Novel Vision-based Thermal People Counting Tool for Tracking Infected People with Viruses Like COVID-19

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Abstract--- People counting applications have been used in diverse applications. The ability and accuracy of thermal imaging over conventional image cameras has led to the implementation of thermal cameras in people counting/tracking applications. This paper presents a thermal people counting/tracking application, capable of tracking people with signs like high body temperature for COVID 19. The people application would be remotely monitored from a single centralized PC station and can be connected also to several thermal imaging sensors for data collection. This application can help speed up the tracking rate of COVID 19 cases that are unknow. By placing the thermal imaging sensor at several locations like malls, schools, airport etc, the application can help identify people with high body temperation and isolate them and their data can help keep others safe.

Keywords--- Counting, Imaging, People, Thermal.

I. Introduction

Thermal imaging is a non-contact temperature measurement technology which can provide remote monitoring of the thermal distributions, and further be applied in the cloud IoT, big data analytics, securing monitoring with no privacy involved. As a main application, people counting is a vital task for operational, safety and security functions. Systems with these functions are often extremely effective tools for establishing awareness [1], [5]. Information about the amount and distribution of individuals in a very given space are often used to develop business intelligence, like the interest on some product can be evaluated by the amount of shoppers visiting the area, count the amount of a store's guests and different applications in behavioral economics [2], [6], [7]. Other areas where people counting is helpful are crowd management [2], transport [8], and staff planning which are related to the density of people traffic or to indicate congestion. This kind of information can also be utilized in several ways. Also real-time people counting in either normal camera mode or people counting in thermal camera mode has been found to be resourceful in some applications. Some of such applications include security, smart buildings, or people management such as in pedestrian traffic management or tourists flow estimation and also improve energy efficiency by optimizing air conditioning, lighting and heating, or to develop emergency evacuation procedures [3].

Over the years several methods have been used to count people, such as tally counter, infrared beams, thermal imaging, computer vision, Service Set Identifier (SSID) from mobile phones, wireless sensor networks and Wi-Fi based counters [9], [10], [11], [12], [13], [14], [15], [16], [17], [18]. But as time passed, computer vision video analytics, where people are counted via a live cameras stream has increased considerably, as a result of the advancement of image processing algorithms and computers' technology. In the study of [19] an adaptive crowd

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counting system for video surveillance applications was developed based on pair of collaborative Gaussian process models (GP) with different kernels, which are designed to count people using normal camera by taking the level of occlusion into Account. Their results indicated that the level of accuracy of method adopted was poor, due to the presence of image noise. The method didn't take into account the fact that in every image there exist sets of noise that needs to be filtered for better pixel estimation. [20] modified the prevailing method but instead they used face detection technics and tested in different scenarios, their application worked but failed in certain instances, one of the very obvious reasons is when a face isn't well detected. Examples is in a crowed place not all faces ate directly facing the camera. So for this method to be accurate all faces must face the camera. Another very crucial area where the use of camera fail was in detection at night, since the camera can only capture proper and clear face in the presence of light. This lead to the use of thermal imaging cameras for proper counting of people in any condition, either day or night. [21] developed a software that counts people using an identifier and the software was connect via USB, this technic performed poorly because The visual analysis was done using background identification technique. Rather than run proper image processing algorithm from stages to stages, an identifier was used to perform the counting. The issue of osculation and poor lightening was taking into account in [21], [22] where they try to address the challenges due to changing lighting conditions and the complexity of scenes with many people occluding one another. Their method was tested on two five-minute video sequences captured at a public event with a moderate density of pedestrians and heavy occlusions. But results indicated poor performance when tested on live video stream.

Although most of this method seem simple though; there are some situations difficult to solve even with today's computer speeds (the algorithm has to operate in real-time, so it makes limits for the complexity of methods for detection and tracking), one of such difficulties is people occlusions. Other issues with visual counting system is the cost. High spatial resolution visual camera and a frame grabber are required which makes the system expensive. Even with high spatial resolution cameras the inaccuracy problem still remains for detection of people. Say if a person is wearing same shades of grey as of background it will be difficult to distinguish between the background and same shades of cloths.

Also there is no such ways of distinguishing with accuracy a person from different objects. These objects in the background are one of the main concerns that raised false alarms in many automated people counting systems. Whereas the background separation is not the easy task. Visual automated counting systems can only work in the presence of ambient lighting such as office environment, sunlight, or other interior types of lighting. In case of emergencies like fire, blackouts the system will malfunction during evacuation of the building thus will render useless during emergencies. Similar case is with exterior use of people counters [5], there will be false alarms during night time by the counting system if there is no special lighting arrangement in the area under consideration.

Thermal imaging cameras, which use thermography, are a fast, contactless, and reliable method to detect a fever, a common symptom of COVID-19.

Figure 1: Thermal Imaging Displaying Temperature

Fever is one of the most common symptoms of the novel coronavirus, affecting 87.9% of people infected with COVID-19, according to the World Health Organization. Remotely monitoring public spaces for early signs of disease and tracking identified cases could prove beneficial in protecting the public and taking some of the load off health care workers. Therefore, while health care workers are putting their lives at risk to treat and save patients, we can also do our part in minimizing the spread of the infection with the help of this thermal people counting/tracking application to ensure that preventive measures are made properly, reducing the burden on the medical staff.

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II. Methodology

The vision based thermal tracking application for infectious disease has the ability to scan as much as 30 people simultaneously at a distance of 3 meters, or nearly 10 feet, with a temperature accuracy of roughly 0.6 degrees Fahrenheit (0.3° C). Installed in major entryways, checkpoints or other crowded venues, it can provide mass screenings, as well as recurrent temperature monitoring for potentially infected individuals. The key feature of this application are thermal camera sensors and an artificial intelligence (AI) driven algorithm for temperature analysis. The thermal sensor provides real-time temperature readings in the targeted area, displaying new data in less than one second. An AI algorithm to recognize human faces and body as seen in figure 1a and 1b, even those obscured by masks, headwear or glasses is used.

Therefore, using video analytics to monitor and process video streams or images in real-time. While tracking the videos or pictures, the software identifies attributes, events or patterns of specific behavior via video or image analysis of monitored environments. Video analysis software also generates automatic alerts and can facilitate forensic analysis of any data identifying trends, patterns and incidents.

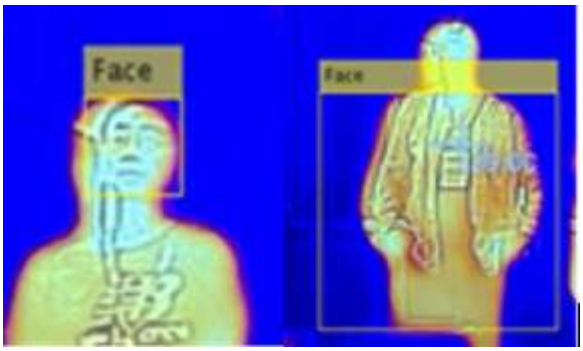

Figure 1a: Face Detection Figure 1b: Body Detection

The second technique used in determining the number of people in a thermal image is by possible body detection. Some thermal photos might not have clear possible head faces of people in it. But with the help of the human figure body detection technique, the people counter application can calculate the number of persons in the thermal image as seen in a figure 1b

III. Discussion of Results

Thermal Imaging Processing

All objects transmit heat by three methods: Conduction, convection and radiation. Conduction moves heat through strong items. Convection moves heat through liquids like air and water. Radiation moves heat through electromagnetic radiation. Items ceaselessly emanate heat with certain frequency. In this way, thermal imaging changes over thermal radiation into advanced signal and which is changed over into obvious picture.

Figure 2: Detected Persons with their Body Temperature

Figure 2 shows the screenshot of the proposed thermal people counting/tracking application as it tracks and reads their body temperature respectively. If an individual's body temperature is high, the application would raise an alarm and the person gets isolated. This thermal counting/tracking application would also provide instant alerts to specified authorities responsible for tracking infected or people with COVID 19 symptoms, with photos, thermal readings and

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geolocation points. The reporting system can be customized to trigger audible alerts at regular intervals, such as daily or weekly, to aid in tracking possible COVID-19 cases.

Also in addition to the thermal imaging sensor and AI driven algorithm, the system would have a processing box with cloud data storage and a web-based user management user interface. videos and photos are automatically deleted in real time, except for pictures of people with high temperatures. Those are stored in a secure cloud account and deleted at a time set by the user, such as 24 hours.

IV. Conclusion

The goal of this study was to develop and test an AI based thermal people counting application with a Smart glass window façade. The application was tested and a precise and accurate count was recorded for all individuals who came into the thermal camera range of view. Their body temperatures were also recorded at the exact time each individual was counted. The test was carried out in both night and day and the result still was accurate. The data gotten from the count and the data of the body temperature can then be used for energy efficacy operations like control of air-conditioning and lightening. This technology has proven to be effective in implementing in smart concept buildings.

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