SMART GLASSES USING ULTRASONIC SENSOR FOR VISUALLY IMPAIRED PEOPLE

A PROJECT REPORT

Submitted by

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ABSTRACT

Smart glasses equipped with ultrasonic sensors offer an innovative solution for enhancing the mobility and independence of visually impaired individuals. These glasses are designed to detect obstacles and provide real-time feedback to the user, helping them navigate their environment more safely and efficiently. The core technology involves ultrasonic sensors embedded in the frames, which emit sound waves and measure the time taken for the echoes to return from nearby objects. This data is processed to determine the distance and position of obstacles. The smart glasses are connected to a Arduino Nano that interprets the Ultrasonic sensor data and triggers the buzzer to alert the blind one, such as vibrations or spoken warnings, to inform the user about the proximity and location of obstacles. The use of ultrasonic sensors is advantageous due to their accuracy, reliability in various lighting conditions, and the ability to detect both stationary and moving objects. By integrating this technology into a wearable device, the smart glasses aim to provide a discrete and user-friendly aid for blind individuals, significantly improving their spatial awareness and confidence in navigating different environments. This innovation represents a step forward in assistive technologies, offering a practical tool to enhance the quality of life for those with visual impairments.

Key words*: *Arduino NANO board, Ultrasonic sensor, Buzzer, Glass.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Smart glasses using ultrasonic sensors are a groundbreaking assistive technology designed to enhance the mobility and independence of visually impaired individuals. These glasses incorporate ultrasonic sensors that emit sound waves to detect obstacles and calculate their distance from the user. The information is processed and conveyed through auditory or haptic feedback, alerting the user to nearby obstacles. This innovative solution provides real-time navigation assistance, improving spatial awareness and safety. By integrating advanced sensing technology into a wearable form, these smart glasses offer a practical, user-friendly aid, significantly enhancing the quality of life for blind people.

1.2 PROBLEM STATEMENT

Limited Mobility and Independence:

Visually impaired individuals often face significant challenges in navigating their environments safely and independently. Traditional mobility aids, such as white canes and guide dogs, have limitations in detecting obstacles at various heights and distances, which can result in frequent collisions and accidents.

Lack of Real-Time Obstacle Detection:

Existing assistive devices often fail to provide comprehensive, real-time feedback about the user's surroundings, particularly for obstacles that are not in direct contact with the cane or within the guide dog's field of detection. This gap in sensory information hampers the user's ability to move freely and confidently in different environments.

1.3 NEED FOR THE PROJECT

- Visually impaired individuals often encounter difficulties in detecting obstacles, especially those that are above ground level or outside the reach of a white cane. Ultrasonic sensors in smart glasses can detect obstacles at various heights and distances, providing timely alerts and significantly reducing the risk of collisions and accidents.
- Traditional mobility aids have limitations that can restrict the independence of visually impaired individuals. Smart glasses offer real-time, hands-free assistance, allowing users to navigate their environment more confidently and independently without relying on additional tools or assistance from others.
- By enhancing mobility and independence, smart glasses can contribute to a better quality of life for visually impaired individuals. The ability to move freely and safely in various environments can lead to greater participation in social, educational, and professional activities, fostering inclusivity and empowerment.

1.4 OBJECTIVES

- Develop a reliable system using ultrasonic sensors to accurately detect obstacles at various heights and distances, ensuring comprehensive environmental awareness for visually impaired users.
- Implement real-time feedback mechanisms, such as auditory cues or haptic signals, to inform users of nearby obstacles and assist in safe navigation.
- Design the smart glasses to empower visually impaired individuals to navigate their environments independently, reducing reliance on traditional mobility aids and external assistance.
- Create a lightweight, comfortable, and user-friendly wearable device that integrates seamlessly into the daily lives of visually impaired users, prioritizing ease of use and long-term wearability.
- Enhance the overall quality of life for visually impaired individuals by providing

a practical tool that enables safer, more confident movement in various settings, including urban, rural, and indoor environments.

- Design the smart glasses with customizable features to cater to individual user preferences and varying levels of visual impairment, ensuring the device meets diverse needs.
- Leverage cutting-edge ultrasonic sensing and wearable technology to create an innovative assistive device, contributing to the advancement of solutions for visually impaired individuals.

1.5 ORGANIZATION OF THE PROJECT

The basic organization of this project is discussed below:

Chapter 1- Deals with the introduction part and objectives to develop this project.

Chapter 2 - Deals with the Already existing systems and journals and conferences about this project.

Chapter 3 - Deals with the proposed work and its advantages and provides block diagram for clear understanding.

Chapter 4 - Deals with the hardware components involved in this system construction and their specifications and also gives details about connections.

Chapter 5 - Deals with the software used to construct this system and also it gives coding structures and its details.

Chapter 6 - Deals with result of this system and includes discussion part for improvement.

1.6 SUMMARY

Smart glasses equipped with ultrasonic sensors represent a significant innovation in assistive technology for visually impaired individuals. This project is designed to enhance mobility and independence by providing real-time obstacle detection and feedback. The system works by emitting ultrasonic waves that detect obstacles at various heights and distances. When an obstacle is detected, the glasses provide immediate feedback through auditory or haptic signals, alerting the user to potential hazards.

CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

This chapter gives basic details about already existing Smart glasses system and their technologies used. The development of smart glasses utilizing ultrasonic sensors for assisting visually impaired individuals represents a significant interdisciplinary advancement, combining elements of sensor technology, wearable electronics, and assistive devices. A literature survey in this field involves examining existing research and technological advancements to understand the current state of the art and identify areas for further innovation.

Previous studies have explored various methods of enhancing mobility for the visually impaired, ranging from traditional aids like canes and guide dogs to more modern electronic devices. Among these, ultrasonic sensors have emerged as a promising technology due to their ability to provide precise distance measurements and detect obstacles in real time. Research has shown that ultrasonic sensors are effective in various applications, such as robotics and automotive systems, suggesting their potential in wearable assistive devices.

The integration of ultrasonic sensors into smart glasses has been explored in several studies. These glasses typically involve embedding sensors in the frame, connected to a microcontroller that processes sensor data and provides feedback through auditory or haptic signals. Literature indicates that such systems can significantly improve spatial awareness and navigation for visually impaired users, offering a more comprehensive and discreet solution compared to traditional aids.

This literature survey aims to review the technological components, design considerations, user interface methodologies, and efficacy of ultrasonic sensor-based smart glasses. By analyzing existing research, the survey will identify gaps and opportunities for innovation, ultimately contributing to the development of more effective assistive devices for the visually impaired community.

2.2 LITERATURE

2.2.1 Low cost ultrasonic smart glasses for blind

This device includes a pair of glasses and an obstacle detection module fitted in it in the center, a processing unit, an output device i.e. a beeping component, and a power supply [1]. The Obstacle detection module and the output device is connected to the processing unit. The power supply is used to supply power to the central processing unit. The obstacle detection module basically consists of a ultrasonic sensor, processing unit consist of a control module and the output unit consists of a buzzer. The control unit controls the ultrasonic sensors and get the information of the obstacle present in front of the man and processes the information and sends the output through the buzzer accordingly. These Ultrasonic Smart Glasses for Blind people is a portable device, easy to use, light weight, user friendly and cheap in price. These glasses could easily guide the blind people and help them avoid obstacles

2.2.2 A Unique Smart Eye Glass for Visually Impaired People

In this paper, we present a unique smart glass for visually impaired people to overcome the traveling difficulties [2]. It can detect the obstacle and measure the distance perfectly using the ultrasonic sensor and a microcontroller. After receiving information from the environment, it passes to the blind person through a headphone. The GSM/GPRS SIM900A module is used to collect the information from the internet. A switch is connected to the system which is used for an emergency task like sending SMS, including time, temperature and location to the subject's guardian when visually impaired people fall into any danger. By using the smart glass visually impaired people can walk in an indoor and outdoor environment.

2.2.3 Smart Glasses: A Visual Assistant for the Blind

Computer vision has helped systems gain high-level understanding in the field of image and video processing [3]. The Smart Glasses allows partially blind and partially sighted individuals to identify and understand the workplace tools that surround them, which they can see through mini camera. Our research aims to utilize the computer vision to detect objects using MS COCO dataset and trained a CNN (Convolutional Neural Network) model. It recognizes faces using deep learning approach. It recognizes text using EAST (Efficient Accurate Scene Text Detector) and EASYOCR models and gives output using Festival Speech synthesis. The glasses are provided by Ultrasonic sensor which is used to measure the required distance between the users and object to avoid obstacle. The Smart glasses start detecting using the wake word “UP” which is trained using CNN and TensorFlow and Vosk speech recognition module for simple commands. The system is a complete visual assistance for the blind.

2.2.4 Ultrasonic Smart Spectacles for Visually Impaired and Blind People

Visually impaired and blind people require constant assistance from others in order to move around, making them extremely depend on others in their social lives [4]. For visually impaired and blind people, object detection and distance calculation are major challenges. Earlier navigation systems were both costly and time-consuming to use in everyday life. This study describes a blind or visually impaired person's electronic navigation system (subject). Using an ultrasonic sensor network, this system detects objects upto 500cm to the left and right of the subject(person). It effectively measures the distance between the person and the detected obstacle(object) and provides a navigation route that avoids obstacle. It employs speech feedback to inform the user of the location and distance of the indicated obstacle. Using an ARM LPC2148 microcontroller-based embedded system, this recommended system handles real-time data acquired by an ultrasonic sensing networks. Based on the directions and distances of the observed barrier, the applicable pre-recorded spoken communications stored in the APR33A3 are called as flash memory. Speaker is used to provide such voice messages to the subject. The project's objective is to equip visually impaired and blind persons with a more cost-effective and portable navigation system.

2.2.5 Smart guiding glasses for visually impaired people in indoor environment

To overcome the travelling difficulty for the visually impaired group, this paper presents a novel ETA (Electronic Travel Aids)-smart guiding device in the shape of a pair of eyeglasses for giving these people guidance efficiently and safely [5]. Different from existing works, a novel multi-sensor fusion based obstacle avoiding algorithm is proposed, which utilizes both the depth sensor and ultrasonic sensor to solve the problems of detecting small obstacles, and transparent obstacles, e.g. the French door. For totally blind people, three kinds of auditory cues were developed to inform the direction where they can go ahead. Whereas for weak sighted people, visual enhancement which leverages the AR (Augment Reality) technique and integrates the traversable direction is adopted. The prototype consisting of a pair of display glasses and several low-cost sensors is developed, and its efficiency and accuracy were tested by a number of users. The experimental results show that the smart guiding glasses can effectively improve the user's travelling experience in complicated indoor environment. Thus it serves as a consumer device for helping the visually impaired people to travel safely.

2.3 SUMMARY

From various journals and papers, it is inferred that Smart glasses using Ultrasonic sensor can be developed with the help of various hardware components and softwares. Literature Survey Summary for Smart Glasses Using Ultrasonic Sensors .The literature on smart glasses equipped with ultrasonic sensors for visually impaired individuals highlights significant advancements in assistive technology. Research indicates that ultrasonic sensors, which measure distances via sound wave reflections, effectively detect obstacles. Integrating these sensors with microcontrollers like Arduino enables real-time processing and feedback through auditory or vibratory signals. Studies demonstrate that such smart glasses enhance spatial awareness and mobility, offering a discreet and user-friendly aid compared to traditional methods. Ongoing developments focus on improving sensor accuracy, user comfort, and battery efficiency, promising further enhancements in independence and quality of life for users. Smart glasses equipped with ultrasonic sensors represent a significant innovation in assistive technology for visually impaired individuals. This project is designed to enhance mobility and independence by providing real-time obstacle detection and feedback. The system works by emitting ultrasonic waves that detect obstacles at various heights and distances. When an obstacle is detected, the glasses provide immediate feedback through auditory or haptic signals, alerting the user to potential hazards.

CHAPTER 3

PROPOSED WORK

3.1 INTRODUCTION

This chapter will discuss the proposed work through block diagram and it gives the description about each block of diagram for clear understanding.

3.2 OVERVIEW OF THE PROJECT

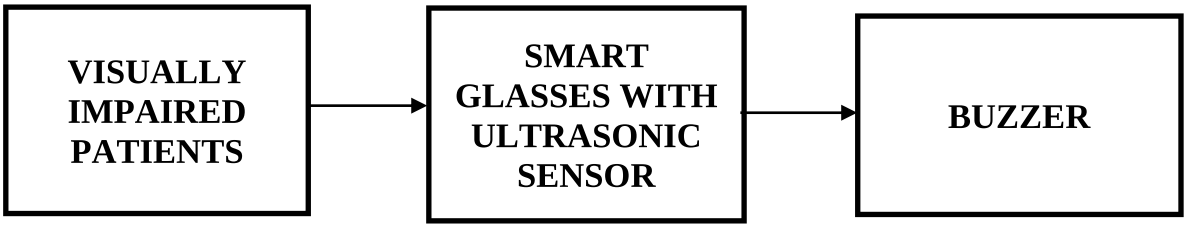


Fig 3.1 Pro ject outline

3.3 BLOCK DIAGRAM OF THE PROJECT

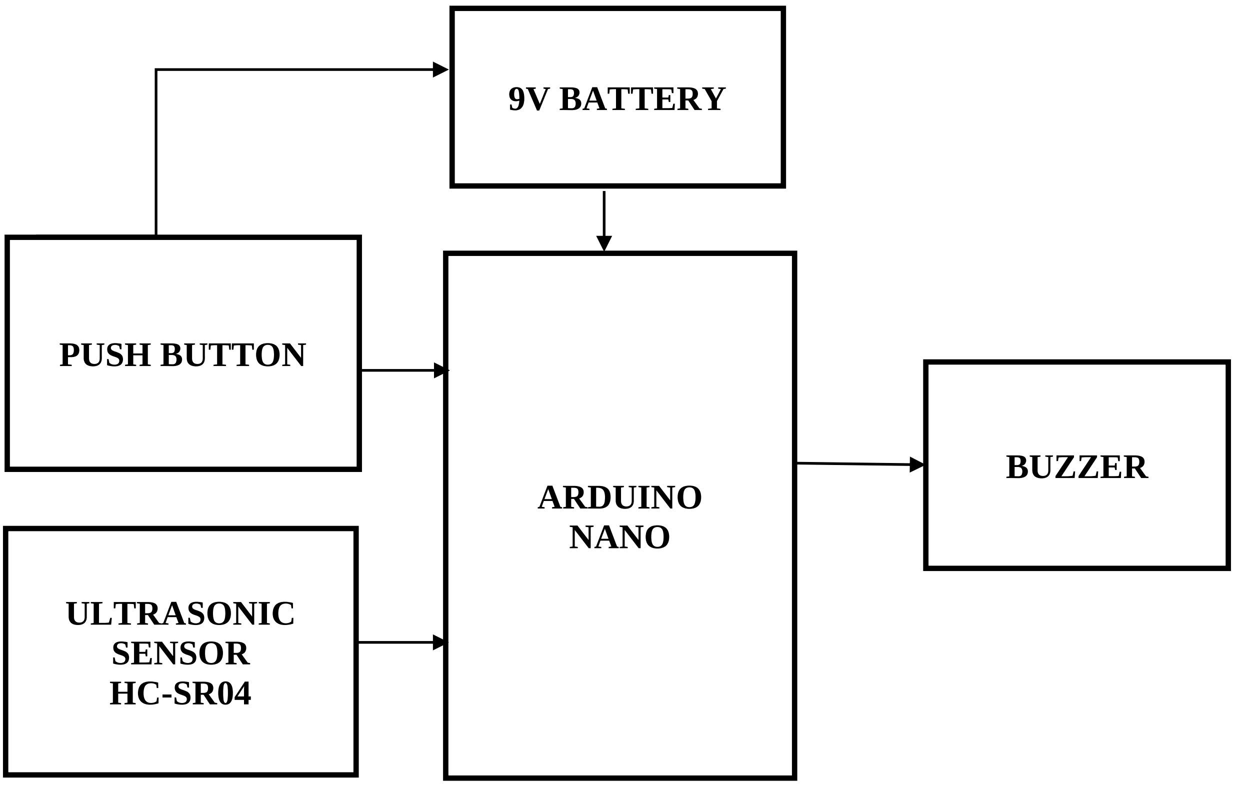


Fig 3.2 Block diagram

3.4 DESCRIPTION ABOUT THE BLOCK DIAGRAM

The Smart glass consists of a Arduino Nano, Ultrasonic sensor (HC-SR04), Buzzer and a 9V Battery which patients with visual impairment wear while walking. The Ultrasonic sensor is connected to the Arduino Nano which acts as the micro controller. The Buzzer is connected to the Arduino Nano through which the signal from Ultrasonic sensor is sent to the Buzzer, when the patient encounters an obstacle while walking.

3.5 SUMMARY

This system is developed in such a way that the patients with visual impairment gets benefited in such a way that it is easy for them to use and makes them know if there is any obstacle in front of them. The proposed smart glasses equipped with ultrasonic sensors aim to significantly enhance the mobility and independence of visually impaired individuals. This innovative device incorporates ultrasonic sensors to detect obstacles in the user's path by emitting high-frequency sound waves and measuring the echo's return time to determine distances. The processed data is then conveyed to the user through auditory signals or vibrations, enabling real-time spatial awareness. Key hardware components include ultrasonic sensors for obstacle detection, a microcontroller for data processing, a feedback mechanism (bone conduction headphones or vibration motors), and a rechargeable power supply. The system is designed to be lightweight, discreet, and user-friendly, ensuring comfort and practicality for everyday use. By providing immediate feedback about the surroundings, these smart glasses aim to empower visually impaired individuals with greater confidence and independence in navigating various environments. This project represents a significant step forward in assistive technology, promising improved safety and quality of life for users.

CHAPTER 4

HARDWARE DESCRIPTION

4.1 INRODUCTION

The hardware Components used to build this system are Arduino NANO, Ultrasonic sensor (HC-SR04), Buzzer, and a 9V Battery . This Chapter will discuss the hardware specifications and gives brief detail about its features. The smart glasses equipped with ultrasonic sensors are designed to aid visually impaired individuals by providing real-time obstacle detection and navigation assistance. The hardware of these smart glasses includes several key components:

1. Ultrasonic Sensors : Mounted on the glasses' frame, these sensors emit high-frequency sound waves and detect the echoes to measure the distance to nearby objects, offering a comprehensive detection range.

2. Microcontroller: Typically an Arduino Nano or similar microcontroller, this component processes the data from the ultrasonic sensors and converts it into meaningful feedback for the user.

3. Feedback Mechanism: This includes bone conduction headphones or vibration motors integrated into the glasses, which provide auditory or tactile feedback, respectively, to inform the user about the proximity of obstacles.

4. Power Supply: The system is powered by a compact, rechargeable battery, ensuring the glasses are lightweight and comfortable while offering extended usage.

4.2 ARDUINO NANO

The Arduino Nano is a compact, versatile microcontroller board designed for use in a wide range of projects. The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P microcontroller. It has almost the same functionality as the Arduino Uno but comes in a much smaller package. This makes it an ideal choice for projects where space is limited.

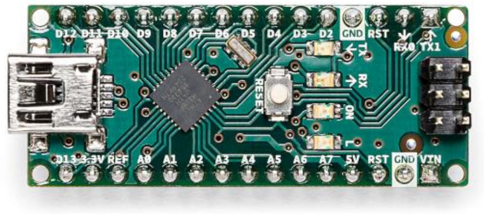


Fig 4.1 Arduino NANO

4.2.1 Specifications

- Microcontroller: ATmega328P
- Operating Voltage: 5V
- Input Voltage (recommended):7-12V
- Input Voltage (limit): 6-20V
- Digital I/O Pins: 14 (of which 6 can provide PWM output)
- Analog Input Pins: 8
- DC Current per I/O Pin: 40 mA
- Flash Memory:32 KB (ATmega328P) of which 2 KB used by bootloader
- SRAM: 2 KB (ATmega328P)
- EEPROM:1 KB (ATmega328P)
- Clock Speed: 16 MHz
- Dimensions: 18 x 45 mm

4.2.2 Features of NANO

Power

The Arduino Nano can be powered via the Mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). The power source is automatically selected to the highest voltage source.

Memory

The ATmega328 has 32 KB, (also with 2 KB used for the bootloader. The ATmega328 has 2 KB of SRAM and 1 KB of EEPROM.

Input and Output

Each of the 14 digital pins on the Nano can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip.

External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.

PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.

LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Nano has 8 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the analogReference() function. Analog pins 6 and 7 cannot be used as digital pins. Additionally, some pins have specialized functionality:

I2C: A4 (SDA) and A5 (SCL). Support I2C (TWI) communication using the Wire library (documentation on the Wiring website).

There are a couple of other pins on the board:

AREF. Reference voltage for the analog inputs. Used with analogReference().

Reset: Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Communication

The Arduino Nano has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provide UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An FTDI FT232RL on the board channels this serial communication over USB and the FTDI drivers (included with the Arduino software) provide a virtual com port to software on the computer. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the FTDI chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A SoftwareSerial library allows for serial communication on any of the Nano's digital pins. The ATmega328 also support I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus. To use the SPI communication, please see ATmega328 datasheet.

Programming

The Arduino Nano can be programmed with the Arduino software (download). Select "Arduino Duemilanove or Nano w/ ATmega328" from the Tools > Board menu (according to the microcontroller on your board). The ATmega328 on the Arduino Nano comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header using Arduino ISP or similar.

Automatic (Software) Reset

Rather then requiring a physical press of the reset button before an upload, the Arduino Nano is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the FT232RL is connected to the reset line of the ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload. This setup has other implications. When the Nano is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Nano. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

4.3 HC-SR04 ULTRASONIC SENSOR

The HC-SR04 is a popular ultrasonic sensor module used for distance measurement in a wide range of applications, The HC-SR04 ultrasonic sensor measures the distance to an object by using sound waves. It sends out a high-frequency sound pulse and then listens for the echo. By timing how long it takes for the echo to return, the distance to the object can be calculated.

Fig 4.2 Ultrasonic sensor (HC-SR04)

4.3.1 Specifications

- Operating Voltage: 5V DC
- Operating Current: 15 mA
- Frequency: 40 kHz
- Range: 2 cm to 400 cm (0.79 inches to 157 inches)
- Resolution: 0.3 cm
- Measuring Angle: 15 degrees
- Dimensions: 45 mm x 20 mm x 15 mm

4.3.2 Pin configuration

- VCC: Power supply pin (5V)
- Trig: Trigger pin (input)
- Echo: Echo pin (output)
- GND: Ground pin

4.4 BUZZER

A buzzer is a simple and versatile device used in many Arduino projects to produce sound alerts, tones, and melodies. There are two main types of buzzers: active buzzers, which have an internal oscillator and produce a tone when powered, and passive buzzers, which require an external signal (such as a square wave from a microcontroller) to produce sound.

Fig 4.3 Arduino Buzzer

4.5 BATTERY AND PUSH BUTTON

It produces an ouput voltage of 9v. Its capacity typically ranges from 400mAh to 600mAh, depending on the battery type (alkaline, rechargeable, etc.).Its shape is rectangular with rounded edges.The common types are Alkaline (non-rechargeable), Nickel-Metal Hydride (NiMH) (rechargeable), Lithium (non-rechargeable).

Using a push button to control the power from a 9V battery to an Arduino is a simple and effective way to add an on/off switch to the project. This setup can help conserve battery life and provide a convenient way to control our project.

Fig 4.4 9v Battery

Fig 4.5 Push button

4.6 HARDWARE CONNECTIONS

The circuit diagram for the smart glass designed to aid blind individuals is relatively straightforward. The main component, the ultrasonic sensor, is connected with its Vcc pin to the 5V power source, its trigger pin to pin 3, and its echo pin to pin 2, while the GND pin is grounded. Additionally, a battery powers the system, with its positive terminal linked to the Vin and the negative terminal grounded. For auditory feedback, a buzzer is incorporated into the design, with its positive pin connected to pin 5 and its negative pin grounded. This configuration enables the ultrasonic sensor to detect obstacles in the user's path, triggering the buzzer to alert the wearer accordingly. Through this setup, the smart glass enhances the mobility and safety of visually impaired individuals by providing real-time obstacle detection and notification.

The circuit diagram for the smart glass designed to assist blind individuals is relatively simple yet crucial for its functionality. At the heart of the system is the ultrasonic sensor, which plays a pivotal role in detecting obstacles in the user's path. Here's a breakdown of the components and their connections:

1. Ultrasonic Sensor (HC-SR04)

Vcc Pin (Power): This pin is connected to the 5V power source, typically from a microcontroller or an external power supply. It provides the necessary operating voltage for the sensor.

Trigger Pin : Connected to pin 3 of the microcontroller (assuming Arduino or similar), this pin is used to send a short pulse to initiate the ultrasonic signal transmission.

Echo Pin: Connected to pin 2 of the microcontroller, this pin receives the echo signal from the ultrasonic waves reflected off obstacles. The microcontroller measures the time delay between the transmission and reception of the signal to calculate the distance to the obstacle.

GND Pin (Ground): Connected to the ground of the power source, ensuring a complete circuit.

2. Power Supply (Battery)

The system is powered by a battery, with its positive terminal connected to the Vin (voltage input) pin of the microcontroller or power regulator.

The negative terminal of the battery is connected to the ground, ensuring a common reference point for all components.

3. Buzzer

A buzzer is used for auditory feedback to alert the wearer about obstacles detected by the ultrasonic sensor.

Positive Pin: Connected to pin 5 of the microcontroller, which controls the buzzer operation.

Negative Pin: Connected to ground, completing the circuit for the buzzer.

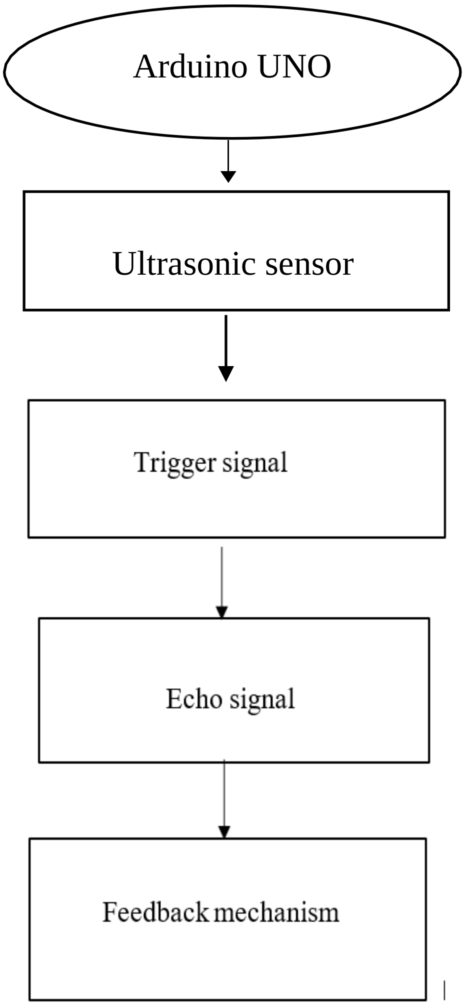
Functionality:

Obstacle Detection: The ultrasonic sensor emits high-frequency sound waves and listens for the echo that bounces back from obstacles in front of the user.

Distance Calculation: By measuring the time it takes for the echo to return to the sensor, the microcontroller calculates the distance to the obstacle using the speed of sound.

Alert System: When an obstacle is detected within a predefined range, the microcontroller triggers the buzzer connected to pin 5. This alerts the wearer in real-time, allowing them to navigate safely around obstacles.

4.7 FLOWCHART FOR HARDWARE COMPONENTS



4.8 SUMMARY

By connecting all the hardware components one to another properly , this system is ready to stimulate with software.The smart glass circuit for the visually impaired consists of an ultrasonic sensor, a battery, and a buzzer. The sensor detects obstacles, activating the buzzer for alerts. This setup provides real-time obstacle detection and auditory feedback, enhancing user safety and navigation. The smart glass circuit, designed for the visually impaired, comprises an ultrasonic sensor detecting obstacles. It triggers a buzzer for alerts, powered by a battery. This setup enables real-time obstacle detection and auditory feedback, enhancing user safety and navigation. The straightforward design facilitates easy implementation, offering an accessible solution for the visually impaired to navigate their surroundings confidently. The smart glass design centers around an ultrasonic sensor (HC-SR04) crucial for obstacle detection, enhancing mobility and safety for visually impaired users. The sensor operates on a 5V power supply, with its Vcc pin connected to the power source and ground pin appropriately grounded. It communicates with a microcontroller, typically an Arduino, via its trigger and echo pins connected to digital pins 3 and 2, respectively. Power for the system is provided by a battery, where the positive terminal connects to Vin on the microcontroller, ensuring stable operation. The negative terminal is grounded to complete the circuit. Auditory feedback is facilitated through a buzzer connected to pin 5 of the microcontroller for sound output, alerting users to detected obstacles. When triggered by the microcontroller based on distance calculations from the sensor, the buzzer emits a tone or sequence to signal the presence and proximity of obstacles in the user's path.This setup enables real-time obstacle detection using ultrasonic waves, where the sensor emits a pulse and measures the time it takes for the signal to return after bouncing off obstacles. The microcontroller processes these signals to calculate distances, determining if an alert should be triggered based on predefined thresholds. Overall, the smart glass with its integrated ultrasonic sensor, microcontroller, battery power, and buzzer represents a sophisticated yet user-friendly solution for visually impaired individuals, promoting independence and safety by providing timely feedback about their surroundings.

CHAPTER 5
IMPLEMENTATION USING SOFTWARE

5.1 INTRODUCTION

This chapter deals with the software implementation . The programming of the Arduino is done by Arduino IDE Software. A description of the software is discussed in the chapter. Implementing software for a smart glass system equipped with an ultrasonic sensor involves leveraging technology to enhance mobility and safety for visually impaired individuals. This introduction focuses on the software aspect of integrating and utilizing the sensor data effectively.The primary goal of the software is to interpret the data provided by the ultrasonic sensor in real-time. The sensor detects obstacles by emitting ultrasonic waves and measuring the time it takes for the waves to return after bouncing off objects in the environment. This data is then processed by a microcontroller, such as Arduino, which calculates the distance to the obstacle based on the time delay.

The software must be designed to perform several critical functions:

1. Data Acquisition and Processing: It collects raw distance measurements from the ultrasonic sensor and applies algorithms to filter out noise and ensure accuracy in distance calculations. This processing is crucial for reliable obstacle detection.

2. Decision Making: Based on the processed distance data, the software determines whether an obstacle is within a predefined danger zone. If an obstacle is detected within this range, the software triggers an alert mechanism to notify the user.

3. Alert System Integration: The software interfaces with an auditory feedback mechanism, typically a buzzer, to provide real-time alerts to the user about detected obstacles. This alert system must be responsive and clear to ensure the user can react promptly to avoid collisions.

4. User Interface: Depending on the design, the software may include a user interface to convey additional information such as battery status, signal strength, or operational mode of the smart glass.

The implementation of software for smart glasses with ultrasonic sensors plays a crucial role in transforming sensor data into actionable information that enhances user safety and independence in navigating their surroundings effectively.

5.2 ARDUINO IDE SOFTWARE

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software.It consists of a circuit board, which can be programmed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment) Software , which is used to write and upload the computer code to the physical board . The Arduino IDE software is a cross - platform application (for Windows , macOS , Linux) that is written in the programming language Java, C and C++ . It is used to write and upload programs to Arduino compatible boards . The source code for the IDE is released under the GNU General Public License, version 2 . The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project , which provides many common Input and output procedures . User-written code only requires two basic functions, for starting the sketch and the main program loop , that are compiled and linked with a program sub m () into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution . The Arduino IDE employs the program argued to convert the executable code into a text file hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

5.2.1 Structure of program

Arduino programs can be divided in three main parts : Structure , Values (variables and constants) , and Functions . In this tutorial , the Arduino software program, step by step and how to write the program without any syntax or compilation error.

Let us start with the Structure. Software structure consist of two main functions

- Setup () function
- Loop () function

5.2.2 Setup() Function

In the Arduino Integrated Development Environment (IDE), the setup() function is a fundamental part of every Arduino sketch. Its primary role is to initialize variables, configure pins, and perform any necessary setup operations before the main execution of the program begins in the loop() function.

Here's a detailed explanation of the setup() function and its significance:

1. **Initialization of Pins**: One of the common tasks in the setup() function is to configure digital and analog pins for input or output using functions such as pinMode(). For instance, if an ultrasonic sensor is connected to digital pins 2 and 3 for trigger and echo signals, respectively, you would set these pins as outputs and inputs accordingly.
2. **Serial Communication**: Another typical setup operation is to initialize serial communication for debugging purposes or for communication with other devices. This is done using Serial.begin() to specify the baud rate:
3. **Library Initialization**: If your sketch utilizes external libraries, the setup() function may include initialization of these libraries using their respective begin() methods or configurations.
4. **Variable Initialization**: Declare and initialize variables that will be used throughout the program. This ensures that variables start with known values and are ready for use in subsequent operations in the loop() function.
5. **One-Time Operations**: Perform any one-time operations needed at the beginning of the program, such as initializing timers, setting initial states of sensors or actuators, or configuring parameters specific to your application.

The setup() function runs only once when the Arduino board is powered up or reset. After setup() completes execution, the loop() function begins executing repeatedly, where the main logic of your program resides.

It's essential to ensure that all necessary configurations and initializations are properly set up in setup() to ensure the correct and reliable operation of your Arduino-based project. Properly initializing pins, serial communication, and other components in setup() sets the stage for efficient and effective execution of your program in the loop() function.

5.2.3 Loop() Function

In the Arduino Integrated Development Environment (IDE), the loop() function is a core part of every Arduino sketch. Its primary role is to continuously execute the main program logic after the setup() function completes initialization. Here's a detailed explanation of the loop() function and its significance:

1. **Continuous Execution**: The loop() function runs repeatedly in a continuous loop for the entire duration that the Arduino board is powered on. This allows the Arduino to continuously monitor inputs, process data, and control outputs based on the defined logic.
2. **Reading Sensors**: One common task within the loop() function is to read sensor inputs. For instance, if you have an ultrasonic sensor connected to the Arduino, you would read the distance measurements in the loop() to detect nearby obstacles
3. **Control Outputs**: The loop() function is responsible for controlling actuators such as motors, LEDs, buzzers, etc., based on sensor readings or predefined conditions. This allows the Arduino to react in real-time to changes in its environment or user inputs.
4. **Decision Making**: Implement decision-making processes within loop() based on sensor readings or other inputs. For example, based on the distance read from the ultrasonic sensor, decide whether to take evasive action or continue normal operation.

}

5. **Communication**: If your application involves communication with other devices or systems (e.g., sending data over serial communication, I2C, SPI, etc.), the loop() function can handle these tasks periodically or continuously depending on your program's requirements.

The loop() function is essential for the continuous operation of Arduino-based projects, allowing for real-time monitoring and control based on sensor inputs and defined logic. Properly structuring the loop() function ensures efficient and responsive behavior of your Arduino application, making it suitable for a wide range of embedded systems and IoT applications.

5.3 PROGRAM

```
const int trigPin = 3;
const int echoPin = 2;
const int buzzer = 5;

long duration;
int distance;
int safetyDistance;

// Adjust this value to change the speed of sound for your environment
const float speedOfSound = 0.0343; // 343 meters per second (default)

void setup() {
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
pinMode(buzzer, OUTPUT);

Serial.begin(9600);
}

void loop() {
digitalWrite(trigPin, LOW);
```

```
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);

duration = pulseIn(echoPin, HIGH);

 // Calculate distance using the adjusted speed of sound value
distance = (duration * speedOfSound) / 2;
safetyDistance = distance;

if (safetyDistance <= 30) {
digitalWrite(buzzer, HIGH);
} else {
digitalWrite(buzzer, LOW);
}

Serial.print("Distance: ");
Serial.println(distance);
}
```

CHAPTER 6
RESULT & DISCUSSION

6.1 RESULTS

The implementation of a smart glass project utilizing an ultrasonic sensor has resulted in a significant advancement towards enhancing the mobility and safety of visually impaired individuals. By integrating hardware components like the HC-SR04 ultrasonic sensor, Arduino microcontroller, and a buzzer for auditory feedback, the system effectively detects obstacles in real-time and alerts the user accordingly.

The smart glass successfully detects obstacles within its detection range using the ultrasonic sensor. When an obstacle is detected, the Arduino microcontroller processes the sensor data to calculate the distance and triggers the buzzer to provide immediate auditory feedback to the user. This real-time alert system allows visually impaired individuals to navigate more confidently, avoiding collisions and obstacles in their path.

The project demonstrates the practical application of sensor technology in assistive devices. The ultrasonic sensor's ability to accurately measure distances and the Arduino's capability to process this data efficiently play crucial roles in the system's functionality. By utilizing inexpensive and readily available components, the project remains cost-effective and accessible for widespread adoption.

Moreover, the project highlights the importance of user-centered design in assistive technology. The audible alerts provided by the buzzer ensure that visually impaired users can easily interpret and respond to environmental cues, thereby enhancing their overall safety and independence during navigation.

Future improvements could include enhancing the sensor's range and accuracy, integrating additional sensors for more comprehensive environment detection, or incorporating wireless communication for advanced functionalities. These advancements would further refine the smart glass system, making it even more effective in assisting visually impaired individuals in various real-world scenarios.

In conclusion, the smart glass project serves as a promising example of how technology can empower individuals with disabilities, offering a practical solution to improve their quality of life through enhanced mobility and safety features.

Fig 6.1 Result of smart glass using ultrasonic sensor

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