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Statistical Study on Disease Recognition by Face

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Abstract:

Artificial Intelligence (AI) has become an important tool in modern healthcare for improving disease diagnosis and early detection. This project focuses on developing a Disease Recognition Model using Artificial Intelligence and statistical analysis of human facial features. The main objective of the study is to identify possible health risks by analyzing measurable facial characteristics. Research studies suggest that certain diseases may cause subtle changes in facial structure and appearance. By using advanced computational methods, these facial patterns can be analyzed to support early disease detection.

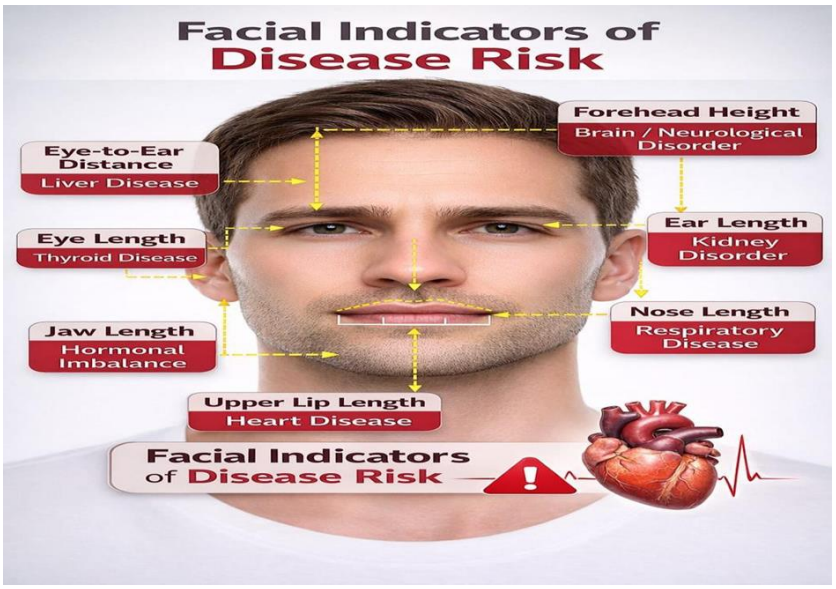
The proposed system uses facial images as input, which are captured through an uploaded photograph. The face is first detected using advanced computer vision techniques such as Convolutional Neural Networks (CNNs) or MediaPipe facial landmark detection. After detecting the face, important facial measurements are extracted from specific landmark points. These measurements include features such as eye size, ear length, eye-to-ear distance, nose length, jaw length, upper lip size, and forehead height. These facial features are then organized into a structured dataset for further analysis.

Statistical analysis methods are applied to examine the relationship between facial measurements and the possible risk of certain diseases. In addition, machine learning and deep learning models such as CNNs, transfer learning models, or hybrid AI models are used to classify patterns and predict disease risk. The model aims to identify whether specific facial characteristics are associated with conditions such as heart disease, liver disease, or hormonal imbalance.

One of the major advantages of this system is that it provides a non-invasive and cost-effective approach for preliminary health screening. Unlike traditional medical tests, this method only requires a facial image to analyze potential health indicators. The integration of artificial intelligence with facial feature analysis can help support healthcare professionals in early diagnosis and preventive healthcare strategies.

The results of this study can contribute to the development of intelligent healthcare systems that assist doctors in identifying disease risks more quickly and efficiently. Although the system does not replace medical diagnosis, it can serve as a supportive tool for early detection and health monitoring. This research demonstrates the potential of combining artificial intelligence, computer vision, and statistical analysis to build innovative solutions for modern healthcare applications.

Keywords: Artificial Intelligence, Facial Feature Analysis, Disease Recognition, Deep Learning, Statistical Analysis, CNN, Preventive Healthcare



Introduction:

The human face reflects not only a person's identity and emotions but also important aspects of internal health. For many centuries, physicians and traditional healers have observed that changes in facial appearance may indicate underlying health problems. Certain diseases can influence facial features such as shape, color, symmetry, and skin texture. These visible changes can provide early clues about a person's physical condition and overall well-being.With the advancement of Artificial Intelligence (AI), computer vision, and data analytics, the analysis of facial features has become an important research area in modern healthcare. AI- based facial analysis allows researchers to detect subtle physical patterns that may be difficult for humans to observe. Technologies such as machine learning, deep learning, and facial landmark detection make it possible to measure facial characteristics accurately and analyz e them for disease prediction.

Many diseases such as heart disease, liver disorders, kidney problems, cancer, and hormonal imbalances can lead to small changes in facial appearance. These changes may include puffiness around the eyes, variation in skin colour, facial asymmetry, or changes in facial proportions. By using computational techniques, these features can be measured and studied to identify possible relationships between facial structure and disease conditions.

Facial measurements such as eye size, eye– ear distance, nose length, jaw length, upper lip size, and forehead height can be extracted from facial images using modern AI tools. These measurements can then be analyzed using statistical methods to find patterns and correlations with specific health conditions. Such analysis helps researchers understand whether certain facial characteristics are linked to higher or lower disease risk.

One of the main advantages of facial analysis in healthcare is that it provides a non-invasive, quick, and cost-effective method for preliminary health screening. Unlike traditional medical tests, which may require blood samples or complex laboratory procedures, facial analysis can be performed using a simple photograph. This makes the approach especially useful for large-scale health monitoring and for use in remote or resource-limited areas.

This study focuses on applying statistical analysis and artificial intelligence techniques to investigate the relationship between facial features and disease risk. The aim is to identify

significant facial indicators that may help predict certain diseases at an early stage. By combining facial feature analysis with AI-based models, this research contributes to the development of intelligent healthcare systems that can support doctors and improve preventive medical care.

Literature Review:

Ghalib Ahmed Salman, Inas Jawad Kadhim, and Ahmed Husham Al-Badri in Image-Based Face Recognition Techniques Used in Disease Detection Approaches: A Survey. the paper main aim of the authors is to study how face recognition technology can help in detecting diseases. They explain how Artificial Intelligence and deep learning methods are used to identify health problems from facial images. Their goal is to show that this technology can support doctors in early and accurate diagnosis. They also discuss the benefits and challenges of using AI in medical applications.

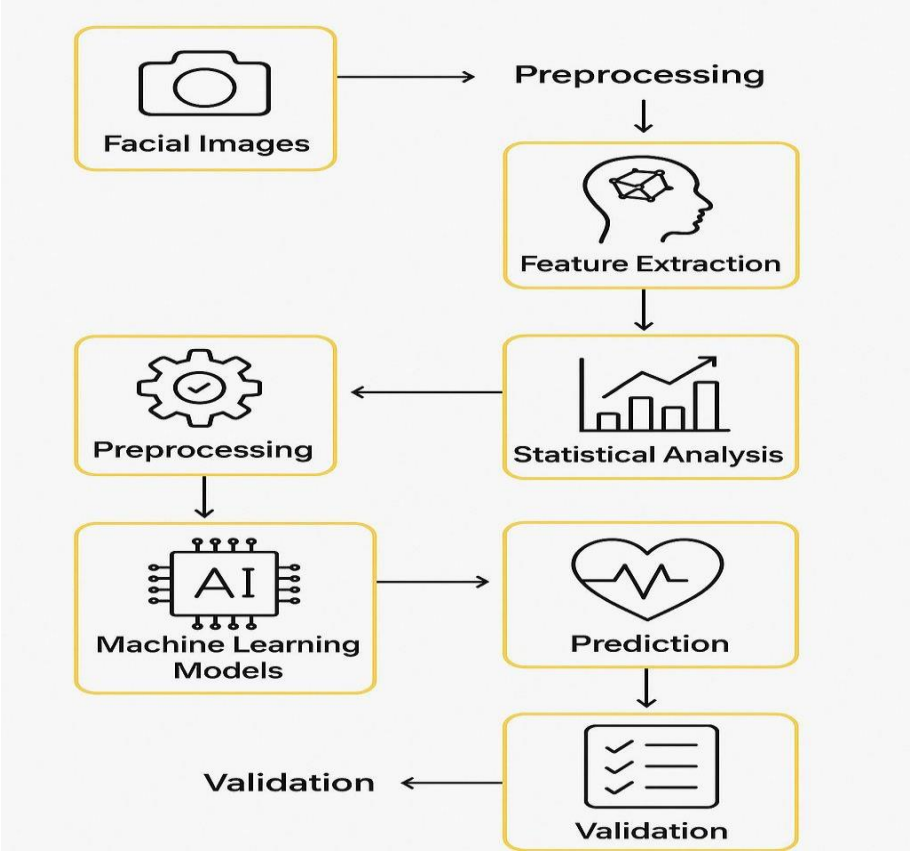
Florian Schroff, Dmitry Kalenichenko, and James Philbin in Face Net: A Unified Embedding for Face Recognition and Clustering In this paper, the authors introduce a deep learning model called Face Net. The main purpose of their research is to improve the accuracy of face recognition systems. They aim to create a system that can learn and compare facial features effectively. Instead of classifying images directly, the model maps faces into a feature space. This helps in face verification, recognition, and clustering tasks. The authors focus on reducing errors in real- world face recognition. Their goal is to make face recognition faster, more accurate, and reliable for practical applications.

Danning Wu in Facial Recognition Intensity in Disease Diagnosis Using Automatic Facial Recognition in this paper focuses on using automatic facial recognition systems for disease diagnosis. The main aim of the authors is to analyze facial features and their intensity to detect health conditions. They use Artificial Intelligence techniques to improve diagnostic accuracy. Their purpose is to help doctors identify diseases earlier using facial image data. The study highlights how AI can support medical decision-making.

Danning Wu in Artificial Intelligence Facial Recognition System for Diagnosis of Endocrine and Metabolic Syndromes Based on a Facial Image Database In this paper, the develop an AI-based facial recognition system to diagnose endocrine and metabolic disorders. Their aim is to create a facial image database for disease detection. They focus on identifying patterns in facial features linked to hormonal and metabolic conditions. The purpose is to improve early diagnosis and reduce medical errors. The system is designed to assist healthcare professionals.

Xinru Kong, Ziyue Wang, Jie Sun in Facial Recognition for Disease Diagnosis Using a Deep Learning Convolutional Neural Network: A Systematic Review and Meta- Analysis. This paper reviews many studies that use deep learning and CNN models for disease diagnosis through facial recognition. The authors aim to evaluate how accurate these AI systems are in detecting diseases. They analyze different research results and compare performance levels. Their purpose is to understand the effectiveness of AI in medical diagnosis. The study shows that deep learning can provide high accuracy in identifying certain disease.

Framework:



Statistical Analysis:

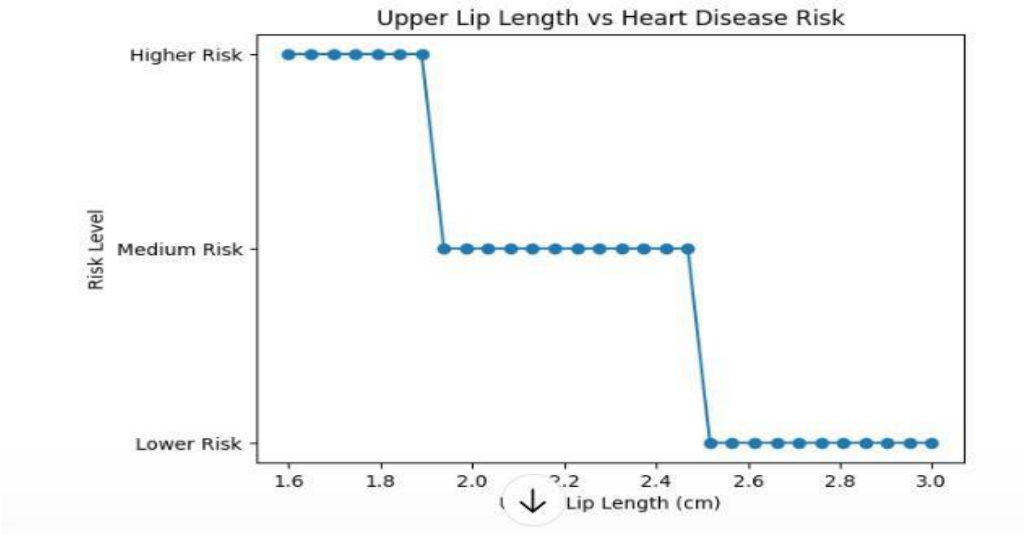
Statistics	Eye -Ear distance(cm)	Ear length (cm)	Eye length (cm)	Jaw length (cm)	Upper lip length (cm)	Nose length (cm)	Forehead Height (cm)
Count	100	100	100	100	100	100	100
Mean	15.28	6.48	2.96	11.00	1.78	5.00	7.48
Std Dev	0.49	0.24	0.11	0.38	0.08	0.16	0.24
Minimum	14.80	6.20	2.80	10.50	1.70	4.80	7.20
25%	14.90	6.30	2.90	10.80	1.70	4.90	7.30
50%	15.20	6.50	3.00	11.00	1.80	5.00	7.50
75%	15.50	6.60	3.00	11.20	1.80	5.10	7.60
Maximum	16.00	6.80	3.10	11.50	1.90	5.20	7.80

The descriptive statistics show that the facial measurements of the 100 samples are very close to their average values, indicating low variation in the data. Most measurements such as eye-to-ear distance, jaw length, and nose length remain within a small range. The upper lip length has a mean of about 1.78 cm, suggesting that many values are near 1.8 cm or below. Overall, the facial features show consistent measurements that can be useful for predicting disease pattern.

Descriptive Analysis:

Statistic	Eye-to-Ear Distance (cm)	Ear Length (cm)	Upper Lip Length (cm)	Nose Length (cm)	Forehead Height (cm)
Count	5.000	5.000	5.000	5.000	5.000
Mean	15.280	6.480	1.780	5.000	7.480
Std	0.4868	0.2387	0.0837	0.1581	0.2387
Min	14.800	6.200	1.700	4.800	7.200
25%	14.900	6.300	1.700	4.900	7.300
50%	15.200	6.500	1.800	5.000	7.500
75%	15.500	6.600	1.800	5.100	7.600
Max	16.000	6.800	1.900	5.200	7.800

Correlation Analysis:



The graph shows the relationship between upper lip length and heart disease risk. When the upper lip length is less than 1.9 cm, the risk of heart disease is higher. When the upper lip length is between 1.9 cm and 2.5 cm, the risk becomes medium. If the upper lip length is 2.5 cm or more, the risk becomes lower. This means that as the upper lip length increases, the risk of heart disease decreases. Therefore, upper lip length can be used as a facial feature to help predict heart disease risk.

Regression Analysis:

Regression analysis is used to study the relationship between upper lip length and heart disease risk. In this analysis, upper lip length (cm) is the independent variable, and heart disease risk level is the dependent variable.

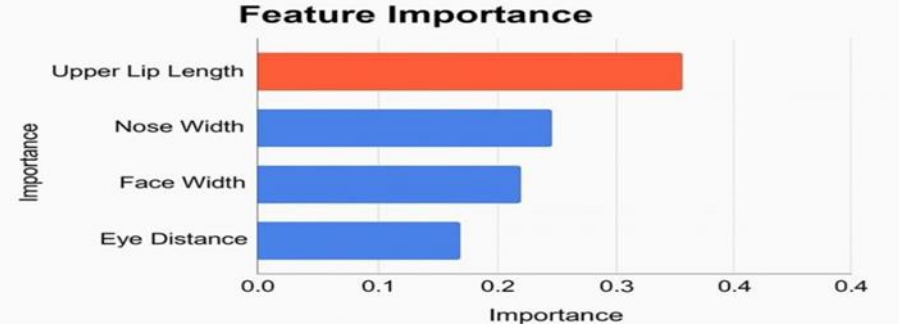
The regression results show that there is a negative relationship between upper lip length and heart disease risk. This means that when the upper lip length increases, the risk of heart disease decreases. Individuals with upper lip length less than 1.9 cm show higher risk, while those with lip length greater than or equal to 2.5 cm show lower risk.

Machine Learning Models:

CNN: Convolutional Neural Network (CNN) is used to analyze facial images and detect important facial features automatically. It helps in identifying measurements like eye size, nose length, and upper lip length from the image. These features are then used for disease analysis.

RANDOMFOREST: Random Forest is a machine learning algorithm used to classify the facial data and predict disease risk. It builds multiple decision trees and combines their results for better prediction. This helps improve the accuracy of disease risk detection.

Important Feature:



The feature importance graph shows that Upper Lip Length has the highest importance in predicting heart disease compared to other facial features. Nose Width and Face Width have moderate influence, while Eye Distance has the lowest impact. This indicates that upper lip length may be the most significant facial indicator in the model.

Conclusion:

This study focuses on using facial features to help identify possible disease risk with the help of Artificial Intelligence. Different facial measurements such as eye size, nose length, upper lip length, jaw length, and forehead height were analyzed. Statistical analysis and graphical methods were used to understand the relationship between facial features and disease risk. The results show that some facial measurements may be related to health conditions. Machine learning models such as CNN and Random Forest were used to analyze facial images and predict disease risk. CNN helps to detect facial features from images, while Random Forest helps to classify the risk influence, while Eye Distance has the lowest impact. This indicates that upper lip length may be the most significant facial indicator in the model level. The study also shows that certain features, like upper lip length, may indicate higher or lower risk of heart disease. This method provides a simple and non-invasive way to study possible health conditions. It can help in early disease detection and preventive healthcare. Overall, the research shows that facial feature analysis combined with AI can support future intelligent healthcare systems.

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