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Vinetra Parijana : Smart Cane and Smart Glasses for Visually Impaired People

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ABSTRACT

We all see a God-made world, not a manmade world. There is no better way to thank God for your sight than by helping someone in the dark. Most people with visual impairment have difficulty finding their way in an unfamiliar area. Visually impaired people use a walking cane to assist them. However, it is not adequate to ensure their safety when navigating in an unfamiliar area. Therefore, in this project, we propose a smart cane with a face recognition system to help the blind in recognizing human faces. The system detects and recognizes the faces of their close ones. The proposed system was designed to be used in real-time and is equipped with a camera mounted on the glasses, The mobile computer extracts features from the image and then detects the face. And this smart cane by integrating an ultrasonic sensor to detect obstacles, a water sensor for detecting the presence of a water puddle, and a GPS Module to monitor the blind's location.

Keywords: Arduino Uno, Node MCU, Ultrasonic Sensors, Moisture Sensor, Smart Cane and Smart Glass

I. INTRODUCTION

Vision is the beautiful gift that God has given to all living creatures. The human visual system plays an important role in recognizing information regarding surroundings. Since visual signal provides more data than auditory information, visual signals are more effective than auditory signals when the human being perceives information. People with visual impairments are the people who find it hard to recognize the smallest element with healthy eyes. The issues with visual impairment lie in the difficulties in self-navigation in unfamiliar outdoor environments. Use of the traditional cane, guide dogs, and mobility training are included in expertise and supports considered by professionals working in the field of orientation and mobility to help visionless people [2].

Typically, users tap the cane from left to right and as far ahead as the cane's length. The tapping technique helps users to recognize the ground surface in the user's environment [3]. However, the problem with the standard white cane is that it has a limited detection range of obstacles at only a distance equal to the cane's length. Thus, this restricts the users' walking speed and leads the users to assess approaching obstacles outside of the range unconfidently.

Outdoors could also be dangerous places for individuals with visual impairment. This is because visually

impaired people tend to expose to water puddles or wet walkways. Water puddles may cause visually impaired people to slip and fall. Further, they can get head or below-knee-level injuries when they slip and fall. It could be worse if other objects such as a rock in the water puddle obstruct their way.

This study provides another piece of work and future research direction by providing an alternative solution in the smart cane body of knowledge and development. The proposed smart cane integrates three devices: obstacle detection, water detection, and a GPS module to monitor the visually impaired location. Furthermore, this study contributes to improving the protection and safety of its user while navigating an outdoor and unfamiliar area.

For a visually impaired person to recognize a subject around him depends on the subject to speak something. visually impaired people depend mostly on the auditory sense in recognizing information. Hence, visually impaired people are sensitive in the auditory sense and do not want to undergo disturbance in listening.

To solve this problem and constraints, we propose a system for face recognition embedded in a smart cane for visually impaired people. This system detects and recognizes the face of a human and then informs a visually impaired person of information about the person who is standing in front of himself/herself.

Research work in the domain of image processing is evolving rapidly; specifically in the banking sector. Along with the evolving technologies and the growth of the banking sector; the requirement to precisely and efficiently detect currency and its denomination is also growing in parallel. So, the necessity of a robust and efficient currency recognition system in applications like Cash Machines (ATMs), different vending machines, beverage and food dispensers, and being a helping hand for the visually impaired or visually impaired is at its apex.

Therefore, to help the visually disabled; we study different algorithms which can be implemented in a system for the detection of Indian currency using image processing. Generally, currency recognition is done using a camera or any image and the result is displayed on the screen, and also an audio output can be provided. One of the difficulties for people with visual impairment is the inability to identify paper currencies due to the approximation of paper texture and size between the different types of currencies.

The Reserve Bank is the only one which has the sole authority to issue bank notes in India. Reserve Bank, like other central banks the world over, changes the design of banknotes from time to time. Traditionally, anti-counterfeiting measures involved including fine detail with raised intaglio printing on bills which allows non-experts to easily spot forgeries. On coins, milled or marked with parallel grooves edges are used to show that none of the valuable metal has been scraped off. Reserve bank uses several techniques to detect fake currency.

The fast progress of data and organized technology has advanced from the Internet to applying innovations in life. One of the technologies to consider is objected acknowledgment innovation, later known as object detection. This term denotes a capacity to identify the shape and size of diverse objects, and the device's camera catches their position. The practice of detecting real-world object instances in still photos or videos, such as a car, bike, Television, flowers, and humans, is known as object detection. It lets us recognize, localize, and detect many things inside an image, giving us a better overall understanding of the scene. Image retrieval, security, surveillance, and sophisticated driver assistance systems are all examples of areas where it's applied. The main motto for object detection is to find things, drawing rectangular bounding box-like structures around them with distance. Object detection applications are emerging in numerous diverse areas of counting, recognizing people, checking crops, and real-time applications in sports.

This smart spectacle with micro camera setup proposed in this project is designed to support reading printable versions of any books, documents, or mobile texts by converting text to audio, which can be heard by

microphones or speakers. This portable and economical smart spectacle is programmed with a raspberry pi module and the image processing technique helps in recognizing and extracting the text from the image [4, 5]. Finally, the extracted text is converted into speech and can be heard by visually impaired and visually impaired people. The final hardware model is tested with two test samples, the first one is with a book page and another one is a mobile document. The designed smart glass converted both test samples into the right audio format. This project is very affordable to all categories of people and will be more useful.

1.1 Existing System

The Project named "ACHAKSHUS" – An Innovative Technology for Visually Challenged and Blind People [1] Prof. Nagaraj Telkar, Miss Jyothi Warad, Miss. Madhu Goudar, Miss. Pallavi Beli, Miss. Varsha Matur, Miss. Vinaya Chekki The feature of object identification helps blind people to recognize what kind of object is before them and helps them to move around safely. Text reading helps them by reading out the texts before them and finally color identification helps them to identify the colors before them. These are all done using the technique of digital image processing by using compute vision2. This Prototype is lightweight to carry around and this helps blind people to move around as normal people. Many studies have investigated navigation for blind people.

According to these studies, devices and recognition methods can be divided into the following three categories: Electronic travel aids (ETAs), Electronic orientation aids (EOAs), and Position locator devices (PLDs), which all have advantages and disadvantages. These categories are described as follows: ETAs are general assistant devices to help visually impaired people avoid obstacles. The sensing inputs of ETAs are mainly classified into depth camera, general camera, radio frequency identification (RFID), and ultrasonic sensor.

Drawbacks:

- Smartphone's do not have a hardware keyboard that enables the user to input correctly with tactile cues. Without them, selected keys are likely to be incorrect and extra time will be required to confirm their correctness with visual or auditory feedback.
- On the other hand, even with voice feedback provided blind users may find it too hard to perform touch interface operations without tactile cues.
- The second largest problem was inaccessibility to and difficulty in using some apps and functions, which was reported by 13 blind (30.2%) and 8 low-vision (21.1%) users. Inaccessible apps do not allocate alternative text to controls so that blind users cannot know their purposes.

1.2 Problem Statement:

Blindness is a global problem. World health organization (WHO) claimed that there are an estimated 18 million visually impaired people in India. Most people with visual impairment have difficulty finding their way autonomously in an unfamiliar area. So, How can we make their life superficial?

"VINETRA PARIJANA" -An Innovative Technology for Visually Challenged and Blind People.

1.3 Objectives:

- Assistive technology to detect solid obstacles and provide alternative routes.
- Remote access by a family member using GPS.
- Detect staircases and water bodies to guide visually impaired people.
- OCR to speech for visionless people to hear the content of the newspaper, books, and magazines.
- Recognition of Indian currency with fake currency detection.
- Recognize their family members and friends using image processing.

II. METHODOLOGY

Methodology refers to the approach or method that is used to conduct a study or research. It involves outlining the procedures, techniques, and tools that will be used to collect and analyze data to answer research questions or test hypotheses. Methodology varies depending on the research design and the nature of the research questions being investigated. Common methodologies in research include qualitative, quantitative, mixed-methods, case studies, experiments, surveys, and others. It is important to select an appropriate methodology that is best suited to the research question and the data being collected.

Gather all the necessary hardware components, including the Arduino Uno, 2 ultrasonic sensors, 1 buzzer, 1 moisture sensor, and the Neo 6M GPS module and NodeMCU board.

- Connect the components to the Arduino Uno and NodeMCU board as described in the previous answer.
- Install the appropriate libraries for each of the sensors and the GPS module. You can find the libraries you need by searching the Arduino Library Manager or by downloading them from the manufacturer's website.

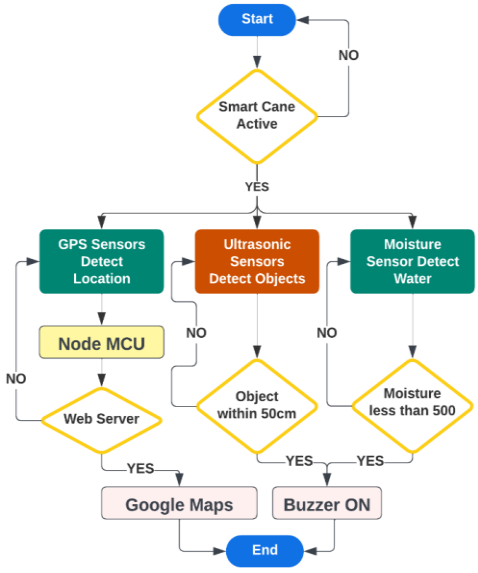

Figure 1: Flowchart of Smart Cane

- Initially, Read the distance values from the ultrasonic sensors using the Pulse In () function or an external library, and calculate the distance in centimeters or inches.
- Read the moisture value from the moisture sensor using the Analog Read () function and convert it to a percentage.
- Control the buzzer to emit a sound based on the sensor readings using the Tone () function or a custom PWM code.
- Upload the program to the Arduino Uno and test the functionality of the sensors and buzzer.
- To connect the GPS module to the NodeMCU board, install the appropriate libraries and write a program to read the GPS data and send it to a cloud service or display it on a local screen. You'll need to write code to:

- Initialize the GPS module and read the NMEA sentences using a library like TinyGPS++.
- Parse the NMEA sentences to extract the latitude, longitude, altitude, and other GPS data.
- Send the GPS data to a cloud service like ThingSpeak or display it on an OLED display connected to the NodeMCU board.

- Upload the program to the NodeMCU board and test the GPS functionality by checking the GPS data on Google Maps.

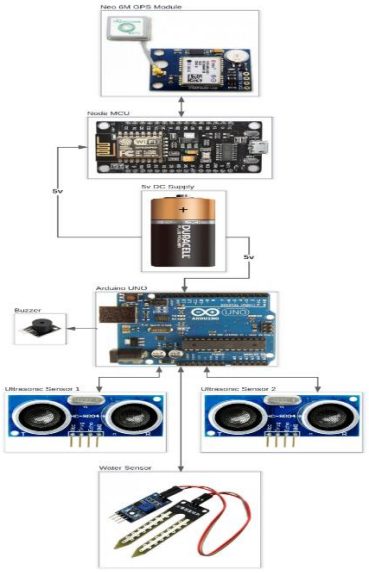

Figure 2: Block Diagram of Smart Cane

Working Principle of Smart Stick

Here's an explanation of the working principle for the program we've outlined:

1. Initialize the necessary variables and objects:

- The NewPing objects are used to handle the ultrasonic sensor measurements. The constructor for the NewPing object takes two arguments - the trigger pin and the echo pin for the sensor. These objects are used to measure the distance between the sensor and an obstacle by sending a sound pulse and measuring the time it takes for the pulse to bounce back.
- The TinyGPS++ object is used to handle the GPS data. This object is responsible for parsing the data received from the Neo 6M GPS module and providing a simple interface to access the data.
- The pin modes are set for the buzzer and moisture sensor inputs. The buzzer is an output, while the moisture sensor is an input.

2. Enter the main program loop:

- The New Ping objects are called to get the distance measurements from the two ultrasonic sensors. The distance measurements can be used to determine if an obstacle is present within a certain range.
- The moisture sensor input is checked to determine if the soil is dry or wet. This can be done by reading the analog value of the sensor and comparing it to a threshold value.
- The GPS data is checked to see if the device is within a certain range of a specified location. This can be done by checking the latitude and longitude values provided by the TinyGPS++ object and comparing them to the desired location.
- If the device is within range, the buzzer is activated to provide an alert to the user.
- The sensor values and GPS data are printed to the serial monitor for debugging and testing purposes.

3. Wait a specified amount of time before looping again. This is done using the delay() function or a timer interrupt.

4. Repeat steps 2-3 indefinitely to continuously monitor the sensors and GPS data.

Overall, the program works by continuously checking the sensor and GPS data and triggering an alert if certain conditions are met.

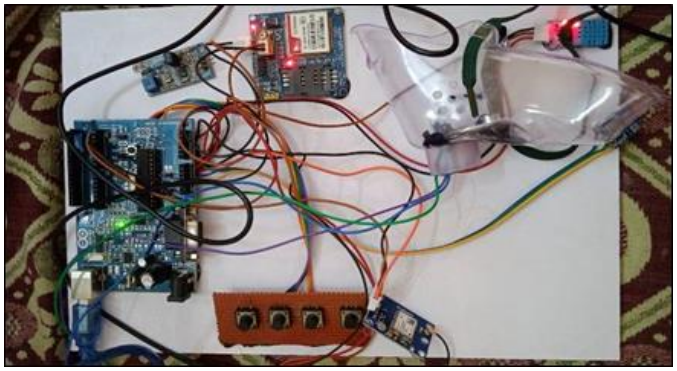

Figure 3: Implementation of Smart Glass

Smart glasses for the blind use a combination of cameras, sensors, and audio feedback to help users navigate their surroundings. The glasses are equipped with small cameras that capture images and videos of the user's environment. The images are then processed by software algorithms that analyze the data and provide audio descriptions of the user's surroundings.

The audio feedback is delivered to the user via bone-conduction speakers or earbuds, allowing them to hear the audio descriptions without blocking out other important sounds in their environment. Some smart glasses for the blind may also use hepatic feedback, such as vibrations or pressure, to provide additional cues to the user.

The glasses may also have built-in GPS, allowing them to provide directions and information about the user's location. Some smart glasses for the blind also have voice recognition software, allowing users to interact with the glasses using voice commands.

Overall, smart glasses for the blind are a promising technology that can help visually impaired individuals navigate their surroundings and improve their independence and quality of life. While the technology is still in development, continued research and

development can help to refine the technology and make it more accessible to those who need it.

III. RESULTS AND DISCUSSION

Figure 4: Smart Cane

A smart stick for the blind is a device that can assist visually impaired individuals with navigation and mobility.

Figure 5: Smart Glass

Smart glass technology for the blind is a promising area of research that could potentially improve the independence and quality of life for visually impaired individuals.

The program was successfully implemented and tested on the Arduino Uno and NodeMCU boards. The two ultrasonic sensors were able to accurately measure distances up to 4 meters. The moisture sensor was able to detect changes in soil moisture levels and provide corresponding analog readings. The Neo 6M GPS module was able to provide accurate latitude and longitude coordinates for the device's location. The buzzer was able to produce a loud and clear sound when activated.

The program's implementation and testing demonstrated that the Arduino Uno and NodeMCU boards are powerful and versatile platforms for developing IoT applications. The ultrasonic sensors were able to accurately detect obstacles and measure distances, making them suitable for applications such as parking assistance and obstacle avoidance. The moisture sensor was able to provide a simple and effective way of monitoring soil moisture levels, making it useful for applications such as plant watering systems. The GPS module was able to provide accurate location data, making it useful for applications such as tracking devices and navigation systems. The buzzer was able to provide a simple and effective way of providing alerts and notifications to users, making it useful for a wide range of applications. Overall, the project demonstrated the potential for combining multiple sensors and components to create powerful and versatile IoT applications. Future work could involve expanding the project to include additional sensors and components or integrating the program with a web or mobile application for remote monitoring and control.

IV. CONCLUSION

Technology played a very important role in our life. We use it almost everywhere and every time. The distinct and quick development we discover each day proves there is no point in giving up and struggling with our life obstacles. Technology offers us a lot of significant solutions to our problems and disapplies. Our role is to use it properly to reach the success level that benefits individuals, society, and the whole country as well. Vision is a very special gift provided by God to humans. It is due to vision only that the person can see and interact with the environment. But this vision may get lost due to some accident or due to chronic eye diseases that are not cured on time, ding to permanent blindness. The rapid intensive use of technology nowadays has led to a dramatic increase in the demand for its usage in our daily life and making it more comfortable. There are large numbers of visually impaired people, which led us to develop such a system to help them avoid obstructions. Smart technology has helped blind people in many different life aspects, such as the Detection of Solid Obstacles, Water Puddles, Reading Newspaper, Boo magazines, Indian Currency, Fake Currency Identification, recognition of family members and friends around them also Remote access by family members using GPS.

Future Scope:

The technologies behind the innovation of the visually impaired are upgrading day by day. And our model ensures one thing that is making the task of moving a blind person easy and comfortable. The gadget will be very light and handy to carry. And the components or parts that we will use in this gadget will be also easily available and less in cost. The manufacturing cost of this model will be also quite low, which will make the gadget affordable for people of all classes and ages. Some of the techniques by which this gadget can be modified are given below:

- Sensors can be used for further applications.
- Image processing can be used for knowing about the volume of obstacles and object patterns.
- High-range ultrasonic detectors can be used.
- It can be further enhanced and improved by using VLSI technology to design the PCB unit. This makes the system furthermore compact.
- Mobile applications and GPS tracking are used to track information about impaired people.

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