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Visually Simplify -An IoT Based Application for Visually Impaired

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ABSTRACT: This project investigates methods and procedures to construct an efficient system to assist visually impaired individuals in their everyday life. In particular, various technologies that can be utilized to build a wearable system are examined. The machine vision and the communication component of the blind navigation and guidance is designed not only to map the surroundings environment but also to determine a safe path to a desired destination. This work highlights the importance and also provides the instructions to blinds for efficient navigation and safe guidance by incorporating object/pedestrian in real-time. In this project, Object recognition is done by the Pre-trained model MobileNet for recognizing the object with more than 95% accuracy. The model is trained with millions of images to recognize the objects like cars, buildings. It can also recognize different individuals based on an existing database. Raspberry Pi interfaced with an open CV library is used. USB camera is interfaced with Raspberry Pi to monitor the objects, and a headphone is provided for output.

KEYWORDS: Image Recognition, Convolutional Neural Networks, Machine Vision, MobileNet

I.INTRODUCTION

India has an estimated 6.2 crore visually impaired people and more than 90 percent of them have no access to necessary technologies required for visual assistance. A smart tool that assists the visually impaired and helps them in recognition and real time object detection.

The existing system uses object recognition algorithms like SIFT(Scale Invariant Feature Transform) and SURF(Speeded Up Robust Feature).

SIFT algorithm works on a set of reference images where it extracts key points of a given object. Recognition is done by individually comparing each feature from the new image to the database and finding a proper match based on Euclidean distance of the feature vectors.

SURF algorithm works on integrator approximation of the determinant of Hessian blob detector. It is computed with 3 integer operation using a precomputed integral image.

The shortcomings of these algorithms include time consumption, i.e., these algorithms consume a lot of time to segregate the images, these algorithms are not suited for low power devices.

The proposed system uses MobileNet Algorithm which overcomes the shortcomings of the previous algorithms. The model works on IoT application integrated on a Raspberry Pi device which runs a MobileNet code for image recognition and segregation.

Ultrasonic sensors are present which helps in guiding and navigating the user smoothly on a congested space.

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II.DESIGN

Embedded System is used for dedicated functions with real time computing constraints that are able do perform various tasks depending upon the programming. The proposed model is also an implementation of Embedded System, dedicated to the task of image recognition, image segregation and identification.

The software is implemented with convolutional neural network, a deep learning algorithm. MobileNet is a framework using depthwise seperable convolutions for image recognition.

The MobileNet framework imports various libraries including Keras which is a Python interface for artificial neural networks, NumPy is also used which is an open source data analysis python library.
The hardware device is a Raspberry Pi board, which has a considerable computing power in a compact package.

Fig 1 Raspberry Pi

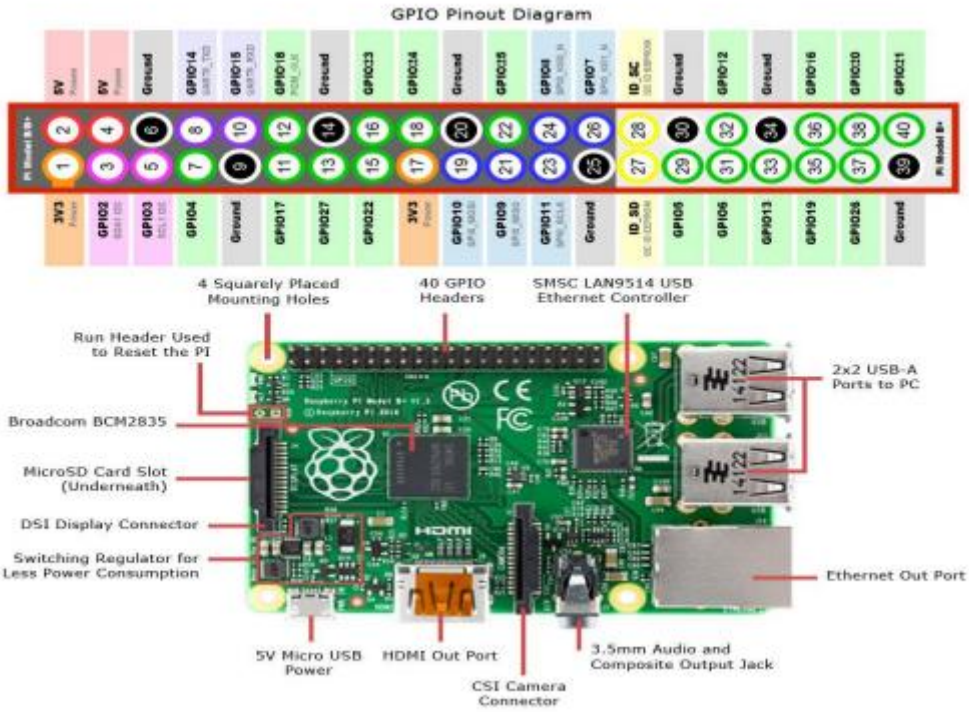

Fig 2 Pin Assignment

III.PRPOSED SYSTEM

The proposed system is an embedded system model with an IoT based core programmed with Convolutional Neural Network. A pre-trained model with MobileNet architecture is used in the system.
The system works on real time recognition and the presence of a huge database makes it highly accurate.

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The pre-trained deep learning model has an accuracy of 90% and can be customized to recognize objects faster with every iteration by Transfer Learning model.
The MobileNet algorithm reduces the number of parameters required to identify the object making it faster and less time consuming. Thus this system is well suited for vision-based application, consuming low power and low memory.

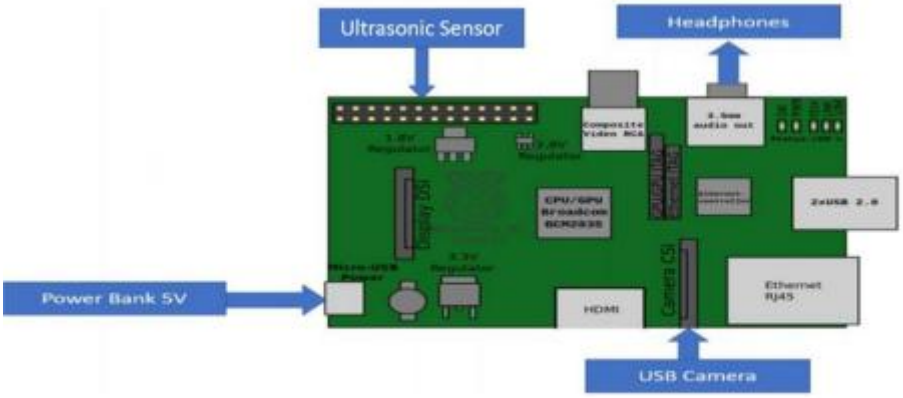

Fig 3. Block Diagram of proposed system

The Raspberry Pi used for image classification and recognition is a third generation Raspberry Pi model. A portable camera is connected to the CSI port which enables the system to monitor its surroundings and a headphone is connected with the controller as an output device. The whole system is powered by a 5V external power source.

IV. EXPERIMENTAL RESULTS

The real time object detection code is developed using python.

```
# USAGE
# python real_time_object_detection.py --prototxt MobileNetSSD_deploy.prototxt.txt --model MobileNetSSD_deploy.caffemodel

# import the necessary packages
from imutils.video import VideoStream
from imutils.video import FPS
import numpy as np
import argparse
import imutils
import time
import cv2
import subprocess
import RPi.GPIO as GPIO

GPIO.setmode(GPIO.BCM)
GPIO.setwarnings(False)
# construct the argument parse and parse the arguments
ap = argparse.ArgumentParser()
ap.add_argument("-p", "--prototxt", required=True,
        help="path to Caffe 'deploy' prototxt file")
ap.add_argument("-m", "--model", required=True,
        help="path to Caffe pre-trained model")
ap.add_argument("-c", "--confidence", type=float, default=0.2,
        help="minimum probability to filter weak detections")
args = vars(ap.parse_args())

# initialize the list of class labels MobileNet SSD was trained to
# detect, then generate a set of bounding box colors for each class
CLASSES = ["background", "aeroplane", "bicycle", "bird", "boat",
        "bottle", "bus", "car", "cat", "chair", "cow", "diningtable",
        "dog", "horse", "motorbike", "person", "pottedplant", "sheep",
        "sofa", "train", "tvmonitor"]
COLORS = np.random.uniform(0, 255, size=(len(CLASSES), 3))

# load our serialized model from disk
print("[INFO] loading model...")
net = cv2.dnn.readNetFromCaffe(args["prototxt"], args["model"])

# initialize the video stream, allow the cammera sensor to warmup,
# and initialize the FPS counter
print("[INFO] starting video stream...")
vs = VideoStream(src=0).start()
# vs = VideoStream(usePiCamera=True).start()
```

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```
        cv2.imshow("Frame", frame)
        key = cv2.waitKey(1) & 0xFF

        # if the `q` key was pressed, break from the loop
        if key == ord("q"):
                break

        # update the FPS counter
        fps.update()

# stop the timer and display FPS information
fps.stop()
print("[INFO] elapsed time: {:.2f}".format(fps.elapsed()))
print("[INFO] approx. FPS: {:.2f}".format(fps.fps()))

# do a bit of cleanup
cv2.destroyAllWindows()
vs.stop()
```

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Fig 4 OpenCV Python Code

The OpenCV python model is implemented using the above code that is able to work for image classification and real time object detection.

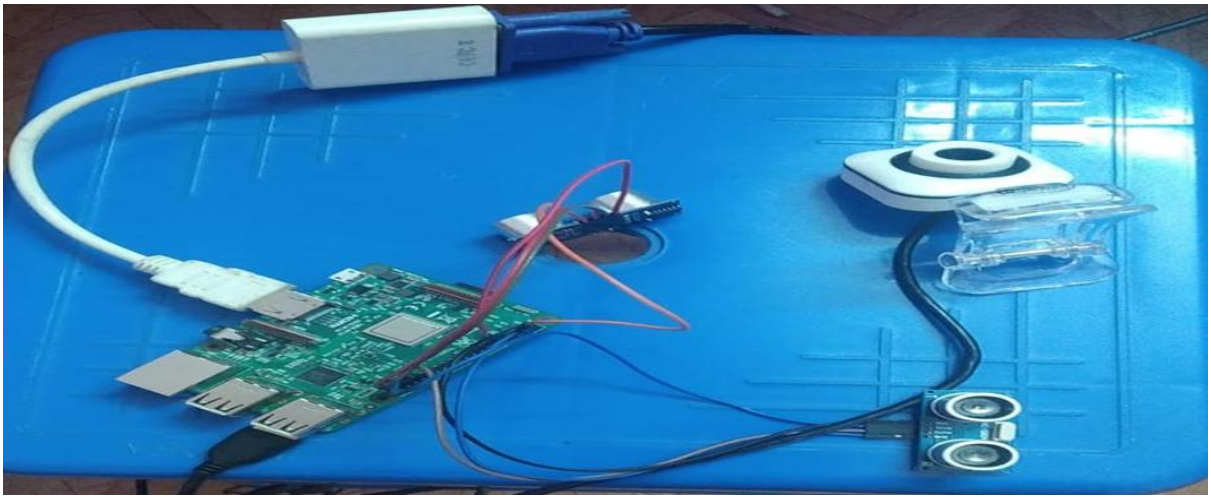

Fig 5 Real Time Model

The final model is built and experimented on. With the use of MobileNet Algorithm its able to recognize different images and real time scenarios. Its also able to recognize different individuals.
The Raspberry Pi has a booting time of around 10 seconds and it takes a response time of about 1-3 seconds given that the image quality is at par.
Thus, it can be inferred that under ideal conditions the system gives fast and accurate results.
At the beginning of a new loop the system overwrites the image, text and audio response for previous loop, and by doing so it helps boost the memory of the system.
The ultrasonic sensors used are able to send warning to the user for any obstruction within a range of 3 feet.

V. CONCLUSION

The model is able to perform image recognition and obstruction detection with the help of Raspberry Pi controller and is able to help visually impaired people.
A deep-learning model with a pre trained MobileNet model is able to achieve this function.
The system is cheap and easy to configure. Its user friendly and does not require any special operational skills.

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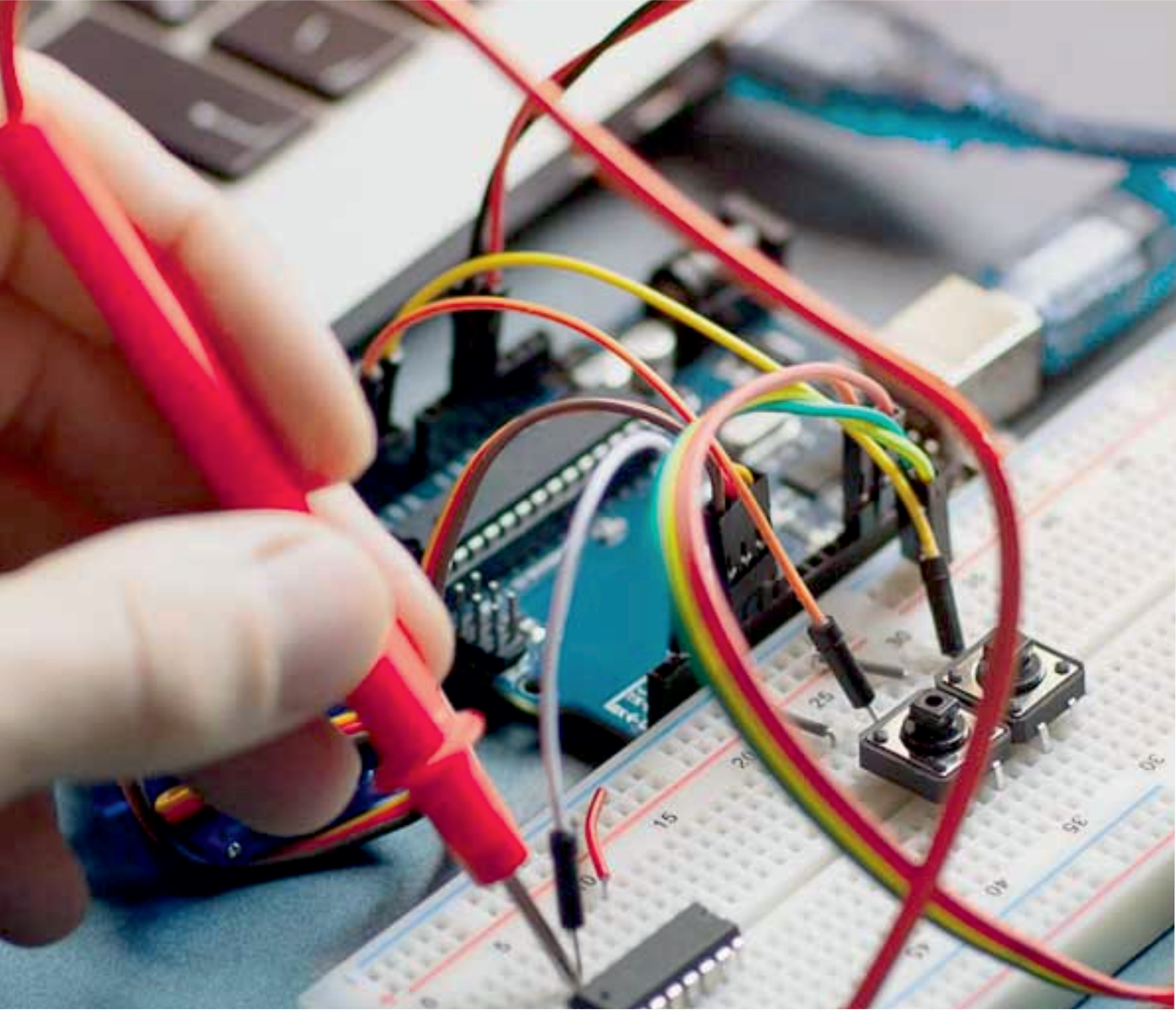

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