# High Level Design (HLD)

## Thyroid Disease Detection

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## Abstract

Thyroid disease is a common cause of medical diagnosis and prediction, with an onset that is difficult to forecast in medical research. The thyroid gland is one of our body's most vital organs. Thyroid hormone releases are responsible for metabolic regulation. Hyperthyroidism and hypothyroidism are one of the two common diseases of the thyroid that releases thyroid hormones in regulating the rate of body's metabolism. The machine learning plays a decisive role in the process of disease prediction and this paper handles the analysis and classification models that are being used in the thyroid disease based on the information gathered from the dataset taken from UCI machine learning repository.

# 1 Introduction

## 1.1 Why this High-level Design document?

High-level design (HLD) explains the architecture that would be used to develop a system. The architecture diagram provides an overview of an entire system, identifying the main components that would be developed for the product and their interfaces. The HLD uses possibly nontechnical to mildly technical terms that should be understandable to the administrators of the system.

The HLD will -

- Present all of the design aspects and define them in detail.
- Describe the user interface being implemented.
- Describe the hardware and software interfaces.
- Describe the performance requirements.
- Include design features and the architecture of the project.
- List and describe the non-functional attributes like:
    - Security
    - Reliability
    - Maintainability
    - Portability
    - Reusability
    - Application compatibility
    - Resource utilization
    - Serviceability

## 1.2 Scope

The HLD documentation presents the structure of the system, such as the database architecture, application architecture (layers), application flow (Navigation), and technology architecture. It uses non-technical to mildly-technical terms which should be understandable to the administrators of the system.

# 2 General Description

## 2.1 Product perspective:

The Thyroid Disease Detection solution system is a data science-based machine learning model which help us to detect the thyroid disease in people and take necessary action.

## 2.2 Problem Statement:

To create an AI solution for detecting thyroid disease and to implement the following use cases.

- To detect thyroid disease and its type in healthy person.
- To detect thyroid disease and its type in healthy person.

To detect thyroid disease and its type in unhealthy person.

Here unhealthy person means person already affected by thyroid disease.

## 2.3 Proposed Solution:

The solution proposed here is a data science model based on machine learning can be implemented to perform above mention use cases. In first use case , we will take input from a healthy person who is not suffering from thyroid disease and see whether proposed solution is going to detect it or not. And in second use case, we will take input

from an unhealthy person, already suffering from thyroid disease and check our solution whether it is performing or not in right way.

## 2.4 Further Improvements:

The Thyroid disease detection solution can be added with more use cases in health care domain. Thyroid Disease Detection solution can

also be synchronized with other health care domain solution to give one step extra confirmation of health to those people who has little symptoms of thyroid disease also.

## 2.5 Technical Requirements:

The primary requirement is a device through which our solution can be accessed. Our solution is deployed locally.

## 2.6 Data Requirements:

Data requirement completely depend on our problem statement.

we need data of people who have already gone with thyroid blood test to know whether they are suffering from thyroid disease or not. If yes then what kind of thyroid disease they are suffering from. We will be required these many attributes, in which some will be personal details and some will be attributes from blood test.

• Age: Because thyroid depend on age, older than 60, especially in women.

• Gender: A woman is about five to eight times more likely to be diagnosed with a thyroid condition than a man.

• People already on thyroxin treatment or not.

• People already on anti thyroid medication or not.

• Pregnancy if gender is female: Postpartum thyroiditis is a condition occurs in 5% to 9% of women after childbirth.

• Whether person is sick at the time of diagnosis.

• Iodine test: Excess and low amount both can cause thyroid disease.

• Lithium test: Lithium is concentrated by the thyroid and inhibits thyroidal iodine uptake.

• Goitre test: A goitre can sometimes occur when your thyroid gland produces too much thyroid hormone

(hyperthyroidism).

• Tumour test: Thyroid cancer occurs when cells in your thyroid undergo genetic changes (mutations). The mutations allow the cells to grow and multiply rapidly. The cells also lose the ability to die, as normal cells would. The accumulating abnormal thyroid cells form a tumour.

• TSH level measure: It supervise thyroid gland, TSH released by pituitary gland. Normal TSH range for an adult:

• 0.40 - 4.50 mIU/mL (milli-international units per litre of blood).

• T3 level measure: Hormone released by thyroid, should be in normal range.

• T4 level measure: Low T4 is seen with hypothyroidism, whereas high T4 levels may indicate hyperthyroidism. Normal T4 range for an adult: 5.0 – 11.0 ug/dL (micrograms per decilitre of blood).

• FTI(Free T4 or Free Thyroxine) : The free T4 index (FTI) is a blood test used to diagnose thyroid disorders. The FTI is obtained by multiplying the (Total T4) times (T3 Uptake) to obtain an index. Normal FT3 range: 2.3 - 4.1 pg/mL (picograms per millilitre of blood).

• Thyroxine-binding globulin (TBG): The TBG blood test measures the level of a protein that moves thyroid hormone throughout your body. In all the above mentioned attributes if attribute is having binary answer then we need it in Boolean and for measures we need them in float values.

## 2.7 Tools Used:

Python programming language and frameworks such as NumPy, Pandas, Scikit-learn, Flask are used to build the model.


- Jupyter notebook, PyCharm, Visual Studio Code are used as IDE.

- Python is used as our programming language.
- HTML is used to design our frontend.
- Pandas, NumPy and Scikit-learn are used for data processing.
- Flask API is used to integrate our backend with our frontend.
- GitHub is used to store our code.
- Matplotlib and seaborn are used to visualize our data.

## 2.8 Constraints:

The Thyroid disease detection solution should be user friendly, as automated as possible and users should not be required to know any of the workings.

## 2.9 Assumptions:

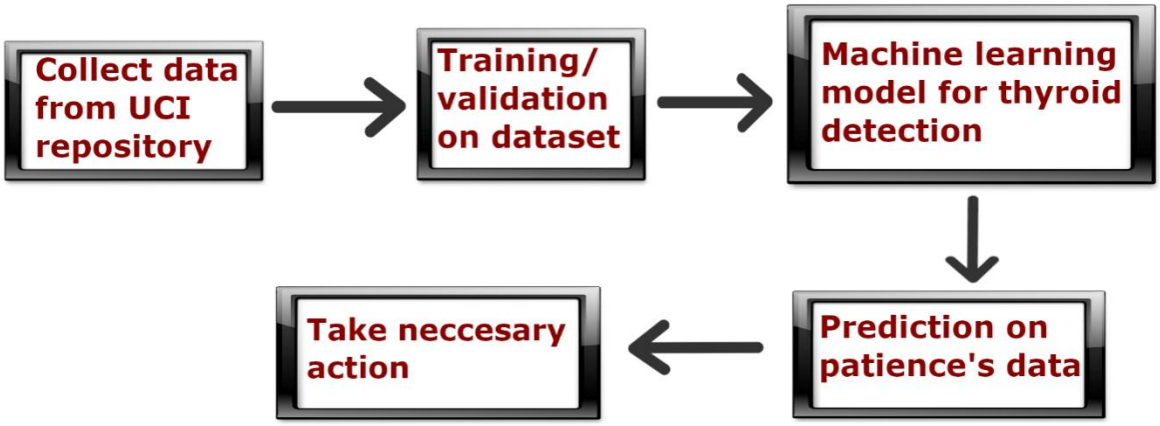
The main objective of the project is to implement the use cases as previously mentioned for new dataset that comes through Hospitals which has this solution install in their campus to capture people reports.

# 3 Design Details

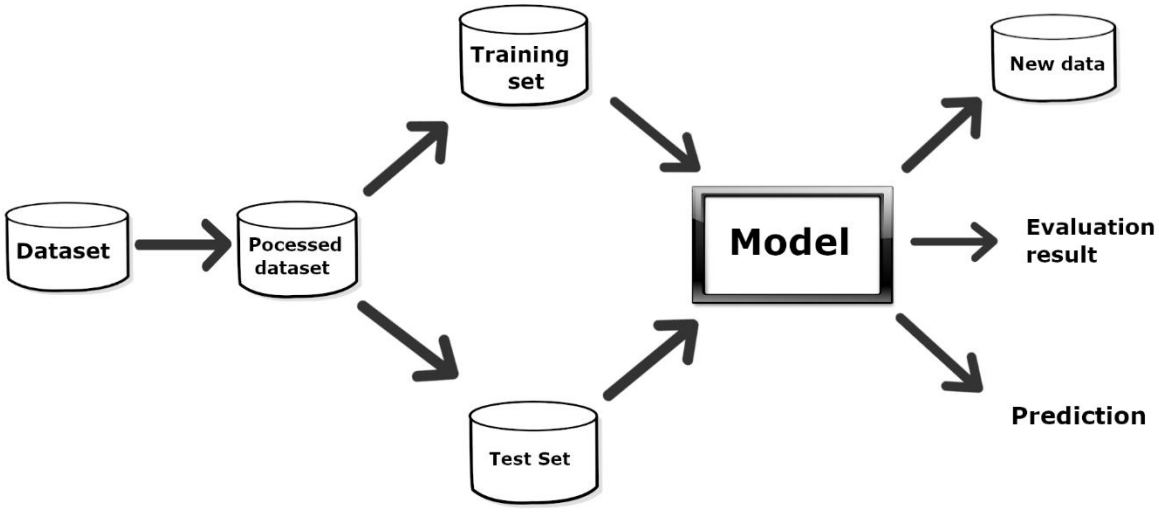
## 3.1 Process Flow

For identifying thyroidal diseases, we will use a machine learning based model. Below is the process flow diagram shown below.

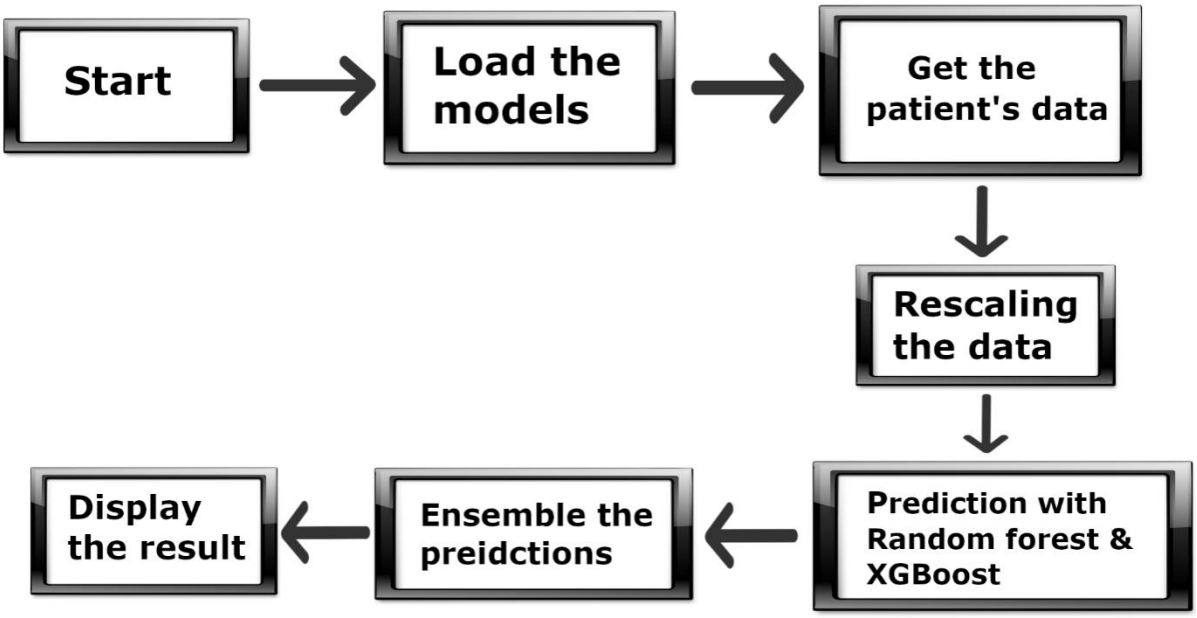
## Proposed methodology




### 3.1.1 Model training and Evaluation



### 3.1.2 Deployment process




## 3.2 Event Log

The system should log every event so that the user will know what process is running internally.

Initial step by step description:

- The system identifies at what step logging is required
- The system should be able to log each and every system flow
- Developer can choose logging method. You can choose database logging or file logging.
- System should not hang even after using so many logging. Logging just because we can easily debug issues so logging is mandatory to do.

## 3.3 Performance

Thyroid disease detection solution is used for detection of thyroid disease in patience based on the amount of hormones present in blood. This will help the medical team in diagnosing thyroidal disease in patience by minimizing human error and increasing efficiency. Also, model retraining is very important to improve the performance.

## 3.4 Reusability

The code written and the components used should have the ability to be reused with no problems.

## 3.5 Application Compatibility

The different components for this project will be using Python as an interface between them. Each component will have its own risk task to perform, and it is the job of the Python to ensure proper transfer of information.

## 3.6 Resource Utilization

When any task is performed, it will likely use all the processing power available until that function is finished.

# 4 Conclusion

Thyroid Disease Detection solution will take health-care domain data of those patients who have undergone diagnosis for thyroid to train our machine learning model and will evaluate its performance over

use cases mentioned above. And then leverage its prediction to detect thyroid disease in people having symptoms of thyroid and able to alert people who is on positive side so that medical attention along with treatment will be given to that particular people as soon as possible. This solution should be as accurate as possible, so that chances of misleading reports will be taken good care of.

## 5 References

1. https://archive.ics.uci.edu/ml/datasets/thyroid+disease
2. Google.com for images