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NETRAM - AI Driven Technology

Abstract: *This paper presents a brief idea of developing an AI driven technology that assists the visually impaired people in carrying out their daily activities with ease. The visually impaired people often face challenges in their day to day life activities and frequently navigate via locating sound sources and sound reflecting objects, a phenomenon known as echolocation. This method of obstacle detection in crowded places does not always come in handy and thus traveling around becomes a cause of concern for them. Therefore, we proposed a device "NETRAM - Your Digital Eye" which is an AI driven technology which assists the blind and elderly in navigation. This device used Azure custom vision AI for training of its model with a precision accuracy of 82.1 % and recall 33 %. This was an attempt to give the visually impaired people a sense of inclusiveness and empower them.*

Keywords: *Visual impairment, navigation, assistive tools, AI driven technology, Azure Custom Vision AI.*

I. INTRODUCTION

Nature has created a stunning image of mother earth all around us, but tragically, some people are unable to see it with their eyes. The world is full of vivid, colorful materials. However, certain case studies suggest that they are otherwise being compensated for the loss by giving them enhanced abilities in their other senses. Blind people utilize their other senses to comprehend the world around them. Over time, they grow accustomed to seeing, hearing, feeling, and smelling things with their other four senses, and they begin to benefit from them in unique ways. Over the years, modifications have been made with regard to foreign and Indian definitions of blindness.[1] Blindness can take many different forms, including total or partial blindness, color blindness, night blindness, and other eye defects. This might result from a deadly accident or come about because of a genetic defect right at the time of birth. A person who is totally blind requires assistance with daily tasks, and their families must support and provide a helping hand to them so they can go about their daily lives with ease. However, a significant downfall has been observed in the visual impairment in the last few decades or so but it is yet to meet the WHA GAP. [2]

If we look at the WHO statistics, there are around 2.2 billion people who suffer from complete blindness in the world in which 300 million people are color blind and around 2200 million people are night blind. According to the WayMap research of the US, there are 20% of visually impaired people traveling around each year which gives them a partial sense of independence in carrying out their daily activities. As stated by WHO, vision impairment poses an enormous global financial burden with the estimated global expenses of lost productivity due to eyesight impairment are $411 billion. [3]

Regionally, low- and middle-income areas are thought to have a four times higher prevalence of distant vision impairment than high-income areas. Untreated near vision impairment is estimated to affect more than 80% of people in western, eastern, and central sub-Saharan Africa, compared to less than 10% in high-income areas of North America, Australasia, Western Europe, and Asia-Pacific.

The main contributors to vision loss worldwide are:

- mature macular degeneration is frequently observed with growing age
- diabetic retinopathy is common in case of cataract [4]
- uncorrected refractive defects due to glaucoma

According to the accessibility of eye care services, their price, and the population's level of eye care knowledge, there are significant differences in the causes between and within countries. If we look at the low and comparatively middle income countries, the population of people suffering from cataract is higher than the high income countries due to the intake of nutrition. Countries with high wealth have higher rates of diseases including glaucoma and age-related macular degeneration. [5] It has also been observed that a large section of the blind population have dietary concerns which have an effect on their life in the later stage. [6] For instance, a case study has proven that women suffering from loss of sight tend to be malnourished than healthy women. [7,8] Furthermore, they often face challenges when it comes to consuming the right foods that are beneficial for their overall health and vision improvement. Men and young children under the age of 15 years are obese which makes them more vulnerable to cardiovascular diseases. [9,10,11] Their quality of life is negatively impacted by this. [12,13,14,15] Vision-Related Quality of Life (VR-QoL) is assessed in study areas like optometry and ophthalmology. The personal reports of patients' worries with regard to their general lifestyle in the presence of eye illness are known as VR-QoL. [16,17,18,19] Compared to people with healthy vision, those who are blind are also more prone to have depressive symptoms and have functional limitations. [20]

Early-onset severe vision impairment in young children can have a lasting impact on their motor, verbal, emotional, social, and cognitive development. Children in school who have eye problems may also perform less well academically. Quality of life is significantly impacted by vision impairment in adult populations. Adults with visual impairment frequently have lower labor force involvement and productivity rates as well as greater rates of anxiety and depression. Vision impairment in older people can increase their risk of falling and fractures, social isolation, difficulties walking, and early admission into nursing or care facilities. India has been successful in implementing various productive therapies that has resulted in the significant decrease in the number of the people suffering from partial or complete visual impairment. [21,22].

II. PROPOSED SOLUTION

To overcome this issue, we have proposed the device “NETRAM- your digital eye”. It serves as a form of assistance for those who have various vision impairments. In line with Microsoft technologies like Azure Machine Learning in the tool, it uses artificial intelligence and the Internet of Things. NETRAM has implemented ground-breaking innovations that will enhance the lives of those who are blind. For the longest period of time, the blind population has been considered a liability in the society and have been left behind. This device will give them a sense of inclusiveness helping them blend into the mainstream of the society and in the long run will allow them to be financially independent which will lead to the economic development of the world. This gadget can be easily accommodated in various clothes and jewelry thus allowing the user ease of carrying it and making it portable. Its features includes 180 degree camera view, ChatGPT, LED indicator, wireless and magnetic charging with a universal charging port, waterproof casing and has a coating of polyvinylidene fluoride which absorbs the electromagnetic radiations emitted by the device making it safer for the users. This device is partially biodegradable and thus is eco-friendly to nature. In absence of the internet, the haptic feedback of the gadget will activate and detect any obstacles in the pathway and vibrate with different intensities based on the distance of the object from the user thus guiding the user.

The minimal cost of the product and its live streaming and color detection ability makes it unique in the market as there are no such pocket friendly products available in the market for navigation purposes. NETRAM also assists the people suffering

from amnesia and older generations in traveling around different places thus easing their lives.

III. CIRCUIT DESCRIPTION

Initially in the camera module, the code is uploaded by using Arduino-Nano and the camera module has been trained using more than one thousand datasets with a view of 180 degrees for object and person detection and has text to speech which facilitates easy navigation. Camera will take data and send it on a web server where the azure cognitive services convert it to text to speech which enables the user easy navigation via audio output and also gives an idea about the object in its surroundings. The ultrasonic sensor detects the obstacles within its range of 60 cm and alerts the haptic feedback system which vibrates with different intensities according to the distance of the object from the users.

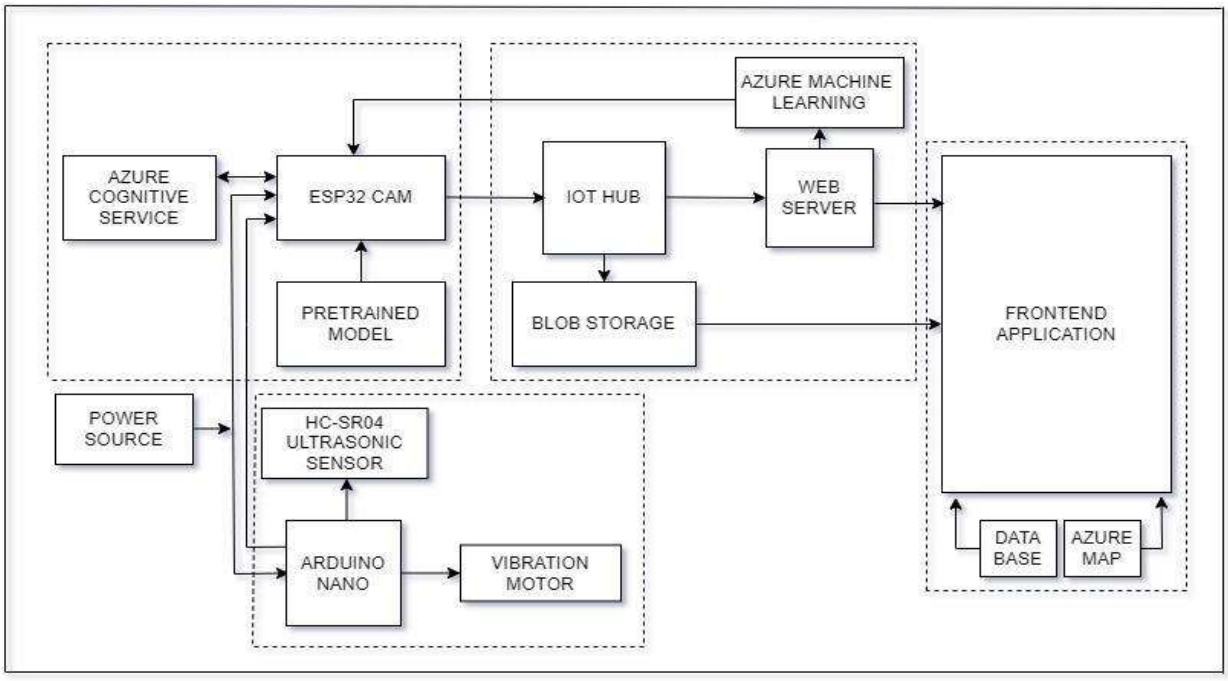

Fig 1: Block diagram

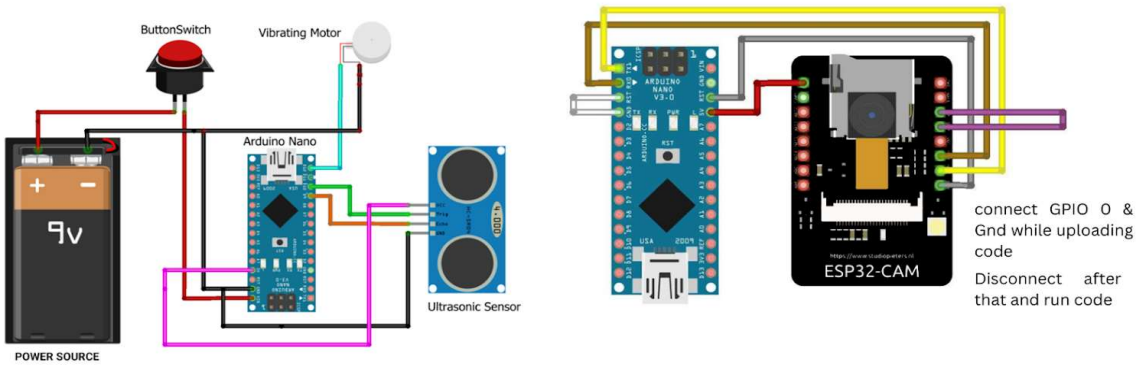

Fig 2: Connection of the components

A. Components of the device and its applications

- ESP32 cam module which detects the objects in the surroundings
- Arduino Nano for coding purpose
- HC-SR04 for distance calculation
- Vibration motor for haptic feedback alert
- Red LED for instant warning in case of system collapse
- Universal charging port 2000 mAh battery (5 V)

IV. WORKING ARCHITECTURE

First to activate the device switch it on connect the device with application by login credentials in it after that device will be activated as device is pre-trained according to the users location local data it will start detecting the objects and sign to navigate the way as when user will command the device by voice command for its current location and drop location it then it will calibrate accordingly to the environment. In the 1st block we had device which is pre trained with the help of azure services then it is coded in device so it can detect object without internet as further data is send to web servers where it is analyzed and further sends to machine learning model which helps device in adapting according to environment in real time.

As it further sends on front end applications where it is presented and saved for future use and training more advanced models for users. In the front end we are using a map service which helps us to get precise location of the user so that it helps our AI model to know where the user is which leads to increase its precision. The feature of talkback plays a major role in communicating with users and getting comments from it and the ChatGPT feature is also controlled by talkback function which plays a major role in communication with new tech in the world.

The device is pre-trained according to the public data of the user's location which helps NETRAM to detect paths without internet. For storing sensor's data, we are using blob storage. If we talk about the adaptive assist, the machine learning model is trained in such a way that it will enhance its features of detecting paths. Talking about front-end applications, it is divided into two parts NETRAM app for family members and a simple edge structured app with the power of ChatGPT which plays a major role in improving the user's experience and adds the features of AI. The use of an azure map will increase the precision of the user's location.

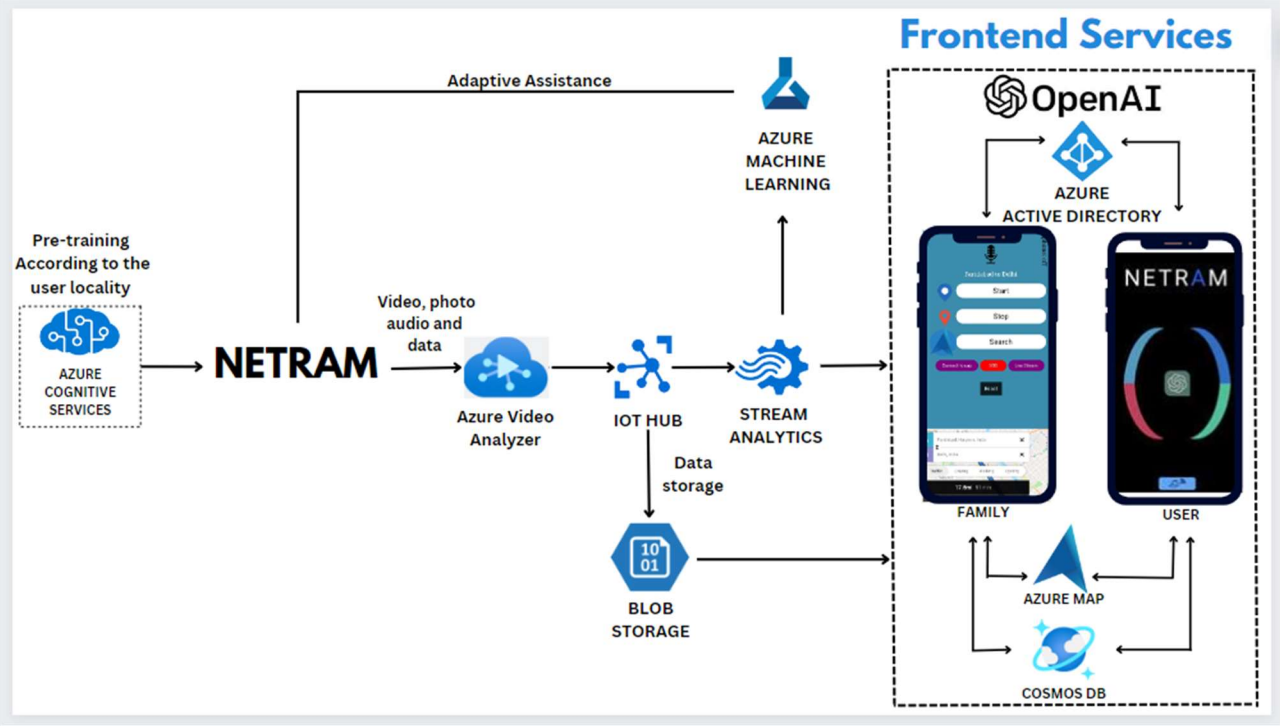

Fig 3: Working architecture of NETRAM

Fig 4: Model training accuracy

Azure Cognitive Services is used here to improve customer experiences with features like text to speech, Speech to Text, Image identification, Video analyzing and for conversational language understanding. Azure Active directory is used here for application management and authentication processes.We have used blob storage for storing sensor's data. Azure stream analytics is directly connected with Azure IOT hub and as well as blob storage so that it performs historical data accordingly. Cosmos Db helps in achieving low latency and high availability. It helps applications to respond in real time, store ever increasing volume of data and make the data available to users in milliseconds. Application is completely voice controlled. Application is designed in such a way so that users can easily understand.

V. RESULT

We generated the data ourselves for model training and uploaded it on Kaggle. The model has been trained using the azure custom vision AI which gives it a precision accuracy of 82.1%, recall 33% which will be further improved in the future installations. So far this device is capable of text to speech, person detection, object detection and with the help of sensors it detects obstacles. The model's accuracy and precision indicates its ability to perform well and provide stable results in the varying environmental conditions. The device has been reviewed by the National association for blind (Faridabad), National association for blind (RK Puram, Delhi) and blind school (Bikaner, Rajasthan). We found that people are able to use our device easily. Keeping in mind sustainable development goals we have used most of the biodegradable components so that devices will become more eco-friendly.

VI. CONCLUSION

There are various models and apps present in the market for the assistance of blind people when it concerns navigation but the ground reality is they are not available on the table due to cost ineffectiveness. Therefore, NETRAM bridges the gap and provides the user easy assistance and is a portable, wearable, fashionable and user friendly device that makes a blind person an integral part of the society. This device is cost effective and its components are certified as per the safety guidelines of TUV and Intertek and the Polyvinylidene fluoride (PVDF) material used for the electromagnetic radiation absorption is ISO certified. The effects of vision impairment on an individual vary based on a wide range of variables. Access to therapies regarding prevention and treatment, in addition to vision rehabilitation, are just a few examples of what this encompasses. (Including aids like eyeglasses or white canes), and whether the person has issues with inaccessible structures, transportation, and information. Innovation is the need of the hour and technology is changing and everyday it's answering real life problems. NETRAM is an attempt to answer one such problem which has remained unanswered so far, this is to enable technology driven navigation

Table 1: Our Competitor

Operations	NETRAM	OrCam MyEye	WeWalk
Auto Detection	yes	yes	yes
Saving of Route	yes	no	no
VC application	yes	No	yes
Color Detection	yes	yes	no
Live Stream	yes	No	no
Text to Speech	yes	yes	no

for the people who need it the most. If self-driving cars are possible in today's world, then why aren't human navigation powered by AI. Visually impaired people have restricted ability to function at all the tasks so this gadget will empower them and help perform their daily activities with ease.

These are some of our competitors given in Table 1 who are working in this field. We are giving external facilities like saving of route, Voice controlled application, Live streaming, text to speech and color detection in a single device. Our aim is to make this device accessible to every user at minimal price with all features.

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