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Pneumonia Detection Using CNN

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Abstract - Pneumonia, an interstitial lung disease, is the leading cause of death in children under the age of five. It accounted for approximately 16% of the deaths of children under the age of five, killing around 880,000 children in 2016 according to a study conducted by UNICEF. Affected children were mostly less than two years old. Timely detection of pneumonia in children can help to fast-track the process of recovery. This paper presents convolutional neural network models to accurately detect pneumonic lungs from chest X-rays, which can be utilized in the real world by medical practitioners to treat pneumonia. Experimentation was conducted on Chest X-Ray Images (Pneumonia) dataset available on Kaggle. The first, second, third and fourth model consists of one, two, three and four convolutional layers, respectively. The first model achieves an accuracy of 89.74%, the second one reaches an accuracy of 85.26%, the third model achieves an accuracy of 92.31%, and lastly, the fourth model achieves an accuracy of 91.67%. Dropout regularization is employed in the second, third and fourth models to minimize overfitting in the fully connected layers. Furthermore, recall and F1 scores are calculated from the confusion matrix of each model for better evaluation.

Keywords: Convolutional neural networks (CNNs) · Pneumonia detection ·

1. INTRODUCTION

1.1 Purpose:

This project is about building a web application that can diagnose a patient with pneumonia correctly by analyzing its X-ray image.

Using Machine Learning techniques predicting patient's pneumonia disease is a time-consuming task which degrades patients survival rate, By Appling different machine learning techniques an early diagnosis of lungs problems will increase patients' survival rate based on accuracy, to find the best suitable algorithm for pneumonia prediction which gives best performance. It added a greater advantage to medical field. Object Detection and recognition becomes a necessity when there is a need of automation, where the identification is done by machines instead of doing it manually for better performance and reliability. Normally, there are people hired specially for counting the number of students and vehicles that enter in a college everyday and maintain their records manually in a register. Automation by this system provides a better way to perform the same work.

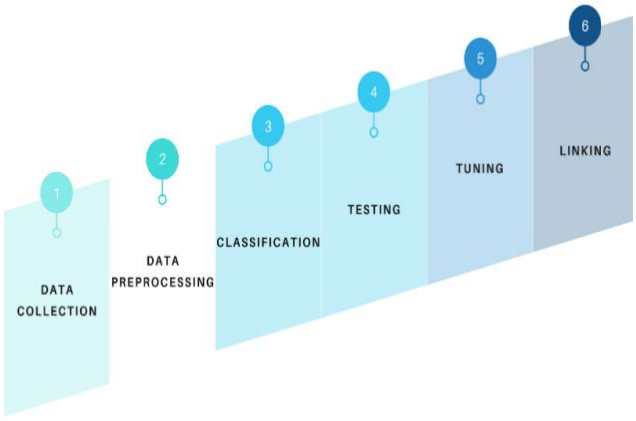
1.2 Objective:

In the early stages when technology was yet to transform the prediction of diseases was mainly based on human knowledge and intuition. The probability of human error is high and thus the prediction of disease also becomes difficult. Hence the treatment may not help the patient. Also, when in a remote area, access to medical facilities is not always possible. Thus, doctors cannot be available during such occasions as well. Thus, we have created a system which will help the patients understand whether they are suffering from anything severe like pneumonia. If yes, they need to take the right actions preventing the same. Patients will be able to understand whether it is a severe pneumonia with minimal doctor consultation.
It will reduce the frequency of the patient to visit hospital again and again.
The chest X-ray is provided by the user as inputs, and the system will determine depending on the input whether the user is suffering from pneumonia or no. The chances of doctors scamming patients to conduct unnecessary test can also be avoided.

- Solution is to use machine learning algorithms to detect whether the x-ray is of a pneumonic patient.
- Image processing yields a good result in preliminary testing.
- Users will be interacting with via a website that will accept digital copies of x-ray.
- The x-ray will be analyzed by the back-end servers and result will be generated.

1.3 Modules of the System:

- An interface for registration of user with validation.
- An interface for users to upload their digital copies of X-ray.
- An interface for the admin to retrieve a specific user data from the database to serve specific needs.
- A server to run the prediction on collected X-rays.
- A database to store and collect user information for later uses.



1.4 Existing System:

DRDO has recently unveiled similar software for Covid-19 on May 10, 2021. The details of it are not public.
No technical solution exists that is implemented for general use. The system is believed to have same working principle and ML algorithms. The software can only be researched on once its public.

1.5 Technology and Development Environment

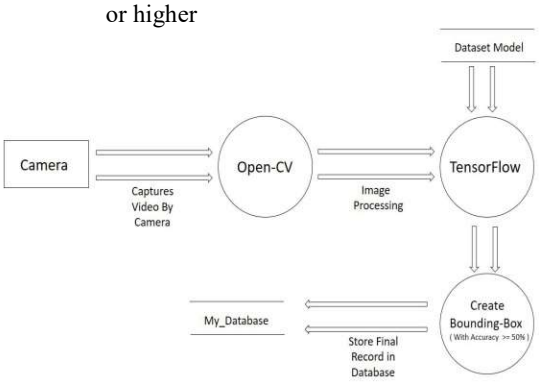
There are various requirements (hardware, software, and services) to successfully deploy the system. These are mentioned below:

1.5.1 Hardware

- 32-bit, x86 Processing system
- Windows 7 or later operating system
- High processing computer system without GPU or with GPU (high performance)
- Clear x-ray images.

1.5.2 Software

- OpenCV
- Python and its supported libraries
- Tensor Flow
- If Installing Tensorflow in GPU systems:
  1. CUDA® Toolkit 9.0.
  2. The NVIDIA drivers associated with CUDA Toolkit 9.0. cuDNN v7.0.
  3. GPU card with CUDA Compute Capability 3.0 or higher



2. SYSTEM FEASIBILITY ANALYSIS

A feasibility study is an analysis of how successfully a system can be implemented, accounting for factors that affect it such as economic, technical, and operational factors to determine its potential positive and negative outcomes before investing a considerable amount of time and money into it.

2.1 Technical Feasibility

For any detection system, there is a need to process images from the x-ray. For this, the kind of framework used must be the one that can extract those objects from the images easily and accurately in real-time. The framework used in this is Tensorflow, which is a framework designed by Google for efficiently dealing with deep learning and concepts like neural networks, making the system technically feasible.

The system once set up completely, works automatically without needing any person to operate it. The result (count and other information) gets automatically saved in the database, without requiring any manual effort for saving it.

For making the system technically feasible, there is a requirement of GPU built system with high processor for better performance.

2.2 Economical Feasibility

For any detection system, there is a need of clear x-ray images for better and accurate results.

Since the system is completely automated, there is a need of continuous electricity supply for it to operate 24X7.

The Tensorflow framework used in the system works great with GPU built systems, which are a little on the expensive side.

Since the system uses high performance processors continuously, so to save any disaster from occurring due to very high temperatures, there is a requirement of a cooling system in the environment where it is implemented.

2.3 Operational Feasibility

The main motto of our system is to reduce the manual efforts of counting the students and vehicles by automating it.
The system can do that accurately and efficiently making the system operationally feasible.

3. BENEFITS OF THE PROPOSED SYSTEM

The current system had a lot of challenges that are overcome by this system:

- Economic: The proposed system is economic as there will not be frequent visits to the doctor resulting in less crowding in hospitals and economically feasible to the patient.

- Manpower: Since India has only 1 doctor per 10000 persons, manpower i.e. doctors can use this site for quick consultation also patient can take some over the counter available medicine if doctor is not available as site can suggest the level infection.

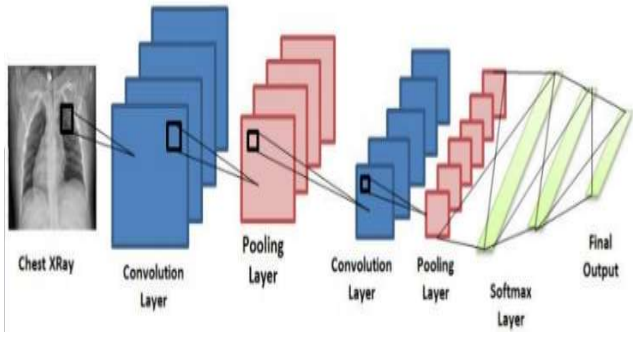
- 24 x 7 Availability: Site unlike doctor can be accessed at any time 24/7.

- Statistical analysis: The number of patients and their level of infection can be counted individually and kept a record for calculating various factors.

4. IMPLEMENTATION

Developing the system involved following steps:

- Selection of a suitable method for pre-processing of data.
- Feature selection and model selection followed by parameter tuning for better accuracy.
- Database design and query building.
- Designing a user interface which would take user information perform classification.
- The result is then stored in DB and conveyed to user.
- For backend classifier we tried hands on three of the best CNN classification algorithms.
- After rigorous tuning and testing, we arrived at the best algorithm.
- The algorithm chosen is not only based on the accuracy it yields but also on various other factors.



5. CONCLUSION

In this project, we have discovered the power of transfer learning and how well it can improve the performance of a deep learning model. The final model certainly could have been improved more by further adding regularization and optimization techniques as well as tweaking hyper-parameters. Also, training on an imbalanced dataset is not optimal so generating new images to balance the distribution would also prove to be useful in this case.
In the future, it is hoped that transfer learning models would be trained on this dataset that would outperform these CNN models. It is intended that larger dataset will also be trained using the models presented in the paper. It is also expected that neural network models based on GAN, generative adversarial networks, would also be trained and compared with the existing models.

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