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Application Details	
APPLICATION NUMBER	202141018141
APPLICATION TYPE	ORDINARY APPLICATION
DATE OF FILING	20/04/2021
APPLICANT NAME	1 . Ms. D. Sree Lakshmi (Assistant Professor) 2 . Ms. A. Divya (Assistant Professor) 3 . Dr. K. Swathi (Professor) 4 . Dr. P. Rama Koteswara Rao (Professor) 5 . Mr. Sridhar Kavuri (Deputy Head) 6 . Dr. Ch. Surya Kiran (Professor)
TITLE OF INVENTION	CROWD DETECTION CAMERA TO MAINTAIN DISTANCE AND IDENTIFY THE SUSPECT USING AI-BASED PROGRAMMING
FIELD OF INVENTION	COMPUTER SCIENCE
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E-MAIL (UPDATED Online)	
PRIORITY DATE	
REQUEST FOR EXAMINATION DATE	--
PUBLICATION DATE (U/S 11A)	14/05/2021

Application Status	
APPLICATION STATUS	**Awaiting Request for Examination**

			View Documents

➡ Filed ➡ Published ➡ RQ Filed ➡ Under Examination ➡ Disposed

पेटेंट कार्यालय
शासकीय जर्नल

OFFICIAL JOURNAL
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THE PATENT OFFICE

निर्गमन सं. 20/2021	शुक्रवार	दिनांक: 14/05/2021
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PUBLICATION OF THE PATENT OFFICE

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(22) Date of filing of Application :20/04/2021 (43) Publication Date : 14/05/2021

(54) Title of the invention : CROWD DETECTION CAMERA TO MAINTAIN DISTANCE AND IDENTIFY THE SUSPECT USING AI-BASED PROGRAMMING

(51) International classification	:G06K0009000000, G06K0009200000, G09B0007000000, F16M0011420000, A61P0037020000
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(62) Divisional to Application Number	:NA
Filing Date	:NA

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6)Dr. Ch. Surya Kiran (Professor)

(57) Abstract :

Our invention Crowd Detection Camera to Maintain the Distance and Identify the Suspect using AI- Based Programming is a Smart appliance with built-in advanced cameras, such as the moveable Nest Cam and 3600D rotation Amazon Echo Look, are becoming pervasive. The invention is also a hold the promise of bringing high fidelity, contextually rich sensing into our complex home system and the workplaces and other environments like office, university, engineering institute, meeting room, etc. The invention is also including a Despite recent and impressive unique advances, complex computer vision intelligent systems are still global in the types of open sensing questions they can answer and more importantly, do not easily set of generalize across diverse human environments.The invention is a researchers have investigated hybrid crowd- and AI-powered methods that collect human labels to advanced bootstrap automatic processes and the However, deployments have been little and confined to institutional defined settings, leaving open complex questions about the scalability approach. The invention we describe our iterative unique development of Zensors++(Z++) a 1/1 full-stack Crowd-Artificial intelligent advanced camera-based sensing system that moves real-time significantly beyond prior global work in terms of scale, question diversity, accuracy, latency, economic feasibility, unique feature, Delay feature, Real time function, etc.

No. of Pages : 19 No. of Claims : 6

FORM 1 THE PATENTS ACT 1970(39 of 1970) & The Patents Rules, 2003 APPLICATION FOR GRANT OF PATENT (See sections 7, 54 & 135 and rule 20(1)	**(FOR OFFICE USE ONLY)** Application No: Filing Date Amount of Fees Paid: CBR NO: Signature:
1. APPLICANTS REFERENCE / IDENTIFICATION NO. (AS ALLOTTED BY OFFICE)	

2. **TYPE OF APPLICATION [Please tick (✓) at the appropriate category]**

Ordinary (✓)		Convention ( )		PCT-NP ()	
Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )

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3B. CATEGORY OF APPLICANT [Please tick (✓) at the appropriate category]

Natural Person (✓)	Other than Natural Person ()		
	Small Entity ( )	Startup ( )	Others ()

4. INVENTOR(S): [Please tick (✓) at the appropriate category]

Are all the inventor(s) same as the applicant(s) named above?	**Yes (✓)**	No ()

If "No", furnish the details of the inventor(s) **N.A**

Name	Nationality	Country of Residence	Address
NA	NA	NA	NA

5. TITLE OF THE INVENTION:

Crowd Detection Camera to maintain distance and identify the suspect using AI-based Programming

6. AUTHORISED REGISTERED PATENT AGENT(S)		NA
ADDITIONAL PATENT AGENTS	NA	

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8. IN CASE OF APPLICATION CLAIMING PRIORITY OF APPLICATION FILED IN CONVENTION COUNTRY, PARTICULARS OF CONVENTION APPLICATION: N.A

Country	App. Number	Filing Date	Name of the Applicant	Title of the Invention	IPC (as classified in the convention country)
NA	NA	NA	NA	NA	NA

9. IN CASE OF PCT NATIONAL PHASE APPLICATION, PARTICULARS OF INTERNATIONAL APPLICATION FILED UNDER PATENT CO-OPERATION TREATY (PCT):

International application number	International filing date as allotted by the receiving office.
NA	NA

10. IN CASE OF DIVISIONAL APPLICATION FILED UNDER SECTION 16, PARTICULARS OF ORIGINAL (FIRST) APPLICATION: N.A

Original (first) application number	Date of filing of Original (first) application
N.A.	N.A.

11. IN CASE OF PATENT OF ADDITION FILED UNDER SECTION 54, PARTICULARS OF MAIN APPLICATION OR PATENT: N.A

Main application / patent Number	Date of filing of main application
N.A.	N.A.

12. DECLARATIONS:

(i) **Declaration by the Inventor:**

(**In case the applicant is an assignee**: the inventor(s) may sign herein below or the applicant may upload the assignment or enclose the assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period).

We, the above named inventor is the true & first inventor for this invention and declare that the applicant herein is my assignee or legal representative: **NA**

(ii) **Declaration by the applicant/s in the convention country:**

(In case the applicant in India is different than the applicant in the convention country: the applicant in the convention country may sign herein below or applicant in India may upload the assignment from the applicant in the convention country or enclose the said assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period)

I/~~We~~, the applicant(s) in the convention country declare that the applicant(s) herein is/~~are~~ my/~~our~~ assignee or legal representative. : **N.A.**

(iii) **Declaration by the applicants:**

We, the applicants hereby declare that: -

1. We are in possession of the above-mentioned invention.
2. The **Complete Specification** relating to the invention is filed with this application.

3. The invention as disclosed in the specification uses the biological material from India and the necessary permission from the competent authority shall be submitted by us before the grant of patent to us: **N.A.**
4. There is no lawful ground of objection to the grant of the patent to me/ us.
5. We are the assignees or legal representatives of true and first inventors:
6. The application or each of the applications, particulars of which are given in Para – 8 was the first application in convention country/countries in respect of our invention: **N.A.**
7. We claim the priority from the above mentioned application filed in convention country/countries and state that no application for protection in respect of the invention had been made in a convention country before that date by us or by any person from which we derive the title: **YES**
8. Our application in India is based on international application under Patent Cooperation Treaty (PCT) as mentioned in Para-9: **N.A.**
9. The application is divided out of our application particulars of which is given in Para-10 and prays that this application may be treated as deemed to have been filed on N.A. Under sec.16 of the Act: **N.A.**
10. The said invention is an improvement in or modification of the invention particulars of which are given in Para-11: **N.A.**

FOLLOWING ARE THE ATTACHMENTS WITH THE APPLICATION

(a) **Form 2**

Item	Details	Fee	Remarks
Complete specification) #	No. of pages:		
Claim(s)	No. of claims: No. of pages:		
Abstract	No. of pages:		
Drawing(s)	No. of drawings: No. of pages:		

In case of a complete specification, if the applicant desires to adopt the drawings filed with his provisional specification as the drawings or part of the drawings for the complete specification under rule 13(4), the number of such pages filed with the provisional specification are required to be mentioned here.

1. Complete specification (in conformation with the international application)/as amended before the International Preliminary Examination Authority (IPEA), as applicable (2 copies) **N.A**
2. Sequence listing in electronic form **N.A**
3. Drawings (in conformation with the international application)/as amended before the International Preliminary Examination Authority (IPEA), as applicable (2 copies) **N.A**

4. Form 1, 2, 26-1750Rs.
5. Statement and Undertaking on Form-3
6. Declaration of Inventor ship on Form-5
7. Request for Publication Form9 -2750.Rs
8. Form18 Examination Request, 4400.Rs
9. Other Form according to need: 880,1600,2500,4000, …
10. Power of Authority
11. Other from 4 to 31 According to needed can fill.

Total fee Rs ……. /- **in ~~Cash~~/ Banker's Cheque /Bank Draft bearing No………**

Date…………...on………… Bank.

We hereby declare that to the best of my knowledge, information and belief the facts and matters stated herein are correct and I request that a patent may be granted to me for the said invention.

Dated :20/04/2021

Ms. D. Sree Lakshmi (Assistant Professor)
Ms. A. Divya (Assistant Professor)
Dr. K. Swathi(Professor)
Dr. P. Rama Koteswara Rao(Professor)
Mr. Sridhar Kavuri (Deputy Head)
Dr. Ch. Surya Kiran (Professor)

To,
The Controller of Patent,
The Patent Office, at ………

FORM 2
THE PATENT ACT 1970 &
The Patents Rules, 2003
COMPLETE SPECIFICATION
(See section 10 and rule 13)

Title of the Invention: **Crowd Detection Camera to maintain distance and identify the suspect using AI-based Programming**

Name	Nationality	Address
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Ms. A. Divya (Assistant Professor)	Indian	Department of Computer Science and Engineering, Prasad V. Potluri Siddhartha Institute of Technology, Kanuru, Vijayawada, Andhra Pradesh, INDIA – 520007. E-Mail: adivya@pvpsiddhartha.ac.in
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Dr. P. Rama Koteswara Rao (Professor)	Indian	Department of Electronics and Communication Engineering, NRI Institute of Technology, Pothavarappadu (V), Agiripalli (M), Vijayawada Rural, Krishna District, AndhraPradesh, INDIA-521212. E-Mail: prkr74@gmail.com
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Dr. Ch. Surya Kiran (Professor)	Indian	Department of Computer Science and Engineering, NRI Institute of Technology, Pothavarappadu (V), Agiripalli (M), Vijayawada Rural, Krishna District, AndhraPradesh, INDIA-521212. E-Mail: suryaneverquit@gmail.com

PREAMBLE OF THE DESCRIPTION

Provisional	**Complete**
~~The following specification describes the invention.~~	The following specification particularly describes the invention and the manner in which it is to be performed.

FIELD OF THE INVENTION

Our Invention is related to a Crowd Detection Camera to maintain distance and identify the suspect using AI-based Programming.

BACKGROUND OF THE INVENTION

COVID-19 belongs to the family of coronavirus caused diseases, initially reported at Wuhan, China, during late December 2020. On March 11, it spread over 114 countries with 118,000 active cases and 4000 deaths, WHO declared this a pandemic.

On May 4, 2020, over 3,519,901 cases and 247,630 deaths had been reported worldwide. Several healthcare organizations, medical experts and scientists are trying to develop proper medicines and vaccines for this deadly virus, but till date, no success is reported. This situation forces the global community to look for alternate ways to stop the spread of this infectious virus.

Social distancing is claimed as the best spread stopper in the present scenario, and all affected countries are locked-down to implement social distancing. This research is aimed to support and mitigate the coronavirus pandemic along with minimum loss of economic endeavours.

and propose a solution to detect the social distancing among people gathered at any public place. The word social distancing is best practice in the direction of efforts through a variety of means, aiming to minimize or interrupt the transmission of COVID-19. It aims at reducing the physical contact between possibly infected individuals and healthy persons.

As per the WHO norms it is prescribed that people should maintain at least 6 feet of distance among each other in order to follow social distancing. A recent study indicates that social distancing is an important containment measure and essential to prevent SARSCoV-2, because people with mild or no symptoms may fortuitously carry corona infection and can infect others. Fig. indicates that proper social distancing is the best way to reduce infectious physical contact, hence reduces the infection rate.

This reduced peak may surely match with the available healthcare infrastructure and help to offer better facilities to the patients battling against the coronavirus pandemic. Epidemiology is the study of factors and reasons for the spread of infectious diseases. To study epidemiological phenomena, mathematical models are always the most preferred choice. Almost all models descend from the classical SIR model of Kermack and Kendrick established in 1927.

Various research works have been done on the SIR model and its extensions by the deterministic system and consequently, many researchers studied stochastic biological systems and epidemic models.

The study of human behavior is a subject of great scientific interest and probably an inexhaustible source of research. With the improvement of computer vision techniques, several applications in this area, like video surveillance, human behavior understanding, or measurements of athletic performance, have been tackled using automated or semi-automated techniques. However, several complex challenges still remain, making this subject relevant in terms of research.

Currently, there are commercial systems developed to track (e.g., www.smarteye.se), recognize (e.g., www.iteris.com), and understand the behavior of a great variety of objects, using one or multiple video cameras, processing the information in one or more computers. Also, there are several scientific papers on the subject (an overview of video-based human motion analysis can be found in.

In terms of recognition, monitoring and behavior analysis of people, an important research topic is their detection/ identification, considering that one person could be occluded in many ways (particularly when lateral cameras are employed). In a high-level analysis, one could segment their body parts (e.g., head, face, hands, and arms) that could be used in gesture recognition or machine-human interaction, for example. It is also possible to deal with group behavior.

On the other hand, retail store managers are also interested in using cameras to extract business intelligence information. Retailers desire real-time information about customer traffic patterns, queue lengths, and check-out waiting times to improve operational efficiency and customer satisfaction. They are more interested in determining the number of shopping groups within their stores than the total number of people who frequent them.

OBJECTIVES OF THE INVENTION

1. The objective of the invention is to a crowd Detection Camera to Maintain the Distance and Identify the Suspect using AI- Based Programming is a Smart appliance with built-in advanced cameras, such as the moveable Nest Cam and 360^{0}D rotation Amazon Echo Look, are becoming pervasive.
2. The objective of the invention is to ourhold the promise of bringing high fidelity, contextually rich sensing into our complex home system and the workplaces and

other environments like office, university, engineering institute, meeting room, etc.

3. The objective of the invention is to ourDespite recent and impressive unique advances, complex computer vision intelligent systems are still global in the types of open sensing questions they can answer and more importantly, do not easily set of generalize across diverse human environments.
4. The objective of the invention is to an Our researchers have investigated hybrid crowd- and AI-powered methods that collect human labels to advanced bootstrap automatic processes and the However, deployments have been little and confined to institutional defined settings, leaving open complex questions about the scalability approach.
5. The objective of the invention is to adescribe our iterative unique development of Zensors++(Z++) a 1/1 full-stack Crowd-Artificial intelligent advanced camera-based sensing system that moves real-time significantly beyond prior global work in terms of scale, question diversity, accuracy, latency, economic feasibility, unique feature, Delay feature, Real time function, etc.

SUMMARY OF THE INVENTION

A computer-interfaced camera system identifies and tracks groups of socially interrelated people. The system can be used, for example, to track people as they wait in a checkout line or at a service counter. In a preferred implementation, each recorded camera frame is segmented into foreground regions containing several people.

The foreground regions are further segmented into individuals using temporal segmentation analysis. Once an individual person is detected, an appearance model based on color and edge density in conjunction with a mean-shift tracker is used to recover the person's trajectory. Groups of people are determined by analyzing inter-person distances over time.

A real-time camera/computer system and method for identifying groups of socially interrelated people by detecting and tracking them is disclosed. In one preferred embodiment, groups of people at a checkout line in a store are monitored. In this context, the group of interest is a “shopping group”, e.g., that set of people who check out together at the register. One camera may be used, or a plurality of cameras may be used to cover a larger area.

In preferred embodiments, the tracking of individuals is accomplished by identifying those pixels in a recorded camera frame corresponding to people and other moving objects as a “silhouette” image of pixels, determining how many people make up that silhouette, and segmenting the silhouette into respective profiles of the individuals. The individuals may then be grouped together, e.g., according to their spatial relationship to one another.

In a preferred embodiment situated in a retail context, this is done by noting that people in a given shopping group stay closer to each other than they do to people in a different shopping group. Additionally, people who belong to the same shopping group are found to exhibit similar global motion patterns, e.g., they move forward together to the register after the transaction of the group in front of them has been completed, and exit the scene together after having completed their own transaction.

In a preferred implementation, the system segments each recorded camera frame into foreground and background (including shadow) pixel regions using a statistical background model based on RGB (red, green, blue) color constancy and brightness. Since the foreground may contain several individuals and more than one group, the foreground is advantageously segmented into individual profiles using temporal segmentation based on motion cues. A temporal silhouette image (or "map") of pixels is then constructed that combines foreground detection and motion-detection results over a period of time.

The temporal silhouette map may then be segmented into profiles of individuals. Once an individual is detected, an appearance model based on color and texture is created, and a tracking algorithm (such as a mean-shift tracker) is employed to recover the trajectory of each individual in the scene. Individuals are grouped together as groups (e.g., shopping groups) by analyzing their relative distances to other individuals given the recovered trajectories. This analysis can be conceptualized as a graph partitioning problem: When detection and tracking results are represented by a weighted graph, the strongly connected components of the partitioned graph represent groups.

Methods:

The present subject matter can be embodied as instructions stored in a computer readable medium for execution by a processor. The instructions can be configured to execute a method as described herein.

An example of the present subject matter includes a method to estimate the number of people in a scene or an environment. The crowd can include an individual or a dense group of people moving together. Each individual or group is separately tracked as an entity using, for example, an extended Kalman filter based tracker.

The present subject matter operates on an image having a foreground region that has been segmented through a background estimation technique. The segmented foreground region can be generated in real-time using various methods, including for example, mixtures of Gaussians.Using the segmented foreground region of the image, the present system identifies regions corresponding to humans based on known characteristics as to human shape and motion.

There are two modes of tracking people. The first mode tracks individuals and uses a filter. In one example, the filter is a Kalman filter. Other types of filters are also contemplated, including for example linear or non-linear filters such as Particle filters, Wiener filters and other types of filters.

The second mode, which extends the filter tracker to count the number of people in a group, is activated when a blob (in the motion-segmented image) is identified to be large enough to correspond to more than one human. A blob is a generally contiguous region in an image. The blob is identified based on prior knowledge about the projected area of a human on the ground plane in the scene. In this manner, the area becomes independent of the location of the blob in the scene.

Step 1: Check function

This function is used to calculate the distance between two different points (a and b) in an image (single frame of a video). The two points denote the center of the individuals detected in the video. The distance that is calculated is the Euclidean Distance between two points.Then, calibration is used to find the midpoint between the two points and the 'if' statement returns a 'True' if the distance lies in between the range, else returns 'False'.

Step 2: Setup function

This function has one input argument 'yolo', which is a string that contains an empty directory into which the 'weights', 'cfg' and 'labels'. will be stored.The os.path.sep. join () function is used to join one or more path components intelligently. In simple terms, it stores the "yolov3.weights", "yolov3.cfg" and "coco.names" files into the "yolo" directory.The variable 'net' is used to read a network model stored in Darknet model files.

The 'ln' function is used to get all the layers of the network model such as 'relu_89', 'conv_89', 'bn_89', 'relu_90', 'conv_90' and then store only the indexes of layers with unconnected outputs. ['yolo_82', 'yolo_94', 'yolo_106'].

Step 3: Image Process function

This is the most *complex* function in our program. In this function, the argument is a single frame of the video. For every iteration, each frame of the input video gets processed along with the social distancing detection between each individual in a crowd and is returned to the main function.The code for this function is available in my GitHub repository (link is available below) and can be used for reference.

Step 4: Input parameters

In this, we initialize the input video file as 'filename' and the output file to be stored in the .mp4 format as 'opname'

```
create = None                    //define as per required
frameno = 0
filename = "videos/video_1.mp4"    // set data and distance as per required
yolo = "yolo-coco/"    // set color mark as per distance.
opname = "output videos/output of_" + filename. Split ('/')[1][-4] + '.mp4'
```

Step 5: Main function

We now come to the final part of the code. In this, the input video is *separated* into many single frames on which the functions defined above will be performed.Once that is done, each output frame is received and *combined* together to create the output video.

BRIEF DESCRIPTION OF THE DIAGRAM

FIG.1: Crowd Detection Camera
FIG.2A and 2B: Crowd Detection Camera to maintain distance Flow Diagram… Continue…
FIG.2A and 2B: Crowd Detection Camera to maintain distance Flow Diagram.
FIG.3: Crowd Detection Camera to maintain distance Display and Indication System.

DESCRIPTION OF THE INVENTION
CROWD ANALYSIS:

This section tackles three important problems that have been reported in the literature regarding automated analysis of crowded scenes: i) people counting/density estimation models, ii) tracking in crowded scenes, and iii) crowd behavior understanding models. A taxonomy for these problems, as well as some existing techniques are presented next.

PEOPLE COUNTING/DENSITY ESTIMATION MODELS:

An important problem in crowd analysis is people counting/density estimation (either in still images or video sequences). For instance, crowd density analysis could be used to measure the comfort level in public spaces, or to detect potentially dangerous situations. There are several models developed to estimate the number of people in crowded scenarios using computer vision techniques.

In this work, these models are divided into three categories: i) pixel-based analysis, ii) texture-based analysis, and iii) object-level analysis. A brief description of each category is provided next, along with some representative approaches. PIXEL-LEVEL ANALYSIS Pixel-based methods rely on very local features (such as individual pixel analysis obtained through background subtraction models or edge detection) to estimate the number of people in a scene. Since very low-level features are used, this class is mostly focused on density estimation rather than precise people counting.

TEXTURE ANALYSIS:

Algorithms that rely on texture analysis explore a coarser grain if compared to pixel-based methods, as texture modeling requires the analysis of image patches. Although this class explores higher-level features when compared to pixel-based approaches, it is also mostly used to estimate the number of people in a scene rather than identifying individuals. Marana et al.

analyzed four methods used in texture analysis and three classifiers to deal with the crowd density estimation problem. Regarding texture analysis, they compared the following four methods: gray-level dependence matrix, straight lines segments, Fourier analysis, and fractal dimension. Regarding the classifiers, they compared the following

Three methods: neural network, statistics (Bayesian), and a fitting function-based approach. They found better results when using the gray level dependence matrix-based method, providing better contrast and homogeneity as texture features, combined with a Bayesian classifier. However, it should be noted that they generated ground-truth information empirically, which could affect the comparison. They estimated the crowd density in one of the five following classes: very low density, low density, moderate density, high density, and very high density.

The authors mentioned that the method cannot discriminate very well the difference between high and very high densities. Wu et al. proposed an approach to estimate the crowd density using support vector machines (SVMs) and texture analysis. In their work, a perspective projection model is adopted to generate a series of multiresolution cells, and the gray-level dependence matrix method is used to extract textural information within these cells.

A multiscale texture vector is built, and an SVM is trained to relate the textural features with the actual density of the scene. The authors reported a maximum estimation error for each cell below 5%, and proposed as future work the possibility of including a background subtraction method in the feature extraction stage. One drawback of their approach, however, is the need of retraining the SVM for scenarios with different camera setups, since the density cells are highly dependent on camera parameters.

FINAL CONSIDERATIONS:

In this work, we presented a survey on crowd analysis based on computer vision. This work tackled three important problems in crowd analysis: people counting/density estimation, tracking in crowded scenes, and crowd behavior understanding in a higher-level analysis, like the temporal evolution, main directions, velocity estimations, and detection of unusual situations. Regarding crowd synthesis, the review was focused on crowd models that either use computer vision algorithms to extract real data information, aiming to improve the realism of the simulation, or that are used to train/validate computer vision techniques. Some considerations about these issues are provided next.

Tracking

Tracking can reduce the number of false alarms including, for example, miscounts based on other moving objects in the scene. Tracking can also reduce errors caused by occlusion due to static and dynamic objects in the scene.

In the case of a single person, tracking is performed using an Extended Kalman filter as per a pedestrian tracker which uses a Kalman filter to treat erratic data as an aberration and smooths the trajectories out. The pedestrian tracker uses a window of previous measurements in order to decide about the weight that it assigns to each new measurement and then proceeds to supplying an estimation about the future expected measurements.

In the case of groups as well, a similar Kalman filter tracker is initialized and used to track the location and velocity of the group. The assumptions and parameters used in the case of the single person tracker are valid for tracking groups as well.

The Kalman filter tracker alone does not provide information about the number of people in the group. It may be insufficient to estimate the count independently framewise since such a method is not robust to unusual situations which may occur temporarily.

For each group, one example of the present subject matter maintains a history of estimates throughout the lifetime of the group. The history of estimates for the blob also enables the system to generate an estimated count for groups which merge and split over time.

Since the shape of the blob does not represent a single group, the assumptions about the shape of the group do not hold true. Thus, the Kalman filter tracker is extended in the following ways for tracking groups:

1. All blobs whose area (area of polygon which is the intersection of the projected blob onto ground and head planes) exceeds an area threshold are classified either as a group or as a large object (i.e., a bus or a car). According to one example, the area threshold is selected as some value less than the area corresponding to two individuals in the real world.

2. For blobs larger than the area threshold, the extended Kalman filter (EKF) tracker is initialized by observing the velocity of blobs for a small number of frames. If the velocity of a blob remains above a particular velocity threshold, then it is assumed that the blob corresponds to a vehicle and the system does not estimate a count for that region. The remaining large blobs are classified as groups and the counting algorithm is applied and a group tracker is initialized.

3. For all blobs whose area is less than the area threshold, a comparison is made as to height and width. A blob is treated as an individual person if the blob height is greater than the width. For each such blob, the present subject matter initializes an EKF tracker and tracks the blob for a minimum number of frames. If the blob can be reliably tracked for a minimum number of frames, then the blob corresponds to an individual. All other blobs correspond to noise and are thus discarded.

In one example, it is assumed that individuals are taller than wider and so all blobs whose width is greater than the height either correspond to a group or noise. For these blobs, if they can be reliably tracked using a Kalman filter for a minimum number of frames, then determine if the blob is a group, otherwise the blob is discarded as noise.

History of Estimates

A group tracker is initialized when a group is detected for the first time. The group tracker includes a single person Kalman filter tracker with the following extensions to estimate the number of people in the group. It is initialized as follows:

1. An estimate for the count C of the group is added to a list for Counts for this group along with a score of 1 for the count C.

2. A list which represents the age (in number of frames) since this count C occurred is appended with the value 0 (i.e., this count occurred 0 frames ago). After initializing a tracker, the lists are updated based on the estimate for the current frame.

Real-Time Per Frame Count

Counts for groups of people are estimated on a per frame basis through a counting algorithm, some examples of which are described below.

For a real-time count on a per frame basis, the system selects a single number from the series of estimates throughout the lifetime of a blob. A number of statistics can be used as the estimator for the count. In various examples, the mode, median, or average are selected. The mode and median are less sensitive to outliers. The move reflects the estimate with the most occurrences and hence confidence of the estimation algorithm. In such an example, the count of people for each group is the modal estimate based on the history of estimates (i.e., the count with the maximum score in the group's lists).

Counting Method Based on Area

The number of people in the scene can be determined, in part, using the area occupied (on the ground) in the real world. The area is computed in the real-world using data from a calibrated camera.

Projection and Measurement of Area

Measurements of the area are conducted in world coordinates or scene coordinates. The segmented image is transformed into world coordinates through projection using the camera calibration information. The camera is calibrated to allow extraction of three dimensional (3D) information from a two dimensional (2D) image taken by that camera. The camera may be virtual or real.

The camera is calibrated as to intrinsic parameters (including attributes of the camera that affect the image such as the image center or principle point, focal length, aspect ratio or skew, scaling factor, and lens distortion—pin-cushion effect) and extrinsic parameters (the camera position in the real world including the placement and orientation of the camera, a rotation matrix and a translation vector).It is assumed that people are moving on the ground plane in the real world.

WE CLAIM

1) The invention is a deployed Z++ in the wild, with real users, over all months and environments, generating 1.634 million answers for nearly 2000 questions created by our participants, costing roughly 66/100 the of a cent per answer delivered and the We share lessons learned, insights gleaned, and implications for future uncounted crowd-AI vision system. The invention is an advanced Cameras are becoming pervasive in civic, commercial settings Indivusal settings and are moving into homes with devices like the Nest Cam, Amazon Echo Look and Owing to their high resolution and wide field of view day night cameras are the ideal sensors to enable robust, wide-area detection. The invention is a camera streams are rarely factionalized into sensor data, and instead are merely used to view a local, remote area and to test the feasibility of ML-machine learning for answering question sensor instances, we ingested information/data at the end of each day and trained classifiers for each question sensor based on all available crowd-powered answers of record.
2) According to claim1# the invention is to a crowd Detection Camera to Maintain the Distance and Identify the Suspect using AI- Based Programming is a Smart appliance with built-in advanced cameras, such as the moveable Nest Cam and 360^{0}D rotation Amazon Echo Look, are becoming pervasive.
3) According to claim1,2# the invention is to an Our hold the promise of bringing high fidelity, contextually rich sensing into our complex home system and the workplaces and other environments like office, university, engineering institute, meeting room, etc.
4) According to claim1,2,3# the invention is to an Our Despite recent and impressive unique advances, complex computer vision intelligent systems are still global in the types of open sensing questions they can answer and more importantly, do not easily set of generalize across diverse human environments.
5) According to claim1,2,4# the invention is to an Our researchers have investigated hybrid crowd- and AI-powered methods that collect human labels to advanced bootstrap automatic processes and the However, deployments have been little

and confined to institutional defined settings, leaving open complex questions about the scalability approach.

6) According to claim1,2,3,5# the invention is to ausdescribe our iterative unique development of Zensors++(Z++) a 1/1 full-stack Crowd-Artificial intelligent advanced camera-based sensing system that moves real-time significantly beyond prior global work in terms of scale, question diversity, accuracy, latency, economic feasibility, unique feature, Delay feature, Real time function, etc.

Date: 20/4/21

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Abstract

Our invention Crowd Detection Camera to Maintain the Distance and Identify the Suspect using AI- Based Programming is a Smart appliance with built-in advanced cameras, such as the moveable Nest Cam and 360^0D rotation Amazon Echo Look, are becoming pervasive. The invention is also a hold the promise of bringing high fidelity, contextually rich sensing into our complex home system and the workplaces and other environments like office, university, engineering institute, meeting room, etc. The invention is also including a Despite recent and impressive unique advances, complex computer vision intelligent systems are still global in the types of open sensing questions they can answer and more importantly, do not easily set of generalize across diverse human environments.The invention is a researchers have investigated hybrid crowd- and AI-powered methods that collect human labels to advanced bootstrap automatic processes and the However, deployments have been little and confined to institutional defined settings, leaving open complex questions about the scalability approach. The invention we describe our iterative unique development of Zensors++(Z++) a 1/1 full-stack Crowd-Artificial intelligent advanced camera-based sensing system that moves real-time significantly beyond prior global work in terms of scale, question diversity, accuracy, latency, economic feasibility, unique feature, Delay feature, Real time function, etc.

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TOTAL NO OF SHEET: 04 NO OF FIG: 05

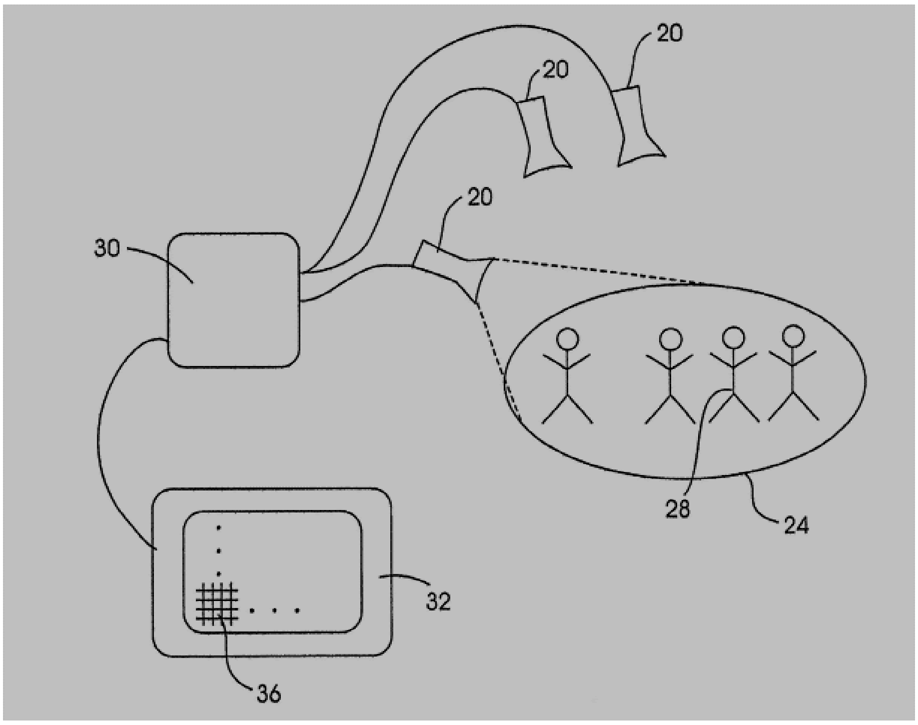

FIG.1: Crowd Detection Camera

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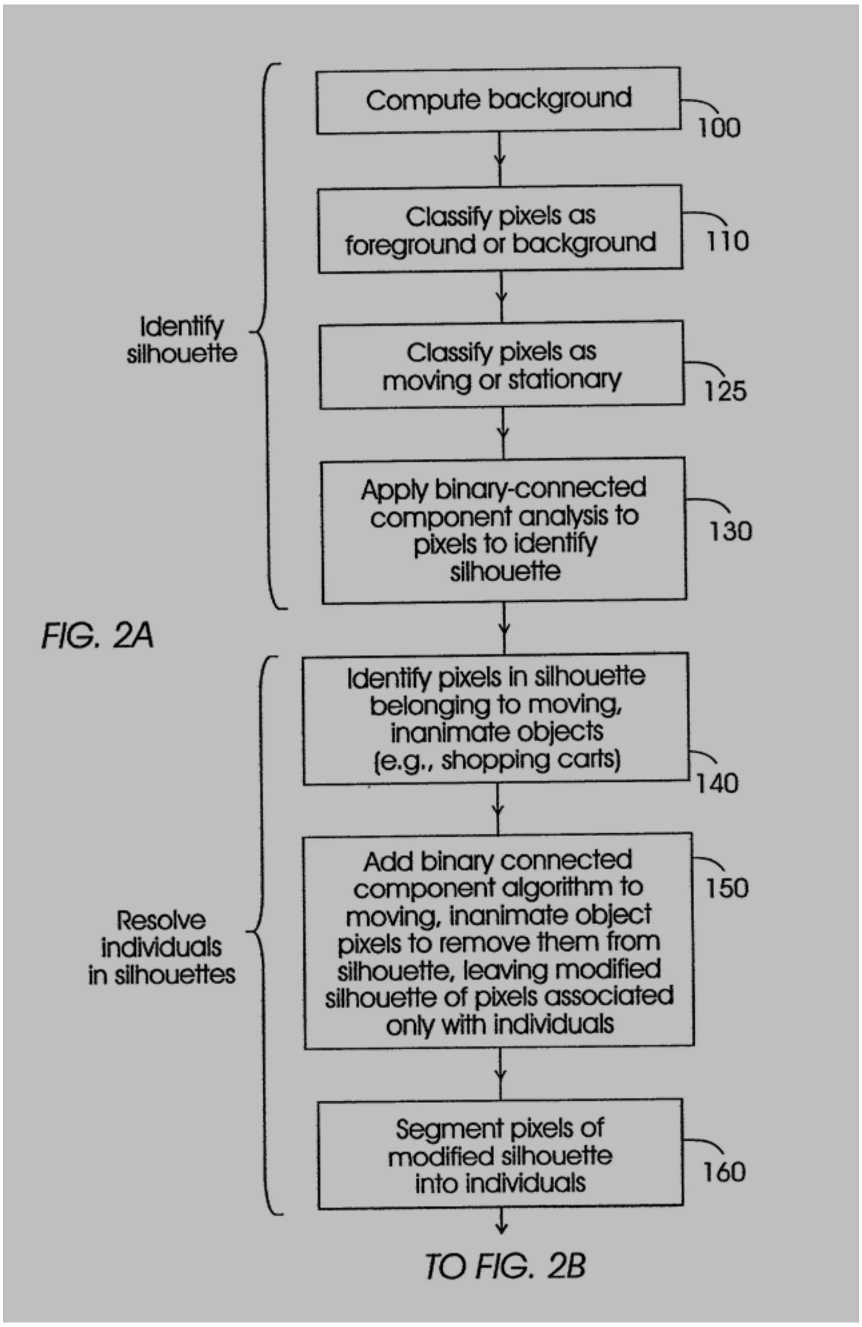

FIG.2A and 2B: Crowd Detection Camera to maintain distance Flow Diagram… Continue…

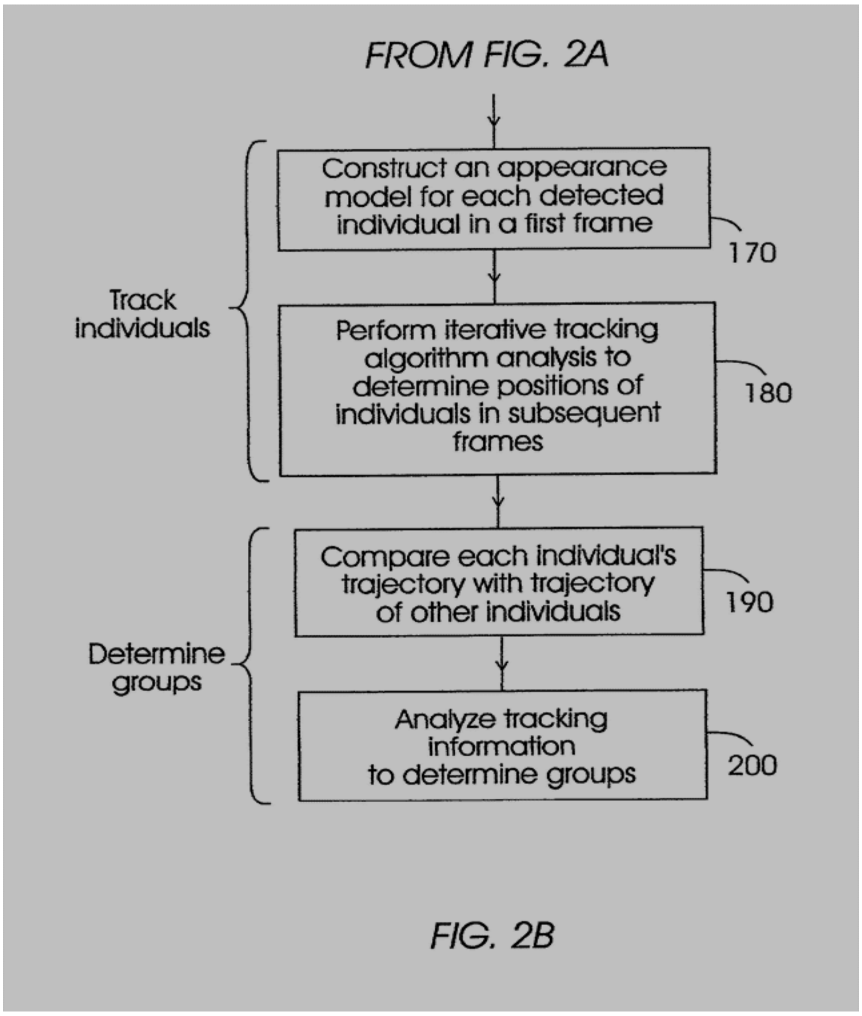

FIG.2A and 2B: Crowd Detection Camera to maintain distance Flow Diagram.

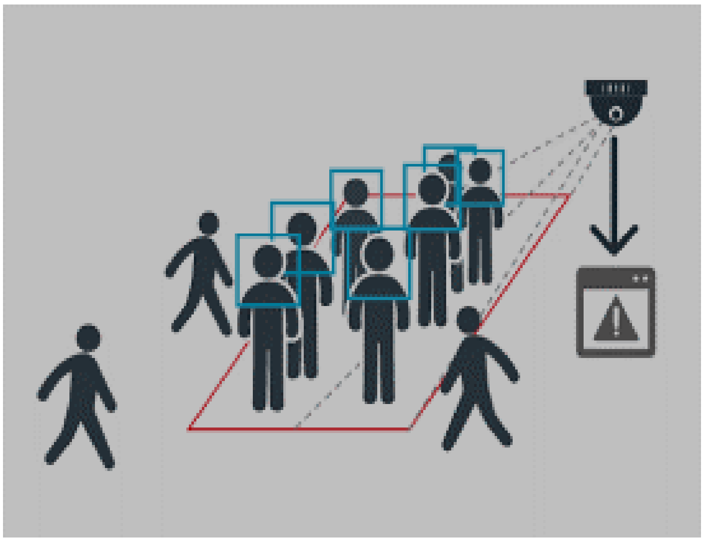

FIG.3: Crowd Detection Camera to maintain distance Display and Indication System.

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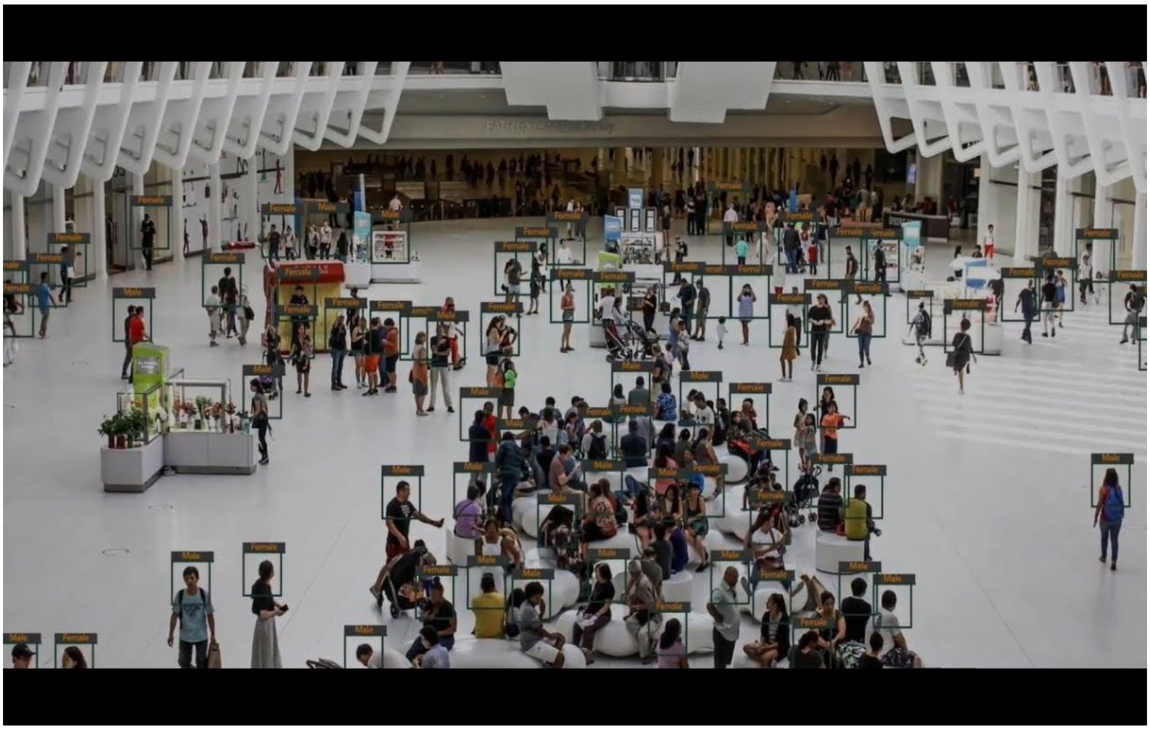

FIG.4: Crowd Detection Camera to maintain distance to Prevent and notify