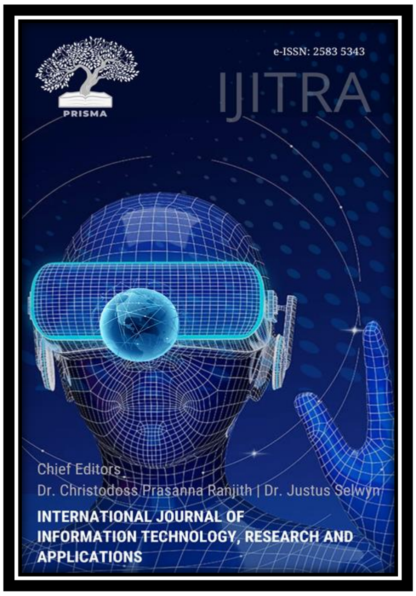

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Early Detection of Cancer using Machine Learning (ML) Techniques

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ABSTRACT

Early detection of cancer sickness leads to rapid treatment, reducing the risk of morbidity and mortality. The diagnosis of oral cancer continues to be a challenge for dental careers, particularly in the location, evaluation, and review of early-stage oral disease. Due to the lack of optimal analysis using conventional methods, oral cancer is identified and grouped using AI at an early stage. AI techniques are used to show the movement and treatment of dangerous locations and may accurately predict future disease effects. AI techniques are used to show the movement and treatment of dangerous locations and may accurately predict future disease effects. A combination of expert AI and highlight determination calculations produces improved results in the early detection and forecast of oral cancer. The main goal and commitment of this audit study is to summarize the use of AI technologies for accurate early prediction of oral malignant development.

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I. INTRODUCTION

As the sixth most prevalent malignancy, mouth cancer has overtaken all others as the leading cause of cancer-related morbidity and mortality globally. The incidence of mouth cancer is highest in Maharashtra. Early cancer discovery through clinical diagnosis results in earlier treatment, which reduces the risk of morbidity and mortality. Implementing a screening programme approach increases the likelihood of finding cancer early so that patients with the disease can receive treatment quickly. Since most diseases share the same clinical symptoms and scales, clinical diagnosis gathers information and features from the patient's history that cause problems with the diagnosis. Although oral cancer is treated with cutting-edge clinical techniques including surgery, radiation therapy, and chemotherapy, the mortality rate linked with mouth cancer has increased over the past 40 years. Benign, premalignant, or malignant tumours are all possible. Cancerous tumours are malignant tumours. The malignancy of mouth cancer is the main cause of death. The mortality rates of oral cancer can be decreased by early assessment of precancerous lesions in the mouth. The dentistry profession continues to face challenges in the diagnosis of oral cancer, particularly in the detection, assessment, and treatment of early phase changes or frank illness. It becomes difficult to predict oral leukoplakia (premalignant) and oral squamous cell carcinoma. One of the most fascinating and difficult tasks for doctors is making an accurate prognosis about how an illness will progress. Due to the difficulties in diagnosing clinical disorders, several specialists looked into the medical and computer science fields for potential answers.

Numerous researchers used various techniques, such as early stage screening, and created novel ways for the early prediction of cancer therapy outcomes. In the realm of medicine, cutting-edge technologies are used, and the medical research community has access to vast volumes of cancer data that have been gathered. Machine learning techniques are now a well-liked tool for medical researchers. Numerous machine learning techniques, including feature selection and classification, are frequently used in cancer detection. To find patterns and relationships in large datasets, machine learning techniques are applied.

The following is how the paper is set up: Overview of oral cancer is covered in Section II. The review of studies using machine learning techniques for the identification of oral cancer is presented in Section III. The methods of machine learning are covered in Section IV. The manuscript is concluded in Section V.

II. ORAL CANCER

Oral cancer is a type of head and neck cancer that starts in the squamous cells that line the mouth, tongue, and lips. Most often, mouth cancer is first found after it has spread to the neck lymph nodes. Types of oral cancer include those that affect the lips, tongue, inner cheek lining, gums, mouth's floor, and both the hard and soft palate. The following are oral cancer signs that should prompt early diagnosis and appropriate treatment: 1) Red, white, or a combination of red and white patches on the lips or inside the mouth; 2) mouth bleeding 3. Swallowing problems or pain. 4. A lump in the neck. Because 70% of cases recur and result in death, treatments for oral cancer, such as surgery, radiation therapy, and chemotherapy, are ineffective. If the lesion is not detected in a timely manner, therapy will not be successful since it is frequently disregarded and the patient presents after the lesion has become incurable.

The sixth to eighth most frequent cancer in the world is oral cavity cancer (OC), which is also known as a malignant tumour on the lip or in the mouth. The previous circumstance resulted in the development of pre-malignant lesions, and clinical screening techniques are used to identify morphologically altered tissue where cancer is more likely to occur than in normal tissue. Such lesions may show epithelial dysplasia (ED) on histopathologic examination. Screening techniques are used to identify mouth cancer or precancerous lesions that may result in mouth cancer at an early stage when lesions are most easily removed and most likely to be cured.

Vital Staining, Light-based detection systems, Histological, Imaging Diagnostic, Cytological, Molecular Analyses, Imaging Diagnostic, and Onco-chip screening procedures are some examples. However, screening techniques have not been shown to be effective in saving lives, so doctors must overcome difficulties in the oral exam for oral cancer screening. Early oral cancer identification and diagnosis can increase patient survival and lower morbidity rates. As a result, modern computer science techniques are currently used for precise diagnosis.

III. LITERATURE SURVEY

In this study [1], a method for using an orthopantomogram to detect oral tumours is proposed. In order to maintain these edge characteristics as well as the conspicuous watershed on images, which causes oversegmentation despite being pre-processed, a novel mathematical morphological watershed approach is suggested. Marker controlled watershed segmentation is used to segment tumours in order to prevent oversegmentation. In this paper [2] a hybrid model is put forth that consists of two stages, the first of which uses the ReliefF-GA feature selection method to identify the best feature of the subset and the second of which uses the ANFIS classification to categorise patient survival after a specific number of years since diagnosis. Two datasets of oral cancer with clinicopathologic and genomic markers each were used to test the suggested predictive model. It has been tested that the suggested model performs better when both types of datasets are used, along with additional techniques like logistic regression, support vector machines, and artificial neural networks.

The high risk markers can be found using this prognostic model, which can also be utilized to assist physicians in the decision-support stage and more accurately forecast each patient's chance of surviving oral cancer. Researchers Wafaa K. Shams and Zaw Z. Htike[3] foresee the potential emergence of oral cancer in OPL patients. They have chosen pertinent features from the gene expression array using Fisher discriminate analysis. As classifier methods, Deep Neural Network (DNN), Multi-Layer Perceptron (MLP) with Back Propagation, Support Vector Machine (SVM), and Regularized Least Squares (RLS) are employed.
Themis P. Exarchos[4] and Konstantina Kourou gave a survey of contemporary ML techniques used in the modelling of cancer progression. In this research, multiple supervised ML approaches, as well as a variety of input attributes and data samples, are used to discuss various predictive models.

Researchers K. Anuradha1 and K. Sankaranarayanan[5] have conducted a thorough analysis of the various techniques used for the early identification of oral malignancies. The comparison of several cancer classification and identification techniques. The cancer detection algorithms include every stage. According to Shikha Agrawal and Jitendra Agrawal [6], categorization of cancer is a hot research topic in the field of medicine. They have provided an overview of various neural network methods. Convolutional neural networks, according to Hakan Wieslander, Gustav Forsli, and Ewert Bengtsson[7], have been shown to be reliable for image classification tasks. Using two datasets encompassing oral cells and cervical cells, the performance of two distinct network designs, ResNet and VGG, was assessed. ResNet was a prereferable network, according to the results, with a better degree of accuracy and a lower standard deviation. The ED&P framework was introduced by Neha Sharma and Hari Om [8] and is used to create a data mining model for the early identification and prevention of oral cavity cancer.

K. Anuradha and Dr. K. Sankaranarayanan[9] presented their research on employing image processing to find oral tumours. Noise is removed from the input dental X-ray image using linear contrast stretching. Tumors are segmented from the augmented image using marker controlled watershed segmentation, which has been improved. The segmentation algorithms' speed and accuracy are compared, and it is discovered that the upgraded method offers better segmentation.

The integrated diagnostic model with hybrid features selection methods for the detection of oral cancer that identify the attributes lowers the number of features that are obtained from various patient records was developed by Fatihah Mohd, Noor Maizura, and Mohamad Noor[10]. Oral cancer patients' diagnoses are predicted using classifiers like Multilayer Perceptron, K-Nearest Neighbors, and Support Vector Machine that are updateable[11]. They also stated that, after adding feature subset selection with SMOTE during the preprocessing stages, the support Vector Machine outperforms other machine learning techniques.

IV. MACHINE LEARNING

Machine learning creates a model that is a good and useful approximation to the data and uses it to solve problems in the real world [12,13]. Nowadays, machine learning is common due to the expanding amounts and types of data available, cheaper computing processing, and more capable and reasonably priced data storage [14]. Even on a very large scale, machine learning swiftly and automatically creates models that can evaluate larger, more complicated data sets and produce faster, more accurate results. Without human assistance, a machine learning model can provide very accurate predictions that can be utilised to make smarter judgments and take clever actions [15].

To progress the field of machine learning and employ it in a number of study fields, including healthcare, it is necessary to create newer algorithms. According to a recent study, machine learning can be used to treat cancer [16,17]. A new era of individualized medicine with swift and sophisticated data analysis, previously unreachable, is beginning with the use of machine learning and AI techniques in basic and translational cancer research. Countless data sets and machine learning algorithms aid in the diagnosis, treatment, and prognosis of cancer, among other aspects of the fight against disease [18,19]. Machine learning makes it possible to tailor the therapy to the patient, which would not be possible without it.

On EMR databases, various machine learning techniques are used to search for hidden patterns that aid in cancer diagnosis [20]. Deep learning neural networks are utilized to evaluate CT and MRI scans, and natural language processing (NLP) is used to interpret doctor's prescriptions [21-24]. Big data and machine learning can be used for diagnosis. When the diagnosis is based on sufficient and high-quality data, it is correct. Machine learning algorithms may query databases to detect similarities and provide precise projected models when the dataset is vast. The discovery of new drugs is being revolutionized by big data and machine learning. Despite the fact that Big Data and Machine Learning have improved the process of cancer diagnosis, therapy, and medication discovery, scientists still confront numerous obstacles in this field. In hospitals where data is not digitalized, it is collected and recorded using antiquated techniques and cannot be processed using cutting-edge technologies.

The foundation of machine learning is the learning process, which is split into two phases: training and testing. When building a learning model, a learning algorithm is utilised in which features are learned from input examples in training data. During testing, a learning model that uses the execution engine to create predictions tests production data. The output of the learning model is classed or tagged data that provides the final forecast.

The three broad categories into which machine learning techniques are divided are as follows:

1. Supervised Learning: In supervised learning, labelled examples that have been trained and the desired output are provided as inputs [25-28]. Features and labels are both present in the training dataset. Using labelled training data made up of a collection of training instances, the goal of supervised learning is to infer a function. It is used to build learning models that forecast an object's label given a set of features. In supervised learning, the learning algorithm takes a set of features as inputs along with the corresponding correct outputs, and learning is performed by algorithm after comparing its actual output with correct outputs. If error occurs after comparison, it then modifies the model accordingly. It training data is missing; model is not capable to infer prediction correctly. Supervised learning is used in applications where classification is done on some data and to predict some data. For instance, an astronomy problem is a classification problem that involves detecting an object and categorising it into different groups, such as a star or a galaxy. However, when the label

(age) is a continuous number, determining an object's age based on observations is a regression problem.

2. Unsupervised Learning: In this type of learning, unlabeled data are utilized as the input, and learning is carried out to examine the data and identify patterns among the objects. The data itself is used to find the labels [29-30].
   Applications involving supplied transactional data use unsupervised learning. For instance, group clients who share characteristics so that they might be addressed similarly in marketing initiatives. Classifying objects into galaxies and stars is a task carried out in supervised learning. Unsupervised learning, on the other hand, uses extensive observations of distant galaxies to identify the traits or feature combinations that are most crucial for differentiating between galaxies.
   In contrast to classification, which requires prior knowledge of the groupings, clustering is an unsupervised operation that divides a set of inputs into groups. Popular unsupervised techniques include nearest-neighbor mapping, self-organizing maps, k-means clustering, and singular value decomposition.

3. Semi-supervised Learning: Semi-supervised learning is used in a variety of real-world learning contexts, including text processing, video indexing, and bioinformatics, where there is a plentiful supply of unlabeled data but a finite amount of labelled data that can be produced at a reasonable cost [31-34]. As a result, training material in semi-supervised learning includes both labelled and unlabeled data. In order to organise the data and produce predictions, the learning model needs to learn the structures. Semi-supervised learning is helpful when the cost of labelling is too high to permit a completely labelled training procedure. Classification, regression, and prediction techniques can all be utilized in conjunction with supervised learning. An illustration would be to recognize a face on a webcam[35-38].

4. Reinforcement Learning: In reinforcement learning, the student interacts with a dynamic environment and completes a specific task without the help of an instructor, who just provides feedback on whether the student has achieved the task. With reinforcement learning, learning techniques are utilized to predict which behaviours will result in the highest rewards and to discover the actions through trial and error [39]. As an illustration, when playing chess, a player must make a series of trial-and-error moves in order to succeed.

In reinforcement learning, the learner, the environment, and the behaviours are the main three fundamental components. The learner's main objective is to select behaviours that produce the desired outcome over a specified period of time. In order to accomplish the goal in this style of learning, the learner selects the optimum policy.

V. ML ALGORITHMS

On the basis of learning style, a broad range of algorithms are implemented to create machine learning models, which are then categorised as follows:

1. Algorithms for regression Regression is a modelling method that iteratively refines the link between constantly varying variables, such as price and temperature, using a measure of error. Logistic regression and linear regression are the two most widely used regression methods [40-42].
2. Instance-based Algorithm: This learning algorithm compares test data to instances of training data using a similarity metric in order to discover the best match and generate a prediction. Because they only store training data and wait until test data is provided before doing the learning, instance-based approaches are known as lazy learners [43]. Therefore, training takes less time but prediction requires more time. k-Nearest Neighbor (kNN), SelfOrganizing Map, and other instance-based algorithms are the most often used ones (SOM).
3. Decision Tree Technique: In this algorithm, a predictive model known as a decision tree is utilised to map observations on input data to forecast the item's target value. In these tree-like structures, leaves stand in for class labels, while branches represent the characteristics that give rise to those class labels. Decision trees are fast and accurate algorithms which \sare trained on data for

classification and regression applications. Popular decision tree algorithms include Classification and Regression Tree (CART) and Chi-Squared Automatic Interaction Detection (CHAID).

4. Bayesian Algorithms: The probability theory, which is utilised to describe uncertainty, is the foundation of Bayesian algorithms. These specifically use Bayes' Theorem to solve classification and regression-related issues. Naive Bayes, Gaussian Naive Bayes, Multinomial Naive Bayes, Bayesian Belief Network, and Bayesian NetworK are the most widely used Bayesian algorithms.
5. The clustering algorithm divides things into many categories. Clustering is a sort of unsupervised learning in which the data set is divided into clusters based on shared properties and a predetermined distance metric. Hierarchical clustering and partitional clustering are two types of clustering techniques. The most often used clustering algorithms are hierarchical clustering, k-means, k-medians, and expectation maximisation (EM).
6. Artificial Neural Network Algorithms: Based on supervised learning, this algorithm for learning has a structure that is comparable to that of biological neural networks. The units of artificial neurons are strongly interconnected, and learning is accomplished by altering the connection weights to carry out distributed processing in parallel. Perceptron, BackPropagation, Hopfield Network, and Radial Basis Function Network are the most widely used artificial neural network techniques.
7. Deep Learning Methods : Updated artificial neural networks provide abundant, affordable computation to create deep learning. When implementing semisupervised techniques with big datasets that contain only a small amount of labelled data, deep learning methods are built on significantly larger and more complicated neural networks. Deep Boltzmann Machine (DBM), Deep Belief Networks (DBN), and Convolutional Neural Network are the three most often used deep learning methods (CNN).
8. Dimensionality Reduction Algorithms: When an item is described using a number of dimensions, the computing cost is decreased by removing unnecessary and redundant data using the dimensionality reduction approach. Principal Component Analysis (PCA), Principal Component Regression (PCR), Linear Discriminant Analysis (LDA), Mixture Discriminant Analysis (MDA), Quadratic Discriminant Analysis (QDA), and Flexible Discriminant Analysis are the dimensionality reduction algorithms (FDA).

VI. APPLICATION AND TOOLS

Machine learning applications are categorised based on learning types like supervised and unsupervised learning. supervised learning is used to classify problems in areas such as pattern identification, facial recognition, character recognition, medical diagnosis, and web advertising. Clustering, association analysis, customer segmentation in CRM, image compression, and bioinformatics are examples of applications based on unsupervised learning. Robot control and game play are examples of reinforcement learning applications.

To use the finest algorithms for machine learning, the correct tool selection is crucial.
Machine learning employs effective techniques to provide quicker and simpler prediction. Machine learning tools provide intuitive interface onto the sub-tasks by offering good mapping and appropriateness in the the task's user interface Great machine learning tools provide best practises for methodology, configuration, and implementation. Algorithms for machine learning are automatically configured

The tool's structure is constructed with a well-executed method. Platforms and libraries are used to categorise ML tools. While a library merely offers a collection of modelling algorithms required to finish a project, a platform offers the environment needed to perform a project. WEKA Machine Learning Workbench, R Platform, and a subset of Python called SciPy, which includes Pandas and scikit-learn, are a few examples of machine learning platforms.

VII. CONCLUSION

In this study, machine learning methods for early oral cancer prediction are reviewed. Additionally, an overview of various machine learning methodologies used in the detection of oral cancer is provided, along with findings regarding these methodologies.

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