

4 Design

4.1 Design Content

There are three modules that have to be developed for the project to succeed: the User Interface, the Cloud Server, and the Database. The User Interface consists of a website where users can upload a picture for the A.I. to analyze, and later receive the results. The Cloud Server contains the A.I. that must be trained before opening to the public. Finally, the database is the place where the training data is located.

4.2 Design Complexity

1. The design consists of multiple components/subsystems that each utilize distinct scientific, mathematical, or engineering principles
 - Database: Contains all the images for training the model
 - Cloud Server: Contains the Deep Learning A.I.
 - User Interface: Sends input images and receives output from the cloud server.
 - Model (neural networks): Structure of the A.I.
 - Website: Website for users to read, send images, and receive results.
 - Controller: Communicates between modules and controls the flow.
2. The problem scope contains multiple challenging requirements that match or exceed current solutions or industry standards.
 - One requirement is being able to provide a diagnosis ourselves based on a patient's info which could be challenging.

4.3 Modern Engineering Tools

Keras.io: Used to run models to get familiar with simple AI models

Cloud: Used for setting up the AI environment

User Interface: Used to collect patient information and give back the results of the diagnosis

4.4 Design Context

Area	Description	Examples
Public health, safety, and welfare	Our project impacts any person who may have skin cancer as well as doctors by giving them a less invasive option to identify skin cancer.	Reduces need for invasive procedures.

Area	Description	Examples
Global, cultural, and social	People who live in regions that get more sun may be more impacted by this project.	People closer to the equator may get more sun than those who live further away.
Environmental	Our project could contribute to climate change by burning fossil fuels and increasing greenhouse gasses.	Since AI uses a lot of computing, it uses a significant amount of energy.
Economic	Our project could decrease the financial responsibility of patients and insurance providers.	Our project provides a non-invasive method of diagnosing skin cancer, which is generally less expensive.

4.5 Prior Work/Solutions

Currently there are numerous AI models available and specifically there are already existing AI models that are able to detect cancer.

- If you are following previous work, cite that and discuss the **advantages/shortcomings**

We will be using existing models to create our model. The shortcoming that current models face that we hope to address with our model is accessibility. We will be using cloud computing to help make our model available to a wider range of people. People all over the world will be able to use our model.

- Note that while you are not expected to “compete” with other existing products / research groups, you should be able to differentiate your project from what is available. Thus, provide a list of pros and cons of your target solution compared to all other related products/systems.

-Pros

-Our model will provide more accessibility by incorporating cloud computing and a user interface

-Cons

-We don’t have access to the same sophisticated datasets that other models may be trained on

The National Institute of Dental and Craniofacial Research supported an international study on cancer detection using AI/deep learning. The AI model they created can detect cancer by checking abnormalities in cell size and structure. This study successfully determined the feasibility of using AI to detect cancer cells. In addition to this, the National Cancer Institute has written an article on how AI models are already currently in use. Dr. Ismail Baris Turkbey is a radiologist who with the help of his National Cancer Institute team trained an algorithm that is capable of detecting prostate cancer when given an MRI scan. Figure 1 below shows two MRI prostate scans on top of each other. Both scans have cancer present. The right side of the pictures show where the AI model was able to successfully detect cancer. It is able to determine the specific area in which the cancer is present. This was done by training the model on what symptoms are common in cells with cancer.

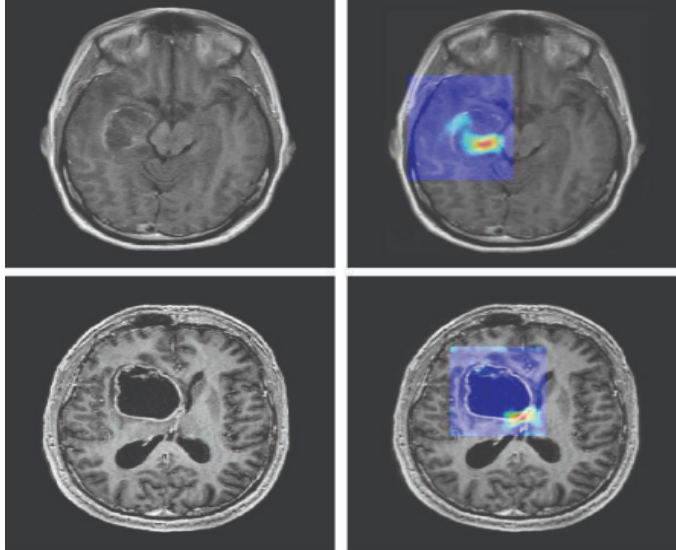


Figure 1 (National Cancer Institute)

Sources:

<https://www.nidcr.nih.gov/news-events/2020/exploring-ai-cancer-diagnosis>

“Exploring AI for Cancer Diagnosis.” *National Institute of Dental and Craniofacial Research*, U.S. Department of Health and Human Services, www.nidcr.nih.gov/news-events/2020/exploring-ai-cancer-diagnosis. Accessed 18 Oct. 2023.

<https://www.cancer.gov/news-events/cancer-currents-blog/2022/artificial-intelligence-cancer-imaging>

September 27, 2023, et al. “Can Artificial Intelligence Help See Cancer in New Ways?” National Cancer Institute, www.cancer.gov/news-events/cancer-currents-blog/2022/artificial-intelligence-cancer-imaging. Accessed 18 Oct. 2023.

4.6 Design Decisions

A few key design decisions that will need to be made are:

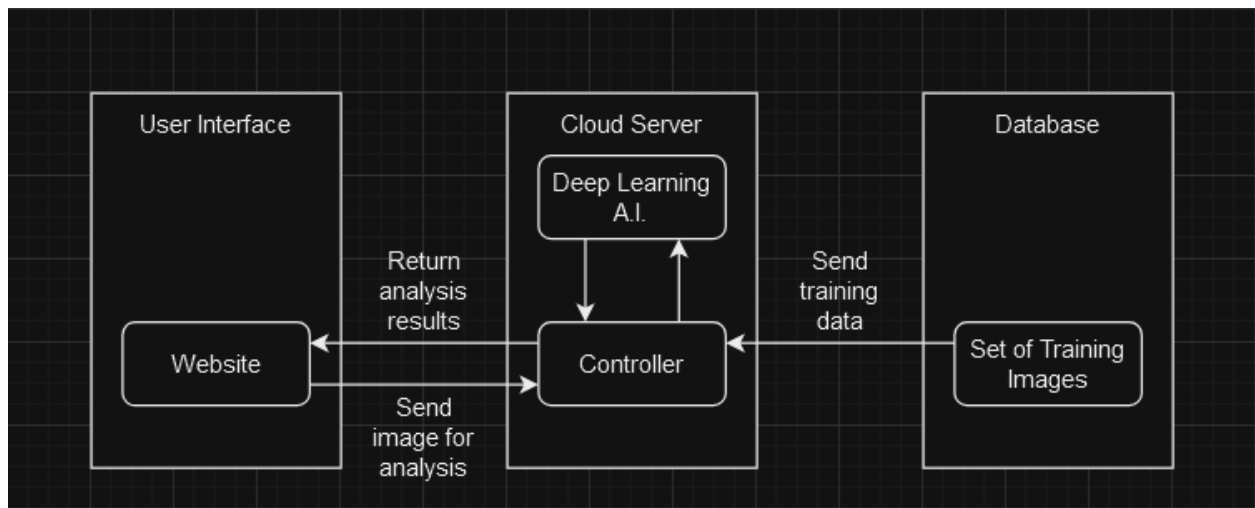
1. Which cloud server will we use, Google or AWS?
2. What accuracy will we consider satisfactory?
3. What type of database will we use to store the information?

4.7 Proposed Design

We have been experimenting with simple AI models and also been researching other products/research that have similarities to our project. This has been giving us a good basis for our next steps within our implementation process.

4.7.1 Design 0 (Initial Design)

Design Visual and Description



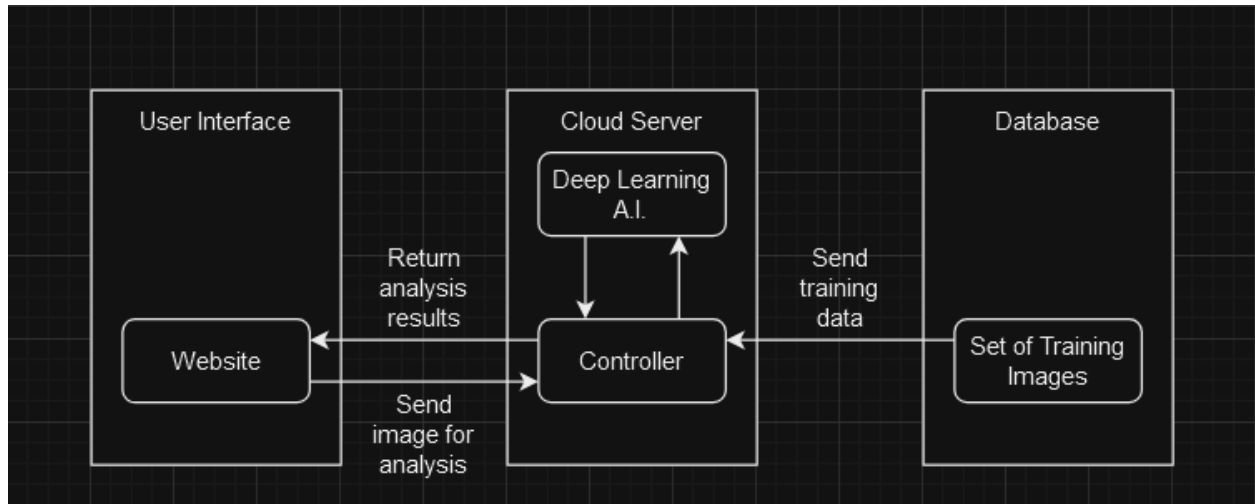
Functionality

Our design will operate on a computer or handheld device. A healthcare professional will upload a photo of an area of skin, and the application will say whether or not it predicts skin cancer is present in the area.

Right now our current design supports most of our functional requirements, such as being able to interact with a user interface and receive corresponding data. As for non-functional requirements the design doesn't support any one particular non-functional requirement as of now, but as we work on the project, we'll figure out ways to implement them, such as performance, security, usability, etc.

4.7.2 Design 1 (Design Iteration)

Design Visual and Description



From our initial design we found that it was sufficient enough to proceed onto our second design unchanged, but we anticipate that we'll be adding more onto the design as time goes on.

NOTE: The following sections will be included in your final design document but do not need to be completed for the current assignment. They are included for your reference. If you have ideas for these sections, they can also be discussed with your TA and/or faculty adviser.

4.8 Technology Considerations

Highlight the strengths, weakness, and trade-offs made in technology available.

Discuss possible solutions and design alternatives

4.9 Design Analysis

- Did your proposed design from 4.7 work? Why or why not?
- What are your observations, thoughts, and ideas to modify or iterate further over the design?