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GESTURE RECOGNITION BASED MACHINE LEARNING APPROACH FOR HUMAN COMPUTER INTERACTION

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Abstract. Gesture recognition provides a way for interaction with the human computer. It has become a large dynamic area of research in computer advances and in machine learning. The reason for this is the great importance that humanity gives to the gesture mainly while communicating with each other or interacting with the machines. The main objective of the research on the recognition of gestures is to create a system that can recognize particular human gestures and use them to transfer information or control the device. The human data which can either be large scale or small scale, based on the surface area, are intelligently processed which enables the computer/robot to make decisions on the past activity or predict the future. To this finish, comprehension of machine learning methods is indispensable. Machine learning (ML) is today one of the fastest growing technologies with a large number of prototypes and applications in the industrial field. Machine Learning learns from past experiences to improve the performance of smart programs. Robotics, artificial vision, production, medicine, acquisition of knowledge, execution and control, planning, planning and programming, among others, are areas that have discovered the potential of technology. This paper explores the feasibility of providing computers with the ability to predict, in a context of interaction of a human computer, the probable emotion of the user and its intensity for a given situation of provocation of emotions.
Keywords:Gesture recognition, Machine Learning, Human computer Interaction

1. INTRODUCTION

Man-machine interaction has appeared to be a significant problem i.e., the problem of identifying ways to communicate with the versatile machines. Gesture recognition is an accepted form of human-computer interaction and has developed as an area in which many academics and industry researchers are at work. To make interactions easier, more natural and more convenient, incessant research is going on. Recognizing a particular gesture, from the series of gestures performed by a human body at any time is the arena of gesture recognition.

Gesture recognition has many applications in the context of human-machine interfaces, sign language translation and human prosthesis control. With this goal, the classic techniques, such as k-Nearest Neighbor (k-NN), Discriminant Analysis (DA), Support Vector Machine (SVM), Relevance Vector Machine (RVM) and Sparse Bayesian Learning (SBL) based on the concepts of machine learning are presented. The characteristics of the gestures are extracted and analyzed in the time domain according to the deformed signal, to model the gestures.

1.1. Gesture Recognition

Gesture recognition is the mathematical interpretation of a human movement created by an information technology device. In gesture recognition, the movements of the human body are read by a camera and the acquired data is sent to a computer. The computer then uses this data as input to manage applications or devices. Gesture recognition helps computers understand the language of the human body. This helps build a more powerful link between man and machine, rather than just basic text user interfaces or graphical user interfaces (GUIs). The approach used is to identify the pixels in the image that make up the body part, extract the characteristics of those pixels identified to classify the part and use these characteristics to recognize the occurrence of sequences of specific poses as gestures.

Given this unique circumstance, the issue of motion acknowledgment can be portrayed as tails: we play out an arrangement of body developments and to measure the movement of constant acceleration in the body as a three-dimensional temporal arrangement, we need to delineate a strategy that is capable before identifying the beginning of the movement and segregate the examples of movement (stage of identification of events), at that point grouping signals of a similar type and describing them with a specific sign (Feature extraction stage), and finally to characterize a recently estimated movement according to the constructed word movement word (classification phase). One critical issue in such a system is identified with the high inconstancy of the information, as far as various individuals playing out the activity of scheme, distinctive gadget utilized for estimation, diverse methodology of finishing the activity assignment (e.g. body starting position, movement course, estimating gadget introduction or reference outline) . The commitment of this work prompts the improvement of a motion acknowledgment calculation in a setting that is client autonomous, gadget free, and gadget introduction free.

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Utilizing motion acknowledgment, human-machine associations (HMIs) can be deciphered without the assistance of any mechanical gadget. For instance, the idea of motion acknowledgment might be utilized to move a cursor just by pointing and coordinating a finger at the PC screen. The potential advantages offered by signal acknowledgment innovation may influence standard info gadgets to like the console, mouse and even touch-screen old. Perceiving motions as info can be extremely useful for physically-debilitated people. Furthermore, motion acknowledgment triggers better, more characteristic collaboration for a 3-D virtual world or a gaming domain.

2. MACHINE LEARNING

Machine learning is a multidisciplinary field in artificial intelligence, likelihood, measurements, data hypothesis, logic, brain research, and neurobiology. Machine learning solves real-world problems by creating a valid model and a useful approach to data. The study of machine learning arose from efforts to explore whether computers can learn to imitate the human brain.

2.1. Supervised learning

Supervised learning is used for data sets in which the desired output is previously known. The supervised learning algorithm is fed with a set of data which consists of both input as well as the corresponding desired output. The algorithm is meant to learn by comparing the actual output with the ones already given. Applications where historical statistics may be used to guess the probable forthcoming actions, is the field where supervised learning may be applied.For example, on application of supervised learning, it is possible to estimate when credit card transactions can be corrupt or the insurance customer can file a claim.

2.2 . Unsupervised Learning

Unsupervised learning uses data that has no historic forename and the goal is to examine the data, to find similarities between the objects. This is the technique for discovering the labels of the data itself. Transactional data is the data upon which the base of unsupervised learning lays. Few cases of an unsupervised learning problem are explained below:
The common interests of the customers are found out so that the interests can be worked out well during marketing campaigns. Working out on attributes that separate the customers among the same market. The distant galaxies are observed in detail to characterize the combinations which can be used to separate the galaxies. A video is examined to categorize the moving and motionless objects and determine the relation between both. An unsupervised task groups a set of inputs and is applied in self-organized maps, mapping of the nearest neighbor, k-means clustering, and singular value decomposition. Segmenting text topics, recommending elements and identifying anomalous data values are some another applications of unsupervised learning.

2.3. Semi-supervised Learning

Semi-supervised learning uses tagged and unlabeled training data. It is applied in the same fields as supervised learning, but for the anticipated prediction the algorithm must learn the structure which will help in organizing the data and making predictions. This learning technique is applicable when we want minimal cost to be associated to the data because it is similar to supervised learning. Domains such as word processing, video indexing, bioinformatics, identifying a person's face on a webcam comes under the application of semi-supervised learning. This learning can be used with classification, regression and prediction.

2.4. Reinforcement Learning

Reinforcement Learning uses brute force method to determine the greatest benefit which can be attained to reach a certain goal at each intermediate step. There is no explicit information whether the goal is reached and thus the goal of reinforced learning is to use the best policy to achieve the goal. The algorithm interacts with the environment dynamically and the student has to choose actions that maximize the expected reward during a certain period. It is majorly applied in games like chess, robotics and navigation.

3. HUMAN COMPUTER INTERACTION

HCI is the systematic study of how people will interact with machines. It covers several disciplines such as Computer Science, Cognitive Science and Human Factors Engineering. It focuses on the discovery of methods and techniques that support people and machine interaction. HCI designers always consider the user-friendliness of HCI and the user experience goals for effective user interaction. The HCI designers also consider the possible contexts, the available tasks, and the users of the information systems. HCI major concern is on user satisfaction and providing ease to mankind while interacting with machines and computers. Importance is given to the interaction of the humans with machine because a poor interface between human and machine can make it hard for users to get profit even from the simplest and easiest systems.The relevance of HCI in the 21st century is particularly evident in the further development of new forms of interactivity, namely the Voice User Interfaces (VUI).

4. MACHINE LEARNING ALGORITHM USED IN GESTURE RECOGNITION

To execute the process of machine learning iteratively an extensive arrangement of machine learning calculations is created.These calculations can be ordered based on learning style as takes after:

4.1. Instance-based Algorithms

This algorithm employs the important cases of training data to find the decidability of the problem. This model predicts by comparing and finding the maximum possible similarities between the database of training data and the test data. Delayed learning simply stores training data and waits until the test data is given and then performs the learning. Therefore, slow learning requires less training time but more time to predict. The algorithms based on the most popular instances are:

k-Nearest Neighbour (kNN)
Learning Vector Quantization (LVQ)
Self-Organizing Map (SOM)
Locally Weighted Learning (LWL)

4.2. Bayesian Algorithms

Machine learning is a cross between statistics and algorithmic computation. The statistics concern about the management and quantification of uncertainty and unpredictability. To characterize all different forms of uncertainty, the algorithm used is called Bayesian Algorithms. The methods which uses the concept of Baye's theorem explicitly for solving classification and regression problems are called Bayesian methods. Basic Bayesian algorithm includes:

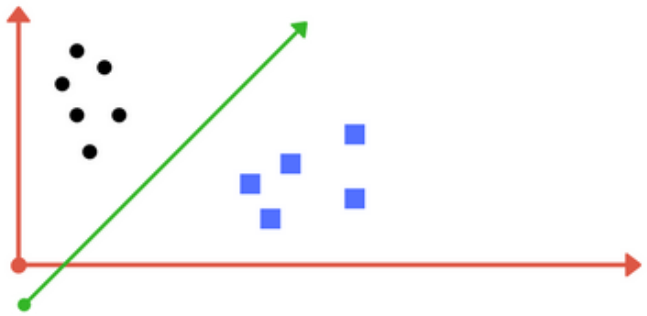
Naive Bayes
Gaussian Naive Bayes
Multinomial Naive Bayes
Averaged One-Dependence Estimators (AODE)
Bayesian Belief Network (BBN)
Bayesian Network (BN)

4.3. Linear Discriminant Analysis

The preprocessing phase of classification and machine learning applications use this model as a dimension reducing technique. This model aims to reduce computational incidentals and overheads of processing by separating a set of data into smaller sets. While this data sets are separated it is mandatory to maintain the information of separability between them. While ensuring reduced overhead, it also minimizes the errors in estimating parameters.

4.4. Support Vector Machine

SVM is classifier which is defined by a hyper plane that divides the labeled data collected from various experiments conducted by supervised learning and the algorithm produces an optimal hyper plan classifying new examples. In 2D spaces, hyper plane is a line which divides a plane into two parts where each class is on either side of the line.Each remaining point of the line are categorized into black circle class and to the blue square class in right of the hyper plane



4.5. Relevance Vector Machine

This technique aims to find an economical solution for regression and classification taking help of the Bayesian algorithm. The functional form of the supporting vector machine is referred to by this model. It provides a probability based classification. Thus, it can be said to be equivalent to Gaussian model with a covariance model. Compared to vector support machines (SVM), the Bayesian RVM formulation avoids the set of free SVM parameters (which generally require post-optimizations based on cross-validation). However, the RVM uses a learning method similar to expectation (EM) and is therefore at risk of local minima. This algorithm finds an economical solution which is different from other algorithms which guarantees a global optimal solution.

5. RELATING HCIWITH GESTURE RECOGNITION

The important steps for machine learning applications can be categorized as feature selection, record preparation and data transformation. To create the correct model, we need to comprehend the data. The correct extraction of data requires much more than the simple selection of a learning algorithm and implementing it on the data. To test the machine learning algorithms two different data sets have been used with different characteristics of the body. The first data set includes the average and the variance of the image of the body segmented in gray, the angle of the body and the area and the perimeter of the binary body and the number of convexity defects. The second data set contains information about the 36 values of the bin of the orientation histogram and the 100 values of the bin of the radial signature of the body angle, the average and the variance of the body image of the segmented gray body. In order to implement all these experiments we first organize the data in a text file describing features of the body using an application which was created in C++ connected to Kinect1 camera and in order to provide functionality or to extract functionality it uses gray scale images and values describing depth of image. After that, .txt file is converted to its corresponding .XLS file imported with Rapid Miner Application in order to test and verify the performance of the experiment conducted on the basis of four selected algorithm.

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