Leveraging Event Marketing Performance using AI in Facial Recognition

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Abstract: With the advances in technology and the rapid changes in human-technology interactions, the event marketing field has seen major developments over the past years. Despite its remarkable growth, many aspects of event marketing do not yet align with the best available technologies. In this paper, we aim to leverage event marketing performance using artificial intelligence techniques. We design a framework that optimizes attendee-feedback generation using a facial-recognition algorithm. The framework measures attendees' engagement levels by periodically extracting attendee facial features during a session, categorizing them into seven states of emotions (anger, disgust, fear, happiness, neutral, sadness, and surprise), and then analyzing session engagements based on the obtained results. These measurements are then used to give insights about an event's performance during and after sessions, thus improving the overall performance of a given event. The proposed framework is easy-to-implement, time-efficient, and cost-effective.

1 INTRODUCTION

Over the past decades, marketing has become one of the most prominent circulating topics, steering most of our activities, decision-making, and influences. It has played a major success role in most industries. With the advances in technology and the rapid changes in human-technology interactions, the event marketing field has seen major developments (Hoyle, 2016; Gupta, 2003). A survey of 700 companies conducted by Harvard Business Review Analytic Services shows that 93 percent of companies put a lot of effort into hosting events, 57 percent of which consider it a very high priority (Services, 2018). Despite its remarkable growth, many aspects of event marketing do not yet align with the best available technologies. While a lot of research has been dedicated to studying the evolving role of artificial intelligence in marketing in general (Sterne, 2017; De Bruyn et al., 2020; Huang and Rust, 2021; Huang and Rust, 2021), only few works have targeted event marketing in particular (Neuhofer et al., 2020).

In this paper, we focus our study on leveraging event marketing performance using artificial intelligence techniques.

Event marketing is known as three main goals: generating brand awareness, measuring engagement during an event, and educating the audience. Engagement during an event is measured by observing attendees in their sessions attended, meetings held, surveys conducted, and social media activities. Generating attendee feedback from these observations is often done using traditional techniques which are mostly prone to high level of inaccuracy and unreliability. In general, people have a tendency, for many reasons, not to reveal their true opinions about events or products. They sometimes do not want to put effort into expressing their likes and dislikes - the reason why many surveys are filled recklessly and inattentively. Gathering proper feedback would require constantly following up with attendees, which not only incurs additional costs, but does not give the correct insights, since many people would simply not want to participate in giving feedback. Such inaccuracies lead to degradation in the Return On Investment (ROI). Hence, a slight improvement in the techniques used to generate customer feedback would imply higher success rates in profit maximization.

Motivated by the above, we develop in this paper a novel framework that leverages event marketing performance by improving attendee feedback generation using Artificial Intelligence (AI) techniques in facial recognition. The idea is to observe attendees during the sessions and identify, based on their facial expressions, whether they feel engaged or not.

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This gives companies insights about their presentations, trainings, and products, without the need to reach out to potential customers to ask about their feedback. Moreover, given that facial expressions are known to be a direct translation of true emotions (Ekman, 1993; Niedenthal et al., 2000), the information gathered in this framework would be way more accurate compared to those gathered using the traditional approaches.

Artificial Intelligence (AI) techniques have been widely used in marketing. (Campbell et al., 2020) studied the revolution of AI in business and society, aiming to understand and engage customers. (Kietzmann et al., 2018) used AI to understand and guide consumers with the help of machine learning techniques, by collecting data from different sources and combining them to gain on-the-spot consumer insights. (Whitehill et al., 2014) calculated the reliability of human observers' judgments to learn about students' engagement from their faces.

To the best of our knowledge, there has been no study about event engagement measurement using AI.

1.1 Our Contribution

In this paper, we propose a new engagement measurement framework that aims to optimize attendee feedback generation. The framework uses a facial-recognition algorithm to classify attendees based on seven states of emotions (anger, disgust, fear, happiness, neutral, sadness, and surprise) and accordingly calculates their average engagement level in a given session. Our proposed approach is easy-to-implement, time-efficient, and cost-effective.

At the heart of the framework is a software that deploys a high-definition camera to extract attendee facial features at specific session times (including time spent in a session). The software inputs the extracted pictures into a facial recognition algorithm, resulting in the attendees' states of emotions. The records are saved in a database and are used to calculate the average session engagements. These engagements are then used to give insights about the success of a given presentation or an event in general. Moreover, what makes the framework even more powerful is the fact that the results of session engagements obtained from the software could be displayed instantly to session presenters. Hence, if during a session, the majority of the states of emotions express confusion, the session presenter can shift immediately to other means of communication to get back attendees' attention. The software would give the proper alerts instantly during a presentation so as to make the best out of a given session.

To output attendees' states of emotions, our framework uses the facial recognition algorithm proposed in (Richhariya and Gupta, 2019). This algorithm is shown to outperform most facial-recognition algorithms available so far in the literature, in terms of speed, accuracy, and implementation cost.

1.2 Outline

The remainder of the paper is structured as follows. In Section 2, we give an overview of works related to AI-based event marketing and facial recognition. In Section 3, we present the algorithmic, hardware, and software requirements of the proposed framework. In Section 4, we present the engagement measurement framework and analyze it in Section 5. In Section 6, we extend the scope of the framework to event organizers and attendees. We conclude in Section 7 with a discussion and future works.

2 RELATED WORK

In this section, we give an overview of AI-based event marketing and facial recognition studies related to our work.

2.1 AI-based Event Marketing

AI has been intensively used to enhance marketing strategies. A study in (Campbell et al., 2020) shows the revolution of AI in business and society in terms of predicting, understanding, and engaging customers. The study is based on using nine marketing functions in the marketing planning process to consolidate how AI can enhance it. The nine components are inherent to strategic marketing, providing an organizing framework to assist marketing professionals with practical uses of AI.

(Kietzmann et al., 2018) studies the importance of AI in the way advertisers understand and guide consumers. With the help of machine learning techniques, advertisers are able to collect consumers' data from different sources, combine the collected data, and mine them, to deliver on-the-spot consumer insights. The study highlights on the role of AI in helping consumer and advertisers at the same time, by giving insights that take into account the public's privacy rights.

2.2 Facial Recognition

Our framework deploys the facial recognition algorithm proposed in (Richhariya and Gupta, 2019). The

algorithm is based on using the so-called Universum data to conduct multiclass face emotion categorization from human facial pictures. Unlike previous Universum-based models which have high training costs, the proposed algorithm, known as, Iterative Universum Twin Support Vector Machine (IUTWSVM), outperforms the previous models. It is characterized by high accuracy in detecting facial expression, speed, and low implementation cost.

A study about automatic recognition of student engagement from facial expressions in (Whitehill et al., 2014) has been an inspiration for our work in this paper. The study considers human observers' judgement, studies the signals made from these judgements, and uses machine learning techniques to automate the process. A comparison between human observers and AI-based observation is made. Low-cost computers with a high-resolution camera are used to monitor the engagement of students in a given class. This information is used to understand when and why students get disengaged and to accordingly shift to other teaching methods.

3 TECHNICAL REQUIREMENTS

To implement the solution and integrate between the infrastructure, the high-definition camera, and the facial-recognition algorithm, a number of hardware and software requirements are to be met. In this section, we give an overview of the facial-recognition algorithm and discuss these requirements.

3.1 Facial-Recognition Algorithm

Facial recognition is generally performed in five steps (Woodward Jr et al., 2003):

1. An image taken by a camera is acquired.
2. The locations of faces are detected in the acquired image.
3. Each detected face is analyzed based on the spatial geometry of face features. There are different ways to extract these features, the most common method is known as Principle Components Analysis (PCA). This process yields a so-called template for each face, which is a reduced set of data representing the unique face features.
4. The generated template is compared to templates of known faces stored in a database. This process results in scores that indicate how similar the generated template is in comparison to those in the database. In case of identity verification, the generated template is compared to only one template in the database, that associated with the claimed identity.
5. The last step determines whether the scores acquired are high enough to declare a match.

We refer the reader to (Richhariya and Gupta, 2019) for a detailed description of how the algorithm performs these steps.

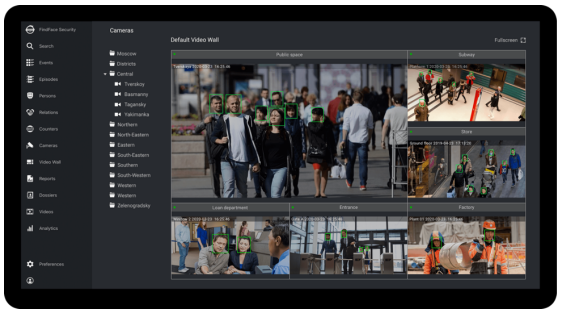

Figure 1: Findface Camera Interface Detecting Several Faces (Findface, 2021).

3.2 Hardware Requirements

Unlike other IT solutions that normally require a server and sometimes with high specifications, our proposed solution does not deploy a server. Instead, one computer with the following specifications is used, to share the resources among the different parts of the solution. The computer needed would run on a Windows 7 operating system and have the following specifications: 64-bit architecture, 3.20 GHz Intel Core i7 2400 processor, 8 GB of RAM, Nvidia video card 3Gb of video functionality. We can additionally add a redundant computer to cover the high availability plan and failover coverage. However, this is only needed for robustness as a form of a contingency plan associated with the event's success.

A high-definition camera is used. We propose the FindFace camera, which is recognized in many worldwide projects and is highly reliable in terms of hardware robustness and service support services (Findface, 2021). It is easily available and has relatively low costs. The FindFace camera is able to simultaneously identify a significantly large number of faces and send notifications at a very high speed - it can detect, identify, and notify about, all the images available within the same frame in 0.5 seconds. Figure 1 shows the camera's interface detecting several faces at a time. Our framework uses this feature to allow a presenter in an event to shift between presentation methods based on the notifications received.

3.3 Software Requirements

The computer would host a database that saves all the inward transactions from the camera using the manufacturer's Software Development Kit (SDK). These transactions would contain the attendees' images that will be fed to the facial recognition algorithm. The latter returns the state of emotion (anger, disgust, fear, happiness, neutral, sadness, and surprise) for each image, which will be saved in the database. At the end of the event, the database will contain loads of data that can be expressed in figures and translated into insights. Depending on the investor's database licensing budget, any of the following databases could be used: SQL Server, MySQL, or Oracle.

MATLAB R2008b will be installed on the computer to implement the facial recognition algorithm.

The software can be developed using any .Net language. Its functionalities are straightforward - it communicates with the camera, sends the images to the facial recognition algorithm, saves the transactions in the database, and reports tools to visualize the final results. We give a detailed software architecture in Section 4.

4 ENGAGEMENT MEASUREMENT FRAMEWORK BASED ON FACIAL RECOGNITION

The engagement measurement framework builds upon the following steps.

1. The FindFace camera is installed in the exact location (kiosk) where a given presentation is taking place.
2. The FindFace camera will be connected to the main network where the computer is deployed.
3. A number of software will be installed to the computer, namely, the Database Management System (DBMS), MATLAB R2008b, and the FindFace driver.
4. A database with the required tables will be created to hold the incoming information from the camera and the facial-recognition algorithm. This database will be installed to the Database Management System (DBMS).
5. The DBMS's high availability will be configured to the other computer to prevent any possible failover. As described in Section 3, this will only be added in case a robust solution is desirable.

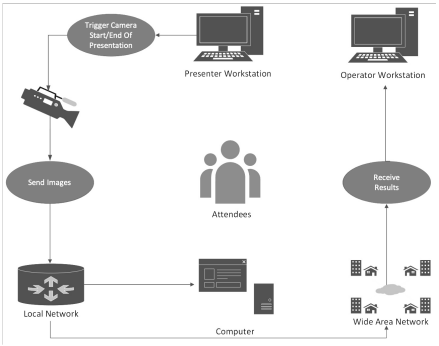

Figure 2: Flowchart/ Process Diagram.

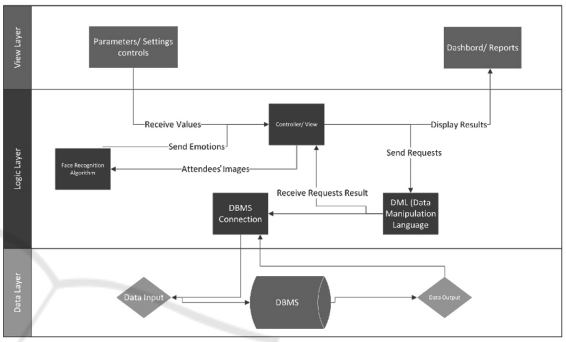

Figure 3: Software Design Structure.

6. The below software will be developed. Its job will be to communicate with the different hardware and software components of the solution.

The software will be developed using any .Net language, preferably C-Sharp. The latter is a high-level language and is easy to use. The implemented software will be straightforward and hence easy to implement. Its functionality is described as follows - we refer the reader to Figure 2 for an illustration.

- integrate, via the SDK, with the FindFace camera
- receive the captured images
- send the received images to MATLAB for feature extraction
- save the results from MATLAB in the database
- generate a report based on the treated data in the database

Next, we describe the software's design in terms of its view, data, and logic layers - we refer the reader to Figure 3 for an illustration.

View Layer: The software's view layer includes two tabs. The first tab contains the FindFace camera and the database controls to input the connectivity link. Other controls display the connectivity status and the number of images saved in the database, after

being processed by the facial recognition algorithm. The database will contain a record for each attendee with information about the time stamp, presentation session, and each emotional status during the presentation. These controls are needed to monitor and ensure that the system functions properly. The second tab contains the dashboard that will display the results associated with the event marketing evaluation in the form of graphs and spreadsheets. These results will contain the live data as well as the conclusive data at the end of the event, of a given presentation. At this point, one can measure the engagement level in the presentation based on the insights concluded from these data.

Data Layer: The data layer uses transactions in all the database classes to ensure the transaction's rollout during interruptions. We create the database connection class, referenced in a separate class that will contain the Data Manipulation Language (DML).

Logic Layer: The logic layer is coded in a scalable way using classes and objects to ensure its adaptiveness with future solution enhancements and different integrations. The facial recognition algorithm will have a separate class, which will return the state of emotion for the corresponding received image. The main form will run a thread having the ordered function as follows:

- Create a record in the database for each attendee once the presentation starts.
- Run the facial recognition algorithm periodically, such as, every one minute, and update the results associated with all attendees in the database.
- Update a flag in the database, during the presentation, about the session's status (in progress, finished)
- The presenter's computer will be linked to the same network as the software, and the software will integrate with the presentation tools to record the start/end of the presentation.

5 PERFORMANCE

Unlike traditional feedback generation approaches that require extensive resources in terms of time, cost, and processing, the proposed framework is able to output large amounts of insightful information within milliseconds.

The framework implements a facial-recognition algorithm, rather than relying on the facial-recognition features offered by the state-of-the-art cameras. This not only implies lower costs, but it also means that by only performing algorithm improvements, one can improve the quality of the solution provided by the framework. Hence, hardware maintainance and support efforts are only limited to the main functionality of the camera, i.e., capturing the faces.

As can be observed in Section 3, the implementation of the entire framework requires merely a high level of integration between the hardware and software. This simplicity makes the framework even more practical and hence desirable.

6 EVENT ORGANIZERS & ATTENDEES

In a broader context, our framework can be extended to be deployed by large event organizers, such as Expos. Event organizers can attract more organizations around the globe by providing features using our proposed framework. Additions can be easily made to allow the framework to collect and analyze the attendee-feedback data related to a particular industry and share this data with the related companies. This helps companies get insights not only about their own products and presentations but also about other competitors. Companies who wish to share such data and be given such features could benefit from the experience of other companies and accordingly make their future decisions.

Moreover, the framework could also be extended to give insights to attendees. In huge events, it is common for attendees to visit several kiosks and keeping track of the visits might not be easy. That is, an attendee is very likely to forget his/her impression about products or companies unless he/she makes an effort to. The extended framework could provide each attendee, upon his/her request, a summary of and an overall impression about the kiosks visited, the presentations attended, and the interactions made during the event. This makes the attendee's visit more efficient and fruitful.

7 CONCLUDING REMARKS & FUTURE WORK

We have proposed in this paper a new AI-based framework that leverages event marketing performance by optimizing attendee-feedback generation using a facial-recognition algorithm. This framework

helps optimize event marketing strategies made by companies after an event and during it.

A next step would be to implement this framework in a real-world event and compare its performance to that of a traditional framework. As described earlier, the approach used in the framework is time-efficient and can be easily implemented, making it a promising event managing and marketing tool.

Like any other AI-based framework, it is important to address the ethical concerns which accompany the proposed framework (Liu et al., 2021; Zhu et al., 2020; Oseni et al., 2021). While such events are generally public and it is common to have cameras installed for security purposes, it is still important to get the approval of attendees when it comes to using their photos and analyzing them to get insights. Hence, depending of the region where the event is taking place, the proposed engagement measurement framework will be accompanied with a number of procedures, policies, and guidelines.

We have demonstrated in this study the role of AI in leveraging event marketing performance, focusing on attendee engagement as an indicator of the quality of presentations/events. Our proposed platform analyzes the feedback of attendees by observing the attendees' facial expressions. The role of the platform becomes even more vital in the case of presentations in which there is no human presenter. In this case, the system is expected to make an automatic intervention as a reaction to the feedback gathered. To achieve this, the system is fed with a number of presenting formats such as image, video, or text. As a reaction to the attendees' feelings, the system would automatically shift between these formats to produce the best results.

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