

# RASPBERRY PI BASED SMART NAVIGATION SYSTEM FOR BLIND PEOPLE

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**Abstract** - This paper will help you to understand the smart navigation system for blind people using raspberry pi in a better way. This smart navigation system is a smart stick that helps the visually impaired or blind people to make their lives simpler and can be seen as an aid that will surpass all the other existing systems. It will provide them with an environment that is safer and will give them a sense of Independence which will help them to lead a normal life. This smart navigation system stick uses raspberry pi 3b, GPS module, voice command module, moisture sensor unit and ultrasonic sensor unit. The voice command module is the highlight as it provides reliable voice command assistance to the users. The GPS module also plays a major role as it provides safe and precise navigation to the users. The ultrasonic sensor plays a role in the detection of obstacles and helps to monitor sound as well and since the range is high, it provides ample time for the user to react. The moisture sensor will help to detect the dampness and will thereby save the visually impaired person from slipping by giving them a warning in advance. Now the whole task of converting the images to the text and text to speech goes to Raspberry pi which will be programmed accordingly and performs the task of TTS (text to speech) conversion.

**Key Words:** RASPBERRY PI, ULTRASONIC SENSOR, MOISTURE SENSOR, TTS, VOICE COMMAND MODULE, SD CARD.

## 1. INTRODUCTION

Vision plays an important role in gathering information from our surroundings on which the brain processes and without vision things can be extremely troublesome, so the motive was to develop a system that is both intelligent and reliable and could help in overcoming some of the problems that these blind and visually impaired people face in their day to day lives.

One of the major problems faced by blind people is the navigation around the places outside their houses. Contrary to this at their homes, blind people are quite comfortable as they know the exact location of the things and nobody changes them but in the outside world, we have things that are in motion and can pose to be dangerous if they move around without any reliable assistance. The existing system uses a white cane or guide

dog method, but they do have many drawbacks that can be effectively and efficiently overcome by this smart navigation system. The white cane used for navigation can only be used for detecting obstacles, once the stick touches the obstacle, the user requires good training and proper mobility skills to be able to use this method. Similarly, while using the guide dog, the blind person is reliable on the dog and hence it cannot be termed as very safe assistance. There is also no assistance in navigation provided by the two techniques mentioned above. Thus, this smart navigation system is needed, it will not only provide precise navigation but also ensure safety by providing ample reaction time after the voice command.

The ultrasonic sensor can monitor both the static and moving obstacles thus ensuring greater safety. The moisture sensor that will be connected to the bottom of the stick will detect any moisture on the road, for the instance if there is a pothole full of water, once the stick comes across the pothole, it will send an alarming message through the voice command module to the user. The GPS module used will also be efficient and will guide the direction with the most precision and accuracy.

## 2. HARDWARE REQUIREMENTS:-

Raspberry Pi, Ultrasonic Sensor, Moisture Sensor, SD CARD, MCP3008:

1. **RASPBERRY PI 3-** Raspberry pi 3 is used as a development board and can be considered as a single-board computer that uses LINUX operating system. Along with some great features, it has very fast processing speed and thus is suitable for various advanced applications. It is the most used system after ARDUINO.

Coming to its pin configuration, it uses +5 V, +3.3 V, GND and Vin pins for the power sources, whereas +5 V and 3.3 V for the power output. GND is used as a ground pin and Vin as a power input pin. It also uses UART (universal asynchronous receiver transmitter) to interface sensors and other devices to transmit and receive data serially. Raspberry pi also uses SPI protocol (Serial Peripheral Interface) for communication. It is inclusive of 26 input/output pins

of which some pin performs multiple functions. It has an SSD memory card of around 12 gigabytes. It also has a wireless LAN and Bluetooth facility which is the best suited for IoT (Internet of things). The main purpose of using raspberry pi in this project is TTS processing, i.e. text to speech processing. The raspberry pi here is capable of converting the message received from the used sensors to text and then to speech so that it could be given as the output of the voice command module. The directions can also be navigated through voice by using this same module, thus giving a better sense of artificial vision to the blind and visually impaired people.



Fig 1 : Raspberry Pi

2. **ULTRASONIC SENSOR-** An ultrasonic sensor is a device that generates a high-frequency sound wave. The sound wave on striking the obstacle reverts along the previous path and is received by the sensor. The time-lapse between the receiving and sending of the signal is measured and this helps in the calculation of the distance between the stick and the obstacle. The distance is then stored in the SD card and is further used by the Raspberry pi for text to speech conversion and thereby alerting the individual about the obstacle through the voice command module. The ultrasonic sensors have only one unit that acts both as transmitter and receiver. It is useful since it can also detect various transparent surfaces or objects glass or liquids. One more advantage is that it will not be affected even if it is surrounded by the dust all around which is an important factor as the stick has to used outdoor. It is also capable of detecting complex objects. They have the range around 2m to 100m and thus can tell in advance about an obstacle that is coming from a distance.



Fig 2 : Ultrasonic Sensor

### 3. MOISTURE SENSOR

The moisture sensor is a device used for the detection of moisture from the soil or road so that the blind person can be saved from slipping. With the moisture sensor installed at the bottom of the stick, it will be easier to perceive any moisture in the surrounding and inform the user. The moisture sensor will be in turn connected to the raspberry pi which will again perform the TTS (Text to speech) conversion.

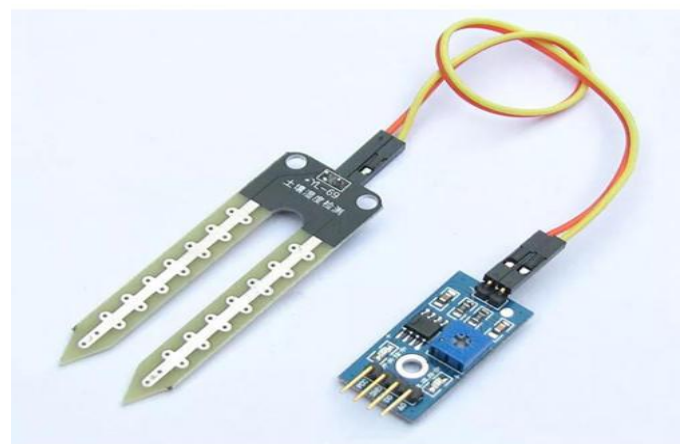


Fig 2: Moisture Sensor

#### 4. SD CARD

SD card stands for the secure digital card which is a non-volatile memory card and was developed by the SD card association. It was developed to be used in a variable portable device. It was introduced by the joint efforts of Toshiba, Panasonic, and SanDisk in august 1999 and to replace the multimedia cards and since then has proved to become the standard of the industry. The main motive of using the SD card here is for the store the value of the distances of the obstacles from the blind person or to store the navigation route for efficient working of this project.



Fig 3: SD card

#### 5. MCP 3008

MCP3008 is an analog to digital converter IC, used for raspberry pi. It constitutes of 8 channels and is capable of the 10-bit analog to digital conversions. The precision of its conversions matches that of the Arduino UNO. It uses SPI communication protocol and has an operating voltage of 2.7 V to 5 V. the method used for analog to digital conversion is successive approximation method and has a sampling rate of 200 kbps for 5V and 75 Kbps for 2.7 V.

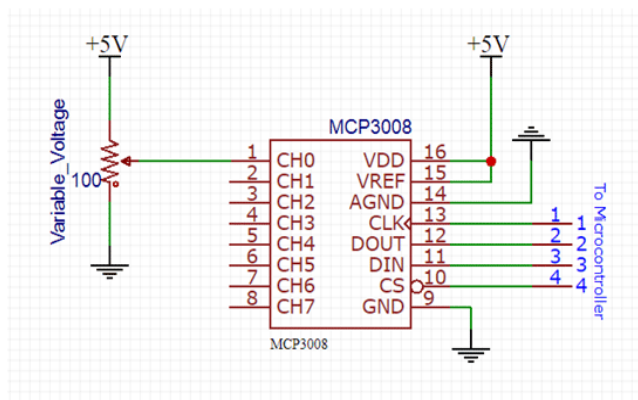
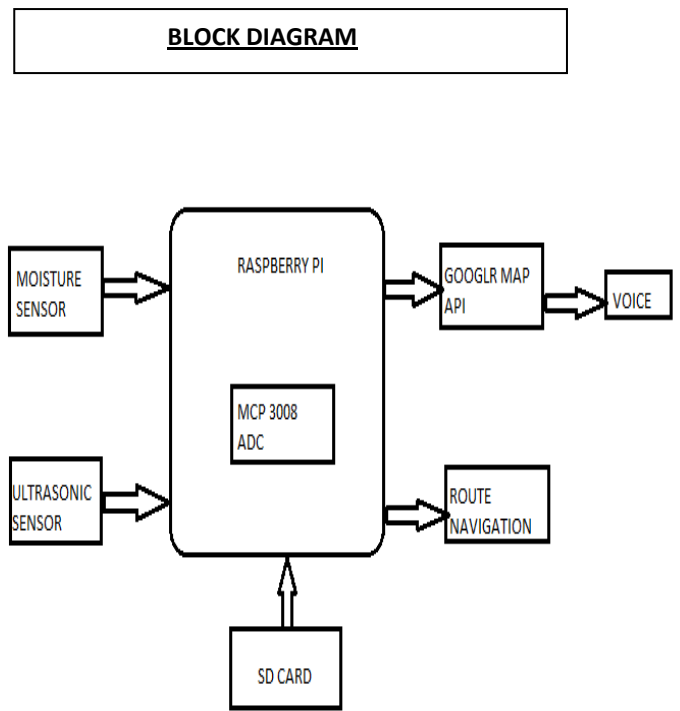


Fig 3: MPC 3008 circuit diagram



BLOCK DIAGRAM

#### 3. RESULT:

Our circuit responded well, and hence results were positive.

A complete prototype implementation of the proposed system is given below-

#### 4. CONCLUSIONS

This project provides a means of active interaction and navigation between the system and the blind person. Its features like interaction or commands over voice, precise navigation, and reliable obstacle detections make its future scope huge. With the advancement in technology and our dependency on it, this project would be proved to be high in demand in the recent future. The test results prove that this system is more reliable than any other existing system, however, some more improvements can make it even more faithful and accurate. Also, the cost of this project is optimum and proves to be the best aid for blind people, and it will help them to be independent of their instincts and other people.

#### Advantages of Smart stick

1. The blind people can lead a life that's less dependent on others.
2. They no longer need to depend on old techniques

like white cane and guide dog.

3. People don't need a lot of training to use this stick.
4. It can easily detect both static and moving obstacles coming from left, right and front.
5. Automatically detects and gives instructions to the user through voice command module, thus easy to understand.
6. The cost is optimum.
7. It can also detect presence of any moisture.
8. It is the only stick that provides on the ground navigation which is both precise and accurate.



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