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PEOPLE COUNTING SYSTEM USING RASPBERRY PI WITH OPENCV

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Abstract - **People observation and counting is of interest in many commercial and non-commercial scenarios. The number of people entering and leaving shops, the occupancy of office buildings or the passenger count of commuter trains provide useful information to shop merchants and marketers, security officials or train operators. To this end, this thesis develops a distributed people counting system using raspberry pi with openCV. A people counter is a device used to count the number of pedestrians walking through a door or corridor. Most of the time, this system is used at the entrance of a building so that the total number of visitors can be recorded.**

Keywords – Raspberry Pi, openCV, Counting System, Sensor.

I. INTRODUCTION

People counting system can be implemented in various domains such as libraries, schools, airports, malls. In school and public libraries, a people counting system can streamline the following functions:

Keep in compliance – Library workers can report yearly statistics to the state as needed. They can stay within budget restrictions by maintaining labour percentages or limiting technology usage.

Make cases to administration – With people counting data, libraries can share impressive numbers with elected officials or board members to prove their need for increased or decreased hours of operation and additional staffing, technology or services. They can prove that usage has increased, even if circulation is down. By installing a door counter above the computer lab, libraries can use traffic numbers to gauge their building's technology usage. They can increase or decrease the amount of technology available based on accurate data.

Make informed business decisions – Door counters allow libraries to learn which entrances are used most and which rooms and times are the busiest. With this knowledge, they can guide the placement and timing of cafes, refreshments, kiosks, exhibits, guest speakers, study groups, etc. Accurate people counts are also a way for libraries to increase their awareness of how many people are using services but not checking out material.

Here are some of the benefits of counting people:

When traffic is fluctuating, business is fluctuating. But do you always understand the factors that are affecting traffic? You may think sales reports and a walk around the shopping centre or museum tell you all about your visitors and customers. But a people counting system is like having an army of people looking at your building, all the time, every day of the year. We can help you see trends. We can help you "zoom out" and reach beyond today's sales or visitor figures. Here are some factors that can be assessed once you

II. LITERATURE SURVEY

A People Counting Technology

People counting is a widely studied and commercially exploited subject. This section briefly reviews the typical technologies used for people counting.

B Video Cameras

In the authors describe an approach to people counting (and localization) using multiple video cameras. The focus lies on

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extracting the size and moving patterns of individuals passing. By means of motion histograms based on frame-differenced images, the histograms classify detected movements. Probabilistic correlation is applied to determine a people count. The results of multiple cameras are joined in order to form a movement vector for each individual recognized. In contrast, proposes a solution based on a single ceiling-mounted camera, which identifies people by background extraction of the camera image. A non-background “blob” is recognized, and its size is estimated and compared to previously established bounds of people’s pixel dimensions. A people count is derived from the results of this analysis. The system reaches a claimed accuracy of 98.5%. The major disadvantage of a camera-based system is that it requires an ambient light source and relatively powerful computer resources to perform image processing.

C Ultrasonic Sensors

The authors of introduce a system employing ultrasonic sensors. Per each observed area a three-node sensor cluster is established, whereby each sensor node mounts an ultrasonic sensor. Multiple clusters are joined to cover a wider area. Nodes in each cluster communicate sensor readings by an RF link to the cluster’s coordinator node. The latter contributes its own sensor measurements. By means of a distributed algorithm, nodes decide on whether to count a detected person. The sensor nodes require clock synchronization at the millisecond level in order to correlate the data exchanged. Despite the availability of clock synchronization protocols this imposes a disadvantage to this approach. The system achieves an overall counting accuracy of 90% using a probabilistic estimate of the total count, despite individual clusters achieving only around 50-70% accuracy.

D Infrared Sensor

IR arrays combine a matrix of IR sensors to form array detectors. As the name suggests the sensor signals are provided as a matrix, where each element of the matrix corresponds to one IR sensor. Pattern recognition algorithms are able to detect people moving across the sensor’s view at a claimed accuracy of 95%. This holds true even if two pedestrian’s paths cross, or people walk in parallel. IR arrays provide a cost-effective solution and also operate without any ambient light source. IR arrays are widely used in commercial systems.

E Infrared Motion Sensors

In people counting system based on PIR motion detectors ,for each passage monitored, three PIR sensors are installed at a distance of 0.8m. The sensors are connected to a coordinator by a wireless RF link. Sensors detect motion events and send these data to the coordinator. The coordinator infers a people count from correlating the number, phase and time difference of peaks found in the signal. The system achieves a rate of 100% to detect the direction of movement, and accurately detects 89% of the number of people passing. PIR sensors provide an alternative to IR sensor arrays, however the cost and effort of employing multiple sensor nodes for each entry/exit point is a cost-side disadvantage. The goal of this thesis is to develop a system based on just one PIR sensor and one sensor node per each observed entry/exit point. Sensor Fusion Results of a building occupancy estimation system applying different types of sensors is found in [6]. The system consists of camera, CO_2 and PIR sensors. It uses a Hidden Markovian Model (HMM) based on an Extended Kalman Filter (EKF) in order to derive building occupancy. The approach integrates historical data and current sensor readings to estimate the true state of the system, adjusting for sensor noise (false observations) and stochastic processes, e.g. uncertain people movement patterns.

III. System Architecture

In this project, to count the number of people entering from the door, Raspberry Pi board has been used.Which is a SBC, on which we interfaced a Picamera. Picamera is used for capturing the images of the people. The Raspberry Pi board is connected to the monitor (Display) through HDMI port, for getting the results. The monitor shows the number of people captured by Picamera.The number of face detected is displayed on the counter. OpenCV is a library which is used for interfacing the camera to the board.

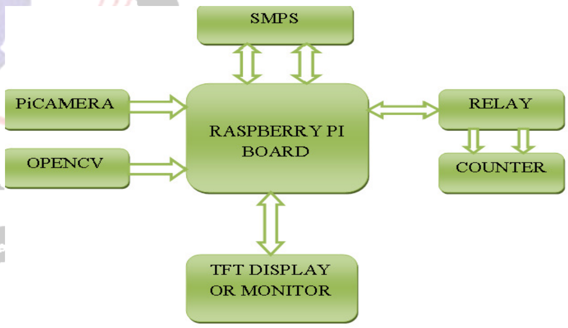

Fig: 1.1 Block diagram of People Counting System

A Block Diagram Description

a Raspberry Pi Board

The Raspberry Pi Camera Board is a custom designed add-on module for Raspberry Pi hardware. It attaches to Raspberry Pi hardware through a custom CSI interface. The sensor has 5 megapixel native resolution in still capture mode. In video mode it supports capture resolutions up to 1080p at 30 frames per second. The camera module is light weight and small making it an ideal choice for mobile projects.

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In this example you will learn how to create a camera board object to connect to the Raspberry Pi Camera Board, capture images from the camera and process them in Python programming.

Raspberry Pi Model B has 512Mb RAM, 2 USB ports and an Ethernet port. It has a Broadcom BCM2835 system on a chip which includes an ARM1176JZF-S 700 MHz processor, Video Core IV GPU, and an SD card. It has a fast 3D core accessed using the supplied OpenGL ES2.0 and OpenVG libraries. The chip specifically provides HDMI and there is no VGA support. The foundation provides Debian and Arch Linux ARM distributions and also Python as the main programming language, with the support for BBC BASIC, C and Perl.

This board is the central module of the whole embedded image capturing and processing system as given in figure 3.1. Its main parts include: main processing chip, memory, power supply HDMI Out, Ethernet port, USB ports and abundant global interfaces.

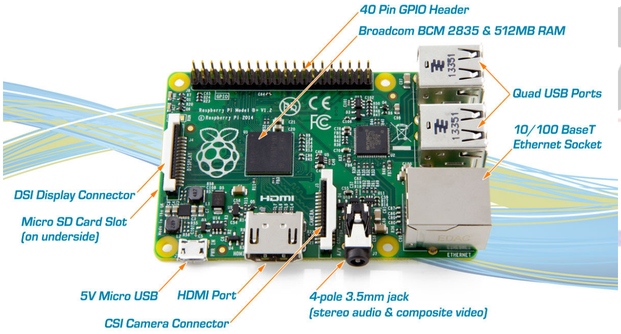

Fig: 1.2 Raspberry Pi Board Model

The Raspberry Pi 2 delivers 6 times the processing capacity of previous models. This second generation Raspberry Pi has an upgraded Broadcom BCM2836 processor, which is a powerful ARM Cortex-A7 based quad-core processor that runs at 900MHz. The board also features an increase in memory capacity to 1Gbyte.

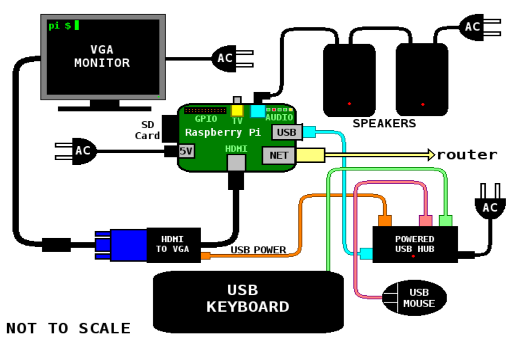

Fig:1.3 Circuit diagram of camera interfacing with Raspberry pi and also HDMI to display.

IV. ALGORITHM

1. Start
2. Initialize the raspberry Pi board.
3. Assign memory using stream.
4. Check for option 1 or option 2.
5. If option = 1 (which is video)
   i. Set the resolution of Picamera
   ii. Capture image from camera.
   iii. Create OpenCV image.
6. If option = 2 (.jpg file)
   i. Read stored .jpg file.
7. Load cascade file for detecting faces haarcascade_frontalface_alt.xml
8. Convert image from colour to grey scale.
9. Detect faces in the image.
10. Before counting faces, generate the reset pulse.
11. Give pulses to counter to show the number of face detected in the image.
12. Show image on tft screen with rectangle around every face found.
13. Save the result image.
14. Wait for break key. Break key = ‘q’.
15. Go to start.

V. RESULT ANALYSIS

While designing PCB for relay circuitry, LED and relay were not working simultaneously. Relays are used as a switch, which is used to reset and give pulse for counter.

So the LED was removed and circuitry containing relays, connectors, resistors, transistors, diodes were designed. Counter was added so that number of face detected could be visible in numbers. Regarding program some algorithms were added, for proper face detection.

Project working snapshot

Step 1

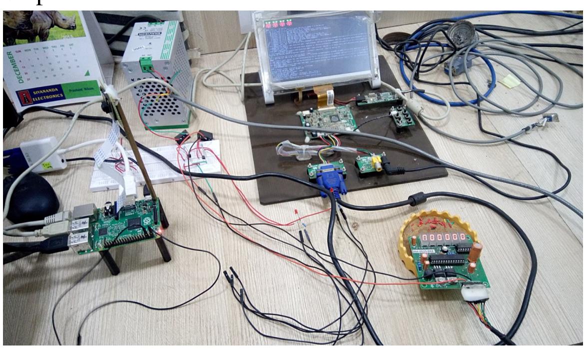

Fig:1.4 Initialization of Raspberry Pi and Counter

In this project counter circuitry has been used for counting the faces detected by the Picamera and also shows the count of

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stored file image. The counter can count upto range 000000 to 999999.

Step 2 (Option 1:Capture image from camera)

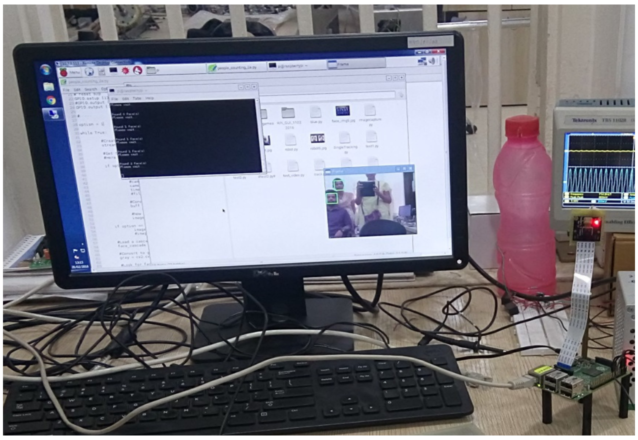

Fig1.5 Face detected by PiCamera and displayed on the screen.

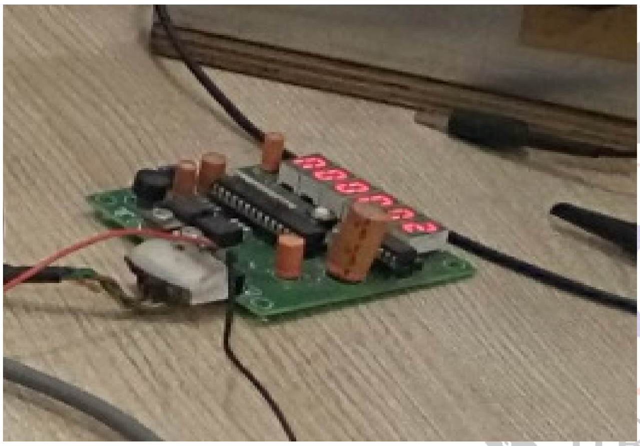

Fig1.6 The count is displayed on the counter.

Step 3: (Option 2: read stored .jpg file)

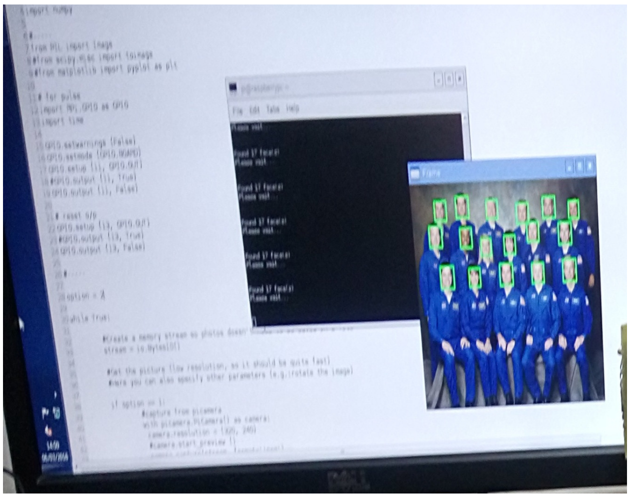

Fig 1.7This are used Face detected from stored file.

Program

```
import io
import picamera
import cv2
import numpy
#-----
from PIL import Image
#from scipy.misc import toimage
#from matplotlib import pyplot as plt
# for pulse
import RPi.GPIO as GPIO
import time
GPIO.setwarnings (False)
GPIO.setmode (GPIO.BOARD)
GPIO.setup (11, GPIO.OUT)
#GPIO.output (11, True)
GPIO.output (11, False)
# reset o/p
GPIO.setup (13, GPIO.OUT)
#GPIO.output (13, True)
GPIO.output (13, False)
#-----
option = 1
while True:
#Create a memory stream so photos doesn't need to be
    #capture from picamera
    with picamera.PiCamera() as camera:
     camera.resolution = (320, 240)
     #camera.start_preview ()
     camera.capture(stream, format='jpeg')
     time.sleep(1)
     #file_ptr = open("/home/pi/Downloads/face_img6.jpg")
  #Convert the picture into a numpy array
    buff = numpy.fromstring(stream.getvalue(),
cv2.CascadeClassifier('/usr/share/opencv/haarcascades/haarcascade_frontalface_alt.xml')
  #Convert to grayscale
  gray = cv2.cvtColor(image,cv2.COLOR_BGR2GRAY)
  #Look for faces in the image using the loaded cascade
# for pulse
   #GPIO.output (11, False)
   GPIO.output (11, True)
   time.sleep (0.05)
   #GPIO.output (11, True)
   GPIO.output (11, False)
     time.sleep (0.05)
   #GPIO.cleanup ()
    # show the frame after pulse in option = 1 and option =
  cv2.imshow("Frame", image)
   #Save the result image
  cv2.imwrite('result.jpg',image)
# wait for break key
```

```
    key = cv2.waitKey(1) & 0xFF
    #print key
    # if the 'q' key is pressed, break from the loop
    if key == ord("q"):
        break
# cleanup the camera and close any open windows
#camera.release()
cv2.destroyAllWindows()
```

VI. CONCLUSION

This master thesis presents an approach to count people passing through a virtual gate using a fixed cheap Picamera mounting vertically on the raspberry Pi board and Python programming tool linked to the application. The results show that using a camera to count people is good alternative to other sensors for big entrance because more accurate. But it shows also that the system needs a lot of improvements to be really reliable.

ACKNOWLEDGMENT

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