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Human Tracking using Autonomous Drone

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***Abstract*: Many days we are reading in the newspapers about a missing person or Criminal ran away or crime due to lack of surveillance. This is a severe issue as it is difficult to locate a person in a large geographical efficiently. Deployment of police of human for that task is tedious and costly. To tackle this problem, we are developing a system to recognize a person using an Unmanned Aerial Vehicle to eliminate physical barriers. In previous decades humans have spent billions locating missing persons and criminals.**

***Keywords*: Face recognition, Autonomous drone, LTE controlled, Face detection, Human tracking.**

1. Introduction

We are developing such a system which can be used to ease the process of searching for a person. We will be developing an UAV consisting an onboard receiver, single board computer, camera, along with the drone this will relay all the information including camera feed, GPS and other geographical information. At controller side we will be developing an android as well as WebApp. Controller side will be used to control drone using a virtual control interface. A Server-Client communication will take place via LTE network. The combination of Latest Wireless communication System and Embedded solutions offer us such modules. The System is intended to operate in two Parts:

1. Drone Unit.
2. Controller Unit.

Controller is to be made cloud based in order to keep it accessible from anywhere in the world and eliminate the geographical barriers.

2. Literature Survey

In this paper [2], review on different object detection, tracking, recognition techniques, feature descriptors and segmentation method which is based on the video frame and various tracking technologies. This approach used towards increase the object detection with new ideas. Furthermore, tracking the object from the video frames with theoretical explanation is provided in bibliography content. The bibliography content is the most significant contribution of research since it will lead to a new area of research. We have identified and discussed the limitation/future scope of various methods. Also, we have noted

Some methods which give accuracy but have high computational complexity. Specifically, the statistical methods, background subtraction, temporal differencing with the optical flow was discussed. However, these technique needs to concentrate towards handling sudden illumination changes, darker shadows and object occlusions.

In this paper [3] it is stated that. The drone was able to follow the line, able to predict the turn and also to make a turn on the corners. This research can be further developed and used for many applications. The one can be auto guidance system for customer in a mall or retail business. We can make lines of different colors on the ground in the whole building and if a customer demanded something we can just ask them to follow the drone. The drone will then follow a predefined path of colors or corners. In the future works, the real time running must be done in various heights and in the outdoor. Besides that, the object recognition must be developing to track or detect more objects. The development of swarm robots is also one of the greatest challenges in the future. Hopefully those works can be done in the near future.

3. Proposed System

Computer vision is one of many techniques that can be used to implement autonomy in robots. Computer vision aims to recreate the human sense in order to extract valuable information from an image or a series of images. The information extracted from the images can then be used to perform various functions such as determine which direction a vehicle should move to avoid collisions or to decide on an algorithm to execute. Computer vision uses various image processing procedures to obtain information from its image feed. The information that can be extracted from these images can often be more useful than the information a human can derive from the same images. This can be attributed to the use of machinery that surpasses human ability.

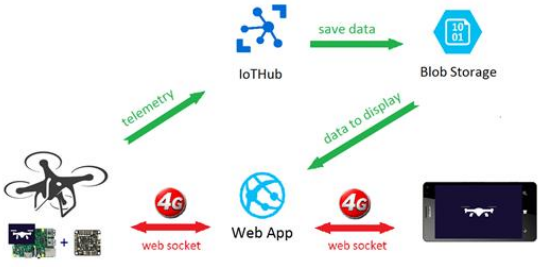

Fig. 1. Functional diagram

UAV is the first part of System which will be doing all the field work, controller consisting of controls and console to control drone and display information relayed by the UAV as shown in Fig. 1.

4. Methods

The suggested system will consist of two different modules as follows, Block diagram of various unit as shown in Fig. 2.

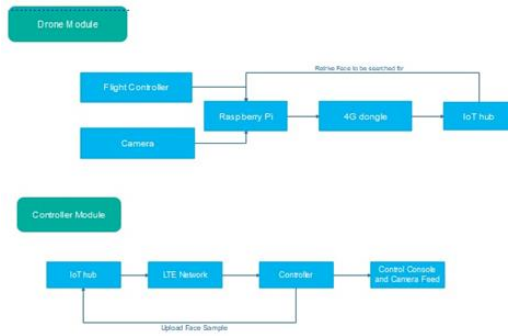

Fig. 2. Block diagram

A. Drone Unit

In UAV, Drone will consist of a single board computer (Raspberry pi) fixed onto the board along with flight controller and camera as well as all other Drone components. The communication between Drone unit and control unit will take place by using 4G Network using the GSM Dongle plugged into the Raspberry pi. All the sensor data and camera data will be processed by Raspberry Pi

1. *Camera (PiCam V2.1):* This is the latest and most refined camera module specially made for raspberry pi along with the CSI interface for less bandwidth acquisition.
2. *Flight Controller (Naze 32 rev 6 acro):* The reason for selection of this flight controller is the compact ness as well as low price. Also being a MultiWii Based it is open source and eliminates the need of proprietary software and tools. It can also be controlled using serial connection via Micro-USB attached to our SBC. Figure 3 shows the diagram of a flight controller and its pin diagram as well as structure.

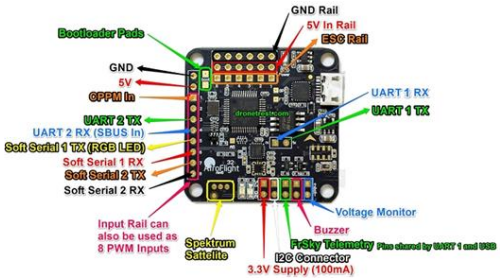

Fig. 3. Naze 32 pin diagram

3. *Raspberry pi 4 4GB RAM:* The main reason behind selection of raspberry pi 4 4GB RAM version is the area of application. I.e. Computer vision and real-time processing of data requires have high memory demand as well as cost effectiveness and large support libraries were the add-on point for its selection. Fig.4 illustrate the raspberry pi 4 and its visuals.

Fig. 4. Raspberry pi 4 4GB RAM

B. Controller Unit

1. This will consist of an android application which will act as a VNC (Virtual Network Computing) client to control the Raspberry pi and ultimately the drone over the 4G network
2. The Message from controller to SBC and then to the flight controller will in passed using MSP (MultiWii Serial Protocol) which is understood by the Flight controller

C. Algorithms and software

1. *MTCNN:* Joint Face Detection and Alignment using Multi-task Cascaded Convolutional Networks [5]. Is the Neural Network based Face detection algorithm. Being a CNN it can detect even a smallest of face from an image. This algorithm is used in our system for better detection of faces thorough the drone camera where the odds are faces to be mostly small compared to overall viewable area or viewfinder.

Fig. 5. MTCNN

2. *Imutil (Webcam Video Stream):* This is the Multi-threaded stream of a webcam thus giving better throughput and smother video stream.
3. *Openface:* Detect faces with a pre-trained models from dlib or OpenCV [6]. Transform the face for the neural network. This repository uses dlib's real-time pose estimation with OpenCV's affine transformation to try

to make the eyes and bottom lip appear in the same location on each image. Use a deep neural network to represent (or embed) the face on a 128-dimensional unit hypersphere. The embedding is a generic representation for anybody's face. Unlike other face representations, this embedding has the nice property that a larger distance between two face embedding means that the faces are likely not of the same person. This property makes clustering, similarity detection, and classification tasks easier than other face recognition techniques where the Euclidean distance between features is not meaningful. We will be using this open source technology for face recognition as faces found using MTCNN will not be crisp sharp owing to vibrations generated by UAV, higher yaw or angle of face recognition, and various other factors implemented to keep cost low.

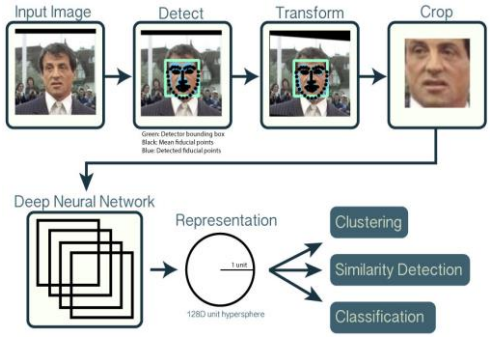

Fig. 6. DNN implementation

4. *DroneKit:* DroneKit-Python allows developers to create apps that run on an onboard companion computer and communicate with the ArduPilot flight controller using a low-latency link. Onboard apps can significantly enhance the autopilot, adding greater intelligence to vehicle behavior, and performing tasks that are computationally intensive or time-sensitive (for example, computer vision, path planning, or 3D modelling). DroneKit-Python can also be used for ground station apps, communicating with vehicles over a higher latency RF-link.

5. Conclusion

1. There are many applications of computer vision and automation in the field of robotics.
2. A swarm of small, light and cheap quadcopters could for example be deployed to quickly and without risking human lives explore collapsed buildings to find survivors.
3. Visual object detection is an important component in such applications of UAVs, and is critical to develop fully autonomous systems.
4. The idea of creating machines that can perform complex tasks without human assistance has great implications in many fields.
5. An autonomous or remote controlled vehicle can enter areas that humans cannot. This can allow humans to survey and interact with environments subject to radioactivity, highly contagious diseases and war.

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