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Cloud-Based Facial Emotion Recognition for Real-Time Emotions

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Abstract :- Business Intelligence is an important aspect of any organized education. With the growing competition and global outlook of the training, metric driven insight has become extremely important for the corporations to analyze, understand and plan their training modules in better ways. Understanding participant's behavior and their sentiments has been an active area of research over a long time. However, due to practical challenges associated with such adaptations, there hasn't been significant work towards participant behavior and sentiment tracking in physical classrooms. In this work, we have addressed this significant challenge of the education sector and proposed EMOMETRIC, which is an intelligent system for class that can track participant's emotion and provide a participant behavioral insight through IOT integrated data intelligence running on Apache Spark Cluster. The proposed system uses model based face and emotion tracking under real use case conditions Results shows that the proposed technique has an overall accuracy of 95% in comparison to the current state of art. The proposed technique also adapts QOS enabled secure MQTT protocol to collect the data by the big data No-SQL storage system. It is also observed that the proposed technique is not only fast and accurate but also illumination and pose invariant. This work can be used as a framework to offer emotion as a service through SAAS platform.

Keywords: *Business Intelligence, Participant Behaviour, Emotion, Apache Spark, MQTT Protocol, No-SQL, Big Data.*

I. INTRODUCTION

Understanding the emotion of the costumer or people during a business process is an important aspect of today's world. Many experiments are been carried out in past in various domains including retail, banking, during performance and so on. Further different techniques are also being proposed over the techniques are also being proposed over the years for emotion detection that includes Eigen face based emotion detection and recognition, feature based emotion detection and recognition, machine learning based emotion detection and recognition and so on. However with the increasing migration of the application to be cloud most of the enterprise business operates from the cloud distance. With the advantage of enormous processing capabilities and online processing as well as device independent API. Cloud provides a platform for almost all enterprise businesses. Therefore cloud based emotion detection and recognition is extremely important in order to model any enterprise system that takes any decision based on user emotion. In this work we propose a unique cloud based emotion detection system.

The system should be independent of the gender and age which the past systems have largely failed to provide. At the same time our system should provide an enterprise level API's to data analytics such that recognition emotion data can be used from a large application perspective. In this work we propose a unique emotion detection based system over the cloud to analyses the behavior of the participates during the process of the lecture. The system should be able to acquire multiple faces, extract their emotion and put it into a cloud-database; further a data analytic system should be able to run a cloud based data analytics to extract meaningful, statistical insight about the aggregation behavior of the user during a class. The overall system should be able to tell us whether the users were happy or skeptical or unhappy during the class.

II. LITERACTURE SURVEY

Gaku and Takakuwa [1] showed how a simulation pushed version for statistics analytics can assist information the business process. They also demonstrated the fundamentals of predicting destiny tendencies relying upon predictive analytics with huge data [2].

Carson et al. [3] argue that huge facts analytics is nothing however a data mining assignment on a huge unconstrained styles. Usually, in a record mining challenge and goal or result is thought before hand, and is searched or extrapolated from to facts. Records Analytics on the other hand is a records science to generate unknown perception from the records. Massive data is essentially a massive quantity of data with variety, varsity and pace. Because of massive variety of uncooked information they maintain, tendencies and insights which can be extracted from the report using unique mathematical, statistical and facts analysis machine, normally known as massive facts analytics.

Ahmed et al. [4] proposed large information analytics using agent primarily based techniques. they have got discussed the challenges of massive data which includes statistics illustration, redundancy reduction, statistics life cycle management, analytical mechanism, records confidentiality, expandability and cooperation needs to be the biggest challenges in huge statistics analytics. An agent based gadget

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is proposed which reveals artificial intelligence, system gaining knowledge of and independent selection making to deal with such statistics. The 3 elements of data processing by means of those dealers are diagnosed as spatial distribution, heterogeneity and actual time processing. big records analytics need to cause better enterprise decisions. Smarter, faster, impactful selections collaboratively create an clever and clever enterprise choice framework. There are numerous business regions which can draw an impartial analytics.

The principle distinction of huge facts analytics with records mining is that a record mining is more of a opposite engineering in which the purpose is known and the method is located. Then again, large facts analytics has standard set of techniques that may lead to critical insights. Supakkul et al. [5] argues that goal orientated analysis is a miles higher technique than raw records analytics in corporations. They advocate GOMA – a goal orientated huge statistics analytics framework that integrates specific tasks of information mining into the big statistics analytics realm. as an instance, boom in profitability or decrease in warehouse inventory may be taken into consideration as enterprise desires. GOMA based approach ends in such information analytics which provides perception approximately afore noted desires.

Jia et al. [6] explored a completely unique dynamic pricing device primarily based on stochastic method the use of strength education quarter for the case look at. Their method proposes establishing a linear mapping among close to random player demand with the pricing the usage of a stochastic method using piecewise linear stochastic approximation. One of these solutions essentially is an optimization problem solved through incorporating a hard and fast of constant and random variables. For example, outside temperature, hour of the day, past usage by the player and so forth. Such dynamic pricing is now being determined across huge variety of industries like air ticketing, celeb suggests and so on. Consequently, one of the regions of large information analytics is pricing management with collaborated call for and supply analysis.

. Ali et al.[7] proposed a bio inspired termite colony optimization to build a recommendation system based on adjusting the path in a connected graph of products bought by the participant in the past. They carried out a case study on big bazaar, a large education chain in India. Burhanuddin et al.[8] proposed a content based recommendation system that employs a pair wise approach for ranking the recommendations where each of the recommendation is generated by pair wise rank of a user and a specific item. They propose a loss function and a similarity function on each pair and generated the recommendation based on a standard iterative optimization process.

Gopalachari and Sammulal [9] proposed an internet based recommendation machine that is depending on person contemporary session, users past conduct extracted from the cache and conduct of the opposite users collaborated in website ontology based totally gadget. Ontology driven recommendation systems are famous even among the web e-schooling and training gadget which utilizes users seek and focus history for the recommendation.

no matter the kind of analytics and processes, fulfillment of any commercial enterprise in the end boils all the way down to understanding the participant, their desires and successfully supplying services and answers for the same. Expertise player options, their demand, lawsuits, expectations can assist a business to improve appreciably. Therefore, a huge quantity of studies has been found in the region of player behavior analysis. player behavior analysis in the e-education education is completed by using members search conduct and click on circulation facts[10]. The facts set blanketed timestamp, the time spent on an item, search category, cart overview, order of selecting gadgets, wide variety of click to recommendation, number of departures without attention and so on. This statistics is then included right into a choice tree gadget to predict the behavior of the player. The work demonstrates the use and edition of device gaining knowledge of with artificial intelligence into analyzing and predicting player conduct with past developments.

Norouzi and Alizadeh [11] used player behavior evaluation to are expecting most likely objects a player is probably to cognizance and rank them for that reason for providing it to the participant. They used a multinomial version with hidden Markov version to rank the products for show. Their method fashions product cognizance conduct of a participant as a Markov chain with discrete random variables being the facts set attributes. Han [12] uses the participant behavior analysis to phase the contributors probably to focus [11], wherein their behavioral pattern have been analyzed to rank the products. A participant segmentation based on recognition and intake conduct viz., probably participation, future participation, VIP participation and so on, can extensively assist the education companies to consciousness on potential participation. This technique used again propagation neural network to categories the members into pre-present classes. that is an example of purpose oriented information analytics.

Ahmed et al. [13] summarizes diverse category strategies and their significance in participant behavior evaluation and ranking. Maximum commonly used green classifiers are Bayes internet, naïve Bayes, k-big name, clustering, filtered classifier, quit (Meta classifier), JReep, RIDOR, decision table, J48, simple cart and so forth. Additionally they analyzed the impact of social posts among the goods via a participant for his behavioral evaluation.

III. SYSTEM DESIGN AND ARCHITECTURE

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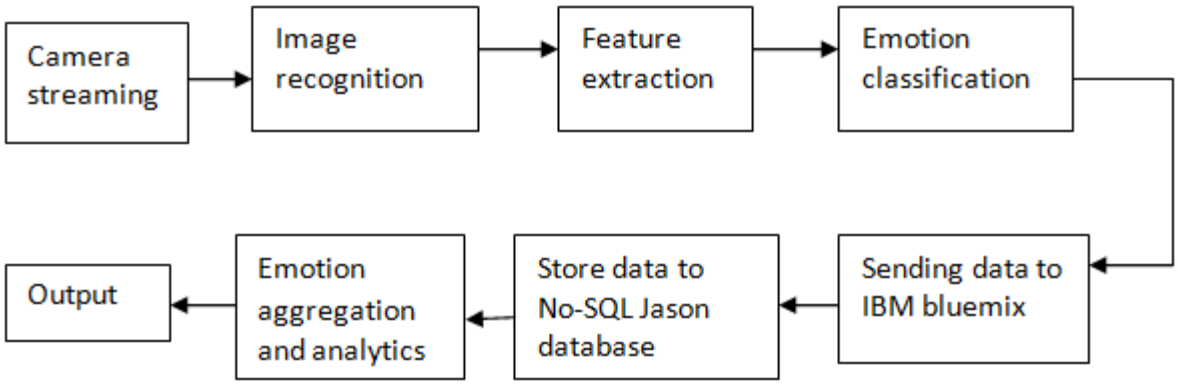

Figure 1: block diagram

In this work for EMOTION recognition we take the input either in image or video format for a certain interval of time. The image may consist of single face or multiple faces. The image is detected and recognized based on the geometric points of the face like eyes, nose, and mouth. Face recognition is done here independent of age, gender and pose. The captured frames are submitted to API. The API and SDK detect and track human face, it it measures and track facial expression of emotion in real-time, identify 13 emoji expression frame posed face. Face is identified using voila Jone's ada boost method. This method combines many weak classifiers and make it strong classifier. The key in building these classifiers are similarities, probabilities and decision boundaries. Here we use model based algorithm. Stages of VOILA JONE'S method.

1. Haar feature selection
2. Creating an integrated image
3. Adaboost training
4. Cascading classifiers

Emotion classification is done by using ensemble learning classifier. It consists of several database. The captured image is then compared with the database and emotion is classified based on which emotion is closely similar to that database emotion. Then the emotion is aggregated and sent to cloud by IBM bluemix and the result is obtained.

An application is created to do this work. We use android studio tool to create this application. It is an user friendly tool and it can run on any android phone. The code written here is in python language. The code includes instruction to track single face and multiple faces. Faces which are closer to the camera are considered as large face and the face which is far away from the camera is considered as small face. The application can also detect whether the person is wearing glasses or not.

In this work, we have proposed a novel solution for analyzing participant emotion and obtaining meaningful insight for the education businesses by integrating machine learning, computer vision and data science techniques. Our contribution of work is in achieving a very high frame rate, fast and real time face detection system . Our model based face detection system achieves a frame rate of 23fps which is about 10 frame per second higher than frame rate associated with Adaboost based technique which is been commonly used. We developed a smart trolley loaded with a camera and a IOT processor. We have used Intel Edison Kit for interfacing the camera. The frames acquired from the camera is sent to a local server using MJPG.

Once the face boundary of the participant is tracked, the data along with the trolley id is stored in is stored in No-SQL Mongodb database in IBM Bluemix. Therefore, every data record contains the id of the trolley, the participant emotional data. We also enable three axis accelerometer with this smart trolley. The accelerometer tracks the participant's data. Therefore, the trolley id, participant emotion, participant mobility data, the weight on the trolley is obtained and sent to the database. Because the amount of data being generated with 23 fps tracking rate, 6 trolleys being used in the pilot phase is huge, playing with web server and database server fails to process such huge amount of data. Hence, it is proposed to use big data system to process this data.

The data acquisition step requires user's authorization which is provided with the access token generated by IBM bluemix at the time of data acquisition. Therefore, the overall data analytics is implemented over extremely secured data access channel. This ensures high degree of confidentiality and security for extremely privacy critical participant data.

A. Emotion Detection

In a image for emotion detection, we need to select the region of interest (ROI), which consists the part of face

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covering the eyes, nose and the mouth of the person. For this purpose we use haar feature based cascade classifier.

Object detection is done by using haar feature. The ROI of the image is obtained and for each image is obtained and for each image the haar-like feature is found out. Haar feature are the weak classifier. We use voila Jone method to make it strong classifier.

EMOTIONS	INCREASE LIKELIHOOD	DECREASE LIKELIHOOD
JOY	Smile	Brow furrow
ANGER	Lid tighten, eye widen, chin raise, lip suck	Smile, brow raise
DISGUST	Nose wrinkle, upper lip raise	Lip stuck, smile
SURPRISE	Eye widen, jaw drop, brow raise	Brow furrow
FEAR	Lip stretch, brow furrow, eye widen	Lip corner depressor, jaw drop, smile
SADNESS	Lip corner depressor, brow raise, brow furrow	Brow raise, eye widen, lip press and stuck, mouth open
CONTEMPT	Brow furrow smirk	smirk

Table 1: The relationship between the facial expression and the emotion predictor Image reorganization

B. Feature analysis

The feature analysis compares the several appearance-based features of the frame captured from a video. There are several methods for explaining this concept. In figure 1 TF stands for tail frame, CF stands for current frame, HF stands for head frame and AFF stands for the average feature frame. K defined as ½ x (N-1).

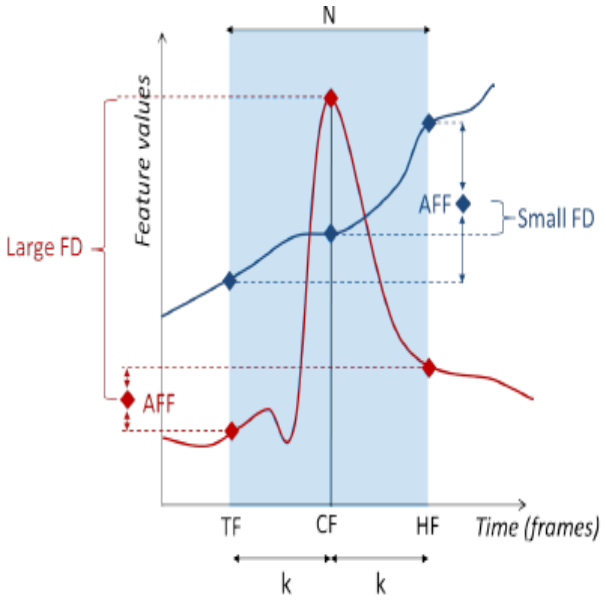

Figure 2: illustration of terms used in facial analysis

The AFF is feature vector of the average of TF and HF. In figure 2 the red curve shows the rapid facial moment curve and the blue curve shows the slower facial moment curve.

IV. EXPERIMENT RESULTS

Figure 3.1 shows the camera demo model in which the emotion of the person smiling percentage is shown. The camera demo model had a toggle which gives us the option chose front or back camera and a separate button to start and stop the camera streaming.

Figure 3.2 shoes the frame detector model which images are converted into frames and emotions are classified. Display of images is shown to the left. The display gives the percentage of each emotion. In this model we have taken 9 emotions to classify. The emotions which are to be classified are anger, disgust, fear, joy, sadness, surprised, contempt, engagement and valence. For this application to run we have to start both camera and SDK. Similar to that of camera detector model even this model have button to switch to front of back camera streaming. Separate buttons to start and stop both the camera and SDK.

Figure 3.3 shows the same fame detector model as similar to previous figure. The display here is of the expressions that are being calculated. The expressions are as follows attention, brow furrow, brow raise, cheek raise, chin raise, dimplier, eye closure, eye widen, inner brow raise, jaw drop, lid tighten, lip depressor, lip press, lip pucker, lip strength, lip suck, mouth open, nose wrinkle, smile, smirk and upper lip raiser. Measurements like yaw, pitch, roll and inner ocular distance is been calculated.

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Figure 3.1

Figure 3.2

Figure 3.3

Figure 3.4 shows the output when it is sent to cloud by IBM bluemix. The percentage if separate emotions are shows by bar graph and the overall emotion is shown via pie chat distinguishing the separate percentage level of emotions.

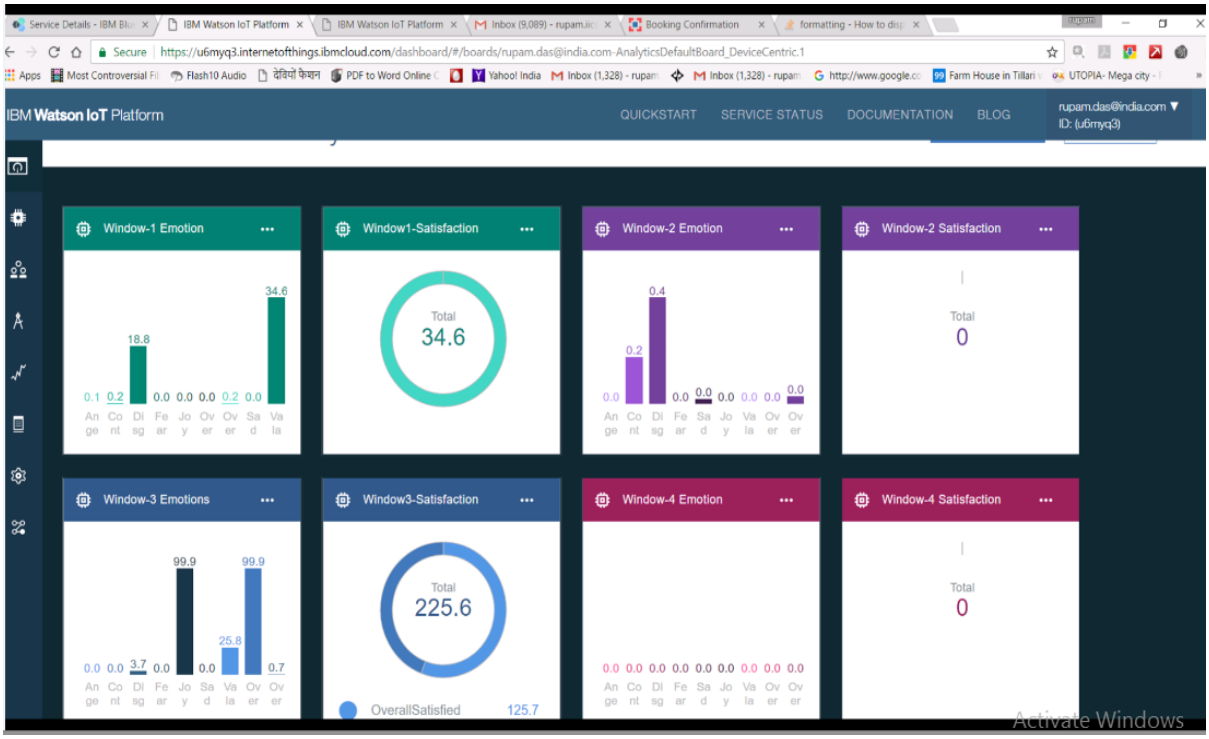

Figure 3.4

V. CONCLUSION

Recent advancement in connected devices, artificial intelligence, machine vision, machine learning, big data and data science has resulted in exceptional innovations across different industries. Recent boom in the education sector requires high end intelligence to improve the business through better understanding of participant preferences and their behavior. Authors have proposed several techniques in the past for participant behavior tracking in an online education context. However, the volume of research in the same direction for physical education has been minimal. We have right to address the problem of understanding participants behavior in large education lectures through an intelligent emotion tracking which incorporates low cost, yet efficient facial emotion tracking combined with IOT and Big Data to provide a meaningful participant behavior insight to the

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educationist. Results show that our technique is robust and efficient for practical pose and illumination variant real time scenarios. The fast model based technique improves upon the popular Adaboost and Fuzzy based emotion tracking system in terms of both accuracy as well as time complexity. The backend processing through apache spark cluster improves the analysis time by multifold in comparison to more popular Hadoop clusters. Our system offers a business intelligence to educationers but also provides a unique framework that can be used by various other industries like HR, Fashion, Media and so on.

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