**Project Proposal:**

**Introduction to Computer Vision - Project**

**Project Title: Detecting the type of bone fracture using image classification**

**1. Introduction**

The focus of the project is on determining the type of bone fracture that is present on X-ray images. The primary purpose of the project will be to develop a system that can accurately classify images into multiple categories based on fracture types.

The project can show great potential in the use of computer vision for medical purposes in a way to reduce human errors and help radiologists to speed up their work and provide them with a preliminary analysis of X-rays.

**2. Problem Statement**

The specific problem addressed by this project is image classification in the field of medical imaging, specifically for orthopedic diagnostics. We aim to develop a model to classify X-ray images from the provided dataset into different categories such as avulsion fractures, comminuted fractures, fracture-dislocations, green sticks, hairline fractures, impact fractures, longitudinal fractures, oblique fractures, pathological fractures, and spiral fractures. This will involve processing and analyzing medical images to identify and differentiate these conditions.

**3. Objectives**

Our initial activities in the short-term goals are focused on a thorough preprocessing of the data set. This includes ensuring that all input images are of high quality and are consistent in size and format, which will be achieved by steps such as scaling images to a uniform size and normalizing pixel values. After preprocessing, we will implement a basic image classification model using pre-trained convolutional neural networks (CNNs), such as ResNet or VGG16. These predefined models will allow us to quickly obtain initial classification results and establish a performance baseline for our further work.

In the long-term goals, we will try to improve the accuracy and reliability of the model so that it is applicable in real conditions. This phase involves advanced parameter tuning and conducting comprehensive model testing and evaluation to ensure accurate results. This platform will enable easy entry of X-ray images and will provide users with quick and precise analyses that will be used as an aid in diagnostics.

**4. Methodology**

The methodology for our bone fracture classification project uses state-of-the-art deep learning techniques, with a particular focus on convolutional neural networks (CNN) due to their proven performance in image classification tasks that are of great importance to us. Our approach starts with the use of transfer learning, which allows us to build on the strengths of previously trained models such as VGG16, ResNet, or InceptionV3. The pre-trained models on the ImageNet dataset have already processed a large number of visual features that we will adapt to our bone X-ray dataset.

The process begins with a comprehensive data augmentation to artificially expand the dataset, thereby improving the robustness of the model and mitigating overfitting. Rotation, zooming, horizontal flipping, and changes in image height and width will be applied to generate training data without changing the underlying content.

After preparing the dataset, we will integrate the pre-trained CNN model and add layers tailored to our specific classification needs. We will lock the weights of the lower layers to preserve useful visual features that we have already learned and fine-tune the higher-level layers to improve the model’s performance on specific fracture typology detection tasks..

Model training will use a carefully selected optimizer and learning rate, followed by an iterative process of hyperparameter tuning, where parameters such as learning rate, packet size, and network architecture are adjusted to increase accuracy and reduce loss.

The evaluation phase will use a reserved validation dataset to compare the model’s performance, using metrics such as accuracy, precision, recall, and F1 score to quantify performance.

**6. Data**

The dataset utilized will be sourced from Kaggle's "Bone Break Classification Image Dataset". It covers a range of fracture classes, including avulsion fractures, comminuted fractures, fracture-dislocations, greenstick fractures, hairline fractures, impacted fractures, longitudinal fractures, oblique fractures, pathological fractures, and spiral fractures. Preprocessing steps will involve scaling images to a uniform size, normalizing pixel values, and augmenting data to prevent overfitting. This ensures the model is trained on a robust and diverse set of images.

**7. Evaluation Metrics**

The project will be evaluated using a combination of the following metrics:

* **Accuracy**: To measure the overall percentage of correct predictions.
* **Precision**: To assess the quality of positive class predictions.
* **Recall (Sensitivity)**: To evaluate the model's ability to identify positive instances.
* **F1-score**: To balance precision and recall, providing a single metric that considers both false positives and false negatives.