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Blind Navigation Guidecane

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Abstract— The Blind Navigation GuideCane is a device to help visually impaired users navigate safely and quickly among obstacles and other hazards. It is an electronic obstacle detecting robotic device coupled with a traditional cane. This robotic device makes use of a sensor for detection and audio output for feedback, which greatly benefits the user in navigating with ease and safety.

Keywords— Guidecane; ultrasonic sensor; DC motors; chassis; arduino uno microcontroller.

I. INTRODUCTION

Visually impaired users would greatly benefit if they could be assisted in walking safely in some form other than the use of a basic white cane which requires to be tapped around to detect some form of obstruction. It has always been observed that the blind have to rely a lot on their instincts leading to various mishaps and dangers being faced by the visually impaired users. Since these instincts are humane, one cannot depend on them completely. In such a situation using an electronic obstacle detecting robotic device coupled with a traditional cane can greatly assist such visually impaired users to navigate with more ease while relying on technology. The obstacle detecting robot would do all the required work of detecting any obstacles present and directing the user accordingly, thus reducing the efforts of the visually impaired user. It could also be equipped with the ability to alert the visually impaired user, by emitting an additional audio message when an obstacle is detected.

II. PROBLEM DEFINITION

As stated, it brings to light the fact that there are a lot of visually impaired users in need for some form of life simplifying technology in relation to their disability. Using a basic traditional white cane is a common practice but it is difficult to use in the right way without proper training which sums up to at the most 100 hours. Another option such as a guide dog is also not favorable, because visually impaired users have difficulty first and foremost to carry out their basic activities, having to care for another living creature would only increase their problems. Recently there has been a lot of research, which includes the Electronic Travel Aids (ETA), the Navchair, the Navbelt etc. designed to help the blind navigate safely. But all these devices have their own drawbacks. Thus with advances in science, it is possible to reduce the hardships of the physically disabled, with the help of this novel device. Our long term goal is to create an independent system that will allow these visually impaired users to travel through any circumstances.

III. MATERIAL AND METHODOLOGY

1. *Details of Hardware and Software*

A. Mechanical hardware

1. Chassis
2. Wheels
3. Guidecane

B. Electronic hardware

Microcontroller (Arduino UNO)

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

Motor shield

The Motor Shield is a driver module for motors that allows you to use Arduino to control the working speed and direction of the motor.

Ultrasonic sensor (HC sr04)

The ultrasonic sensor calculates the distance from an object by sending bursts of ultrasound towards it and measuring the time it takes to the sound waves to get back (Distance = Velocity * Time). This information can be used in order to determine whether there's a close "obstacle" nearby and then avoid it.

Dc motors

It is a simple electrical motor, a DC motor is used.

Buzzer OR Piezo speaker

This is a small 12mm round speaker that operates around the audible 2kHz range.

C. Software

Obstacle avoidance algorithm for detecting and avoidance of obstacles used for Arduino Uno microcontroller.

2. *Implementation Methodology*

The implementation of this device would first and foremost begins by putting together the core components. A chassis will be used to mount all the electronic components of the device. The components will include: The Arduino UNO microcontroller, HC sr04 Ultrasonic sensor, Motor shield (or motor driver). The brain of this device is the Arduino UNO microcontroller which will be connected to the Ultrasonic sensor. In order for the chassis to move, as required later stages of implementation, it will be mounted onto wheels. These wheels will be rotated as per requirement using a DC motor which will be powered through the use of batteries. A

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motor shield or motor driver will be used to power the motors effectively by connecting it to the power source (batteries) and the DC motor. The Block Diagram showing the interconnections between components is shown in figure 1.

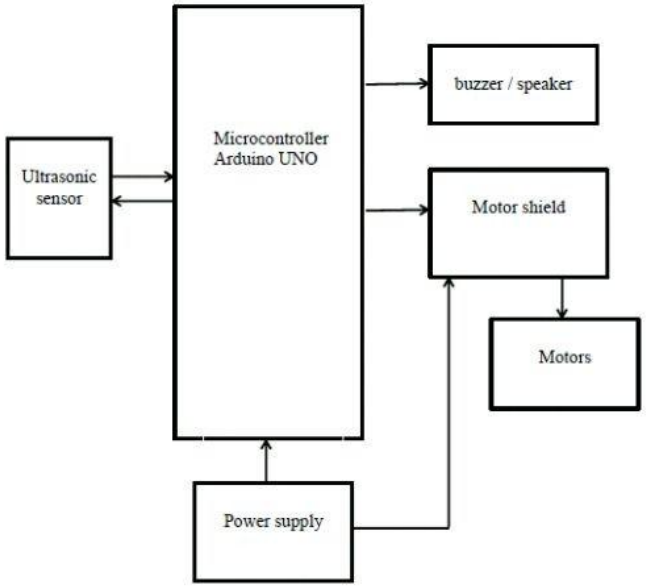

Fig. 1. Block diagram.

After the chassis is successfully mounted onto wheels and the wheels are connected to the respective servomotors, the Arduino UNO microcontroller will be mounted onto the top and so will the Ultrasonic sensor. The ultrasonic sensor can be connected to a mini breadboard for simplifying the process of wiring. The microcontroller and the sensor can both be connected using jumper wires. Additionally, a buzzer of some sort will be included in order to emit an audio alert to the user. This will also be attached to the microcontroller along with the ultrasonic sensor. After these connections are carried out, then the Motor shield will be mounted on top of the Arduino. The Motor shield is required to be connected to the power supply and the servomotors. Every Motor Shield has (at least) two channels, one for the motors, and one for a power source. The respective connections will be made. After these main connections, the handle or the cane will be attached in the very end to the chassis, after the required software implementation is carried out. After these hardware connections have been made the programming of the device will be done following the concept of an obstacle avoiding algorithm.

The basic functioning of the Algorithm would be that on detection of an obstacle, the audio signal is emitted while simultaneously making the device move in order to avoid said obstacle.

The basic concept of the code is for the Guidecane robot to always be monitoring for objects in front of it while moving. This is done by the sensor where it sends out a 40kHz chip which is not audible, and retrieves the echo. The program then gets the duration it takes for the pulse to get back and converts it into distance. Once the Guidecane detects an object where the distance forward is greater than the danger threshold - the path is clear so our program tells the robot to move forward. Otherwise the robot will stop then pan left and right. Depending upon which path is "clearer", it will rotate to that clearer path and start heading in that direction.

V. Implementation and Results

Step1: Constructing the Chassis

The chassis consists of 2 DC motors connected on either side –which are used to rotate the wheels. And a battery used to power the device.

The Chassis is shown in figure 2:

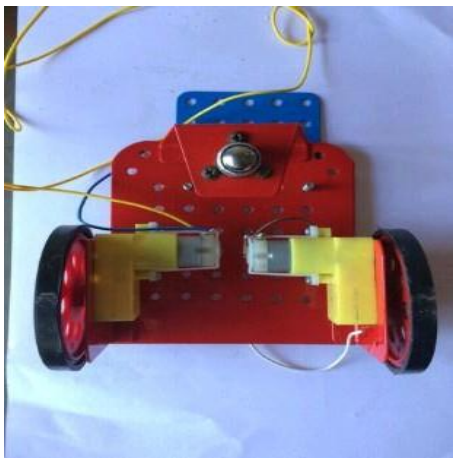

Fig. 2. Chassis.

Step 2: Connecting the Ultrasonic Sensor to the Arduino Uno

The following table shows the US pins which are connected to the Arduino:

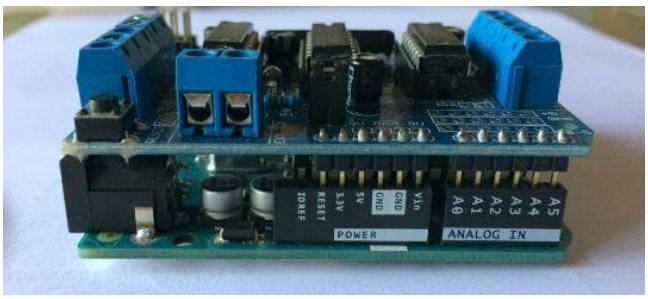

Fig. 3. Table of pin connections.

Ultrasonic Sensor Pin	Arduino Pin
Vcc	5V
Trig	12
Echo	13
GND	GND

Step 3: Connecting the Motor Shield to the Arduino Uno

The Diagram of Motor Shield connected to the Arduino Uno is shown in figure 4.

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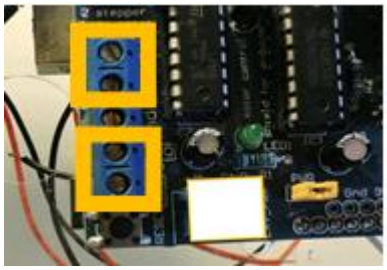

Fig. 4. Diagram for connecting the motor shield to the Arduino Uno.

Step 4: Connecting the motors and Battery to the Arduino
The diagram of Motors and Battery connected to the Arduino board is shown figure 5.

Fig. 5.Diagram for connecting the motor and battery to the Arduino Uno

Step 5: Programming the Arduino

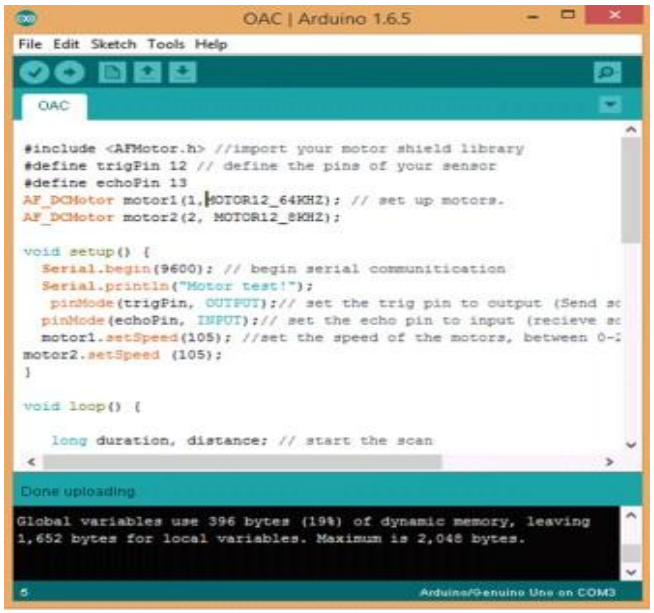

Fig. 6. Screenshot of programming the arduino.

VI. CONCLUSION

The GuideCane is not only a mechanical device but also uses robotic assistance making it more powerful. The advantage of the system lies in the fact that it can prove to be very low cost solution to millions of blind person worldwide. The Guidecane is also more reliable than any other device available as it is easily maneuverable and the user does not require much time to get used to it as compared to a traditional Guidecane available. The proposed model is known to be an overall ease for the visually impaired person in order to locate the obstacles. The results obtained from the testing show that several performance measures can vary due to certain changing factors such as mobility, terrain etc.

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