ISSN 2063-5346

An Intelligent Third-Eye for visually impaired person using Deep learning Algorithm

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Article History: Received: 01.02.2023 **Revised:** 07.03.2023 **Accepted:** 10.04.2023

Abstract

The major issues faced by the blind people is navigating from one place to another place and also lack of accessing the information from the sources like books, website or in any other form of sources . In occur of any situation, they need to be depend on others to avoid obstacles or to access the information from the sources. To rectify these problems and gain self-sufficiency, a smart stick was developed for the blind people to assist in moving from one to another location either in indoor or outdoor environments and also to access the information from the sources. In the proposed model, the smart stick consists of a floor water sensor, pi camera, GPS, and GSM module. The sensor detects the surface's moisture and notifies the blind person with the help of a buzzer. The Pi camera is capable to capture the images in both day and night time, that the captured image will be processed to extract the features using YOLO, CNN and Local Binary Pattern Algorithm. Once the device detected, the trained data set was matched with the detected substances, it will give an audio message about the type of an object or face of a person orthe amount of currency and it gives step by step instructions to the users to avoid obstacles. By using an GPS Module, the stick also give some random visual experience to the user. For a security mechanism, a GPS module is also attached. In case of any emergency situation, the location of the user and the alert message will notify the guardian through the GSM module. The proposed model majorlyprovides visual experience to the user by analyzing the surroundings in various perspective or by accessing the information efficiently. Also it detect object, currency and the face of the person. It also gives an security in an emergency situation by sending notifications to the guardian and police station.

***Keywords*:** Assistive tool, visual experience, object, currency and face detection, location tracing, accessing sources.

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DOI: 10.31838/ecb/2023.12.s1.164

I . INTRODUCTION

Visually impaired persons mean such a people who have low visual capacity.It may also be seen as visual loss that is unrecoverable with the use of glasses or contact lenses.

Vision loss is the loss of vision, whether it occurs suddenly or steadily worsens over time.The major issues with blind people is how to navigate their places. The excessive traffic on the roads and in unfamiliar regions prevents many people with severe visual impairments from travelling independently. To navigate unfamiliar places that the blind person will depends on family member or friend for support.

Safe navigation and detailed awareness in unfamiliar environments are challenging activities for blind people. Some system provides only indoor navigation, some gives only outdoor navigation which is not able to use in a sufficient environment where a visually impaired person wants indoor as well as outdoor navigation.There are different types of smart navigation system for the blind person like glass, gloves, shoes, helmets, sticks, etc…But most of the blind person is using the stick. The stick will entirely find the obstacles or moistness from the user giving little time to require any preventive measures.

The objective of the system is not to provide only navigation andsecurity but also to make blind people perceive the worldin a sufficient way and live like a normal person. Image processing is used in system to recognize various objects, persons, currency and patterns in images.

A combination of computer hardware and Software is an embedded system that designed for a specific function. By processing image and video it converts the visual data into an alternate rendering modality that will be suitable for a blind user. The motive of an GPS and GSM module to track the location and sending messages. The most of the blind people in the world are unemployed legally. Because of that, such a limited jobs only they can do. The blind stick is one of the system for blind people to make them feel safe when they walk outside as well as indoor without guardian.

II.LITERATURE SURVEY

"Smart stick with GPS navigation and sensor detection", proposed by Nurafiqah Binti Rosman. Visually impaired people are facing problems because of lack of sufficient information about the surrounding and atmosphere. And also we use GPS to track where they go and this smart stick will inform the keeper about current location. It can beable to detect the object from a further distance and they could avoid by using ultrasonic sensors. In a case of any difficult situation, using GPRS and GSM modules their family members can track the location.

"Navigation system for visually impaired people based on RGB-D Camera and ultrasonic sensor", proposed by Heba Hakim and Ali Fadhil..The navigation system utilised to recognise and categorise it as either an object or the floor had an RGB camera and ultrasonic sensors. The user is provided an auditory warning message to remind them to avoid an obstruction.

"Depth Camera based Navigation System for blind people assistance", proposed by Haider Abbs Afridi. The number of visually handicapped people nowadays is rising daily. They receive a lot of help in a variety of ways. This portable stick-based navigation device for blind persons uses a GPS, camera, and ultrasonic sensor. The obstructions are

detectable by the ultrasonic sensor within a 180 degree arc. Following detection, it warns the user via a buzzer or vibrator.

"ASSIST: Evaluating the usability and performance of an indoor navigation assistant for blind and visually impaired people", proposed by Vishnu Nair,Greg olmschenk,William H.Seiple & Zhigang Zhu. Turn-by-turn directions comparable to those given by a sighted guide are offered by the system. Blind people are alerted to the type of an object if they are within 10 feet of an obstruction or object. When they get close to an elevator, they are told to use the call button to direct it to a specific floor and use oneof its capabilities

"Navigation Aid for Blind Peoples", proposed by Samruddhi Khamgaonkar, Nikita Warkar, Arpita Vishwakarma, Siddhant Mishra,Dr. P. R. Selokar. The Serious vision impairments prevent some people from travelling on their own in foreign environments. To assist those who are visually impaired, several methods exist. With this approach, information is provided by a straightforward walking stick fitted with sensors. Furthermore connected to a security system, hitting the button sends a text message to the guardian as well as the blind person's position. It aids in alerting the carer that the blind person is in difficulty.

"StereoPilot: A Wearable Target Location System for Blind and Visually Impaired Using Spatial Audio Rendering", proposed by Xuhui Hu.A wearable visual approach module to identify objects in an environment is presented by the project. It executes the tracking algorithm used to determine the 3-D position of objects using a head-mounted RGB-Camera. It offers the BVI target position and suggests a spatial audio rendering strategy for auditory feedback. As a result, it provides a virtual environment, allowing the user to vocalise in accordance with the real surroundings to create the illusion of a target object. The user will then be motivated to follow the acoustic cues in order to receive localisation support.

"CNN-Based Object Recognition and Tracking System to Assist Visually Impaired People", proposed by Fahad Ashik. -In this project, a mobile smart system for visually challenged people is created. It delivers guidance in real time through voice processing. With the use of this device, family members may monitor the movement interface of blind or visually impaired people as they leave their homes via a web-based application. As a result, the technology aids those who are blind in visualising their surroundings and ensuring their safety. Periodically, it broadcasts the user's location to a web server.

"Analysis of Navigation Assistants for Blind and Visually Impaired People: A Systematic Review", proposed by Sulaiman Khan; Shah Nazir; Habib Ullah Khan. The project involves the creation of a navigation system for those who are blind or visually challenged. The development is used to identify various factors, such as the ability to detect objects in adverse weather, from a distance while measuring, in real-time testing, with perfection, using an eye-mask test, and many more. It offers a smart device designed for people who are blind to navigate.

"GuideCopter - A Precise Drone-Based Haptic Guidance Interface for Blind or Visually Impaired People", proposed by Felix Huppert. It gives visually impaired people access to a drone-based navigation system to support their

walking activities. The technique is used to find various objects in uncharted territory. It provides haptic feedback using a drone-based interface and navigates physically in-hand object localisation tasks in uncharted territory.

"Blind Navigation System Using Artificial Intelligence", proposed by Ashwani Kumar, Ankush Chourasia. The goal of the project is to give the superior image processing by artificial intelligence. The objects or obstacles in the image are detected using CNN image classifier, so the model gives 90% accuracy rate.

III . PROPOSED SYSTEM

The smart stick is designed to give the visual experience to the user by analyzing the surroundings in various perspective or by accessing the information from the sources efficiently. The device also assist the blind people with turn by turn instruction about the environment through voice output so they can walk easily and avoid obstacles in both day and night time using image processing techniques and special detection sensors. The proposed system also have a feature of currency detection and location tracking for a security purpose. This system uses a microprocessor, Camera board, GSM module, GPS module along with a speaker, head phones, vibrator and SMS to alert the concerned. The water floor sensor is used to detect whether any liquid substances are present in the floor. Using an Image processing techniques, it will classify the type of an objects and gives turn by turn instructions to avoid obstacles and move from one destination to other and also it classify the name of the persons and the amount of currency. As to classify and detect the objects, faces, currency in the images, YOLO, CNN and Local Binary Pattern algorithm are implemented in this model. The purpose of YOLO algorithm is to detect objects like chairs, staircases, etc. The Local Binary Pattern Algorithm is used to specify the face of certain family members and friends and convolutional neural network(CNN) algorithm is to detect the amount of currency. Once the image is detected, it will convey the object type or person's name or the amount of currency through the audio output. For security purposes, the smart stick is attached to the security mechanism. It will generate analarm sound, when the user faces any difficult situation and also the messages will be sent to the guardians and the police station along with an exact location of a person. The Smart Stick is designed to reduce the difficulties faced by blind people.

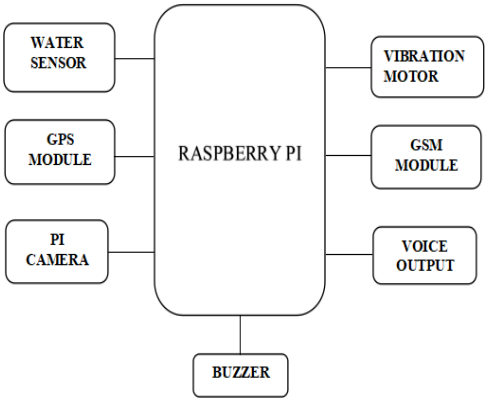

Fig. 1. System Design

IV. SYSTEM ARCHITECTURE

Once the System was started, it detects an image usinga Raspberry camera board.The pi camera is used to recognize an object or amount of currency or a person in both day and night time environment with the help of a YOLO object detection algorithm, CNN and the Local Binary Pattern Algorithm. Once the object and face was detected and matched with the trained data set, it will give an audio message about the type of an object or a person name as a reply.

The system made with a special feature to access the information, so they can educate by themselves or able to get an information from the various sources

without dependon others. The system also gives some random visual experience to the blind people. Thissystem is also coupled with special sensors like floor water sensors which is used to detect the moistness of a surface. For security purposes, the stick also has a feature of location tracking. Once the user presses the emergency button, the location of the user will be sent to the guardians and police station as an alert message through a GSM module.

FLOW CHART OF SMART NAVIGATION

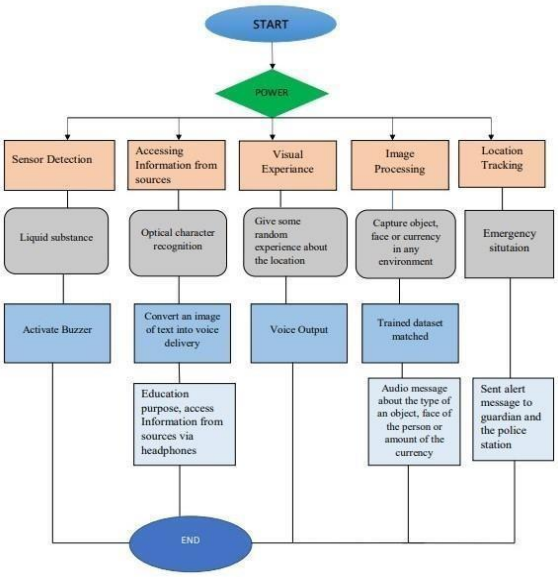

Fig. 2. Flow chart for smart navigation system

A. *RASPBERRY PI*

The Raspberry Pi is a computer the size of a credit card that can be connect to a various type of of sensors and other modules like LCD displays, servos and motors.

Fig. 3. Raspberry Pi

B. *RASPBERRY PI CAMERA BOARD*

It is an add-on module created especially for the Raspberry Pi computer hardware. A Camera Serial Interface is connected to the Raspberry Pi's hardware. The sensor's native resolution in capture mode is 5 megapixels. The capture of videos up to 1080p at 30 frames per second is supported.

Fig. 4. Raspberry Pi camera board

C. *GPS MODULE*

A satellite-based navigation system that delivers position and timing data is the Global Positioning System (GPS).Anyone having a GPS receiver and a clear line of sight to at least four GPS satellites is free to use the system.

Fig. 5. GPS Module

D. *GSM Module*

Cellular communication networks use the Global System for Mobile Communication (GSM) standard. The GSM standard is one of the most widely used cell technologies today. GSM modules provide connectivity and wireless data transmission.

Fig. 6. GSM Module

v. METHODOLOGY A.SENSOR DETECTION

The water floor sensor is used to detect the surface whether any liquid substance is present or not.

B. IMAGE CAPTURING AND

The Image was captured by Raspberry pi Camera board. It can take high-resolution photos as well as HD videos in any environment and can be fully controlled automatically. If the captured pictures and the trained pictures are similar directory, then it will give an audio output about the image as a reply.

The Captured image was identified using a YOLO, SSD and LBPH algorithm.The algorithm detects and recognize different types of objects or faces in a image.

Convolutional neural networks are used by the YOLO method to detect objects in real-time (CNN). As the name suggests, the approach only needs one forward propagation through a neural network to detect objects

A single shot detector, such as YOLO, uses only one shot to detect multiple objects in an image using a multibox. It has a much faster and more accurate object detection algorithm. The Convolutional Neural Networks used to identify the amount of currency in a efficient way .To Identify and recognize the person, Local Binary Pattern algorithm has used that transform the facial image into a numerical expression.The system also have a special feature to access the information,so they can able to get an information from the various sources. The visually impaired person get some random visual experience.

1 . YOLO (You Only Look Once) Excess Section

Several grids are used to split the image. The size of each grid is S x S.There are numerous equal- sized grid cells, and each one of them is capable of detecting items into the bounding box.

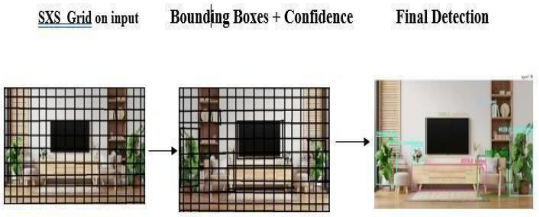

Fig. 7. Excess section

Each bounding box in the picture possesses the qualities listed below:

Height, Width (bw) (bh), Class (for example, teddy bear, cat etc) (for example, teddy bear, cat etc.) - It is symbolised by the letter C and the centre of the bounding box (bx,by) YOLO use a single bounding box regression to ascertain an object's height, width, centre, and class.

Boxes overlapping is described by the object detection phenomena known as intersection over union (IOU).In order to create an output box that perfectly encloses the items, YOLO uses IOU. Each grid cell is in charge of forecasting the bounding boxes and their confidence scores. The IOU is equal to 1 if the projected and actual bounding boxes match. With this method, bounding boxes that don't correspond to the real box are eliminated.

2. CONVOLUTION NEURAL NETWORKS

Convolution Neural Networks that share their parameters are known as covnets. Think of having an image. It can be visualised as a cuboid with its length, breadth , and height. Consider running a small neural network with, say, k outputs on a small portion of this image and

representing the results vertically. Move the neural network across the entire image, anda new image with altered width, height, and depth will appear. We now have extra channels, however they are narrower and taller than the original R, G, and B channels. Convolution is the name of this operation. If the patch's size matches the size of theregular neural networks will be usedto create the image.

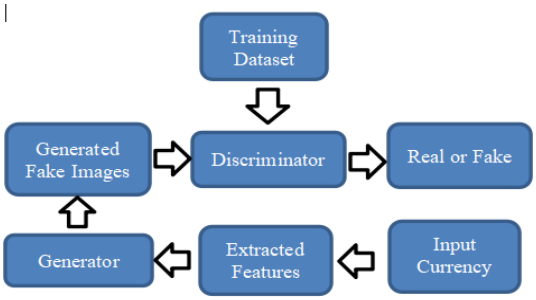

Fig. 8. Flowchart of an CNN Algorithm

This little region means that we have fewer weights. A group offilters that can be learned make up convolution layers. Eachfilter is narrow, tall, and has a depth equal to the input volume. For instance, suppose we need to perform convolution on a 34x34x3-pixel image. The size of filters may be axax3, where 'a'may be 3, 5, 7, or another tiny number compared to the size ofthe image.

Each step of the forward pass, known as stride , involves slidingeach filter across the entire input volume in a single motion.

3. LOCAL BINARY PATTERN HISTOGRAMALGORITHM

Local binary pattern is an algorithm used to identify theface.We can represent the facial photos with a straightforward data vector by combining the LBP with histograms.

LBP Algorithm employs different steps to implement, Initially, the images were trained. The initial computational phase of the LBPH is to produce an intermediate image that, by emphasising the face features, more accurately describes the original image. The method does this by utilizing a sliding windowide a depending on radius and neighbors.

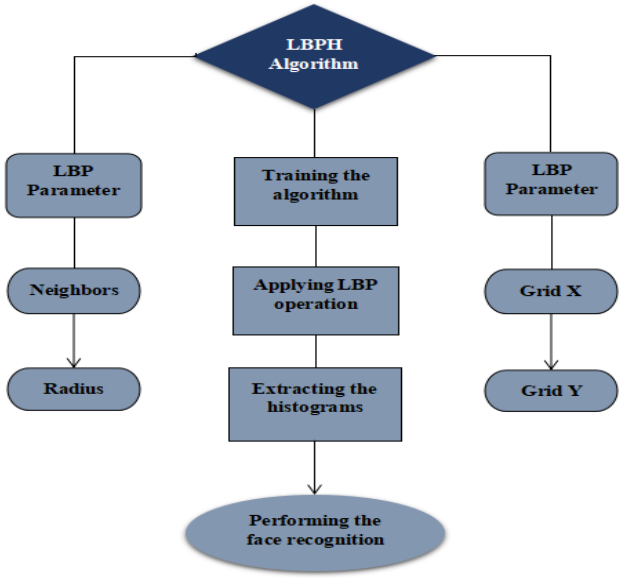

Fig. 9. Flowchart of an LBPH Algorithm

The facial photo is in gray scale.The facial picture is divided into 3x3 matrices window. A 3x3 matrix with the intensity of each pixel(0–255) can likewise be used to represent it.

The matrix's central value must be used as the threshold. The new values from the eight neighbors will be defined using the centralvalue.

For values that are equal to or higher than the threshold, we set to 1. for values that are lower, we set to 0. The matrix will now only have binary value. Each binary value from each place in the matrix must be concatenated line by line to create a new binary value.

The central value of the matrix, which is actually a pixel from the original picture, is then set to this binary value after being converted to a decimal value.After this

process, we obtain a new image that more accurately captures the qualities of the original image.

C. LOCATION TRACKING AND ALERT MESSAGES

The GPS module and the GSM Module are this module's main parts. We SMS the GPS receiver module's real-time coordinates to a mobile device using the GSM module.

A device that receives data from GPS satellites and establishes its geographic location is known as a GPS receiver module.

A tool that enables communication over a mobile network is known as a GSM module. The GSM Module needs a SIM card in order to function or register a connection with the network operator or service provider. The 16x2 LCD Adafruit library and the Daemon(GPSD) library provide data for the GPS receiver. Then, an SMS message is delivered to the selected number by the GSM module.

VI. RESULTS

The Smart Stick consists of image processing techniques, Sensor Detection, Visual experience and also location tracing.

1. The intelligent stick provides the visual experience by giving step by step guidance to navigate , some random instructions will be given about their location and accessing the any type of information from the various sources.

2. It is also capable to detect objects, faces and the currency in both day and night. In any case of any challenging situation, the guardian and the police station will be notified through SMS with an exact location.

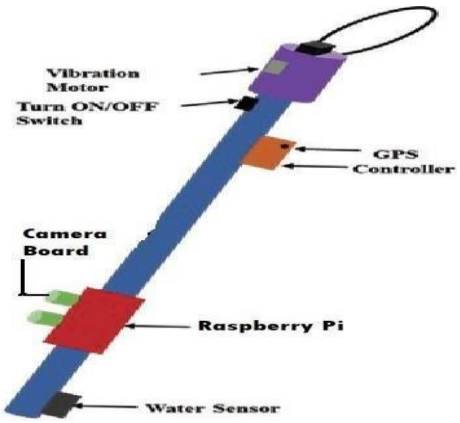

Fig. 10. Object Detection

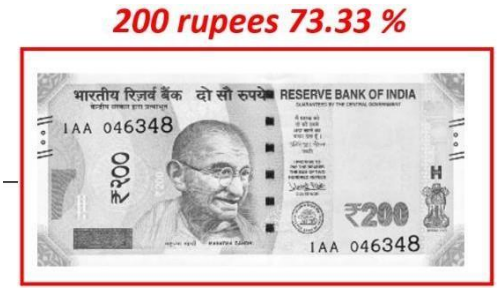

Fig. 11. Currency Detection

Fig. 12. Face Detection

TABLE 1. COMPARISON OF OBJECT DETECTION ALGORITHM

Algorithm	**Backbone**	**Size/Pixel**	**mAP %**	**fps**
SSD	VGG16	300x300	77.2	46
YOLOv2	Darknet-19	544x544	78.6	40
YOLOv3	Darknet-53	608x608	33	51
R-CNN	VGG16	1000x600	66	0.5
Faster R-CNN	ResNet101	1000x600	76.4	5
Fast R-CNN	VGG16	1000x600	70.0	7

TABLE 2. COMPARISON OF FACE DETECTION ALGORITHM

comparison	**LBPH**	**Fisherface**	**Eigenface**
Value predictionwith same face	29.32	318.59	4633.81
Smallest Value prediction with different faces	71.88	61.42	2004.2
Biggest Value prediction with different faces	367.5	2805.77	8360.78
FPS Range	6.58	1.23	0.67

VI. CONCLUSION

The Intelligent stick is designed based on image processing techniques, sensor detection along with a security system. The stick have a special feature of accessing the any type of information, so they can educate by themselves or can able to get an information from the various sources without depend on others. The system also gives some random visual experience to the blind people. It monitors obstacles, faces and the currency during both day and night time. The step-by-step instructions for obstacles avoidance will be given with an audio output which is helpful for the blind people. In the emergency situation the exact station. By implementing this system blind people will be independent and secure.

VII. FUTURE WORK

The intelligent stick does not describes about the state of an object such as dynamic/static obstacle for both indoor and outdoor navigation. Then the system equipped with android phones is the worth for exploring the routes with a high accuracy. Blind individuals often facing problems in accessing healthcare equipment's. By integrating the healthcare equipment's in the system ,they can get additional advantages.

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