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Blind Navigation System

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Abstract - *The need to move from place to place is a crucial task for any human who intends to complete a specific task. The path a human takes doesn't always favour the type of path feasible for that person. He has a greater chance of encountering any sort of obstacles which may lead to a point where the human must make use of his visual and cognitive skills to decide which path avoids the obstacle. This creates an issue to visually impaired people. This project illustrates one way of overcoming this issue keeping visually impaired people in focus. We have devised a system capable of identifying objects and suggesting the user to choose his path based on the obstacle ahead of him. We have implemented YOLO algorithm for classification and identification of objects. This involves a client-server feature to ensure that the device is more real-time and efficient. The outcome of the project is to ensure the safest path to choose with respect to the object ahead of the user by audio guidance.*

Key Words: **Impaired People, Obstacles, Cognitive skills, YOLO, Path Finding, Client server**

1. INTRODUCTION

The world is ever changing. There has been a phenomenal growth in technology and economy in the past few decades. As a result, we are expected to adapt ourselves as per the changes implemented. These changes however may be comfortable to quite a large portion of the population. Nevertheless, the other set of population fail to adapt to these changes. Amongst them are the blind. Analysis of data from 188 countries suggests there are more than 200 million people with moderate to severe vision impairment. That figure is expected to rise to more than 550 million by 2050. Considering a blind person travelling in a region once familiar may not be the same in a couple of days to come.

With the advancements in Artificial Intelligence, we now have various algorithms that can perform tasks like identifying an object. This ability comes in handy, as this could practically act like an artificial eye to the blind. It could distinguish between static objects and dynamic objects and help the blind to walk around. A voice assistant is a software whose key role is to provide a voice command to the blind person. With machine learning algorithms that processes a speech (Google gTTS).

2. LITERATURE SURVEY

Research [1] In the paper, our unified architecture is extremely fast. Our base YOLO model processes images in real-time at 45 frames per second. A smaller version of the network, Fast YOLO, processes an astounding 155 frames per second while still achieving double the mAP of other real-time detectors. Compared to state-of-the-art detection systems, YOLO makes more localization errors but is far less likely to predict false detections where nothing exists. Finally, YOLO learns very general representations of objects.

[2] Two of the most demanding and widely studied applications relate to object detection and classification. The task is challenging due to variations in product quality differences under certain complicate circumstances influenced by nature and human. Research in these fields has resulted in a wealth of processing and analysis methods. In this paper, we explicitly explore current advances in the field of object detecting and categorizing based on computer vision, and a comparison of these methods is given.

[3] In this paper we tried to share the dream of having a domain independent search engine and not only an ordinary one but a smart search by voice engine which searches user speech automatically without the user's request and provide him with evidence on his speech, this engine was called SVSE.

[4] Voice assistants are software agents that can interpret human speech and respond via synthesized voices. Apple's Siri, Amazon's Alexa, Microsoft's Cortana, and Google's Assistant are the most popular voice assistants and are embedded in smartphones or dedicated home speakers. Users can ask their assistants questions, control home automation devices and media playback via voice, and manage other basic tasks such as email, to-do lists, and calendars with verbal commands.

3. SYSTEM DESIGN

The field of creation of intelligent machines that work like humans and respond quickly, in computer science is known as Artificial intelligence. The core part of AI research is Knowledge engineering. Machines can react and act like humans only when they have abundant information related to the world. To implement knowledge engineering, Artificial intelligence should have access to objects, categories, properties, and relations. To initiate common sense, reasoning and problem-solving power in machines, it is a difficult and tedious task. Machine learning is another one of the core parts of AI. Learning without any kind of supervision requires an ability to identify patterns in streams of inputs, whereas learning with adequate

supervision involves classification and numerical regressions.

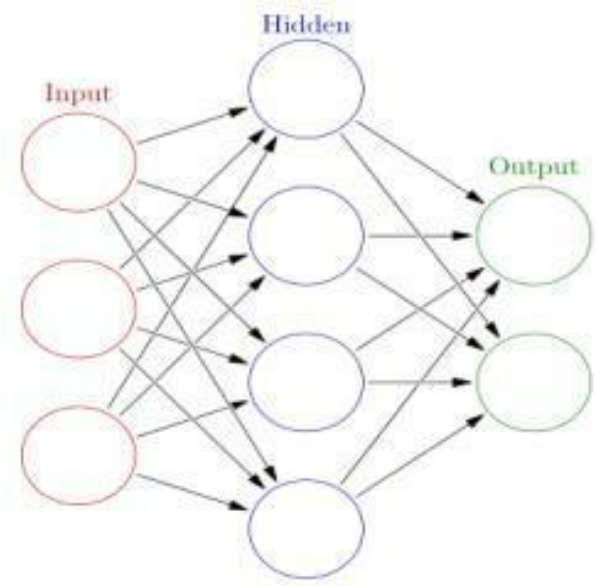

FIGURE 3 ARTIFICAL NEURAL NETWORK

Classification determines the category an object belongs to and regression deals with obtaining a set of numerical input or output examples, thereby discovering functions enabling the generation of suitable outputs from respective inputs. Mathematical analysis of machine learning algorithms and their performance is a well-defined branch of theoretical computer science often referred to as computational learning theory. Machine perception deals with the capability to use sensory inputs to deduce the different aspects of the world, while computer vision is the power to analyze visual inputs with a few sub-problems such as facial, object and gesture recognition. Artificial neural networks (ANNs) or connectionist systems are computing systems inspired by the biological neural networks. An ANN is based on a Collection of connected units or nodes called artificial neurons. Each connection (analogous to a synapse) between artificial neurons can transmit a signal from one to another. The artificial neuron that receives the signal can process it and then signal artificial neurons connected to it0. In common ANN implementations, the signal at a connection between artificial neurons is a real number, and the output of each artificial neuron is calculated by a non-linear function of the sum of its inputs. Artificial neurons and connections typically have a weight that adjusts as learning proceeds. The weight increases or decreases the strength of the signal at a connection. Artificial neurons have a threshold. Only if aggregate signal crosses that threshold, then the signal is sent. Artificial neurons are generally organized in layers. Different layers have different functions and perform different kinds of transformations on their inputs. Signals travel from the first (input) to the last (output) layer, possibly after traversing the layer's multiple times.

3.1 BLOCK DIAGRAM

The basic structure of blind Navigation system consists of Raspberry Pi 3 model, and Pi Camera, Ultrasonic Sensor, and earplug. Here the sensor is connected to Raspberry Pi .Ultrasonic Sensor senses whether object is in path of the person.

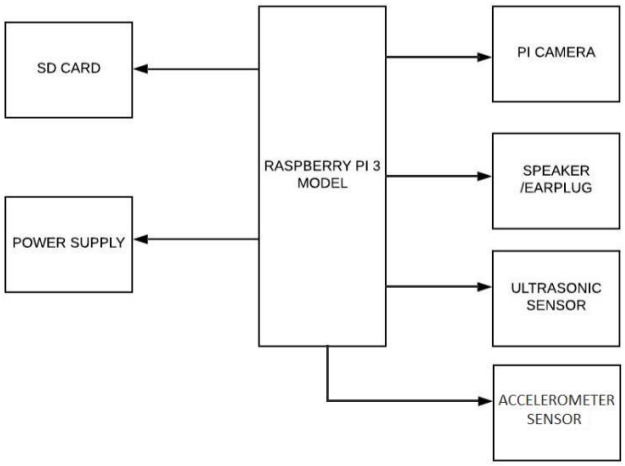

FIGURE 3.1 ARCHITECTURE /BLOCK DIAGRAM

1. SD CARD: It is the storage section in the Raspberry Pi which contains Raspbian (LINUX) and we can store scripts in it. Here, we have used 8GB SD card.

2. POWER SUPPLY: Raspberry pi 3 requires power supply .here, we supply 5v to the model.

3. RASPBERRY PI 3: It has a LINUX on which we run the scripts which is server socket. We connect the Ultrasonic sensor, Pi Camera and earplug to this module. Once the Ultrasonic sensor detects the object in the path and camera captures images of all objects in the path which is encountered as obstacle for person and stores in it.

4. PI CAMERA: Camera is used to capture the images of the objects in the path of the blind person to identify and classify about type of object and guide the person to understand about the objects.

5. ULTRASONIC SENSOR: Ultrasonic sensor used to detect the object which lies within the threshold set and records the distance of the objects which is used to make decision about how far the object is.

6. EAR PLUG/SPEAKER: It is used to give voice output to the blind person about the guidance of what type of object and direction for deviation to overcome the obstacle present in front.

7. ACCELEROMETER: It is used to detect the changes in the x,y,z axes. These changes will be used to detect the movement of the user.

3.2 FLOWCHART

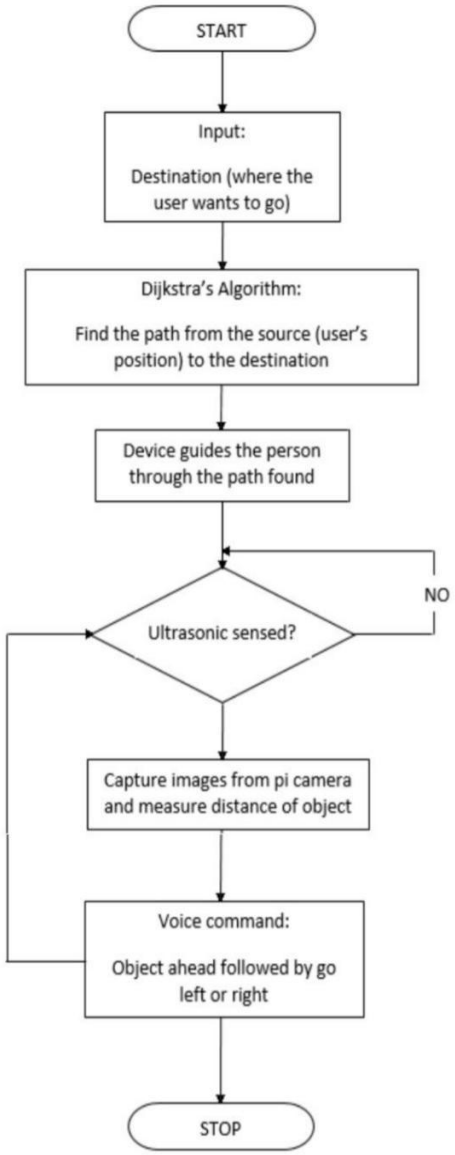

FIGURE 3.2 FLOW DIAGRAM

Flow chart of a system is the step by step illustration of the process that takes place in the system. It can be considered as a guide book to explain any system in an illustrative manner. In the above presented flow chart, we have explained the step by step process that happens in the blind navigation system which is as following:

Step 1. Start the system.

Step 2. Voice output that is, Device ready, the user will be asked for his desired destination.

Step 3. Dijikstras Algorithm will be used to find the shortest path to the destination.

Step 4. If Ultrasonic sensor detects object then proceed else loop in the step 3.

Step 5. Pi camera captures images and also takes distance of the object from the blind person. Step 6. This captured image is sent to the yolo algorithm for identification and classification of the objects in the path.

Step 7. Voice output that is, <object> ahead and go <direction>.

3.3 SEQUENCE DIAGRAM

Sequence diagram describes about how the Raspberry Pi model is connected to the Ultrasonic Sensor, Pi camera and Earplug. When device is ON, it indicates the user that device is ready. User will give his desired destination by audio input using mike. Then the shortest path will be found using Dijikstras Algorithm. On every step he takes the accelerometer will detect its movement. This will act as a measurement unit. Once the Ultrasonic Sensor detects the object that is in its range, the Pi Camera captures the images and stores in it. Now, the server waits for connection with client. When client socket is initialized then connection is established. Client receives all the captured images and distance data from server. In the client, all the images are processed for identification and classification of object and produces decision parameter set. Based on this parameters, decision is made about object and direction. This is guided to the blind person as audio output.

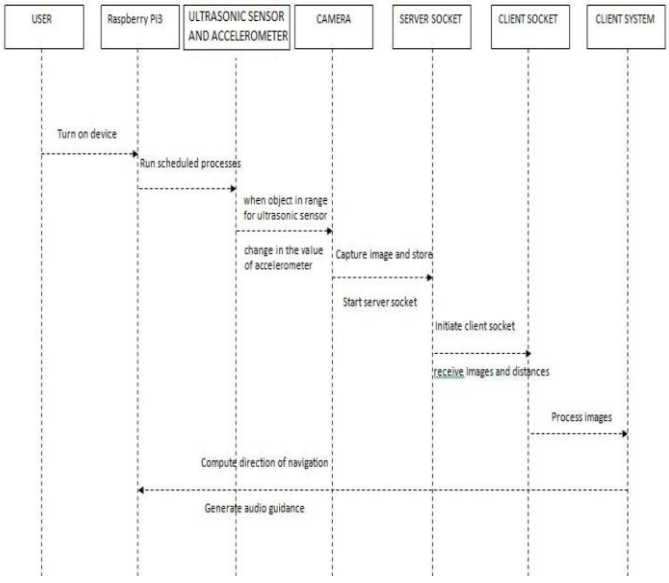

FIGURE 3.3 SEQUENCE DIAGRAM

4. IMPLEMENTATION

4.1. Turning on Device:

The basic most step involved in the project is to ensure the activeness of the server end of the entire system (Raspberry pi).the user baring the device, must just connect the device to a power source like a power bank /battery pack. Once the

device loads and boots up. It begins to execute the set of scheduled instructions set at the CronTab interface of the raspberry pi. An audio clip saying "Device online and ready" confirms the activeness of the server end of the system (raspberry pi).

4.2. Audio Input & its Text Conversion:

The user will turn on the device and then give the system an audio command regarding the destination of the place where he wants to navigate using the system. The system will take the audio voice as the input and then convert it into text to process the destination place and then starts the system according to the given audio input.

4.3. Detection of the Shortest Path:

After the audio input given by the user the device will detect the shortest path to reach the destination given by the user using dijikstras algorithm and then the audio output texts which are already present in the device storage will guide the user to its destination according to the determined shortest path.

4.4. Waiting for object in path:

Once the device is online, the crontab automatically executes a python code. This code is associated with the ultrasonic sensor module. Here, the code gets to know how far the object is from the perspective of the user. A threshold is set such that, any object within the minimum distance coded for will trigger a stop signal for the user. That is when the user must come to an halt. And then a python code responsible for capturing images is triggered.

4.5. Capture and store images of object:

When the user is at halt, the camera module of the raspberry pi begins to capture images of the object ahead automatically and stores these images in a folder. The images are associated with the distance determined from the ultrasonic sensor. Once the images are successfully saved and stored, the server socket on the raspberry pi begins to wait for a connection from the client.

4.6. Enable server socket and send images:

The server socket is now waiting for any connection to be established between the client system through the client socket. The connectivity ensures that the sockets to be connected are on the same network. This is to just ensure security and clarity of the data transfer. Then, the images stored are transferred to the client's system via network port through this connection.

4.7. Initiate Client socket and receive images:

In order for the client to establish a connection between the server device, it must know the ip address of the server device. This is already determined during the startup for the server device it creates an audio clip baring the ip address of the device. Once this is connected, the client is ready to receive data sent from the server device (images).

4.8. Process images at client:

Once the client gets the images of the object ahead from the server device, the process of image classification and object detection occurs. The client device runs an algorithm called YOLO that is helpful to determine several common day-to-day objects. The computation is expensive in terms of processing. And hence, a system with high end processing capacity is recommended. The output generated results in the determination of which object and where the object lies in the frame. Based on the position of the object in the frame, a decision is made to move on either left or right of the object detected.

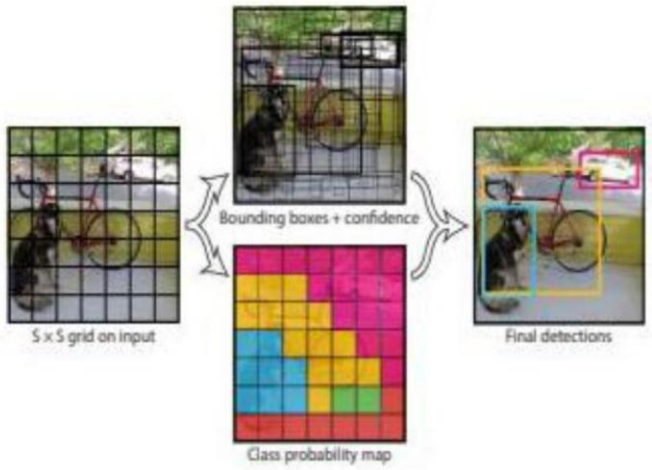

FIGURE 4.1 YOLO ALGORITHM IDENTIFICATION AND CLASSIFICATION.

4.9. Generate audio of navigational decision

Once the algorithm determines where the object lies in the frame of the captured image, it is now crucial to determine where the person should more likely to take turn. This decided based on a logic statement that judges the position of the object with respect to the person. Once the decision of whether to go left or right is made, an audio is generated and tells the user about the direction he has to go.

5. RESULTS

The output is the voice which guides the blind person what type of object is in his path and in which direction to navigate based on the objects in the frame and its distance from blind person. The process of ultrasonic sensor detecting object which is in its range and the Pi Camera capturing the images of the object and then processing of the

object to detect what type of object it is, which is repeated for every sensing of the ultrasonic sensor and guide the visually impaired person to navigate along his path.

6. CONCLUSIONS

The goal of this research is to provide the better image processing using artificial intelligence. By using RCNN image classifier, we predict the correct answer with more than 90% accuracy rate. We also use the trained model with real time image and obtained the correct label.

This device could be integrated with navigation related applications found in the internet. Such as booking a cab, home delivery services, etc. and moreover could also be made traceable to ensure that the person isn't lost.

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The foundation for any successful venture is laid out not just by the individual accomplishing the task, but also by several other people who believe that the individual can excel and put in their every bit in every endeavor he/she embarks on, at every stage in life. And the success is derived when opportunity meets preparation, also supported by a well-coordinated approach and attitude.

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