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Emotion Analysis for Online Patient Care using Machine Learning

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ABSTRACT

Nowadays, telemedicine has become increasingly important for patient monitoring, as due to the confinement caused by the pandemic, public care has been banned by the government in many countries. For this reason, online patient care has been exercised by many physicians. Therefore, this research paper makes a proposal of emotion analysis for online patient care using machine learning, a branch of artificial intelligence that has been very successful in different studies. In this article, a methodology capable of identifying the emotional state in which the patient is and that is able to classify it at the time of being in an online care was applied. In short, the Dlib library containing algorithms in Phyton language was used for data collection. For data collection, a tool was used to identify coordinates of the facial features of the study. Finally, a model was applied using the SVM, vector machine for the classification and detection of evidence extracted from emotions. As a result, the mood of the patients is evaluated and the necessary measures are taken for better online care.

1. Introduction

In the world of learning, Machine Learning studies the construction of systems that are capable of learning with data. That is to say, it comes to include great varieties, from the system of the visions by computers to the systems that are detected by mails that are not wanted for the user. Therefore, it is a system that learns and is able to generalize patterns and regularities in the data that can be allowed to perform well because they have not been observed before [1]. In recent years Machine Learning was very important for all disciplines and in medicine was no exception, since, there has been one of the most important increases in the procedures that are in Machine Learning for the study of neural pathologies [2].

It is very useful the diagnosis that is made with Machine learning because it can predict diseases, if they incorporate enough data, not only can detect an ailment, but also may have a better accuracy than a human pathologist [3].

In clinical psychology, Machine Learning is already being used for various purposes, for example to be able to have the assistance of people with mental pathologies such as Alzheimer's or senile

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dementia. In other cases, this Machine Learning technology is more related to psychiatry, for example, the use of virtual reality for the treatment of phobias or post-traumatic stress in patients. In addition, there are several programs such as Emibot, which has been developed to capture human emotions, was developed in China was developed in China and can recognize people's facial patterns through emotions with an accuracy of 96% which could help patients to have a better control of their emotions to help in their improvement of their disease [4].

Telemedicine is presented as an essential solution for remote monitoring, allowing large numbers of different chronic patients to be cared for at home. Several studies have investigated various telemedicine activities. These studies involve remote assessment, diagnosis and treatment of patients with chronic diseases [5].

Diagnostic Imaging (hereinafter, DPI) is a medical specialty that uses different types of technologies (X-rays, magnetic fields and ultrasound, among the most commonly used) for medical imaging, which are used by the medical specialist to detect, diagnose and treat diseases. Dr. Ricardo Garcia considers that DPI was born as an innovative specialty. Its history was marked by the implementation of technologies that allowed it to reach the greatest potential within its time. AI will be no exception [6].

For example, a cancer diagnosis can affect the emotional health of patients, families and caregivers. Common feelings during this life-changing experience include anxiety, distress and depression. Roles at home, school and work can be affected. It is important to recognize these changes and get help when needed [7].

The aim of the article is a proposal of emotion analysis for online patient care using Machine Learning.

The article is composed by sections, in section II the methodology to be implemented, in section III the case study will be developed, in section IV the results, in section V the discussions and finally in section VI the conclusions.

2. Methodology

2.1 Machine Learning

Machine learning allows the study of pattern recognition, making it possible for the computer to learn without being programmed. It is based on algorithms that yield relevant results through a set of data [8]. It searches for data patterns and facilitates them by relating them in a labeled data set or data point, it is worth mentioning that each data point has a label or a target [9]. For that, an algorithm is trained by giving it other questions that are the characteristics, and the answers are obtained, which would be the labels [10].

2.2 Tools

Next, the tools to be used for the development of the proposal are as below

i. *Face_utils*: It is that library that contains open-source code for the most common face detection models [11].
ii. *NumPy:* Standard representation of numerical data since it allows the implementation of high-level language computations such as vectorization, avoiding data copying and minimizing the number of operations [12].
iii. *Dlib*: Machine learning library used in C++ language for the extraction of all facial points of a face in terms of recognition, since its algorithm is able to detect 68 facial points [13].

iv. *OpenCV:* Open CV is a library that allows you to run computer vision algorithms efficiently in real time. CV2 detects movements, object recognition, among others [14].
v. *Pandas*: It is that Phyton library that allows working in a simple way with data that are labeled and relational. That is to say, in an interactive way it will be possible to manipulate and visualize the data quickly [15].
vi. *Support Vector Machines (SVMs):* They are a set of algorithms that solve classification problems, currently useful with character recognition, intrusion detection, among others [16].

3. Case Study

3.1 Data Collection

The data collection will have two fundamental steps: the first is the collection of images by the physician who, depending on the videoconferencing tool, will obtain the video or images of the patient; and the second is the collection of emotions through photographs of different moods, to be subsequently analyzed with the Dlib library.

As a first step, the physician has to obtain an image bank with captures of the patient at moments where he/she considers that important issues of care are addressed and are relevant to the research work.

For the second step, the information of the faces must be collected using a Python-based algorithm, which will obtain the patterns that identify 6 feelings in each: neutral, sadness, surprise, disgust, anger and fear. This algorithm recognizes the facial points of a selected image, which will obtain the patient's faces and store them in a folder for further analysis. Figure 1 shows the recognition according to facial points, which were recognized by the Dlib library.

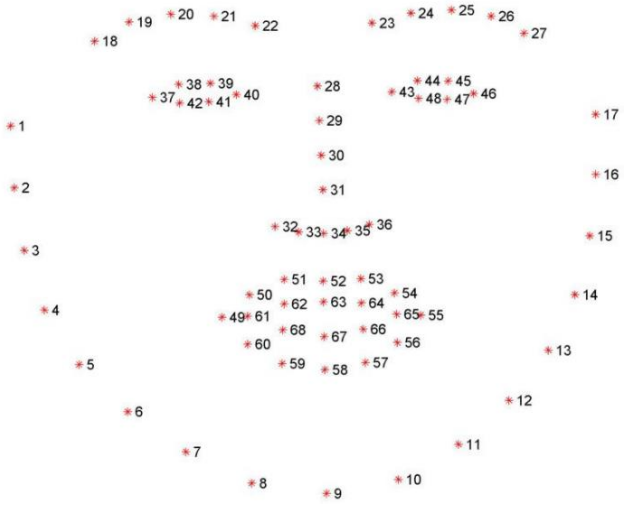

Fig. 1. Facial points

Continuing with the analysis of emotions, the libraries cv2, glob, random, math and Dlib will be used for the development of the algorithm that will result in the measurement in percentage in the mentioned emotions. This percentage will be observed in each face, depending on the expression of each student.

3.2 Data Preparation

For facial expression recognition, you must first have a database with some of the requirements so that you can facilitate the work. The points that you find, indicates on the points of the coordinate "X" and "Y". This process is done because people do not have the same size and it is possible to have a scale of points.

Using the machine learning tool with the same database, the images are cropped in order to obtain the faces of each image. To do this, the models must be tested and the images must be labeled with the corresponding sentiments. In an Excel the code must be put detailing the facial points and the feelings. So that they can validate it was possible to make a partition of the database to separate and validate.

The number of feelings being considered is

i. Train (Happy, Sad, Neutral, Surprise, Angry, Fear and Disgust).
ii. Validate (Happy, Sad, Neutral, Surprise)

Therefore, 2 different scenarios will be tested

i. 2 feelings (happy and sad).
ii. 4 feelings (fear, happy, neutral and sad).

3.3 Application of The Model

For facial expression recognition, you must first have a database with some of the requirements so that you can facilitate the work. The points that you find, indicates on the points of the coordinate "X" and "Y". This process is done because people do not have the same size and it is possible to have a scale of points

To start with the neural networks, we will work under the following layers: convolution layer and the grouping layer. Three models will be used, where each one will have one, two and three layers respectively. The filters that each model will have will be increasing, where each layer will double its number with respect to the previous one.

Subsequently, within each model, feelings will be evaluated and several iterations will be made to learn: the more iterations are programmed, the better it will improve with respect to its errors and will have better accuracy at the time of evaluation until it stabilizes.

By means of the vector machine (SVM) it will be used for the training classification and for the feature testing of the extracted emotion detection. Then, these parameters will be stored in a database in a CVS file format for later use.

Once the models have been prepared with greater precision, we will begin to evaluate the feelings of the students' previously captured images.

4. Discussions

In this section, the analysis will be compared with other research, which presents similarities or inequalities with respect to the proposed project, taking into account the methodology and the way it is executed.

The objective of the article Emotion analysis for online medical care by means of artificial intelligence and machine learning techniques is to predict the work, in addition, a study on the

detection of emotions using the DEAP database, which contains EEG signals and excitation-valence values that relate these physiological signals with emotional states. This database was collected with the help of the Biosemi active II with active electrodes for the acquisition of physiological signals. With this equipment, physiological signals including ECG, EEG (32 channels), respiration amplitude and skin temperature were recorded while the stimuli were shown to the participants. From this, accompanying actions can be deployed and immediate actions can be taken to improve the patient's condition [18]. Also, it can be considered to add different processes in emotion recognition, such as arousal (dimension) recognition using peripheral physiological signals, valence (dimension) recognition using audio-visual and EEG signals, and then resolving subtle overlaps between adjacent emotion classes; this to better consider patients' feelings during a videoconference and obtain better results in query analysis [19].

In addition, what was added in the project is to show you the feelings that were put in the database, what was considered the most important and that the doctor has a report of how the patients are in the virtual appointment to get some recommendations.

5. Results

One of the most important tasks for doctors is to help patients to feel emotionally better so that their recovery process is faster, in addition, the pandemic made patients feel more insecure and they shut themselves up at home, therefore, people became emotionally depressed because at every moment they heard about the deaths of many relatives or acquaintances, they felt that they were not able to move forward. It helps the doctor a lot to listen to each patient's experience because it is a feeling or emotion that cannot be controlled. Within the recognition of emotions with machine learning, neutral emotion is the easiest to identify from speech, in contrast to disgust, which is the most difficult and forms the most prominent mixed pair with fear; these being the emotions where the most work will have to be done at the time of running the application of the model [20]. Although significant advances have been made in emotional state detection methods, there is still work to be done to identify effective stimuli for emotion detection, which are largely shaped by cognitive aspects of knowledge such as expectations and perceptions, socialization, personal history and culture. as in sadness and anger. It often turns out that while the basic emotions are common, the stimuli that elicit them with great intensity are not [21]. For that, protocols have to be implemented in which each patient actively participates and is informed of the intention to investigate in order to awaken his or her own emotions.

As we can see in Figure. 2 the result shown by the application is a neutral feeling but according to the statics it has a high level of stress, so we implemented the project to improve it and take action quickly for improvement and there may be a better treatment for patients and their prompt improvement.

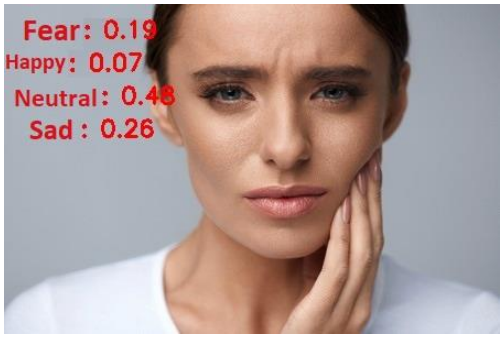

Fig. 2. Emotion test results

6. Conclusions

The conclusion of this research work was to analyze the emotions of patients online using machine learning. These Machine Learning technologies are presented as powerful tools when performing pattern analysis.

As observed in this work, the analysis of emotions through phyton-based facial recognition algorithms is feasible both in production and implementation in a healthcare environment. This in turn demonstrated that the use of these technologies presents a future of possibilities and solutions when predicting situations in the health, educational, commercial, economic and other fields. As future work, these algorithms can be implemented to recognize the status of an appointment in real time, as well as to analyze the level of stress or interest shown by the patient to the virtual appointment.

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