

Image Processing based Drone for Monitoring and Surveillance

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Abstract - The aim of this research paper is to design a light-weight & cost-effective quadcopter. The quadcopter will be controlled by a RC (Remote Controller) from a specific distance wirelessly. This compact sized system will acquire data such as video/images from the camera installed on the quadcopter and store this data on a memory card. Multiple object detection and tracking are essential for video surveillance. A drone or Unnamed Aerial Vehicle is very useful for aerial surveillance due to its efficiency in capturing remote scenes which are not easily visible through manual inspection. This project will have a great impact to carry out inspection of a larger geographic area in minimal amount of time, especially in large crowded areas during festivals.

Key Words: Unnamed Aerial Vehicle(UAV), Quadcopter, Remote Controller, Image Processing & Computer Vision, surveillance

1. INTRODUCTION

The surveillance is a tedious task when it comes to cover a large area then surveying by foot is near to impossible. That is the main reason we've drafted this project. This project consists of 2 main parts first is the physical hardware and secondly is the different software's required for this project which range from initialization software like Libre Pilot to the camera's proprietary software and the custom after processing software that we've written.

The main aim of our project is to create a level 2 autonomous system which would act like a framework for any future development and modifications. To facilitate this from the hardware side we've have tried using parts which are readily available online or in the nearest electronics retail store. If we look in the software realm of our project we have used open source software's which are readily available on the internet and for any extra snippets of proprietary code we've uploaded it on GitHub which has been referred to an the end of the document.

To explain the working our drone would capture the incoming signals in its camera and stream the video feed

to the paired smartphone device using an application (available on android or ios) and would also simultaneously save the data in the SD card onboard the UAV. Once it completes its successful manoeuvre we could extract the footage into a computer and by using openCV we could detect the faces of the people in it and extract their information from the already stored database of faces.

To explain the in depth working of the project we've divided it in 2 main parts the hardware side and the software side

2. LITERATURE SURVEY

Prof.A.V.Javir, Ketan Pawar, Santosh Dhudum, et al. this paper focuses on the aerodynamic effects of a quadcopter and addresses all the aspects of quadcopter ranging from mechanical design to the components used. It provides backup to the selection of different components with the help of various formulas from research papers. It also gives clear results with respect to weight of components and their corresponding costs. Yiwen Luo, Meng Joo Er. et al. presented an approach to develop an intelligent control and navigation system of an indoor quadcopter. It documents developing a stabilized flying control system with low cost components such as the budget friendly Raspberry Pi computer including traditional PID controller, and electronic speed controller developed to provide the basic platform for the quadcopter. PID tuning is utilized to optimize the overall performance. Also, RGB and depth cameras and other sensors are deployed to enable remote semi-autonomous control. Gordon Ononiwu, Arinze Okoye, et al., this paper presents the design and implementation of an aerial surveillance quadcopter for search and rescue applications. The first phase of the paper considered modelling of the quadcopter while the second phase involved system implementation and simulation. It results in surveillance and reconnaissance quadcopter which can take the photographs from environment captured through the aid of the on board mounted camera while live streaming with the help of laptop during flight.

LITERATURE SURVEY ON UNMANNED AERIAL VEHICLE written by SAURAV KUMARE.KANNIGA (Senior Research Fellow, Professor) have specified in their paper that the UAV is an automatic system and the shrinking size and increasing capabilities microelectronic devices in recent years has opened doors for more real-time UAV applications and also development of auto-pilot project:

3. METHODOLOGY

Our methodology is divided among a hybrid hardware and software based solution to the problem. The basic solution could be understood by this following block diagram.

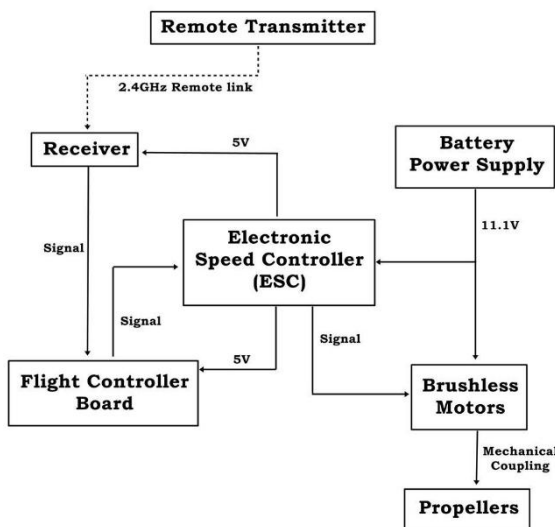


Fig -1: Detail Block Diagram

Here we capture image through the camera which is stored in memory card or any storage device. After capturing the image useful information is being extracted from the following image. In the next step we try to find correlation between different points in an image i.e putative points. Finally after a relationship is established the object is detected like a human individual.

To explain everything in detail we would firstly list out the components used to build the UAV(Unmanned Ariel Vehicle) and then explain the workflow adapted by us to develop the 2 tier solution which comprises the involvement of both the electronics department and the computer department of Keystone school of engineering college.

3.1 Components used

Components used in this project are readily available in the market and with most online retailers.

- We've used an F450 frame
- Motors 980kv
- Electronic Speed Control (ESC)
- Battery 11.1V 2200mAh

- Balanced charger
- Fs-i6 Receiver/Transmitter
- CC3D Flight Controller Board
- Propellers 10*4.5
- SD Card
- Action Camera with Gimbal

After building a basic drone we turn to the software side of things but firstly to understand our software implementation we should know what we've used in object detection and image processing to address the problem.

3.2 Object Detection, Computer Vision(CV) and Image Processing(IP)

Object detection algorithms for computer vision tasks are some of the most powerful tools in machine learning and artificial intelligence. These are decision algorithms that enable computer system to make speculation of different real-world objects around them that are being filtered through a camera. Without object recognition robots that manipulate objects, autonomous vehicles & image classification software would be a non-viable option. Computer Vision is a field of Computer Science that seeks to provide computers with the ability to extract and interpret high-level features of images & videos. The interpretation of high-level features determines the way human individuals recognize objects. First, the edges of the objects are identified & are combined to form an outline of the object. This is followed by filling in the details of the object and the brain uses these recognizable patterns to determine what the object is. High-level interpretation refers to the fact that many small features which make up the image are joined together & the object is recognized at the highest level of processing. The main goal of computer vision is to provide computers with the ability to examine an image and recognize parts of the image which have a specific meaning. A computer or a system can select the appropriate route and carry out other instructions depending on the type of object classified in an image. For instance, if the object detection system in an autonomous vehicle recognizes an object as a car which is at a specific distance from it, then computer can use this information to reduce the speed of the vehicle by applying the braking system in order to avoid any collision. Object recognition is a computer vision technique to identify objects in images or videos. Object recognition is a key technology behind driverless cars, enabling them to recognize a stop sign or to distinguish between a pedestrian and a lamppost.

OpenCV is used to implement this project.

OpenCV represents open source Computer Vision , which is an open source(free) library .It is created by Intel Russia focus in Nizhny Novgorod and now it is upheld by Willow Garage and Itseez. OpenCV is used for object and image processing

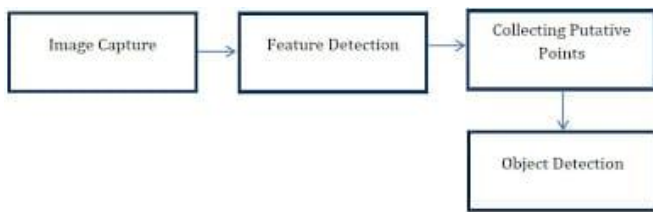


Fig -1: OpenCV implementation

On the off chance that the library discovers Intel's Integrated Performance Primitives on the framework, it will utilize these restrictive improved schedules to quicken it. One of the most well-known strategies for preprocessing a picture for object identification is background subtraction. It is accomplished by building a portrayal of the scene called a background model and afterward discovering deviations from the model of every approaching casing. An edge contrast in the picture district from the foundation model implies a frontal area object. The downside of this methodology is the affectability to dynamic scene changes because of lighting and unessential occasions.

Image processing is a method of translating an image into digital form to perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input can be an image, like a video-frame or a photograph and output may be an image or characteristics associated with that image. The purpose of image processing is divided into five groups, they are as follows: Visualization- Observe the objects that are not visible. Image Sharpening & Restoration- To create a better image.

Image Retrieval- Seek the image of interest. Image Recognition- Distinguish the objects in an image. Measurement of pattern- Measures various objects in an image.

By using the technique of OpenCV and IP we've implemented our custom software in the following way.

3.3 Implementation

The implementation part will be carried out on Python and the algorithm that we will be using to carry out the image processing is Haar Cascade algorithm.

A Haar Cascade is fundamentally a classifier which is utilized to identify the item for which it has been trained for, from the source. The Haar Cascade is prepared by superimposing the positive picture over a lot of negative pictures. The preparation is commonly done on a server and on different stages. Better outcomes are gotten by utilizing high quality pictures and expanding the measure of stages for which the classifier is trained.

The drone will monitor a specific geographic area and the user will get a live video feed on his mobile (after installing the specific camera application). The data will be stored on the memory card which is been mounted (inserted) on the flight controller.

4. COMPARISON WITH OTHER METHODOLOGIES

The methodology that we took is in no way perfect but we've adapted the methodology which seemed most feasible and robust and also easy to implement as the main purpose of our drone is to be acted as a frame work for future development and to provide the least hassle to setup and work upon.

There are multiple different approaches and alternatives to using openCV SimpleCV is an open source framework for building computer vision applications, user can get access to several high-powered computer vision libraries such as OpenCV without having to learn about bit depths, file formats, color spaces, buffer management, eigenvalues, or matrix versus bitmap storage. But it does not complete our requirements hence we didn't used SimpleCV DeepPy is a MIT licensed deep learning framework that tries to add a touch of zen to deep learning as it allows for Pythonic programming based on NumPy's ndarray, has a small and easily extensible codebase, runs on CPU or Nvidia GPUs and implements the following network architectures feed forward networks, convnets, siamese networks and auto-encoders. Since deepPy is not an open source solution we avoided it.

Caffe is a deep learning framework made with expression, speed, and modularity in mind. Caffe is also not open source.

Dlib Image Processing is a tool that deals with array2d objects that contain various kinds of pixels or user defined generic image objects. Was considerably more complex than our implementation in OpenCV Torch is a scientific computing framework with wide support for machine learning algorithms that puts GPUs first. It is slower to reach ROI than OpenCV

Gesture Recognition Toolkit (GRT) is a cross-platform, open-source, C++ machine learning library designed for real-time gesture recognition. Since we were not dealing with gestures we avoided the use of this library.

Google Cloud Vision API is a tool that enables developers to understand the content of an image by encapsulating powerful machine learning models in an easy to use REST API, it quickly classifies images into thousands of categories (e.g., "sailboat", "lion", "Eiffel Tower"), detects individual objects and faces within images, and finds and reads printed words contained within images user can build metadata on image catalog, moderate offensive content, or enable new marketing scenarios through image sentiment analysis. Even though its better than OpenCV its not open source in nature hence we did not use google cloud vision API.

5. CONCLUSION

Thus we've implemented a level 2 autonomous drone which would help the police department supposedly for surveillance purpose and would detect the face of any person whose face is stored in the database afterwards.

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