Helping Hand

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Raspberry pi Object Detection With Voice Response For Aiding The Blind

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Abstract: There are about 253 million people in the world living with visual impairment, of which about 36 million are blind. 217 million people have moderate to severe vision impairment. It is very important to consider the difficulties of visually impaired people to help them perform with their daily activities. Through sensation, these people identify and understand the obstacles. Proposed is a device for identifying obstacles, in a cost-effective manner. In this device, the identification is carried out based on object detection. The object recognition is done using the concept of Convolutional Neural Network. The device is able to identify the objects with adequate accuracy.

Keywords: Machine Learning; Image Processing; Open CV; Python; Raspberry Pi.

1. Introduction

Blindness is a problem that afflicts millions of people everywhere. When performing everyday routine work, blind people may face many types of difficulties. Even in their own homes, they must exhibit efforts to navigate from one place to another and to locate objects. So visual impairment can affect one's ability to function independently, to perform day-to-day activities of life and to travel safely. According to the World Health Organization (WHO), 253 million people in the world live with visual impairment, out of which 36 million of them are blind and 217 million people have some form of vision impairment. Though canes for visually impaired people help them to avoid obstacles on their way, that don't help to identify the type of object and to locate them. Hence identifying the object will be of great help for them.

Due to the difficulty in getting visual information, in many circumstances blind people seek the help of others. Several technologies have been developed to assist visually impaired people. Among the various technologies, due to their affordability and accessibility computer vision-based solutions are emerging as one of the most promising options. This paper proposes an assistive system for visually impaired people and the main idea behind this is to create a handheld device that detects and identifies the surrounding objects and notify the user with an audio message. This will help people with vision problem to carry out daily activities without much external help.

Real time object detection: In first stage real-time objects are detected. It inputs real time video, which contains a lot of objects and outputs the detected objects.

Convert output to audio: In this stage it produces an audio output of the detected object. Real time detected object is given as the input and it outputs the corresponding audio.

2.Design and Implementation

System takes video as input and uses a sensor to calculate the distance and provides feedback to user as audio. Through pi camera real time video is captured and converted into different frames. These frames are fed to Convolutional Neural network. Camera pooled with Raspberry Pi is used for object identification.

Raspberry pi: The Raspberry Pi is a low cost, small sized computer that can be connected to a computer monitor or any other external display and also with the mouse and keyboard via USB. This device is capable of computing and programming languages like C and Python. The device is powered by 1.4GHz 64-bit quad-core ARMv8 CPU and 1 GB of RAM. The same device also includes on board Wi-Fi and Bluetooth, 40 pin GPIO, 4 x USB ports, composite video and HDMI port, Micro SD port and Micro USB power source.

Pi camera: The Pi's camera module is a add-on for Raspberry Pi. It is attached to one of the sockets on the upper surface of the board. It has a dedicated CSI-2 interface, which facilitates the connection for small camera module. 5 MP Pi camera is used to take high resolution video and the output is fed to Raspberry Pi for further processing.

Open CV and Python: OpenCV is an open-source computer vision library used for image processing, computer vision and machine learning.

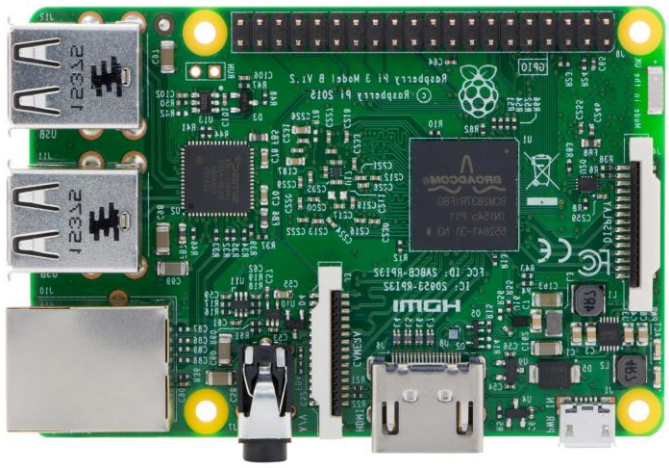

Fig 1. Raspberry pi 3B

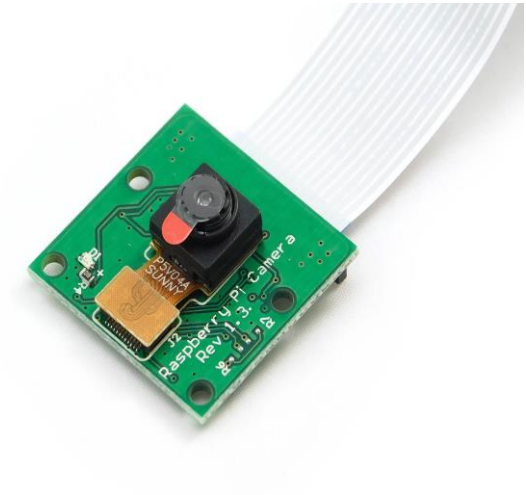

Fig 2. Pi camera

3.Code sample

```
import cv2
import numpy as np
from gtts import gTTS     #internet
from io import BytesIO
import pygame
import time
pygame.init()
pygame.mixer.init()
```

Imports and initialization

```
def say(text) :
    tts=gTTS(text, slow=True)
    tts.save("hello.mp3")
    pygame.mixer.mu-
sic.load("hello.mp3")
    pygame.mixer.music.play()
```

TTS (text to speech)

```
model = cv2.dnn.readNet (model='frozen_inference_graph.pb', config='/home/admin/Desktop/Object_Detec-
tion_Files/ssd_mobilenet_v3_large_coco_2020_01_14.pbtxt', framework='TensorFlow')
```

Used model and frameworks for the code

```
cap = cv2.VideoCapture(0)
frame_width = 320
frame_height = 240
cap.set(3,frame_width)
cap.set(4,frame_height)
out=cv2.VideoWriter('video_result.mp4'      ,
cv2.VideoWriter_fourcc(*'mp4v'),                30,
(frame_width, frame_height))
```

Utilized resolution of camera (higher the resolution lower the fps and higher the accuracy of detection)

```
blob = cv2.dnn.blobFromImage(image=image, size=(150,150), mean=(104,117,123), swapRB=True)
```

Image fed to the model

```
for detection in output[0,0,:,:] :
    confidence = detection[2]
    if confidence>.6 :
        class_id =detection[1]
        class_name=class_names[int(class_id)-1]
        color =COLORS[int(class_id)]

        box_x =detection[3]*image_width
        box_y =detection[4]*image_height
        box_width =detection[5]*image_width
        box_height =detection[6]*image_height
        cv2.rectangle(image, (int(box_x), int(box_y)), (int(box_width), int(box_height)),color,thickness=2)
        cv2.putText(image,class_name, (int(box_x), int(box_y -5)),cv2.FONT_HERSHEY_SIMPLEX, 1, color, 2)
        cv2.putText(image, f"{fps:.2f} FPS", (20,30), cv2.FONT_HERSHEY_SIMPLEX, 1, (0,255,0), 2)
        say(class_name)

cv2.imshow('image',image)
```

Saying image class and showing the end result (main for loop)

4.Result

The statistical measures such as precision, recall and accuracy are used to analyze the detection process. The Proposed system focuses on identification of objects and convert it into audio. The system is efficient, user friendly and portable. The real time video is captured using the pi camera module which is connected to raspberry pi and converted into frames. The object is detected from the real-time video and provided as Audio output to the user. The detected object is displayed as Label with the Accuracy of Detection. This Label is converted to audio and provide that as output to the user. This makes them aware of the object before them.

Fig 3. Form factor of the proposed device

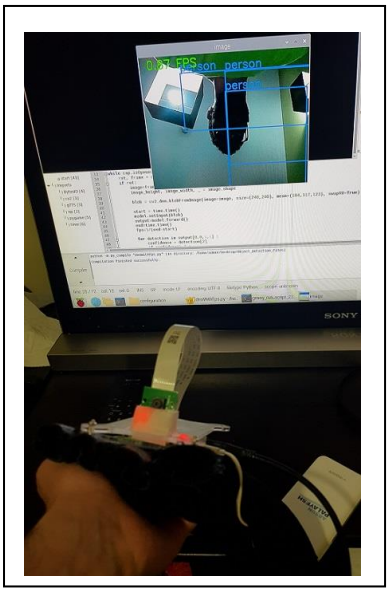

Fig 4. Detected Person by the device

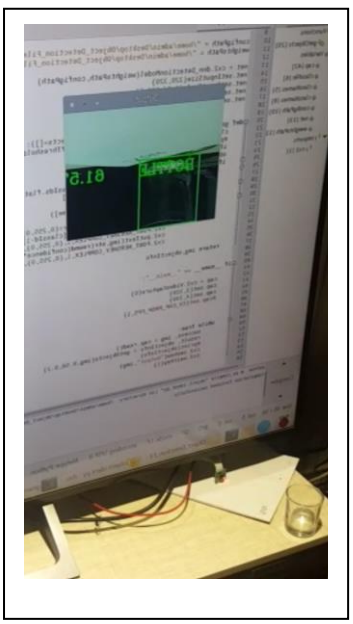

Fig 5. Detected Bottle by the device

5.Conclusion

This paper describes a low-cost handheld device for aiding blind people. Equipped with deep learning techniques, this device provides audio feedback to the user regarding the objects detected. Results shows that using Fast-RCNN technique is efficient for object detection as compared to other mechanisms and can easily be used by deaf people. For this Fast-RCNN is compared with SVM and DNN based techniques.

6.Refrenses

- **Tacit Project : https://gist.github.com/Grathio/1175994**
- **Third Eye for the Blind : https://www.hackster.io/muhammedazhar/third-eye-for-the-blind-8c246d**
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