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Machine Learning-Based Real-Time Emotion Detection System For Employees

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Abstract—

These days, companies care more about their workers' health and happiness than anything else. Just because it will have an impact on how productive an employee is and how much they contribute to the team. A fascinating and busy field of study for the last few decades has been the automated interpretation of facial expressions using machine learning. To automatically identify employees' emotions in real time using machine learning, this research proposes the Real time Employee Emotion Detection System (RtEED). Through the RtEED system, employers are able to monitor their workers' emotional health and communicate with them through messages when any distress becomes apparent. As a result, workers will be able to make more informed choices, increase their focus at work, and embrace healthier lifestyles that lead to greater productivity. In order to train a machine learning model, CMU Multi-PIE Face Data is used. A camera will be provided to every employee so that any expressions on their face may be captured in real-time. Based on the picture, the RtEED algorithm can determine whether the subject is happy, sad, surprised, afraid, disgusted, or angry. We have accomplished what we set out to do. Emotion recognition, machine learning, and facial expression analysis are some of the keywords related to artificial intelligence.

I. INTRODUCTION

Numerous industries are making use of AI and ML, including medicine, online retail, supply chain management, and farming. These days, artificial intelligence is used in every facet of running a company. Businesses should take full use of this technology. Pattern recognition and pattern classification challenges make heavy use of machine learning methods. Specifically, these methods have been used in electroencephalography (EEG) and facial expression/emotion identification for a number of years now [1]. In addition, the application of IoT technology in the construction of smart homes, cities, hospitals, and businesses brought more attention to facial expression analysis. Using both verbal and nonverbal cues, emotion detection software can decipher how a person is feeling. Among these feelings are dread, disdain, disgust, wrath, surprise, sadness, joy, ambivalence, and a host of others. Subtleness is key to these feelings. Therefore, detecting emotions is quite a challenge, but it is also important. One of the most effective, direct, and natural ways for humans to convey their feelings and intentions is via facial expressions. Company personnel are asked not to display their emotions in certain situations, such as with ill patients. Therefore, a system that can detect human emotions is essential, since it facilitates productive dialogue and yields desirable outcomes. Although it's easy for the human eye to pick out obvious facial expressions in photos and videos, detecting subtler emotions is a much more difficult process. In the beginning, companies didn't care much about their employees' feelings. However, a number of studies have been conducted lately to examine the impact of emotions on output, employers, and organizational performance. Since emotions immediately impact numerous current factors, such as customer care service, employee retention, organizational capital investment, and so on, it follows that a positive emotional climate among all workers will always contribute to the success of the business.

Therefore, in this context, employee emotion detection is critical to the success and happiness of both the company and the employee. Since even a little change in facial muscle tone may elicit a wide range of emotions, it's not an easy process to identify individual distinctions. Emotions are always context dependent, thus even when two people are experiencing the same feeling, their manifestations will be different. This study proposes RtEED, an automated system that uses machine learning to identify employees' emotions in real time. Using this method, the employer may send the right messages to check on the employee's well-being. Here is how the paper is structured:. Part II discusses articles that deal with the topic of employee emotion detection. In section III, the suggested system, RtEED, is detailed. Section IV delves into the discussion of the experimental set-up and findings. In section V, we make some remarks on the conclusion.

II. LITERATURE SURVEY

This section delves into the researchers' contributions to emotion detection. Representing and recognizing facial expressions are essential components of emotion detection. Part A: Representing expressions on the face Using a number of predetermined attributes extracted from the source picture of the face, automated facial expression recognition is used [2] to accurately portray the faces. In order to maximize variance across classes, the best characteristics are used to reduce expression variations inside classes. Optimal characteristics consistently achieved accurate recognition. Flow analysis was used to represent muscular actions in previous publications [3,4,5,6]. In addition to being very susceptible to motion discontinuities and inaccurate picture registration, non-rigid motion and fluctuations in illumination substantially disrupted the flow estimations. Facial geometry analysis, which involves extracting the positions and forms of faces for representation, was extensively employed in facial representation. Geometric feature-based representation, on the other hand, depends on reliably identifying and tracking face characteristics, which may be challenging to implement in many contexts. Modeling the face expressions is another way to convey them. Emotions were extracted from faces using Holistic spatial analysis [8]. To isolate the changes to the face, Gabor wavelet analysis was used on either the targeted area or the whole face. In a study conducted by Donato et al. [9], facial actions were identified using principal component analysis (PCA). The optimistic performance compared to all other strategies for facial image analysis is shown by gabor-wavelet representation. The memory and processing demands of Gabor-wavelet representations are two of its drawbacks. This leads to the widespread adoption of Local Binary Patterns [15]. Part B: Recognizing Expressions on Faces Face expression classification makes use of a variety of approaches and techniques, such as Support Vector Machines, Neural Networks, and others. The training pictures in the work of Lyons et al. [7] are analyzed using LDA to create discriminant vectors. (1) and (2). Due to the lack of high-resolution video input in real-time applications, facial expression recognition systems always confront their greatest difficulty while working at low resolutions to identify facial expressions. Research has shown that LBP works reliably and robustly even when faced with low-resolution facial photos, thereby solving this issue. The recognition can only be done using static photos, which do not capture the facial expressions' temporal behaviors. This is another drawback. The use of dynamic pictures, according to Bassili[10], allows for more accurate recognition of facial emotions. One further drawback of these technologies is that the recognition system can only identify expressions in very controlled environments using high-resolution frontal faces. However, gathering photos at such low resolutions makes it impractical to use in real time. Expression recognition has become a challenging real-time challenge due to the utilization of these low-resolution photos. The Viola-Jones technique, in conjunction with the Haar feature selection and the AdaBoost training algorithms, is used to identify the eye and nose regions. The algorithm isn't without its flaws, however. Only frontal photos are effective. Eleven and twelve.

III. THE PROPOSED ARCHITECTURE

A. Real-time Employee Emotion Detection

A representation of the Real-time Employee Emotion Detection system is shown in Figure 1. The camera records the worker's likeness. The cropping process begins with identifying the face in the picture. The picture has been prepared in advance to accommodate any necessary resizing. Finding the optimal match in an image is what feature extraction is all about. To determine the employee's emotional state, a small number of strategically placed best-match points in the picture are used. Lastly, the employee's identified emotions are shown on the screen.

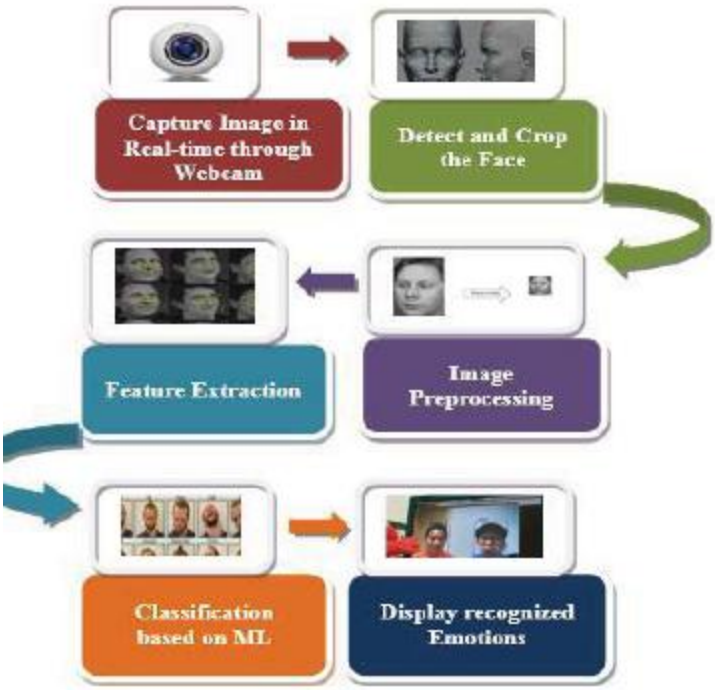

Figure 1. Block Diagram of Real-time Emotion Detection System.

The proposed Algorithm:

Algorithm: Real-time Employee Emotion Detection

//Recognizes the emotions of the employee in the image captured and displays it

Input: Employee image captured using webcam

Output: Display of recognized emotions of the employee

Step1: Capture the image of the employee using webcam.

Step2: Detect the face in the image and crop it.

Step2.1: Select Haar-like features

Step2.2: Create an integral image

Step2.3: Select subset of features which helps more to identify face in image

Step2.4: Create classifier cascades

Step3: Pre-process the image for required size.

Step4: Find the best match position in the image.

Step5: Identify the emotions of the employee by choosing few important best match positions in the image.

Step6: Display the recognized emotions and also intimate the same to the concerned authority via message.

Step7: End

IV. EXPERIMENTAL SETUP AND RESULTS

A. Setup

On a little scale, there's the Raspberry Pi. We just dump the whole trained model onto the Raspberry Pi. Every single one of our employees has their very own desktop, laptop, and webcam. A login to the RtEED app will be installed on each employee's personal computer. He or she will be able to see visualizations of the emotions picked up by the RtEED system after logging in successfully. Raspberry Pi will be linked to the cameras of every employee. Every half an hour, the camera will record the employee's face expression and send it to the Raspberry Pi for processing. In order to identify the employee's emotional state from the picture, many OpenCV algorithms are used. The computations done on the image's pixel values in the back end are done using the TensorFlow Python package. Javascript and java are used to build the front end and back end of web applications, respectively. The RtEED system can identify six different emotions: joy, sorrow, surprise, fear, disgust, and rage. The experimental configuration of the RtEED system is shown in figure 2.

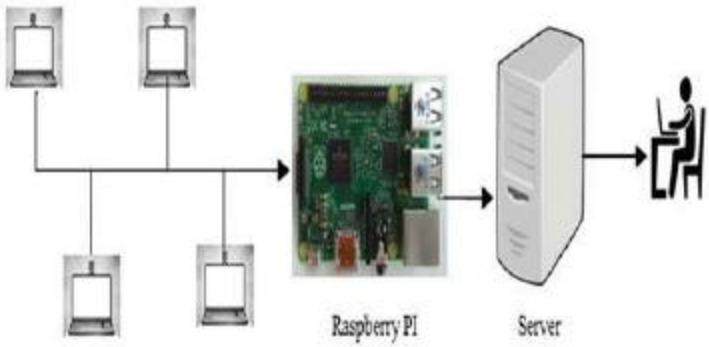

Figure 2. Experimental setup

B. Data source

There are two datasets needed by the RtEED system. You use one to make sure your model is right after training it, and the other to see how well it did. The model is trained using the CMU Multi-PIE Face Database, which is an existing data source. There are a total of 750,000 photos based on 337 individuals. The dataset is created by taking pictures in four separate sessions spread out over five months, with fifteen different vantage points and nineteen different lighting scenarios taken into account. We use real-time webcam capture of workers' facial expressions to assess the accuracy of the model. Section C: RtEED system deployment Following is a discussion of the algorithms used at each phase of the RtEED process. 1. Take a picture of a worker using their webcam: An employee's face expression is recorded every half an hour using a camera. 2. Find the face in the photo and trim it: This module's goal is to find the face in the photo. In order to identify faces in the taken picture, a deep learning system known as the Viola Jones method is used. The four primary parts of this algorithm are to identify the subject's face in the picture and then crop it. a. Choosing Haar-like features: Here, we may split the picture into brighter and darker areas based on the pixel values. b. Integral picture creation: adding the values of nearby pixels yields the same feature. b. Conducting training using AdaBoost: In all, 160,000 distinct characteristics may be used to determine a person's identity. On the other hand, not every feature is crucial. In order to extract a face from a picture, the AdaBoost algorithm is applied to a subset of the features. d. Building classifier cascades: The AdaBoost method selects features and evaluates each subregion of the picture using those features. Every subregion must go through cascading since each feature is applied sequentially. It is not necessary to compare a subregion with the remaining characteristics if it does not match with any of the specified features. The subregion does not fit the face, according to the indication. Step three: prepare the picture for the desired size. This involves cropping the image to the desired dimensions before feeding it into the sobel channel algorithm to identify edges. Step four: Use Active Shape Model (ASM) to determine where in the picture the model and the input image are most closely aligned. 5. Determine an employee's emotional state by using the Ada Boost algorithm to pick out a small number of very relevant best-match locations in a picture. The chosen feeling will fall somewhere in the range of the six possible ones: joy, sadness, surprise, fear, disgust, and wrath. 6. Reveal the detected emotions: The detected emotions will be communicated to relevant parties via messages, allowing them to take necessary measures to prevent issues.

D. Results

Both "Manage Employee" and "Manage Report" are found on the dashboard of a web application. Various workers' emotional information are shown in Manage Employee based on the date. The Manage Report shows the total proportion of various emotions shown by all workers during a certain time period. With this data, the company can better address its workers' mental health. The dashboard of the RtEEd system is shown in Figure 3. Figure 4 displays the chronological list of employee emotions identified by the RtEED system. Both the collected picture and the detected emotion are shown in Figure 5, which is the result of the RtEED system. Figure 6 shows the employee's emotional state message provided to them via SMS.

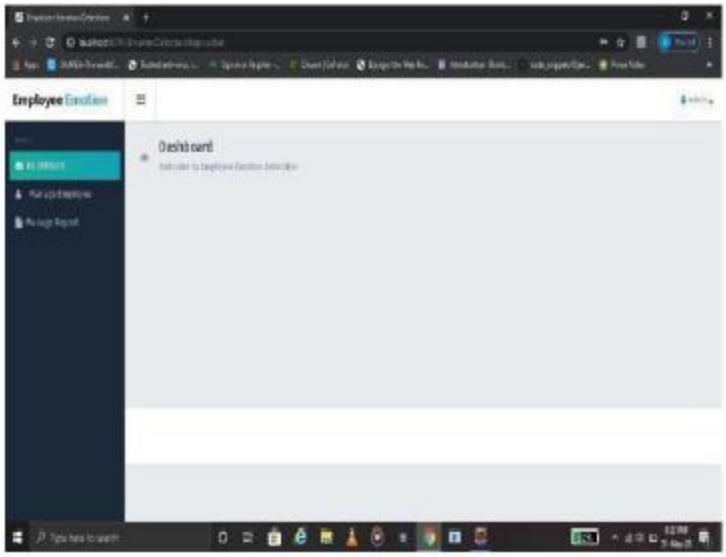

Figure 3. RtEED system dashboard

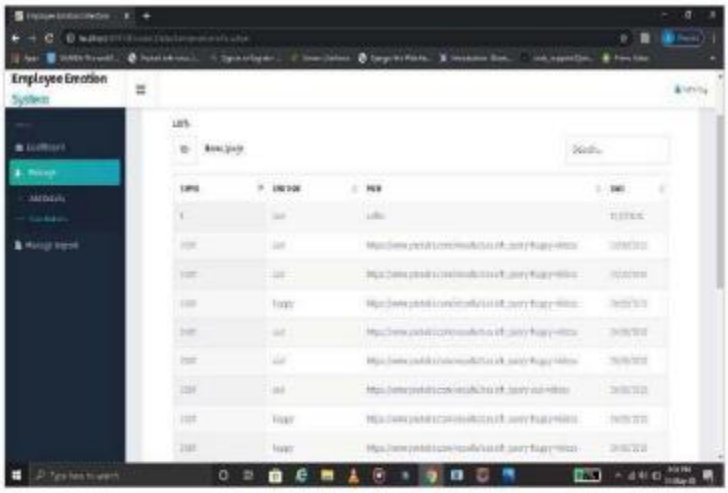

Figure 4. List of detected emotions of employees with date

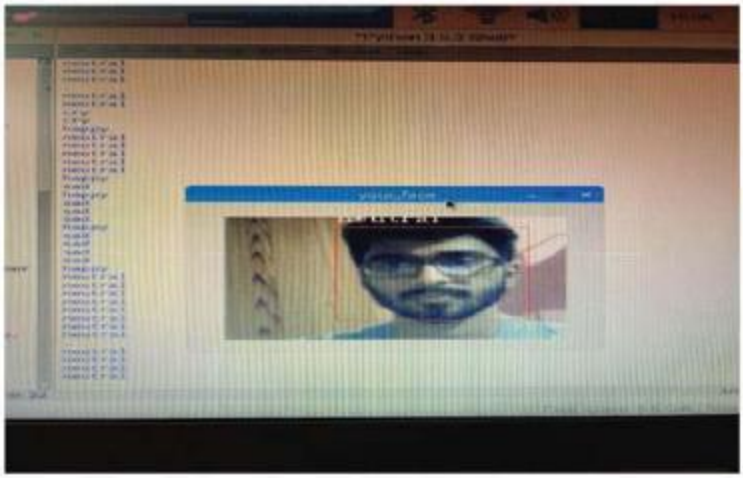

Figure 5. Sample output of emotion detection system

Figure 6. SMS sent to respective employee

V. CONCLUSION

These days, many companies' success and profitability depend on being able to read their employees' emotions. The RtEED system, described in this article, would use machine learning algorithms to identify an employee's emotional state in the present moment. After a certain amount of time has passed, the RtEED system successfully crops the picture, detects the employee's mood, and captures the image in real time using the camera. So that the business may prioritize its workers' health and happiness.

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