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Smart Aid for Blind People

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Abstract: Eyesight is one of the most useful living organisms, but visually impaired people do not realize that sense. They are unable to see the beauty of nature. Not all the problems of the visually impaired can be solved but with the help of modern technology life could be made easier for them. In this era, where everybody tends to be independent in order to survive, people with lack of visuality find it almost not possible. Blindness is a very common disability across the world. Our project is designed in order to give blind people a helping end in overcoming their daily life challenges. The "Smart Aid for Blind People" project consists of Ultrasonic sensors for detection of obstacles like a car, staircase and alert the person with the help of in-built buzzer and a voice module. It also detects the motion of the object by Sensors. We have also used vibrating motor and voice module for sending alert message to the blind person. The overall aim of the project is to provide a safety and convenience to blind people.
Keywords: Blind People, Ultrasonics sensors, Voice Module, Arduino Microcontroller, Wearable Device, Ear Phone, Buzzer, Obstacle.

I. INTRODUCTION

This Chapter will cover the basic information of the project and the main reason behind choosing this project.

A. Background

Vision is extremely essential in a person's existence. According to a WHO estimate, over 285 billion people suffer from vision problems, with 39 million of them being blind. We have grown so materialistic as people's living conditions have improved that we have forgotten how physically handicapped individuals live a difficult existence. Because they are physically handicapped, they are subjected to harsh, apathetic, and uncaring treatment. In certain ways, they become reliant on others to do their daily tasks. For their mobility, blind and disabled people are constantly reliant on others. The eye is the primary sense organ for seeing the outside world; its malfunction has a significant impact on the outside world's knowledge perceiving capabilities. As a result, getting about in such an environment is a huge problem for blind individuals, who are unable to rely on their own sight and so confront several challenges.

With recent technology advancements, several clever solutions have been created to assist blind individuals in navigating independently. Many people have significant vision impairments that prohibit them from travelling freely, necessitating the use of a range of aids and procedures to assist them in their movements. There are mobility specialists who teach visually impaired and blind persons how to walk freely and securely.

Another option is to use guide dogs, which are taught to assist blind persons in their movement by navigating around obstacles and alerting them to them. However, this approach has drawbacks, such as dogs having difficulty understanding complicated orders, being only useful for 4-5 years, and being expensive to train. There is also a sign tool for blind people, such as a white cane, which is used to improve a blind person's mobility. The walking cane is a basic mechanical device that uses tactile-force feedback to identify any obstruction or hole.

1) *Motivation and Scope of the Report:* Previously, many approaches, such as electronic travel assistance (ETA) devices, have previously been created to improve the mobility of blind individuals who rely on signal processing and sensor technologies. These devices are divided into two groups: sonar inputs and camera input systems. These devices function similarly to radar, which employs ultrasonic fascicle to determine the height, direction, and speed of moving and stationary objects. The time it takes for the wave to travel between the obstruction and the blind person is used to calculate the distance between them.
2) *Problem Statement:* All existing systems, on the other hand, alert the blind person to a barrier placed at a specific distance in front of or near him, allowing the person to adjust his path. Information regarding the object's qualities, on the other hand, might provide extra knowledge to help a person's recall. This concept proposes a simple, effective gadget enabling the blind to circumvent this constraint.

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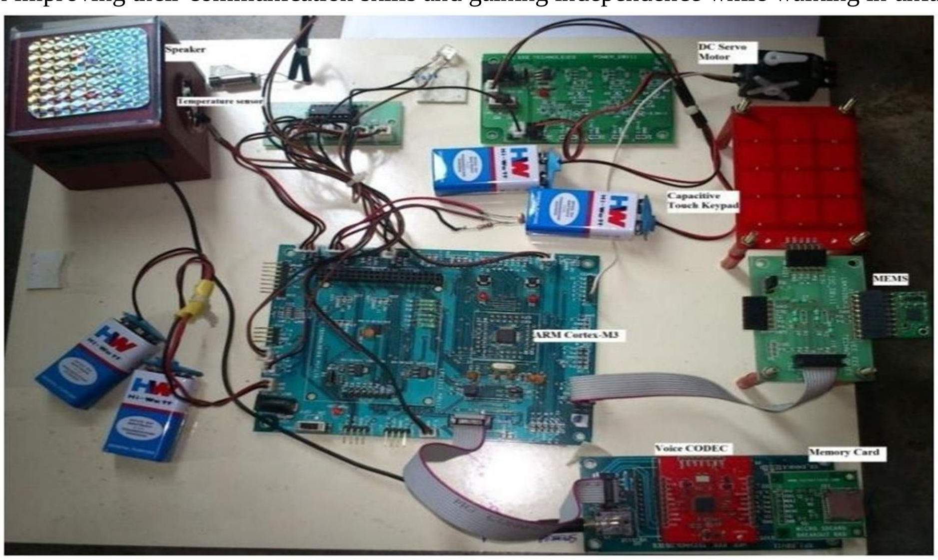
3) *Salient Contribution:* The goal of this project, dubbed "Smart Aid for the Blind," is to design an item that will be especially beneficial to persons who are physically unable and who regularly rely on others. Third eye for Blind task is a breakthrough that allows visibly disabled people to move around and between various locations with speed and certainty by detecting nearby obstacles with the use of a worn band that emits ultrasonic waves that alert them with a buzz sound or sensations. It allows clients who are physically hampered to walk freely by identifying obstacles. The "Smart Aid for Blind People" is a wearable gadget that uses other senses such as sound and touch to help blind people overcome their lack of vision. The device is small, light, and handy, but it isn't used for dynamic snag detection. These devices function similarly to radar, with the ultrasonic waves fascicle being used to determine the height, direction, and speed of the objects. When the wave travels, the distance between the individual and the obstacle is calculated. Nonetheless, all existing frameworks warn the visually impaired of the protest's proximity to him at a specific separation in front of or near him. The project's major goal is to provide a clever, easy-to-use, and understandable assistance for visually impaired people. The project comprises of ultrasonic sensors and an Arduino NANO microcontroller that will assist blind people in moving about and alerting them to any obstacles within a 2-meter radius. The initiative is cost-effective, accessible to blind people, and simple to operate because no training is necessary. The goal of this project is to design a gadget that will assist those who regularly feel reliant on others. Smart Aid for Blind would aid individuals in moving around and between different locations with speed and certainty by detecting nearby obstacles with the use of a worn band that emits ultrasonic waves that alert them with a buzz sound or vibrations. The device will be worn as a band on the body by the blind individuals.

II. LITERATURE SURVEY

Over the years of human nature development and behavior pattern development shows that he sees, realizes, he understood. It is unpleasant for a blind person to be unable to see, but he attempts to ask questions and get realization of the location so that he may remember it when he goes about by detecting noises and some pick point. If he accidentally removes the remembered tag from his memory, he will be unable to recognize the location and will have to seek aid from his colleague or other moving individuals. A similar situation involves determining a course of action to reach a desired destination. It clearly demonstrates that all people, whether handicapped or not, memorise location information and feel tags and retrieve them when they want to move about. Furthermore, research has been performed in recent years, if not decades, for new gadgets and technologies to build a good, dependable, and efficient system for blind or visually impaired individuals to detect barriers and warn or alert them at danger areas or obstacles. There are various systems that have restrictions and limits.

1) "Voice Assisted Embedded Navigation System for the Visually Impaired" [1] by V. Ramya, Laxmi Raja, B Palaniappan system allows vision challenged people to input notes and control device operation via a touch keypad. The gadget also offers auditory feedback to the user, such as navigation direction, ambient light, and temperature. The goal of this research is to assist visually impaired people in improving their communication skills and gaining independence while walking in unfamiliar locations.



2.1 Prototype of Navigation Device for Visually Impaired

The goal of this project is to create a system that will allow the visually impaired greater freedom in terms of navigational skills in unfamiliar locations, as well as increase their comfort and safety when travelling without the assistance of human guides or guide dogs. The device uses an ARM processor to assist visually challenged people with navigation. LPXpresso software is installed on an ARM CPU. Also installed and operational are the temperature sensor, magnetometer, accelerometer, and capacitive touch keypad. Speakers and an audio CODEC are also included. When wandering in unfamiliar locations, the user may now take notes on the touch pad screen. The user will be notified of the current temperature conditions in the surrounding area via a pre-recorded audio message sent through the speaker. The user can also listen to his or her favorite music. To determine whether it is dark or bright, light sensors are employed. If the surroundings are dark, a light is immediately turned on to alert others to the user's presence.

2) "Intelligent Path-Finder for The Blind" [2] by A. Z. M. Tahmidul Kabir, Nirmol Deb Nath, Mohitosh Pramanik, Mohitosh Pramanik is an amazing gadget that can detect a variety of obstacles from knee to ground level, such as fluids, uneven surfaces, and so on. In the dark, a particular function is utilized to avoid mishaps with the assistance of a bright led light that is activated by sensing the lack of light in the surroundings. This light can safeguard the user from moving cars and other issues by attracting the attention of ordinary people. If the user is in danger, he can activate an emergency switch to communicate his position. A microprocessor, ultrasonic sensor, light dependent resistor, and other components make up this gadget. The combination of all of these components results in a device that is generally accurate, user-friendly, sturdy, and inexpensive. The gadget is not a third eye for the blind, but it is extremely useful in making their daily life simpler.

2.2 Design of Intelligent path Finder

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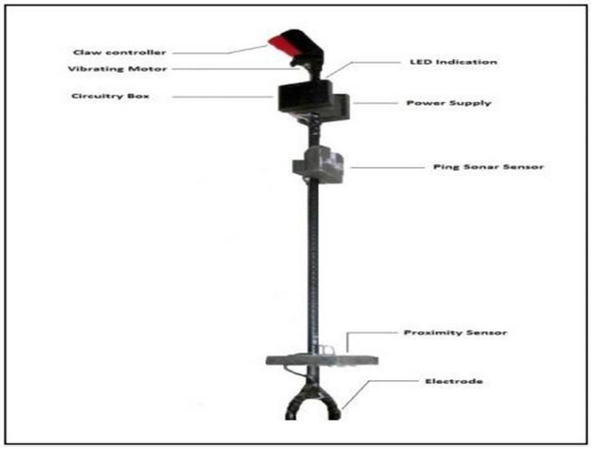
3) "Smart Walking Stick" [3] by Mohammed H. Rana and Sayemil, the major goal of this article is to alleviate the limitations of blindness by developing microcontroller-based automated hardware that can quickly identify impediments in front of a blind person. A microcontroller with ping sonar sensor, proximity sensor, wet detector, micro pager motor, and other components make up the hardware. The ping sensor identified the barrier, and the vibration of the motor conveyed the obstacle distance to the sight handicapped.

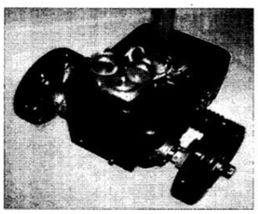


2.3 Prototype of Smart Walking Stick

The goal of the study was to provide a blueprint and architecture for a wiser idea of SMART WALKING STICK for individuals who are blind or disabled. This blind aid system may be given a new level of usefulness by providing a feeling of artificial vision as well as specialized obstacle and hollow detecting circuitry. This low-cost, light-weight gadget may be made to resemble a clastic and portable device that can be installed absolutely on a standard white cane or blind stick. A time-consuming system that monitors the environmental situation of static and dynamic objects and gives essential input to make navigation more accurate, safe, and secure is created by combining various functional sub-systems.
Shraga Shoval, Iwan Ulrich, Johann Borenstein, "NAVBELT AND GUIDECANE Robotics-Based Obstacle-Avoidance Systems for the Blind and Visually Impaired" [4] is a wearable portable computer with obstacle avoidance that is only for interior navigation. The Navbelt had two modes: one in which the system information was translated to audio in various noises, and the other in which the system information was converted to audio in various sounds. It was difficult for the person to distinguish between the noises for free and barred travel directions. Another issue was that the system would not recognise the user's current position. Both the NavBelt and the Guide Cane are new navigation aids designed to assist visually impaired people in navigating around densely packed obstacles swiftly and securely. Both gadgets employ obstacle avoidance technology based on mobile robotics to establish a safe path for travel in real time and assist the user along that path. This is in stark contrast to existing ETAs, which at most simply notify the user of the existence and location of barriers but do not direct them past them. This gadget, known as a "Guide Cane," includes a control button on the handle with four distinct orientations. Third of Blind's innovation has the same restrictions as the Guide Cane. Due to the usage of ultrasonic sensors and a large number of servo motors, this project has a significant cost.

2.4 Prototype of Navbelt

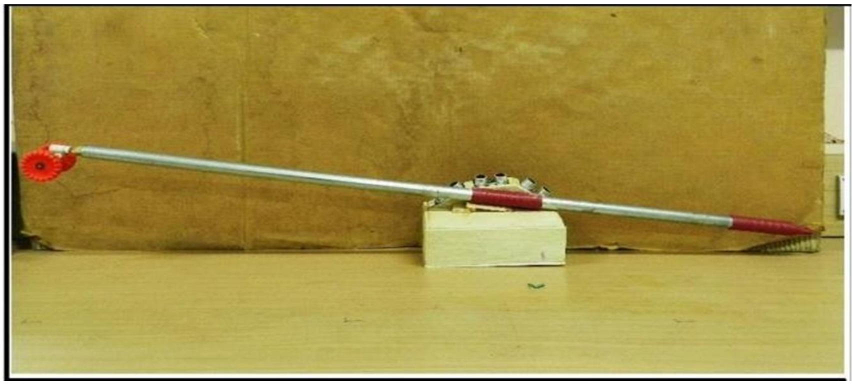
4) "Design and Development of Virtual Eye for the blind" [5], by Pooja Sharma, Mrs. Shimi S.L, Dr. S.Chatterji is a system that comprises wearing equipment such as a head cap, a tiny hand stick, and shoes to assist a blind person in securely navigating alone and avoiding any obstacles that may be encountered, whether fixed or movable, in order to avoid an accident. The ultrasonic sensor is the system's key component, which emits and reflects waves to survey a preset region around the blind. The Arduino microcontroller receives the reflected signals from the barrier items as inputs. The microcontroller executes the orders and then uses the Raspberry Pi speech synthesiser to transmit the status of a specific appliance or gadget to the headphones. The system will be effective and one-of-a-kind in its capacity to specify the source and distance of items that may come into contact with the blind. It can scan regions to the blind person's left, right, and in front of them, independent of their height or depth. If the suggested architecture is built correctly, the blind will be able to walk from one location to another without the assistance of others.
5) "Development of an Intelligent Guide-Stick for the Blind" [6] by Sung Jae Kang, Young Ho, Kim, In Hyuk Moon, an ultrasonic displacement sensor, two DC motors, and a microcontroller make up this system. The guiding stick's overall weight is 4.0kg, and its width and height are 24cm and 85cm, respectively. Using in-house Visual C" software, computer simulations were run to identify the traces of the guide stick on three distinct pathways. Actual experiments were also carried out to compare the results of the computer simulation. In the straight path, the difference between the real experiment and the simulation was 1.19cm. However, after the first 90" tum, the difference was 9.3cm, and after the second 90" tum, it was 11.9cm. Nonetheless, the intelligent guide stick will assist the blind in travelling by providing a more convenient mode of transportation.



2.5 Photograph of intelligent Guide-Stick

This guide-stick system employed an ultrasonic sensor to identify back-and-front impediments as well as left-and-right obstacles, and artificial intelligence to avoid them. It was demonstrated through different tests that this technology could be used on a straight line, a right-angle path, or a curved one. For appropriate guide stick handling, a minimum of l m width was necessary. The actively operated guide stick does not require adaptation training, but the blind's response is immediate.

6) "Development of an Ultrasonic Cane as a Navigation Aid for the Blind People" [7] by Krishna Kumar, Biswajeet Champaty, Uvanesh K, Ripunjay Chachan, Kunal Pal is a study deals with the development of an ultrasonic based cane for the navigation of the blind persons. The created cane can identify objects in the air and on the ground, as well as potholes (drop-off). In the Arduino microcontroller, ultrasonic signals are collected, categorized, and control signals are created. The control signals are wirelessly transferred to the receiver, which is maintained in the shoulder pocket. Another Arduino microcontroller controls the receiving device, which controls three speaker panels (worn around the chest) and three LED panels. The gadget has a range of 5-150 cm and can be used by blind people as a navigational aid.



2.6 Picture of Ultrasonic cane

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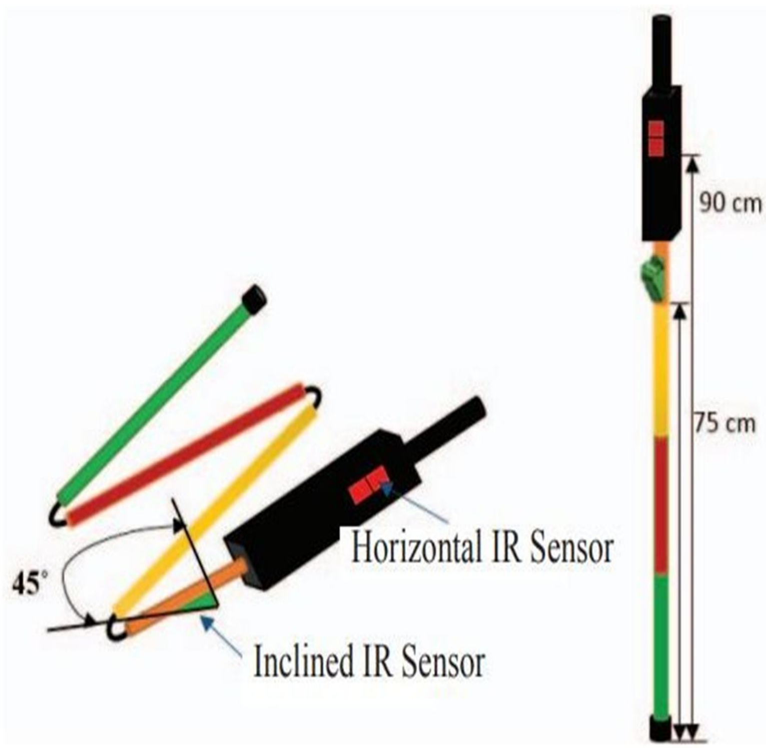
The gadget was able to create audible alerts in order to inform the user of the obstacles' position. The suggested gadget is anticipated to enable safe movement to blind people due to its capacity to detect impediments. The preliminary experiments, which were done with a small group of volunteers, yielded encouraging results. Additionally, efforts will be made to incorporate a global positioning system (GPS) in order to detect the user's location and provide tele-instructions to the users from a central monitoring station.

7) "Assistive Infrared Sensor Based Smart Stick for Blind People" [8] by Ayat A. Nada, Mahmoud A. Fakhr, Ahmed F. Seddik is a smart stick that has been presented as a way to help blind and visually impaired persons enhance their movement. Stick solutions include a variety of technologies, including ultrasonic, infrared, and laser, but they all have disadvantages. In this work, they suggest a smart stick based on infrared technology that is light weight, inexpensive, user-friendly, has a quick response time, and consumes little power. Within a two-meter range, a pair of infrared sensors can identify the existence of stairwells and other impediments in the user's route. The experimental findings show that the stick can identify all obstacles with high accuracy.



2.7 Design of Infrared Sensor Based Smart Stick

This device's solution consisted of a foldable stick with two infrared sensors attached on it. It is linked to an earpiece and sends a voice warning message to the blind when impediments are detected. The results of the real test were positive since all of the obstacles could be detected, despite the fact that the avoidance accuracy ranged from 75% to 90%.
After conducting the research, we came to the conclusion that the challenge is not in building a system with all the "bells and whistles," since technology advances fast, but in conceiving an idea/system that will stand the test of time and be helpful. We'd like to draw attention to the following characteristics:

a) *Free-hands:* They don't require the user to hold them. Remember that the white cane, the most indisputable travel aid, will remain in the hands of the users.
b) *Free-ears:* Notwithstanding the benefits of echolocation, spatial sound, and other similar approaches, the user's capacity to listen to the surroundings should not be compromised.
c) *Wearable:* It provides consumers with flexibility and takes use of wearable technology's benefits.
d) *Simple:* Simple to use (no superfluous elements in the operation or interface) and does not require significant training.

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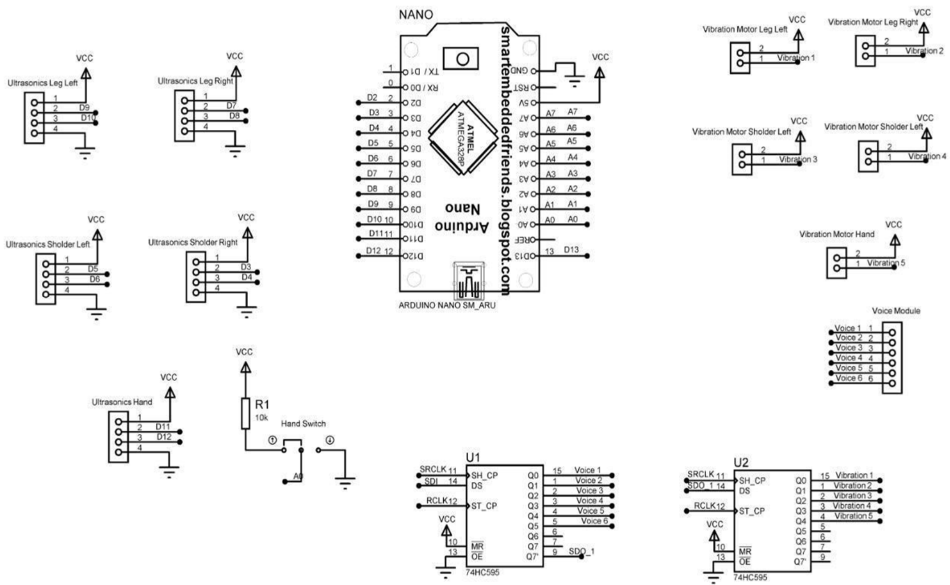
III. METHODOLOGY AND IMPLEMENTATION

A. Description of Methodology

1) System Architecture



3.1 System Architecture

The “Smart Aid for Blind” device or a wearable band is circuited with the Arduino NANO. The voice module and vibration motor are connected to Arduino NANO similarly all the 5 ultrasonic sensors are also connected on the Arduino board. There are 5 ultrasonic sensors one for hand, two for knees and two for shoulders. The ultrasonic sensors are taken as they measure the distance between the blind person and obstacle by ultrasonic waves. The sensor measures the distance by measuring the time between emission and reception. By far we have connected all the sensors the Arduino board and the coding are done likewise required for the detection of the movement in the sensors remaining devices to connect are the voice module, vibration and low voltage indication circuit. We have also used 3.7 LiPo battery and led lights, jumper wires to complete our circuit. To complete the coding on we are using Arduino IDE (using C++).

2) *Existing System:* The current system includes equipment such as a white cane that assists in the detection of obstacles and travel routes, a walking stick with a vibration motor that alerts the user to an obstruction, traditional pet dogs, and navigation aids. However, all of these technical advancements had their own set of restrictions. Pet dogs, for example, are costly and require extensive training. The white cane is a useful instrument, but it is easily broken or cracked. Whereas navigation aids are a worthless innovation for blind people, they do allow them to walk around independently. However, they have their own set of restrictions. Similarly, a walking gadget has the potential to be misplaced or broken. It can also become trapped in the cracks in the pavement.
3) *Proposed System:* The concept is built on an Arduino NANO-based wearable band that may be worn on the wrist, shoulder, or knee. The gadget has five ultrasonic sensors, each of which is made up of five modules attached to one hand, two shoulders, and two knees. It will be up to the individual to decide whether to perform one or all five bands. Blind people can identify impediments in a five-dimensional perspective and move anywhere with the aid of the five sensors. When an ultrasonic sensor identifies an impediment, the gadget uses a speech module and vibrations to alert the blind individual. The vibration strength will rise as the distance between the barrier and the blind person decreases, and this is a completely automated gadget. The Smart Aid for Blind gadget has the function of assisting visually impaired persons in a variety of ways. They can completely eliminate using other assistive equipment such as a white cane, walking stick, or trained companion canines by wearing it. This gadget will totally assist them in navigating without assistance. They can even wear the gadget around their wrists like a bracelet. Most importantly, the gadget is inexpensive and only takes a little training because it is so simple to use and wear.

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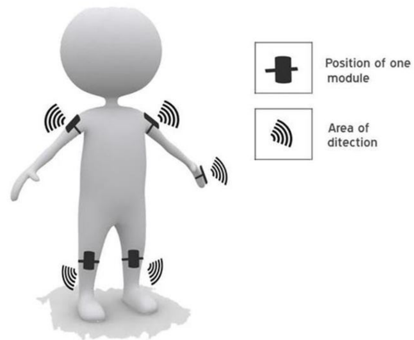


3.2Position of Module

B. Description

1) Hardware Description

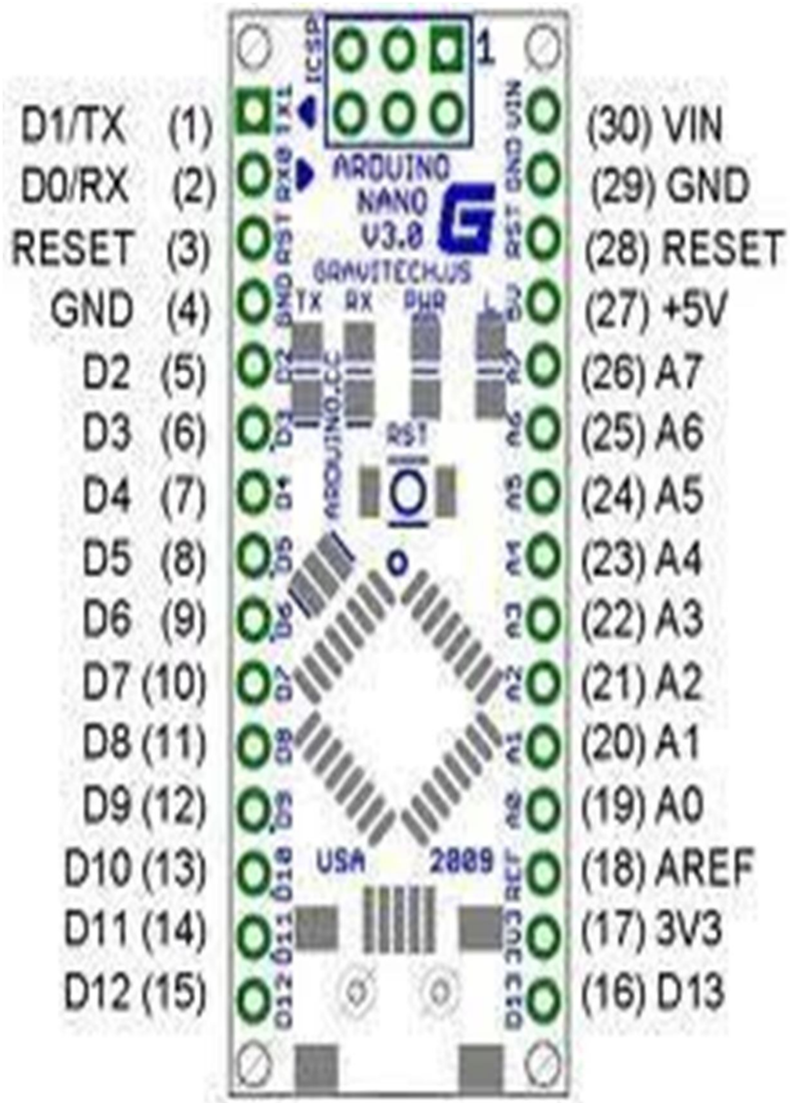
a) Ultrasonic Sensor: An ultrasonic sensor is used to identify obstacles. Any item in the range of 2cm-400cm may be detected by an ultrasonic sensor. Ultrasonic transmitters, receivers, and a control circuit are all included.

3.2 Ultrasonic Sensor HS-SR04

By generating high-frequency sound waves and measuring the time it takes for the echo to be picked up by the detector, the sensor can estimate the distance to a reflecting surface. Any item closer than 3cm will cause sound waves to echo back to the sensor before the detector is ready to receive, and any object closer than 3cm will result in sound waves repeating back to the sensor before the detector is ready to receive. It is made up of two parts: an emitter that generates a 40kHz sound wave and a detector that detects the sound wave and provides an electrical signal back to the microcontroller. It is important to use a time loop device to measure the length of time required by the sound wave emitted by the emitter and detected by the detector in order to calculate the distance of an obstacle.

b) Arduino NANO: Arduino is a single-board microcontroller that enables the creation of interactive objects and surroundings. The ATmegs328P-8-bit AVR family microcontroller is used in the Arduino NANO. It features a 5V working voltage and a 7-12V Vin input voltage recommendation. It features 6 analogue input pins (A0-A5), 14 digital I/O pins, 32KB flash memory, 2KB RAM, 1KB EPROM, 16 MHz clock speed, USB connection and power connector, and a reset button. It comes with everything needed to support the microcontroller; all that is needed to get started is to connect it to a computer by USB connection or batteries.

3.3 Arduino NANO microcontroller



3.4 Pin Diagram of Arduino NANO microcontroller

c) *Vibrating Motor:* It is a little coreless DC motor that vibrates to notify the user that a signal has been received. There is no sound. An eccentric rotating mass vibration motor (ERM) is a DC motor with a tiny unbalanced mass that produces a force that causes vibrations while it rotates.

3.6 Vibrating Motor

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d) Voice Module: It's also a little and simple to use speech recognition board. It's a speaker-dependent module that can handle up to 80 different voice commands. Any sound may be programmed to serve as a command. It's a technology that uses the voice recognition module to create a natural and easy human-machine interaction. It extracts and analyses human voice characteristics transmitted through microphone to a machine or computer.

3.7 Voice Module

e) Shift Register: In digital circuits, a shift register is a chain of flip flops that share the same clock and have their outputs connected to the "data" input of the next flip flop in the chain, resulting in a circuit that shifts the "bit array" stored in it by one position at each clock transition, "shifting in" the data at its input and "shifting out" the last bit in the array. A shift register can also be multidimensional in the sense that its "data in" and "stage outputs" are both bit arrays; this is accomplished by operating multiple shift registers with the same bit length in parallel.

2) Software Description: The Arduino Integrated Development Environment (IDE) is a cross-platform programme developed in C and C++ functions for Windows, macOS, and Linux. It's used to create and upload programmes to Arduino-compatible boards, as well as other vendor development boards with the aid of third-party cores. The GNU General Public License, version 2 is used to license the IDE's source code. The Arduino IDE has unique code structure guidelines to support the languages C and C++. The Wiring project offers a software library that is included with the Arduino IDE and provides numerous common input and output operations. User-written code just needs two basic functions to start the sketch and the main programme loop, which are built and linked into an executable cyclic executive programme with the GNU toolchain, which is also included with the IDE release. The Arduino IDE uses the avrdude software to convert executable code into a text file in hexadecimal encoding, which is then loaded into the Arduino board's firmware via a loader programme. Avrdude is the uploading tool by default for flashing user code onto official Arduino boards. Other manufacturers began to develop bespoke open-source compilers and tools (cores) that can produce and upload sketches to microcontrollers that are not supported by Arduino's official range of microcontrollers as the popularity of Arduino as a software platform grew.

3.7Arduino IDE logo

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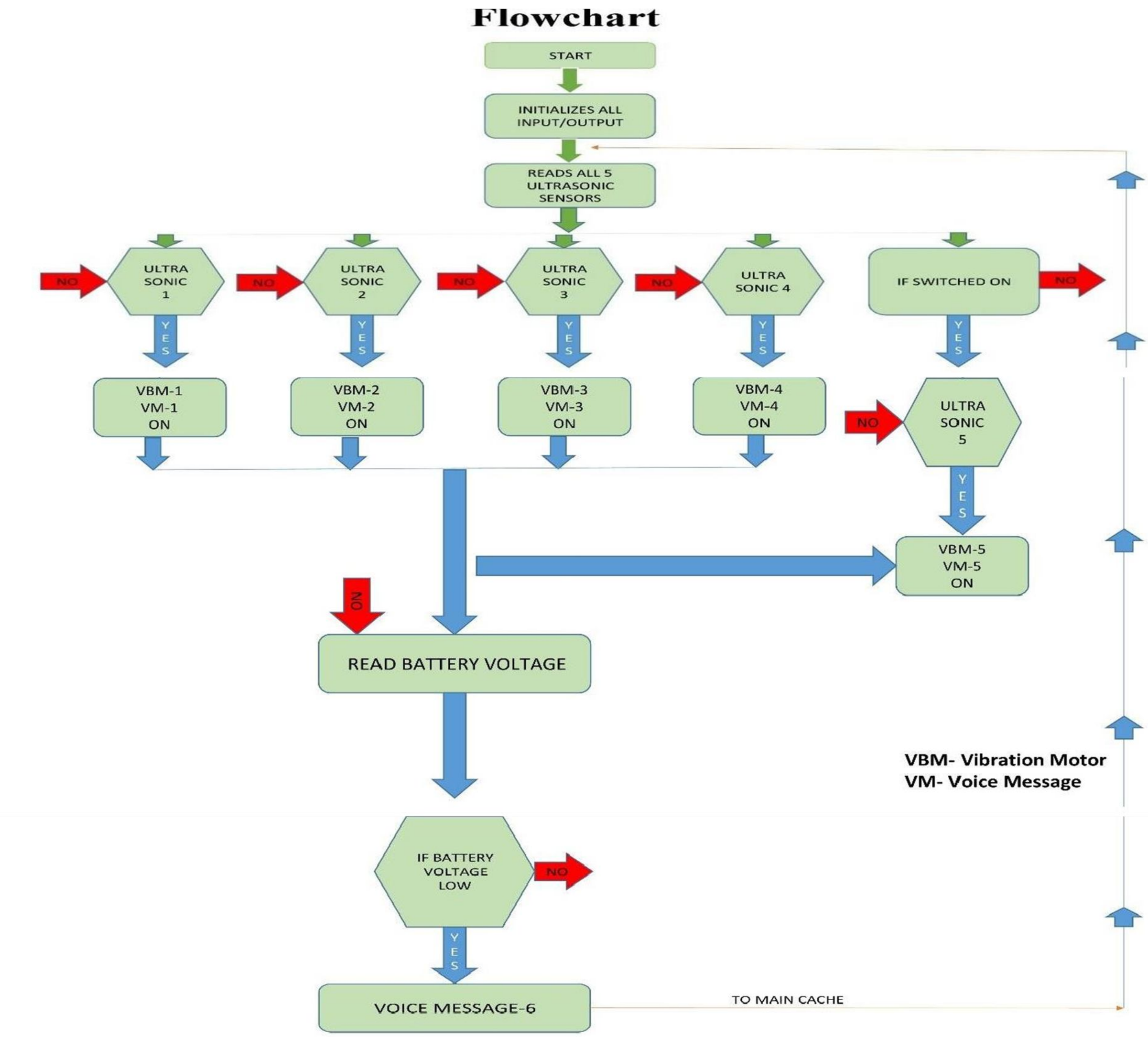
C. Flowchart



3.9 Flowchart

As shown in the figure:

1) The process starts.
2) It starts initializing the inputs and outputs of the surrounding captured by the sensors.
3) Once, it initializes all inputs and outputs, it reads all the five ultrasonic sensors used in the projects.
4) The four sensors are on two shoulders (left and right), two knees (left and right), and a hand (palm).
5) If ultrasonic sensor (1) detects any kind of obstacle nearer to them, the voice message and the vibration motor gets started which will help the blind to know that there is some type of obstacle.
6) Same goes for other three ultrasonic sensors, ultrasonic sensor (2), ultrasonic sensor (3), ultrasonic sensor (4).
7) If not, the process will start from the beginning. The process with continue till there will be any kind
8) But for the ultrasonic sensor (5), which is the sensor on hand (palm) will have an on/off switch. The switch is given because the sensor should not continuously keep ringing. As when the palm gets closed the sensor detects that there is some obstacle but in real there is no obstacle.
9) If the switch for the ultrasonic sensor (5) is on and if it detects any kind of obstacle, it will have the vibration motor and the voice module which will let the person know about the obstacle.
10) Meanwhile, there will be a 3.7v lithium-ion battery connected to the sensors on which the sensor works.

11) The device will read the battery voltage every time in use.
12) As this sensor works on lithium-ion battery, there will be a time when the battery will get discharged. So, when the battery voltage will be low, there will be alert given by the voice module saying “Low Battery Voltage” which means the person needs to recharge the battery.
13) Till the battery voltage is not low, it will not ask the device user to rechargeit.
14) The process continues till the battery dies, and a USB type charger willbe given to it by which the user can recharge the battery.
15) If battery dies, the process will return to main cache where the reading of ultrasonic sensor is done.

IV. ADVANTAGES, APPLICATION & FEATURES

A. Advantages

1) Low design time.
2) It is cost efficient.
3) This system is applicable for both the indoor and outdoor environment.
4) No training needed for using it.
5) No problem carrying it.

B. Application

1) This system can be used in the home, hospital and colleges for blind people.
2) This system can be used for both known and unknown environments like airports, malls, public parks etc.
3) This is the wearable technology for blind to overcome lack of visual senses by using other senses like sound and touch.

C. Features Available in the Device

1) Detects any kind of obstacles in its path up to 180°.
2) Uneven surface detection is another special feature of this device.
3) The other feature we added to this device is an ON-OFF switch for ultrasonic sensor detecting for the palm, mainly this feature is for indoor navigation.
4) Highly effective, much accurate, user-friendly and affordable.
5) As the distance from the obstacle decreases, the vibration and buzzer (beep sound) increase.
6) For sending alert message to the blind people, we added a voice module feature which we say “obstacle on right/left/front” and vibration signal to them.
7) The main feature is it is not a stick or a carrying device, they just have to wear that and they can roam everywhere.

V. CONCLUSION AND FUTURE OUTLOOK

A. Conclusion

As a result, this project presented the design and architecture of a Smart Aid for the blind people using Arduino and Ultrasonic sensors. To give constructive assistance and support for the blind and visually impaired, a simple, affordable, efficient, easy to carry, customizable, easy to manage electronic guiding system with many more remarkable features and advantages is presented. The system will be effective and one-of-a-kind in its capacity to specify the source and distance of items that may come into contact with the blind. It can scan and identify obstacles on the blind person's left, right, and in front of them, independent of their height or depth. This system does not necessitate the holding of a large gadget over a long distance, nor does it necessitate any particular training. This method also eliminates restrictions associated with the majority of mobility issues that may affect blind individuals in their environment.

B. Future Scope

Future development will concentrate on improving the system's performance and decreasing the user's workload by using a camera to precisely guide the blind. Images captured with a web camera and NI-smart cameras aid in item recognition as well as scanning the entire scene for the existence of a large number of things in the blind person's path. It may also determine the object's substance and form. If it is to be trusted and dependable, the matching % must be virtually always right, as there is no possibility for correction for a blind individual. Mono pulse radar techniques can be applied to determining long-range target objects. A novel idea of optimum and safe path identification for a blind person based on neural networks may be included in the other scope.

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Appendix A: Source Code

```
/*
 *
 *  Ultrasonics 1 - shoulder Right M5
 *  Ultrasonics 2 - shoulder Left M6
 *  Ultrasonics 3 - Leg Right M3
 *  Ultrasonics 4 - leg Left M4
 *  Ultrasonics 5 - Hand M2
 *
 */

#define trig_1 3
#define echo_1 4

#define trig_2 5
#define echo_2 6

#define trig_3 7
#define echo_3 8

#define trig_4 9
#define echo_4 10

#define trig_5 11
#define echo_5 12


#define DATA A3
#define STROBE A2
#define CLK A1



const int Hand_Switch =  A0;
const int LED =  13;
int Hand_Switch_State = 0;

long duration, distance; // Duration used to calculate distance
int ultra_sense = 0;
int ultra_count= 0;
int Final_Distance=0;

int Final_Distance_SH_L=0;
int Final_Distance_SH_R=0;

int Final_Distance_Leg_L=0;
int Final_Distance_Leg_R=0;

int Final_Distance_Hand=0;

boolean Final_Distance_SH_L_Voice=false;
boolean Final_Distance_SH_R_Voice=false;
boolean Final_Distance_Leg_L_Voice=false;
boolean Final_Distance_Leg_R_Voice=false;
```

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```
boolean Final_Distance_Hand_Voice=false;
boolean Low_Power_Voice=false;

void setup()
{
  Serial.begin(9600);

    Serial.print("Start  ");
  pinMode(trig_1, OUTPUT);
  pinMode(echo_1, INPUT);
  pinMode(trig_2, OUTPUT);
  pinMode(echo_2, INPUT);
  pinMode(trig_3, OUTPUT);
  pinMode(echo_3, INPUT);
  pinMode(trig_4, OUTPUT);
  pinMode(echo_4, INPUT);
  pinMode(trig_5, OUTPUT);
  pinMode(echo_5, INPUT);

  pinMode(LED, OUTPUT);
  pinMode(Hand_Switch, INPUT);
  digitalWrite(Hand_Switch, HIGH);

  pinMode(DATA, OUTPUT);
  pinMode(STROBE, OUTPUT);
  pinMode(CLK, OUTPUT);
  digitalWrite(DATA, HIGH);
  digitalWrite(STROBE, HIGH);
  digitalWrite(CLK, HIGH);

  for(int i=1; i<=8; i++)   // Voice Message clear
    {
      digitalWrite(DATA, HIGH);
      clock_call();
    }
    strobe_call();

}

void loop()
{
    read_Level_1();
    delay(10);
    read_Level_2();
    delay(10);
    read_Level_3();
    delay(10);
    read_Level_4();
    delay(10);

    Hand_Switch_State = digitalRead(Hand_Switch);

  if(Hand_Switch_State==HIGH)


  {
    read_Level_5();
    digitalWrite(LED, HIGH);
  }
  else
    digitalWrite(LED, LOW);

  delay(10);
  process_data();
 if(
   Final_Distance_SH_L_Voice==true ||
   Final_Distance_SH_R_Voice==true ||
   Final_Distance_Leg_L_Voice==true ||
   Final_Distance_Leg_R_Voice==true ||
   Final_Distance_Hand_Voice==true ||
   Low_Power_Voice== true
 )
 {
      Voice_Mode();
    delay(2000);
 }
}

void process_data()
{

if(Final_Distance_SH_L<=20)
{
    Serial.println("shoulder Left ");
    Final_Distance_SH_L_Voice=true;
    delay(10);
}
else Final_Distance_SH_L_Voice=false;

if(Final_Distance_SH_R<=20)
{
    Serial.println("shoulder Right  ");
    Final_Distance_SH_R_Voice=true;
    delay(10);
}
else Final_Distance_SH_R_Voice=false;

if(Final_Distance_Leg_L<=20)
{
    Serial.println(" Leg Left  "); Final_Distance_Leg_L_Voice=true;
    delay(10);
}
else Final_Distance_Leg_L_Voice=false;

if(Final_Distance_Leg_R<=20)
{
    Serial.println("Leg Right ");Final_Distance_Leg_R_Voice=true;
    delay(10);
}
```

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```
else Final_Distance_Leg_R_Voice=false;

if(Final_Distance_Hand<=20)
{
    Serial.println("Hand Objects ");Final_Distance_Hand_Voice=true;
    delay(10);
}

else Final_Distance_Hand_Voice=false;

}


void read_Level_5()
{
   ultra_count=0;
    Final_Distance=0;
    while(ultra_count!=20)
      {
          delay(10);
          ultra_count++;
          digitalWrite(trig_5, LOW);
          delayMicroseconds(2);

          digitalWrite(trig_5, HIGH);
          delayMicroseconds(10);

          digitalWrite(trig_5, LOW);
          duration = pulseIn(echo_5, HIGH);
          distance = duration / 58.2;
          Final_Distance=Final_Distance+distance;
      }

    Final_Distance_Hand=Final_Distance/20;
    Serial.print("Hand:  ");
    Serial.println(Final_Distance_Hand);

}

void read_Level_1()
{
   ultra_count=0;
    Final_Distance=0;
    while(ultra_count!=20)
      {
          delay(10);
          ultra_count++;
          digitalWrite(trig_1, LOW);
          delayMicroseconds(2);

          digitalWrite(trig_1, HIGH);
          delayMicroseconds(10);

          digitalWrite(trig_1, LOW);


          duration = pulseIn(echo_1, HIGH);
          distance = duration / 58.2;
          Final_Distance=Final_Distance+distance;
      }

    Final_Distance_SH_R=Final_Distance/20;
    Serial.print("Shoulder Right:  ");
    Serial.println(Final_Distance_SH_R);

}

void read_Level_2()
{
   ultra_count=0;
    Final_Distance=0;
    while(ultra_count!=20)
      {
          delay(10);
          ultra_count++;
          digitalWrite(trig_2, LOW);
          delayMicroseconds(2);

          digitalWrite(trig_2, HIGH);
          delayMicroseconds(10);

          digitalWrite(trig_2, LOW);
          duration = pulseIn(echo_2, HIGH);
          distance = duration / 58.2;
          Final_Distance=Final_Distance+distance;
      }

    Final_Distance_SH_L=Final_Distance/20;
    Serial.print("Shoulder  Left:  ");
    Serial.println(Final_Distance_SH_L);
}
void read_Level_3()
{
   ultra_count=0;
    Final_Distance=0;
    while(ultra_count!=20)
      {
          delay(10);
          ultra_count++;
          digitalWrite(trig_3, LOW);
          delayMicroseconds(2);

          digitalWrite(trig_3, HIGH);
          delayMicroseconds(10);

          digitalWrite(trig_3, LOW);
          duration = pulseIn(echo_3, HIGH);
          distance = duration / 58.2;
          Final_Distance=Final_Distance+distance;
      }
```

```
    Final_Distance_Leg_R=Final_Distance/20;
    Serial.print("Leg Right:  ");
    Serial.println(Final_Distance_Leg_R);
}
void read_Level_4()
{
   ultra_count=0;
    Final_Distance=0;
    while(ultra_count!=20)
      {
          delay(10);
          ultra_count++;
          digitalWrite(trig_4, LOW);
          delayMicroseconds(2);

          digitalWrite(trig_4, HIGH);
          delayMicroseconds(10);

          digitalWrite(trig_4, LOW);
          duration = pulseIn(echo_4, HIGH);
          distance = duration / 58.2;
          Final_Distance=Final_Distance+distance;
      }

    Final_Distance_Leg_L=Final_Distance/20;
    Serial.print("Leg Left:  ");
    Serial.println(Final_Distance_Leg_L);
}

void Voice_Mode()
{
    int i=0,count=0;
    Serial.println("First");


     digitalWrite(DATA, HIGH);
     clock_call();

     digitalWrite(DATA, HIGH);
     clock_call();

     if(Final_Distance_SH_L_Voice==true)digitalWrite(DATA, LOW);
     else digitalWrite(DATA, HIGH);
     clock_call();
     if(Final_Distance_SH_R_Voice==true)digitalWrite(DATA, LOW);
     else digitalWrite(DATA, HIGH);
     clock_call();
     if(Final_Distance_Leg_L_Voice==true)digitalWrite(DATA, LOW);
     else digitalWrite(DATA, HIGH);
     clock_call();
     if(Final_Distance_Leg_R_Voice==true)digitalWrite(DATA, LOW);
     else digitalWrite(DATA, HIGH);


    clock_call();
    if(Final_Distance_Hand_Voice==true)digitalWrite(DATA, LOW);
    else digitalWrite(DATA, HIGH);
    clock_call();
    if(Low_Power_Voice==true)digitalWrite(DATA, HIGH);
    else digitalWrite(DATA, HIGH);
    clock_call();

   strobe_call();

delay(100);
   Serial.println("Second");
   for(i=1; i<=8; i++)
   {
     digitalWrite(DATA, HIGH);
     clock_call();
   }
   strobe_call();
delay(2000);

}

void clock_call()
  {
     digitalWrite(CLK, HIGH);
     delay(10);

     digitalWrite(CLK, LOW);
     delay(10);
  }

void strobe_call()
  {
     digitalWrite(STROBE, HIGH);
     delay(10);
     digitalWrite(STROBE, LOW);
     delay(10);
  }
```

Appendix B: Data Sheets

1) *Ultrasonic Sensor*

Working Voltage	DC 5V
Working Current	15mA
Working Frquency	40Hz
Max Range	4m
Min Range	2cm
Trigger Input Signal	10us TTL pulse
Echo Output Signal	Input TTL lever signal and the range in proportion
Measuring Angle	15 degree

2) *Arduino NANO*

Specifications	Arduino NANO
Processor	AT mega 328P
Input Voltage	5V/ 7-12V
Speed of CPU	16 MHz
Analog I/O	8/0
Digital I/O/PWM	14/6
USB	Mini
EEPROM/SRAM [kB]	1/2
Flash	32

3) *Voice Module*

Pin	Description
VCC	DC3.2-5.0V
RX	UART serial input
TX	UART serial output
DAC_R	Audio output right channel
DAC_L	Audio output left channel
SPK2	Speaker-
SPK1	Speaker+
IO1	Trigger port 1
IO2	Trigger port 2
GND	Ground

4) *Shift Registers*

PINS 1-7,15	Q0” Q7	Output Pins
PIN 8	GND	Ground, Vss
PIN 9	Q7”	Serial Out
PIN 10	MR	Master Reclear, active low
PIN 11	SH_CP	Shift Register clock pin
PIN 12	ST_CP	Storage register clock pin (latch pin)
PIN 13	OE	Output enable, active low
PIN 14	DS	Serial data input
PIN 16	Vcc	Positive supply voltage

5) Vibration Motor

Parameter	Value
Rated Voltage	1.3V
Operating Voltage	0.9-1.6V
Road Speed	$9000min^{-1}$
Starting Voltage	0.8V
Starting Current	120mA
Armature Resistance	12 ohms
Weight of motor	1.1g
Motor diameter	4mm
Vibration	$12.74\ m/s^2$

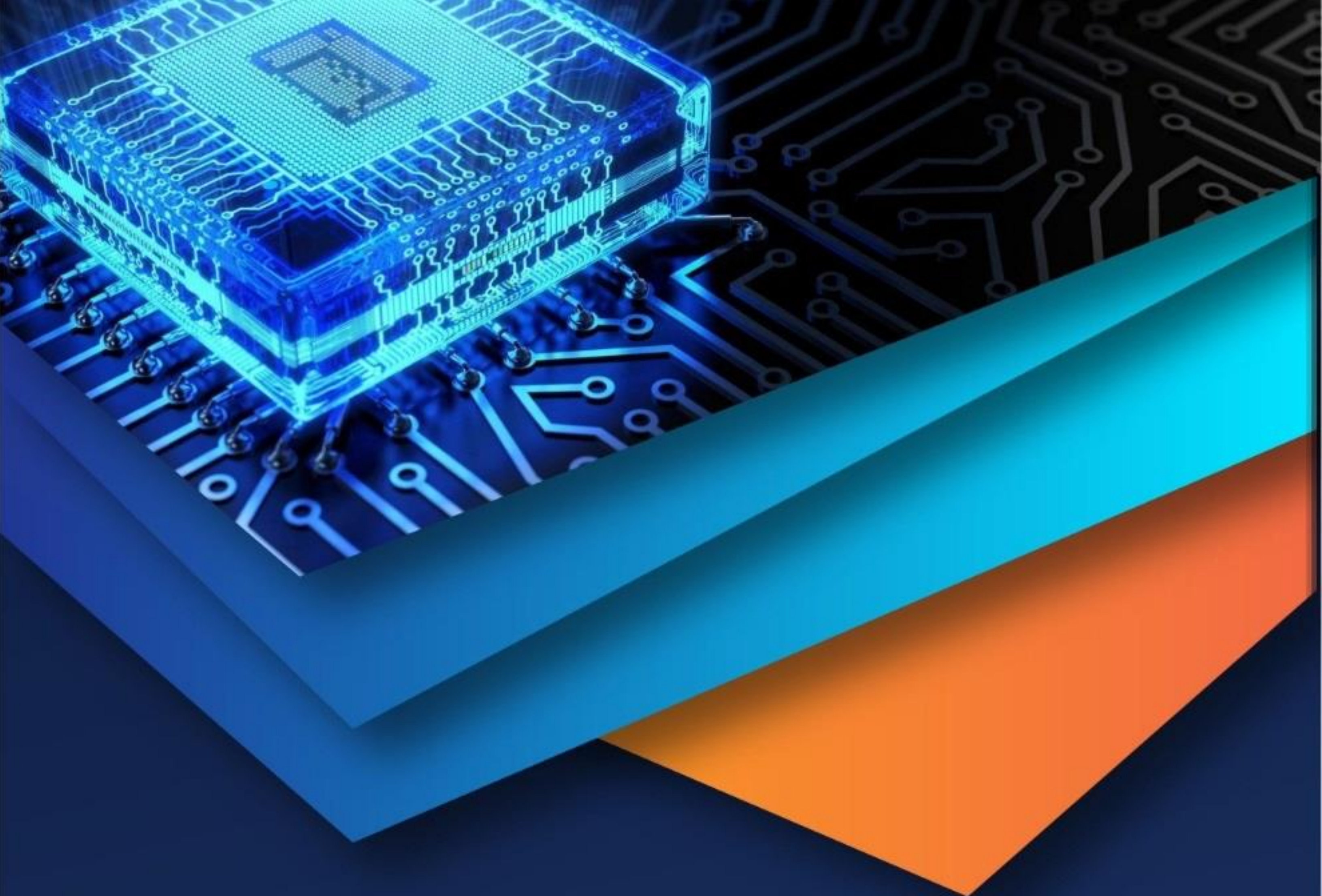
Appendix C: List of Components

A. Hardware Components

1) Arduino NANO
2) Ultrasonic Senso
3) Vibrating Motor
4) Voice Module
5) Buzzer
6) Led Lights
7) Power bank
8) 3.7 V LiPo Battery
9) Jumper Wires
10) Slide Switch
11) Male and Female Headers

B. Software Components

1) Arduino IDE



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