Mathematical Statistician and Engineering Applications
ISSN: 2094-0343
2326-9865

In-store Intelligent Customer Counting and Monitoring System

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Article Info
Page Number: 2598-2605
Publication Issue:
Vol. 71 No. 4 (2022)

Article History
Article Received: 25 March 2022
Revised: 30 April 2022
Accepted: 15 June 2022
Publication: 19 August 2022

Abstract
A big group of individuals that have congregated in one location is referred to as a crowd. The relevance of crowd surveillance is becoming more apparent to different security and event management organizations all over the globe as a result of the rising worry about the general population. These difficulties with crowding seen in retail malls need immediate attention. This article will discuss how we are utilizing picture classification and object recognition to acquire a count of the number of individuals currently in the shop. A sophisticated crowd monitoring system for the shop has been designed by our team employing the regression techniques. In this case, we utilize the Yolo algorithm for real-time object identification. Yolo is a method that employs a single neural network for the purpose of object detection. To put it simply, we want to anticipate a set of objects and the bounding box that specifies where the objects are located. Each box may be traced by employing a total of four descriptors, including the center of a bounding box, its height, and its breadth value, which each relate to a different grouping of objects. It is anticipated that this would boost the ability of shops and consumers alike to gather information about traffic patterns of individuals. Because of this, we are able to make predictions in almost real-time, and it is simple to obtain information such as the density map, the calculation of the number of people or count, and the retail rush hour.

Keywords: Crowd Monitoring, Object Detection, Customers, and Headcount are some of the Keywords that may be used here.

I. INTRODUCTION

The level of competition in the market is increasing on a daily basis, making it very vital for merchants to adjust their practices to accommodate the most current trends. Many consumers do not prefer to shop at establishments that are very busy; hence, it would be of great assistance to customers if they are informed of the number of shoppers present in each individual section of the business. Customers may easily go to another department if they choose to do so, since this allows them to do so. Retailers also have the opportunity to maximize production at the busiest time of the year for their businesses. In the course of performing these ceremonial rites, there is a possibility of bias or of making a mistake. The in-store automation or mechanics should be programmed to initiate the in-store monitoring system as part of an effort that should be made to make things better. This would be one approach to accomplish this goal. The system that is being suggested now provides users with a selection of techniques for accumulating information regarding traffic patterns. These

methods include those that are connected to IoT and deep learning. We will, for the most part, calculate how many people live in each unique sector or zone by collecting certain video inputs dependent on the shopping departments. The structure is going to have a procedure to analyze and process the data in the form of frequency or the analysis map of people, which is going to provide the information of frequently visited zone in the store, and the bar graphs are going to have the representation of count of people and the rush hours. Users will always discover to their satisfaction that the sequence of photographs as well as the visualization tools offered by the system are to their benefit. [2]

The most recent developments in the internet of things and deep learning have led to a number of inspection requisitions being fulfilled and successes being made, especially in the area of crowd monitoring. Surveillance systems that are authorized with sensors and gadgets have over the time supplied a practical and accurate method to regulate and record crowds of people in retail complexes. These systems have been developed throughout the years. It's possible that the sophisticated approaches will not work well because of the crowded sceneries, the close interaction of the objects, the point of view of the camera, the abrupt changes in motion, and the blockage issues. In order to get beyond these obstacles, we have used a few deep learning and attribute-related strategies. When it comes to detecting and counting persons in the footage, the approaches that we have mostly worked on are those that focus on the face or head region. It has been observed on the occasion that the persons seen in the photographs are blurry or otherwise masked by the presence of other people. We may examine this issue by shifting our perspective from the frontal to the above one. By implementing these steps of the crowd monitoring system, we have achieved a state-of-the-art answer to the problem of objectively managing big crowds. This enables the shop to have a better knowledge of their consumers, which ultimately helps improve the performance of the business when it is open.

[3] The unexpected spread of the covid-19 virus over the whole planet. As a result of this, proper crowd surveillance systems are required to be allotted in locations such as public gathering areas and particularly in retail establishments. This is the precautionary course of action that should be taken. By implementing measures of social separation at an earlier stage, the number of newly discovered viruses may be cut by a significant amount. The YOLO v4 image classification, and object detection approach will be used in this proposed system in order to differentiate each person from the background. Following this step, bounding boxes will be utilized in order to track the identified individuals. Using frames per second, we were able to determine the performance or representation of this system (FPS).

The processing of videos, which we will provide as inputs, is the answer to this problem. Because of this, we will be able to estimate the number of customers shopping during peak shopping hours, and it will also assist us in doing retail crowd study.

II. WORK CONNECTED TO THIS

[4] Purchases Made In Store- The creation of an intelligent system for monitoring large crowds is one of the most difficult jobs that must be accomplished. Since its inception, image processing and information about the head region have been the two most crucial components

of the Crowd Monitoring System in urban contexts. Some researchers have also created methods for detecting and counting people in overhead views by employing information from the head, head-shoulders, or the whole body from above. These methods may be used to recognize and count people in a crowd. It is possible for these methods to make use of information from any combination of these three locations. This section gives an overview of the many aerial views that may be utilized for counting persons and locating them.

III. A STUDY OF THE LITERATURE

[5] A Method for Managing Large Gatherings The physical distance monitoring system includes both real-time trajectory and group analysis as components of the system. Alessandro Corbetta, Caspar Federico Toschi, A. S. Pouw Alessandro Corbetta, Frank van Schadewijk [1]. Since real-time and privacy-preserving observation of pedestrian dynamics in public places is becoming more widespread, it is only logical to use these technologies to evaluate adherence to physical separation in crowded locations and to compare the efficacy of crowd control techniques in congested regions. In this system, we have two key goals that we want to accomplish: first, we want to show an efficient and scalable analytical framework that, by using sparse graph technology, is capable of managing pedestrian tracking data in real time as well as offline. Second, we examine the pre-Covid situation in comparison to the current one while carrying out a comprehensive assessment of the mutual distances and exposure times at a railway station in the Netherlands. This method, which was developed to investigate different strategies for managing crowds in public transportation facilities, was selected due to its adaptability and ease of implementation. The research project investigated different strategies for managing crowds in public transportation facilities. As a consequence of this, it is possible to handle problems other than the physical separation of persons. These concerns include the surveillance of groups while respecting their privacy and identifying where they travel. In addition, it is able to determine where individuals go.

[6] Practical Automated Video Analytics for Crowd Counting and the Monitoring of Crowds: This research was carried out by the following scientists: Kenneth Jian Wei Tang, Kang Hao Cheong, Jin Ming Koh, Joel Weijia Lai, Sandra Poeschmann, U. Rajendra Acharya, and Simon Ching Man. In addition, the following researchers contributed to this study: Yu, Kenneth Jian Wei Tang, Kang Hao Cheong, Jin Ming Koh, Joel Weijia Lai, Sandra Poeschmann, U. Rajendra Acharya, Simon Ching Man [2]. The use of video analysis is becoming more common in a broad variety of contexts, including urban security, facility management, and demographic research, to name a few. Despite the growing need for closed-circuit television (CCTV) and other related technologies in public spaces, there is still a significant shortage of easily deployable automated monitoring. This is the case despite the fact that there are many public locations. We provide a solution that is both cost-effective and efficient in this system. It combines the use of computational object recognition with video feeds in order to enable completely automated tracking, identification, and counting of human traffic. The use of computational object identification with video feeds is the approach taken by this solution. People of a medium-sized stature are now capable of doing automatic video analysis thanks to the introduction of this technology.

[7] System for the Monitoring of Crowds [3]: During the process of the [7] crowd monitoring system [3]: detection and following protocol technique, a model for machine learning is constructed using the data that was collected during that time. It could be difficult to stand in line depending on the amount of time that you have to wait as well as the conduct of other people who are moving through the line. Because of this, as part of this system, they will develop an application that will identify every person in the surrounding region and keep track of those who are entering a queuing system. The difficulty of waiting in line will decrease as a result of this. When the owner of the firm is reviewing the present situation and making decisions, such as whether or not to add additional queues to the system, this will be beneficial to them. The owner of the firm will use this application as a template for doing business analysis for the company. In order to arrive at an accurate computation of the average, the data collected via the tracking and identification of individuals is used.

[8] Wafaa M. Shalash, Aliaa Al Hazimi, and Basma Al Zahrani, "A Mobile-Based Crowd Management System" [8] Wafaa M. Shalash, "A Mobile-Based Crowd Management System"

1 [4] The purpose of the technical advances that have been made in recent times is not only to make people's lives easier, but also to make them safer. While a person is in a crowded location, such as a stadium, metro station, or holy site when conducting Hajj, it is possible that not only their degree of comfort, but also their level of safety, is impacted. The presence of a large crowd may bring about a number of unfavorable outcomes, some of which include but are not limited to crowd crushes, mass panic, pushing, stampedes, and a general loss of control. One of the improvements that came up as a result of this initiative was a mobile-based approach to the management of crowds. The system is made up of two components: the first is a server-side software that makes use of IP cameras to determine the number of people present in certain areas, and the second is a mobile application that has a number of different capabilities. The first component of the system is a software that runs on the server, and the second component is an application that runs on mobile devices.

Shobhit Saxena1, Francois Br'emond2, Monique Thonnat2, and Ruihua Ma are the authors of the paper titled "Crowd Behaviour Recognition for Video Surveillance."

[5]: In this work, we begin by discussing the selection and extraction of crowd features, and then we go on to propose a KLT tracker-based method for identifying and tracking multiple-frame feature point locations. The identification of crowd behavior is rapidly becoming a prominent research topic in the field of video surveillance for public areas. The approach for monitoring the crowd is reliable and generates precise motion vectors for the crowd. There are now specified models for crowd events; in particular, composite events that contain evidence accumulation have been shown to increase detection reliability and visibility. It is possible for basic specialized models to accurately forecast a few common crowd behaviors if they are used to identify crowd events on real-world sequences. In the testing, real surveillance video sequences were shown, some of which had crowd scenarios. Because of this, the same kind of event may be represented quite differently depending on the circumstance, which would need the formulation of a lot of models.

IV. METHODOLOGY

A. Representation in Schematic Form

The Basic Block Diagram that can be seen in figure 1 gives an overview of the manner in which the various components of the proposed system are structured as well as related to one another. This diagram can be viewed by clicking on figure 1. As can be seen in the illustration, the camera supplies the video input for image capture, which is then followed by object recognition and feature extraction, and finally, it shows the number of people that were counted in a certain department.

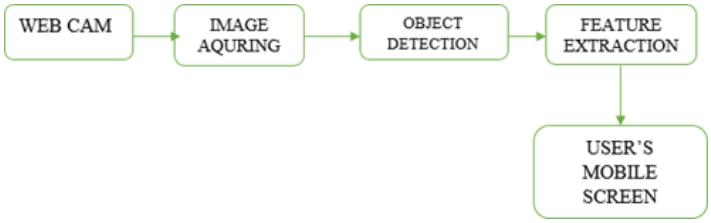

Fig.1. Basic Block Diagram

A. Architecture of the System

This architecture description is a precise description and representation of a system, organized in a way that supports the reasoning about the structures and the behavior of our application. This description was organized in a way that helps support the reasoning about the structures and the behavior of our application. This architecture is made up of a number of different created system components and sub-systems that will collaborate with one another to put the full system into action. The architecture of the system is shown in figure 2.

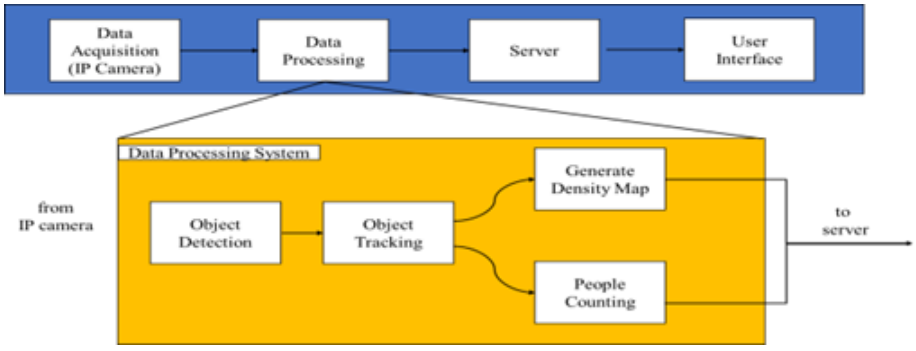

Fig.2. System Architecture

A. Flow Chart

The flow chart that is shown here is an example of a possible method that may be utilized to solve the modules in sequential order. In the flow chart that can be seen in figure 3, we demonstrate how a user will be able to access a certain department crowd via the application. First, he will install the program, and then on the main screen, he will see symbols representing each of the departments. This will allow him to decide, based on the footage obtained from the camera, which departments have the greatest number of people working in

them.. Additionally, there will be an objection detection mechanism that will identify individuals and the flow of their path accordingly..

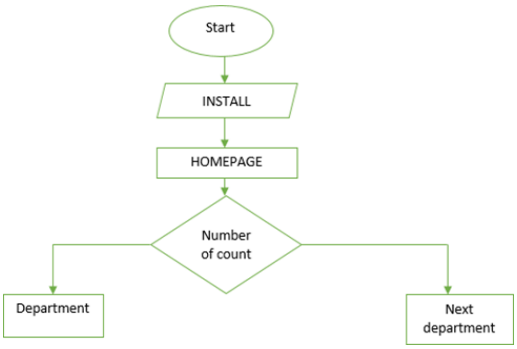

Fig.3. Flow Chart

C. Use Case

This use case will illustrate the many communication options available to consumers as well as store managers when interacting with the system. In the use case that is depicted in figure 4, we show that an administrator is able to have a look at a video sequence or video inputs, in which we will have videos of each departmental section, such as the grocery section and the fashion department zones, and later on, these videos go to object detection, in which the people are identified using YOLO algorithm, from which we will get the count of the people these are three sections where an administrator is able to interact with the videos and get information about the videos.

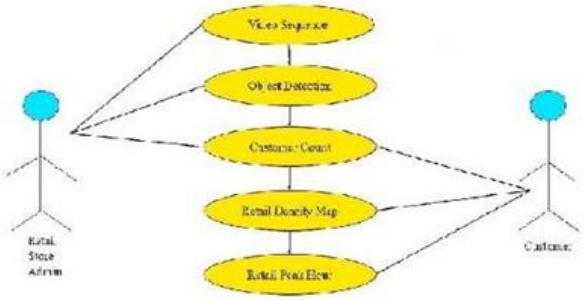

Fig.4. Use Case

I. RESULT

The number of persons that were counted in the shop may be deduced from the output obtained by the implementation. It gives the total number of people, which is 4.

II. CONCLUSION

The purpose of this study is to demonstrate a crowd monitoring system that is based on artificial intelligence. Retailers may benefit from an in-store crowd monitoring system since it provides information in near real-time and makes them readily accessible. These statistics can include a retail density map, customer count, and more. The system is already in place thanks to its essential technology as well as the retail peak hour. The use of overhead cameras allowed for both the counting of persons and the detection of their presence. sequences of video Lastly, we feel that the technology we have presented, which we call the "In-store smart crowd monitoring system," will assist business owners in more effectively collecting crowd data.

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