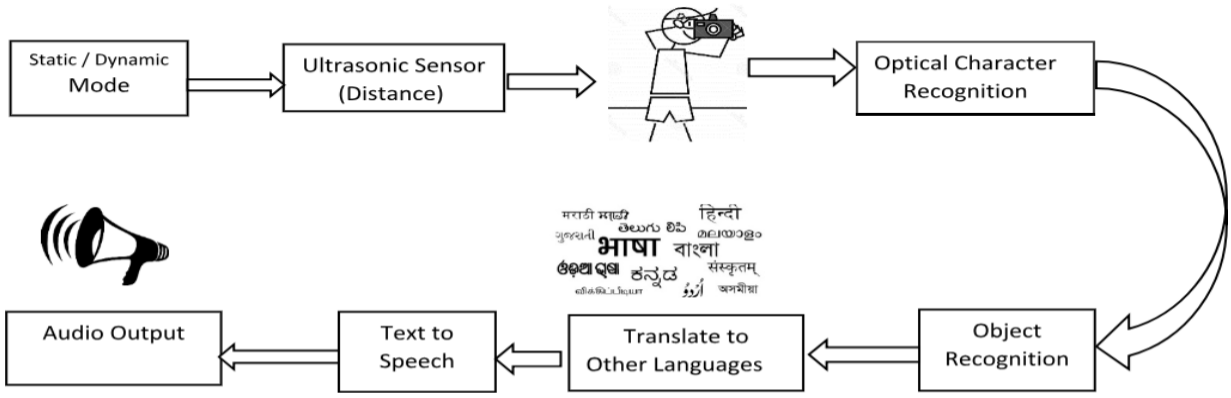
• The application of public signs recognition on the smart glass system detectsand recognizes public signs in cities, providing corresponding voice hints to the blindness. The proposed prototype system is based on Intel Edison, a tiny computer offered by Intel as a development system for wearable devices.
• The smart glass system aims to help visually impaired people gain increased independence and freedom in city life by allowing them to "see" the world withthe help of other devices. The extended demonstration of the system will be presented to show how the system helps the blindness "see the world."

III. METHODOLOGY OF PROPOSED SURVEY

In our proposed system, the blind people have sensor enabled smart glass to examine which object it is. Here, we have distance sensor detects depth or height the staircase step and tells to people. The proposed system deals with the cheaper and effective obstacle detection with a wide range of coverage. The block diagram of the proposed system is shown in below picture. The product uses the Ultrasonic sensor to find the distance to the closest object and informs the user of the same. The Raspberry pi camera module then takes a picture of the user's surroundings with the camera which is later passed on to the OCR and object detection module.



In our system we use backend processing device to reduce a load of glass to make it easily wearable, as shown on below architecture user can keep it in their pocket or hand.

Fig.1 Architecture of device

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Considering modern era, and revolution in technology we try to introduce an equipment which can help to face daily life problems of visually impaired person. An open source smart glasses project is what we want to create. This smart glass can assist them while walking alone in new environments by taking inputs through a camera and providing feedback to the person through headphones. So, blind people can be trained to visualize objects using sensory substitution devices programmed. Working of proposed system is shown in below fig.2.

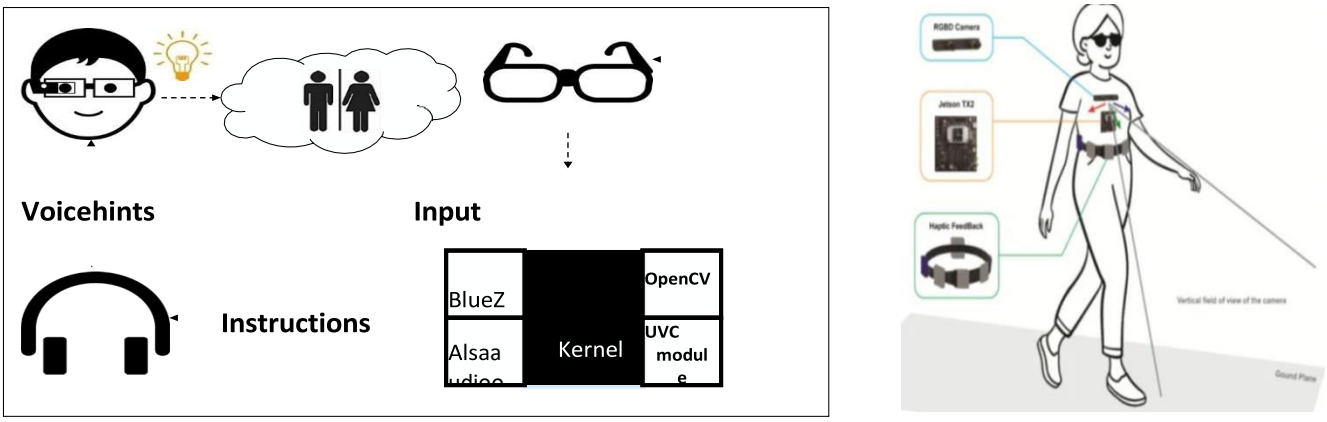

Fig.2 working flow of proposed system

Development Tools Hardware –

1. Raspberry pi
2. Ultrasonic Sensor
3. Camera
4. Speaker
5. Power source (e.g., battery pack)
6. Enclosure or casing for wearable device

Software – Operating System: 64 bit Linux and windows 10, Technology: python, Software: Anaconda, python 3.11, visual studio

IV. BLOCK DIAGRAM AND CIRCUIT DIAGRAM

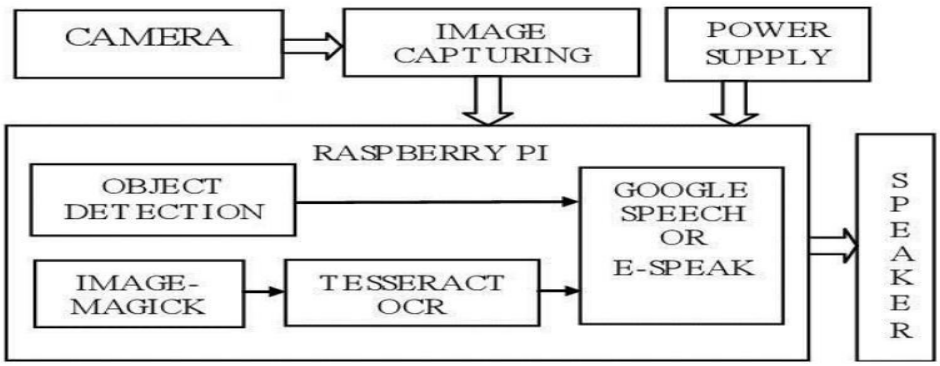

Figure 1. Block Diagram

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The major elements of block diagram are:

- Raspberry pi
- Camera

RASPBERRY PI

Fig Raspberry Pi 4

The Raspberry Pi 4 is the latest product in the Raspberry Pi range, boasting an updated 64-bit quad core processor running at 1.4GHz with built-in metal heatsink, USB 3 ports, dual-band 2.4GHz and 5GHz wireless LAN, faster (300 mbps) Ethernet, and PoE capability via a separate PoE HAT.
This version comes with 1GB of RAM, but we also have versions with 2 and 4 GB if you like.
Pi 4 B is upgraded with Latest High-Performance Quad-Core 64-bit Broadcom 2711, Cortex A72 processor clocked at 1.5GHz speed. Which is designed to use 20% less power or offer 90% greater performance than its old version. Hardware upgrade on Pi4 developed for more faster performance not only the loading time with all new 1GB/2GB and 4GB LPDDR4 SDRAM variants but also in connectivity with Dual-band 2.4GHz and 5GHz, 802.11 b/g/n/ac wireless LAN and PoE capability via a separate PoE HAT. Addition to it USB 3.0, improve the transfer speed by 10x than USB 2.0 to provide you significantly faster true Gigabit internet experience.
Though the Pi 4 has type C USB port for 5V 3A input power capacity, new Hardware on Pi 4 even required less power than the previous versions therefore old power adapter can provide plenty of power to the chip, Ethernet, and any USB add-ons you plug in on board.

Specifications of Raspberry 4:

- Model-Raspberry Pi 4 Model-B
- Processor- Broadcom BCM2711, quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
- RAM Memory - 1 GB LPDDR4 SDRAM

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ULTRASONIC SENSOR

Fig 17 Ultrasonic sensor

This HC-SR04-Ultrasonic Range Finder is a very popular sensor which is found in many applications where it requires to measure distance and detect the objects. The module has two eyes like projects in the front which form the Ultrasonic transmitter and Receiver. The HC-SR04 ultrasonic sensor uses sonar to determine the distance to an object like bats or dolphins do.

This ultrasonic sensor module is a transmitter, a receiver, and a control circuit in one single pack. It has a very handy and compact construction. It offers excellent range accuracy and stable readings in an easy-to-use package. Its operation is not affected by sunlight or black material like Sharp rangefinders are (although acoustically soft materials like cloth can be difficult to detect).

Also, an internally threaded hole is there on the shaft to allow attachments or extensions such as wheel to be attached to the motor. The outer body of the gear head is made of high density plastic but it is quite easy to open as only screws are used to attach the outer and the inner structure. The major reason behind this could be to lubricate gear head from time to time. The plastic body has a threading through which nut can be easily mounted and vice versa from the gear head.

Camera

This full functionality Webcam can deliver smooth and detailed high-quality video. With bright, crystal clear footage and vibrant colors, make your video chat or online conference session, a wonderful experience. Audio quality is also immaculate. Use this camera with common Videotelephony programs such as Skype, windows Live Messenger, Google Duo, Viber and Facebook Messenger.

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V. ADVANTAGES AND APPLICATIONS

Advantages

1. Blind stick is an innovative stick designed for visually disabled people for improved navigation. Blind stick allows visually challenged people to navigate with ease using advanced technology.
2. Help blind people to easily walk to destination.
3. Having feature to left and right turn alarm signal.

Applications

The vision aid system developed in this project has various potential applications, including:

1. Personal navigation assistance for visually impaired individuals in indoor and outdoor environments.
2. Enhanced accessibility features for public spaces, such as transportation hubs and shopping centers.
3. Integration with existing assistive technologies, such as smartphones and smart glasses, to provide seamless user experiences.

VI. CONCLUSION AND FUTURE WORK

In conclusion, device is designed for visually impaired individuals represent a remarkable fusion of cutting-edge technology and inclusive design. These innovative devices offer a profound opportunity to enhance the lives of those with visual impairments, empowering them with newfound independence, accessibility, and social inclusion. Through the application of AI, machine learning, and real-time data processing, device can identify objects, provide navigation assistance, read text aloud, recognize faces, and offer comprehensive environmental information. As technology continues to evolve, so does the potential to bridge the accessibility gap and empower visually impaired individuals to lead more independent, fulfilling lives.

FUTURE WORK

1. Advanced Sensory Capabilities: Future smart devices may incorporate additional sensors, such as thermal imaging, depth sensors, and advanced environmental sensors, to provide users with more comprehensive information about their surroundings.
2. Enhanced AI and Machine Learning: AI algorithms will become more sophisticated, allowing smart devices to recognize a wider range of objects, interpret complex scenes, and provide more accurate and context-aware information.
3. Global Navigation: Improved navigation systems will offer global coverage and real-time data, making it easier for users to travel independently, even in unfamiliar locations.
4. Voice Control and Natural Language Processing: Enhanced voice control and natural language processing will make interactions with smart devices more intuitive and user-friendly.
5. Personalization and Customization: Future devices will provide more options for users to tailor the user interface, settings, and feedback to their specific needs and preferences.
6. Health Monitoring: Smart devices may incorporate health monitoring features, such as heart rate and blood pressure monitoring, to support users' overall well-being.

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