Background

The local hospital in Bolzina is overwhelmed by the sheer number of Covid-19 tests they have to perform, and the director of the hospital has contacted our company, bending steal, to build them an AI tool that can detect Covid-19 from digital X-Ray images. Being the lead project manager of the company, I have been assigned to tackle this problem by building a tool for the hospital.

The administration of the hospital thus aims to invest internally to an innovative software tool for quick diagnosis and screening with specificity and sensitivity higher than 97% and 80% respectively[1]. The application would aid the hospital in running diagnosis on patients with Covid-19 disease in accurate, efficient, and cost effective way during the current Covid-19 pandemic.

Scope

- A simple desktop application would be built, powered by deep learning technology, that would take an X-ray image as input and predict whether that image belongs to a Covid -19 patient or not, further providing a severity score, along with a visual explanation
- All the X-ray images would be processed locally without the data leaving the local premises of the hospital thus protecting the privacy of the patients
- Running clinical tests to measure actual accuracy of the application would be beyond the scope of the project

Working of the Final Application

Below figures show what the end application will do. It will give the option to upload an X-ray image to a medical worker, run the diagnosis on it using the trained model and produce findings with a visual explanation:

Process of loading image

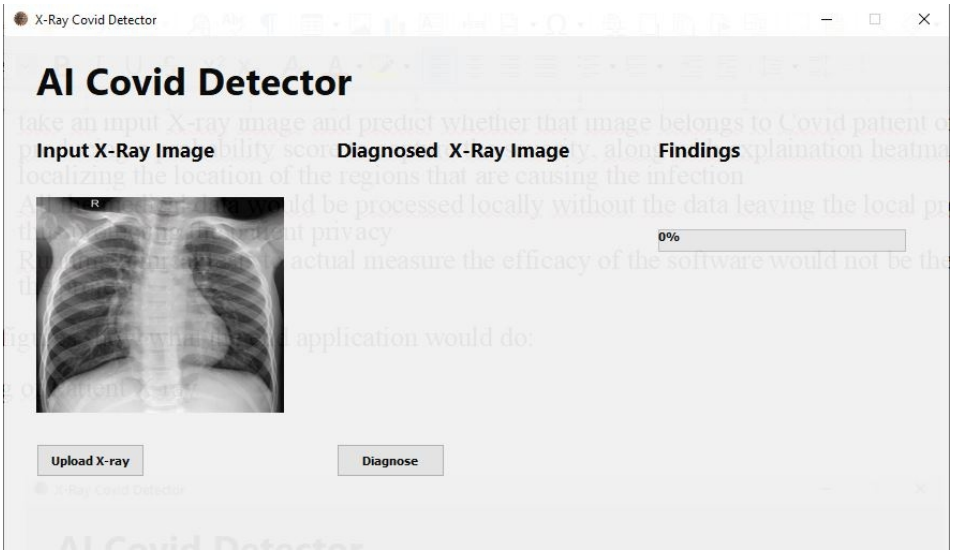

Figure 1: Health worker would be uploading a test x-ray image in the application

[1] "Options for the Use of Rapid Antigen Tests for COVID-19 in the EU/EEA and the UK." *European Centre for Disease Prevention and Control*, 19 Nov. 2020, www.ecdc.europa.eu/en/publications-data/options-use-rapid-antigen-tests-covid-19-eueea-and-uk.

System making Covid-19 diagnosing

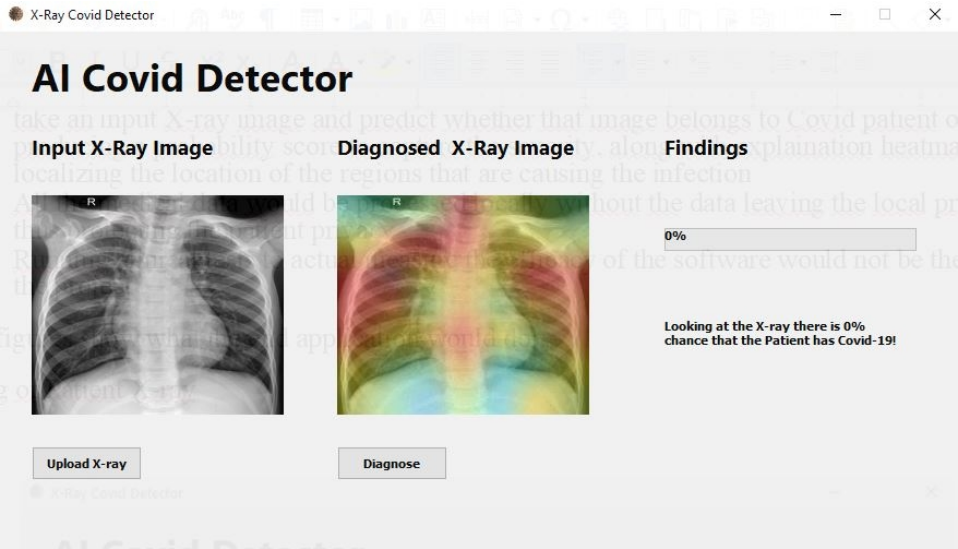

Figure 2: Diagnosis with the findings and explanation

Goals

- Review literature from AI and medical publications to aid in the design of the application
- Gather and process X-ray images
- Train and test several deep neural network architectures
- Design user interface to upload an X-ray data image and to get understandable diagnosis
- Process all the patient data locally
- Build and install a desktop app on the hospital machines

Metrics

The main metrics that would be used to evaluate the system would be: sensitivity, specificity and time to diagnose. All of these metrics would be evaluated in an off-line setting to estimate how well the system would perform on new unseen X-ray images.

Below are their working definitions:

Sensitivity: *True Positive / (True Positive + False Negative)*
Specificity: *True Negative / (True Negative + False Positive)*
Time to diagnose: Number of minutes taken to evaluate an X-Ray image

Project would be successful if the evaluation metrics would achieve the following results:

- **Sensitivity** > 80%
- **Specificity** > 97%
- **Time to diagnose** < 5 minutes

Internal Personnel involved

- Project Manager, Data scientist, Software Engineer, UI Designer
- The Client: Director of Emergency unit Dr. Kirchlechner Christine

Key Stakeholders

Client	Local Hospital
Sponsor	Dr. Kirchlechner Christine
Project manager	Prof. Molinari Andrea
Project team members	Mahmood Bilal (Data Scientist), Kevin Jones (Software Engineer), Elena Sophia (UI Designer)

Project Milestones

The below figure describes the main milestones of the project. The project has four main moments:

- Approval of the project charter by the Dr. Kirchlechner Christine
- Finalization of the UI
- Start the building the application
- Finish the task of building the deep learning model

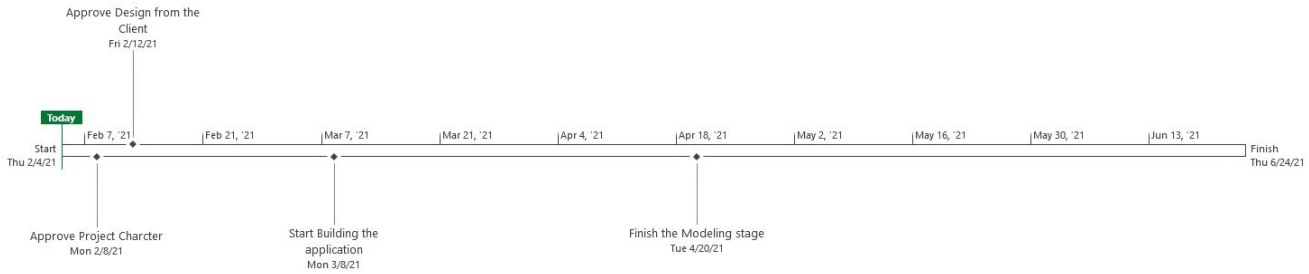

Figure 3: Major milestones of the Project to keep it on track

Project Budget

The total expenses of the project would be **21.953 €** and it would be broken into three equal payments of **7.318€** each. The first payment would be made after the approval of the project charter, the second payment would be done after building the model and sharing its performance with the client and the final one would be made at the end project.

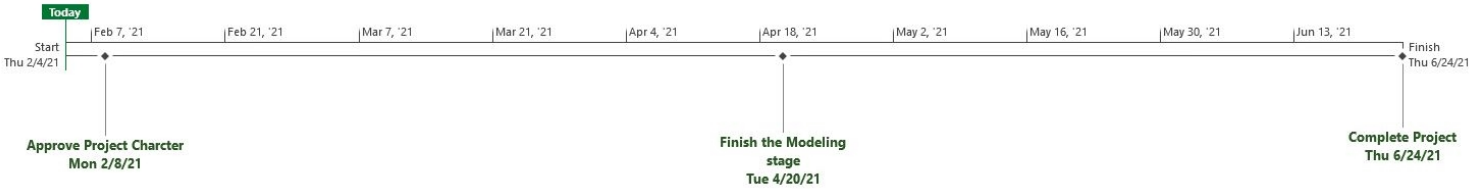

Figure 4: Timeline of the payment cycle

Data Architecture

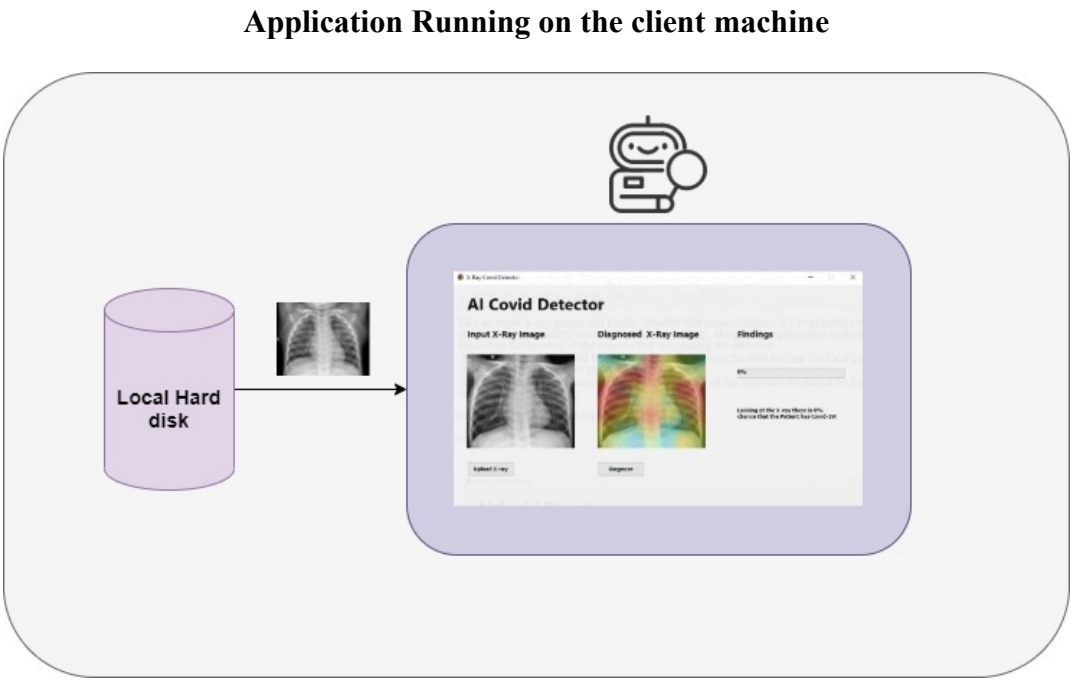

Figure 5: Data Architecture of the application running on the client machine

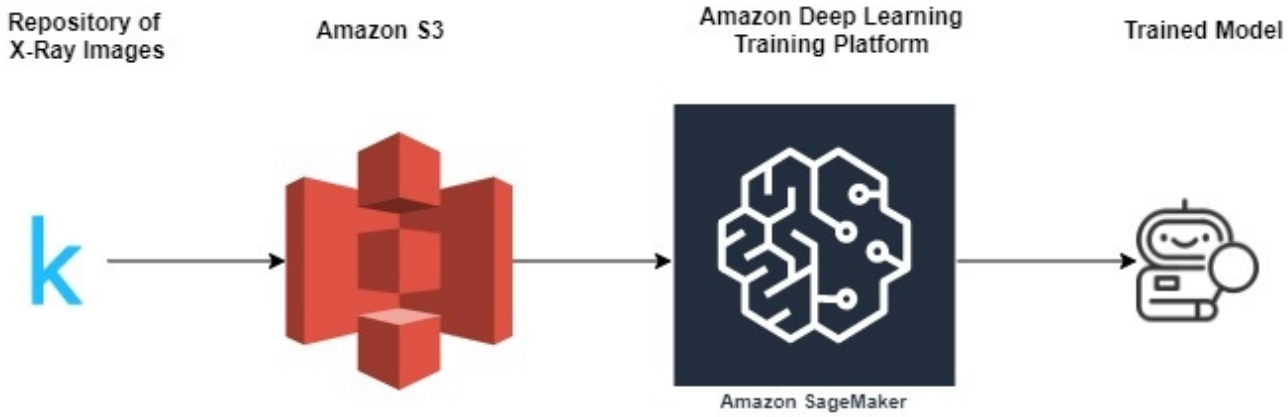

Figure 6: Data Architecture of building the deep learning model

Constraints, Assumptions, Risks and Dependencies

Constraints	• Limited availability of X-rays images • Lack of availability of professional radiologists on the team to verify the results
Assumptions	• X-ray images are representative sample • X-ray images are of good quality • X-ray images are labeled accurately • Size of the training data is sufficient to make use of deep learning technology to find out the underlying disease classification pattern • Visualizing algorithm would correctly label the problematic regions in the absence of annotations of the problematic regions in the training data • The trained model will perform no worse than the metrics evaluated during offline testing
Risks and Dependencies	• Trained model does not meet the desired performance metrics • Data used to train the model is not representative, leading to AI detector performing poorly in the clinical settings • AI solution does not get approved by the board of directors

Approval Signatures

Dr. Kirchlechner Christine, Project Client	Dr. Kirchlechner Christine, Project Sponsor	Prof. Molinari Andrea, Project Manager