Patent Draft

Smart and Innovative Mobile Interface for Chest X-ray Report Generation

Abstract:

This introduces an intuitive mobile application that streamlines the chest X-ray report generation process for users by incorporating a machine learning (ML) model in an android app. The app seamlessly uses machine learning (ML) model in the form of encoder decoder mechanism, to provide comprehensible reports in layman's language in the android mobile application. The application enables users to capture chest X-ray images using their smartphone cameras, facilitating personalized reports based on the provided x ray image by the user.

The user-friendly process begins with the user capturing the image of the chest X-ray through the app's camera interface or directly selecting the image file from the file. The image is then processed through the ML model, utilizing the encoder decoder mechanism thus generating reports with commonly used words and phrases that are easily understood by individuals a non-medical background. The generated report not only highlights the presence or absence of chest-related abnormalities but also conveys the information in a clear and accessible manner. By providing actionable insights in layman's language, users can promptly understand the results and make informed decisions about their health.

In response to the heightened awareness of chest diseases post-COVID-19, this app serves as a crucial tool for individuals to actively monitor their chest health. The feature of capturing the image through your own mobile camera of your chest x ray simplifies the process, making chest X-ray analysis accessible to users without specialized medical knowledge. This innovative solution not only addresses the increased consciousness about chest health but also promotes early detection and informed health management.

Background:

Medical Imaging is indispensable for clinical analysis and the visualization of organ functions within the human body, especially chest. Techniques like X-ray play a pivotal role in diagnosing

and treating various conditions. The unprecedented demand for x ray reports during the COVID-19 pandemic highlighted the critical need for swift and accurate diagnostics, particularly concerning chest-related ailments. Even in the post-pandemic era, increased awareness has led to a surge in medical imaging demands, underscoring the necessity for efficient and time-sensitive diagnostic tools.

Challenges in Manual Report Generation:

The traditional method of generating radiological reports relies heavily on the expertise of radiologists. While experienced professionals can provide accurate interpretations, the process is time-intensive, requiring an average of 10 minutes or more per report. In crowded healthcare settings or regions with limited resources, this approach proves impractical and potentially problematic.

Moreover, inexperienced medical professionals, especially those in rural areas with lower healthcare standards, face challenges in interpreting complex chest X-ray images. A multitude of skills, including an in-depth understanding of thoracic anatomy, knowledge of chest disease physiology, and correlation with various diagnostic results, is necessary for accurate reporting. This patent addresses these challenges by proposing an innovative solution aimed at automating chest X-ray report generation.

Objectives:

- Develop a user-friendly android app, allowing users to effortlessly capture images of chest Xray using their camera of your mobile phone.
- Image Processing with ML Models: Implement encoder decoder mechanism for image analysis, enabling the extraction of relevant information from chest X-ray images.
- Layman-Friendly Reports: Using global vectors (glove.840B300d) in language generation for reports this converts the extracted information into commonly used words and phrases, ensuring reports are comprehensible to users without a medical background.

- Common chest Disease Detection and Identification based on x ray images: Implement machine learning for disease detection within chest X-ray images, providing accurate and reliable information about the presence or absence of abnormalities in the provided x ray.

- Accessible Reporting and security: Develop a reporting system that conveys analysis results in layman's language, emphasizing clarity and ease of understanding for users.
- Real-Time Analysis: To enable real-time processing and reporting, allowing users to receive immediate reports on their chest X-ray images.

Methodology:

The proposed methodology revolves around encoder decoder model, utilizing the DenseNet 121 architecture pre-trained with CheXNet weights. The model is fine-tuned using a meticulously curated dataset comprising 3500 post-COVID-19 pandemic chest X-ray images, including some prevalent diseases such as pneumonia, fibrosis, and pleural effusion etc. This model is thus converted in TensorFlow lite model for integration in the android app and now app provides the interactive user interface, and this app can be used in the smartphones for chest related x ray image report.

Dataset Characteristics:

The dataset used for model training and fine-tuning is carefully selected to mirror the prevalence of diseases in the post-COVID-19 era. Comprising 3500 images, this dataset incorporates data augmentation techniques to enhance model generalization on the provided dataset to tackle variations in datasets.

Advantages:

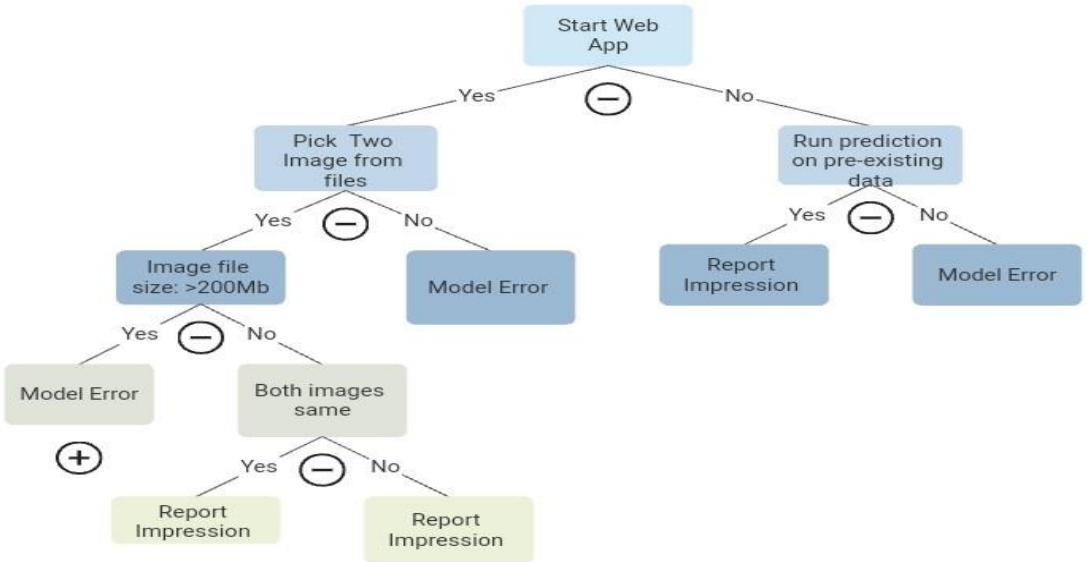
- Time Efficiency: Automated report generation significantly reduces the time required for manual analysis and reporting.
- Consistency: The model ensures consistent reporting, over the variations even in irregular images of chest x ray.
- Accessibility: The ml model is deployed in the form of an android mobile app thus increasing accessibility. It is especially beneficial in resource-constrained or rural areas where experienced radiologists are scarce.

- Accuracy: The model has been trained for 10 epochs with very low training loss and with pre-trained weights and attention mechanisms which enhances the model's diagnostic accuracy.

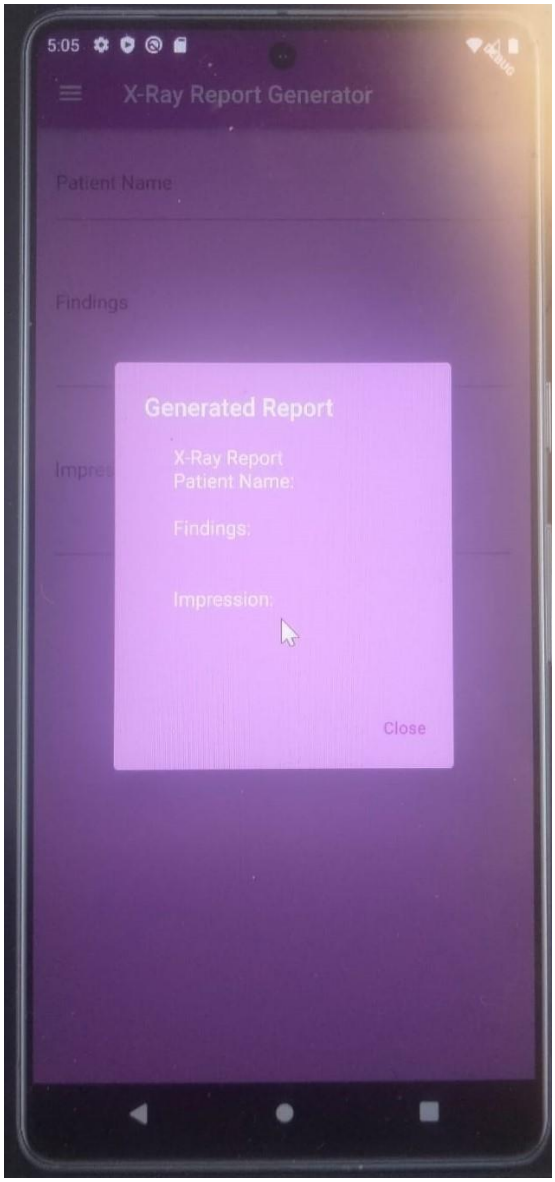
Architecture and Report Generation Mechanism:

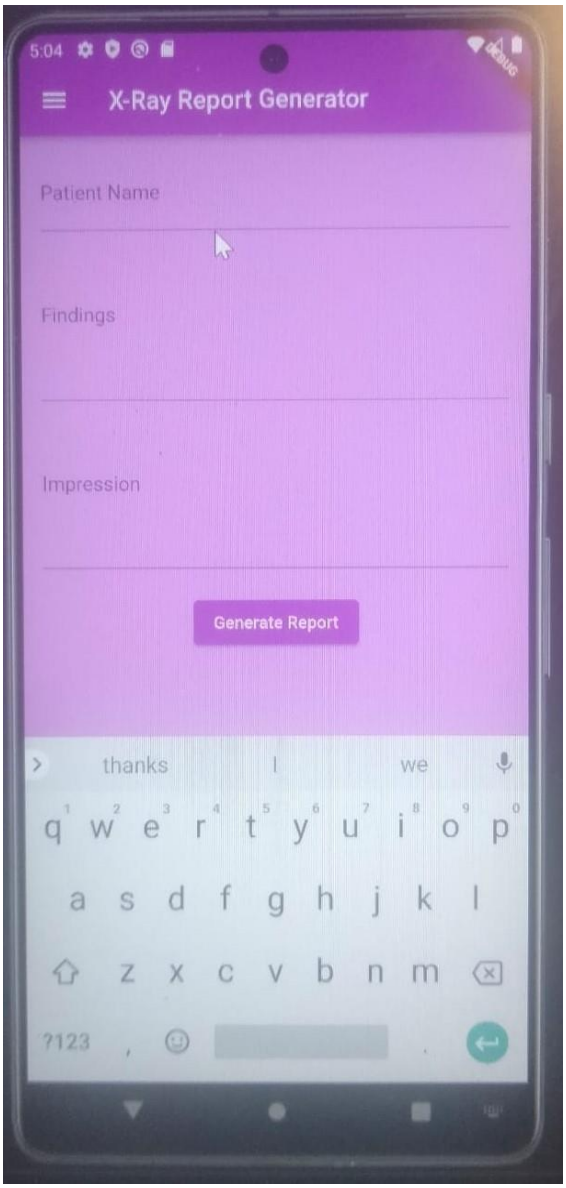
The proposed model as encoder decoder mechanisms. It leverages DenseNet 121, pre-trained with CheXNet weights, it comprises of input layer, embedding layer, LSTM , which is further connected to self-attention mechanism and lastly connected with dropout layer it uses the global vector (glove.840B300d) for language generation of report into common words that is easily understand by non-medical background people. This choice ensures a robust foundation for accurate and reliable chest X-ray analysis. This model accepts two images as input (and by default if provided only one image then it will consider the same image as second image too) and generate the report as string sequence. The string generated based on the learning of the model uses the common words for generating report which is easily understandable by even non-medical background people.

Working of the App:



Result:





Claims:

Developing an android application for capturing images of chest X-ray (in .png format) using the mobile camera and enabling users to generate report in layman's terms for non-medical background people.

Developing a specialized machine learning model which is trained on generating report strings as output by extracting the features of the input image of the chest x ray.

Utilizing the specialized medical dataset containing x ray and their reports of abnormalities (mainly consists of common chest-based diseases and other abnormalities). The dataset contains approx.. .

3500 images out of which 80:20 ratio is used for training and testing the model.

This dataset also incorporates data augmentation techniques to enhance model generalization on the provided dataset to tackle variations in datasets.

The model is highly accurate as, it has been train for 10 epochs with very low training loss (how well the model is fitting the training data) and also using specialized pre-trained weights and attention mechanisms which enhances the model's diagnostic accuracy.

Conclusion:

This android application presents a pioneering initiative that addresses the evolving landscape of medical imaging reports. By fusing advanced deep learning techniques with carefully curated datasets, the proposed method offers an automated and efficient solution for chest X-ray report generation. The implications of this innovation are far-reaching, promising to reducing the burden on healthcare professionals and also facilitating the user to let them get and understand their generated report if containing any abnormalities by themselves, enhancing heath consciousness of the users.

Further, we can also facilitate broader access to other medical diagnostics in diverse healthcare settings by extending and incorporating the features of the present model and diverse dataset, thus creating the hybrid model to generate reports on different body parts x rays as extended feature of the present app.

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