IOT Based-Smart Cap

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Abstract—The World Health Organization has stated that the number of human beings with visible impairments worldwide is 285 million. Of these, 9 million human beings are blind.1 Vision, being one of the vital human senses performs the maximum crucial position in human environmental perception. The biggest challenge for a person with vision and hearing impairment is to navigate around the world. A way to this hassle has been proposed. Smart Cap targets to assist human beings with such disabilities and assist them conquer regular challenges. The architecture of the proposed system consists of an Arduino UNO, an ultrasonic sensor to locate obstacles, and a vibration motor to alert deaf-blind human beings of obstacles. An advanced technology called talkie library which is a speech synthesizer is used to help the blind by giving voice commands. In case of emergency, the person's guardian may be alerted through the WiFi module.

Keywords— Arduino UNO, Ultrasonic Sensors, Vibration Motors, Talkie Library, WIFI Module.

I.INTRODUCTION

In recent years, as a result of public health measures, the number of people losing their sight due to disease has decreased. Individuals with visual impairments utilize various assistive technologies in their daily routines for tasks like navigation and reading text. [1]. However, there is an increasing rate of 2 million visually impaired people in an age group of 60 every 10 years. Persons with weakening rely on additional assistance by persons, guide dogs, or devices as decision support systems [2]. Several solutions like UltraCanne [3], Isonic [4], Teletact [5], and others are already available in the market but still have many drawbacks. These drawbacks are overcome by the proposed system. Smart caps aim to enable visually challenged people to recognize objects and provide acoustic details about the recognized objects [7] using active and passive sensors. Passive sensors collect information about the presence of passive sensors only the electromagnetic radiation rebounded, radiated, or conveyed from natural sources. When employing an active sensor, the device emits a signal reflected. It discerns the reflected reaction from an object illuminated by an artificially generated energy beam. Such sensors can detect and detect distant and nearby obstacles.

Additionally, it accurately measures the distance between visually impaired people and obstacles. Overall, four different types of active sensors can be used in the field of obstacles: laser, IR, ultrasonic, and radar sensors.in the field of obstacles with laser, IR, ultrasonic, and radar sensors. The system uses an ultrasonic sensor, which is an active sensor. The system architecture also includes a vibration motor to alert the person to obstacles. The ultrasonic sensor detects the direction of the obstacles which Arduino will indicate.

The speech is produced utilizing Talkie Library software, an Arduino library crafted by Peter Knight and Armin Joachim Meyer. It comprises a software rendition of a speech synthesis architecture originally developed by Texas Instruments during the late 1970s and early 1980s. If the visually impaired person is in an emergency, they can alert their guardians. This is achieved using a Wi-Fi module and ThingSpeak. The ThingSpeak API functions as open-source software designed to monitor and timestamp incoming data, displaying it to human users through visual graphics and to machines through easily parsable code. The Smart Cap integrates the fields of the Internet of Things and Deep Learning, offering capabilities such as face recognition, image captioning, text detection and recognition, and online newspaper reading. [10].This system helps visually impaired people move independently and is portable.

II. PROPOSED SYSTEM

Three Ultrasonic sensors are placed on the cap, one facing front, the other towards the right, and the last towards the left. With the aid of headphones, voice commands from the talkie library can be sent to guide the blind.

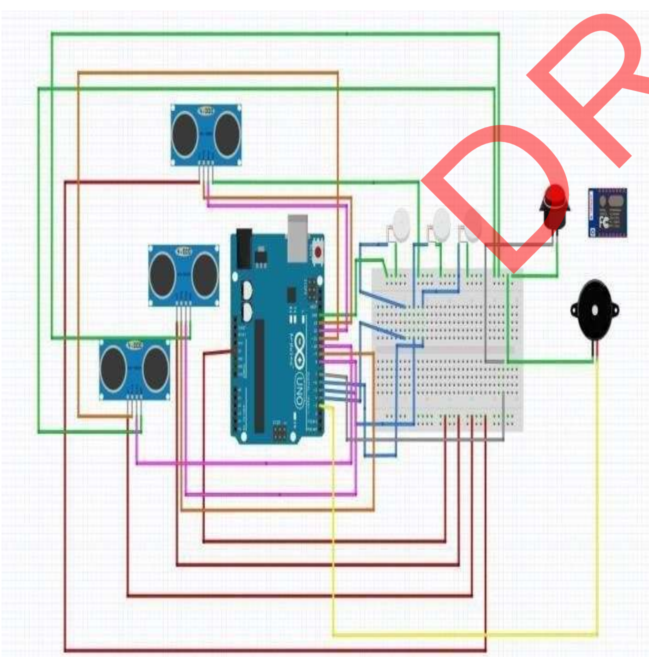

Fig.1. Basic Circuit Diagram

In the sensitive regions of the body, such as the frontal and temporal areas, a vibration motor is incorporated alongside the sensor to assist individuals who are deaf-blind. Each of the sensors sends eight 40 KHZ pulses. Upon detecting an obstacle, the sound will bounce back to the receiver. The microcontroller interprets the ultrasonic sensor readings to trigger the motor and audio output via pulse width modulation, ensuring low power consumption. Subsequently, the microcontroller sets the motor in motion for vibration and delivers the necessary auditory warning message through an earphone. In case of any emergency, an alert message is sent to their protectors via the Wi-Fi module.

1. ULTRASONIC SENSOR:

To select the appropriate sensor several factors to be noted down such as cost, atmospheric conditions, nature of obstacles, and detection range.

TABLE I. GENERAL CHARACTERISTICS OF ACTIVE SENSORS

	Laser	Infrared	Radar	Ultrasonic
Principle	Transmission and reception of light wave	Transmission and reception of pulse of IR light	Transmission and reception of microwave	Transmission and reception of acoustic waves
Range	SLR: 15cm to 120cm LLR: about 10-50m	From 20cm to 150cm	About 150-200m	From 2cm to 4m
Beam Width	Narrow	Fairly thin	Depended on size of antenna	wide
Cost	Very high	Low	High	Low

Ultrasonic sensors are used for the following reasons:

- Not affected by color or object transparency
- Can be used in dark environments
- Low-cost option
- Less susceptible to dirt, dust, and high-humidity environments
- Easy to connect to microcontrollers and other types of controllers

The sensors are small and easy to connect, making them suitable for various robotics projects. They offer an outstanding non-contact area detection ranging from 2 cm 6 to 400 cm (approximately 1 inch to 13 feet) with an accuracy of 3mm. Since Operating on 5 volts they can be Operating on 5 volts, they can be directly connected to Arduino or other 5V logic microcontrollers.

The ultrasonic distance sensor HC-SR04 comprises two ultrasonic transducers among which One serves as a transmitter, converting electrical signals into 40 kHz ultrasound pulses, and the other one functions as a receiver, awaiting the transmitted impulse. Upon reception, it generates an output pulse width, indicating the presence of objects within the sensor's range.

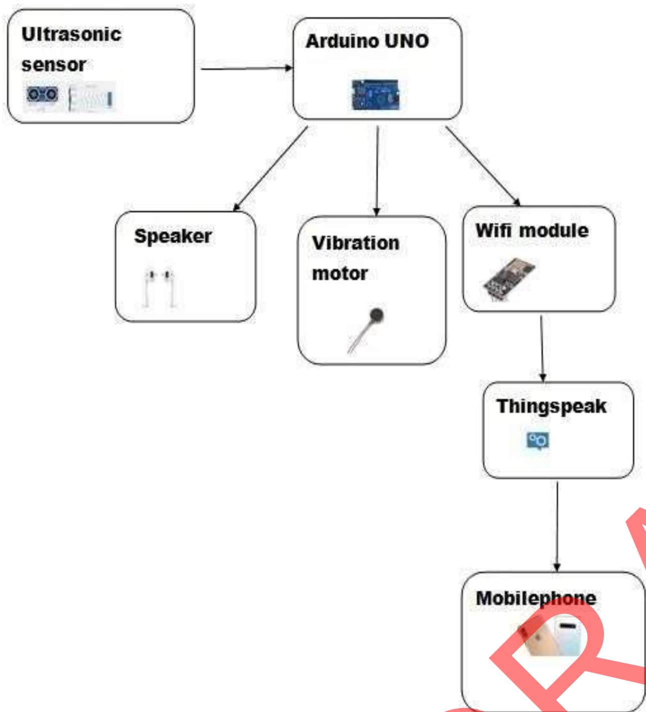

Fig.2. Block Diagram

1. VIBRATION MOTOR

The motor used is a flat 1034 mobile phone shaftless vibration motor enclosed fully, and moving parts are not exposed moving parts. The world's thinnest motor, with a maximum thickness of 1.8mm at its thinnest part. The size is approximately 10mm in diameter and 3.4mm in height. This small button-like vibration motor vibrates with an amplitude of 0.75g and pulls about 60mA when you apply 3V to its leads.

2. WIFI MODULE

The ESP82646 WiFi module is an independent System-on-Chip (SOC) containing an integrated TCP/IP protocol stack. This module has enough powerful built-in processing and storage capabilities to easily integrate with sensors. A high level of on-chip integration reduces the need for external circuitry, such as front-end modules, and is optimized to minimize the PCB footprints.

- It is loaded with various features.
- It is very cheap and more powerful than the Arduino.
- ESP8266 WiFi module with SOC and integrated TCP/IP protocol stack allows you to link your microcontroller to WiFi.
- ESP8266 acts as a server, capable of hosting applications and acting as a client. External processors can utilize its comprehensive Wi-Fi network capabilities.
- Compatible with Arduino boards, enabling programming of the ESP using the ARDUINO IDE.
- Each ESP8266 module is pre-loaded with firmware containing an instruction set.

III. SYSTEM DESCRIPTION

The various software and open-source platforms used in this system are discussed below. The system uses Talkie Library for speech synthesis and ThingSpeak for data storage and retrieval in the cloud.

TALKIE LIBRARY:

It is from the late 1970s-early 1980s speech synthesis (linear predictive coding) architecture used in several popular applications. A talkie can store more than 1000 words of audio data. Most words only take up a small portion of a KB, so you can add a lot. Talkie sets up a special high-speed PWM so that it can record audio directly without filtering. ThingSpeak serves as an IOT analytics platform service enabling Data captured by devices to be transmitted to ThingSpeak, where it is promptly visualized, allowing for real-time insights, and alerts can be generated based on predefined conditions.

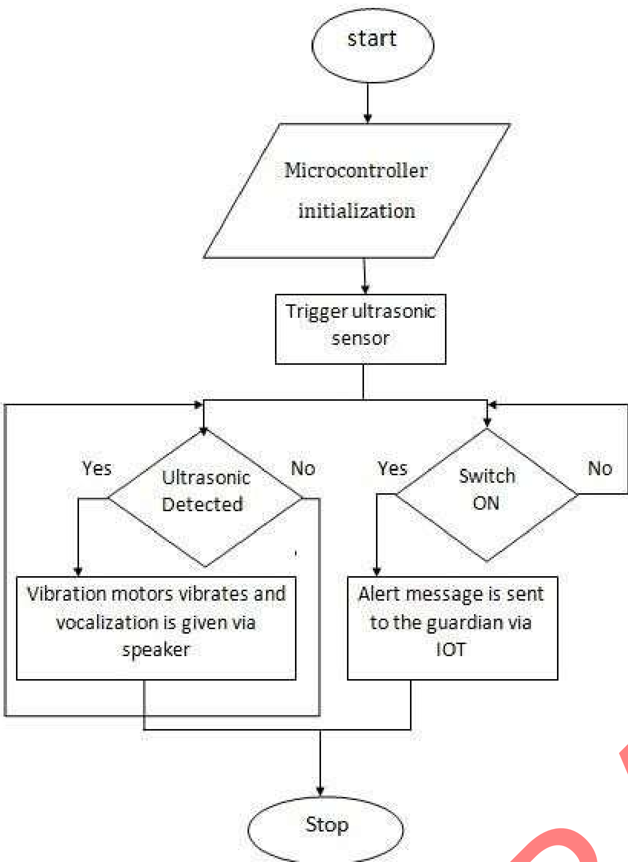

Fig.3. Flow Chart

IV. RESULT AND ANALYSIS

The timing chart of the ultrasonic sensor is shown below. Initially, the microcontroller sends input, initiating measurement. Subsequently, distance transmits 8-detects rising edges depending on the distance of the obstacle. If no obstruction is detected, the sensor waits 38ms before starting the next transmission.

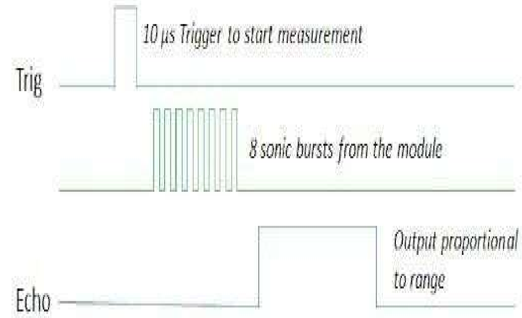

Fig.4. Timing diagram of Ultrasonic Sensor

The Ultrasonic sensors calculate the distance of objects based on the speed of sound. When sound propagates through the atmosphere, the speed of sound at room temperature is approximately 344 m/s. However, it's important to note that the speed of sound is temperature-dependent and alters by roughly 0.17% per degree Celsius. These variations can impact ride times and skew the distance calculations. Vapor-rich liquids create a constantly changing atmospheric density, which can affect the speed of sound and significantly reduce the accuracy of measurements. Using soft or sound-absorbing materials, such as powdered or foam-like surfaces, can dramatically reduce communication range.

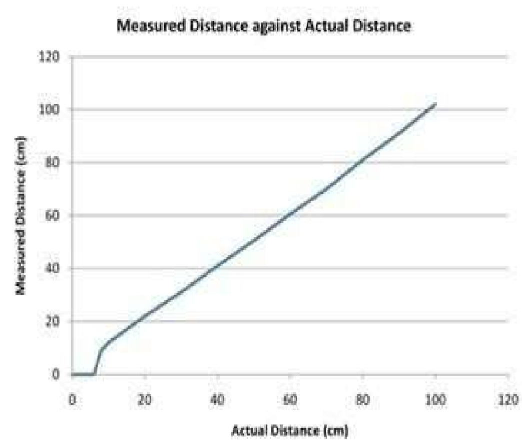

Fig.5. Graph-Actual Distance vs. Measured Distance

The above graph is almost linear when the ultrasonic sensor is operating at normal room temperature (operating temperature -25° C to +70° C).

Fig.6. Thingspeak graph

The incoming data can be effectively managed through two primary methods: time-controlled processing or reactive application. The Time Control application enables users to schedule computations at intervals ranging from once a day to as frequently as every 5 minutes. On the other hand, the React App serves as a tool for condition monitoring, allowing real-time surveillance of data from various devices and triggering alerts in case of emergencies. Utilizing the reactive app, such as a mobile phone, facilitates constant vigilance and immediate response to critical situations as they unfold.

IV. CONCLUSION

The system has a simple architecture consisting of an ultrasonic sensor that detects objects and responds according to the sensor's data via audio output. In case of an emergency, a warning message will be sent to parents via the Wi-Fi module. This device serves to monitor the surrounding environment, providing audio information about the environment to enhance safer navigation. The proposed system is ergonomic. Those who use it do not need any special skills to operate it. The disadvantage of the cap is that it can only detect objects in a certain area of the sensor. But with Open CV, Raspberry Pi, and Microsoft, you can improvise by converting visual information captured by a camera into audio information. In the future, Smart Cap will also be able to track the location live, allowing parents to know where the person is.

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