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Design & Implementation of Intelligent System for Visually Impaired People: A Review

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Abstract: ***There are about 285 billion visually imaired people in the world; 39 billion people in that are blind and 285 billion are low vision. They are not able to experience the world the way we do. This System aims to provide this missing experience for them. The system uses state of the art deep learning techniques from Microsoft Cognitive Services for image classification and tagging. The Experience is powered by voice assistant 'Alexa' through Amazon Echo. This System aims bring the beautiful world as a narrative to the visually impaired. The narrative is generated by converting the scenes in the front of them to text which describes the objects in the scene. Examples of text includes 'A group of people playing a game of football', 'yellow trunk parked next to the car' ,'a bowl of salad kept on table'. For the first prototype of the system, one line along with some keyword are played as an audio to the users but in the later versions a detailed description would be added as the feature.***
Keywords*: Raspberry Pi 3, Amazon Echo, Webcam, Visually Impaired, Amazon Web Services.*

I. INTRODUCTION

Vision is most important part of human Physiology as 83% of human gets information from the environment via sight. The 2011 statistics by the World Health Organisation (WHO) estimates that there are 285 billion people in the world are visually impaired; 39 billion people in that are blind and 246 billion with low vision. The Oldest and Traditional mobility aids for visually impaired people are walking stick and guide dogs. The guide dogs are assistance dogs and they are trained to lead visually impaired around obstacles. The main Drawback of this aids are necessary skills, training phase, range of motion and very little information conveyed. Also this White cane has several restrictions such as long length if cane, limitations in recognizing obstacle and difficulty to keep in public places. The Advance modern technologies are introduced for the visually impaired people for navigation includes both hardware and software. Recently there has been lots of Electronic Travel aids (ETA) [1] designed and devised to help visually impaired people navigate independently and safely. Also recently, high end technological solutions have been introduced to help blind people navigate independently. The Blind people use the Global Positioning System (GPS) [2] technology for outdoor navigation to identify position and orientation and location due to need for the line of sight access to satellite, they still need additional components to improve on the resolution and proximity detection to prevent collision of the blind persons with other objects and hence person life in danger. However in comparison to other technologies many blind guidance systems uses an array of ultrasonic sensors[3],[4] which is basically works on the principle of the ultrasonic sound generation and alert mechanism. Also, the ultrasonic is popular because the technology is relatively inexpensive, and also ultrasound emitters and detectors are small enough to be carried without the need for complex circuitry.

For both blind and visually impaired people, our proposed work offers a simple, efficient, configurable electronic intelligent system to help them in their mobility regardless of where they are, outdoor or indoor. Also, the user of the system does not need to carry a stick or any other self-explanatory tool. The Blind person can just wear a cap just like others. This intelligent system aims bring the beautiful world as a narrative to the visually impaired. The relations generated by converting the scenes in front of them to text which describes the important objects in that scene.

II. LITERATURE REVIEW

Literature review is carried out to gain knowledge and skill to complete this project. The main sources for this project are the previous publications related to this project. And the other sources are journals and articles. Therefore the analysis of the project did by other researches, these is the possibility to know are lacking in their projects. It is very important to improve and to develop a successful project.

Information about few research papers or previously implemented projects that we have used as a reference for making our project is mentioned below:

D. Yuan et al [5] proposed an international symbol tool of blind and Visually Impaired People just like the white stick with a red tip which is used to enhance the blind movement. However, this tool has several restrictions such as long length of the cane, limitations

in recognizing obstacles, and also difficulty to keep it in public places. No smart phones have designed for blind person until now. Thus accessibility of the Mobile application is a different question.

Due to the development of modern technology, many different types of Navigational Systems are now available to assist the blind people. They are commonly known as Electronic Travel Aids. Some of these travel aids are Sonic Pathfinder [6], Mowat-Sensor [7] and white stick [5], but having very narrow directivity. K. Magatani et al [8] proposed Electronic Travel Aid (ETA) devices which are used to help the blind people to move freely in an environment regardless of its dynamic changes. ETAs are mainly classified into two major standpoints one is sonar input such as laser signal, infrared signals, or ultrasonic signals and another is camera input systems which consists mainly of a mini CCD camera. These devices operate like the radar system which uses ultrasonic laser to identify height, direction, and speed of fixed and moving objects. The distance between the obstacles and the person is measured by the time of the wave travel. However, all existing systems inform the visually impaired people to the presence of an object at a specific distance in front of or near to people through tone signals or vibrations that need to training. These details permit the blind people to change their way only, but they are not comfortable and safe.

Some of these ETA devices are vOICe [10], NAVI [11], SVETA [12] and CASBLIP [13].In voice, the image is captured by using single video camera mounted on a headgear and the caught picture is filtered from left to right direction for sound generation. The sound is generated by altering the top of the image into high frequency tones and the bottom portion into low frequency tones. The loudness of sound depends on the brightness of the pixels. Similar work has been carried out in NAVI where the captured image is resized to 32x32 and the gray scale of the image is reduced to 4 levels. The image is differentiated into foreground and background using image processing techniques. The foreground and background are assigned with high and low intensity values respectively. Then the processed image is converted into stereo sound where the amplitude of the sound is directly proportional to intensity of image pixels, and the frequency of sound is inversely proportional to vertical orientation of pixels. In SVETA, an improved area based stereo matching is performed over the transformed images to compute dense disparity image. Low texture filter and left/right consistency check are carried out to remove the noises and to highlight the obstacles. To map the disparity image to stereo musical sound, sonification procedure is used. In CASBLIP, the object is detected through sensors and stereo vision. In addition to this, orientation is computed using GPS system. This system is embedded on the Field Programmable Gate Array (FPGA).

D. Dakopoulos et al [5] proposed a camera based technique to identify the hand-held objects. From cluster of background an object is identified. For that region of interest (ROI) are used. To find region of interest (ROI), we uses novel content localization algorithm to get the gradient features of edge pixels using Adaboost model. These compositions arebinarized and threshold value is obtained for that content character. Finally speech output is obtained from the binarized content character. This project also used for the blind person in their daily lives. Firstly, we have to shake the object to recognize the content. In any case, now it will automatically recognize the content character in the hand of visually impaired person. It is also converting the content into binaries but optical character recognition (OCR) software is used here. Then finally speech output is obtained.

III.RESEARCH METHODOLOGY

The architecture of the system includes Raspberry Pi 3, Amazon Echo and online computer vision API`s. The Block diagram of this system is as follows.

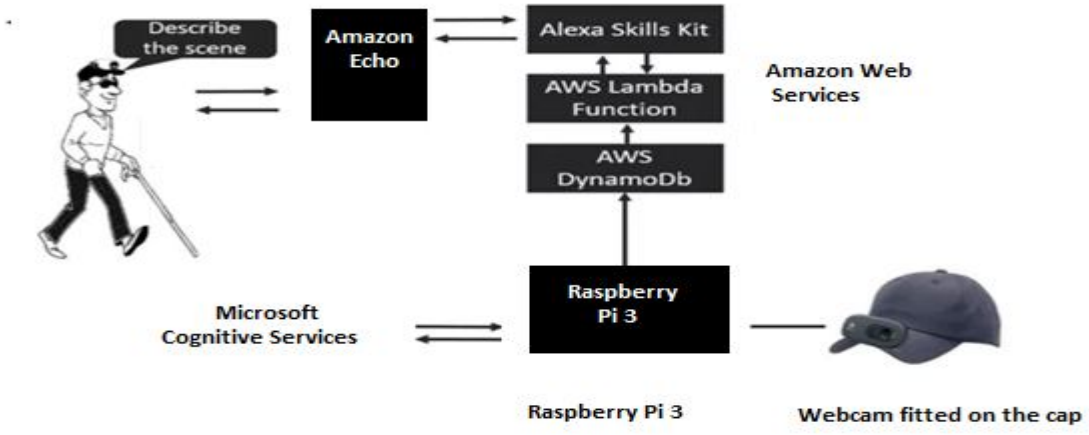

Fig.1. Block Diagram of the Intelligent System

A. Hardware Description

1) *Raspberry Pi 3*: The Raspberry Pi is a progression of little single-board computers. The processor used in Raspberry Pi 3 is a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512 KB L2 cache. It has potentially fast enough to decode H.265-encoded videos in software. The Raspberry Pi primarily uses Raspbian, a Debian-based Linux operating system. The GPU in the Raspberry Pi 3 runs at higher clock frequencies of 300 MHz or 400 MHz than previous versions which run at 250 MHz Raspberry Pi 3 has the functions over other models of Raspberry Pi such as

a) A 1.2GHz 64-bit quad-core ARMv8 CPU
b) 802.11n Wireless LAN
c) Bluetooth 4.1
d) Bluetooth Low Energy

Fig. 2.Raspberry Pi 3

2) *Amazon Echo:* Amazon Echo is a brand of smart speakers. The devices connect to voice-controlled intelligent personal assistant service Alexa, which responds to a name “Alexa”. These gadgets is a fit for voice cooperation, music playback, making plan for the day, setting alarms, streaming podcasts, playing audio books, and provides weather, traffic and other real time information, such as news.

Fig.3. Amazon Echo

3) *Webcam:* The webcam is a high definition video camera that feeds or streams its pictures progressively to or through a PC to a PC arrange. When “captured” by the PC, the video stream may be saved, viewed or sent on to other networks via systems such as the internet, and email as an attachment. At the point when sent to a remote area, the video stream may be saved, viewed or on sent there. The Webcam is generally connected by a USB cable, or similar cable, or built into computer hardware, such as Laptops.

B. Software description

1) *AWS Dyanamo DB:* Amazon DynamoDB is a completely overseen NoSQL database service that provides fast and predictable performance with seamless scalability. It is offered by Amazon.com as part of the Amazon Web Services portfolio. DynamoDB exposes a similar data model &derives its name from Dynamo, but has a different underlying implementation. Its flexible data

model, reliable performance and automatic scaling of throughput capacity, makes it a great fit for mobile, web, gaming, ad tech, IoT, and many other applications.

2) *AWS Lambda Function:* AWS Lambda is an occasion-driven, server less figuring stage provided by Amazon as a piece of the Amazon Web Services. It was introduced in 2014..It supports the Python, Java and C# language.AWS Lambda was originally designed for such cases like image upload, responding to website clicks or reacting to sensor readings from an IoT connected device. It runs code in response to events and automatically manages the compute resources required by that code. It supports the Python, Java and C# language.

C. Working

1) The blind person can have our system which is portable and easy to use. As he/she has to carry the module with them for assistance.
2) In this intelligent System, the Webcam is retrofitted on a cap to capture the real time image of the Obstacle (such as Human Being, table, chair etc.).
3) The main module is of raspberry pi which is on its own a mini-computer, which processes the image captured by the webcam.
4) The Image is converted into Text using AWS Dynamo DB Which is one type of the software used which is a fully managed NoSQL database service that provides fast and predictable performance with seamless scalability.
5) When the blind people request that Amazon echo to describe the scene, then the Alexa Skills Kit triggers Amazon Lambda function to bring the data from the database DynamoDB. The AWS Lambda Function is used to convert text into speech.
6) The correct text is the played as an audio on the Alexa device.

IV. CONCLUSIONS

A simple, straightforward, configurable, simple to deal with intelligent system is proposed to provide constructive assistant and support for blind and visually impaired people. The advantage of this system lies in the fact that it can prove to be very effective solution to millions of Visually Impaired People worldwide. The main functions of this system are narrating the scene. The proposed mix of different working units makes a real-time system that screens position of the client and gives double input making navigation more safe and secure.

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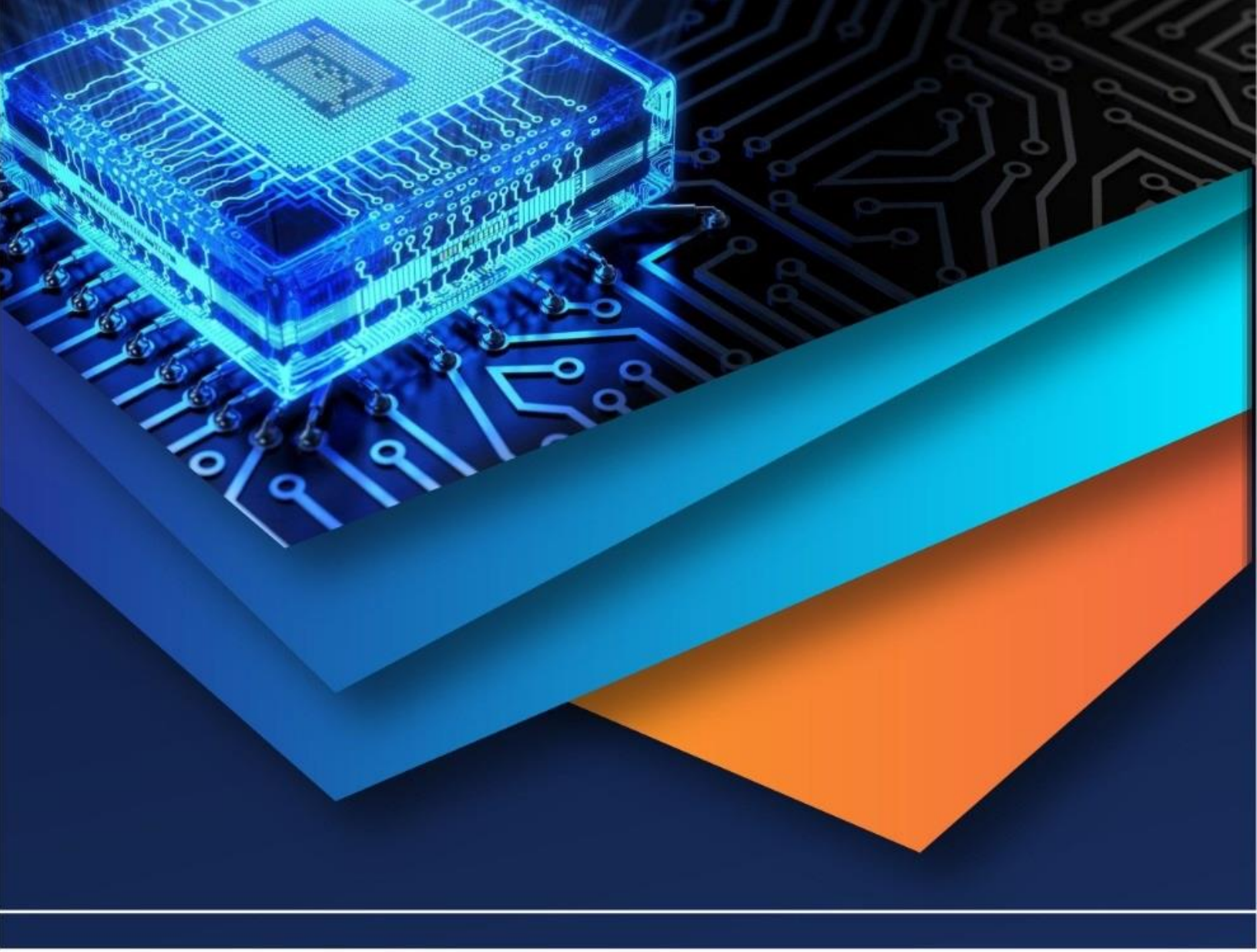

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