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IMAGE PROCESSING BASED INTRUDER DETECTION USING RASPBERRY PI

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ABSTRACT

The current paper is mainly about maintaining a secure environment and also free from thefts that are happening in our home. The present paper discusses about the detection of intruders with the help of the various devices and software.. OpenCV(open source computer vision) is the major software that is being used in our present work. For detecting faces we are using various algorithms like Haar cascade, linear SVM, deep neural network etc. The main method that we have proposed in our work is, if any person comes in front of the pi camera, first it will look for potential matches that we have already stored in our system If the module finds a match then it continues to record until any intruder comes. If the face is not recognized then the unknown person's face will be captured and a snap shot will be sent to the user's email. The device is developed using Raspberry Pi b+ with 1.4 GHz quad core processor, raspberry pi camera module and a Wireless dongle to communicate with user's email.

Key Words: OpenCV, Rassberry pi, python

I INTRODUCTION

Open source computer vision(OpenCV)is a software that is used to process various images and convert it to the required format that the user needs. OpenCV includes a statistical machine learning library that contains some of the algorithms like SVM(support vector machine),DNN(deep neural network) etc. This paper presents a robust approach for Face detection and also providing security to the people who will be staying alone in the house. Device will be tested on a raspberry pi platform.The Raspberry Pi is a basic embedded system and also a low cost single board computer used to reduce the flaws in systems. Python is the major scripting language that has been implemented in our device. Raspberry pi consist of Camera slot Interface (CSI) to interface the raspberry pi camera.The Pi is initially connected to the internet through wireless dongle. The OpenCV software is installed using the following command lines. Following steps are to be followed:

1.first step is to install cmake library, which helps us build the OpenCV build process.
2. Second step is to install the OpenCV files from github and also extracting it.
3. Third step is to run the make command, which will install all the required dependencies.
4.Final step is to test whether OpenCV is installed in our Pi by running some commands.

The Device is set up as shown in Figure. 1a. The Picam is focused manually towards the persons face. It looks for a potential match using the counting system. If the persons face is found then his or her name will pop up. If the persons face is not detected then that persons face will be captured and a copy of it will be sent to the users email. We have a set a timer for about ten second. Between this time interval if any intruder comes then his face will be stored in the system for further investigation and also a photo of the intruder will be sent to the email of the user.

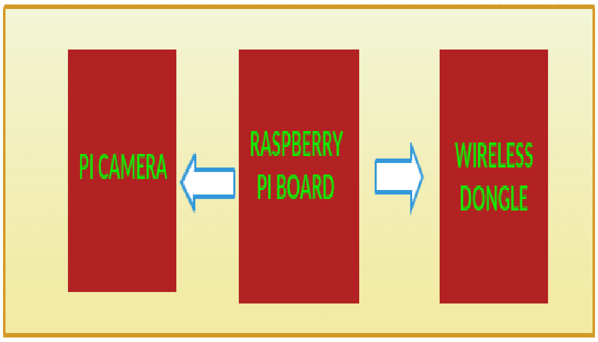

Fig. 1aBlock diagram of Image processing based Intrusion detection.

II BASIC CONCEPT OF FACE DETECTION

In general, any digital image processing algorithm consists of three stages: input, processor and output. In the input stage image is captured by a camera. It sent to a particular system to focus on a pixel of image that's gives, its output as a processed image. This processed image is then used to translate after extracting the text from the image through OCR.

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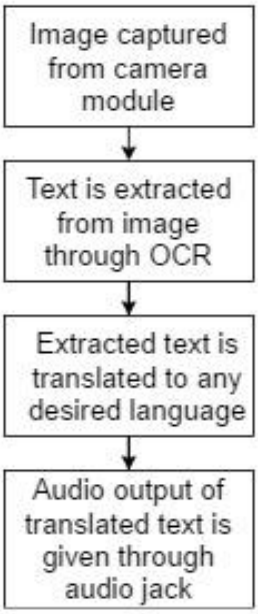

Fig. 1b. Procedural flow of image processing based translation

III SYSTEM HARDWARE DESIGN

The Raspberry Pi board is the central module of the whole embedded image capturing and processing system as given in figure. 2. Its main parts include: main processing chip unit, memory, power supply HDMI Out i.e. VGA display, Ethernet port, and USB ports. The webcam is connected to Raspberry pi through one of its USB ports and pushbutton switch S1 to its GPIO pin 16 (or GPIO23) through resistor R2 (1-kilo-ohm)

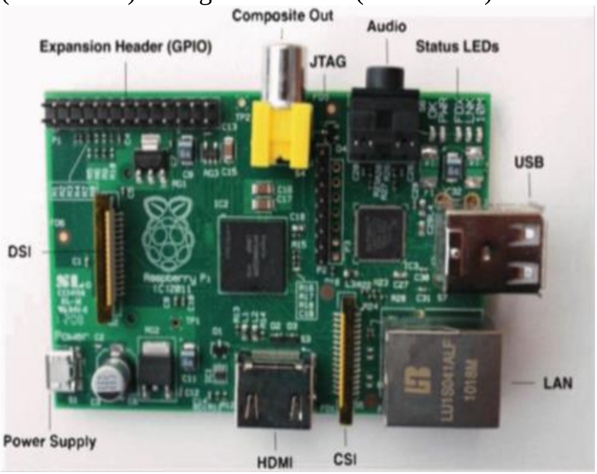

Fig. 2: Raspberry Pi board (Model B+).

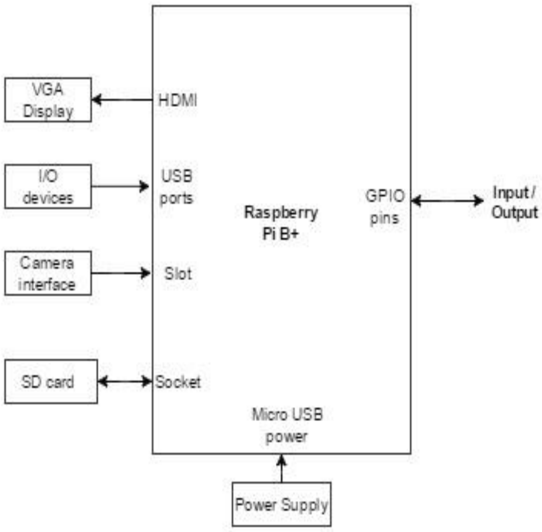

Fig. 3: System Block Diagram

A. *Raspberry pi board*

The Raspberry Pi is a basic embedded system having a credit card-sized single board computers developed in the UK by the Raspberry Pi Foundation [2]. The Raspberry Pi is based on the Broadcom BCM2835 system on a chip (SOC) which includes an ARM1176JZF-S Core (ARM V6K)700 MHz CPU processor, Broadcom Video Core IV GPU having 17 pins, 3.5W of power, and 512 MB of RAM memory. This main processing chip connects a camera and display. The Raspberry Pi design does not include a built in hard disk or solid state drive, instead used an SD card for booting and long term storage. This board is intended to run Linux Debian based operating systems. Python is used as main programming language for raspberry pi .This Raspberry Pi module has a Samsung class 4 micro SD card preloaded with the Raspberry Pi NOOBS (New out of Box Software) package, and a printed Micro SD card adaptor.

B. Camera interface

The camera module used in this paper is raspberry pi camera module as shown in the Figure. 3. The camera module plugs to the CSI connector on the Raspberry Pi. It's able to deliver clear 5MP resolution image, or 1080p HD video recording at 30fps. The camera module attaches to Raspberry Pi by a 15 pin Ribbon Cable, to the dedicated 15 pin MIPI Camera Serial Interface (CSI), which was designed especially for interfacing to cameras. The CSI bus is capable of extremely high data rates, and it exclusively carries pixel data to the BCM2835 processor.

Fig. 4: Raspberry Pi camera board

C. Pushbutton switch set up

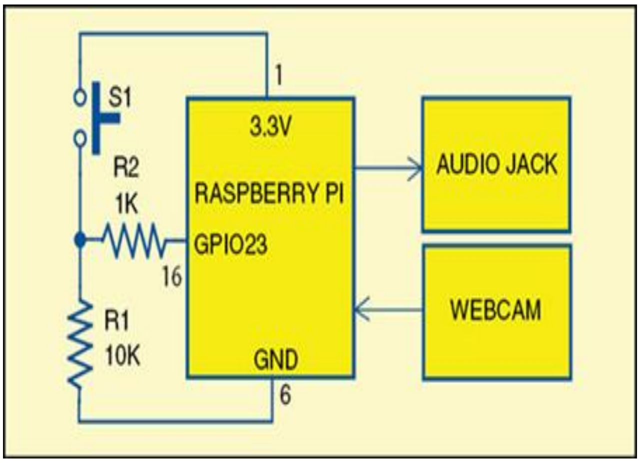

Fig.5 Circuit connection to Raspberry pi board.

In Figure.5, When the GPIO pin is set as input, it is floating and has no defined voltage level, to detect whether the input is high or low, simple resistive circuit is needed so that it is always connected and reads either high or low voltage. One of the terminals of switch S1 is connected to ground (GPIO pin 6) through pull-down resistor R1 of 10 kilo ohm. The other terminal is connected to 3.3V of GPIO pin 1.When S1 is pressed, a high voltage is read on GPIO pin 16. When S1 is released, GPIO pin 16 is connected to ground through R1, hence a low voltage is read by GPIO pin 16.When pushbutton S1 is pressed, the webcam takes a picture of the text (after a delay of 10 seconds).

IV METHODOLOGY

The device consists of two main modules, the image processing module and translator module (Figure.6). Image processing module captures image using camera, converting the image into text. Translate module translates the text into any desired language and processes it with specific physical characteristics so that the sound can be understood. Figure 6 shows the block diagram of the device, 1st block is image processing module, where OCR converts .jpg to .txt form. 2nd is voice processing module which translates and gives .txt to speech output.

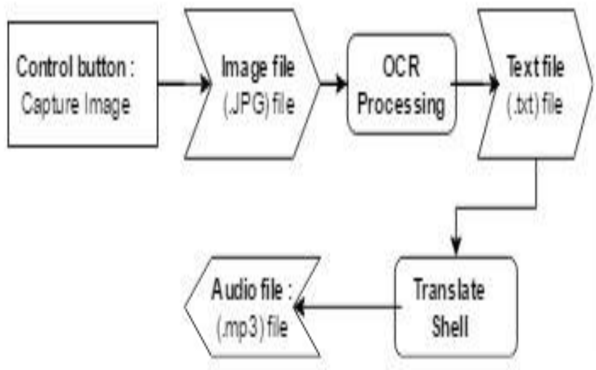

Fig.6 Image processing and translator modules

Figure 6 shows the block diagram of the device, 1st block is image processing module, where OCR converts .jpg to .txt form. 2nd is translate module which translates the text and gives audio output.

IV.(i) IMAGE PROCESSING MODULE USING OPTICAL CHARACTER RECOGNITION

OCR is important element in this module. OCR or Optical Character Recognition is a technology that automatically recognize the character through the optical mechanism, this technology imitate the ability of the human senses of sight, where the camera becomes a replacement for eye and image processing is done in the computer engine as a substitute for the human brain [3]. Tesseract OCR is a type of OCR engine with matrix matching [4]. The selection of Tesseract engine is because of its flexibility and extensibility of machines and the fact that many communities are active researchers to develop this OCR engine and also because Tesseract OCR can support 149 languages. In this project we are identifying English alphabets. Before feeding the image to the OCR, it is converted to a binary image to increase the recognition accuracy. Image binary conversion is done by using Image magick software, which is another open source tool for image manipulation. The output of OCR is the text, which is stored in a file (speech.txt) .Machines still have defects such as distortion at the edges and dim light effect, so it is still difficult for most OCR engines to get high accuracy text [5]. It needs some supporting and condition in order to get the minimal defect.

a.Tesseract OCR Implementation

The input image is captured by the 5 megapixel fixed focus raspberry pi camera which supports 720p60, 1080p30 video modes. Based on the specifications of the Tesseract OCR engine, the minimum character size that can be read is 20 pixels uppercase letters. Tesseract OCR accuracy will decrease with the font size less than 14pt.

b.Software Design

Software processes the input image and convert it into text format. Then the text is translated into any desired language. The software implementation is showed in Figure. 7.The image is taken by the user via GPIO pin (23) that is connected to the button, using interrupt function. Furthermore, the picture can taken by using raspistill program with sharpness mode to sharpen the image. The resulting image has a .jpg format with a resolution of 720 x 340 pixels.

c. The Translate Module

In this module text is converted to text of desired language. The output of OCR is the text, which is stored in a file (speech.txt). Here, Translate Shell software is used to convert the text to translated speech output. Translate Shell is an open source translate (TTS) system, which is available in many languages. In this project, English TTS system is used for reading the text.

V. DESIGN IMPLEMENTATION

The testing was done using Raspberry Pi platform with the following specifications:

• SBU Raspberry Pi 2 900 MHz Quad Code ARM Cortex-A7
• 5mp Raspberry pi b+ camera module
• Bootable SanDisk Ultra 8GB micro SD Card

Steps Followed:

1. Import and Initialization:

Import sub process, time and RPi. GPIO and initialize GPIO pin 23 as input.

2. Main Program:

The main program [6] provides functions to retrieve and process the input image, translate it and convert it into an audio signal. Picture will be taken as soon as push button switch is pressed then this Captured image is threshold before feeding it to OCR to increase the accuracy. The text from the captured image is extracted. The extracted text is translated to desired language and given out as audio signal. Overall flow of program is done as in flowchart fig 7.

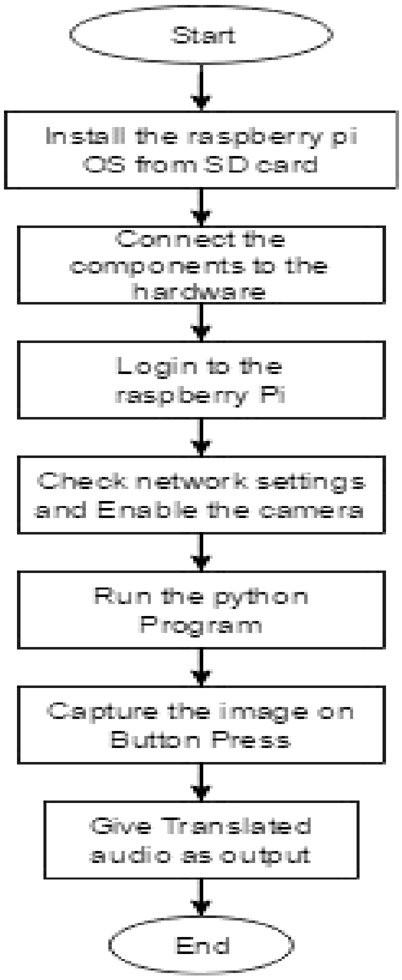

Fig.7 Flow chart of Image processing based translator device program

Screenshot Program execution for english to spanish translation is shown in figure 8

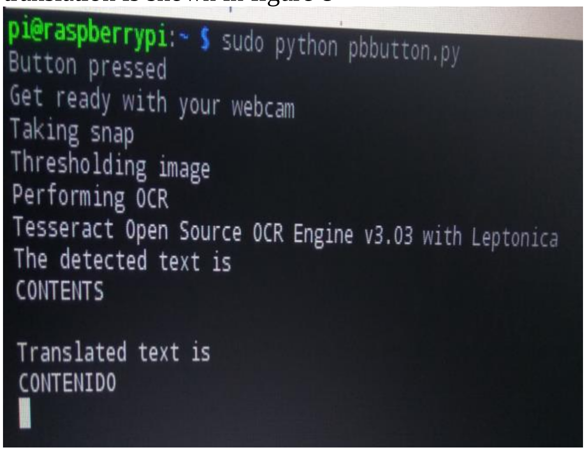

Fig.8 : Program execution-Screenshot

VI RESULT

From the present work, the following can be inferred:

- Text is extracted from the image and translated to any desired language.
- It recognizes both capital as well as small letters.
- It recognizes numbers as well.
- Range of reading distance was 38-42cm.
- Character font size should be minimum 14pt.
- Maximum tilt of the text line is 4-5 degree from the vertical.
- The audio of the translated text is outputted.

VII CONCLUSION

Text-to-Speech device can change the text image input into sound with a performance that is high enough and a readability tolerance of less than 2%, with the average time processing less than two minutes for A4 paper size. This portable device can be used independently by people. Through this method, international travelers can hear the text images of sign boards, routes in their own languages

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