IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 8.102 ⁜ Vol. 12, Issue 4, April 2023

DOI: 10.17148/IJARCCE.2023.124110

# Detection of Knee Osteoarthritis and its severity using Convolutional Neural Networks

**Kumuda D K[1], Lochana K S[2], Prathibha N M[3], Sahana L J[4], Dr.Natesh M[5]**

Computer Science and Engineering, Vidyavardaka college of Engineering, Mysuru[1-5]

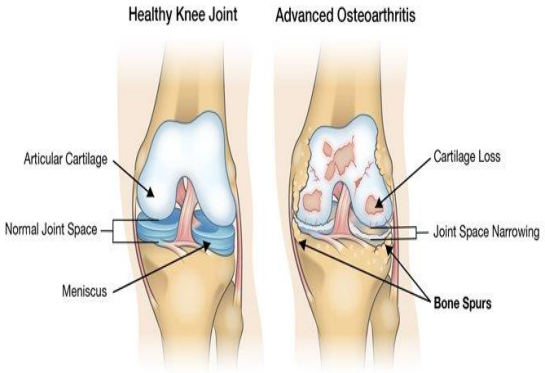
**Abstract:** This research study is devoted to the investigation of deep neural networks (DNN) for classification of the complex problem of knee osteoarthritis diagnosis. Osteoarthritis (OA) is the most common chronic condition of the joints revealing a variation in symptoms' intensity, frequency and pattern. A large number of features/factors need to be assessed for knee OA, mainly related with medical risks factors including advanced age, gender, hormonal status, body weight or size, family history of disease etc. The main goal of this research study is to implement deep neural networks as a new efficient machine learning approach for this classification task taking into account the large number of medical factors affecting OA. The potential of the proposed methodology was demonstrated by classifying different subgroups of control participants from self-reported clinical data and providing a category of knee OA diagnosis. The investigated subgroups were defined by gender, age and obesity. Furthermore, to validate the proposed deep learning methodology, a comparison analysis between the proposed DNN and some benchmark machine learning techniques recommended for classification was conducted and the results showed the effectiveness of deep learning in the diagnosis of knee OA.

**Keywords:** data classification, machine learning, deep learning, osteoarthritis

## 1.INTRODUCTION

Osteoarthritis of the knee develops when the cartilage in the joint wears away, allowing the bones to scrape against one another. The friction causes your knees to ache, stiffen, and occasionally bulge. There are numerous therapies to delay the progression of knee osteoarthritis and improve your symptoms, despite the fact that there is no cure for the condition. More severe cases of osteoarthritis may be treated with surgery.

Knee osteoarthritis is a relatively frequent condition. Approximately 46% of people will experience it at some point throughout their lives. Osteoarthritis of the knee is more common in women than in males. This illness typically strikes people once they turn 40. However, other elements like trauma or genetics may speed up the process. Although osteoarthritis of the knee cannot be cured, there are therapies that can ease your symptoms and reduce the progression of your condition.




Knee OA is not easy to be detected, diagnosed or treated due to its complexity including a relatively large number of risk factors, such as advanced age, gender, hormonal status, body weight or size, that is usually quantified using body mass index (BMI), family history of disease along with joint loading during occupational or physical activities. It is challenging to diagnose knee OA at the early stage of the disease as it is reported in [6]. According to the literature, it is obvious an urgent need for clinical tools that will be able to diagnose and potentially predict KOA with respect to the recognized clinical and biological heterogeneity of knee OA. In this research study we focus on prior works using deep learning algorithms for OA diagnosis and classification using knee datasets, with images.

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## 2 LITERATURE SURVEY

[1] This study proposes automated computer-aided diagnosis method for the detection of Osteoarthritis, which uses combination of feature extraction using ICA and normalization based on predictive modeling using multivariate linear regression. multivariate linear regression reduced inter subject variability and also to increase to separate CC and Osteoarthritis groups. The classification obtained has higher performance in differentiating healthy and Osteoarthritis patients in various knee areas. Hence analysis method serves early detection of Osteoarthritis. Although, generalization capabilities of the proposed approach might be overestimated and to be handled carefully.

[2] This study proposes deep learning method based on label weak for machine learning which depends on information not shown explicitly in pictures as predictions along with combination of clinical variables BMI approach. Data-driven approach intends to anticipate the disease, which cannot be evaluated in the clinical routine by radiologist. Thus it shows an added advantage of deep learning in clinical practice.

[3] This study proposes a method to classify knee Osteoarthritis severity from x-ray which is based on Convolutional Neural Network-Long Short-Term Memory method. The experimental results shows that, VGG-16 model shows the is highest performance by extracting the high-level characteristic and thus enables the efficiently differentiate KL grade 0-4.

[4] This research proposes , a method for classifying Knee Osteoarthritis pictures based on unobserved local center of mass segmentation method and deep Siamese Convolutional Neural Network is presented. Knee Osteoarthritis anatomical features are extracted by using GLCM matrix.The clinical data is trained with 75 iterations and validated to increase the accuracy. The results shows greater efficiently in detection of knee osteoarthritis, obtaining 93.2% of accuracy with multi-class classification accuracy of 72.01% and quadratic weighted Kappa of 0.86.

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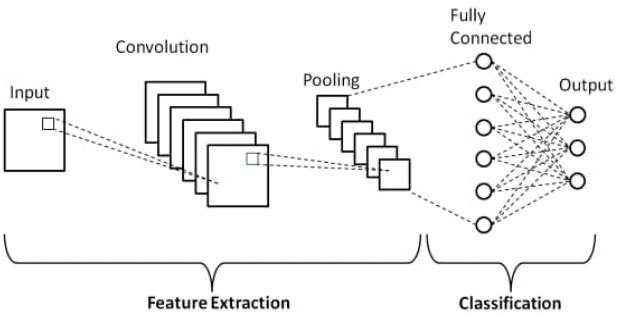
[6] This research proposes DNN method to classify knee osteoarthritis. There are various features need to be evaluated for knee osteoarthritis, which including age, gender, hormonal imbalance, weight, size, family history etc. The proposed approach was illustrated for classifying clinical data and to provide a categorize knee osteoarthritis disease. The analyses were defined based on gender, age and obesity. In addition, for validating deep learning method its compared with DNN and M L method. The results shows the efficacy of deep learning in early detection of knee osteoarthritis.

[7] In this study, YOLOv2 model is proposed for the knee joint detection and fine tuned CNN model with ordinal loss for knee Kellgren Lawrence grading system. Based on the performance of YOLOv2's knee joint detected, first stage detector of YOLOv2 is fine tuned to detect with less assorted size. The ordinal loss enhances the classification precision and decreases the mean absolute error between prediction and ground truth which is compared using cross entropy for classifying knee Kellgren Lawrence grading system.The results shows predominant performance in classifying the disease and CNN models are validated.

[8] This study proposes a state of the art Machine Learning method for knee osteoarthritis detection at early stages. The progression obtained is of high accuracy which is based on few characteristics. This study finds the characteristics of JSW, mean cartilage thickness and JSN is vital in detecting knee osteoarthritis progressors. These results are used for developing a tool for enabling predicting knee osteoarthritis at early stage.

[9] This proposed work provides necessary characteristics required for prediction the knee Osteoarthritis. The proposed method shows higher accuracy than the existing one using CNN algorithm for early detection of knee Osteoarthritis. 3D deep learning has increased the early detection of knee osteoarthritis. This is remarkable in knee osteoarthritis prediction since a three-dimensional image allows the evaluation of knee joint from various angle and gives the precise details of the disease, especially on early detection of knee Osteoarthritis.




[10]The proposed system uses radiography to compare with various symptoms between radio graphic observations and clinical outcomes. Most orthopedic consultants depend on standard radiography. The Kellgren Lawrence osteoarthritis

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is classified by using grading system by grading the severity from 0 to 4. which helps doctors for further management. Increasing the reliability for these predictions would be highly beneficial.

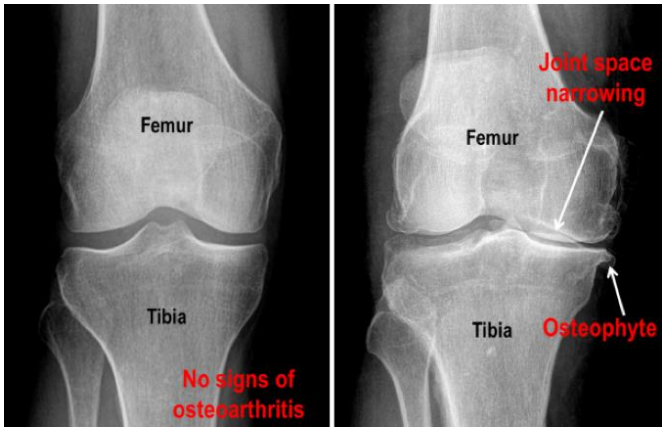
## 3. IMPLEMENTATION

Utilizing patient-specific statistical data from clinical and medical records, a deep neural network was used to differentiate between the various forms of osteoarthritis.

A computer-aided analysis that would evaluate the severity of KOA and also forecast the onset of knee OA might be used to find the features from X-ray pictures. In a variety of picture recognition and classification applications, deep learning techniques, particularly CNN, have s demonstrated amazing results.

The adaptive learning feature representations utilizing CNN that are provided in this work can be more effectively used for evaluating KOA images and determining the degree of KOA prognosis than direct radiography characteristics.

The reliability of the results was increased by considering these criteria to appropriately determine the KOA type. The network is examined for accuracy following training. Following the training and evaluation phases, the CNN was used to divide the KOA into five classes: Grade 0 or normal, Grade 1, Grade 2, Grade 3, and Grade 4.



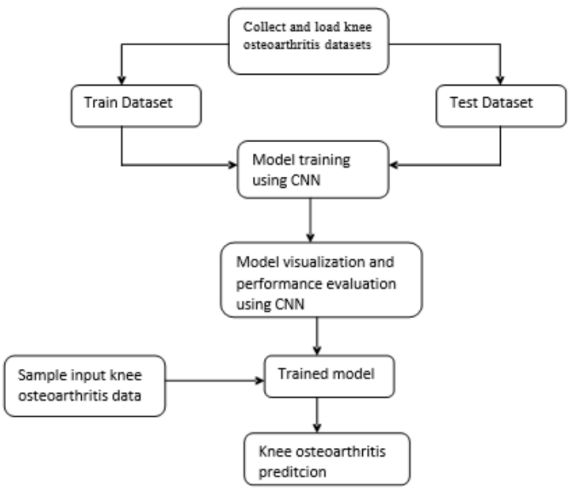

When compared to already used methods, the proposed method's performance evaluations are offered.

## 4. MODELLING

Training and Testing:The conventional CNN contains several convolutional layers. Usually, each convolutional layer produces numerous alternate convolutions.We are tasked with predicting the categories for a new set of test photographs given a set of images that have all been labeled with a single category. The accuracy of the predictions is then evaluated.

An X-ray image training dataset serves as our input.We then train a classifier with this training set to understand the appearance of each class. We test the classifier's performance by asking it to make predictions for labels on a new set of x-ray images.

Processing



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Data Pre-processing:In data pre-processing we are going to perform some image pre-processing techniques on the selected data,Image Resize And Splitting data into train and test Data

Modeling:The split train data are passed as input to the GAN model and custom CNN, which helps in training.The trained Knee Osteoarthritis data is evaluated by passing test data to the algorithm and accuracy is calculated.

Build Model:Once the data is trained and if it shows the accuracy rate as high, then we need to build a model file

### 5.COMPARISON TABLE

| AUTHORS | YEAR | METHODOLOGY | LIMITATIONS |
|---|---|---|---|
| Parisa Moridian1, , Navid Ghassem | 2022 | Lasso, SVM,KNN, Ai technques, PCA,RFE | Presenting MRI datasets of different types of autism disorder need to be addressed |
| Fawaz Waselallah Alsaade and Mohammed Saeed Alzahrani | 2021 | CNN, VGG16 | The detection is based on face recognition only |
| Sakib Mostafa1 , Lingkai Tang2 , and Fang-Xiang Wu | 2019 | LDA, CNN | Accuracy is around 77% |
| Kazi Shahrukh Oma, Prodipta Mondal, Nabila Shahnaz Khan | 2020 | Random Forest-CART,and Random Forest-Id3 | evaluated with AQ-10 dataset and 250 real dataset |
| Chongruo Wu ,Sidrah Liaqat ,Halil Helvaci, Sen-ching Samson Cheung | 2020 | Neural Network, SMOTE | Did not incorporate temporal dimension for general improvement in accuracy of behavior detection. |
| Astha Baranwal, Vanitha M | 2020 | ANN, Random Forest, Logistic Regression, Decision Tree and SVM | time-conserving method to screen potential ASD individuals for self-screening |
| Osman Altay, Mustafa Ulas | 2018 | LDA,KNN | Detection only for children of age 4-11 |
| Bhawana Tyagi, Rahul Mishra , Neha Bajpai | 2020 | SVM, LDA | Data of adult people from the age of 17 to 60 years to diagnose by applying data mining techniques |
| Koushik Chowdhury, Mir Ahmad Iraj | 2021 | Guasian naïve bayes, SVM | classify s for a specific kind of dataset |
| Zahra Kndan ,Khadem-Reza and Hoda Zare | 2022 | SVM, RF, KNN, and ANN classifiers | There is no information about diseases associated with autism in selected patients. |

## 5. CONCLUSION

Autism spectrum disorder (ASD) is a neuro-developmental disorder which can be caused by genetic, exposure to heavy metals or other environmental factors.The machine learning approaches have been used which result in lower accuracy

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rate, This paper presents, various deep learning algorithms will be used to predict autism and improve the accuracy.Deep learning algorithms give more accurate results compared to other algorithms.The proposed model helps in achieving more accuracy compared to previous model and on the validation dataset and Train datasets.This architecture is used to extract the features from fixation maps.Various deep learning algorithms is used to improve the accuracy The model would be able to observe whether eye tracking data of fixation map could classify children with ASD and typical development.

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