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Design and Analysis of Motion Detection by using Open-Source CV

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Abstract
In the world of home security, motion detection has become one of the most important features because it can be used to enhance already existing home security devices like motion sensor lighting to indoor and outdoor security cameras. In order to better secure our home, public places, private places and workplaces, motion detecting devices having artificial intelligence are a must-have. Taking this into account we are developing a project to detect motion that will aid to the existing home security system. We will be using open CV module in order to achieve our goal. Background subtraction of a scene is executed and the frame to be analyzed is kept being the foreground. Therefore, we have a background from which we are subtracting the unique frames. As the result, a scene with a black heritage is observed where movement is detected.
Keywords: *Motion sensor, Background subtraction, Open CV, Frames,Python*

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I. INTRODUCTION

In many systems based on machine vision, motion detection is used. For example, when we want to count number of people gathered at a place like stadium or a park or how many units of a certain product is getting manufactured by a machine in a factory. In all these cases, we must extract the people or other things that are at the scene. There are different techniques, methods, or algorithms that enable motion detection. We will be using Open-Source CV to do so.

Security cameras are one of the most common devices that use motion detecting technology. The demand for a modernized and technologically advanced security system is increasing rapidly and therefore people nowadays demand for artificial intelligence-based applications to create theft free environment.

Security is a tradeoff, a balancing act between attacker and defender. Unfortunately, that balance is never static. Changes in technology affect both sides. Societies uses new technologies to decrease what we call the scope of defection- what attackers can getaway with and attackers use new technologies to increase it. Now, in order to better secure our home, public places, private places and workplaces, motion detector cameras and other instruments are a must-have.

The purpose of this Project to detect motion using artificial intelligence. The benefit is that the motion will be detected efficiently, and it will aid to the existing security systems we have.

The following Technologies will get used in this project:

1.1Open-Source CV

Open-Source Computer Vision isa machine learning software library which provides a real-time optimized Computer vision library and tools. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code. It can be used in python for image processing, motion detection, face recognition, and other function.

1.2 Raspberry Pi

Raspberry Pi is a card sized computer plugged into monitor used for programming the system. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It is capable of doing everything you'd expect a desktop computer to do.

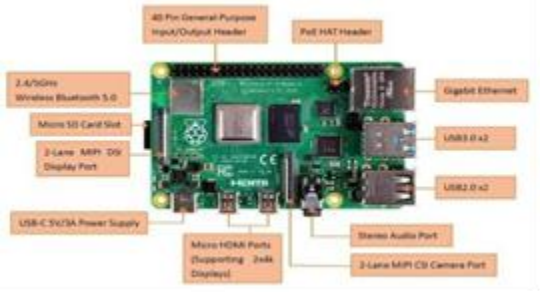

Fig.1 Raspberry Pi

1.3 Python

Python is a high-level general-purpose programming language. It is object oriented which helps programmers to write a clear, logical code for a problem. Open CV supports python than can process images and videos to detect movements, identify objects, recognize faces and much more.

II. BLOCK DIAGRAM

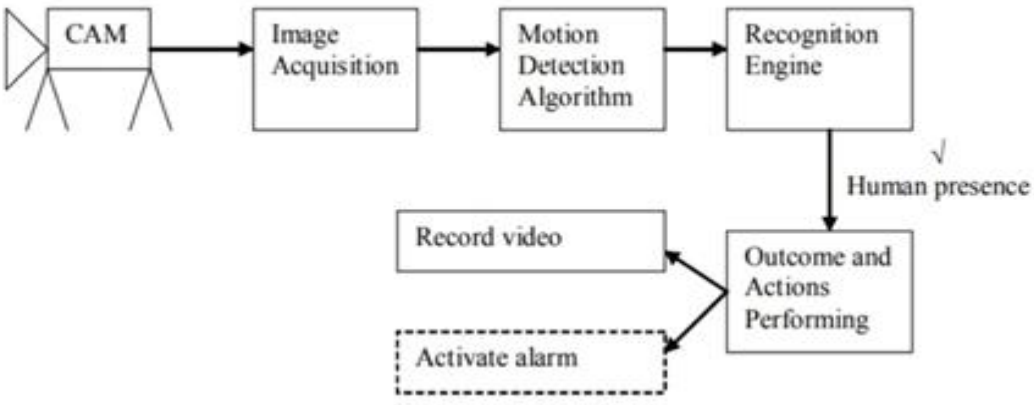

Fig.2 Block Diagram Representation

Fig.2 explains the overview of the project, the step-by-step process to detect motion. First, we need a camera to capture the video then image acquisition will be done in which background subtraction of a scene will be executed. Motion detection algorithm will be written in python and a recognition engine will be used to detect the movement.

Additional sensors will also be used to detect the motion efficiently:

2.1 Motion Sensors

A motion sensor (or motion detector) which is the linchpin of our security system detects when someone is there where they should not be.A motion sensor uses one or multiple technologies to detect movement in an area. When a sensor detects motion, it sends a signal to security system's control panel, which connects to a monitoring centre which alerts the user.

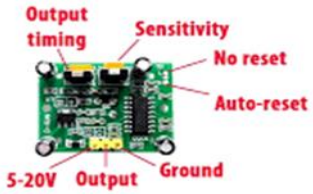

Fig.3 Motion Sensor Fig.4 IR Sensor Fig.5 Pi Camera

2.2 IR Sensor

An infrared (IR) sensor is an electronic device that measures and detects infrared radiation in its surrounding environment. An IR sensor can measure the heat of an object as well as detect motion.

2.3 Pi Camera V2 (8MP)

The Raspberry Pi Camera Module v2 is perfect for taking high-definition pictures and video. So we will be using it to take good videos and pictures.

III. PROJECT EXECUTION PLAN

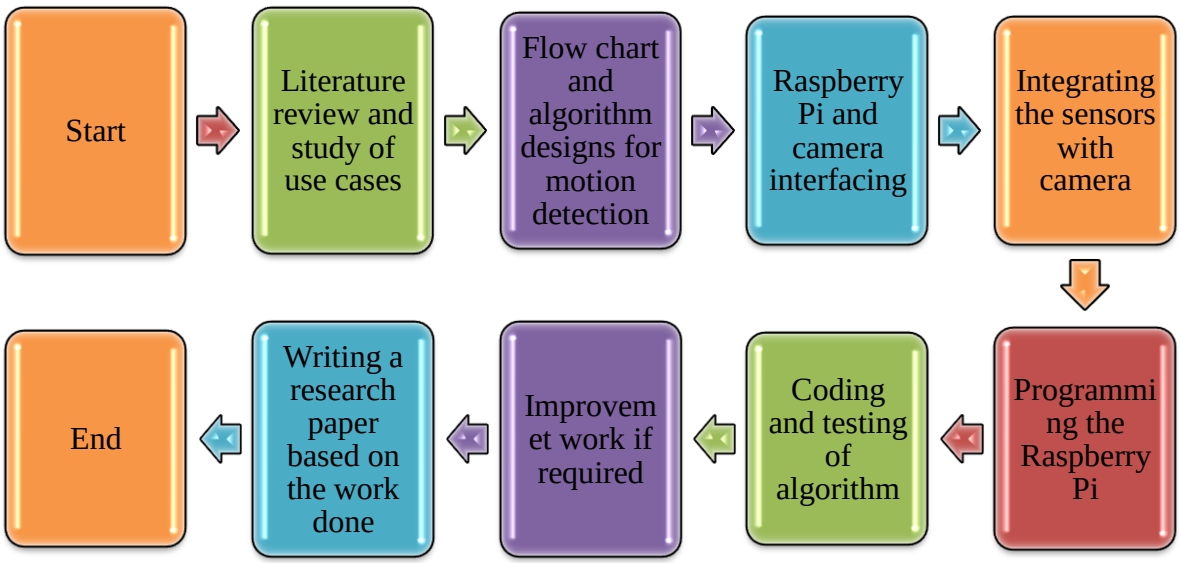

Fig.6 Project Execution Plan Diagram

Initially, we collected information from different research papers related to the detection of motion which were available on the internet. Then a choice had to be made to choose the paper which used technologies which is in a way cost-effective. Then out of many we selected a technology which best suited for our budget.

In many applications based on machine vision, motion detection is used. There are different techniques, methods, or algorithms that enable motion detection. We used Open-Source methods in python to achieve our goal. Background subtraction of a scene is executed to obtain frames after subtracting the successive frames that we are obtaining from a video.

To create an algorithm that will allow us to detect movement with OpenCV, we will need to perform various tasks. Grayscale conversion and noise removal, subtraction operation between the background and the

foreground, applying a threshold to the image resulting from the subtraction, detection of contours or blobs are few steps which will be executed to design an algorithm for motion detection.

Raspberry Pi will be connected with the camera, and it can also be connected with different sensors which are necessary for the project. The camera was integrated with the motion sensors which uses an array of millions of tiny light cavities or "photo sites" to record an image. It combines the images generated by a security camera, with software that can analyze the images as they are captured. We installed the Raspberry Pi camera module by inserting the cable into the Raspberry Pi camera port. The Raspberry Pi was booted so that it can be operational. Once booted, we updated it by running the commands like sudo apt-get-update, sudo apt-get upgrade. After these things got ready it was connected to the pi camera and was combined with the program using python. This method of motion detection relies heavily on two key components: the quality of the image from the camera and the quality of the analytics software in use. We used the Open-Source CV to integrate the camera with motion sensors to get the feed. The Open-Source CV library was installed, and eventually a program was created which can capture real time image with our camera module of the scene upon which the camera interfacing is set to. We have done Python programming on Raspberry Pi for interfacing & proper function of Motion Sensors, and then using optical character recognition we were able to extract the relevant information we need to either detect the movement or other functions.

IV. CIRCUIT DIAGRAM

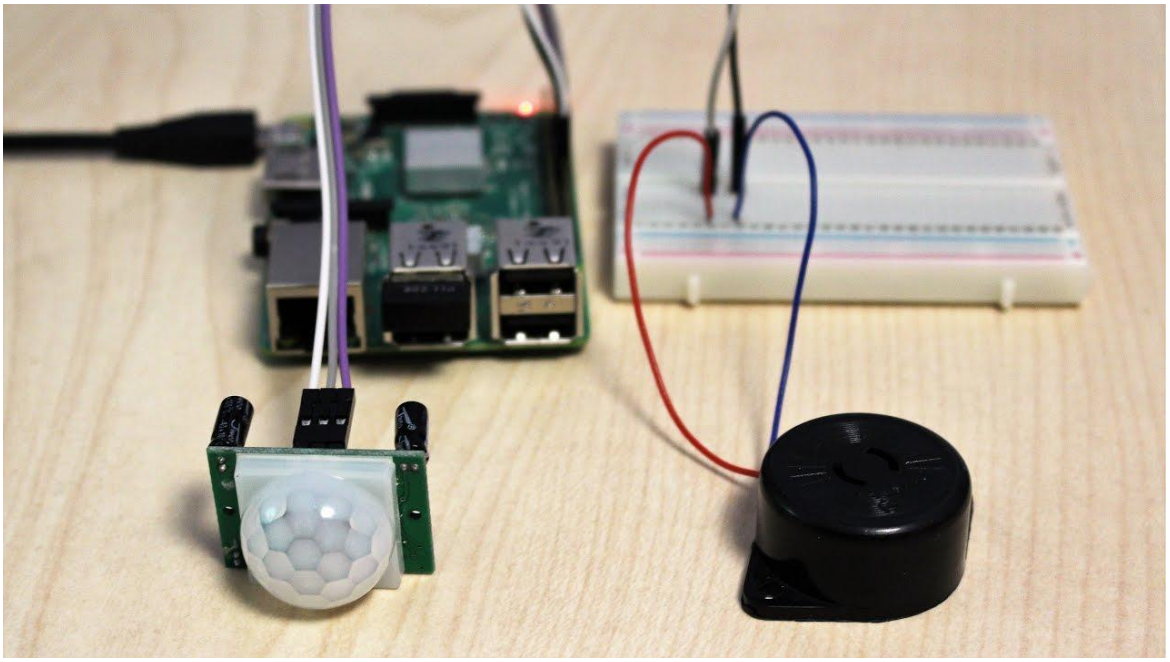

Fig.7 Circuit Diagram

Fig.7 represents the circuit diagram which is created during the project. We have used IR Sensor, which has three pins such as VCC, GND and Data. Connect the VCC and GND Pins of IR Sensor to +5v and GND pins of Raspberry Pi. Then the Data pin of the IR Sensor is connected to Pin 13,15,16,18 of the Raspberry Pi. Then the IR sensors were programmed in Python code. We integrated the programs of python by creating different functions of small programs.

All the VCC and GND of all the different sensors to the breadboard were connected with common GPIO pins for power. All the reading/writing connections of different sensors are connected individually to the GPIO pins.

V. APPLICATION

Application of the project includes but is not limited to just home security, public and private place surveillance. It can be used to save energy by using motion sensor lightning in unoccupied spaces. Alert the officials when something enters the restricted areas in the industries, experiment labs, international border areas.

VI. CONCLUSION

The purpose of this project is to come up with a solution that detects motion effectively record it down with one or more objects that are moving or causing motions. To enhance the already existing home security devices like motion sensor lightning to indoor and outdoor security cameras.

In this project, the issues related to home securities, public and private place surveillance are presented, and solution is given by using artificial intelligence technology which is integrated with Open-Source CV and python. The project provides real time information about the motion detected in a frame and the relevant information in the frame.

The main goal achieved during this project is that with latest technology of artificial intelligence we developed a system that will aid to the existing security systems to detect motion effectively and send an alert signal to the user. In the project, the background is obtained from the previous frames. The technique consists of taking a reference image, letting some time pass applying a delay and begin to compare with the frames that we are obtaining. This delay will depend on factors such as the speed of the objects.

One of the biggest issues we faced was that if the moving object or person stays still, it is not detected. It is not able to detect silhouettes. However, it is a fairly robust method to changes in lighting and camera movements and it gets stabilized after a while.

VII. FUTURE SCOPE

This Project can be integrated with machine learning, IOT and other latest technologies and it can also be used in autonomous vehicle technologies and can be a very effective business model which uses automation to create a theft-free environment.

VIII. ACKNOWLEDGEMENT

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