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Emotion Recognition using Human Activity From Smartphone Data

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***Abstract* –Social interaction has become an important concern in our daily activities. The social interactions tell us about the emotion and the mental state of a person. Both the body movements and the facial expression of a person can be used to analyses the emotion of a person. Numerous researches have been conducted for analyzing the emotion of a person with the help of face reaction. The proposed project focuses on analyzing the emotion of a person with the help of body movements. These movements will help to find the underlying emotion of a person whenever the face isunclear/occluded. Recognition of human activity is performed first with the help of the data recorded from a smartphone's sensor such as accelerometer and gyroscope. The data is recorded when the smartphone is attached to the waist of the subject, as this provides accurate results. The human activity recognition is done using the UCI HAR Smartphone dataset which has data recorded from 30 volunteers at age difference of 19-48 years and with 561 measurements variable. After the human activity are identified it is compared with the 2-D stimuli from the dataset and features are extracted from the dataset frame which are preprocessed and matched against the same human activity identified from the smartphone dataset and the extracted features are fed to the KNN and Support Vector Machine (SVM) classifiers to classify the emotion of the human. In this way, a human emotion can be found from the activity recognized from the smart phone data.**

***Keywords*–Spatio-temporal interest points (STIPs), Support Vector Machine (SVM) classifier, Emotion Recognition.**

I. INTRODUCTION

TheSmartphoneweuse these days is very advanced. They can become our assistants and can also record our heartbeat and play our favorite song based on our wishes. There are different sensors present in Smartphone like an accelerometer, gyroscope, Magnetometer, GPS, Proximity Sensor, Ambient Light Sensor, Microphone, Touch screen Sensors, Fingerprint Sensor, Pedometer, Barcode/QR Code sensors, Barometer, Heart Rate Sensor, Thermometer, Air Humidity Sensor and the list might grow even more in the future An accelerometer is used to detect acceleration, vibration, and tilt which is used to determine movement and exact orientation along the three axes.

Smartphone's App uses this sensor to determine whether the smartphone is in portrait orientation or landscape orientation. A gyroscope will provide orientation details and direction like up/down and left/right with greater precision. A gyroscope will detect how much the device is tilted. Gyroscope can measure rotation too, but the former cannot. Angles yaw, pitch, and roll are used to represent the absolute orientation of the phone. The absolute orientation is detected by a combination of the accelerometer, compass, and gyroscope. The data retrieved from the accelerometer and the gyroscope sensor of the smartphone is classified to recognize human activity.Recognition of human activity is performed first with the help of the data recorded from a smartphone's sensor such as accelerometer and gyroscope. The data is recorded when the smartphone is attached to the waist of the subject, as this provides accurate results. The human activity recognition is done using the UCI HAR Smartphone dataset which has data recorded from 30 volunteers at age difference of 19-48 years and with 561 measurements variable. After the human activity are identified it is compared with the 2-D stimuli from the dataset and features are extracted from the dataset frame which are preprocessed and matched against the same human activity identified from the smartphone dataset and the extracted features are fed to the KNN and Support Vector Machine (SVM) classifiers to classify the emotion of the human. In this way, a human emotion can be found from the activity recognized from the smartphone data.

1. Machine learning

Machine learning is an artificial intelligence (AI) sub-field. The goal of machine learning is to understand the data structure and fit the data into models that people can

understand and use. Although machine learning is a computer science field, it is different from traditional approaches to computing. Algorithms are a series of specifically programmed instructions used by computers in conventional computing to measure or solve problems. Instead of machine learning algorithms, computers can train on data inputs and use statistical analysis to generate values within a specific range.

Machine learning therefore, makes it easier for computers to create models from sample data to automate decision-making processes based on data inputs. Each consumer of technology today has benefited from learning the machine. Face recognition technology enables social media platforms to assist users in tagging and posting friends ' images.

Software for optical character recognition (OCR) transforms text images into phone form. Recommendation engines, driven by machine learning, suggest what movies or TV shows to watch next based on user preferences. Recommendation engines, driven by machine learning, suggest what movies or TV shows to watch next based on user preferences. Consumers may soon be able to access self-driving cars that rely on machine learning to navigate.

Machine learning is a field that continues to evolve. Common machine learning methods are categorized into supervised and unsupervised learning, and common algorithmic approaches to machine learning include neighboring k-nearest algorithms, learning decision-making, random forest deep learning, etc.

2. Machine Learning Methods

Tasks are usually classified into broad categories in machine learning. Such categories are based on how to acquire learning or how to provide the established process with input on learning.
Two of the most widely adopted machine learning approaches is supervised learning which trains algorithms based on examples of human-labeled input and output data, and unsupervised learning which provides the algorithm with no labeled data to allow it to find structure within its input data.

3. Supervised learning:

Examples of inputs with the desired outputs are presented in supervised learning. The aim is to enables the algorithm to "learn" errors by comparing its real output with the "taught" ones and to adjust the template accordingly. Supervised learning therefore uses patterns to predict tag values on additional data that are unstated. The supervised learning can be supplied to a software algorithm with shark images classified as fish and images of oceans identified as water. Then, unlabeled shark images as fish and unlabeled ocean images should be recognized as water by the supervised learning algorithm by training on these findings. Historical data are widely used to predict future events that are statistically likely. It can forecast future fluctuations by using data from previous stock markets or by filtering spam emails.

4. Unsupervised learning:

Information is unlabeled in unsupervised learning, so the learning algorithm remains to be found among its input data. Machine learning methods that facilitate unsupervised learning are particularly valuable as unlabeled data are more abundant than labeled data. The goal of unsupervised learning may be as straightforward as the discovery of hidden patterns in a dataset, but it may also have a goal of feature learning, allowing the computing machine to automatically discover the representations needed to classify raw data.

For transactional data, unsupervised learning is widely used. Without a "correct" answer being told, unsupervised methods of learning can look at complex data that is more expansive and seemingly unrelated to organize it in potentially meaningful ways. Unsupervised learning is often used to detect anomalies, including fraudulent purchases of credit cards, and to recommend systems to recommend which products to purchase next.

4. Approaches

As a discipline, machine learning is closely related to computational statistics, so having background knowledge in statistics is useful for understanding and exploiting machine learning algorithms. Correlation is a measure of interaction between two variables, which are not described either as dependent or independent. In order to evaluate the relation between a dependent variable and an independent one, the basic stage of regression is used. Since regression statistics can be used to estimate the dependent variable when the independent variable is known, regression allows for estimation capacities. Machine learning methods are being developed on a continuous basis. Below are some of the most common ones

4.1 K-nearest neighbor: The K-nearest neighbor algorithm is a pattern recognition model that can be used for both classification and regression. The k in the neighborhood nearest to K is often defined as k-NN, a small positive integer. The input will consist of the nearest examples of k training within a space, either in classification or regression.

4.2 Decision Tree Learning: In general, decision trees are used to visually represent decisions and to explain or direct decision-making. Decision trees are used for machine learning and data mining as a predictive model. These models map data findings to assumptions about the target value of the data. The aim of the decision tree learning is to create a model that predicts the value of a target base.

4.3 Deep learning: Deep learning tries to mimic how the human brain can transform into the stimuli of vision and hearing light and sound. A deep learning architecture, inspired by biological neural networks, consists of several layers in an artificial neural network composed of hardware and GPUs.

Deep learning requires use of a cascade of nonlinear layers of processing units to extract or transform information (or representations) characteristics. The performance of one layer is the following layer results. It is possible to control and use algorithms to classify in-depth learning knowledge or to un-monitor and perform pattern analysis.

Deep learning consumes more data and has managed to beat humans among the machine learning algorithms currently being used and built in some cognitive tasks. Because of these features, deep learning has become the approach with significant potential in the artificial intelligence domain

4.4 Random Forest: Random forest classification creates a set of decision trees from the randomly selected training set sub-set.

II. RELATED WORKS

The existing system describes how human activity can be predicted using smartphone data [1] and how an emotion can be predicted using the video frames.

1. **Human Activity Recognition using Machine Language Algorithm**
   Recognizing human activity is the problem of classifying accelerometer data sequences recorded by specialized harnesses or smartphones into well-defined known movements [1]. Given the large number of measurements every second, the spatial complexity of the results, and the lack of a clear method to link accelerometer data to recognized movements [5], this is a task.

   Classical solutions to the problem include hand-crafted interfaces from time series data based on fixed-size windows and testing machine learning models, such as ensembles of decision trees. Data Mining based techniques are used to exaggerate performance metrics of the human activity recognition system using data preprocessing, feature selection,feature extraction, five different classification types: Decision tree, KNN, Naive Bayes, Support Vector Machine, and Random Forest, used to classify human activities[2][4].
2. **Emotion recognition using face visible in images/videos**
   In the existing system, the human emotion is identified using photographs of the human face or the video of the person where the facial features are visible [12]. An embedded smartphone camera or a surveillance camera captures image of the face. Some representative frames are removed from the video, and the facial regions in the images are recovered using a face detection system. To predict the appropriate emotion, on the extracted function areapplied classification algorithms for machine learning. [14]
3. **Emotion recognition using Poses/gestures in images/videos where the face is not visible**
   Recently, increased attention has been paid to recognizing spatio-temporal points of interest (STIPs) [3], which has become a key computer vision strategy and topic of study. Local Image Features or Interest Points include a lightweight and abstract representation of patterns in frames [6][9]. In the existing system, images or gestures of the body / pos are used to identify emotions.

III. PROPOSED SOLUTION

The existing system predicts human activity like walking, walking upstairs, and sitting, standing and walking downstairs and laying. A human body exhibits the perfect picture of how the persons feel when this prediction combined with emotion recognition can give an accurate result of how the human is currently feeling. So, the proposed system tries to find the emotion of the human activity from the activities recognized from the Smartphone. After the human activity is identified it is compared with the 2-D stimuli from the dataset. For a given activity there might be many possible poses possible. From the possible poses/gestures, features are extracted from the dataset frame which is preprocessed. The extracted features are fed to the KNN and Support Vector Machine (SVM) classifiers to classify the emotion of the human. In this way, a human emotion can be found from the activity recognized from the smartphone data.

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