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Survey paper on Application of Machine Learning in Various Fields

[Wine quality prediction, Water quality prediction, Human Activity Recognition, virtual assistance and self-driving cars]

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1. ABSTRACTION

The purpose of this paper is to give a brief overview of the fundamental ideas and algorithms behind machine learning and its applications. We start with a definition of machine learning and then go over different learning modalities, such as supervised and unsupervised methods and deep learning paradigms. The remainder of the paper discusses applications of machine learning algorithms in a variety of fields, such as wine and quality prediction, human activity recognition, self-driving cars, and virtual assistance, which includes pattern recognition, sensor networks, anomaly detection, Internet of Things (IoT), and health monitoring. Since machine learning is still in its infancy, there is a lot of room for further research in this area.

The purpose of this study is to provide researchers with knowledge about machine learning, which has gained a lot of popularity recently, and its applications. We conclude with some software tools and a comprehensive bibliography.

2. INTRODUCTION

It will always be recognised as the most pivotal time in human history, when

computing transitioned from mainframes to PCs to the cloud to artificial intelligence. Machine learning, a significant branch of artificial intelligence that gained prominence, enables computers to enter an involuntary state of self-learning. Building different machine learning models based on different needs is the goal.

A machine learning algorithm that examines the different chemical properties present in wines and water to forecast their quality, Both the environment and public health are directly impacted by water quality. Water is utilised for several purposes, including industrial, agriculture, and drinking. In light of recent developments in machine learning, the process of creating accurate and successful models for predicting water quality has drawn increased attention. A machine learning classifier is used in the wine quality prediction instance to determine if an input piece of data belongs to the low-, mediocre-, or high-quality wine class. Machine learning classifiers for predicting wine quality include Decision Trees and k-Nearest Neighbours (KNN).

Considerable progress has been made in the field of activity recognition, with numerous new models being proposed based on scientific and technological advancements. These highly trained models enable the most efficient and effective real-time monitoring of various activities, such as human activity recognition (where suspicious or anomalous activity can be handled with practical solutions to maintain harmony and peace in the living world, enabling the creation of smart homes and smart healthcare services through routine monitoring).Virtual Personal Assistants, or VPAs, are computer programmes designed to communicate naturally with users, responding to inquiries, carrying on conversations, and carrying out various duties.

Significant progress has been made in the field of activity recognition, as evidenced by the creation of numerous new models based on scientific and technological advancements. The real-time activities can be monitored optimally and effectively thanks to these highly trained models. One such example is human activity recognition, which allows for the prompt treatment of suspicious or anomalous activities, promoting harmony and peace among living things and facilitating the creation of smart homes and smart healthcare services through routine monitoring. VPAs, or virtual personal assistants, are computer programmes designed to communicate naturally with users by answering inquiries, carrying on conversations, and carrying out various activities.

3. LITERATURE SURVEY

- **Water Quality Prediction**

In 2018, Ali Heidar Nasrolahi along with Amir Hamzeh Haghiabi and Abbas Parsaie predicted the Water Quality of a river bed in Iran Tireh River by taking pH, Na, Ca, Mg, etc such components into consideration. Performance was tallied by using several ML and DL algorithms. It was observed that results of SVM was the front runner and gave the best accuracy. ANN gave acceptable accuracy for practical purposes.

In 2019, Umair Ahmed and others explained ways to efficiently predict water quality using supervised Machine Learning. Harrowing diseases have been in increased proportions due to the depreciation and deterioration of water quality at an alarming rate which was a direct impact of rapid urbanization and industrialisation. Their research monitors and works with supervised Machine Learning algorithms to calculate Water Quality Index (WQI) and Water Quality Class (WQC), the former being a singular index which describes the general quality of water and the latter being the derivative and distinctive class on the basis of WQI.

In 2022, Manisha Koranga et.al discussed the use of Machine Learning Algorithms for water quality prediction for Nanital Lake, Uttarakhand. Analysed the use of machine learning algorithms and used eight regression algorithms and nine classification algorithms. Three algorithms Random Forest, SVM and Stochastic Gradient Descent comes out to be the most effective machine learning algorithms.

- **WINE QUALITY PREDICTION**

Machine learning research focuses on utilising machine learning to address real-world problems by breaking problems down into manageable chunks that may be handled individually using one or more machine learning algorithms (Samuel, 1959). Dahal and colleagues chose essential features that affect wine quality using a variety of machine learning methods (Dahal et al., 2021). The authors of this study employed 11 physiochemical characteristics to create machine learning models for predicting red wine quality (Dahal et al., 2021). Kumar et al. (2020) used data mining methods to extract information on red wine quality from the UCL machine learning repository.

According to Samuel (1959), machine learning research focuses on applying machine learning to solve problems in the real world by segmenting issues into smaller, more manageable pieces that may be solved separately using one or more machine learning algorithms. Dahal et al. (2021) employed diverse machine learning techniques to choose critical attributes that impact wine quality. The study's authors used machine learning models to estimate the quality of red wine by utilising eleven physiochemical traits (Dahal et al., 2021). Kumar et al. (2020) extracted quality information on red wine from the UCL machine learning repository using data mining techniques. The SVM model yielded an accuracy of 67.25 percent, whereas Random Forest and Nave Bayes yielded, respectively, 65.83% and 55.91% (Kumar et al.,)

As per Kumar et al. (2020), the accuracy of the SVM model was 67.25 percent, but the Random Forest and Nave Bayes models had respective accuracy of 65.83% and 55.91%. Shaw and colleagues (2020) and Trivedi and Sehrawat (2018) conducted a comparative analysis of multiple classification algorithms, elucidating the reasons for the superior accuracy of certain algorithms' results relative to others. A machine learning model based on RF and KNN algorithm is built in Mahima Gupta et al. (2020) to determine if the wine is good, average, or terrible. In a study by Lee and group (Lee et al., 2015), a decision tree classifier is used to assess wine quality.

Physio-chemical and chemical properties are used in machine learning algorithms to predict wine quality, which is the main objective of this research. This research undertaking does, however, come with certain challenges. The biggest challenge we are trying to solve in this study is the small sample size. In viticulture, as in other experimental studies, obtaining large volumes of data is very expensive and challenging. In order to address this issue, we generated synthetic data with features that were similar to the real data. The potential for data leakage is another problem to deal with. The sharing of information between data sets during the pre-processing phase of a program's execution is known as data leakage.

- **Human Behaviour Recognition**

Behaviour Recognition via Sparse Spatio-Temporal Features. (Piotr Dollar, Garrison Cottrell, Vincent Rabaud, Serge Belongie) This paper presents the work of doing behaviour recognition by characterizing the behaviour according to spatiotemporal features. They have presented a new spatiotemporal interest point along with analysis of many cuboid descriptors. Due to the use of these cuboid prototypes, an efficient as well as much robust behaviour descriptor is implemented. Many different types of datasets are compiled together into 3 different datasets namely facial behaviour, mouse behaviour and human activity. As the differences between behaviours can be very minute or indistinct therefore the optical flow calculation can sometimes be faulty or imperfect. To overcome such defects the datasets are highly trained in recognition of activities having different characteristics and occurrences. The repetition of some activities are also stored as subsets in a dataset.

Action Recognition with Improved Trajectories. (Heng Wang, Cordelia Schmid) In this paper improvisation of dense trajectories is done by explicitly estimating the camera motion. It is shown that performance can be improvised by removing the background trajectories by estimating approximation in camera motion. In this model four datasets are used – Hollywood2, HDMB51, Olympic Sports and UCF50. These datasets are implemented for effective categorization of activity detection.

In the experimental setup of this model the presentation of implementation details of the features of trajectories is done. Firstly a brief description of dense trajectories is given which are used as baseline in the experiment. The features are encoded using bag of features and Fisher vector. Long-term Recurrent

Convolutional Networks for Visual Recognition and Description. (Jeff Donahue, Lisa Anne Hendricks, Marcus Rohrbach, Subhashini Venugopalan, Sergio Guadarrama, Kate Saenko, Trevor Darrel)

In this model LRCN has been presented which is a class of models that is deep both spatially as well as temporally and also flexible for its application on variety of vision tasks involving sequential inputs and outputs. These tools are aggregated with much ease into the existing visual recognition pipelines due to which they are considered as instinctive option for perceptual problems as they can easily handle time varying visual input or sequential output with very little input

preprocessing as well as no hand-designed features. The evaluation of this model is done by using the dataset UCF101 which contains various videos which are classified and categorized into different human action classes. Apart from UCF101, other datasets like LSTM, COCO2014 and LRCN have also been used to evaluate this image description model for tasks like retrieval and generation.

- **Virtual Assistance**

The Speech Recognition Model is one of the most important part of a Virtual Assistant. Considering the various Neural Networks that are required for building up of a speech recognition system, it was necessary to survey the models that provided the insight by determining the accuracy and other factors of each Model. It was observed that High Accuracy and less Validation Accuracy was achieved for Convolutional Neural Network (CNN) model as compared to Basic Neural Network. Thus,proving that CNN is a better choice for speech recognition systems. Considering the Limitations for the Model, other parameters such as Word Error rate, throughput of the system was not taken into consideration. Various Machine Learning Algorithms are used for speech recognition. It was found that on application of Auto- WEKA on various algorithms, determined Random Forest as the best algorithm which is useful for learning the dataset based on the training set. However in this survey, Speech samples consisting of noise was not tested for determining the scalability and robustness of the models. In the Survey of scaling speech recognition using CNN, following metrics were taken into consideration:

(i) throughput,

(ii) Real-Time Factor(RTF) and latency, and

(iii) Word Error Rate (WER)

for the overall framework, helped in achieving an efficient model. But due to the increase in the number of the layers the implementation of the same was difficult. Other Algorithms such as the Long Short-Term Memory (LSTM) is very powerful in speech recognition and Hybrid model of Hidden Markov Model (HMM) and Gaussian Mixture Models (GMM) can give excellent results. In various Projects of developing a Virtual Assistant it was observed that the platform failed to support various other languages of the countries including China, Japan, India, etc. The survey paper provided with detailed study on the Recurrent Neural Networks (RNNs) that can be used for Speech Recognition System but with more research to be carried out on the same. However, the survey focused more on the Supervised Learning Models and less importance was given to the Unsupervised Learning Models.

- **SELF DRIVING CARS**

In literature, further research was carried out in realtime order to find the positions on the roadway by Xiaodong Miao, Shunming Li, and Huan Shen. An operation such as canny edge extraction is carried out in order to obtain a map for the matching technique and then to pick possible edge points. In another research[3], an Autonomous RC car was built that uses Artificial Neural Network (ANN). It explains the thesis for autonomous vehicles and the neural network. A car is made using L298N IC and motor driver which can be managed by a microcontroller and then sent to the model car in return. CNN detects only grayscale parts and ignores the unnecessary detection data. The use of the system is very limited but accurate. Using an implanted pi camera for input and grayscale images for neural network processing. For each direction, the system detects lane markings and offers no other functions but that. In another research, by Malay Shah, Prof, Rupal Kapdi. The problem discussed in this article is object detection using deep neural network especially convolution neural networks. Object detection was previously done using only a conventional deep convolution neural

network whereas using a regional-based convolution network increases the accuracy and also decreases the time required to complete the program. Training a neural network from scratch takes more time and processing power as it is very difficult to find the dataset of sufficient size and ground truth. Using Regional Convolutional Neural Network(RCNN) helps in finding appropriate regions in an image and it enables the system to give real-time outputs. This deep neural network is used for image processing, mainly for medical

uses like tumors and such where the data set is too complex to detect regions in comparison to a model road environment. In Literature, by Aditya Kumar Jain. His proposed model takes an image with the help of Pi cam attached with Raspberry Pi in the car. The Raspberry-Pi and the laptop are connected to the same network, the Raspberry Pi sends the image captured which serves as the input image to the Convolutional Neural Network. The image is gray-scaled before passing it to the Neural Network. Upon prediction the model gives one of the four output i.e. left, right, forward, or stop. When the result is predicted corresponding Arduino signal is triggered which in turn helps the car to move in a particular direction with the help of its controller. Their car was trained under different combinations of the track i.e. straight, curved, a combination of straight and curved and etc. A total of 24 videos were recorded out of which images were extracted.10868 images were extracted and were categorically placed in different folders like left, right, straight, and stop. In this paper, a method to make a model of a self-driving car is presented. The different hardware components along with software and neural network configuration are clearly described. With the help of Image Processing and Machine Learning, a successful model was developed that worked as per expectation. Thus the model was successfully designed, implemented, and tested. The car slightly moves out of the track which can be a serious issue if it hits nearby objects if we consider a real car.