Design of Voice Guided Smart Glass for Visually Impaired Individuals

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ABSTRACT–Visual impairment poses significant challenges to the independence and mobility of affected individuals. This paper introducesa novel solution, the "Voice-Guided SmartGlass," designed to empower visually impaired individuals by providing them with an intuitive and accessible tool for navigating their surroundings. The system leverages ultrasonic sensors and Bluetooth communication technology to create an innovative wearable device. Ultrasonic sensors built into the Voice-Guided Smart Glass continuously scan the user's surroundings to identify obstacles in real time. These sensors measure distance and transmit the data to the device's microprocessor. The Voice-Guided Smart Glass is a noteworthy improvements in assistive technologyfor those with visual impairments. Its smooth Bluetooth communication and ultrasonic sensor integration encourages more independence and confidence in day- to-day living in addition to improving mobility and safety. This paper discusses the design, implementation, and potential impact of this innovative solution on the lives of visually impaired individuals, offeringa promising path towards a more inclusive and accessible future.

I.INTRODUCTION

The smart glasses for the impaired will be improved with many sensors, each with unique features to help visually impaired persons navigate. Visual impairment is a profound challenge that impacts the independence and quality of life for millions of individuals worldwide. The loss of sight often necessitates a heightened reliance on assistive technologies to navigate the complexities of the modern world.

The Voice-Guided Smart Glass (VGSG) designed explicitly for visually impaired individuals. VGSG leverages the latest advancements in technology, incorporating ultrasonic sensors and Bluetooth communication, to provide real- time assistance and empowerment to those with visual impairments. A visually impaired person through their daily life is filled with obstacles and uncertainties. Simple tasks, like crossing the street, reading signs, or navigating unfamiliar environments, can be daunting challenges.

Traditional assistive devices, though valuable, often lack the sophistication needed to provide dynamic and real-time guidance. VGSG consists of a lightweight pair of smart glasses, discreetly designed to be worn comfortably throughout the day. Modern ultrasonic sensors built into these glasses continuously scan the wearer's environment to identify items and difficulties in real time. An on- board microprocessor processes the gathered data and converts it into audible instructions that are actionable and understandable. The user receives these instructions via a headset.

VGSG doesn't stop at obstacle detection and voice guidance alone. The glasses are seamlessly integrated with a companion mobile application via Bluetooth communication. This innovative technology has undergone rigorous testing in diverse real-world scenarios, consistently demonstrating its effectiveness in providing precise obstacle detection and reliable guidance.

LITERATURE SURVEY

The advancement of navigation and routing systems over the past few decades has made it more difficult for researchers to create clever and intelligent guiding mechanisms for blind and visually impaired persons (BVIPs) both indoors and outdoors. The current body of research must be examined historically, from the early studies on the first electronic travel aids to the use of contemporary artificial vision models for BVIP navigation. Diverse approaches such as: e-cane or guide dog, infrared-based cane, laser based walker and many others are proposed for the navigation of BVIPs. But most of these techniques have limitations such as: infrared and ultrasonic based assistance has short range capacities for object detection. However, others may be harmed by laser-based help if it strikes them in the eyes or any other part of the body. Implementing this technology will require making these trade-offs. To offer a review of the trends and data collected in the suggested topic while methodically evaluating, analyzing, and identifying the major studies in this specialized sector. To carry out this systematic research, a collection of pertinent keywords must be defined, four research questions must be developed, article selection criteria must be established, and the empirical data in this field must be synthesized. The 191 most pertinent papers to the suggested field published between 2011 and 2020 make up our studypool. Researchers will be able to make more informed judgments byimpairments typically utilize them to detect obstacles because they are familiar with all the familiar spots. In a foreign and unfamiliar setting, they are entirely dependent on passersby asking questions about specific locations. Along with a variety of sensors, a system with the simplest invention should exist in the modern world to help people live a little more peacefully. In this proposed study, a contactless, hands-free, LVU discrete wearable gadget was built to help blind persons detect impediments. A proper mobile assistance equipment is required to give the disabled people safe mobility. In order to help the user distinguish between empty space and impediments, this study proposes a safe wearable device with audio output for benign local navigation in both indoor and outdoor environments. The gadget on display consists of a wearable strap equipped with sensors. The pulses from the LiDAR offer accurate and dependable measurements of the distances between the handler and obstacles when they are used in conjunction with a TOF sensor that is fastened to the front of the belt that the users wear. The convolution neural network algorithm processes and classifies the image that was taken by the camera. One audio input is provided, which is the identified image. The goal of this study was to create a smart walking stick that could identify hazards for blind individuals. The chosen sensors and electronic parts might be programmed using Arduino. To identify barriers and calculate their closest distance, an ultrasonic distance sensor was employed. When an ultrasonic distance sensor picked up obstructions, it was utilized to sound an auditory alert. Additionally, experimental studies were applied on GPRS sensor which is used forsend locational information via SMS to caretaker of blind person when she or he lose the way.

EXISTING SYSTEM

Merits

The identifying effective technologies and highlighting areas needing improvement, the development of more accessible and user - friendly navigation solutions.

Many smart walking sticks are integrated with features like SOS buttons, allowing users to quickly request help in emergency situations.

These devices offer specific location information, aiding in finding destinations like bus stops, entrances, specific rooms within buildings.

The open-source nature of Arduino allows customization to cater specific needs and preferences of individual users, making the technology adaptable to a wide range of situations. Demerits

High costs may limit adoption among individuals with limited financial resources or in developing regions, the limited availability of high- quality research studies. Devices with GPS and

connectivity capabilities raise potential privacy concerns, as they may collect and transmit user data. Technical limitations, like signal interference or incorrect guidance. Situations where precise depth of perception is crucial.

Overall information about navigation systems, different hardware components used for obstacle avoidance, shortest path deciding, route finding and many others are explained in this section of the paper. The discussion section encapsulates all the relevant articles of the final cost, making it possible to be widely used in the consumer market.

PROPOSED METHOD

The Voice-Guided Smart Glass (VGSG) for visually impaired individuals is an innovative. This technology system designed to enhance the daily lives of individuals with visual impairments. To provide real-time environmental information and navigational guidance, offering a new level of autonomy and safety. VGSG is advanced technology, including ultrasonic sensors, Bluetooth communication, and an Arduino Uno microcontroller, to deliver real- time obstacle information directly to the user via a headset Ultrasonic sensors, which generate high-frequency sound waves and time duration that it takes for the waves to recur after hitting obstacles, serve as the navigation system. The Arduino Uno microcontroller processes this data in real-time, generating precise information about the location, size, and proximity of obstacles. The navigation system consists of ultrasonic sensors, which emit high - frequency sound waves and measure the time it takes for the waves to bounce back after hitting obstacles. By analysing these measurements, the system can accurately detect the presence and proximity of obstacles in the user's path. These sensors are typically placed strategically on a wearable device or a walking cane, ensuring a 360- degree coverage area around the user. This microcontroller is connected to a Bluetooth module, which allows for seamless communication with a user-friendly mobile app installed on the blind or visually impaired individual's smartphone. The mobile app serves as the user interface and provides real-time navigation guidance.

HARDWARE REQUIREMENTS

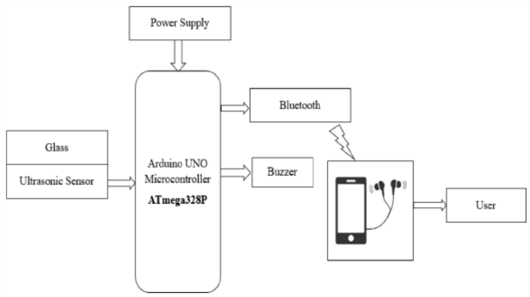

Fig 1.Proposed Block Diagram

WORKING PRINCIPLE

Voice-guided smart glass for visually impaired individuals is an innovative assistive technology that leverages a combination of hardware and software to enhance mobility and accessibility. At its core, the system is powered by an Arduino Uno microcontroller, which serves as the brain of the device. The power supply unit ensures a stable and reliable source of energy to keep the system running. One of the key components of this smart glass system is the ultrasonic sensor. This sensor emits high-frequency sound waves and measures the time taken for the waves to bounce back after hitting an obstacle. By analyzing this data, the system can accurately determine the distance between the user and objects in their vicinity. This information is then translated into real-time auditory feedback, providing the user with essential spatial awareness. When an obstacle is detected, a signal is sent to the Arduino Uno, which in turn triggers the Bluetooth module.

The Bluetooth module plays a crucial role in enabling communication between the smart glass and a paired mobile device. The visually impaired user can get additional information about their surroundings, including navigational instructions, sites of interest, and even alerts about potential hazards, by using a specialized smartphone application. Through two-way communication, the user is empowered to stay informed and make wise decisions as they navigate a variety of surroundings. Additionally, the system incorporates a buzzer, which can provide immediate, localized feedback to the user, acting as a supplementary alert the voice- guided instructions. This combination of technologies creates a comprehensive solution that enhances the mobility and independence of visually impaired individuals.

Ultrasonic Sensors: The system is equipped with ultrasonic sensors (typically, ultrasonic distance sensors) that are strategically placed on the smart glasses. These sensors emit high-frequency sound waves (ultrasonic pulses) and measure the time. It takes for these waves to bounce off objects in the

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user's vicinity and return to the sensors. The system can calculate the distance between the user and the barriers in front of them by computing the time delay.

- Arduino Uno: The Arduino Uno is the system's central nervous system. It receives the distance measurements from the ultrasonic sensors and processes this data to identify obstacles and their proximity to the user. The Arduino is programmed to trigger specific actions based on the detected distances, such as generating voice instructions and activating the buzzer when an obstacle is too close.
- Voice Instructions: To provide real-time guidance to the visually impaired user, the Arduino generates voice instructions based on the distance data from the ultrasonic sensors. These voice instructions are transmitted to the user via bone conduction speakers integrated into the headset. Bone conduction technology allows sound vibrations to be sent directly through the user's skull bones to the inner ear, bypassing the need for traditional earphones or headphones, thus keeping the user's ears open to ambient sounds for safety.
- Bluetooth Communication: The systemalso incorporates Bluetooth communication capabilities. It pairs with a companion mobile application running on a smartphone or other compatible devices. This app not only allows users to customize settings such as voice volume andfrequency but also provides additional features suchas GPS navigation assistance and remote assistance services. The mobile app communicates with the

Arduino via Bluetooth to relay relevant informationand receive updates from the device.

- Buzzer: In addition to voice instructions, a buzzer is included as an additional alertmechanism. When an obstacle is detected at a very close range or in critical situations, the Arduino triggers the buzzer to provide an audible warning to the user, ensuring their safety by providing redundant feedback.
- Battery and Power Supply: To make the system portable and wearable, it is powered by a battery. The power supply circuit ensures that the Arduino, sensors, bone conduction speakers, and buzzer receive a stable power source. Depending on the power requirements of the components and the battery capacity, the system can operate for extended periods before needing recharging.

HARDWARE DESCRIPTIONS POWER SUPPLY CIRCUIT:

The power supply unit is responsible for providing a stable source of electricity to the entire system. It typically connects to an external power source or a rechargeable battery, ensuring that the smart glass functions reliably without interruption. It has two pins they are positive pin and negative pin.

ARDUINO UNO

Controlling every other component in the system, the Arduino Uno serves as its brain. It oversees the ultrasonic sensor's data processing. By detecting obstacles, the Bluetooth module produces voice- guided instructions. The Arduino Uno's pins are designed to handle power to various components, send commands, and receive sensor data.

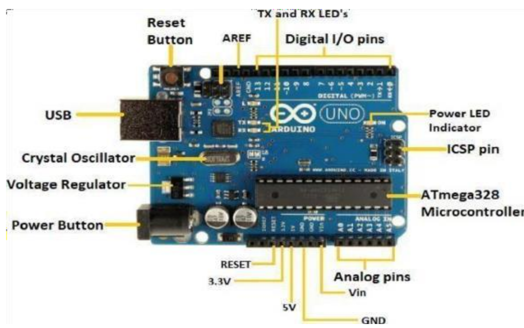

Fig 2. Arduino uno

PINS General Pin functions

✧ LED: A built-in LED is powered by digital pin 13. The LED is on when the pin has a HIGH value and off when it has a LOW value.

✧ VIN: When the Arduino/Genuino board is powered by an external source other than 5 volts from a USB connection or other regulated power source, the input voltage to the board changes. This pin can be used to supply voltage or to access voltage if it is supplied via the power jack.

✧ 5V: This pin uses the board's regulator to provide a controlled 5V output. Three options are available for powering the board: the VIN pin (7– 20V), the USB connector (5V), or the DC power jack (7–20V). The board may sustain damage if voltage is supplied through the 3.3V or 5V pins, which avoids the regulator.

✧ 3V3: An on-board regulator-generated 3.3 volt supply. 50 mA is the maximum current draw.

✧ GND: Ground pins.

✧ IOREF: The Arduino / Genuino board's pin that supplies the voltage reference for the microcontroller's operation. When a shield is configured correctly, it can read the voltage on the IOREF pin, choose the right power supply, and activate voltage translators on the outputs to operate at either 3.3V or 5V.

✧ Reset: usually used to add a reset button to shields that prevent the board's reset button from working.

✧ Special Pin Functions

✧ Pin Mode (), digital Write(), and digital Read() routines can be used to convert any of the Uno's 14 digital and 6 analog pins into an input or output.They run on five volts. Each pin contains an inbuilt pull-up resistor of 20–50k ohm that is unconnected by default and can supply or receive 20 mA as recommended operating conditions. To prevent irreversible harm to the microcontroller, no I/O pin should have its value exceeded over 40mA. The six analog inputs on the Uno are denoted A0 through A5, and each one offers 10 bits of resolution, or 1024 distinct values. They measure from ground to five volts by default, but can you adjust the higher limit of their range utilizing AREF pin and Analog Reference() Functions. In addition, some pins have specialized functions:

BLUETOOTH MODULE

The HC-05 Bluetooth module is an integral component of voice- guided smart glasses designed for visually impaired individuals. Its primary purpose is to enable wireless communication between the smart glasses and external devices, such as a smartphone or earpiece. The HC-05 module facilitates the transmission of voice-guided instructions generated by the system, ensuring that the user receives real-time guidance and information.

Pin Configuration and Explanation:

- ❖ VCC (Voltage Supply): This pin provides power to the HC-05 module. It typically operates at
- ❖ 3.3 volts, and you should connect it to an appropriate power source, ensuring it receives the required voltage to function correctly.
- ❖ GND (Ground): The GND pin is connected to the ground or negative terminal ofthe power source, creating a complete electrical circuit.
- ❖ TX (Transmit): The TX pin is used for transmitting data from the HC-05 moduleto external devices. It is connected to the corresponding RX
- ❖ (Receive) pin on the microcontroller, allowing data generated by the smart glass system, such as voice instructions, to be sent to external devices.
- ❖ RX (Receive): The RX pin is used for receiving data from external devices. It is connected to the TX pin on the microcontroller, allowing the module to receive data from external devices, such as user input or configuration changes.
- ❖ STATE/EN (State or Enable): This pin may have two functions depending on the module's configuration. It can be used to check the module's status
- ❖ (connected ornot connected) or to enable or disable the module's

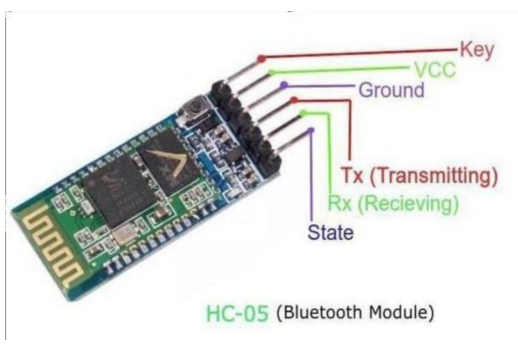

Fig 3. Bluetooth Module

communication function. Key/PIO11: The Key or PIO11 pin is used for entering AT command mode when pulled high or low, depending on the module's configuration. AT command mode allows for configuration and pairing of the module with other devices.

ULTRASONIC SENSOR:

An essential function of the Ultrasonic Sensor in a voice-guided smart glass system for the blind is obstacle detection. The high-frequency sound waves this sensor releases are measured for the duration of time it takes for the waves to return after hitting an object. It allows the wearer to calculate the distance to barriers in their path, which allows the system to recognize and react to possible threats. The Ultrasonic Sensor typically has four pins:

- ❖ VCC (Voltage Supply): This pin connects to the positive terminal of the power source (usually
- ❖ +5V) to provide the necessary power for the sensor to operate.
- ❖ GND (Ground): This pin is connected to the ground (0V) to complete the electrical circuit and ensure

proper functioning of the sensor.

❖ Trigger (Trig) Pin: This pin is used to send out the ultrasonic pulses. When the sensor is triggered, it sends a pulse of sound waves.

❖ Echo Pin: The Echo pin is responsible for receiving the reflected sound waves. By measuring the time delay between the Trigger and Echo pins, the Arduino or microcontroller can calculate the distance to an obstacle.

❖ The Ultrasonic Sensor, with its specific pin configuration, enables the smart glass system to detect obstacles accurately by emitting and receiving

Fig 4. Ultrasonic Sensor

ultrasonic waves. This real-time data is crucial for providing voice-guided instructions to visually impaired individuals, helping them navigate their environment safely and independent.

APPLICATIONS :

- Navigation and Way finding
- Education and Learning
- Employment and Workplace Integration
- Social Interaction
- Access to Public Services
- Recreation and Leisure Activities
- Daily Living Tasks
- Emergency Situations

BUZZER

The intensity or frequency of the buzzer indicates the proximity and size of the obstacle. A higher intensity or frequency signifies a closer and larger obstacle. When an obstacle is detected within a predefined distance, a buzzer is activated toalert the user.

Fig 5.Buzzer

A. SOFTWARE REQUIREMENTS ARDUINO IDE

A complete software platform for programming and creating applications for Arduino microcontrollers is the Arduino Integrated Development Environment (IDE). Arduino boards are open-source electronicsplatforms that allow hobbyists, tinkerers, and professionals to create a wide range of interactive and embedded projects. The

CIRCUIT DIAGRAM

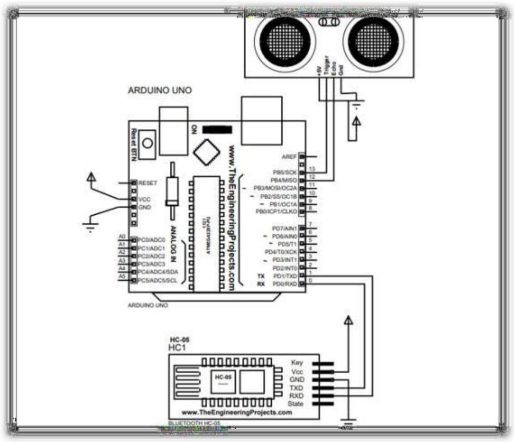

Fig 6. Circuit diagram

RESULT

The Voice-Guided Smart Glass for Visually Impaired Individuals offers an invaluable enhancement in the perception of obstacles, granting the visually impaired time to comprehend their surroundings. This expanded field of vision results in improved comfort, safety, and simplicity of carrying out daily duties. It functions essentially as a well-defended shield, preserving the user's independence and empowering them to move around their environment with assurance and security.

CONCLUSION

The Voice-Guided Smart Glass for Visually Impaired Individuals, powered by ultrasonic sensors and Bluetooth communication, represents a transformative leap forward in enhancing the daily lives of visually impaired individuals. By integrating cutting-edge technology components such as the Arduino Uno, a rechargeable battery, and a power supply unit, this innovative system addresses the crucial challenge of obstacle detection and navigation for the blind. The working principle of this smart glass is rooted in the precise detection of obstacles using ultrasonic sensors. These sensors, guided by the Arduino Uno, continually scan the user's surroundings, enabling real-time obstacle identification. When an obstacle is detected, the system generates clear and immediate voice instructions, which are transmitted directly to the user via a headset model, typically bone conduction speakers.

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