The Virtual Assistant: A Wearable Device for Independent Living of the Visually Impaired

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ABSTRACT

This research aims to develop a wearable device with a virtual assistant system to provide blind individuals with a more convenient means of independent living. The proposed device includes Arduino UNO, RF module transmitter and receiver, IR sensors, a voice board module, and an earphone for audio output. There are visually impaired individuals worldwide, some of whom may be present in our daily lives, and they encounter difficulties in performing day-to-day tasks. The proposed device can serve as a personal assistant for the visually impaired, offering integrated modules and functionalities to aid them. The device aims to provide voice-over assistants to help with tasks such as understanding their surroundings, without requiring the assistance of others.

Keywords—Arduino UNO, RF module, IR sensor, Voice module

1.INTRODUCTION

Assisting visually impaired individuals requires the translation of the visual environment into an audio format, which can provide information on objects and their respective spatial locations. Everybody deserves to live independently, especially those who disabled. In the last decades, technology has given attention to disabled to make them control their lives as much as possible. Good vision is a precious gift but unfortunately loss of vision is becoming common nowadays. The project provides an alert system through headphones. Visually impaired individuals often experience difficulties with safe mobility as they may encounter obstacles in their path that they are unable to detect or avoid. This can lead to emotional distress and a loss of independence. To address this challenge, Infrared (IR) Sensors are strategically positioned in the front, left, and right directions to detect obstacles and provide corresponding feedback. People who suffer with visual impairment and blindness face numerous challenges in their daily lives. Navigating around places is a significant challenge for visually impaired individuals, especially those who have complete vision loss. This study introduces a smart assistance approach that seeks to enhance the safety and social inclusion of visually impaired and blind people. Despite the availability of numerous visual assistance devices in the market, there is a need for a low-cost, portable, highly dependable solution that can accurately detect objects from significant distances.

2. RELATED WORKS

"Assistive Technology for Blind and Visually Impaired People: A Systematic Review" by Mohammad H. Alshehri et al. (2020) - This systematic review paper provides an overview of the latest assistive technologies for blind and visually impaired people, including wearable devices, navigation systems, and tactile interfaces.

"Assistive Technology for Blind and Visually Impaired People: A Comprehensive Review" by Mohammad H. Alshehri et al. (2020) - This comprehensive review paper provides a more detailed analysis of assistive technologies for blind and visually impaired people, including haptic devices, audio-based systems, and sensory substitution devices.

"A Review of Assistive Technologies for People with Visual Impairments" by G. P. Richardson et al. (2020) - This review paper discusses the latest developments in assistive technologies for blind and visually impaired people, including image recognition systems, braille devices, and GPS-enabled navigation aids.

"Assistive Technology for the Blind and Visually Impaired: A Review of Recent Advances" by S. H. Kim et al. (2020) - This review paper provides an overview of recent advances in assistive technologies for blind and visually impaired people, including wearable devices, smartphone apps, and assistive robots.

"Assistive Technology for the Blind: A Review of the State of the Art" by F. Wu et al. (2020) - This review paper discusses the current state of the art in assistive technology for blind people, including text-to-speech systems, obstacle detection devices, and assistive tools for daily living activities.

3. PROPOSED METHODOLOGY

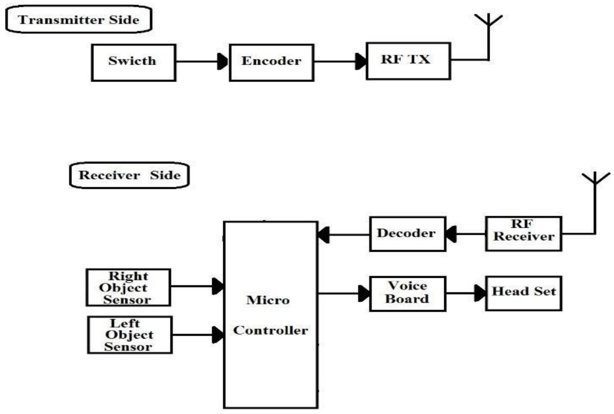

Fig -1 Block Diagram

As discussed earlier, the proposed system is a wearable device**.** The device is primarily made up of two parts: the first is a headset that includes a IR sensor, microphone, and earbuds, and the second is a processing unit that can be conveniently worn or transported in a backpack and houses the processor and battery. The fig-1 is shows the proposed methodology. Connecting the headset to the processing equipment only requires one wire. The design of the system was created using a Python interpreter and consists of five device component components that can be reached using vocal instructions. In order to create the system's features, deep learning state-of-the-art techniques like objects.

The inventive "smart device" was created to help the vision impaired navigate more effectively. Here, we suggest an advanced smart device that enables people with vision impairments to travel. In the first step of our suggested endeavor, the sensor transmits this information to the microprocessor when it detects obstructions. After processing this information, the microcontroller determines whether the barrier is near enough. If the barrier is not immediately present, the circuit has no effect. The microcontroller transmits a signal to the voice module to play if the obstacle is nearby.

It is incorporated into a full gadget, frequently with hardware and mechanical components. 98 percent of all microprocessors are produced as embedded system components, and they are used to operate numerous everyday gadgets. Low cost per unit, compact size, tough operating ranges, and low power usage compare favorably with general-purpose peers. This comes at the expense of having fewer computing capabilities, which makes programming and interacting with them much more challenging. However, by adding intelligence mechanisms on top of the hardware, making use of already-installed sensors, and creating a network of embedded units, it is possible to both manage resources at the unit and network levels as efficiently as possible and offer augmented functionalities that go far beyond what is currently offered.

4.HARDWARE REQUIREMENT

RF Receiver:

The RF emitter transmits encapsulated data, which is received by the RF receiver. The transistor that serves as an amplifier is then provided the incoming data. The carrier demodulator portion receives the enhanced signal next, and transistor Q1 is switched on and off depending on the signal. As a result, the capacitance C14 is charged and released, removing the carrier signal and replacing it with a sawtooth signal. The comparison receives this saw tooth indication after that. The LM558 is used to build the comparison circuit as shown in fig 2. The saw teeth signal is transformed into a precise square pulse using the comparator. The encoder is then provided the encoded signal in order to obtain the original signal after decoding.

Decoder:

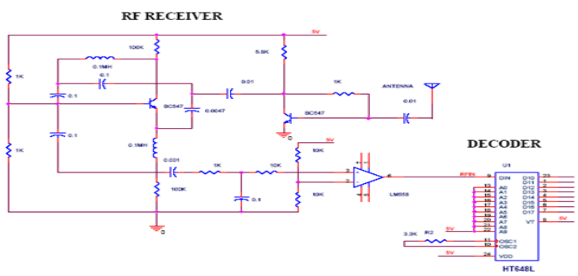

Fig -2 Circuit of RF Transmitter and Decoder

The HT648 is used as the encoder in this device. A group of CMOS LSIs called the 318 encoder are used in remote control system applications. They are coupled with encoders from the 318 line. A pair of encoder/decoder pairs with the same number of addresses and data format should be chosen for appropriate functioning. A carrier using an RF or an IR transmission transmits serial addresses and data to that series of encoders, which are received by the 318 series decoder. The serial input data is then constantly compared twice to the local location. The incoming data codes are decoded and then sent to the output ports if there are no mistakes or mismatched codes. In order to signal a successful transfer, the VT wire also goes high. The decoder's ninth port is where the circuit's received encoded data is located. The encoder now separates the data stream and address (A0-A9) (D0-D7). Following that, a microcontroller or other interfacing device receives the outgoing data stream.

Encoder:

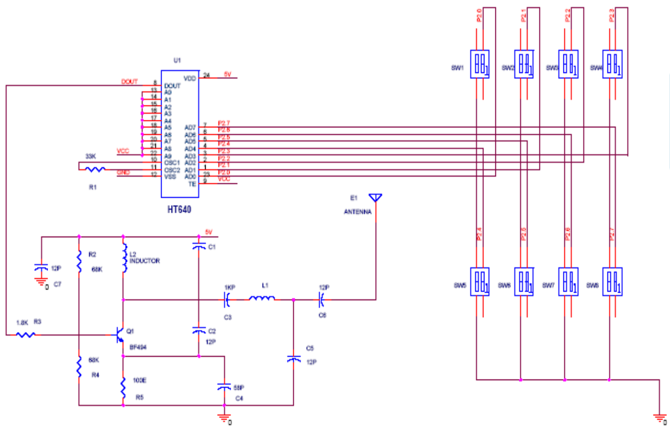

Fig-3 Circuit of RF Receiver and Encoder

As an engraver, HT 640 is used in this device. A group of CMOS LSIs called the 318 encoders are used in remote control system applications. They are able to encode information in 18 bits, which are made up of 18-N data bits and N location bits. If bonded out, each address/data entry is openly trinary programmable. Otherwise, internal drifting is enabled. Upon receiving a trigger signal, different packages of the 318 encoders give customizable combinations of programmable address/data that are relayed along with the header bits over an RF or infrared transmission channel. The 318 line of encoder's application versatility is further increased by the option to choose a TE trigger type. In this circuit the input signal to be encoded is given to AD7-AD0 input pins of the encoder; it is shown as the fig-3. The address pins of the encoder output are joined, resulting in an encoded output signal that combines the address signals (A0-A9) with the data signals (D0-D7). The encoded signal is retrieved from the 8th pin, which is linked to the RF transmitter section.

RF Transmitter:

The transistor BF 494 conducts whenever a high output pulse is applied to its base, causing the tank circuit to pulsate. L2 and C4 create the 433 GHz carrier signal in the tank circuit. The LC filter portion is then applied to the modulated output. The RF modulated information is relayed through a receiver after filtering.

Object Sensing Circuit

For a variety of applications, this product is used to detect the object. The 38 KHZ carrier signal is generated by the 4046 clock generator and relayed via the TSOP1038 sensor. A low power, linear, voltage regulated oscillator, a source follower, a Zener diode, and two phase comparators make up the CD4046 micro power phase locked loop. A common signal input and a common comparator input are shared by the two phase comparators. For a signal with a high voltage, the signal input can be connected directly; for a signal with a low voltage, the signal input can be capacitively linked to the auto biasing amplifier.

Providing a digital error signal and maintaining 90 phase changes between the signal input and comparator input at the VCO center frequency, phase comparator 1 is an exclusive OR gate that has the potential to latch onto input signal frequencies that are close to harmonics of the VCO center frequency. A digital memory network with border management is phase comparator 2. It maintains a 0 phase shift between the signal input and comparator input and offers a digital error signal to signify a sealed state.

The voltage at the VCO input, the capacitor and resistors there, as well as the capacitance and resistors attached to pin C1a, C1b, R1 and R2, all affect the linear voltage controlled oscillator's output signal's frequency.

Node MCU ESP8266

Node MCU is an open-source Lua-based software and programming board that is purpose-built for Internet of Things (IoT) applications. It incorporates components that are based on the ESP-12 module and software that runs on the ESP8266 Wi-Fi SoC, developed by Espressif Systems.

The Node MCU ESP8266 prototype board comes equipped with the ESP-12E module, which incorporates the ESP8266 chip featuring a Tensilica Xtensa 32-bit LX106 RISC CPU. This microprocessor is capable of supporting an adjustable base frequency range of 80 MHz to 160 MHz, as well as Real-Time Operating Systems (RTOS). With 4MB of Flash memory and 128 KB of RAM, the Node MCU is well-suited for IoT applications, boasting high computing power, built-in Wi-Fi and Bluetooth, and Deep Sleep Operating capabilities.

Arduino

Arduino board designs utilize a range of microprocessors and drivers. The boards come equipped with digital and analog input/output (I/O) ports that can be interfaced with a variety of expansion boards called "shields," breadboards for prototyping, and other circuitry. The devices are also outfitted with serial communications ports, some of which support USB (Universal Serial Bus), enabling the installation of applications. The microcontrollers can be programmed using the C and C++ computer languages, along with the Arduino Programming Language, which follows the model of Processing language and is compatible with a customized version of the Processing IDE. The Arduino project provides an integrated development environment (IDE) and a command line utility that is built in Go, in addition to using traditional language toolchains.

6. CONCLUSION

In conclusion, developing an assistant for blind people using RF modules, Arduino Uno, and IR sensors can be an effective solution to help visually impaired individuals navigate and detect obstacles in their surroundings. The RF module and Arduino UNO can work together to provide wireless communication, while IR sensors can detect objects in front of the user and alert them using sound. The system can also be customizable based on the specific needs and references of the user. Overall, this technology can make a significant impact in the lives of visually impaired individuals, providing greater independence and safety in their daily activities.

REFERENCES

1. A. H. A. Rahman, A. R. A. Rahman, and M. R. Uddin, "Design of an Intelligent Assistant for Visually Impaired People using Computer Vision," in 2020 International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST), Dhaka, Bangladesh, 2020, pp. 213-218. DOI: 10.1109/ICREST49258.2020.9103725.
2. K. Ramachandran and R. Ponnusamy, "Smart cane for the visually impaired with obstacle detection and avoidance," in 2019 International Conference on Intelligent Computing and Control Systems (ICCS), Madurai, India, 2019, pp. 1302-1306. DOI: 10.1109/ICCS45662.2019.9014919.
3. Mohanty, S., Das, S. K., & Tripathy, S. K. (2019). Design and development of an intelligent assistant for visually impaired people. In 2019 International Conference on Communication and Signal Processing (ICCSP) (pp. 148-153). IEEE. DOI: 10.1109/ICCSP.2019.8698192
4. N. N. Nandeshwar, V. S. Bhadane, S. S. Mahajan, and M. V. M. Prasad, "Real-Time Intelligent Assistant for Visually Impaired using Raspberry Pi," in 2019 International Conference on Electrical, Electronics and Communication Engineering (ICEECE), Noida, India, 2019, pp. 1-4. DOI: 10.1109/ICEECE.2019.8868344.
5. Ramachandran, K., & Ponnusamy, R. (2019). Smart cane for the visually impaired with obstacle detection and avoidance. In 2019 International Conference on Intelligent Computing and Control Systems (ICCS) (pp. 1302-1306). IEEE. DOI: 10.1109/ICCS45662.2019.9014919
6. Ravi, P., & Jyoti, K. (2021). Real-time implementation of intelligent assistant for the blind using Raspberry Pi. In 2021 International Conference on Communication, Computing and Networking (ICCCN) (pp. 1-5).IEEE.DOI:10.1109/ICCCN52002.2021.9539592.
7. S. Al-Mohaimeed, A. Alotaibi, and M. Al-Shahrani, "A Smart Wearable System for Assisting Blind People," in 2020 International Conference on Computational Intelligence and Communication Networks (CICN), Bhopal, India, 2020, pp. 153-157. DOI: 10.1109/CICN49678.2020.9307931.
8. S. U. Zaman, A. F. M. Sultan-Ul-Islam, and M. A. Bashar, "Development of an intelligent assistant for the blind and visually impaired people," in 2018 21st International Conference on Computer and Information Technology (ICCIT), Dhaka, Bangladesh, 2018, pp. 1-6. DOI: 10.1109/ICCITECHN.2018.8637606.
9. Shukla, R., Goyal, P., & Sharma, A. (2021). An intelligent assistant for visually impaired people using deep learning. In 2021 International Conference on Computer Communication and Informatics (ICCCI) (pp. 1-5). IEEE. DOI: 10.1109/ICCCI52545.2021.9389391.
10. Yu, Z., Li, X., & Zhang, X. (2020). Design and implementation of intelligent assistant for the visually impaired based on IoT technology. In 2020 International Conference on Artificial Intelligence and Computer Engineering (AICE) (pp. 77-82). IEEE. DOI: 10.1109/AICE49289.2020.00023