ISSN XXXX XXXX © 2017 IJESC

Research Article Volume 7 Issue No.7

Autonomous Object Detection and Tracking using Raspberry Pi

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Abstract:
We present the design and implementation of a real-time vision-based approach to detect and track features in a structured environment using an autonomous robot.. Object detection and tracking are important and challenging tasks in many computer vision applications such as surveillance, vehicle navigation and autonomous robot navigation. Object detection involves locating objects in the frame of a video sequence. Every tracking method requires an object detection mechanism either in every frame or when the object first appears in the video. Object tracking is the process of locating an object or multiple objects over time using a camera. The high powered computers, the availability of high quality and inexpensive video cameras and the increasing need for automated video analysis has generated a great deal of interest in object tracking algorithms. There are three key steps in video analysis, detection interesting moving objects, tracking of such objects from each and every frame to frame, and analysis of object tracks to recognize their behavior. Therefore, the use of object tracking is pertinent in the tasks of, motion based recognition. Automatic detection, tracking, and counting of an application.

Keywords: At mega 32 MC, LM35 Temperature Sensor, Infra-Red LED Receiver, L293D Motor Driver, DC motor 6 v,16x2 LCD Display.

I.INTRODUCTION

Nowadays, the objective of the tracking of a moving object is to estimate some characteristics of interest (pose, velocities, accelerations, shape, size. from the information provided by the sensors. It has been widely studied and it constitutes a research domain itself. Furthermore, the necessary techniques to perform the tracking highly depend on the specific application. The aim of this project will be design and development of a real-time system to detect and track objects in video streams used in traffic surveillance, security cameras, etc. The goal of object detection is to detect all instances of objects from a known class, such as people, cars or faces in an image. Typically only a small number of instances of the object are present in the image, but there is a very large number of possible locations and scales at which they can occur and that need to somehow be explored. Each detection is reported with some form of pose information It plays a vital role to select a proper feature in tracking. So feature selection is closely related to the object representation. For example, color is used as a feature for histogram based appearance representations, while for contour-based representation, object edges are usually used as features. Generally, many tracking algorithms use a combination of these features.

II.PROPOSED APPROACH

The process of object detection and tracking, either by using three-frame differencing or background subtraction approach requires some kind of pre-processing on input and post-processing on the output to get higher accuracy in detection. The complete process followed here for real-time object detection and tracking which also covers the background movement problem is presented in Figure 2.1

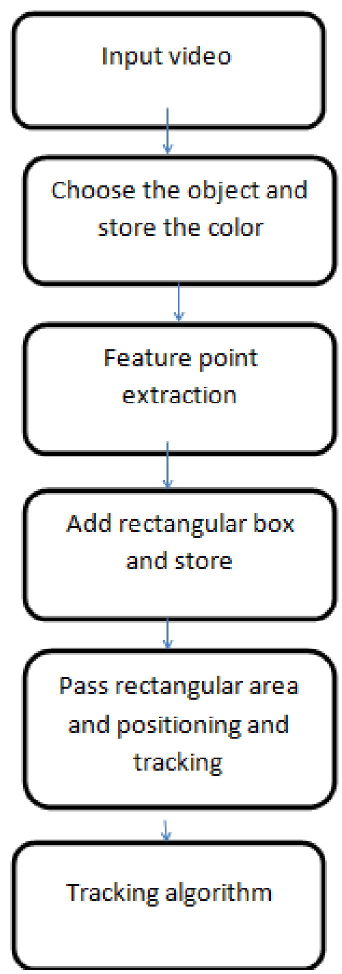

Figure.1. Architecture for the proposed approach

A classification algorithm distinguishes object from non-object/background part of the image. This technique is good in detecting both moving and static objects. This technique is more time complex as it involves feature computation and n-stage classification. Since the object of interest is the moving object, the other less complex approaches are also proposed in the literature, such as background subtraction and three frame differencing. In background subtraction approach, the background or the static part of the image is modeled.

III.HARDWARE SPECIFICATION:

1. Raspberry Pi 3 Model B

Figure.1. Basic Structure of Raspberry Pi

- Broadcom BCM2837 64bit ARMv7 Quad Core Processor powered Single Board Computer running at 1.2GHz.
- 1GB RAM.
- BCM43143 Wi-Fi on board.
- Bluetooth Low Energy (BLE) on board.
- 40pin extended GPIO.
- 4 x USB 2 ports 4 pole Stereo output and Composite video port Full.
- Size HDMI.
- CSI camera port for connecting the Raspberry Pi camera.
- DSI display port for connecting the Raspberry Pi touch screen display.
- Micro SD port for loading your operating system and storing data.
- Upgraded switched Micro USB power source (now supports up to 2.4 Amps).
- Expected to have the same form factor has the Pi 2 Model B, however the LEDs will change position.

2. IR Reciever (acting as IR sensor)

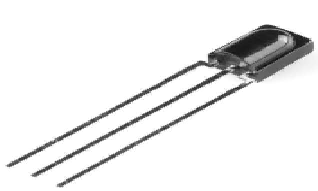

Figure.2. shows IR Receiver

• Very low supply current
• Photo detector and preamplifier in one package
• Internal filter for PCM frequency
• Supply voltage: 2.5 V to 5.5 V
• Improved immunity against ambient light
• Insensitive to supply voltage ripple and noise

3. ATmega32

Figure.3. shows the ATmega32

ATmega32 is an 8-bit high performance microcontroller of Atmel's Mega AVR family. Atmega32 is based on enhanced RISC (Reduced Instruction Set Computing) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega32 can work on a maximum frequency of 16MHz.

- High-performance
- Low-power Atmel AVR 8-bit Microcontroller
- High Endurance Non-volatile Memory segments
- Operating Voltages – 2.7V - 5.5V for ATmega32L.
- Speed Grades – 0 - 8MHz for ATmega32L.
- Power Consumption at 1MHz, 3V, 25°C – Active:1.1mA , Idle Mode: 0.35mA ,Power-down Mode: < 1µA.

4. L293D Motor Driver IC

Figure.4. shows the L293D Motor Driver IC

These devices are designed to drive a wide array of inductive loads such as relays, solenoids, DC and bipolar stepping motors, as well as other high-current and high-voltage loads. All inputs are TTL compatible and tolerant up to 7 V
• Wide Supply-Voltage Range: 4.5 V to 36.
• Separate Input-Logic Supply.
• Internal ESD Protection.
• High-Noise-Immunity Inputs.
• Output Current 1 A per Channel (600 mA for L293D).

5. DC motor 6 V

This small DC motor runs off any battery or solar cell ranging from 0.5-volts to 6-volts and it is our best all-purpose motor. It is ideal for experimenting with direct current (DC) electricity or creating motorized projects of your own design. It can also be used as a small DC generator.

6.16x2 LCD Display

Figure.6 shows the 16x2 LCD Display

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

7. Webcam

Figure.7. Webcam

The camera used in this case will be overhead camera; it will take the snapshot of the object for color sensing purpose.

- Integrated microphone.
- Adjustable clip/stand.
- Video Call Quick Launch.
- Webcam Control Center software.
- Video/photo capture program.

IV. SOFTWARE SPECIFICATION:

1. LINUX

Linux was originally developed for personal computers based on the Intel x86 architecture, but has since been ported to more platforms than any other operating system. Because of the dominance of the Linux kernel-based Android OS on smartphones, Linux has the largest installed base of all general-purpose operating systems.[19] Linux is also the leading operating system on servers and other big iron systems such as mainframe computers, and is used on 99.6% of the supercomputers. The development of Linux is one of the most prominent examples of free and open-source software collaboration.

2. Basic Motion Detection and Tracking with Python and Opencv

```
# import the necessary packages
import argparse
import datetime
import imutils
import time
import cv2
# construct the argument parser and parse the arguments
ap = argparse.ArgumentParser()
ap.add_argument("-v", "--video", help="path to the video
file")
ap.add_argument("-a", "--min-area", type=int, default=500,
help="minimum area size")
args = vars(ap.parse_args())

# if the video argument is None, then we are reading from
webcam
if args.get("video", None) is None:
	camera = cv2.VideoCapture(0)
	time.sleep(0.25)
# otherwise, we are reading from a video file
else:
	camera = cv2.VideoCapture(args["video"])
# initialize the first frame in the video stream
firstFrame = None
```

The first frame of our video file will contain no motion and just background — therefore, we can model the background of our video stream using only the first frame of the video.

Obviously we are making a pretty big assumption here. But again, our goal is to run this system on a Raspberry Pi, so we can't get too complicated. And as you'll see in the results section of this post, we are able to easily detect motion while tracking a person as they walk around the room.

3. Secure Shell

Secure Shell (SSH) is a cryptographic network protocol for operating network services securely over an unsecured network.[1] The best known example application is for remote login to computer systems by users. SSH provides a secure channel over an unsecured network in a client-server architecture, connecting an SSH client application with an SSH server. [2] Common applications include remote command-line login and remote command execution, but any network service can be secured with SSH. The protocol specification distinguishes between two major versions, referred to as SSH-1 and SSH-2. The most visible application of the protocol is for access to shell accounts on Unix-like operating systems, but it sees some limited use on Windows as well. SSH is typically used to log into a remote machine and execute commands, but it also supports tunnelling, forwarding TCP ports and X11 connections; it can transfer files using the associated SSH file transfer (SFTP) or secure copy (SCP) protocols.[2] SSH uses the client-server model.

V.APPLICATIONS

1.Face Detection: Popular applications include face detection and people counting. Have you ever noticed how Facebook detects your face when you upload a photo? This is a simple application of object detection that we see in our daily life.

2. People Counting: Object detection can be also used for people counting, it is used for analyzing store performance or crowd statistics during festivals. These tend to be more difficult as people move out of the frame quickly (also because people are non-rigid objects).

3.Vehicle Detection: Similarly when the object is a vehicle such as a bicycle or car, object detection with tracking can prove effective in estimating the speed of the object. The type of ship entering a port can be determined by object detection (depending on shape, size etc). This system for detecting ships is currently in development in some European countries

4. Manufacturing Industry: Object detection is also used in industrial processes to identify products. Say you want your machine to only detect circular objects. Hough circle detection transform can be used for detection.

5. Online Images: Apart from these object detection can be used for classifying images found online. Obscene images are usually filtered out using object detection.

6.Security: In the future we might be able to use object detection to identify anomalies in a scene such as bombs or explosives (by making use of a quad copter).

VI. CONCLUTION:

Autonomously Tracking and detecting of object is use for motion detection of various objects on a given video or an image. The applications of object detection and tracking is farming, military, transportation, civil, security and for commercial use. Some methods commonly use in it are background subtraction, Frame difference, template matching and shape based methods.

Figure.6Autonomous Object Detection and Tracking Using Raspberry Pi

VII. FUTURE SCOPE:

The task of finding objects belonging to classes of interest in images has long been a focus of Computer Vision research. The ability to localize objects is useful in many applications: from self-driving cars, where it allows the car to detect pedestrians, bicyclists, road signs, and other vehicles, to security, where intruding persons can be detected. Though a lot of progress has been made since the conception of the field of Computer Vision more than five decades ago, as always, there is scope for further improvement.

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