Development of Smart Stick for Visually Challenged People

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ABSTRACT

Human can able to deal with the world with the help of their senses. But an individual cannot have any control when they lack their sense organs. One of amongst is lack of vision. It made an individual completely dependent on others. However, missing the wonder of nature is a big worry in them. They always suffer to do their routine tasks like reaching their destination, meeting their dearer ones, travelling, and transporting in day-day life. They perpetual-ly need human help to accomplish these tasks. Sometimes, they didn't get help for their tasks, such moment they cannot complete their routines and works. To overcome this, we are coming to a rendezvous method and smartly guiding them to achieve their goals. With the help of modern technology, we designed a 'smart cane'. It helps the individual and guides them in the right to complete their tasks. It identifies all obstacles within the path with the help of varied sensors put in it. The microcontroller can retrieve the knowledge and pass it on as vibrations which can apprise the hurdles on the way. It is an Eco-friendly device and can influence an enormous boon for blind folks.

Introduction

In this modern era, technology plays a prominent role in all our life. Every achievement in technology directly or indirectly improvising our life. The technology developed from pigeons to optical fibre in communication and horse-carts to sonic planes for transport. Technology helps us in achieving many things and brought drastic changes in our lives. Apart from technology, humans are marvellous beings to gain knowledge and make wonderful achievements in this world. But they are some disabilities that drag humans away from their achievements and shield them from reaching their goals.

One of those lack of visual perception, these people struggle a lot to do their daily tasks. They cannot freely move to their favourite places and face many problems to do their jobs. People will use trained dogs to help these individuals, but such dogs are very difficult to maintain. Now, the maintenance cost of the dog has reached thousands of rupees. Generally, the afford fewer Individuals uses the traditional stick doesn't provide any help to them. Some of the technologies are present in the market, which is very expensive for purchase and maintenance.

Now, we look up to develop a prototype that can simulate their work easily. We will develop the traditional smart stick into a smart and better one with the use of technology. We embed the ultrasonic sensors and other sensors into the stick to stimulate the external environment to sense the water and flame. We implanted nano-microcontroller Arduino UNO to reduce the weight of the cane and give an immediate response to those senses. Many of the pre-existing projects used the Arduino UNO, which adds weight to the stick and individual cannot able to carry the stick

much time We are using two special sensors, namely moisture sensor, which indicates the individual about the water on the way and flame sensor which detects the flame from fire and send the responses to the Arduino UNO. The Nano-Arduino UNO module supports the respective coding, sends the output through the speaker, and makes the individual understand the type of obstacle and its distance.

Problem Statement

Nearly 37 million people are suffering vision-related problems. Among them, some of them completely lack vision. They cannot be able to complete their routine tasks in their lives. It is very difficult for them to achieve their goals and fulfil their dreams. They need someone who helps to accomplish their daily tasks and needs someone guidance to reach their destination.

Literature Survey

The smart stick is prepared for visually challenged people because they can't walk independently. By fixing the ultrasonic sensor at a 30-degree angle on a smart stick, sense any obstacles and holes In them. A moisture sensor was placed at the bottom of a stick, indicating the water level and avoiding placing the foot's small water crack on the road [1]. The stick is made up of one ultrasonic sensor and one infrared sensor. The ultrasonic sensor is used to identify the distance long-range distance, and the infrared sensor is used to identify the nearby obstacle. Arduino UNO is a microcontroller that receives signals through sensors and gives the output through a buzzer [2].

Visually challenged people will face so many difficulties by day by day on daily activities like walking, reading, socializing etc. the smart stick is designed with obstacle detection, heat detection, water detection, light detection, ir sensor, GPS and GSM modules which all are connected with their mobile which gives the alarm.[3]. When blind people want to travel to unknown places, they will face so many difficulties. The solution for this was an automated smart stick based on goggles cloud video intelligence API [4]. Visually impaired people will face so many difficulties when they want to interact with nature. The main theme of this paper was making blind people independent by making a smart stick which is going to in-built with an ultrasonic sensor and PIC microcontroller 16F877A, and output is received through a buzzer [5].

Blind people use a cane for they have contact with the environment, but this cane doesn't give all suitable information about the surrounding object; we can implement ultrasonic sensors and inform users by audio signals in the cane made it effective [6]. For visually challenged people doing their routines would be the toughest thing. To make it finer, a traditional cane is converted into an assistive cane by penetrating an infrared sensor and Arduino UNO to it [7]. This system includes an embedded e-SOS (electronic Save Our Souls) system with an ultrasonic sensor and Arduino UNO. The system helps the individual with the others through video call. It works based on android application [8].

This model develops with the module consists of two ping sensors. CMP compass sensor 511 is used to give information about the direction of wind flow. The output is sent as the sound, and the buzzer activates within the range of 3cm-150cm when the obstacle is detected with a speed of 0.3 sec [9]. This model combines the three sensors Ultrasonic sensor, a Force sensor and a pressure sensor. The force sensor is attached to the individual shoe, measuring the distance between the stick and shoe. The pressure sensor helps to walk the individual if the individual lost the grip on the stick handle. This trio makes the stick into an assistive one [10].

It is hard to live a life with disabilities. To make blind people smart, so we are implementing so many sensors, which makes it a smart stick, which gives alarm when the user faces any obstacle and gives the audio command through speakers connect-ed by Bluetooth [11].

Travelling from one place to another place is hard for visually challenged people. They will face so many obstacles, stairs and so many crack s etc. IoT paradigm provides a medium between blind and environment. With the help of several sensors [12]. A blind person normally uses a stick for assistance. With the smart walking cane, they will

make independent, and it makes their life easier with the help of GPS and GSM technology useful for them to locate the place easily [13-27].

Proposed Work

Block Diagram

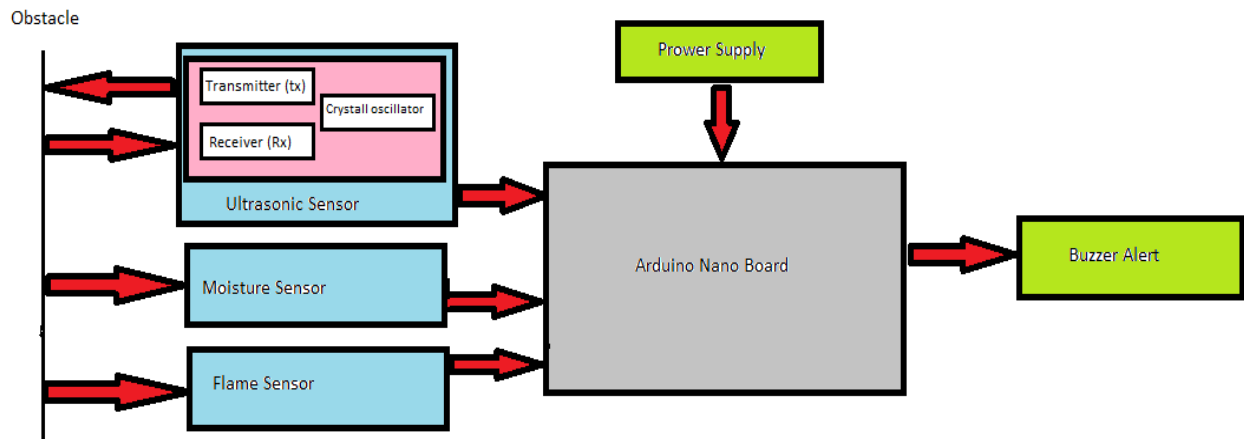The Block Diagram of the Proposed Work has been explained in figure 1.

Figure 1. Block Diagram of the Proposed Work
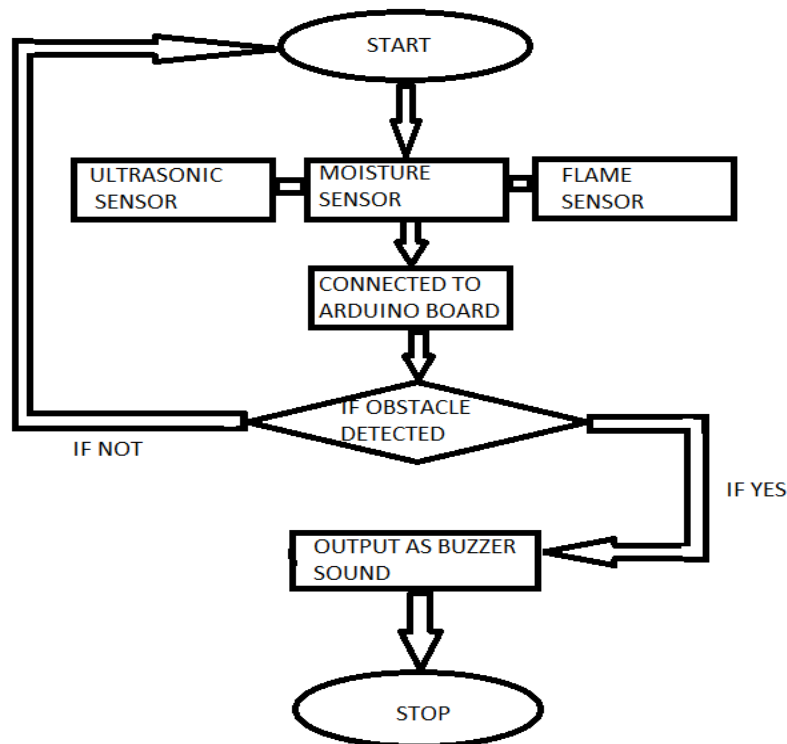
Flow Chart

Figure 2. Flow diagram of the Proposed Work

The Flow diagram of the Proposed Work has been mentioned in figure 2.

Flow Chart Description

1. Initialization of the Arduino Nano
   - The power supply is given to the Arduino Nano module from the battery system to power the internal components [28-35].
   - The device's internal components are subjected to initialization for the proper working of all the electronic components [36-41].
2. Once the initialization is done, the sensors remain ON to detect their respective senses from the external environment.
3. Working of Ultrasonic sensor
   - After initialization, the Ultrasonic sensor detects the obstacle in the path and sends those responses to the microcontroller
4. Working of Flame sensor:
   - The flame sensor detects the spectrum of light from the ignition and send the corresponding impulses to the microcontroller.
5. Working of Moisture sensor:
   - The moisture sensor detects moisture present on the path and carry these responses to the microcontroller.
   - Detection and Authentication
   - Once the microcontroller gets the signals from the sensors, the microcontroller started to identify the type of obstacle.
   - Then the signal went for processing with the code.
   - The microcontroller analyzes the type of obstacle with the help of the respective code.
6. Sending the Status:
   - The microcontroller coding section consists of blocks of code.
   - If the specific block of code gave the output response to the microcontroller.
7. Last Step:
   - The microcontroller sends the alert note to the individual through the memory module.

Arduino Uno for Smart Stick

The designed smart cane consists of Arduino UNO, which helps for the fast pro-cessing of signals and interfaces the input and output devices. That Arduino UNO Nano is the smallest board which is based on ATMEGA328 microcontroller [42-49].

When the blind person is walking with the stick, the stick senses the obstacles with the help of an ultrasonic sensor and sends the stimulations to the microcontroller. Here, the microcontroller grasps it and then analyses the obstacle type and responds to the obstacle sensation with a response. The response is through two ways. One is in the form of vibration, and the other is in the form of voice, which is the speaker's output. The individual can sense the vibration with a handle of a stick [50-58].

The uneven surfaces and stairs are perfectly identified by this method with high precision. For this purpose, we are using 8 sensors that cover 360 degrees around the stick. It identifies up and downstairs and tells the individual about the particular stair type and its dimensions [59-67].

To detect the water level and recognize the pool on the ground, we are including the water level indicator in this project. Whenever the stick is placed on the water, it automatically senses and gives some vibrations. We use the flame sensor in the stick to detect the fire if the stick approaches near to fire. The sensor automatically de-tects it and indicates the individual [68-75].

Overview Arduino Uno Nano Module

The Arduino UNO Nano is a microcontroller of ATMEGA328p that belongs to the Arduino family, and it resembles almost like the Arduino Duemilanove board; it is very little weight. These traits made it to use in embedded systems, electronic projects, and robotics [76-89]. It is provided with a mini-USB jack, and it supports three modes of communication like USART, SPI & IIC. We can design our code in this module, and it supports various types of programming languages, as shown in figure 3.
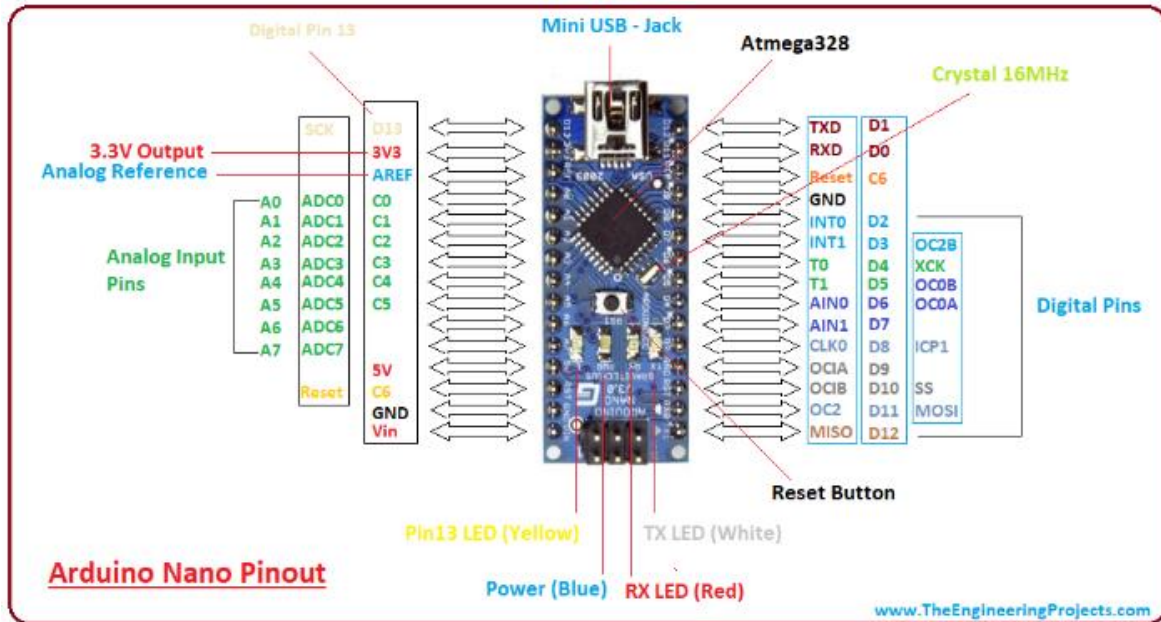

Figure 3. Aruduinoi Uno Pinout Diagram

Overview of Ultra-Sonic Sensor

This device senses the distance of objects. The ultrasonic sensor is extendable proximity sensors. We can able to extend the range of a sensor according to project requirement. It radiates the ultrasonic waves and grasps the range of the object. It is used in a vast number of projects for object range detection. It sends to the respective CPU like microcontroller and microprocessor after transforming it to an electrical signal. We can calculate the range of an object and sensor using formula R=0.5XTXS (where R is Range, T is Time and S is the speed of sound in m/s). This sensor consists of two nodes for transmitter purposes and the other for receiver purposes. The transmitter transmits the UV rays, and the object is hit by the UV rays reflected towards the sensor in the opposite is grasped by the receiver. The receiver sends the corresponding signals to the microcontroller. For detecting some transparent objects, especially where the optical technologies may fail, there is a great scope for ultrasonic sensors. It requires very little power when compared to other sensors for its operations, as shown in figure 4.

Figure 4. Ultrasonic Sensor

Overview of PIR Sensor

A flame sensor can detect the light from the flame. It is based on the wavelength mechanism. The light from the ignition emits within a certain range. The flame sensor responds to the wavelength by sensing it. Technically, the receiver of this sensor using the electromagnetic radiation principle. The sensor's response is very fast, 3-4 secs; it absorbs the radiation from the sensor and responds to it. The Accuracy of the sensor can be adjustable like an ultrasonic sensor. Flame sensor operation is very accurate and quick compared to smoke and thermal sensors, as shown in figure 5.

Figure 5. PIR Sensor

Overview of Moisture Sensor

It is used to analyze the water present in the ground. The sensor is placed at the bottom of the stick; if the moisture content is high on the ground, it alarmed the microcontroller by sending the impulses. Generally, the moisture level sensors are vastly used for irrigation purposes. It measures the moisture content in the soil, and now here we are using it to absorb the moisture in the ground and send the responses to the processing unit. The water senses the water level, and moisture indicates the presence of moisture and water on land. So, this sensor is more preferable to a water level sensor in this type of projects, as shown in figure 6.
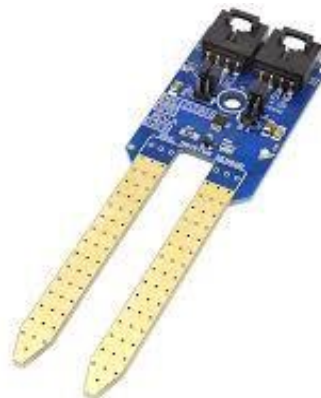
Figure 6. Moisture Sensor

Result and Discussion

Python language is one of the versatile languages which consists of numerous key-words. This makes it comfortable to code and also reduce the unnecessary arguments in the code. Hence, we use python language for coding. Before starting the coding process, the user needs to configure Arduino NANO. The user starts to code the pro-gram in the Arduino software. The communication happens with the STK500 proto-col within the microcontroller. The various sensors embedded in the cane senses those respective signals and retransform those signals into the electrical form.

The microcontroller consists of various files and pre-library functions related to those responses from sensors. It analyzes the incoming inputs from various sensors and sends the corresponding signals to the output, as shown in figures 7 and 8.

Figure 7. The Smart Stick

Figure 8. Device detecting the flame and alerting the user

Conclusion and Future Work

Every individual in the world has to lead their life. Comfortably. But, some of them lack their activities due to defects. We can overcome this with the usage of technology. We made everyone leading their life independently. This device makes every blind individual can do their routines by themselves. They can able to go to their destinations easily through this device. The smart stick lightweight, portable to use, affordable in price, and a nature-friendly device. This device is very effective and unique among all the implementation of smart guidance devices. It covers 180 degrees of an individual, senses each obstacle, and provides an immediate response to the individual. In addition to it, it has some special sensors which guide and protects from accidents. We developed it based on the python programming language. We can apply deep neural networks to the project for machine learning purposes.

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