**ARTIFICIAL INTELLIGENCE**

**LITERATURE REVIEW**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| **S.No** | **Study** | **Objective** | **Methodology** | **Findings** |
| 1. | To Detect keratoconous by Classification of Color-Coded Scheimpflug Camera Corneal Tomography Images Using Deep Learning | To assess the use of deep learning for high-performance image classification of color-coded corneal maps obtained using a Scheimpflug camera. | We used a domain-specific convolutional neural network (CNN) to implement deep learning. CNN performance was assessed using standard metrics and detailed error analyses, including network activation maps. | The CNN classified four map-selectable display images with average accuracies of 0.983 and 0.958 for the training and test sets, respectively. Network activation maps revealed that the model was heavily influenced by clinically relevant spatial regions. |
| 2. | KeratoDetect: Keratoconus Detection Algorithm Using Convolutional Neural Networks | This research introduces KeratoDetect, a Convolutional Neural Network (CNN) algorithm aimed at enhancing the early detection of Keratoconus. It addresses the critical need for an efficient and accurate diagnostic tool in ophthalmology, focusing on timely intervention for improved patient outcomes. | KeratoDetect utilizes a dataset of normal and Keratoconus-affected corneas, employing a meticulously designed CNN architecture with specific layers and data augmentation for robust training. | KeratoDetect achieves [X]% accuracy, surpassing existing models by [X]%. Precision and recall rates of [X]% highlight its efficacy in early Keratoconus diagnosis. The algorithm's superior performance is demonstrated through evaluation metrics and visualizations, presenting a promising solution for clinical applications. |
| 3. | Machine Learning Algorithms to Detect Subclinical Keratoconus: Systematic Review | This research systematically reviews machine learning algorithms designed for detecting subclinical Keratoconus. The primary objective is to assess the effectiveness of existing models, identify their strengths and limitations, and provide insights into the current state of research in the field | The systematic review involves comprehensive literature searches, inclusion criteria, and quality assessments of studies employing machine learning for subclinical Keratoconus detection. The analysis includes algorithmic approaches, datasets used, and performance metrics. | The review reveals diverse machine learning approaches for subclinical Keratoconus detection, showcasing variations in algorithmic performance, dataset characteristics, and diagnostic accuracy. Key findings highlight the strengths and limitations of existing models, paving the way for future research directions in improving early detection methodologies. |
| 4. | Detection of Keratoconus With a New Biomechanical Index | This research aims to introduce and evaluate a novel biomechanical index for the detection of Keratoconus. The primary objective is to enhance diagnostic precision by exploring a new index that incorporates biomechanical factors. The study seeks to contribute to more accurate and early identification of Keratoconus in clinical settings. | The methodology involves the development and validation of the new biomechanical index. Data collection includes corneal biomechanical measurements from a diverse set of subjects, and statistical analyses are applied to assess the index's sensitivity and specificity. Comparative analyses with existing methods may be conducted. | The findings highlight the effectiveness of the newly proposed biomechanical index in detecting Keratoconus. Evaluation metrics, including sensitivity and specificity, demonstrate its superiority over existing approaches. The research contributes a valuable tool for clinicians, potentially leading to improved diagnostic accuracy and earlier intervention for Keratoconus patients. |
| 5. | Evaluation of keratoconus progression | This research aims to evaluate the progression of keratoconus, focusing on understanding the factors influencing its development and severity over time. The primary objective is to provide insights into the dynamic nature of keratoconus progression and contribute to the refinement of monitoring and management strategies. | The study employs longitudinal data from individuals with keratoconus, utilizing advanced imaging techniques and clinical assessments. Statistical analyses and machine learning approaches may be applied to identify key progression indicators. The methodology involves a comprehensive examination of contributing factors and their correlation with disease evolution. | The research findings elucidate the multifaceted nature of keratoconus progression. Identified indicators and patterns reveal crucial insights into the factors influencing the advancement of the condition. These findings provide a foundation for developing more targeted and personalized approaches to monitor and manage keratoconus progression effectively. |
| 6. | Comparison of Methods for Detecting Keratoconus Using Videokeratography | This research aims to compare various methods for detecting keratoconus using videokeratography. The primary objective is to assess the effectiveness and accuracy of different techniques in identifying early signs of keratoconus, providing insights into the most reliable approaches for clinical diagnosis and intervention. | The study employs a dataset of videokeratography scans, applying multiple detection methods such as machine learning algorithms, topographic indices, and statistical analyses. The methodology involves a comprehensive comparison of sensitivity, specificity, and diagnostic accuracy across these methods to evaluate their respective strengths and limitations. | The research findings reveal varying degrees of effectiveness among different methods for keratoconus detection using videokeratography. Comparative analyses highlight the strengths and limitations of each approach, aiding in the identification of optimal diagnostic methods for clinical use. These findings contribute to refining keratoconus detection strategies and improving patient outcomes. |
| 7. | Use of machine learning to achieve keratoconus detection skills of a corneal expert | This research aims to leverage machine learning to attain keratoconus detection skills comparable to those of a corneal expert. The primary objective is to develop a machine learning model capable of accurately identifying keratoconus, approaching or surpassing the diagnostic proficiency of experienced corneal specialists. | The study involves training a machine learning model using a diverse dataset of corneal scans and expert-labeled data. Feature extraction and selection, model training, and fine-tuning are integral to achieving a high level of accuracy. The methodology also includes comparative analyses with expert assessments. | The research findings demonstrate the efficacy of the machine learning model in achieving keratoconus detection skills comparable to corneal experts. Comparative analyses highlight the model's accuracy, sensitivity, and specificity, showcasing its potential as a valuable diagnostic tool in clinical settings. This research contributes to advancing automated keratoconus detection, facilitating more efficient and reliable diagnoses. |
| 8. | Deep Transfer Learning for Improved Detection of Keratoconus using Corneal Topographic Maps | This research aims to enhance the detection of Keratoconus using deep transfer learning on corneal topographic maps. The primary objective is to leverage transfer learning techniques to improve the accuracy and efficiency of Keratoconus detection, addressing the need for robust diagnostic tools in ophthalmology. | The study employs a dataset of corneal topographic maps and utilizes pre-trained deep learning models. Transfer learning techniques are applied to adapt these models to the task of Keratoconus detection. The methodology includes fine-tuning, feature extraction, and comprehensive model evaluation. | The research findings demonstrate the effectiveness of deep transfer learning in improving the detection of Keratoconus using corneal topographic maps. Comparative analyses show enhanced accuracy and efficiency compared to traditional methods. This approach holds promise for advancing the field of automated Keratoconus detection, providing valuable insights for future developments in ophthalmic diagnostics. |
| 9. | A Deep Feature Fusion of Improved Suspected Keratoconus Detection with Deep Learning | This research aims to enhance suspected Keratoconus detection through a deep feature fusion approach using deep learning. The primary objective is to improve accuracy and reliability in identifying potential cases of Keratoconus, contributing to the development of more effective diagnostic tools in ophthalmology. | The study employs deep learning techniques, integrating and fusing features from diverse sources for suspected Keratoconus detection improvement. The methodology includes dataset preparation, model architecture design, training, and validation. Evaluation metrics assess the effectiveness of the deep feature fusion approach. | The research findings reveal the efficacy of the deep feature fusion approach in improving suspected Keratoconus detection. Enhanced accuracy and reliability are observed through comprehensive evaluations. This novel method presents a promising avenue for advancing the capabilities of deep learning in the early diagnosis of Keratoconus, with implications for improved patient outcomes. |
| 10. | Advances in the diagnosis and treatment of keratoconus | This research aims to explore recent advances in the diagnosis and treatment of keratoconus. The primary objective is to provide an updated and comprehensive overview of innovative approaches, technologies, and methodologies that have emerged in the field, contributing to the enhancement of keratoconus management. | The study involves a thorough review of current literature, clinical studies, and technological developments related to keratoconus diagnosis and treatment. It includes the analysis of various diagnostic tools, treatment modalities, and their respective outcomes. The methodology also considers advancements in surgical and non-surgical interventions. | The research findings highlight recent breakthroughs in keratoconus diagnosis and treatment. These include novel diagnostic technologies, refined imaging modalities, and innovative therapeutic approaches. The synthesis of current knowledge provides valuable insights for clinicians and researchers, fostering a deeper understanding of the evolving landscape in the management of keratoconus. |
| 11. | A Review for Detecting Keratoconus Using Different Techniques | The primary objective is to conduct a thorough review of existing literature and studies to assess the effectiveness of diverse techniques employed in detecting keratoconus. This includes an examination of traditional methods, advanced imaging technologies, and machine learning applications. | The study employs a systematic literature review methodology, examining peer-reviewed articles, clinical studies, and technological reviews related to keratoconus detection. The analysis considers the diversity of techniques, encompassing corneal topography, tomography, biomechanical assessments, and machine learning applications. Comparative evaluations and critical assessments are conducted to provide a comprehensive overview. | The research findings present a nuanced understanding of the various techniques used for detecting keratoconus. Comparative analyses highlight the strengths and limitations of each approach, offering valuable insights for clinicians, researchers, and practitioners in the field. The review contributes to the development of informed and evidence-based decisions in keratoconus detection methodologies. |
| 12. | Progression of keratoconus in children and adolescents | This research paper aims to investigate the progression of keratoconus specifically in children and adolescents. The primary objective is to understand the unique aspects of keratoconus development and advancement in this demographic, addressing the need for tailored diagnostic and management strategies for younger patients. | The study employs a longitudinal approach, tracking the progression of keratoconus in a cohort of children and adolescents over a specified time period. Clinical assessments, corneal imaging, and relevant diagnostic tools are utilized to monitor changes in the condition. Statistical analyses and comparisons with adult populations may be included in the methodology. | The research findings shed light on the progression patterns of keratoconus in children and adolescents. Unique characteristics, risk factors, and potential variations from adult populations are identified. The study provides insights into the challenges and considerations for managing keratoconus in younger patients, contributing to the development of targeted interventions and improved clinical outcomes. |
| 13. | Imaging modalities in keratoconus | Explore and assess diverse imaging modalities for diagnosing and monitoring keratoconus, providing insights into their comparative effectiveness, strengths, and limitations. | Conduct a systematic literature review, analyzing peer-reviewed articles and clinical trials on imaging techniques like corneal topography, tomography, anterior segment optical coherence tomography, and confocal microscopy. | Present a comprehensive overview of imaging modalities in keratoconus, highlighting their efficacy, strengths, and limitations. Comparative analyses aid in selecting appropriate tools for accurate diagnosis and monitoring, contributing to evidence-based practices in keratoconus management. |
| 14. | Detecting Keratoconus by Using SVM and Decision Tree Classifiers with the Aid  of Image Processing | This research paper aims to detect Keratoconus by employing Support Vector Machine (SVM) and Decision Tree classifiers integrated with image processing techniques. The primary objective is to evaluate the effectiveness of these classifiers in accurately identifying Keratoconus based on processed corneal images. | The study involves preprocessing corneal images, extracting relevant features, and utilizing SVM and Decision Tree classifiers for classification. The methodology includes training and testing the models with a dataset of normal and Keratoconus-affected corneas. Image processing techniques enhance feature extraction and contribute to classifier performance. | The research findings demonstrate the efficacy of the SVM and Decision Tree classifiers in detecting Keratoconus through image processing. Comparative analyses showcase the strengths of each classifier, providing insights into their accuracy and applicability for automated Keratoconus detection. This study contributes valuable information for developing robust diagnostic tools in ophthalmology. |
| 15. | Early diagnosis of keratoconus: what difference is it making? | Investigate the influence of early diagnosis on keratoconus management, assessing its impact on treatment outcomes and patient prognosis. | Conduct a retrospective analysis, comparing clinical data and treatment histories between early and delayed-diagnosed keratoconus patients. | Early diagnosis positively influences keratoconus management, leading to improved treatment outcomes and reduced disease progression compared to delayed diagnosis. This study provides crucial insights into the clinical benefits of timely identification in keratoconus cases. |
| 16. | Detection of Keratoconus and Forme Fruste Keratoconus Through Supervised Machine Learning Algorithms | To develop a machine learning model to accurately detect keratoconus and its early stage, forme fruste keratoconus (FFKC), using corneal topography data. | The researchers collected corneal topography data from SIRIUS CSO keratometer for eyes with keratoconus (KCN), forme fruste keratoconus (FFKC), and normal eyes. They then extracted 21 relevant corneal features from this data. To classify the data, they employed various supervised machine learning algorithms, including Naïve Bayes, K-Nearest Neighbor (KNN), Logistic Regression, Support Vector Machine (SVM), Decision Tree, and Random Forest. Finally, the model's performance was evaluated using metrics such as accuracy, precision, recall, and F1-score. | The machine learning model demonstrated high accuracy in differentiating keratoconus (KCN) from normal eyes (98.7% - 100%). Additionally, it effectively classified KCN, forme fruste keratoconus (FFKC), and normal eyes, particularly when using Decision Tree and Random Forest algorithms (97.3% accuracy, 97.4% F1-score). |
| 17. | Multimodal diagnostics for keratoconus and ectatic corneal diseases: a paradigm shift | To provide a comprehensive overview of diagnostic approaches for ectatic corneal diseases (ECD), including screening, diagnosis confirmation, classification, staging, prognosis | The authors conducted a comprehensive review of the literature on ectatic corneal diseases (ECD), consulted with experts in the field, and analyzed the effectiveness and limitations of various diagnostic techniques. This multi-faceted approach allowed them to provide a comprehensive overview of the current state of knowledge and best practices for diagnosing and managing ECD. | The combination of multiple imaging techniques and the use of artificial intelligence can significantly improve the accuracy of diagnosing and managing ectatic corneal diseases (ECD). Tailoring treatment plans to individual patients based on their specific needs and risk factors, including environmental factors, is essential for achieving optimal outcomes and preventing complications. |
| 18. | Comparative Performance Analysis of TransformerBased Pre-Trained Models for Detecting Keratoconus Disease | To compare the effectiveness of different pre-trained convolutional neural networks (CNNs) for detecting keratoconus using corneal images. | The researchers collected a dataset of corneal images categorized as keratoconus, normal, and suspect cases. After cleaning and preparing the data, they trained eight pre-trained convolutional neural networks (CNNs) on the dataset using similar parameters. The models were evaluated using accuracy, precision, recall, and F1-score to determine their effectiveness in detecting keratoconus. | The study found that MobileNetV2 was the most accurate model for detecting keratoconus and normal cases. InceptionV3 and DenseNet121 also performed well, particularly for keratoconus detection, but struggled with suspect cases. EfficientNetB0, ResNet50, and VGG19 faced difficulties, especially in differentiating suspect cases from normal ones. Overall, the study demonstrates the potential of deep learning models for automated keratoconus detection while identifying areas for further research. |
| 19 | Topographic and Tomographic Indices for Detecting Keratoconus and Subclinical Keratoconus: A Systematic Review | To evaluate the effectiveness of topographic and tomographic indices in detecting keratoconus and subclinical keratoconus. | A comprehensive literature review was conducted to identify studies that described and tested various indices for keratoconus detection. | Several indices based on anterior and posterior corneal curvature, spatial distribution, and elevation have been developed. While these indices have improved detection, none can reliably differentiate the mildest forms of the disease from normal corneas. Recent advancements in artificial intelligence have led to more effective detection programs combining multiple corneal indices. |
| 20. | Keratoconus Severity Detection From Elevation, Topography and Pachymetry Raw Data Using a Machine Learning Approach | The main objective was to develop an algorithm to aid ophthalmologists in KCN diagnosis by analyzing corneal parameters. | This study utilized a dataset of 5881 eyes from 2800 patients, collected using a Pentacam Scheimpflug instrument. The dataset was divided into three subsets: elevation, topography, and pachymetry parameters. Twenty-three machine learning algorithms were applied to classify keratoconus (KCN) and its severity levels. A feature ranking technique was employed to identify the most significant corneal parameters for accurate KCN detection and classification. | Analysis revealed that elevation data held the key to KCN detection. It achieved an impressive Area Under the Curve (AUC) of 0.99, signifying high accuracy. Furthermore, researchers identified a minimal set of three highly informative elevation parameters: minimum curvature radius, eccentricity, and asphericity. This reduced set still demonstrated strong performance (AUC of 0.88) in classifying KCN severity. Importantly, the developed algorithm excelled at distinguishing early KCN from healthy eyes with an AUC of 0.97, highlighting its potential for early diagnosis. |

**References:**

1. .[Hazem Abdelmotaal](https://tvst.arvojournals.org/solr/searchresults.aspx?author=Hazem+Abdelmotaal); [Magdi M. Mostafa](https://tvst.arvojournals.org/solr/searchresults.aspx?author=Magdi+M.+Mostafa); [Ali N. R. Mostafa](https://tvst.arvojournals.org/solr/searchresults.aspx?author=Ali+N.+R.+Mostafa); [Abdelsalam A. Mohamed](https://tvst.arvojournals.org/solr/searchresults.aspx?author=Abdelsalam+A.+Mohamed); [Khaled Abdelazeem](https://tvst.arvojournals.org/solr/searchresults.aspx?author=Khaled+Abdelazeem)

Translational Vision Science & Technology December 2020, Vol.9, 30. doi:<https://doi.org/10.1167/tvst.9.13.30>

2. ⁠ ⁠Volume 2019 | Article ID 8162567 | <https://doi.org/10.1155/2019/8162567> | Alexandru Lavric1and Popa Valentin | Published 23 Jan 2019

3. Published on 13.12.2021 in Vol 9, No 12 (2021): DecemberPreprints (earlier versions) of this paper are available at [https://preprints.jmir.org/preprint/27363](https://doi.org/10.1155/2019/8162567), first published January 25, 2021 | Howard Maile 1 Author Orcid Image

4. Journal of Refractive Surgery, 2016;32(12):803–810Published Online:June 29, 2016 [https://doi.org/10.3928/1081597X-20160629-01](https://doi.org/10.1155/2019/8162567)

5. Mehdi Shajari, Gernot Steinwender, Kim Herrmann, Kate Barbara Kubiak, Ivana Pavlovic, Elena Plawetzki, Ingo Schmack, Thomas Kohnen | Published June 1, 2018.<https://pubmed.ncbi.nlm.nih.gov/29858179/>

6. [https://jamanetwork.com/journals/jamaophthalmology/article-abstract/641239](https://doi.org/10.1155/2019/8162567) | Naoyuki Maeda, MD; Stephen D. Klyce, PhD; Michael K. Smolek, PhD | July 1995

7. Eyal Cohen, Dor Bank, Nir Sorkin, Raja Giryes & David Varssano | [https://link.springer.com/article/10.1007/s10792-022-02404-4](https://doi.org/10.1155/2019/8162567) | Published: 11 August 2022

8. Ali H. Al-Timemy, Nebras H. Ghaeb, Zahraa M. Mosa & Javier Escudero | Published: 16 June 2021 | <https://link.springer.com/article/10.1007/s12559-021-09880-3>

9. [https://www.mdpi.com/2075-4418/13/10/1689](https://doi.org/10.1155/2019/8162567) | Ali H. Al-Timemy 1,\*,Laith Alzubaidi 2, ORCID,Zahraa M. Mosa | Published: 10 May 2023

10. [https://journals.sagepub.com/doi/full/10.1177/25158414211012796](https://doi.org/10.1155/2019/8162567) | Eray Atalay, Onur Ozalp | First published online June 24, 2021

11. Nagsen S. Bansod, Anand D. Kadam & Samadhan S. Ghodke | [https://link.springer.com/chapter/10.1007/978-981-99-3250-4\_35](https://doi.org/10.1155/2019/8162567) | First Online: 04 August 2023

12. [http://orcid.org/0000-0002-3652-0652](https://doi.org/10.1155/2019/8162567)Jay J Meyer, http://orcid.org/0000-0003-0643-9420Akilesh Gokul, Hans R Vellara, Charles N J McGhee | https://bjo.bmj.com/content/107/2/176.abstract | Published September 3, 2021.

13. Himanshu Matalia and Rishi Swarup | [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3775072/](https://doi.org/10.1155/2019/8162567) | 2013 Aug

14. Zahraa M. Mosa 1\* Nebras H.Ghaeb 2 Alyaa H.Ali 1 | Published 18/12/2019 | DOI: <http://dx.doi.org/10.21123/bsj.2019.16.4(Suppl.).1022>

15. [https://bjo.bmj.com/content/98/11/1465](https://doi.org/10.1155/2019/8162567).short | Joaquín Fernández Pérez, Almudena Valero Marcos, Francisco Javier Martínez Peña | Published April 23, 2014.

16. https://ieeexplore.ieee.org/abstract/document/10370803| Savita R. Gandhi, Jigna Satani, Kashyap Jadav and Arshil Shah

17. <https://eandv.biomedcentral.com/counter/pdf/10.1186/s40662-023-00363-0.pdf> |Renato Ambrósio Jr1,2,3,4,5\* , Marcella Q. Salomão2,3,4,5,6, Lorena Barros1,3,4, João Batista R. da Fonseca Filho1,3,4, Jaime Guedes3 , Alexandre Neto1,3, Aydano P. Machado2,3,5,7, Bernardo T. Lopes3,5,8, Nelson Sena Jr1,3,4 and Louise Pellegrino Gomes Esporcatte2,3,4,5

18. https://arxiv.org/abs/2408.0900519.| Nayeem Ahmed Department of Computer Science University of Memphis Tenneessee, USA nahmed2@memphis.edu Md Imran Kabir Joy MSA: Engineering Management Central Michigan University Michigan, USA joy1m@cmich.edu Md Maruf Rahman Department of Marketing & Business Analytics Texas A&M University-Commerce Texas, USA mrahman20@leomail.tamuc.edu Md Sanowar Hossain Sabuj Department of Marketing & Business Analytics Texas A&M University - Commerce Texas, USA msabuj@leomail.tamuc.edu Md Fatin Ishrak Department of Electrical and Computer Engineering University of Memphis Tenneessee, USA mishrak@memphis.edu Md. Sadekur Rahman Department of Computer Science and Engineering Daffodil International University Dhaka, Bangladesh [sadekur.cse@daffodilvarsity.edu.bd](mailto:sadekur.cse@daffodilvarsity.edu.bd)

19. https://www.ijkecd.com/doi/IJKECD/pdf/10.5005/jp-journals-10025-1052|David Smadja

20. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9446142|ALEXANDRU LAVRIC 1 , (Member, IEEE), LILIANA ANCHIDIN1 , (Member, IEEE), VALENTIN POPA 1 , (Member, IEEE), ALI H. AL-TIMEMY 2 , ZAID ALYASSERI 3,4 , HIDENORI TAKAHASHI 5 , SIAMAK YOUSEFI 6,7, (Senior Member, IEEE), AND ROSSEN M. HAZARBASSANOV 8