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BLIND VISION-USING AI

TAMILARASAN M [1]

[1] 2nd Year M Tech Sri Siddhartha Institute Of Technology, Tumkur, Karnataka.

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Abstract - *Visually impaired people face many difficulties in their daily lives. They oftenrely on the help of others. Several techniques have been developed to help the visually impaired. Among the various technologies used to assist the visuallyimpaired, computer vision-based solutions have emerged as one of the most promising options due to their affordability and accessibility. We have proposed a system to provide wearable visual aids for the visually impaired. Its function deals with the identification of objects and helps them to cope with their daily activities ofshopping for their things and to navigate to their surroundings on their own. The Raspberry Pi is used on the OpenCV platform to implement artificial vision using the Python language. The system is portable and it can be carried as a model like an ID card and can be carried anywhere. A built-in battery connected to the system powers the device and certain sensors attached to the device detect objects and obstacles in front of blind people and alert them through vibration. It also consists of a camera module that captures and identifies the object and gives voicefeedback to blind people. With the use of this smart system, blind people can easily identify the people in front of them, and hear audio feedback with object name and theirpositions, it acts as a virtual eye for them, understands their surroundings, and helps them to survive confidently.*

Key Words: Data set, YOLO Algorithm, Blindness, Machine learning, Python

1. INTRODUCTION

1.1 VISUAL IMPAIRMENT

The organ that makes humans see the beautiful world, which is only one pair in the body that is the eyes. If the eyes have visual loss or blindness, they are improbable to get better vision even with proper medical treatment. The serious visual impairment, also known as blindness. Eyes are the gateway for what we perceive and understand, only when we are able to see something, then only we understand a thing in its totality, and we can realize and analyse situations first and foremost by seeing them through our own eyes. Blindness alters this scenario completely. A person who is blind cannot experience the world the way a normal person does. They have to put extra effort on their other senses to compensate for thelost vision in their eyes and try to perceive the world from those senses. Blindness can be caused by many causes, including injury and some illnesses, which may affectthe eyes, optic nerves, or brain. Loss of vision is the early sign of blindness. The blindness can be classified into two types. The first type is complete blindness, whichmakes the patient cannot see everything or see all the dark. The second type is the partial blindness, which gives the patient limited visibility. Visual impairment can require adaptations in the way you manage your everyday life and activities. Losingyour vision, however, does not mean that you'll have to give up your independence or any of the activities you currently enjoy. Earlier blind people use canes as mobilitytools. Nowadays we have to thank the modern technology for allowing people with vision loss to do numerous things such as to write documents, to browse on the internet and to send and receive emails. Screen Reading software and special talkingand Braille devices allows the people with no vision to use computers, cell phones and other electronic devices independently.

1.2 CHALLENGES FACED BY BLIND PEOPLE

Blind persons face a variety of visual obstacles on a daily basis, ranging from reading the label on a frozen dinner to determining whether they are at the correct bus stop. While various technologies have been launched to help solve these issues using computer vision and other sensors (talking OCR, GPS, radar canes, and so on),their capabilities are dictated as

much by the state-of-the-art in technology as by real-world human difficulties. A better knowledge of the questions that arise in blind people in their daily lives could aid in the development of solutions.

ENVIRONMENTAL CHALLENGES

People who are fully blind or have poor vision sometimes have difficulty navigating outside of their familiar environments. Physical mobility is, in fact, one of the most difficult things for blind individuals to do. It can be difficult to travel oreven walk through a congested street. As a result, many persons with limited visionprefer to navigate unfamiliar places with the help of a sighted friend or family member.

Fig.No. 1 ENVIRONMENTAL CHALLENGES FACED BY BLIND

SOCIAL CHALLENGES

Blindness can provide considerable social obstacles, mostly because some activities are difficult for blind persons to participate in. Blindness often limits a person's ability to do a variety of work responsibilities, limiting their career prospects. This could have a negative impact on their finances and self-esteem. Blindness can make it difficult to participate in activities such as sports and recreational activities outside of the workplace. This can hinder a blind person's capacity to mingle and meet new people, which can have a negative impact on theirmental well-being.

Fig.No. 2 SOCIAL CHALLENGES FACED BY BLIND

TECHNICAL CHALLENGES

It can be difficult to utilise the internet for research, recreation, social networking, or shopping if you are blind. A blind person cannot read the informationon a web page immediately. Due to total blindness, it may be required to use screen reading software to have information read out to you. Surfing the web might becomea slow and inconvenient procedure as a

result of this. Someone who is blind must rely on a description of what the picture displays instead of seeing it. Even those whoaren't blind but have poor vision may have trouble reading small fonts, interpreting icons, and perceiving the colours utilised by many websites. People with impaired vision will usually require special equipment or software to expand screen images sothey can be read.

Fig.No. 3 TECHNICAL CHALLENGES FACED BY BLIND

1.3 BLIND VISION - USING AI

There are lot of challenges faced by blind people apart from the above mentioned.One of the common problems that I noticed is that they couldn't buy their necessaryproducts on their own. Blind people always seek the help of their friends or their family members for guiding them their path. They also couldn't sense if any obstacleis reaching them at a far distance. To overcome these difficulties, I have proposed a**"BLIND VISION"** smart device which could be carried along with blind people inthe form of ID tag around their neck. The proposed system uses machine learning and artificial intelligence to have a trained AI model that contains all the basic datasets of real-world objects. The system includes a Raspberry Pi camera, and an ultrasonic sensor and a vibrator.

This device will help the visually impaired people in the following ways:

Alerts them with vibration if any object is coming close to them. Captures any object that occurs Infront of them and gives them an audiooutput about the object.

Fig. No 4 BLIND WITH SMART DEVIC

2. SYSTEM ANALYSIS

2.1 EXISTING SYSTEM

The existing system comprises of automatic invoicing for a client via RFID- based searching, which is supported by a variety of simple technologies. Instead of barcodes, RFID tags are used to label merchandise at shopping malls and supermarkets. The shopping carts come with an RFID reader, an IR sensor, and a door with a motor, a relay, a GSM module, an LED, a CLCD, a keypad, and a pushbutton. Customers are given smart RFID cards to let them identify themselves.

The IoT-based trolley can be used for the following purposes: 1) At the retail complex, automatic billing is available. 2) Provides assistance to the proprietors. There are two portions, one for the transmitter and one for the receiver. If a customer needs to purchase something, he or she should place it in the cart. The RFID scanner reads the RFID Tag placed on the merchandise as soon as it falls into the trolley. The microprocessor is attached to the RFID reader. The information obtained from the RFID reader and the data stored in the microchip's memory are cross-checked by the microprocessor.

If the data is correct, the price of the product, its name, and the total bill are displayed on the LCD. If a user wants to get rid of a product, he or she just takes it out of the cart and the LCD displays the name of the goods, the cost of the thing, and the total bill once more. The trolley comes with an ESP that does the same functions as ZIGBEE and Ethernet. ESP sends the data to the main server, which is within range. This main server has its own cloud, which allows the owner to view data from anywhere with the user ID and password.

Using the existing smart shopping system, the product is scanned by visually challenged people using RFID cards, and the audio is transformed into voice by the Raspberry Pi, which the person hears. The result is shown in the VNC viewer for their convenience. Without the assistance of others, the visually impaired person will be able to identify the grocery racks by scanning the RF tags on the racks with their RF reader module. If the person is eager to complete the shopping, he will scan the final card in the RF reader. The billing section with the total amount that has be paid, is addressed by the specific person's Raspberry Pi IP address.

As a result, for supermarkets and malls, this smart shopping trolley application produces an Automated Central Billing System (ACBS). Customers will not have to wait in line for their bill payment if they use pid (product identifier). Customers can pay their bills using credit or debit cards because their purchased product information is transmitted to the central billing system. The existing smart shopping trolley system is designed to facilitate in-person shopping and to reduce the amount of time spent in shopping.

2.2 DRAWBACKS

- It is difficult to replace RFID tags instead of barcodes for all the products.
- RFID tags are much expensive when compared to barcodes
- It does not give any alert for the visually impaired when they are in a crowded surrounding.
- The main drawback in the system is the distance barrier due to ZIGBEE which is used to establish the communication between Cart and billing counter

3 TECHNICAL DESCRIPTION

3.1 PROJECT DOMAIN ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is the simulation of human intelligence in robots that have been trained to think and act like humans. The phrase can also refer to any machine that demonstrates human-like characteristics like learning and problem-solving. The ability of artificial intelligence to rationalise and execute actions that have the best likelihood of reaching a certain goal is its ideal feature. Machine learning is a subset of artificial intelligence that refers to the idea that computer systems can learn from and adapt to new data without the need for human intervention. Deep learning algorithms allow for this autonomous learning by absorbing large volumes of unstructured data including text, photos, and video.

The simulation of human intelligence in computers is referred to as artificialintelligence. Artificial intelligence aims to improve learning, reasoning, and perception. Artificial intelligence is being employed in a variety of fields, includingfinance and healthcare. Weak AI is more simplistic and focused on a single task, whereas strong AI is capable of more complicated and human-like activities.

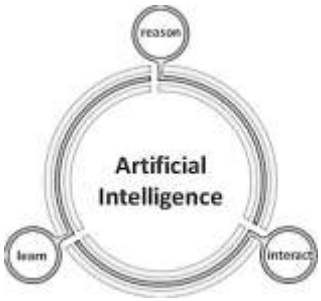

Fig. No. 5 CONCEPTS OF AI

3.2 MACHINE LEARNING

Machine learning (ML) is a sort of artificial intelligence (AI) that allows software applications to improve their prediction accuracy without being expressly designed to do so. In order to forecast new output values, machine learning algorithms use historical data as input. The way an algorithm learns to become moreaccurate in its predictions is how traditional machine learning is often classified. supervised learning, unsupervised learning, semi-supervised learning, and reinforcement learning are the four basic methodologies. The algorithm that data scientists use is determined on the sort of data they wish to predict. We have used YOLO algorithm in this system for object detection.

3.3 YOLO ALGORITHM

The term 'You Only Look Once' is abbreviated as YOLO. This is an algorithmfor detecting and recognising different items in a photograph (in real-time). Object detection in YOLO is done as a regression problem, and the identified photos' class probabilities are provided. Convolutional neural networks (CNN) are used in the YOLO method to recognise objects in real time. To detect objects, the approach justtakes a single forward propagation through a neural network. This indicates that a single algorithm run is used to anticipate the entire image. The CNN is used to forecast multiple bounding boxes and class probabilities at the same time.

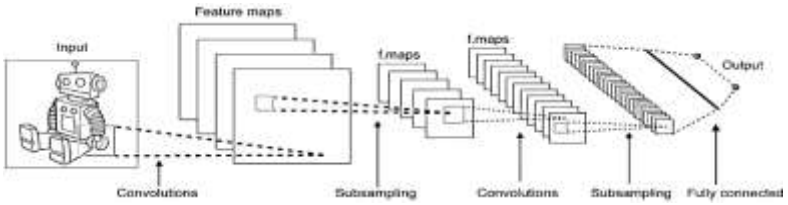

Fig. No. 6 YOLO ARCHITECHTURE

The YOLO algorithm is significant for the following reasons

Speed: Because it can forecast objects in real time, this approach enhances detectionspeed.

High precision: YOLO is a prediction technique that yields precise findings withminimum background noise.

Learning skills: The algorithm has exceptional learning abilities, allowing it to learnobject representations and apply them to object detection.

3.4 PROGRAMMING LANGUAGEPYTHON

Python is a high-level programming language that is interpreted, interactive, object-oriented, and general-purpose. Guido van Rossum designed it between 1985 and 1990. Python source code is also available under the GNU General Public License, just like Perl (GPL). This tutorial provides sufficient knowledge of the Python programming language.

Python is commonly used to create websites and applications, automate operations, and perform data analysis. Python is a general-purpose programming language, which means it can be used to develop a wide range of applications and isn't tailored to any particular problem.

Python has become a data science standard, allowing data analysts and other professionals to perform complex statistical computations, produce data visualisations, design machine learning algorithms, handle and analyse data, and perform other data-related tasks using the language.

4. METHODLOGY

4.1 IMPLEMENTATION OF THE PROJECT

The proposed system is implemented using machine learning and artificial intelligence with trained AI model that contains all the basic datasets of real-world objects. The system includes a Raspberry Pi, a Raspberry Pi camera, and an ultrasonic sensor. The system is portable, can be carried as a model like an ID card, and can be carried anywhere. A built-in battery connected to the system powers the device and attaches an ultrasonic sensor to the device to detect objects and obstacles in front of blind people. The vibration sensor attached to this device vibrates when the ultrasonic sensor detects an object in front of a blind person. When the camera identifies the object and is automatically processed by the TensorFlow API, the input image data is compared to the existing trained model and the trained model produces audio output. The smart system is classified into modules with object detection or sensing as their main aim in functioning to alert and to produce audio feedback for the blind people of what they cannot see.

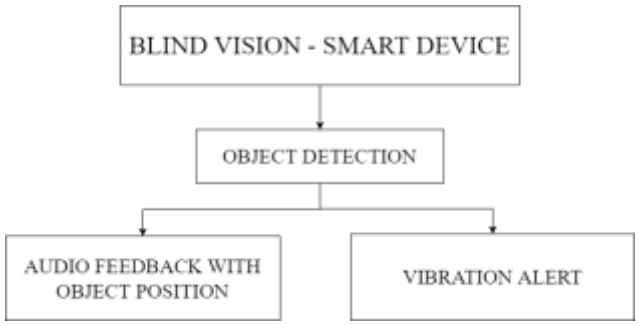

Fig. No. 7 BLOCK DIAGRAM

4.2 OBJECT DETECTION

Object detection is performed using the classifier and color-based object detection techniques when the Pi camera captures an image

Yolo algorithm: Python's open CV library has special functions for recognizing objects and provides a software package used to train a classifier for an object recognition system.

Yolo Algorithm works in the following waysResidual Blocks

The image is first separated into several grids. The dimensions of each grid are S x S. Every grid cell will detect objects that appear within them. For example, if an object center appears within a certain grid cell, then this cell will be responsible for detecting it.

Bounding Box Regression

To forecast the height, width, centre, and class of objects, YOLO use a single bounding box regression. Every bounding box in the image consists of the following attributes:

Width (bw)
Height (bh)

Class (for example, person, car, traffic light, etc.)- This is represented by theletter c.
Bounding box center (bx, by)

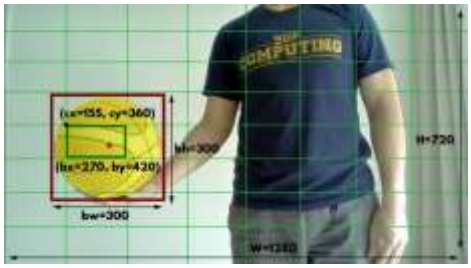

Fig. No. 8 BOUNDING BOX REGRESSION

Intersection Over Union (IOU)

The concept of intersection over union (IOU) is used by YOLO to create an output box that properly surrounds the items. If the predicted and real bounding boxes are identical, the IOU is 1. This approach removes bounding boxes that aren'tthe same size as the actual box. The red box is the predicted box while the green boxis the real box. YOLO ensures that the two bounding boxes are equal. This phenomenon eliminates unnecessary bounding boxes that do not meet the characteristics of the objects (like height and width). The final detection will consistof unique bounding boxes that fit the objects perfectly.

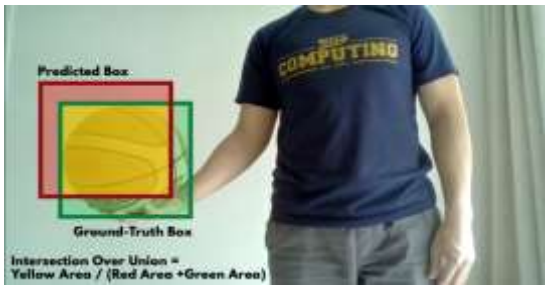

Fig. No. 9 INTERSECTION OVER UNON

VIBRATION ALERT SYSTEM

The vibration module is set in a way to alert the visually impaired people**.** Those people really suffer a lot to walk independently to their willing places. The proposed system comes with a solution to this with the help of ultrasonic sensor.

The ultrasonic sensor attached to the smart device are highly accurate in sensingand detect every small alterations in the postion. It sense the objects that are aroundthe visually impaired by transmitting and receiving signals. The length of the objectsthat shouldn't appear close to the blind person is predefined in the device. When thereceiving signals from the objects is greater than or lesser than the pre-defined length, it senses and gives a **vibration alert** automatically to the blind people thosewho are carrying our smart device. This is a continous process as it alerts the blind people until they power off their device.

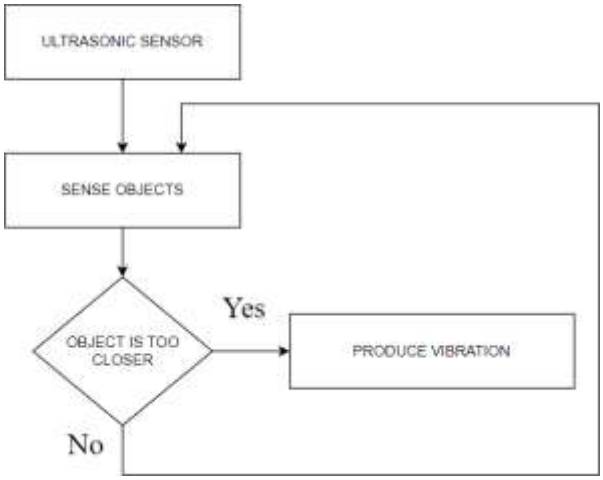

Fig. No. 10 WORKING OF VIBRATION MODULE

BLIND SHOPPING SYSTEM

Blind people often hesitate to come out as they would not be treated as same as the other human beings and they always require assistance to assist them in thingsthey do. In our proposed system, we have designed a smart system in the form of ID card holder around the neck, which could be worn by the blind people. This smart device will help them a lot when they use it for their daily activities. Let us look in detail about our solution to this scenario.

The smart device worn by the blind has a **Raspberry pi camera** which captures any images that occurs in front of them. Likely when a blind person goes into the shop for purchasing, he/she could select any product and hold them in frontof the device, the device captures the product. It then **Pre-process** the captured image using **TensorFlow API.** The processed image is compared with trained datafor proper object detection and this is quickly done using the **YOLO** algorithm. If it matches with the trained data, the corresponding trained name of the object and its exact position is heard as audio feedback through the headphones.

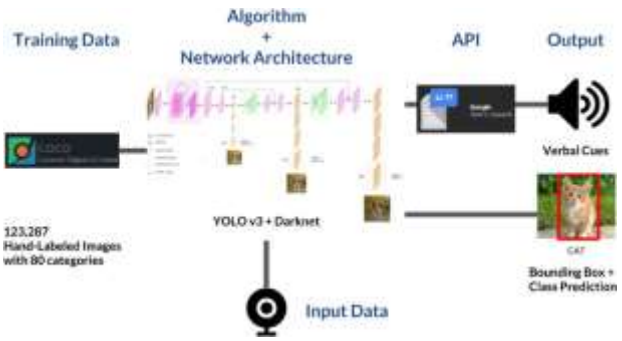

Fig. No. 11 ARCHITECHTURE OF THE SMART SYSTEM

This system could be well understood with clear picture of its architecture given in the Fig. No. The flow graph of the system for determining the position of the object after its detection is depicted below in Fig. No. Decision is made based onthe audio output given by the system.

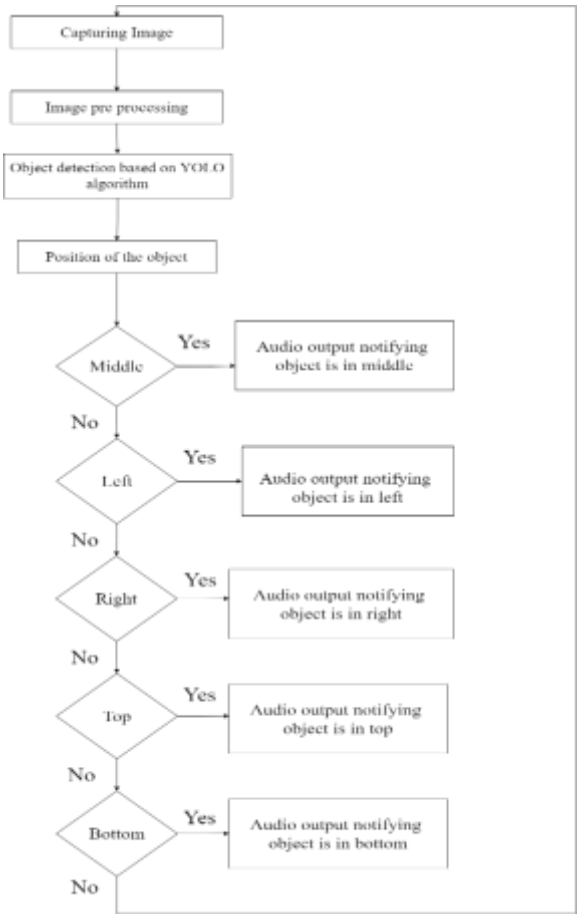

Fig. No. 12 WORKING FLOW OF PRODUCT RECOGNITION

4.3 RESULTS

The proposed system focuses on detection of objects. The system is made wearable and is portable. The system is mounted on the chest of the person in the form of ID card. The proposed system uses machine learning and artificial intelligence to have a trained AI model that contains all the basic datasets of real- world objects. The Pi camera connected to Raspberry Pi captures the images of the scene and are isolated from cluttered backgrounds to extract and this is converted into frames by the pre-processing techniques. Then if the processed image matcheswith the trained data, trained voice feedback of that object is heard as audio throughthe headphones connected to their device. Screenshots shows an object beingdetected and guiding the user whether the object is to his right, left, top, bottom or center respectively. Fig. No. shows an object (green bottle) being detected and guiding the user with its position. The system has a simple architecture and makes ituser friendly thus, making the subject independent in his/her activities. The system also aims at helping blind to navigate in his/her surroundings by detecting obstacles,locate his basic necessities, read sign boards and texts. Preliminary experiments show promising results as the user can freely navigate in his surroundings safely.

5 CONCLUSION AND FUTURE WORK

5.1 CONCLUSION

I have presented an approach for automatic detection and recognition of objects with audio feedback for the blind people. The proposed approach can robustly detect and recognise objects and text signs from the object with its position.This system gives an alert as well as audio feedback. The alert system is achieved using the ultrasonic sensor and the audio feedback of the object detected is obtainedusing high resolution Raspberry Pi camera, pre-processing technology for better object detection. The algorithm used for this system mainly relies on the fundamental feature of detecting the type of the object

even in a contrasting, uniformbackground and thus proved to have high performance and speed in detecting objectswith little computation process.

5.2 FUTURE WORK

In future we will be using different types of sensors for more accurate predication of the obstacles and to make the device solar battery operated, so the device will charge automatically when we are exposed to sun light. We are also planning to reduce the size of the device in their upcoming enhanced versions and increase the stability and performance. We will be including analytics for better understandability of the things that they are seeing and buying frequently. We couldbring out a sos button for emergency alert. It could also be connected for traceability and safety. This could also be enhanced by maintaining the history or record of the objects they have gone through till date, which would help the blind to recall their past situations

6 DATASET

person	handbag	hot dog
bicycle	tie	pizza
car	suitcase	donut
motorbike	frisbee	cake
aero plane	skis	chair
bus	snowboard	sofa
train	sports ball	potted plant
truck	kite	bed
boat	baseball bat	dining table
traffic light	baseball glove	toilet
fire hydrant	skateboard	TV monitor
stop sign	surfboard	laptop
parking meter	tennis racket	mouse
bench	bottle	remote
bird	wine glass	keyboard
cat	cup	cell phone
dog	fork	microwave
horse	knife	oven
sheep	spoon	toaster
cow	bowl	sink
elephant	banana	refrigerator
bear	apple	book
zebra	sandwich	clock
giraffe	orange	vase

backpack	broccoli	scissors
umbrella	carrot	teddy bear
hair drier	toothbrush	

7 SCREENSHOTS

Fig. No 13 SCREENSHOT OF BOTTLE DETECTED TOWARDS THELEFT AS SEEN FROM PI CAMERA

Fig. No 14 SCREENSHOT OF BOTTLE DETECTED TOWARDS THERIGHT AS SEEN FROM PI CAMERA

Fig. No 15 BLIND VISION DEVICE WITH ITS COMPONENTS

Fig. No. 16 BLIND VISION DEVICE

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BIOGRAPHIES

Tamilarasan M. He earned a B.E. in Computer Science and Engineering from Dr NGP Institute of Technology in Coimbatore, Tamil Nadu, through Anna University in Chennai in 2022. He is currently pursuing a PG in M.Tech Computer Science and Engineering at Sri Siddhartha Institute of Technology in Tumkur, Karnataka, through Sri Siddhartha Academy of Higher Education in Agalakote, Tumkur, Karnataka in 2024. I published papers in international journals. He can be contacted at email: tamilarasan072001@gmail.com.