MONITORING PEOPLE MOVEMENTS AND FACE TRACKING USING UNMANNED AERIAL VEHICLES (UAV) DURING COVID – 19 USING CLOUD COMPUTING

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Abstract

Face recognition is a process of identifying a person using a digital image. In nowadays there are varieties of face recognition software available but in general they work on facial axis which will be compared with the stored data within a database. There are lots of artificial intelligence based applications that can be able to uniquely identify the persons based on the patterns on ones facial texture while capturing the image it exchanges the GPS location with the cloud to identify the face gesture with the cloud. We will provide a thorough survey of the concepts of Cloud Computing and Big Data. In this paper, we conduct empirical studies to evaluate several factors that may influence the performance of face detection and recognition techniques on drones. Our findings show that the current face recognition technologies are capable of recognizing faces on drones with some limits in distance and angle, especially when drones take pictures in high altitudes and the face image is taken from a long distance and with a large angle of depression. We also find that augmenting face models with 3D information may help to boost recognition performance in the case of large angles of depression.

Keywords: Big Data, Cloud Computing, Face Recognition, UAV

1. Introduction

Drones, as known as unmanned aerial vehicles (UAV) and these are mini aircrafts without pilots on board it can be piloted remotely or autonomously. They can fly pre-programmed missions without manual controls using autopilot suites. Drones can easily reach locations which are too difficult to reach or dangerous for human beings to take pictures from bird's-eye view. Drones with aerial cameras are widely used in photogrammetric, surveillance, and remote sensing. In these applications, drones are used to detect or track down specific people on the ground, and to identify individuals from drones is thus a critical feature. Faces are part of inherent identities of people, and identifying individuals through their faces is human nature. Face recognition is popular in the field of computer vision and can be viewed as a badge of success in image analysis and understanding. Face recognition capability is undoubtedly a key for drones to identify specific individuals within a crowd. For example, during corona the peoples are restricted to come out of home and should not meet in groups so the drones first need to know who the targets are, and then the search can be launched. Thus, face recognition on drones would be a vital technical component in such applications; consequently, how well face recognition perform on drones is a research topic worth to be investigated. In this paper, we aim to understand the limits of the present face detection and recognition technologies while they are applied on drones, and provide possible guidelines for integrating face recognition into drone-based applications. Since drones may fly in-door or out-door under any kinds of illumination or environment conditions and may take pictures from the air with any possible combination of distance, altitude, and angle of depression. We conduct a series of empirical studies to examine the capability of two popular online face recognition services, Face++ and Recognition , in recognizing specific human faces on pictures collected by drones. The influences caused by distances and angles of depression from drones to the subjects are investigated so as to systematically investigate the limits of current face recognition technologies when applied on drones.

2. Face Recognition and Big Data Analysis

These are the two facets that scarcely had scarcely anything in common, but recent advances in several related domains such as Social Networking along with headway in the nationalization of law enforcement facial Databases have led them to converge in impactful ways and effectively aid in the forthcoming applications such as Face Tagging in Social Networking hubs such as Facebook along with being crucial component in critical applications such as criminal apprehension through mug shot matching, finding missing persons and so on. The principal advantage of Big Data analysis (BDA)is the significant accuracy boost and improvement in performance that it can tender due its capability of proffering massive number of images for the task at hand. This upsurge in accuracy is due to the fact that BDA relies on N=all sample size[1][3] i.e. all the facial characteristics for comparison (as opposed to about five or six points in conventional mechanisms). The popular BDA technologies include: Apache Hive, Apache Giraph and the already prominent Horton works, Hadoop and so on. Yahoo developed Apache Giraph in 2010, on the basis of a prominent Pregel paper published by Google [3]. Apache Giraph technology is based on the strategies of distributed computing and iterative graph processing system and is decisively reliant on the there three critical components of parallel computation and processing: Concurrent computation, communication and barrier synchronization [1][3]. These properties make Apache Giraph it an ideal candidate to aid in proffering efficient FR systems. Facebook also continues to widen its presence in the sphere of BDA by opting for the Apache Giraph methodology in order to proffer a novel social graph search that can effectively scale up to a trillion edges.

2.1 Face Recognition and Cloud Computing

It is a model in which the resources such as computational power, storage, and network and so on are proffered as services through a remote access mechanism. It has several desirable characteristics such as Rapid Elasticity, On-demand self services, ubiquitous network access and resource pooling In an FR system incorporating cloud services, the FR engine is located in the cloud, not in the local processing unit as is the case with traditional mechanisms. This attribute renders the system broadly accessible, in addition to providing the capability for quick and reliable integration with other applications. Moreover, the cloud incorporation facilitates high scalability in order to ensure that the system can be adapted to a wide user base. In addition, cloud-based FR systems have the advantage of real-time and parallel processing.. In the design phase, the decision regarding the bifurcation of components into the modules to deploy on the cloud and the ones to be located locally is crucial. It is suggested that a suitable choice regarding this, is to move both the FR engine and FR database onto the cloud to render a seamless system this direction has merits as it has been demonstrated to produce favourable results in. Several prominent commercial applications follow the client server model, where the query face is captured by the user and transmitted to the cloud server for conducting authentication with the gallery faces of the FR database located on the cloud. The aforementioned design choice prompts the need for the employment of privacy-preserving security protocols to secure the network traffic between the client and server. There are several reliable mechanisms available for the Cloud-based FR system such as Animetrics, BioID and the robust Face.com technique that serves as the primary component in Facebook's FR implementation.

3. Proposed Methodology

This section elaborates on a novel FR methodology that is cloud-based i.e. both its FR engine and FR database reside on the cloud and operates on a large-scale database of images (Big Data). The working of the proposed system applied for the task of Face Tagging in the context of social networks in illustrated in Fig.1. The new faces are enrolled through the user interface, which can either be a desktop or web application. In order to carry out the task of Face Tagging, the user interface communicates with the cloud-based web API (which typically runs on REST that contains the FR engine and a massive database of faces (the Big Data repository of Facebook for instance would consist of trillions of faces). The application (user interface) enrolls new faces and proceeds to encoded the face image, which is then sent to the cloud-based API which processes the image through the FR engine, which runs a pre-defined FR algorithm which will consist of several stages (face detection, extraction, matching and so on).The query face (the input face from the user interface) is then compared by the FR engine against a gallery of images (Big Data set of Facebook with tagged images in this instance) and once a conclusive match is determined, the query face classified as belonging to a particular individual. Subsequently, the face can be tagged accordingly and the result is sent back to the local or web

application. Although the framework described above centers on Face Tagging, it can also be employed for Face Authentication/Access Control tasks. The modular design of the proposed system, as illustrated in Fig.1 ensures that the system can be upgraded with relative ease
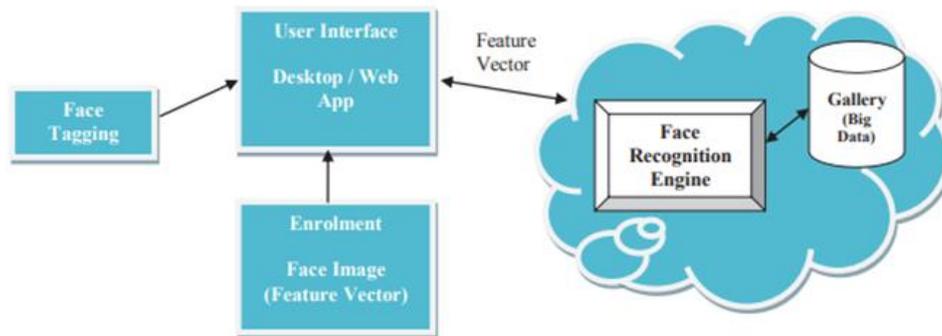

Fig1: Framework of proposed Methodology

The network traffic between the user interface and the cloud needs to be secured to preserve privacy and the application of the following multi-level security solution is demonstrated to be feasible employment of HTTPS protocol for data transfer, utilization of certificates (through SSL protocol), encryption of the faces and other sensitive data in the database and restrict access to the cloud service through a complex 40 digit password

4. Experiments Setup

Face++ and Recognition are two famous on-line face recognition services. They perform well in corresponding benchmarks and provide open API for development of various kinds of applications. Thus, Face++ and Recognition are adopted for examining how current methods are effective on recognizing faces from the pictures collected by drones. Figure 1 shows our experiment setup. We took frontal facial images from 11 subjects with GoPro, the most popular sports camera for aerial photography in the market. Because controlling drones to take pictures at exact altitudes and positions for various subjects is difficult, we put our GoPro onto a cradle for photographing instead of taking pictures with drones. The GoPro is set up at 3, 4, and 5 meters in heights to simulate the drones flying at the certain altitudes, and the pictures are taken every 0.5 meters between 2 to 17 meters away from the subject on the ground to simulate a 15 meters straight flight toward the subject. We also take the frontal facial pictures at 1.5 meters in heights for comparison. The angles between the horizontal and the line from the GoPro to the subjects' top are considered as the angles of depression between the aerial camera and the subjects. We also ask the subjects to observe the following rules: (1) taking off their glasses to simplify the factors in face recognition, (2) gazing straight ahead to keep a consistent pitch angles of their faces, (3) keeping a deadpan face to suppress influences introduced by facial expressions, and (4) standing still to eliminate the affects caused by movement.
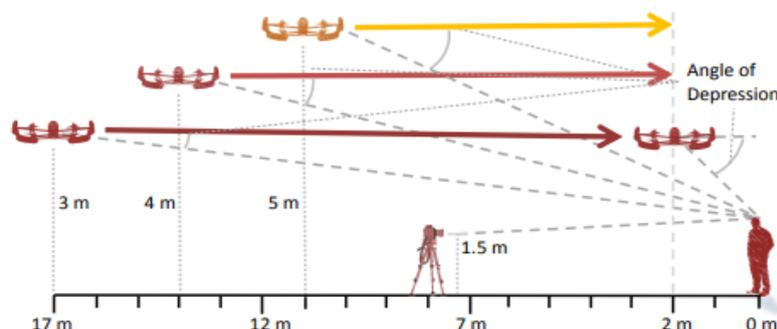

Fig2: Sketches of experiment setup

4.1. Face Recognition

In this section, we evaluate how distances and angles of depression influence the performance of face recognition. 5.2.1 Impact of Distances First, we investigate how distances between drones and their targets impact the performance of face recognition in this section. Among all the facial images we extract, the faces obtained while the camera is set up at 1.5 meters in heights and 2 to 12 meters in distances are used for the evaluation because within the settings, (1) both Face++ and Recognition show relatively high and stable TPR in face detection, and (2) taking the heights of the subjects into consideration, the angles of depression from the camera to the targets among the settings are less than 10° , and thus, the influences introduced by angles of depression are alleviated.
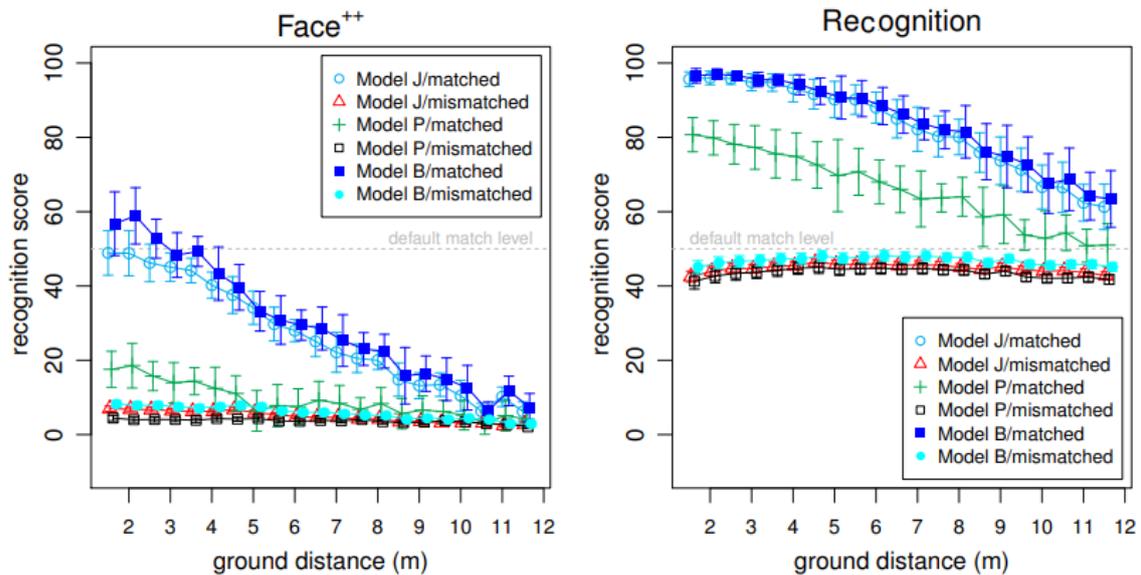

Fig3: Scores under various ground distance between the drone and the subject.

Face++ gives scores between 50 to 100 for evaluation of whether a face belonging to or not to a designated person. For example, we train a face recognition model for ram with his own portrait photos. Then, another picture of Ram and a picture of Kumar, a person who looks nothing like Ram, are input to Face++ for recognition. To evaluate the distinguish ability of Face++ and Recognition; we define matched and mismatched cases as following. A matched case represents the face being rated belonging to the owner of the model used for recognition. On the contrary, a mismatched case is recognitions between a face and the models belonging to the subjects other than the face owner. The score of a mismatched case is the mean value of the scores for all such recognitions.

5. Discussion

From the results, we know that both Face++ and Recognition suffer poor face detection rate in large angles of depression. Since we do not consider the face detection rate, The influences introduced by low face detection rate at large angles of depression are discussed in this section. Assuming both the methods give 0 points to the undetected faces for matched and mismatched cases. Figure 6 shows the AUC (area under curve) of ROC (receiver operating characteristic curve) representing the capability of both the methods in distinguishing the matched cases from the mismatched ones among various combination of heights and distances while Model B is applied. As a result, the influences from angles of depression and distances are significant. Take 0.75 as the standard of acceptable distinguish ability, Face++ is applicable on drones while the distances are within 12 meters, and so does Recognition within 14 meters. Both the methods show no distinguish ability in large angles of depression (with 5 meters in heights and ground distances less than 3 meters), and need some distances away from the targets to prevent the influences introduced by angles of depression. Face++ needs about 3 and

5 meters on the ground for heights in 4 and 5 meters correspondingly, and Recognition needs 3 meters on the ground for heights in 5 meters.

6. Conclusion and Future work

In this paper, we investigate how altitudes, distances, and angles of depression are influential to the performance of face recognition on drones. Through the empirical studies on Face++ and Recognition, we conclude that the present face recognition technologies are able to perform adequately on drones. However, some obstacles need to be conquered before such techniques can unleash their full potentials: 1. The small-sized facial images taken by drones from long distances do cause trouble to both face detection and recognition. 2. The pose variances introduced by large angles of depression dramatically weaken the capability of both face detection and recognition. Power consumption will be part of our future work.

References

[1]. G. B. Huang, M. Ramesh and T. Berg and E. Learned-Miller. Labeled Faces in the Wild: A Database for Studying Face Recognition in Unconstrained Environments. Technical Report 07-49, University of Massachusetts, Amherst, October 2007.

[2]. GoPro, Inc. GoPro, http://gopro.com. [6] International Civil Aviation Organization. CIR328 AN/190 Unmanned Aircraft Systems (UAS), 2011.

[3]. Ira Kemelmacher-Shlizerman, Ronen Basri. 3D Face Reconstruction from a Single Image Using a Single Reference Face Shape. IEEE Transactions on Pattern Analysis and Machine Intelligence, 33(2):394–405, 2011

[4]. P. Korshunov and W. T. Ooi. Video quality for face detection, recognition, and tracking. ACM Trans. Multimedia Comput. Commun. Appl., 7(3):14:1–14:21, Sept. 2011.

[5]. M. Bartholmai, E. Koeppe, and P. P. Neumann. Monitoring of Hazardous Scenarios using Multi-Sensor Devices. In Proceedings of SENSORDEVICES 2013, pages 9–13, 2013.

[6]. Megvii, Inc. Face++, http://www.faceplusplus.com/.

[7]. N. Davis, F. Pattaluga, and K. Panetta. Facial recognition using human visual system algorithms for robotic and UAV platforms. In Proceedings of TePRA 2013, pages 1–5, 2013.

[8]. N. Dijkshoorn et al. Amsterdam Oxford Joint Rescue Forces - Team Description Paper - Virtual Robot Competition - Rescue Simulation League - RoboCup 2011. In Proceedings of the 15th RoboCup Symposium, pages 1–8, 2011.

[9]. N. Shachtman. Army Tracking Plan: Drones That Never Forget a Face, http://www.wired.com/2011/09/dronesnever-forget-a-face/.