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AI Based Smart Glasses for Blind Navigation

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ABSTRACT: Visually impaired people face the major problem of travelling alone. Though attempts have been made to develop smart assisting sticks for blind, people have to carry it and the limitations of the same leave the problems of visually impaired still unattended. This project proposes a smarter solution to the above problems. This project focuses on development of smart guiding glass for blind people. The proposed project consists of development of smart glasses which can automatically guide the blind people to navigate in day to day life. The developed smart glasses consists of camera which captures the video stream of the surroundings and uses deep learning and sensor fusion techniques to determine the obstacles and type of obstacles in the path of the blind person. The proximity of obstacles is informed to the blind people using sound alert. The proposed concept also implements OCR techniques to read the boards and messages on the boards to help blind people. Voice assisted navigation using speech recognition is also included in this project which will make it complete fail proof and provide voice based navigation to the blind people using GPS. Thus this project provides complete solution to the blind people using DL and sensor fusion.

KEYWORDS: Visually impaired, Obstacle, voice assisted, Deep Learning, Sensor Fusion, Speech Recognition, OCR, GPS, Navigation etc.

I .INTRODUCTION

Visually impaired people face the major problem of travelling alone. Though attempts have been made to develop smart assisting sticks for blind, people have to carry it and the limitations of the same leave the problems of visually impaired still unattended. This project proposes a smarter solution to the above problems. This project focuses on development of smart assistive device for blind people. The proposed project consists of development of smart glasses which can automatically guide the blind people to navigate in day to day life. The developed smart glasses consists of camera which captures the video stream of the surroundings and uses deep learning and sensor fusion techniques to determine the obstacles and type of obstacles in the path of the blind person. The proximity of obstacles is informed to the blind people using sound alert. The proposed concept also implements OCR techniques to read the boards and messages on the boards to help blind people. Voice assisted navigation using speech recognition is also included in this project which will make it complete fail proof and provide voice based navigation to the blind people using GPS. Thus this project provides complete solution to the blind people using DL and sensor fusion. The purpose of this document is to outline all the hardware as well as the software requirements as well as provide the brief insight of the procedure to follow for the complete development of the end product from start to finish.

II .RELATED WORK

The blind or visually disabled people face the problem to be always dependent on someone for their day to day navigation. It is difficult for them to navigate freely or independently which is the major problem faced by the community of the visually impaired. We conducted a literature survey to study the current solutions available for visually impaired and existing devices, we conclude that though number of solutions are available for blind people but most of them just notify the blind people about the obstacles. The blind people will not know the type of obstacle in their path. In addition smart sticks are developed for blind people but yet they are far away to handle real world problems and do not solve the problem of navigation of blind people. The blind people feel helpless due to the lack of proper technological aid in determining the problems faced in day-to-day life. The sticks are available and are obsolete solution and needs to carried with wherever they go. Additionally they just show nearby obstacles and do not assist the problems faced by blind people in real world. Thus there is a need to develop an effective solution to assist blind people and which can easily accompany them in their day to day life. This project proposes the solution of smart assistive device for blind people using a smart system which will not only detect the obstacles in the path of the blind people but also notify the same to the blind people using sensor fusion and deep learning regarding the type. The speech

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recognition system implemented will also facilitate the blind people to control everything over the voice which will provide them with the freedom to navigate freely.

III .PROPOSED WORK

The proposed system consists of development of smart assistive device for blind using computer vision and machine learning. The proposed system consists of a smart glass which can automatically detect the presence and type of obstacles in the path of blind person and alert them using voice feedback. The developed system uses sensor fusion techniques to detect the obstacle in the proximity of the blind person while he is moving and detect the type of the obstacle using camera present in the glass using deep learning. To help the blind person navigate independently the developed smart glass consists of GPS module which can be used to guide the blind person regarding his current location. To help the blind person speech recognition has been implemented in this system which makes the operation of the system easier and the blind person can interact with the smart glasses using voice commands. The proposed system also implements Text reading using OCR and text to speech conversion which can help the blind person to read the boards and other texts. The Following are the objectives of the proposed system.

1.To develop a smart device for blind people which can detect the presence of obstacles in the path of the blind people when they are navigating.

2.To develop an ML based model capable of detecting few different type of obstacles in the path of the blind person using camera mounted on the system

3.To develop hardware which can be carried by visually impaired people which can detect the different obstacles as well as proximity of obstacles.

4.To implement image processing techniques using opencv to set the region of interest and find the proximity of the approaching objects in the proximity visually impaired person.

5.To the voice feedback will timely alert the user regarding different using voice output

6.To use sensor fusion techniques to determine the exact proximity of the obstacle using SONAR

7.To implement speech recognition and onboard navigation system using GPS which will assist the blind person regarding the steps to be taken to reach specific destination using GPS

8.To implement the voice assisted board reading system which will read the text on the boards using Optical character recognition and inform the message on the board using voice feedback

9.To make the device portable so that it can be carried

1.SOFTWARE IMPLEMENTATION:

The following software interface requirement is required for the project:

- Python IDLE
- Open CV
- Serial Monitor
- Terminal
- Arduino IDE

2. HARDWARE IMPLEMENTATION :

- **PCB Fabrication**

The printed circuit board (PCB) acts as a linchpin for almost all of today's modern electronics. If device needs to do some sort of computation-such as is the case even with the simple digital clock. Chances are there is the PCB inside of it. PCBs bring electronics to life by routing electrical signals where they need to go to satisfy all of the device's electronic requirements.

There are three main types of circuit boards that get manufactured on a consistent basis, and it's important to understand the differences between each so you can decide the right circuit board for your requirements. The three main types of circuit boards in current manufacture are:

- **Single-Sided Circuit Boards:** These boards when made with a FR4 base have rigid laminate of woven glass epoxy material, which is then covered on one side with a copper coating that is applied in varying thicknesses depending on the application
- **Double-Sided Circuit Boards:** Double-sided boards have the same woven glass epoxy base as single-sided boards — however, in the case of a double-sided board, there is copper coating on both sides of the board, also to varying thicknesses depending on the application.

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- **Multi-Layer Boards:** These use the same base material as single and double-sided boards, but are made with copper foil instead of copper coating — the copper foil is used to make "layers," alternating between base material and copper foil until the number of desired layers is reached.

❖ **Parts of PCB**

- **Substrate:** The first, and most important, is the substrate, usually made of fiberglass. Fiberglass is used because it provides core strength to the PCB and helps resist breakage. Think of the substrate as the PCB's "skeleton".
- **Copper Layer:** Depending on the board type, this layer can either be copper foil or a full-on copper coating. Regardless of which approach is used, the point of the copper is still the same — to carry electrical signals to and from the PCB, much like your nervous system carries signals between your brain and your muscles.
- **Solder Mask:** The third piece of the PCB is the solder mask, which is a layer of polymer that helps protect the copper so that it doesn't short-circuit from coming into contact with the environment. In this way, the solder mask acts as the PCB's "skin".
- **Silk screen:** The final part of the circuit board is the silkscreen. The silkscreen is usually on the component side of the board used to show part numbers, logos, symbols switch settings, component reference and test points. The silkscreen can also be known as legend or nomenclature.

The hardware is designed using an EDA software and PCB for the same is fabricated
The figure below shows the schematic and PCB:

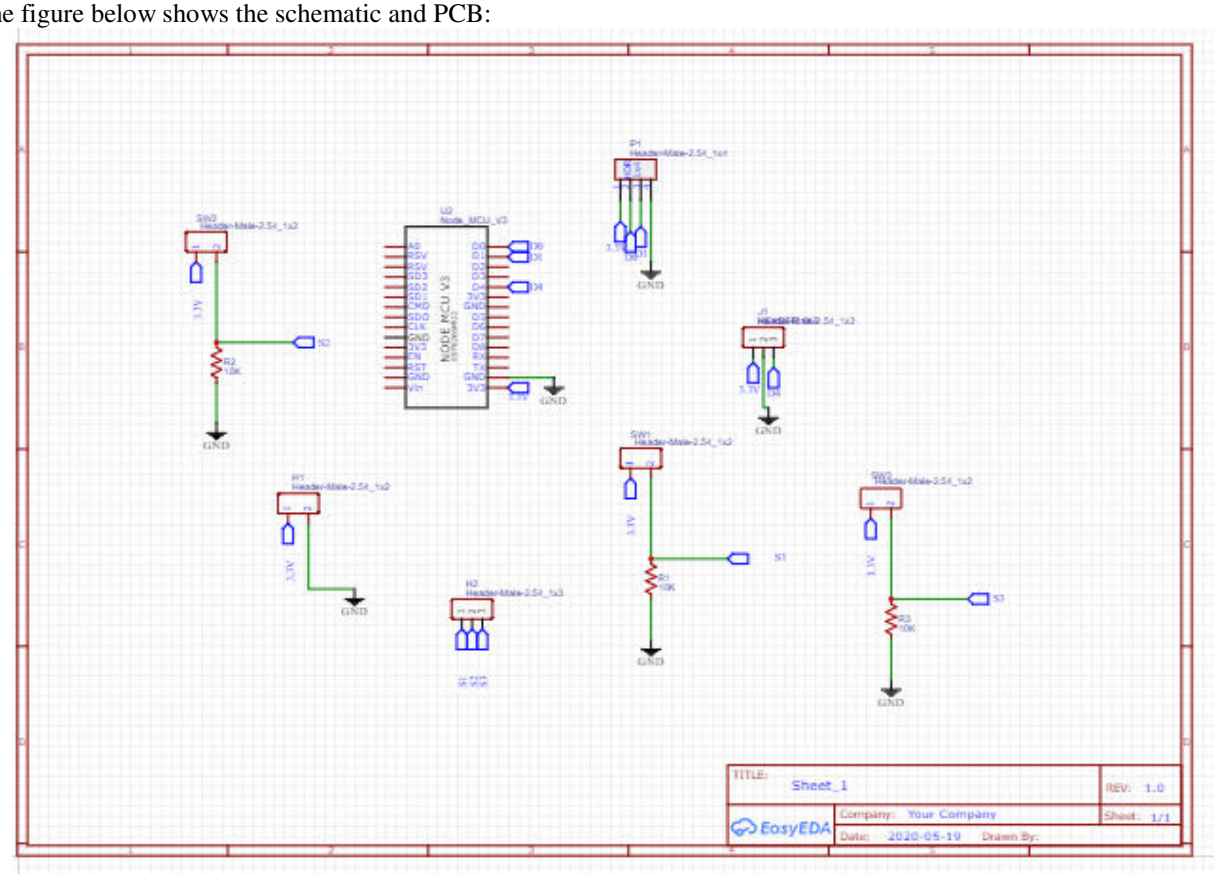

Fig. Schematic and PCB

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IV. BLOCK DIAGRAM

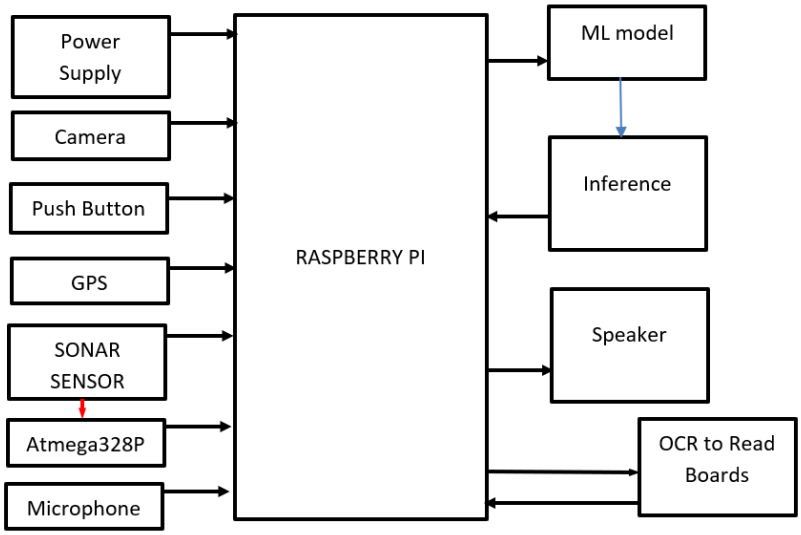

Fig. Block Diagram

In the center Raspberry pi .The project is based on Raspberry pi ,so all the sensors ,which is used will be interface to Raspberry pi. The left hand side will be input and right hand side will be output.

- Power supply- Power supply is used to give the power for raspberry pi.
- Camera– Camera is used to detect the type of obstacles which have implemented, the system will capture the image and it will feed to machine learning. This is the use of camera.
- Push button- Push button is used to select the three major objectives that are 1) Detection of obstacles and type of obstacles,2) Navigation assistance and 3) board reading.

when the blind person have to read board that only at that time the person a will press the board reading button or the person wants to navigate for example he/she want the distance or direction of destination only at that time the person will press the respective button. Total three push button will be implemented first for activating obstacle detection mode ,second for activating board reading mode ,third for activating GPS based navigation system.

- GSP – GPS sensor is directly interfaced to Raspberry pi.GSP model will give the location of blind glasses for example, If the person wants to go somewhere in that case it will test first the GPS coordinates of the current location than it will give the direction and distance of the target location.
- Sonar sensor - Sonar sensor is connected via Atmega328P which is microcontroller.

  If we connect sonnar sensor directly to Raspberry pi the system will get slow so we can not interface the sonar sensor directly to Raspberry pi.

  In the working principle of sonar sensor there is time delay that means transmitter emits the sound waves and it reset by the delay of 50 milliseconds, on tht basics the obstacles is determined. We can not operate the sonar sensor.
- Only if obstacles is detected than only Atmega328P will communicate with Raspberry pi that obstacles is detected. In this case by eliminating delay ,the response is not given to the system for this purpose Atmega328P is used.
- Microphone- Microphone is for speach recognition for example. It will ask “please read the board” or “please enter the target destination”. When the person gives the input by saying any destination like canteen than the 'Canteen' will be determined by microphone and for speech recognition it is implemented towards Raspberry Pi.

This all is input for the implementation and let's see output side.

- ML model- The output side consists of trained machine learning model which is capable of detecting different objects in the front of blind person. The sonar sensor on input side checks the proximity of obstacles and if the obstacle is present the camera captures the images and feeds it to the ML model in the form of matrix.

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- Inference- The ML model checks for the presence of the know obstacles in the image captured and this process is called inference.The inference returns a python dictionary which consists of name of the obstacle such as person,car etc ,which is returned to Raspberry pi.
- Spearker- The Raspberry pi commands the speaker to play the detected obstacle in the form of audio.
- OCR to read boards the second part is the OCR which is used for text reading.The OCR module captures the image from the camera detects the text.The OCR API will check the Text in image and return it to the raspberry pi the same is played on speaker.

V.RESULTS

Integration testing:

Integration means combining. For Example, In this testing phase, different software modules are combined and tested as a group to make sure that integrated system is ready for system testing.Integrating testing checks the data flow from one module to other modules. This kind of testing is performed by testers.The integration testing consists of testing the combined testing as a whole. The system with all the modules are tested as a whole working system and the results were obtained. The Output of the same is shown below:

Output of Obstacle Detection:

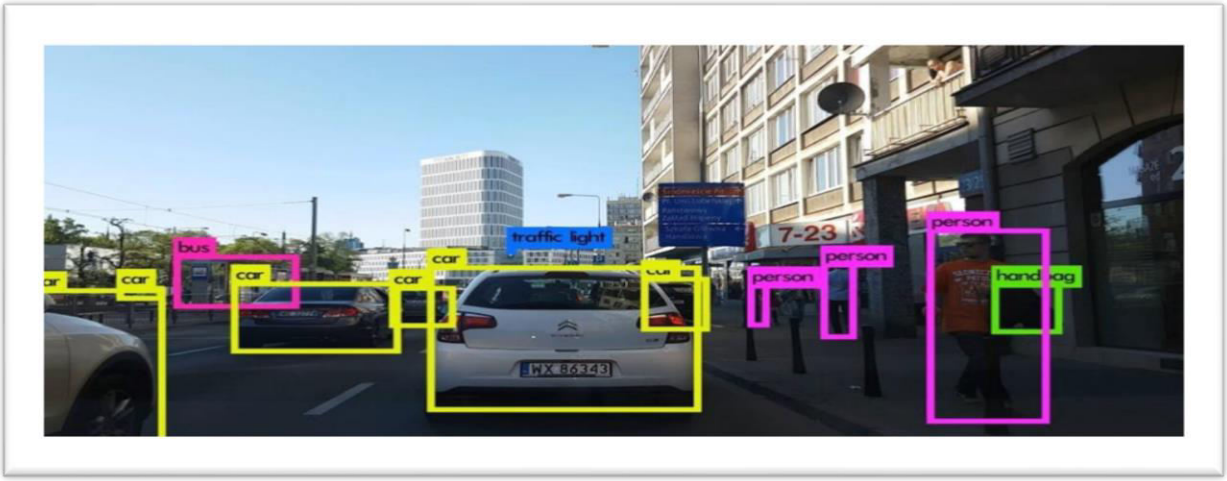

Fig.No.23.Output of OCR

The output of board reading is shown below:

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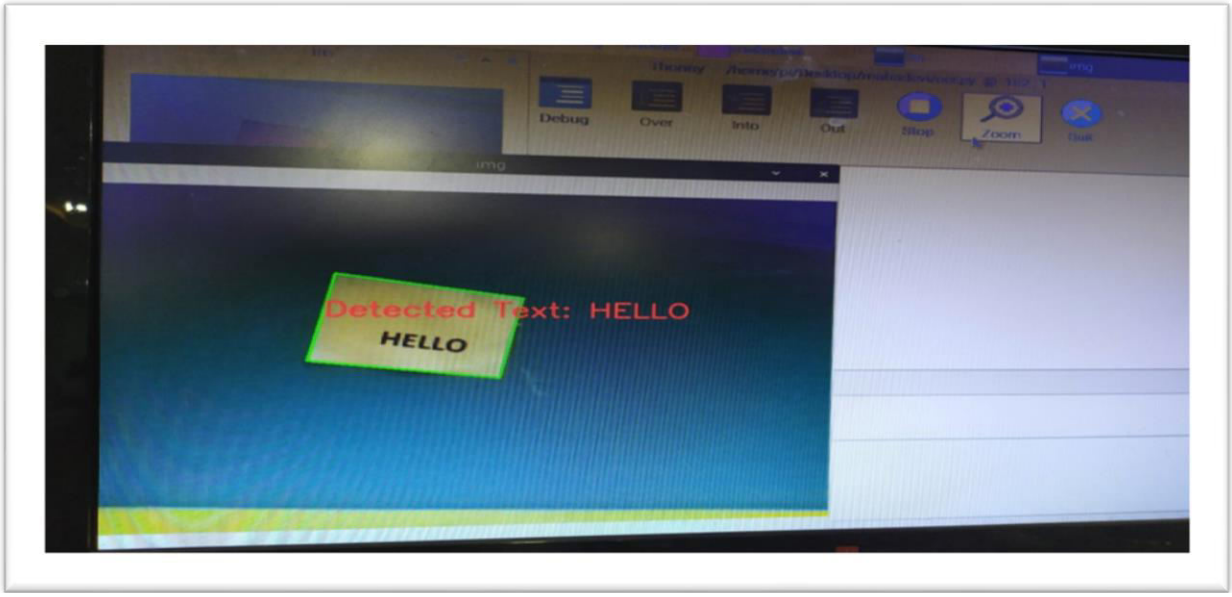

Fig.No.24.Board Reading Feature

VI .CONCLUSION AND FUTURE WORK

The implementation deals with the concept of smart assistive device for blind using machine learning. From the project it is concluded that it serves as a helping aid to blind people by providing them with smart glasses which can help them in speech based navigation assistance using GPS. The obstacle and type of obstacle sensor can make sure that the blind person is always aware of the environment surrounding him and can navigate independently. The OCR system implemented will help the blind person to read the text on the boards and translate it to speech. Thus the project serves as a powerful tool which will help blind person to navigate freely.

The only downside of the project is the inference time of the deep learning model. The system in future canbe implemented using deep learning accelerator hardware instead of raspberry pi to speed up the type of obstacle detection time. Additionally the system can also be made more compact using four layer pcb manufacturing techniques.

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