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Assistive Communication System for Visually Impaired People

Prarthana B S
Student (BE)
Dept. of ISE
EWIT, Bangalore
prarthana8421@gmail.com

Sneha H S
Student (B.E)
Dept. of ISE
EWIT, Bangalore
sneha573103@gmail.com

Vijaykumar Ramachandra Hegde
Student (B.E)
Dept. of ISE
EWIT, Bangalore
khushputti33@gmail.com

Yoganand P
Student (B.E)
Dept. of ISE
EWIT, Bangalore
yogaram2002@gmail.com

Abstract— **Smart Blind Glass is a device designed to help guide the visually impaired by detecting objects and portray the information to them in the form of speech. This reduces the human effort and gives better understanding of the surrounding. Furthermore, it also provides an opportunity for visually impaired people to move from one place to another without being assisted by others. The aim is to aid people in need to "see" the surroundings. Since the field of artificial intelligence is doing great progress at present and features like object detection is getting easier and computationally feasible, these features are implemented in the project. The project focuses on object detection and classification on pictures which are captured by the device, whose information can then be relayed to the user in means of sound or speech**.

INTRODUCTION

Vision is a beautiful gift of being able to see. Vision enables individuals to see and comprehend the encompassing scene. Till date daze individuals battle a considerable measure to carry on with their hopeless life. In the displayed work, a basic, shabby, well-disposed client, virtual eye is composed and actualized to enhance the versatility of both visually impaired and outwardly disabled individuals in a particular region. This project is helps blind people to map their world using the sense of hearing. It's a visual based project consisting of few main components such as camera, Arduino and earphones mounted together and additional working technologies of the internet interlinked. The input of the project will be an image/video (multiple frames), the image captured and analyzed with the help of the camera interfaced to the Arduino/IOT technology. Hence the object is detected and audio information is conveyed to the blind person through earphones. This system deals with an approach to make better life for blind people as it well equipped with the latest technology and it is meant to aid

the visually impaired to live a life without constraints. Visual deficiency is a condition of lacking visual recognition because of physiological or neurological components Virtual impairment may cause people difficulties with normal day activities. the incomplete visual impairment speaks to the absence of development in an optic nerve or visual focus of the eye. According to recent estimation 253 million people live with vision impairment. 36 billion are blind & 217 million have moderate to severe vision impairment. The loss sight causes enormous human suffering for the affected individuals and their families. Vision allows human being to view the surrounding world.

There are 285 million people worldwide that have some level of visual impairment. The blind navigation system caters to the needs of the blind people who are not able to move from one place to another without the help of others. Recent survey source of India has now become the world's largest number of blind people. There are 37

million blind people across the globe, of which 15 million people are from India. The usage of the blind navigation system is very less and not efficiently used for Indian environment. The blind traveler should depend on any other guide like blind cane, people's information, trained dogs, etc. Visual function can be classified by four tiers: normal vision, moderate visual impairment, severe impairment, and complete blindness. Legally blind refers to a person who has less than 20/200 vision in either eye, or a limited field of vision. Many virtually impaired people use walking sticks and guide dogs to move from place to place. For this group of population; the goal is often to complete tasks in the least obstructive method. A guide dog is trained to guide its users to avoid the accidents from objects and barriers. When a visually impaired person is using a walking stick, they wave their walking stick and find the obstacle by striking obstacles ahead of them.

God gifted sense to human being which is an important aspect in our life is vision.

We are able to see the beauty of nature, things which happen in day-to-day life with the help of our eyes. But there are some people who lack this ability of visualizing these things. They face many difficulties to move on with their daily life. The problem gets worse when they move to an unfamiliar location. Visually impaired people face many challenges when moving in unfamiliar public places. Hence a system has to be found to minimize the difficulties of virtually impaired people to reach their destination. Studies indicate that there are approximately 10 to 11 million blind and visually impaired people in North America, and this number is growing at an alarming rate. As many of these people have difficulty knowing where they are or where they are going, frequently feeling totally disorientated or even isolated, supplemental navigational guidance is very important for them. Navigation involves updating one's position and orientation while he or she is travelling an intended route, and in the event the person becomes lost, reorienting and re-establishing a route to the destination.

The Internet of Things (IoT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications (M2M) and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects), is expected to user in automation in nearly all fields, while also enabling advanced applications like a Smart Grid.

Things, in the IoT, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, or field operation devices that assist fire- fighters in search and rescue. Current market examples include thermostat systems and washer/dryers that utilize Wi-Fi for remote monitoring.

According to Gartner, Inc. (a technology research and advisory corporation), there will be nearly 26 billion devices on the Internet of Things by 2020.ABI Research estimates that more than 30 billion devices will be wirelessly connected to the Internet of Things (Internet of Everything) by 2020.

Integration with the Internet implies that devices will utilize an IP address as a unique identifier. However, due to the limited address space of IPv4 (which allows for 4.3 billion

unique addresses), objects in the IoT will have to use IPv6 to accommodate the extremely large address space required. Objects in the IoT will not only be devices with sensory capabilities, but also provide actuation capabilities (e.g., bulbs or locks controlled over the Internet).

To a large extent, the future of the Internet of Things will not be possible without the support of IPv6 and consequently the global adoption of IPv6 in the coming years will be critical for the successful development of the IoT in the future. The embedded computing nature of many IoT devices means that low-cost computing platforms are likely to be used. In fact, to minimize the impact of such devices on the environment and energy consumption, low-power radios are likely to be used for connection to the Internet. Such low-power radios do not use Wi-Fi, or well-established Cellular Network technologies, and remain an actively developing research area.

However, the IoT will not be composed only of embedded devices, since higher order computing

devices will be needed to perform heavier duty tasks (routing, switching, data processing, etc.). Companies such as Free Wave Technologies have developed and manufactured low power wireless data radios (both embedded and standalone) for over 20 years to enable Machine-to-Machine applications for the industrial internet of things.

Besides the plethora of new application areas for Internet connected automation to expand into, IoT is also expected to generate large amounts of data from diverse locations that is aggregated and very high-velocity, thereby increasing the need to better index, store and process such data.

I. LITERATURE REVIEW

A literature survey is a proof essay of sorts. It is a study of relevant literature materials in relation to a topic we have been given. For thorough development of the device Smart glass for Blind using Arduino Uno, we need to go through each and every technical aspect related to it. This chapter provides an introduction to the area of research. A brief Study and Survey has been carried out to understand various issues related to the project which involves providing a smart electronic aid for blind people to provide artificial vision and object detection, real time assistance via using Arduino. This project mainly focuses on the visually impaired people who cannot walk independently in unfamiliar environment. The main aim of this project is to develop a system that helps blind people to move independently.

In a rapidly flourishing country like our innumerable number of attempts has been made for the welfare of especially able people of our society. One of such attempts is the project Smart Blind Stick for Visually Impaired People by Ashish Kumar and Reeta Verma, the electronic smart stick which guides the blind person by a buzzer which beeps when the ultrasonic sensors, infrared sensor detects any obstacles present in its way. The smart stick presented here also incorporates the LDR sensor and the water sensor for detection of the dark by the LDR and the potholes filled with water by the water sensor.

Sukriti Sudhakar proposed a project on smart cane which has sensors embedded on it, thereby it senses the obstacles/ intruder, when any object come in range of an ultrasonic sensor. Then the person is alerted with a quick response time. This System also has a water sensor at the bottom of the stick and Infrared sensor for effective obstacle detection.

Anuj Parikh, Dhvani Shah, and Krupa Popat with their Prof. Harish Narula proposed a blind man stick that can detect obstacles, potholes and thus help the blind person travel independently. The system is constructed using ultrasonic sensors, Programmable Interrupt Controller (PIC 16F877A) that has an On-chip Analog-to-Digital Converter (ADC), a vibrator, buzzer and a power supply.

A Smart cane was proposed by Muhsin Asaad H, which was assigned to detect the obstacles up-to knee level within the range of 2 to 3 feet (0.91 m). When an obstacle is detected, the cane vibrates makes a sound. The sensor and therefore the controller are embedded inside the cane, and it always offers a battery lifetime of 10 hours. The delay time can be calculated by the calculation of the time taken to reach the waves to the obstacle and its return journey. Distance information is given to the user through a buzzer.

II. LIMITATIONS IN EXISTING SYSTEM

• In existing system lasers are used to object detection but lasers are harmful for humans, can damage their skin and eyes.

• Infrared sensor cannot detect darkness (its need of light).

• Sensors cannot detect long distance objects and downstairs objects.

• Existing system does not have multiple features like traffic signal detection, text reader, and object detection etc.

III. PROPOSED SYSTEM

Proposed system addresses the following objectives:

- o Helping blind person to read
- o Object Detection
- o Emergency intimation to the care taker

Implementing a Reading System for Blind person using Python, Embedded C and Arduino

- o Object Detection

o Image Capture

o Convert to Text

o Convert to Voice

It helps blind person to walk independently. It informs the blind person regarding obstacle in voice. Optical Character Recognition (OCR) and Text to Speech Synthesis (TTS) are integrated to take a picture and hear the text that exists in the picture. “Smart Glasses” can read any English text images by converting the text in the image into an audible one. It can also translate the text and can be heard by the user using headphones. Glasses are designed to be the eye for the blind person and people who suffer from vision difficulties to make their life easier and be able to continue living their life as a normal human to follow up and achieve their goals and dreams.

Here the device is going to capture the image of commonly used products through a mini camera mounted on spectacles. After acquisition of image, it has to be pre-processed and compressed. Various daily use objects images are used to train the model. It is trained by performing feature extraction on the image to obtain the required pattern in the image. Followed by feature fusion and dimension reduction to compress the image for reliable and real time performance. Then this dataset is used to train the classifier. Comparing the performance of various classifiers, and select the optimum one, and thus the object recognition model is achieved. Now any test image may be given to this model which will be classified into one of the classes the model has been trained into.

IV. SYSTEM DESIGN

System design is the process of defining the architecture, components, modules, interfaces and data for a system to satisfy specified requirements. System design is one of the most important phases of software development process. The purpose of the design is to plan the solution of a problem specified by the requirement documentation.

Arduino:

Arduino Uno is a microcontroller board based on theATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Fig 1: Arduino UNO

Ultra Sonic Sensors:

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

Fig 2: Ultra-sonic Sensor

Power Supply:

A power supply is an electrical device that supplies electric power to an electrical load. The main purpose of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load.

Fig 3: Power Supply

NodeMCU:

NodeMCU is a low-cost open source IoT platform. It is an open-source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit).

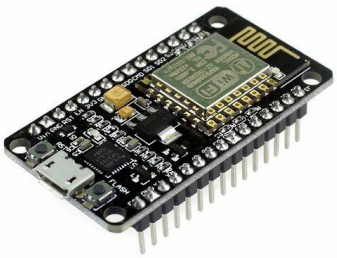

Fig 4: new NodeMCU

Emergency Switch:

An emergency switch, also known as E-stop switch, E stop switch, emergency switch, kill switch, or emergency button, emergency stop pushes button switch, it is a fail-safe control switch that provides safety for the device and for the person using the device. The purpose of an emergency switch is to help the user to intimate the emergency to the care taker.

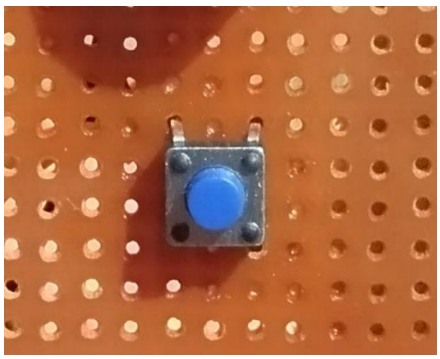

Fig 5: Emergency Switch

Buzzer:

It is a basic audio device that generates a sound from an incoming electric signal. When an object is detected by the ultra-sonic sensor a alarm sound is produced by the buzzer which informs the user about the obstacle.

Fig 6: Buzzer

V. IMPLEMENTATION

This project basically consists of sensor, controller and communication parts. The visually impaired person will be provided with the device containing switch and camera which can be used as a glass. At certain distance, camera identifies the object and spells it through the Bluetooth. It also captures the text from the images and convert it to speech. In an emergency situation, the user presses the button immediately and the alert message is sent to the care taker. In order to track the visually impaired person location we use GPS which gives the exact location.

A. Module Description

1. Image-to-speech using camera (ITSC) System design:

In order to help blind people, we have interfaced the Logitech camera to capture the image by using OPENCV tool. The captured image is converted to text using Tesseract OCR and save the text to file out.txt. Open the text file and split the paragraph into sentences and save it. In OCR, the adaptive thresholding techniques are used to change the image into binary images and they are transferred to character outlines. The converted text is read out by the espeak.

2. Object Recognition System Design:

Human beings are highly dependent on vision sensor for daily tasks such as walking, eating, finding food, searching, driving vehicle, reading book etc., object recognition is the core algorithm in most of vision related task. The approach to solve object recognition problem

is using Deep learning-based methods where a deep neural

network is designed and then train it. Deep neural network architecture can be trained in unsupervised learning where network is trained with unlabeled data and it takes very less training time. In our object recognition method, we are using convolutional neural network (CNN) and feature extraction followed by pooling stage and then the combined features vector is used to train the classifier.

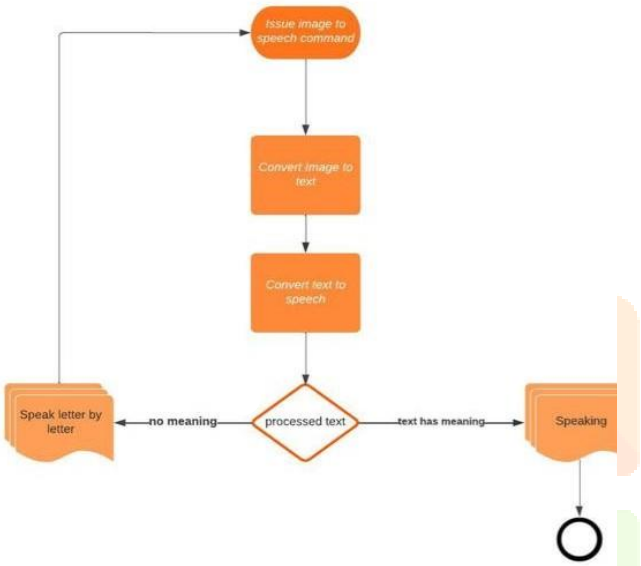

Fig 7: Image-to-speech using camera (ITSC)

Syste

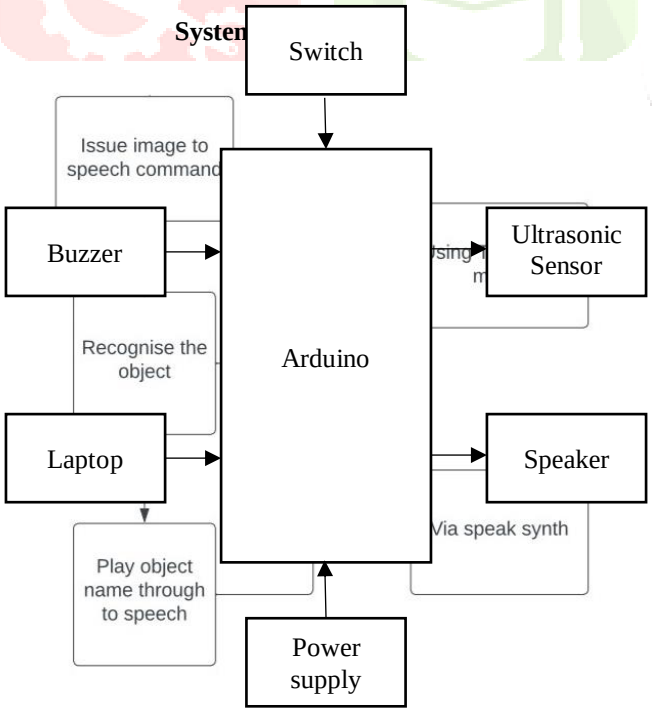

Fig 8: System design for object recognition

B. High Level Design

System design is the process of defining the architecture, components, modules, interfaces and data for a system to satisfy specified requirements. System design could see it as the application of systems theory to product development. Theory is some overlap with the disciplines of system analysis, systems

architecture and systems engineering. System design is one of the

most important phases of software development process. The purpose of the design is to plan the solution of a problem specified by the requirement documentation. In other words, the first step in solution is the design of the project.

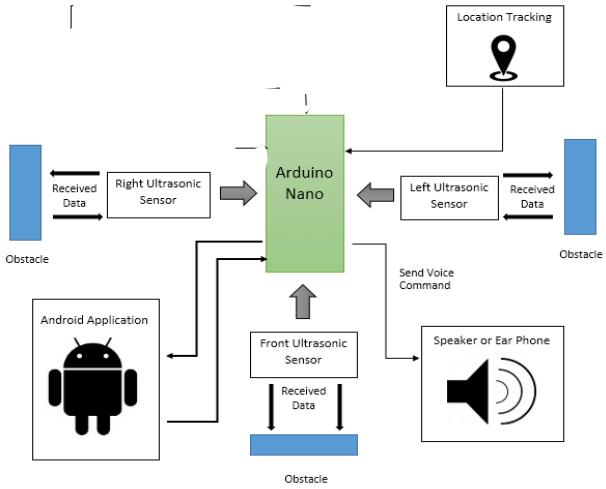

Fig 9: High level Design

VI. RESULTS

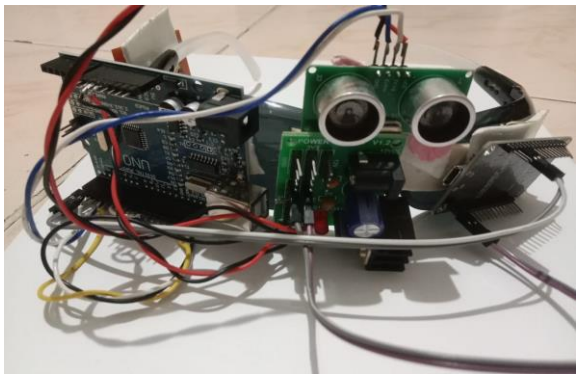

Fig 11: Prototype Model

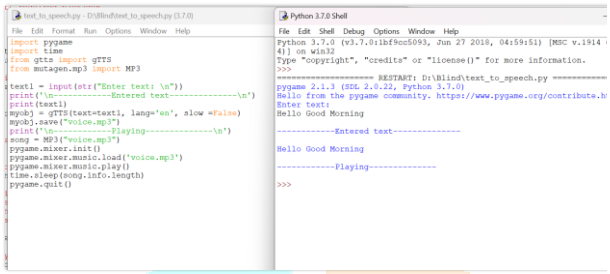

Fig 12: Text to Speech

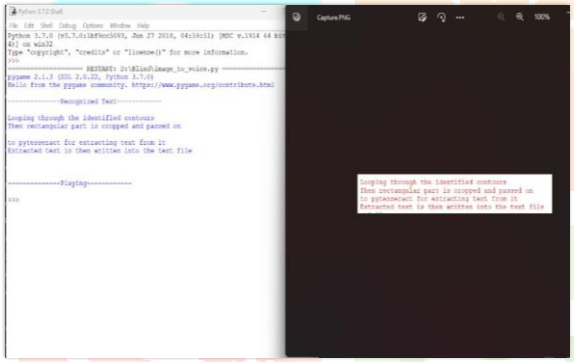

Fig 13: Image to Speech

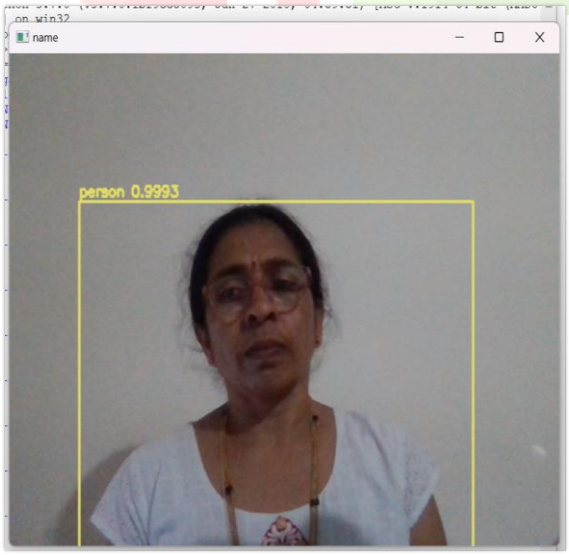

Fig 14: Person detected

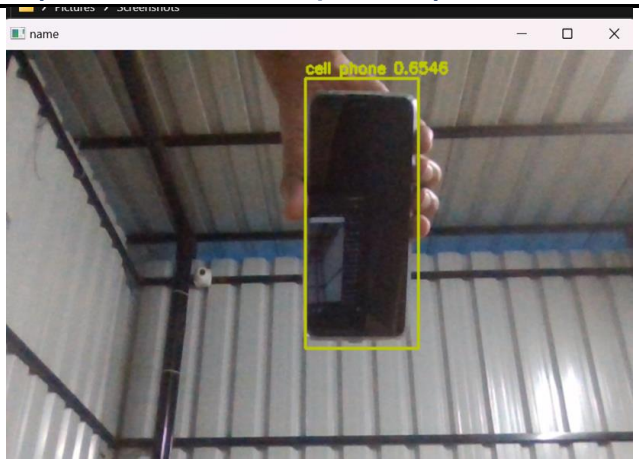

Fig 15: Cell phone detected

VII. CONCLUSION

Technology plays a very important role in day-to-day life. We use it almost everywhere and every time. The distinct and quick development that we discover each day is a proof for us that there is no point to give up and struggle with our obstacle in life. Technology offers us a lot of significant solutions to our problems. Our role is to use it properly to reach the success level that benefits individual, society and whole country as well.

By attempting to create a prototype for assisting blind people to sense the objects around them so that the probability of collisions can be reduced. More over by using more efficient and reliable components a reliable device is made which effectively visualizes the blind people. This device can used to convert text/image to voice for blind, detects objects and informs them in terms of speech. The advantage of this device is that it can be easily carried (portable) due to its less weight and size. This device can be used as smart assistant for differently abled people to communicate with others and it is a language independent system.

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