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Security Camera Powered With Machine Learning For People Detection For Queue Data Analytics

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Abstract: Human face detection has been a challenging issue in the areas of image processing and patters recognition. An application for tracking and detecting faces in videos and in cameras which can be used for multipurpose activities. The intention of the paper is deep study of face detection using open CV.

The proposed system also improves the waiting experience of clients choosing to stay in the waiting area by connecting them to the audio signal of the often muted television sets running entertainment programs, advertisement of services, or news. The image processing concept is essential parameter to count number of people in count detection. This system is using Open-CV platform and DNN (Deep neural networks) algorithm for image processing with real-time person detection and taking the record of number of counts of the people. The future predictions based on the count of people in a particular interval of time are done by analyzing the past data using machine learning algorithm as the DNN.

Key Words: DNN (Deep neural networks), Open-CV platform, Queue Management, Haar cascade and artificial neural network (ANN).

I. INTRODUCTION

Queuing systems, even smart ones, whereby a client gets a digital ticket from a machine or online and waits for a turn, face many limitations in terms of creating an improved user experience. These deep neural networks help developers to achieve more sustainable and high-quality results. Hence, they are even replacing several conventional machine learning techniques. First, machine learning had to be developed. ML is a framework to automate (through algorithms) statistical models, like a linear regression model, to get better at making predictions. A model is a single model that makes predictions about something. Those predictions are made with some accuracy.

A deep neural network (DNN) is an ANN with multiple hidden layers between the input and output layers.

Similar to shallow ANNs, DNNs can model complex non-linear relationships. The main purpose of a neural network is to receive a set of inputs, perform progressively complex calculations on them, and give output to solve real world problems like classification. We restrict ourselves to feed forward neural networks.

1.1 Problem Definition:

To provide people detection for queue data analytics by Real time Queue tracking using DNN to enhance the environment for people as well as administration by proposing the solution to the problem of client dissatisfaction concerning the long waiting time associated with the services of the organization.

1.2 Objectives:

- To perform accurate face detection and tracking process
- To perform real-time queue management using computer vision technique
- To achieve better performance in terms of accuracy and response time

II. LITERATURE SURVEY

1) A Smart Mobile System for the Real-Time Tracking and Management of Service Queues International Journal of Computing and Digital Systems.

ISSN (2210-142X) Int. J. Com. Dig.Sys. 5, No.4 (July-2016)

Function: The smart queue management system has the potential to improve client satisfaction and productivity, and to solve the problem of improving waiting time for services. delivery of audio-visual updates using smartphones, and entertaining clients with reading material and a TV audio stream can be done using it.

Advantages:

To reduce waiting time and make them more tolerable.

Disadvantages:

In the system, a radius near the desire service is specified where the app may be used to reduce false service requests, which also make the dynamic time prediction algorithm more accurate.

2) Tackling Rare False-Positives in Face Recognition: a Case Study

IEEE 16th International Conference on Smart City. DOI 10.1109/HPCC/Smart City/DSS.2018.00260.

Function: This application is about developing a queue management system which uses facial recognition for an airport in the UK. The approach involved capturing the faces of passengers while entering trough Boarding Pass Gates (BPG) and while exiting through Security Gates (SG). Thereafter, detecting and comparing of the faces is done, within a fifteen-minute window, from BPG against the ones from SG. If the match is found, the time that someone has spent inside the security area is calculated, using the capture time of matched face.

Advantages:

This application is about developing a queue management system which uses facial recognition for an airport in theUK.

Disadvantages:

We have to deal with reducing the number of the false positive, i.e. incorrectly matched faces.

3) GSM Based Queue Management

Device for OPD

International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 04 | Apr2018

Function: In the assessment of health care quality assessment Patient satisfaction is major priority. Waiting time is considered as an important factor of patient satisfaction. In general hospitals when patient comes to visit to a Doctor, he/she have to go through a process of first registering their names in OPD section and then waiting for their turn to come. This all procedure is handling by a human being on the basis of first come first serve basis.

Advantages:

The system is useful to deal with increased rate of population and their demand for the healthcare service.

Disadvantages:

The issues like customer retention, value, safety, litigation, and reputation may be faced by the healthcare organizations.

III. EXISTING SYSTEM APPROACH

Queue management has undergone various developments over time, and traditional techniques have had their share of disadvantages. Here are some common disadvantages associated with previous queue management techniques:

1) Manual Queue Management:

- Inefficiency: Manual queue management relies heavily on human oversight, making it prone to errors and inefficiencies.
- Limited Scalability: Handling large crowds becomes challenging as manual systems struggle to scale efficiently.

3) Token Systems:

- Token Distribution Delays: Token systems can lead to delays as customers wait to receive their tokens, especially during peak hours.
- Inflexibility: It might be challenging to adapt token systems to dynamic queue conditions or changing service priorities.

4) Linear Queues:

- Unequal Waiting Times: In linear queue systems, individuals at the end of the line may experience longer wait times,leading to potentialdissatisfaction.
- Space Inefficiency: Linear queues may not make the most efficient use of space, especially in environments with limited area.

5) Appointment-Based Systems:

- Rigid Scheduling: Appointment-based systems can be inflexible for customers who may need to reschedule or have unpredictable service needs.
- No-shows: There is a risk of customers not showing up for their appointments, leading to underutilized resources.

IV. PROPOSED SYSTEM APPROACH

In this work, computer vision-based queue management leverages advanced imaging technology and machine learning algorithms used to optimize the efficiency of queues in various settings. Here are the key

components, advantages, and considerations associated with computer vision-based queue management:

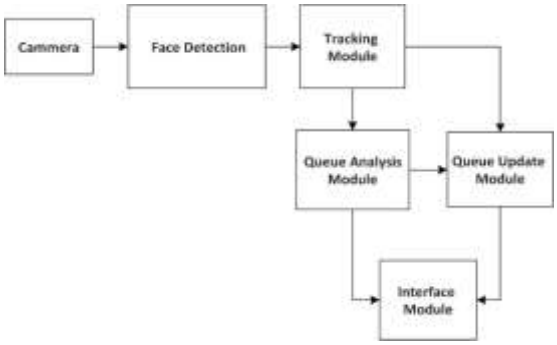

Figure 1: System Architecture Diagram of Proposed System

The above figure is the block diagram of the system that we are going to implement that is "people detection for queue data analytics". In the above diagram the system has a video input. After adding video piquet will extract the location where rectangular box locate the size of face location. After taking the input frame conversion is done. For the person detection we are using the CNN algorithm. On the basis of human detection, person counter will be increased. Analysis will be done on the gathered data. By considering the specific average time for each person, prediction of number of people who will be there on counter will be done and according to this, the prediction of number of counters will be done. And for this prediction we are using DNN (deep neural network) algorithm. Haar-cascade is then used to detect the outlines of people and determine how many people are present in that particular queue by analyzing the frames. After queue editor will calculate waiting time of person by queue management. Face reorganization will done by open CV. After calculate waiting time of person in the organization.

V. METHODOLOGY

1) Image Acquisition (Open-Computer Vision)

The Image acquisition is the process of collecting input image sample. The component collects scenes containing objects of interest in the form of images. Here, generally system webcam is used for image acquisition. We use Python, Open-CV, face recognition library and piquet to make our very own image detector. We are working with all image operations by using open computer vision python library. It is an Open source Computer Vision and a machine learning software library which is a common infrastructure for computer vision applications and to accelerate the use of machine perception. The use of OpenCV in this system is to process the image, remove the noise and extract the required information from the image, creating them as the boundary boxes.

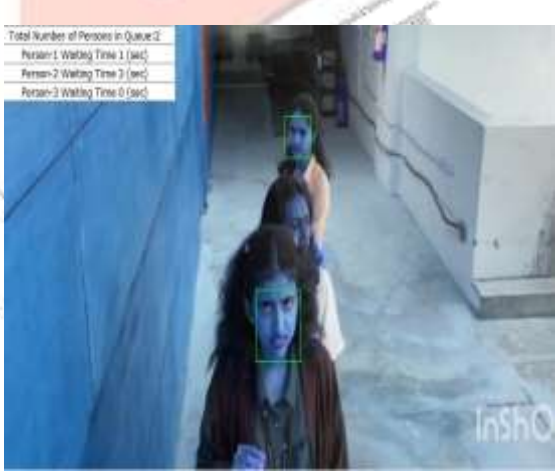

Figure 2: Face Recognition

2) Gray Scale Conversion

After get image acquired by open-cv this color image further converted into a gray scale by reducing noise. Gaussian

filtering is used to blur images and remove noise and detail. Gray Scale Conversion Pre-processing of document images is the way of using image processing techniques to enhance the quality of images. Its purpose is to improve and extract objects information of images for later processing purposes. Two pre-processing works, binary conversion and noise removal, are performed here.

3) DNN

It uses sophisticated mathematical modeling to process data in complex ways. The use of DNN in our system is to predict the number of counts by taking the input from CNN and the database. Deep neural networks (DNNs) are currently the foundation for many modern artificial intelligence (AI) applications. Since the breakthrough application of DNNs to speech recognition and image recognition, the number of applications that use DNNs has exploded. These DNNs are employed in a myriad of applications from self-driving cars, to detecting chance to playing complex games. In many of these domains, DNNs are now able to exceed human accuracy. The superior performance of DNNs comes from its ability to extract high-level features from raw sensory data after using statistical learning over a large amount of data.

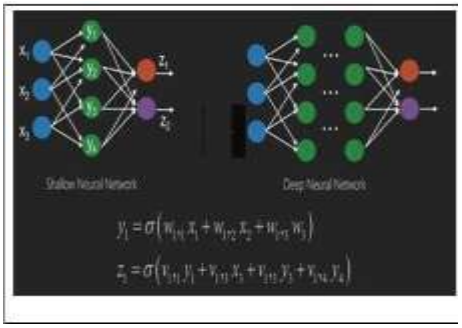

Figure 3: DNN

4) Haar cascade

Haar cascade is used to detect the face positive and negative position. Haar features are nothing but a calculation that happens on adjacent regions at a certain location in a separate detecting window. The calculation mainly includes adding the pixel intensities in every region and between the sum differences calculation. Instead of calculating at every pixel, it creates the sub-rectangles, and the array references those sub-rectangles and calculates the Haar Features.

VI. RESULT AND DISCUSSION

In this Person detection and counting system we have been invented greatly trained model that can accurately recognize real time images. In this system we used tensor-flow machine learning framework and predefined libraries. The proposed work is relay on DNN and Har Cascading Algorithm frameworks.

A) Training Models

In machine learning, accuracy is a commonly used metric to evaluate the performance of a model. Accuracy is defined as the ratio of correctly predicted instances to the total number of instances in the dataset. It provides a general measure of how well the model is performing.

The accuracy formula is given by:

Accuracy=Total Number of Predictions / Number of Correct Predictions

While accuracy is a straightforward metric, it may not be suitable for all types of datasets, especially when dealing with imbalanced classes. In

cases where one class significantly outnumbers the others, a model can achieve high accuracy by simply predicting the majority class. In such situations, other evaluation metrics like precision, recall, F1 score, and area under the ROC curve (AUC-ROC) might be more informative.

Human Faces are detected and tracked for time spent in the queue – on for every 15th Frame.

```
while (True):
    ret, img = cam.read()
    count += 15  # i.e. at 30
fps, this advances one second
cam.set(cv2.CAP_PROP_POS_FRAMES,
count)
rgb_frame = cv2.cvtColor(img,
cv2.COLOR_BGR2RGB)
face_locations =
face_recognition.face_locations(
rgb_frame)
```

B) Testing Models

Confusion matrix : which is a table used to evaluate the performance of a classification model. A confusion matrix provides a summary of the predictions made by a model, showing the counts of true positive, true negative, false positive, and false negative predictions.
Here's a typical structure of a confusion matrix:
Using the values from the confusion matrix, you can calculate various evaluation metrics, including accuracy, precision, recall, F1 score, and more.

Here's a brief explanation of the terms:

- True Positive (TP): Instances that are actually positive and were correctly classified as positive.
- True Negative (TN): Instances that are actually negative and were correctly classified as negative.
- False Positive (FP): Instances that are actually negative but were incorrectly classified as positive.
- False Negative (FN): Instances that are actually positive but were incorrectly classified as negative.

Accuracy, as mentioned before, is calculated as

TP+TN+FP+FNTP+TN.

Understanding these components can provide a more nuanced assessment of a model's performance, especially in situations where imbalanced classes or specific types of errors are crucial to consider.

Code :

```
self.retranslateUi(MainWindow)
QtCore.QMetaObject.connectSlotsB
yName(MainWindow)

height, width, channel =
cvImg.shape
bytesPerLine= 3 * width
qImg= QtGui.QImage(cvImg.data,
width, height, bytesPerLine,
QtGui.QImage.Format_BGR888)

self.photo.setPixmap(QtGui.QPixma
p(qImg))
```

C) Table based on total number of person on queue per waiting time (sec)

In the Queue management we are calculating how many time waiting of person in a queue after wards we should count person waiting time by p1,p2, p3 upto p15 in the phases are created and calute the waiting time of person.

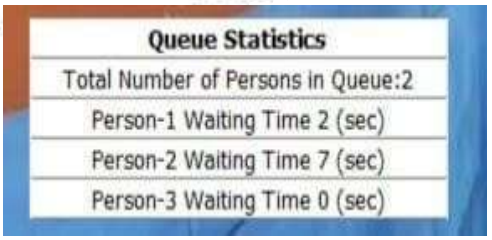

Figure 5: Outcome result of Queue Statistics

VII. CONCLUTION

This project leverages the expressiveness of DNNs object detector. The simple Formulation of detection can

yield strong results when applied using a multi-scale course-to-fine procedure. During the design space exploration process, it is necessary to understand and balance out the main system metrics. Camera captures, images and videos are taken as input and further processed for person detection. Person counting and Queue prediction is done using the convolution algorithm, deep neural network techniques and DNN algorithm. The system pays heed on delivering real-time service request updates to organization in the form of audio notification system accordingly with the success or failure of the results. The system to its core is a queue management system with real-time. Along with this, the proposed system improves the quality of the waited time on location. To conclude, the person detect data analytics has the potential to improve client satisfaction and productivity, and to mitigate waiting time for services.

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