**Osteoarthritis Check-up System**

GitHub Link: <https://github.com/Gauravsharma-20/Minor-Project>

Deployed At: <https://oa-checkup-system.herokuapp.com/>

Group ID - 3

* Mentor: Dr. Trilok Chand
* Group Members:
* Aditya (SID **18103075**), Saarisht Thaman (SID **18103063**)
* Gaurav Sharma (SID **18103050**), Aditya Kumar (SID **18103010**)

**Introduction:**

Osteoarthritis is one of the most common form of arthritis, affecting millions of people worldwide. It occurs when the protective cartilage that cushions the ends of your bones wears down over time. Osteoarthritis is the second most common rheumatologic problem and it is the most frequent joint disease with a prevalence of 22% to 39% in India.OA is more common in women than men, but the prevalence increases dramatically with age. The knee is one of the joints most commonly affected by osteoarthritis. Cartilage in the knee may begin to break down after sustained stress, leaving the bones of the knee rubbing against each other and resulting in osteoarthritis

**Overview of System:**

Essential the whole system can be summed up as an Osteoarthritis (commonly referred to as Arthritis) Grade Prediction and Concise Report Generation System. Primarily the main motivation behind the project was that the traditional method takes too much time mainly due to high population, dependence on experience of Radiologist, Lack of proper infrastructure and services in rural regions and art effects on X-ray images.

Some of the PHD Students were already working on something similar under our mentor so when we started, they were able to give us a proper problem statement of what the system was supposed to do and how our team was supposed to construct different modules. At the end of the project we were able to construct a full-fledged system with 1/5th the size of industry standard model (published by Stanford in early 2019) and an increment in accuracy from 69.7% to 75.42% (more details [here](https://github.com/Gauravsharma-20/Minor-Project/blob/master/SystemDetails/ModelDetails.png)) and a proprietary Pre-processing method which is able to resolve all sorts of art effects from images (sample results [here](https://github.com/Gauravsharma-20/Minor-Project/blob/master/SystemDetails/SamplePreprocessedResults.jpg)). Alongside that, a robust web application with a proper database management system designed in a way to be more scalable in future. Our team is currently working on a research paper for this project as suggested by our mentor and is planning to roll this out to PGI for use once post-graduate students complete the testing procedure for our system.

**Motivation:**

Nowadays, Medical Imaging in the sector of Pathology, Radiology etc. generate and capture enormous amounts of data containing extremely valuable signals and information this data is being generated at a pace far surpassing what “traditional” methods of analysis can process. Machine learning therefore quickly enters the picture, as it is one of the best ways to integrate, analyse and make predictions based on large, heterogeneous data sets. The techniques namely Magnetic Resonance Imaging, X-ray radiography, Ultrasound etc. are being widely used by Medicine Practitioners, that usually involves diagnosis by them and then further treatment depending upon the severity level of the reports.

The reading of the images is usually conducted by expert Medical Professionals. However, reading every report and then diagnosing can be a challenging task especially in rural and highly populated regions, this is usually because in these sectors writing medical reports and maintain them is a very challenging task as it requires skills, hours and a surplus number of supporting staff which is highly unlikely for the task case under consideration. Also, in these areas where there are a significant number of patients and the task of reading, writing and maintain that many reports by a few health professionals can be tedious and time-consuming.

A study by National bureau of Economics Research shows increment in human life expectancy with incremental use of medical imaging. To the point that Deep learning rose to its prominent position in Medical Industry when neural networks started outperforming other methods on several high-profile image analysis benchmarks. Most famously on the ImageNet Large-Scale Visual Recognition Challenge (ILSVRC) in 2012 when a deep learning model (*a Convolutional Neural Network*) halved the second best error rate on the image classification task, it has been 8 years since then and by now Convolutional Neural Network have surpassed even human performance on the ILSVRC, and reached a level where the ILSVRC classification task is essentially solved (i.e. with error rate close to the Bayes rate).

As evident from recent statistics, inculcating these technologies with already implemented system and infrastructure helps in saving a lot of time, resources and work force involved for the overall procedures. The rising cost of healthcare and shortage of healthcare professionals are just some of the reasons which increase the use of Artificial Intelligence and Machine Learning in Medicine and diagnostic industry. Classification and Segmentation are the main applications of Convolutional Neural Networks in healthcare through Deep Learning.

**How System Utilizes Web Technology**:

System uses **Node*.*jswith Express** frameworkat its Backend and **HTML, CSS(Bootstrap), JavaScript** at its Frontend.

* On opening the web application, the user is greeted by a Login/Registration Page. The login system uses the passport local strategy to authenticate users and ***MongoDB*** is used as the database to store user information as well as patient information and report data. All the passwords are encrypted and thus **made secure by *bcryptjs***.
* On successfully logging in, the user gains access to the dashboard from which the user can generate a new report or visit old reports at his/her leisure. Most of the **webpages are dynamic** which is made possible by the ***EJS* package in Node**.
* After entering the details of a new patient and uploading their X-ray scan, a Deep Learning Model predicts the Grade of Osteoarthritis using **Python** script on the basis of the given information and generates a HTML report which is converted into a PDF format using the ***puppeteer* API**. The user now has the option to print/download the report and save the information onto the database.
* Going back to the dashboard, the details of the patient added and the report can be accessed from the View Reports section. The server queries the database for information and displays the information of all the patients in a tabular form. Reports can be re-downloaded from here and the user also has the option to search for patients according to their Serial No., name, age etc.
* System also has the feature to change Language of the entire Interface using ***Google-Translate-Script***. (137 languages including Hindi and Punjabi)
* Finally, the user can Logout to end the session!