ICD DETECTION AND RECOMMENDER SYSTEM

Final Year Project Report

B.S. in Software Engineering

By

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2022-2023

DEPARTMENT OF SOFTWARE ENGINEERING

Sir Syed University of Engineering and Technology

Preface

The purpose of this project is to design a machine that can analyze, monitor, and alert Impulse Control Disorder and Body-Focus Repetitive Behavior to analyze the cause of performing that gesture and recommend a possible therapy.

With the ever-rising mental illnesses and disorders around the world, we aim to detect the symptoms of such illnesses through the machine, which will work by detecting the Body-Focus Repetitive Behavior that might be the cause of such illnesses. So that they can be identified and treated. The device will make use of Artificial Intelligence which is on the rise and machine learning is one of the most successful fields with great success in face recognition, image classification, and so on.

As we know, the world is still learning the importance of mental health and how it is so important to address the issue so that it can be treated instead of silently suffering from it and taking any extreme step when it becomes unbearable.

Especially in our region where there is very little awareness regarding the importance of mental health and how to address and detect it. This device aims to play a major role in raising awareness and detecting the illness and suggesting a possible remedy.

Impulse Control Disorder (ICD) and Body-Focus Repetitive Behavior (BFRBs) are unwanted habits and actions that can produce self-harming. These conditions trigger stressful situations and most of the time are subconscious, making the person unable to control their execution. ICDs are prevalent in the younger population of children and adolescents and can be controlled by continuous monitoring and nursing.

Acknowledgments

"We would like to express our sincere gratitude to all those who have contributed to the success of our ICD ML project. From the technical team who worked tirelessly to bring our vision to life, to the advisors (Sir Danish Jameel) and mentors (Sir Danish Jameel) who provided invaluable guidance and support, this project would not have been possible without your efforts.

Special thanks go out to our stakeholders who believed in us and supported us every step of the way. Your confidence in our abilities and unwavering support were a source of inspiration and motivation for us all.

Finally, we would like to acknowledge the tremendous impact of machine learning on the field of ICD coding and the positive impact it will have on healthcare as a whole. Thank you all for being a part of this exciting and groundbreaking project."

Introduction to Group Members

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CERTIFICATE OF COMPLETION

This is to certify that the following students

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Have successfully completed the requirements for Final Year Project titled

ICD DETECTION AND RECOMMENDER SYSTEM

In the report submission for the Degree of Bachelor of Science in Software Engineering

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Abstract

Performance evaluation of a machine learning model for impulse control disorders (ICD) would involve measuring the model's accuracy, precision, recall, and F1-score on a holdout dataset. Other evaluation metrics such as specificity, sensitivity, AUC-ROC, and precision-recall curves could also be used.

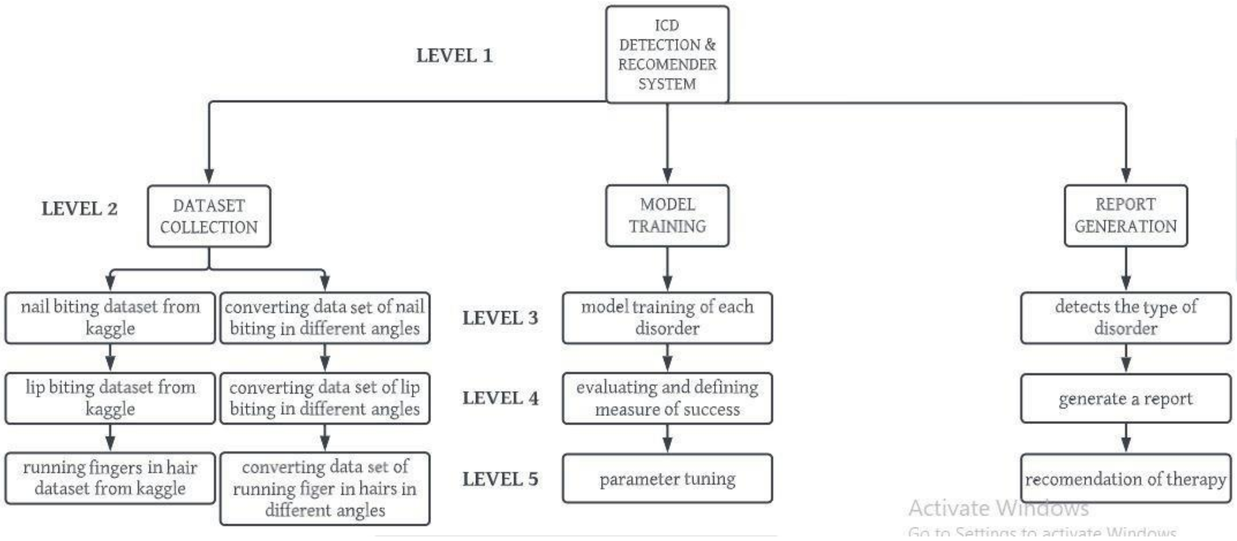
Additionally, the model's performance could be evaluated using real-world clinical data, if available, to determine its effectiveness in a real-world setting. This could involve comparing the model's predictions to the actual diagnosis made by a clinician, and measuring the model's accuracy and other performance metrics in this context.

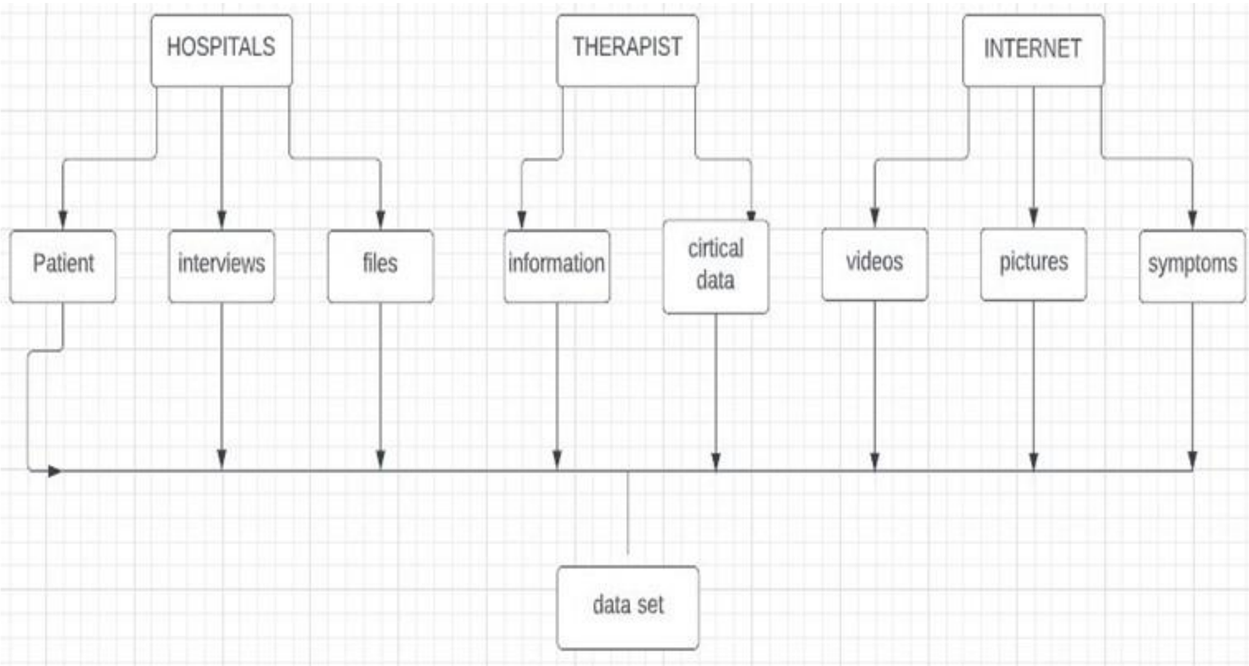
It's important to note that performance evaluation should be conducted on multiple datasets and with multiple evaluation metrics to obtain a comprehensive understanding of the model's performance.

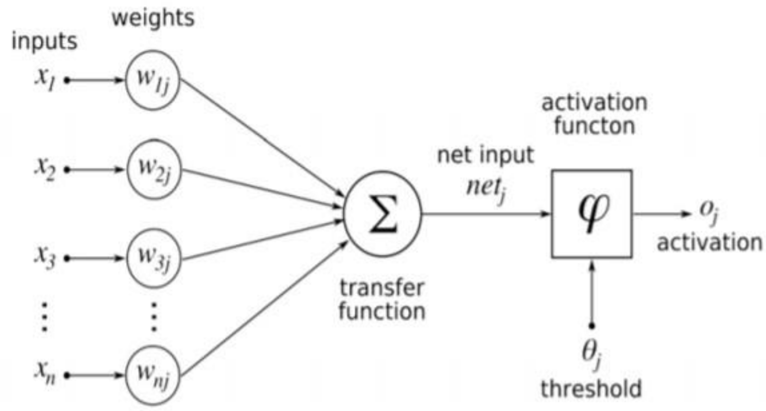
The model's performance should also be evaluated over time as new data becomes available, to ensure that it continues to perform well as the underlying data patterns change.

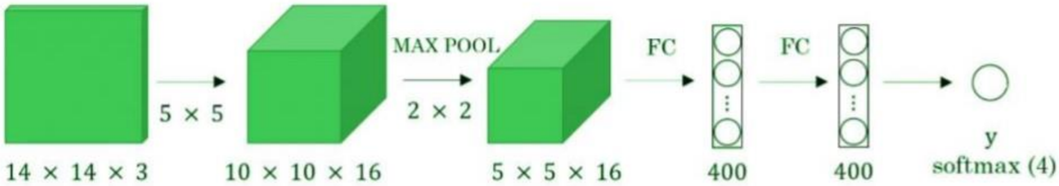
It is also important to evaluate the model in terms of its explain ability and interpretability. This is important for medical applications as the ability to explain the model's predictions to clinicians and patients is crucial for its adoption and trust.

List of Figures









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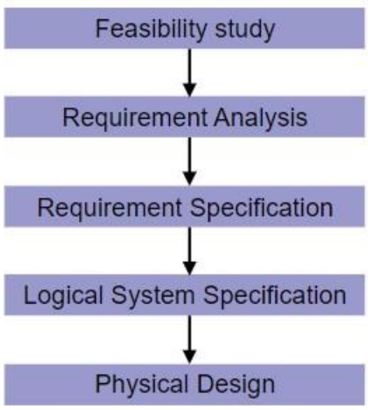

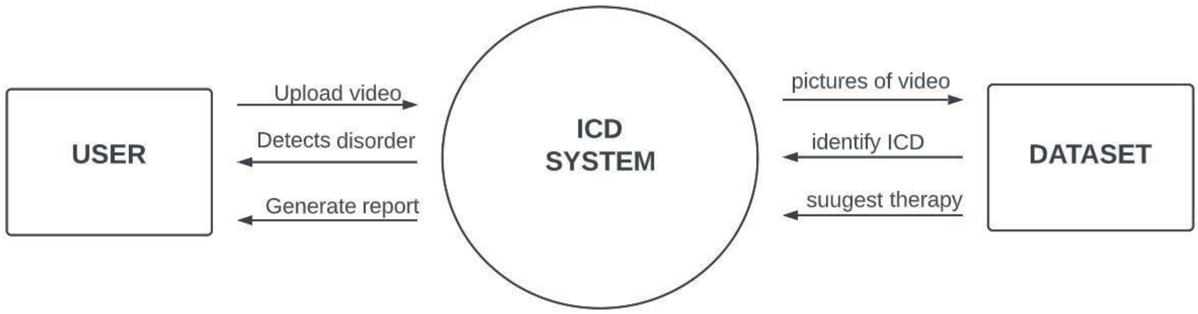
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Generate report
ICD
SYSTEM
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identify ICD
suugest therapy
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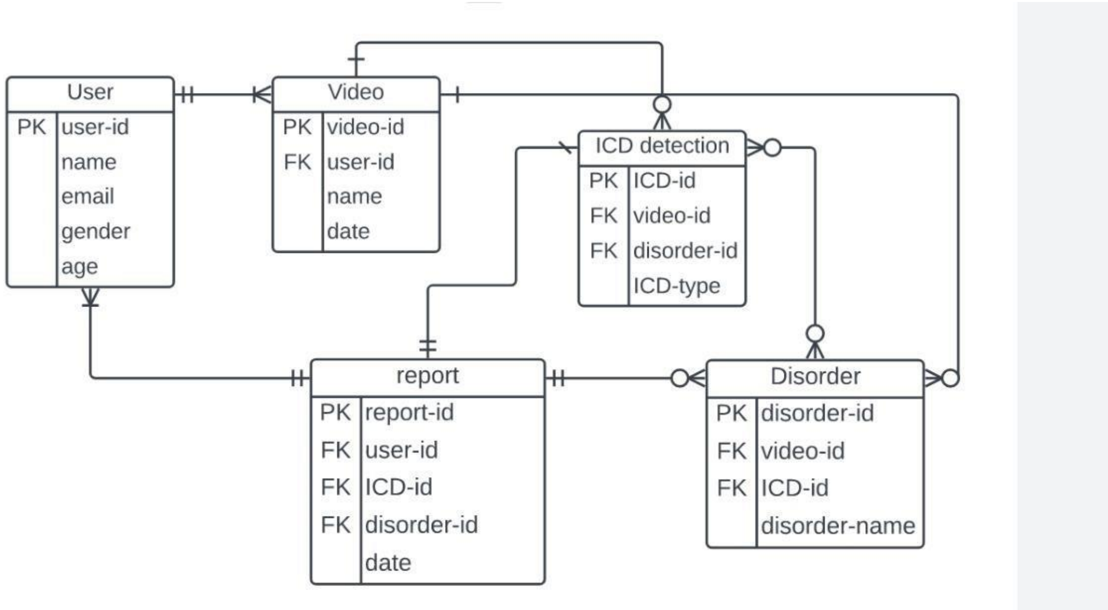
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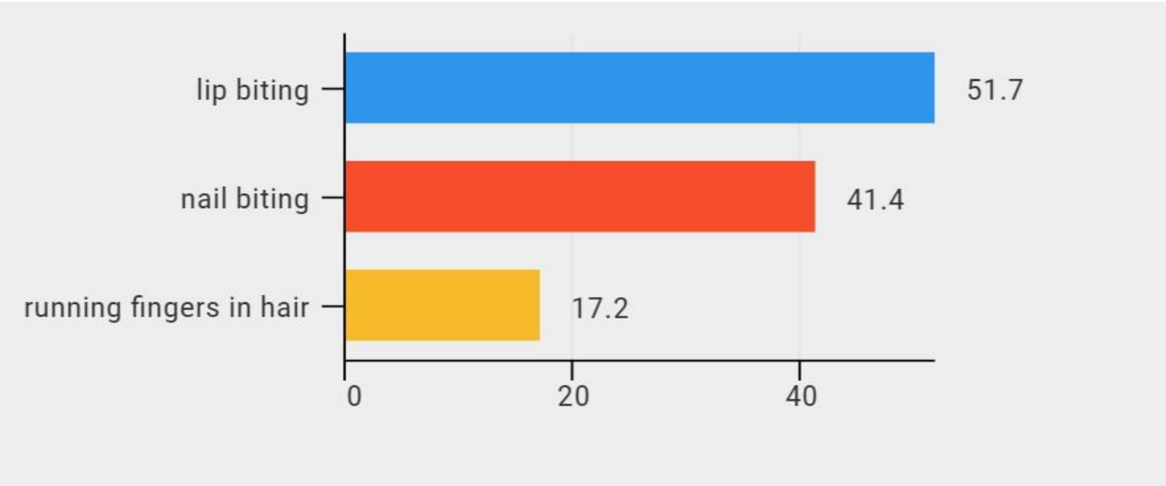
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running fingers in hair
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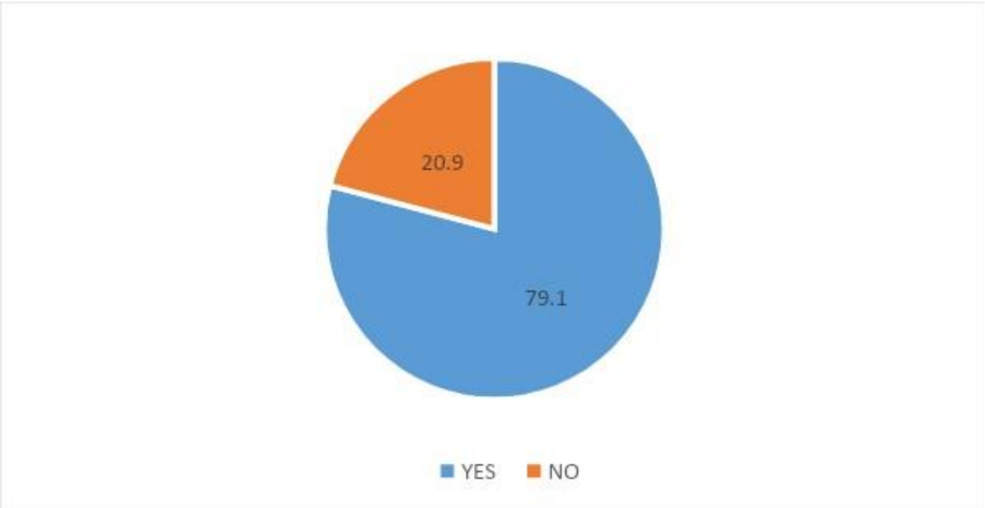
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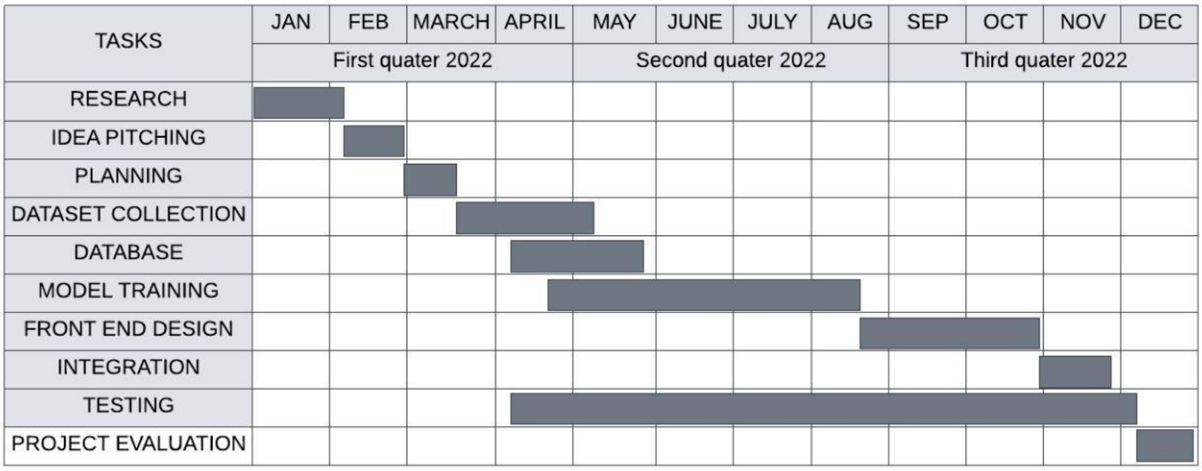


Chapter 1

Introduction

1.1 Overview

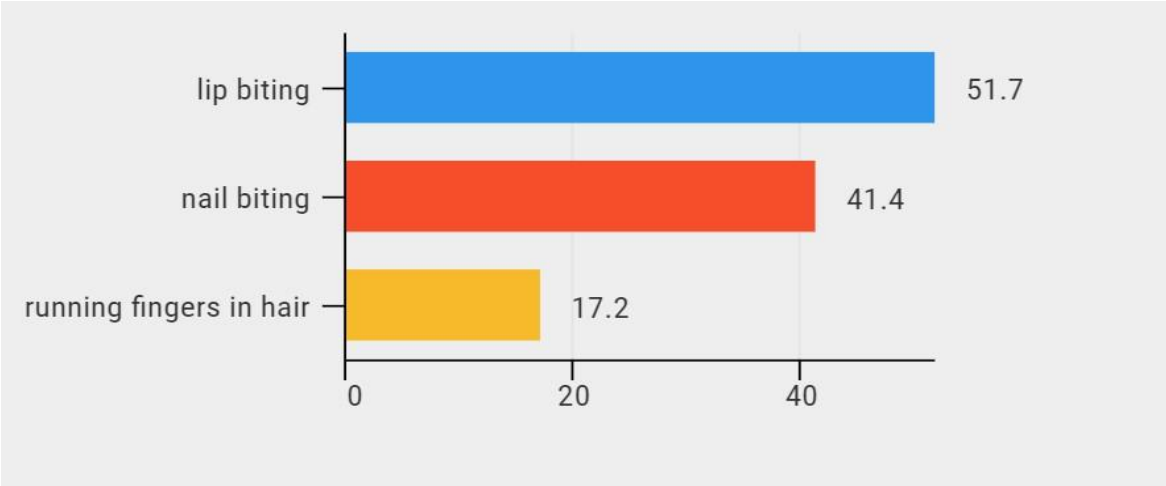
The purpose of this project is to design a machine that can analyze, monitor, and alert Impulse Control Disorder and Body-Focus Repetitive Behavior to analyse the cause of performing that gesture and recommend a possible therapy

1.2 Problem Statement

- With the ever-rising mental illnesses and disorders around the world, we aim to detect the symptoms of such illnesses through the machine, which will work by detecting the Body-Focus Repetitive Behavior that might be the cause of such illnesses. So that they can be identified and treated. The device will make use of Artificial Intelligence which is on the rise and machine learning is one of the most successful fields with great success in face recognition, image classification and so on

- As we know, the world is still learning the importance of mental health and how it is so important to address the issue so that it can be treated instead of silently suffering from it and taking any extreme step when it becomes unbearable.

- Especially in our region where there is very little awareness regarding the importance of mental health and how to address and detect it. This device aims to play a major role in raising awareness and detecting the illness and suggesting a possible remedy



1.3 Objectives

The objectives envisioned for this project are:

- To create an application that can identify body-focused repetitive behaviors.
- To classify two or more classes of ICD
- To analyze the gesture and diagnose the possible disorder if there is any.
- To recommend possible therapies for that particular disorder.

1.4 System Features

- This system will process the video and split it into the 0.05-sec frame.
- Then the system will compare the input with the data set.
- CNN Algorithm will be used for image processing.
- For all three factors we will prepare our own data set and train the system on those factor's data sets.
- This system will then analyze the reason for performing those gestures.

- Moreover the system will also recommend the therapies (for example Psychoanalysis and psycho dynamic therapies, Behavior therapy, Cognitive therapy, Humanistic therapy, and Integrative or holistic therapy) considering the reason for performing those gestures.

- The Report comprising of Analysis and therapy recommendation will be generated.

1.5 Project Scope

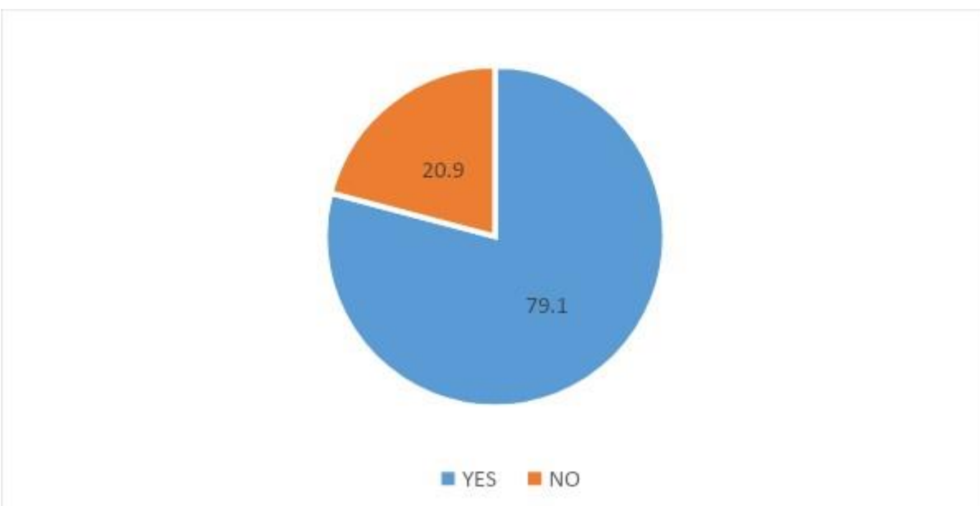
Impulse Control Disorder (ICD) and Body-Focus Repetitive Behavior (BFRBs) are unwanted habitual actions that can produce self-harming. These conditions trigger stressful situations and most of the time are subconscious, making the person unable to control their execution. ICDs are prevalent in the younger population of children and adolescents and can be controlled by continuous monitoring and nursing.

ICD gestures are:

- Nail Biting

- Lip Biting

- Playing with fingers or running fingers in hair



1.6 Chapter Summary

Chapter 2

Literature Review

Impulse control disorder (ICD) is a group of mental health conditions characterized by the inability to resist impulsive behaviors that can harm oneself or others. ICDs include conditions such as kleptomania (the recurrent failure to resist impulses to steal objects), pyromania (the recurrent failure to resist impulses to set fires), and trichotillomania (the recurrent failure to resist impulses to pull out one's hair). Other ICDs that have been identified in the literature include intermittent explosive disorder, compulsive buying disorder, and pathological gambling.

ICDs have been found to have a strong association with other mental health conditions such as depression, anxiety, and substance use disorders. Studies have also found that ICDs are more common in individuals with certain neurological conditions, such as Parkinson's disease, and in those with a history of trauma or abuse.

Research has also found that people with ICDs have an altered functioning in the brain's reward system, which is thought to be involved in regulating impulsive behavior. Studies have shown that impulse control disorders are associated with changes in the activity of certain neurotransmitters, such as dopamine and serotonin, which play important roles in regulating mood, motivation, and impulse control.

Treatment for ICDs typically includes a combination of cognitive-behavioral therapy, medication, and other therapies such as dialectical behavior therapy (DBT), and acceptance and commitment therapy (ACT). Medications that have been found to be effective in treating ICDs include antidepressants, antipsychotics, and mood stabilizers. Some studies have also found that neurofeedback and mindfulness-based interventions may be beneficial in treating ICDs.

Overall, research on ICDs is limited, but suggests that it is a serious mental health condition that can have a significant impact on the individual's quality of life. People with ICDs may experience significant distress, difficulties in social and occupational functioning, and even legal problems. More research is needed to better understand the causes of ICDs and to develop more effective treatments for those affected.

Chapter 3

Design

3.1 Design Methodology and Software Process Model

The design methodology and software process model for a machine learning project focused on impulse control disorders (ICD) would likely include several key steps and considerations.

Problem definition: The first step would be to clearly define the problem and objectives of the project. This might involve identifying specific ICDs to be targeted, as well as the population or groups that the model will be applied to.

Data collection and preprocessing: The next step would be to collect and preprocess relevant data for the project. This might include gathering data on individuals diagnosed with ICDs, as well as control groups, and preprocessing the data to ensure it is ready for analysis.

Feature selection and engineering: This step would involve selecting and engineering the features that will be used to train the model. This might involve identifying relevant demographic, clinical, and behavioral features that have been found to be associated with ICDs in previous research.

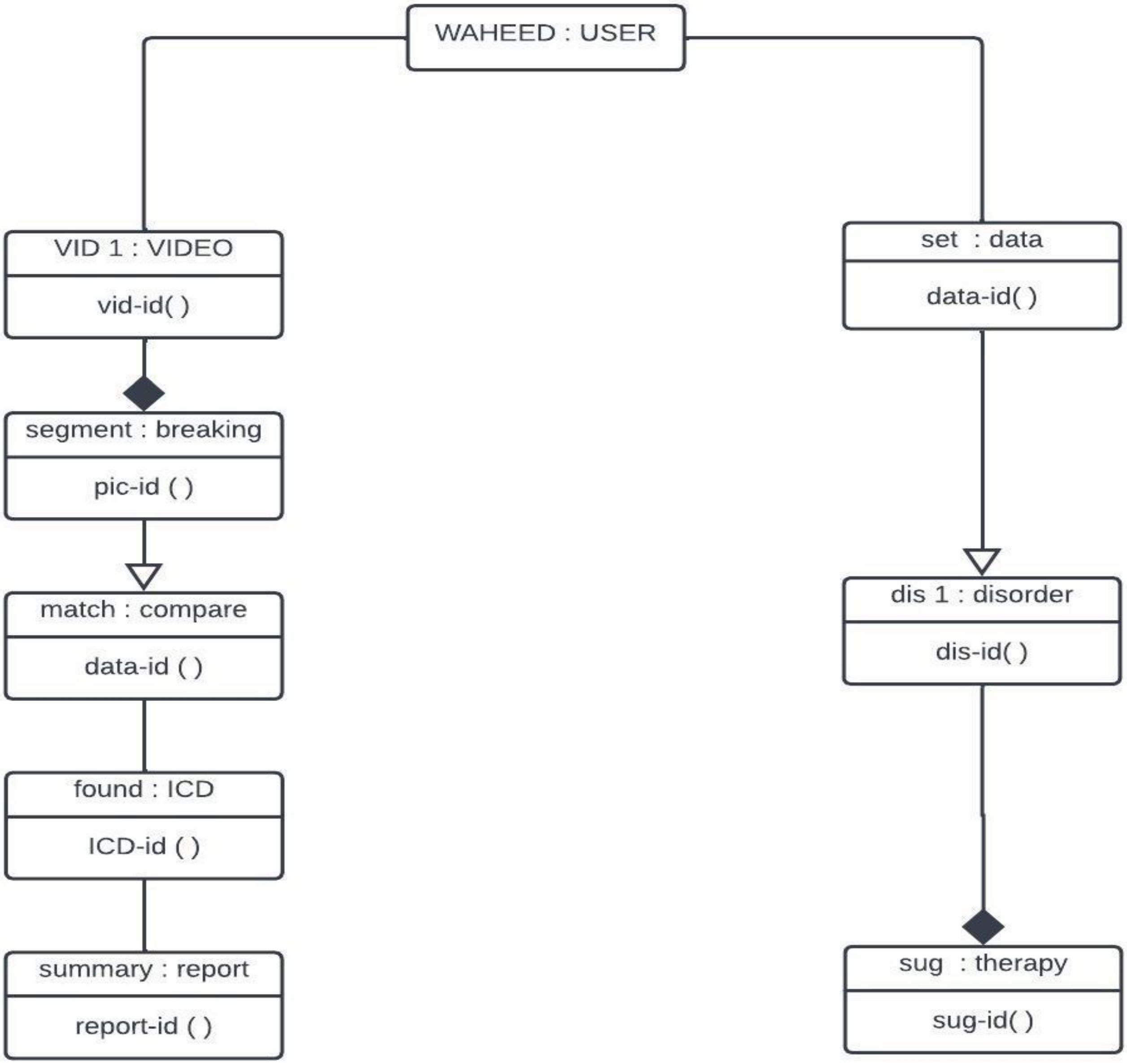
Model selection and training: This step would involve selecting an appropriate machine learning algorithm and training the model using the preprocessed and engineered data. The selection of the model could depend on characteristics of the data, the aim of the project, and the resources available.

Model evaluation: The model would then be evaluated using various metrics such as accuracy, precision, recall, F1-score, ROC-AUC, etc. to evaluate its performance and identify areas for improvement.

Model deployment: Once the model has been trained and evaluated, it can be deployed for practical use, for example, in a clinical setting to help diagnose and treat individuals with ICDs.

Maintenance: Regular monitoring and maintenance of the model would be necessary to ensure that it continues to perform well and adapt to changing data patterns. This could involve re-training the model with new data, fine-tuning the model's parameters, or updating the features used in the model.

The software process model that could be used for this type of project is the CRISP-DM (Cross-Industry Standard Process for Data Mining) which is a widely accepted process model in the field of data science and machine learning. It consists of six phases: Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation and Deployment.



3.2 Architectural design / Design Patterns

The architectural design and design patterns for a machine learning project focused on impulse control disorders (ICD) would likely include several key elements.

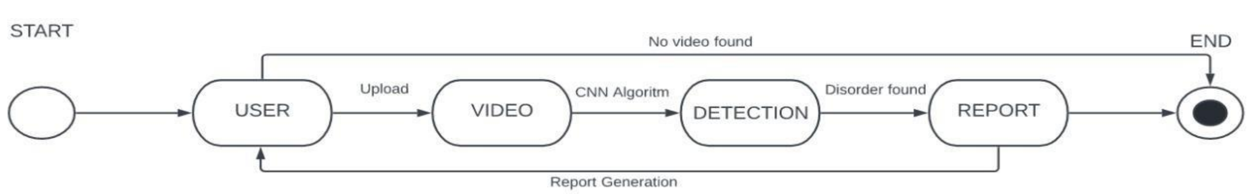
Data pipeline: The project would likely include a data pipeline that ingests and preprocesses data from various sources such as electronic health records, clinical notes, and surveys. This pipeline would be responsible for cleaning, transforming, and normalizing the data before it is used to train the model.

Model training and validation: The project would include a system for training and validating machine learning models using the preprocessed data. This system would include the necessary infrastructure and tools for selecting and tuning the model, as well as evaluating its performance.

Model deployment: Once the model has been trained and validated, it would be deployed to be used in a production environment. The model could be deployed in a web-based interface or integrated into an existing clinical system.

Monitoring and maintenance: The project would include a system for monitoring and maintaining the model over time. This would include regular retraining of the model with new data, updating the features used in the model, and fine-tuning the model's parameters.

Security and privacy: The project would include measures to ensure that the data used for training and deploying the model is kept secure and private. This might include encrypting sensitive data, using secure communication protocols, and implementing access controls.



Some of the design patterns that could be used in this project include:

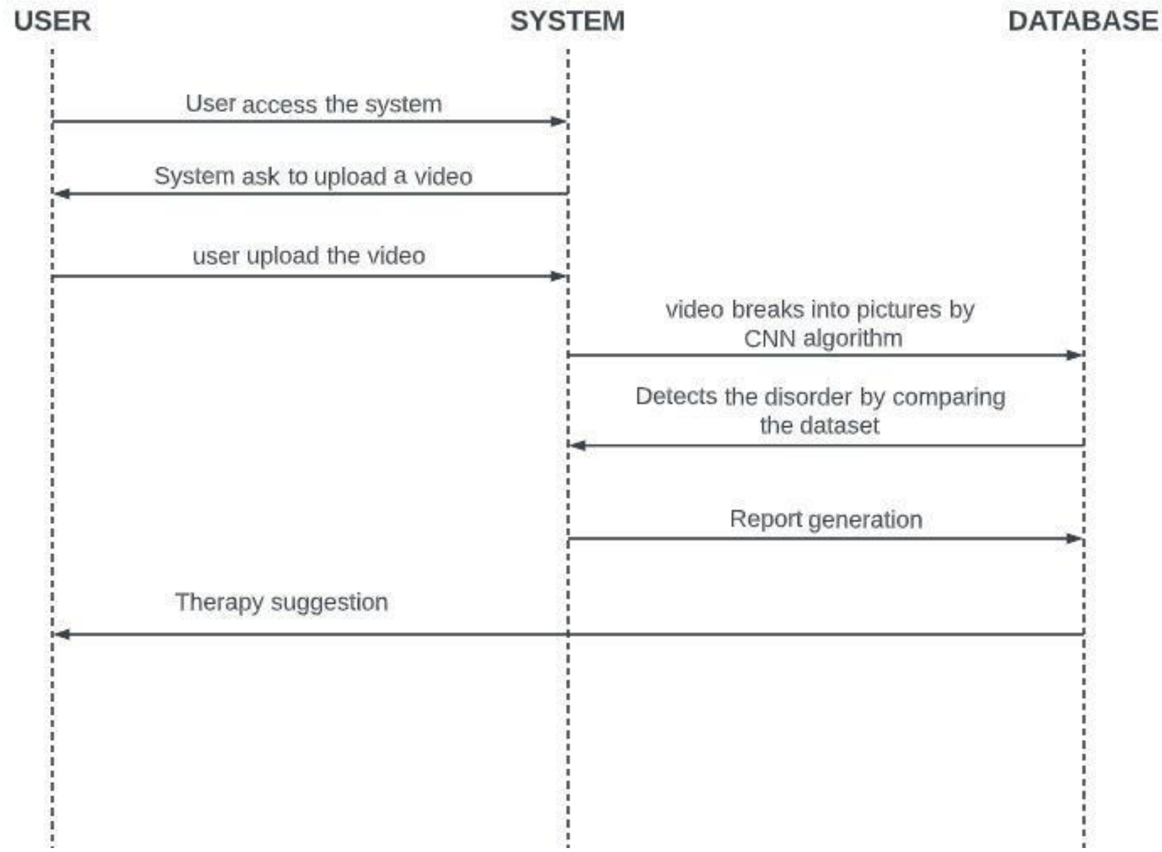
Micro services architecture: This design pattern would allow the project to be broken down into smaller, independently deployable services, each with a specific responsibility. This would make the system more scalable and resilient.

Event-driven architecture: This design pattern would allow different components of the system to communicate and respond to events in real-time, making the system more responsive and adaptable to changing conditions.

Containerization: This design pattern would allow the project to be deployed as a set of portable, lightweight containers. This would make it easier to deploy and manage the system in different environments.

Ensemble modeling: This design pattern would allow multiple models to be combined to improve performance and robustness.

These architectural design and design patterns will be subject to change based on the specific requirements of the project and the resources available.



3.3 Process flow / Representation

The process flow or representation of a machine learning project focused on impulse control disorders (ICD) would likely include several key stages.

Data collection: The process would begin by collecting relevant data from various sources such as electronic health records, clinical notes, and surveys. This data would be used to train and validate the model.

Data preprocessing: The collected data would then be preprocessed to ensure that it is ready for analysis. This would involve cleaning and normalizing the data, as well as selecting and engineering the features that will be used to train the model.

Model training: The preprocessed data would then be used to train a machine learning model. This would involve selecting an appropriate algorithm and tuning the model's parameters to optimize its performance.

Model validation: The trained model would then be validated using a holdout dataset to ensure that it is performing well and has not overfitted to the training data.

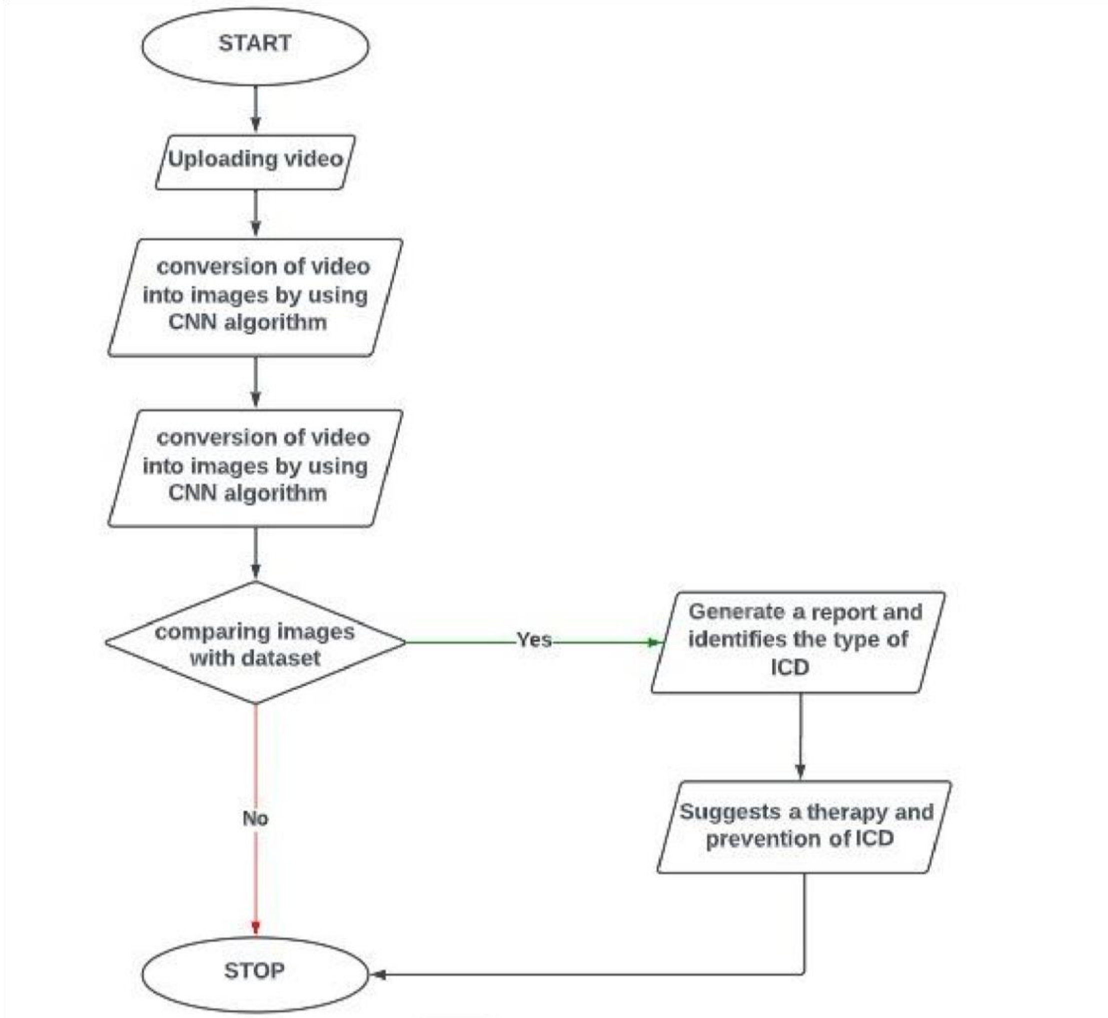
Model deployment: Once the model has been validated, it would be deployed for practical use in a clinical setting to help diagnose and treat individuals with ICDs.

Model monitoring and maintenance: The model would be regularly monitored and maintained to ensure that it continues to perform well and adapt to changing data patterns. This could involve re-training the model with new data, fine-tuning the model's parameters, or updating the features used in the model.

The process flow can be represented in a flowchart or diagram that illustrates the different stages of the process and the relationships between them. Each stage of the process flow would have different inputs and outputs, and different actions would be taken at each stage based on the inputs and outputs.

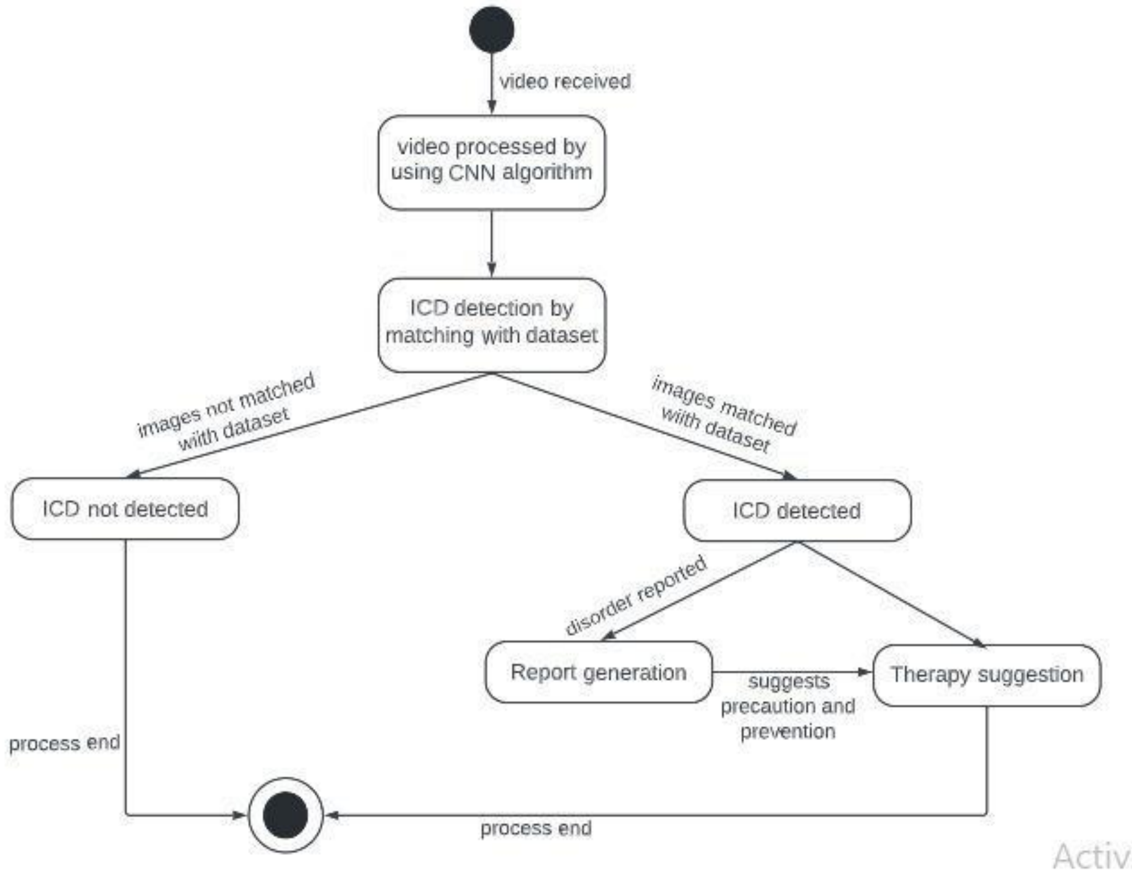
It's worth noting that the process flow can vary depending on the specific requirements of the project, the resources available, and the specific ICDs that the project is targeting.

4.3.2.3 Flow chart



3.4 Design models

There are several different machine learning models that can be used to diagnose and treat impulse control disorders (ICD). Some commonly used models include:



Decision Trees: These models use a tree structure to represent a series of decisions and their possible consequences. They can be used to classify individuals based on their symptoms and other factors, and can also be used to identify important features that are associated with a particular ICD.

Random Forest: These models are an ensemble of decision trees. The random forest algorithm creates multiple decision trees and combines them to create a more accurate and stable model. Random forests are often used for classification and regression problems.

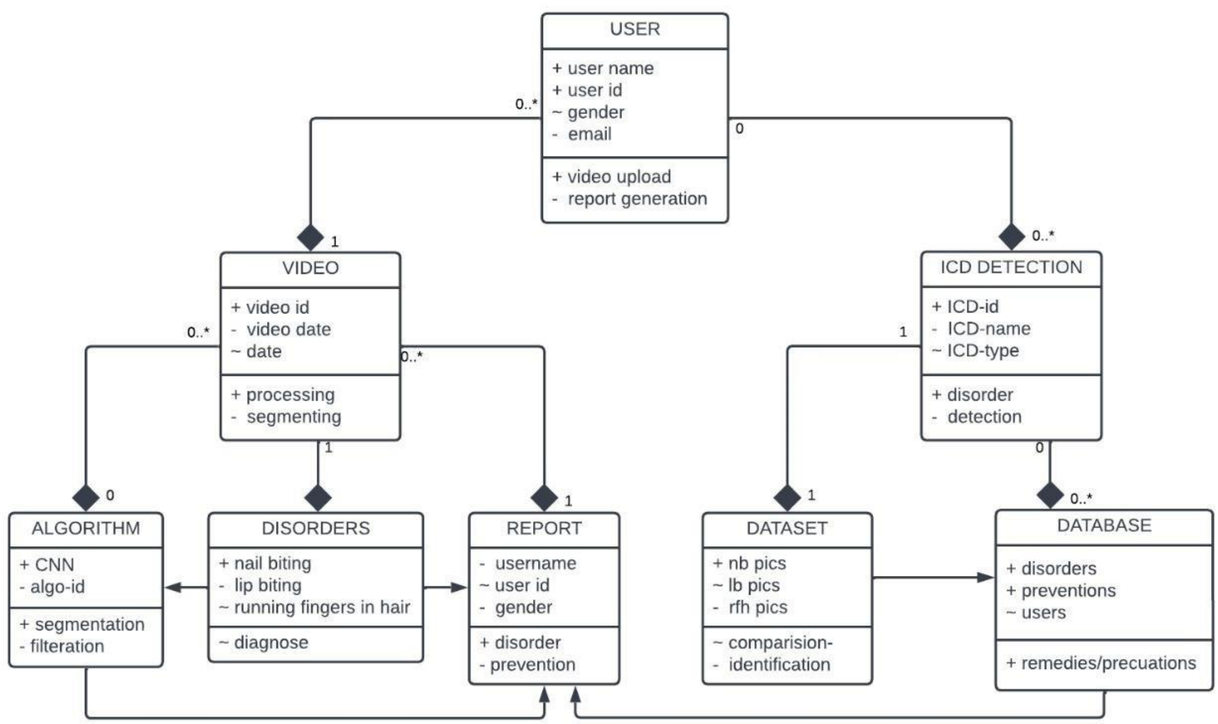
Support Vector Machines (SVMs): These models are a type of supervised learning algorithm that can be used for both classification and regression. They work by finding the best boundary (or "hyperplane") that separates different classes in the data.

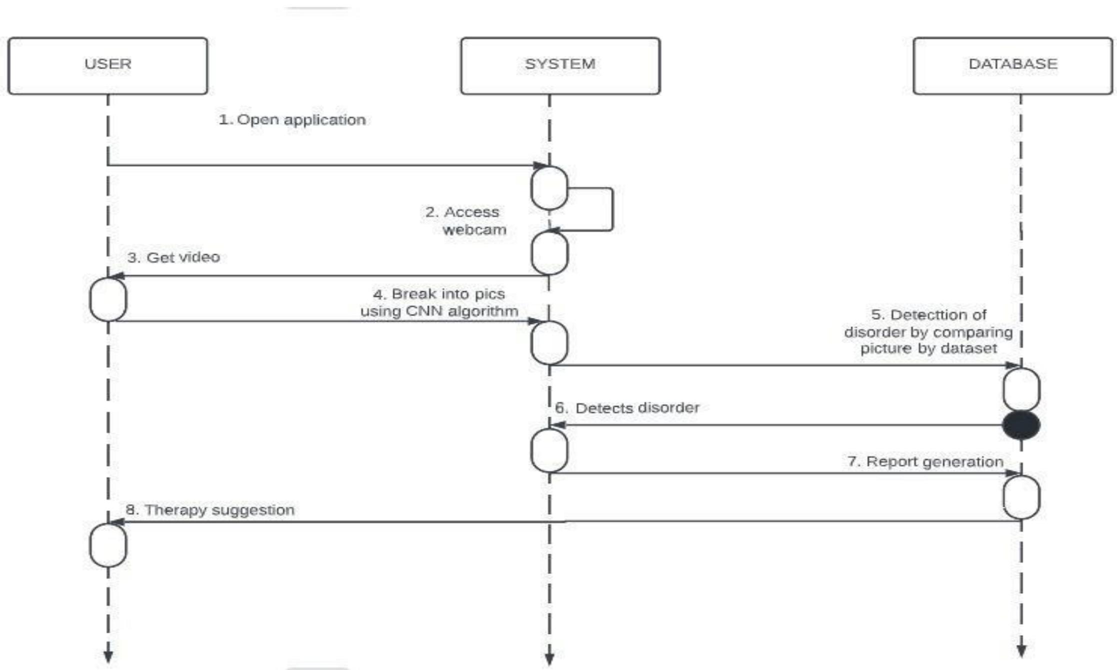
Neural Networks: These models are a type of deep learning algorithm that can be used for a wide range of tasks, including image recognition, speech recognition, and natural language processing. They are particularly useful for analyzing complex and high-dimensional data.

Recurrent Neural Networks (RNNs): These models are a type of neural network that is particularly well-suited for sequential data, such as time series data or natural language data. They have memory cells that allow the model to maintain a state across different time steps.

Long Short-Term Memory (LSTM) Networks: These models are a type of recurrent neural network that are designed to handle the long-term dependencies in the sequential data. LSTMs are particularly useful for analyzing data with long-term dependencies, such as natural language data.

These are some of the commonly used models in the field of machine learning to diagnose and treat impulse control disorders (ICD). However, the choice of a model depends on the specific requirements of the project, the resources available, and the specific ICDs that the project is targeting.





3.5 Data Design

The data design for a machine learning project focused on impulse control disorders (ICD) would involve several key elements:

Data collection: The process would begin by collecting relevant data from various sources such as electronic health records, clinical notes, and surveys. This data would be used to train and validate the model.

Data preprocessing: The collected data would then be preprocessed to ensure that it is ready for analysis. This would involve cleaning and normalizing the data, as well as selecting and engineering the features that will be used to train the model.

Data labeling: The preprocessed data would be labeled with the appropriate ICD diagnosis, this will allow the model to learn from the data and make predictions.

Data splitting: The labeled data would then be split into training, validation, and testing sets. The training set would be used to train the model, the validation set would be used to tune the model's parameters, and the testing set would be used to evaluate the model's performance.

Data storage and management: The data would be stored and managed in a way that ensures its security, privacy, and availability. This would involve using appropriate data storage and management systems and following relevant laws and guidelines.

Data visualization: The data can be visualized using various techniques, such as histograms, scatter plots, and heat maps, to help understand the patterns and relationships in the data.

It's worth noting that the data design can vary depending on the specific requirements of the project, the resources available, and the specific ICDs that the project is targeting. Additionally, the data design should consider the ethical and regulatory issues surrounding the use of machine learning in a clinical setting and to ensure compliance with relevant laws and guidelines.

3.6 Data Dictionary

A data dictionary for a machine learning project focused on impulse control disorders (ICD) would likely include several key elements:

Variable names: The names of the variables in the dataset, such as "age," "gender," and "ICD diagnosis."

Variable definitions: The definitions of the variables, including what each variable represents and how it is measured.

Variable types: The data type of each variable, such as continuous, categorical, or ordinal.

Variable ranges: The range of values that each variable can take, such as age (18-65) or gender (male, female, and other).

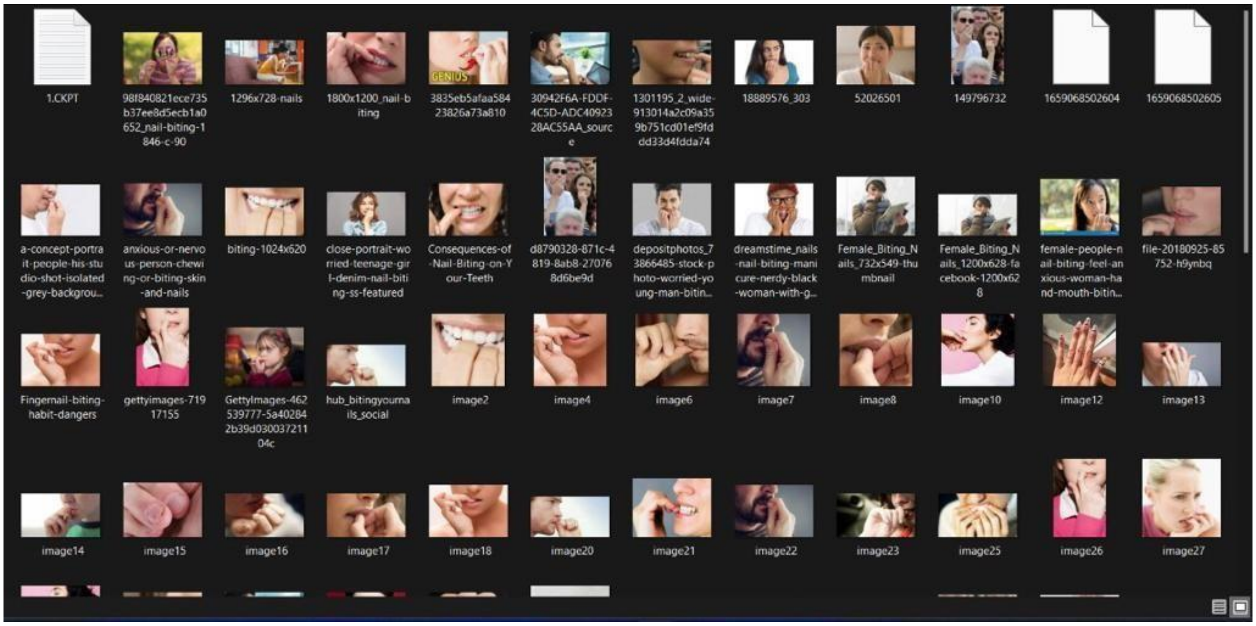
Missing data: Information on how missing data is represented in the dataset, and how it will be handled during preprocessing.

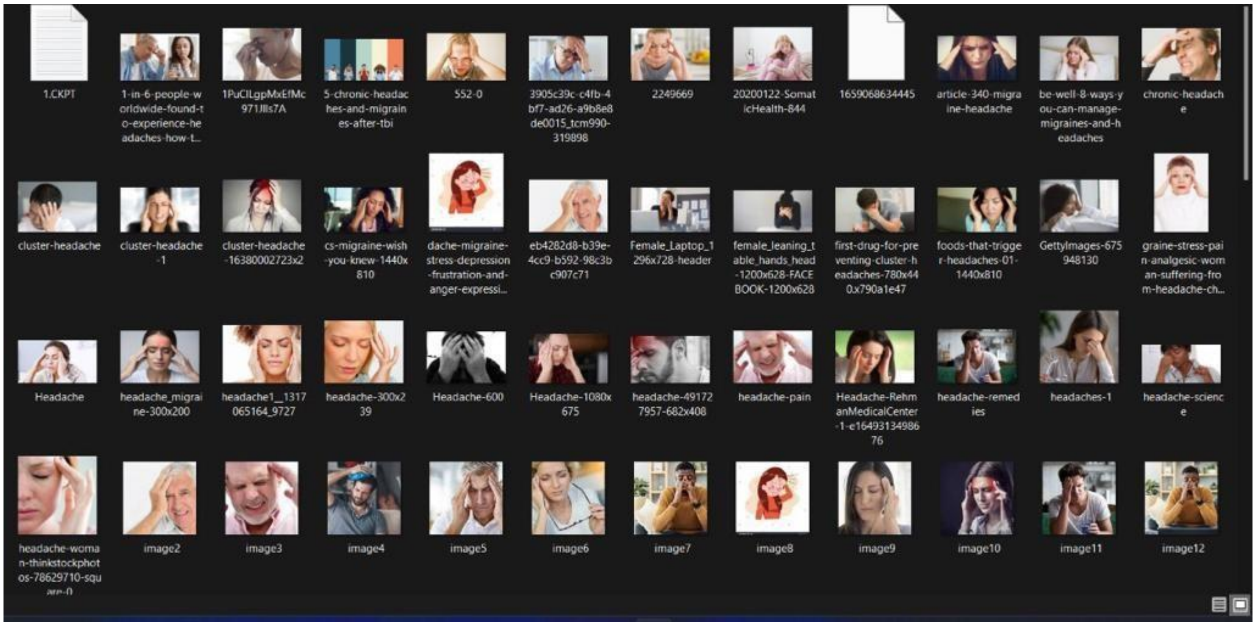
Data sources: The sources of the data, such as electronic health records, clinical notes, and surveys.

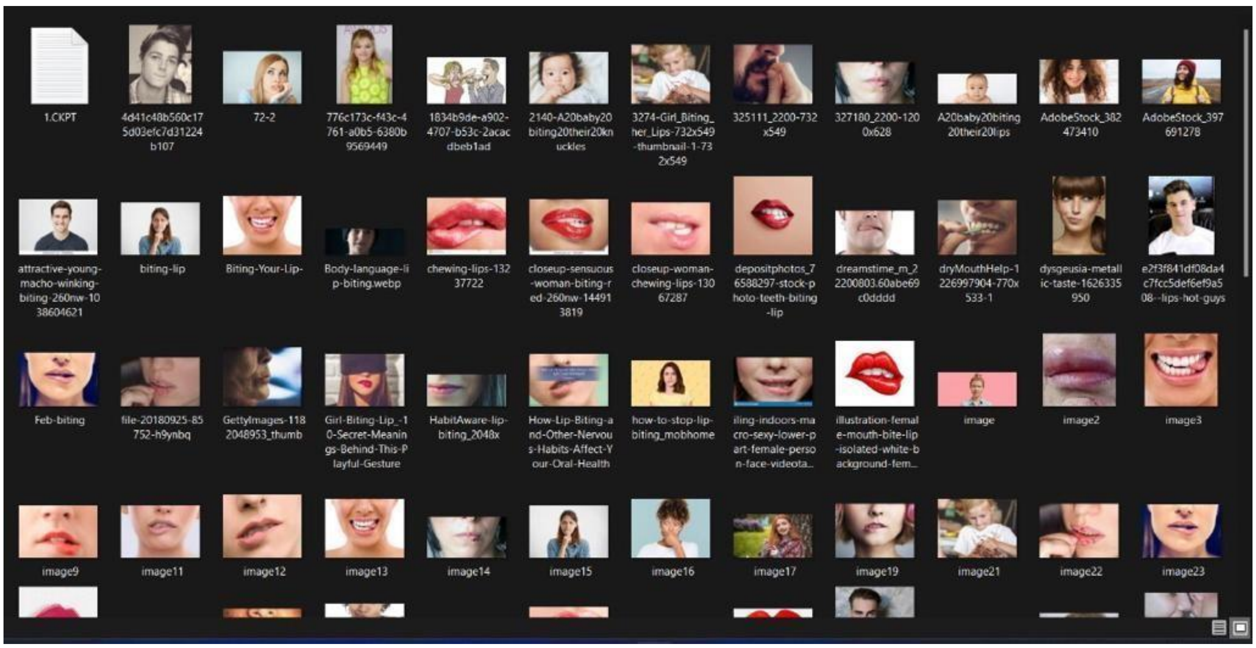
Data quality: Information on the quality of the data, such as whether it has been validated or whether it has been collected from multiple sources.

Data security and privacy: Information on how the data will be protected and kept confidential, including the measures taken to ensure the security and privacy of the data.

A data dictionary is a useful tool for documenting the data used in a machine learning project, and it can help ensure that the data is used consistently and correctly throughout the project. The data dictionary also helps to make the data more understandable for people who are not familiar with the data and the project, such as stakeholders and reviewers







3.7 Chapter Summary

ICD (International Classification of Diseases) design is a system of medical classification used to classify and code diseases, health conditions, and related health information. It is maintained by the World Health Organization (WHO) and is updated periodically to reflect advancements in medical knowledge and technology. The ICD design categorizes diseases into groups based on their causes, symptoms, and other relevant factors, making it possible to standardize data collection, analysis, and reporting on diseases and health outcomes globally. The ICD design is widely used in healthcare settings for disease management, public health surveillance, and health information management. It plays a crucial role in shaping public health policies, guiding healthcare research, and supporting effective healthcare delivery.

Chapter 4

System Development

The system development of a machine learning project focused on impulse control disorders (ICD) would likely include several key stages:

Requirements gathering: The process would begin by gathering requirements from stakeholders such as clinicians, researchers, and patients. This would involve understanding the specific ICDs that the project is targeting, as well as the specific needs and goals of the stakeholders.

System design: The gathered requirements would be used to design the system. This would involve creating a high-level architecture of the system, and selecting the appropriate technologies and tools to be used in the development of the system.

Development: The actual development of the system would then begin. This would involve writing code, building and testing the system, and implementing any necessary features and functionalities.

Testing: The system would then be thoroughly tested to ensure that it is working correctly and that it meets the requirements of the stakeholders. This would involve both functional testing and user acceptance testing.

Deployment: Once the system has been tested and is deemed ready, it would be deployed to a production environment. This would involve installing the system on the target platform, configuring it, and making it available to users.

Maintenance: The system would then be regularly maintained to ensure that it continues to work correctly and that any issues are addressed in a timely manner. This would involve monitoring the system for errors, implementing updates and upgrades, and providing user support.

The system development process can be represented in a flowchart or diagram that illustrates the different stages of the process and the relationships between them. Each stage of the process would have different inputs and outputs, and different actions would be taken at each stage based on the inputs and outputs.

It's worth noting that the system development process can vary depending on the specific requirements of the project, the resources available, and the specific ICDs that the project is targeting.

Chapter Summary

ICD is a comprehensive system for coding and categorizing diseases, health conditions, and related health information. The design of the ICD system is based on a hierarchical structure that allows for the systematic and standardized classification of diseases and health conditions. It is widely used by healthcare providers, public health agencies, and researchers to facilitate data collection, analysis, and reporting.

The ICD system is updated periodically to reflect advances in medical knowledge and to ensure that the classification remains relevant and up-to-date. The latest version, ICD-11, was released in 2018 and features a number of improvements over previous versions, including a more user-friendly interface, enhanced search functionality, and the integration of machine learning algorithms to improve coding accuracy and efficiency.

The ICD system is widely recognized as a critical tool for advancing the field of public health and for improving the quality of healthcare globally. Its use is mandatory for the reporting of diseases and health conditions in many countries and is widely used for data analysis and research purposes. The continued development and refinement of the ICD system is essential for ensuring its continued relevance and usefulness in a rapidly evolving healthcare landscape.

Chapter 5

Testing

5.1 Manual Testing

Video upload test cases

Test Case 1: Video Upload Functionality Test

Test Objective: To verify that the video upload feature is working correctly and that users are able to upload videos successfully.

Test Steps:

Open the application in a web browser.
Navigate to the video upload page.
Click on the "Choose File" button to select a video file from the local machine.
Click on the "Upload" button to start the video upload process.
Verify that the video is being uploaded by checking the progress bar.
Once the upload is complete, verify that the video is displayed on the video upload page.
Verify that the video can be played by clicking on the play button.
Verify that the video can be deleted by clicking on the delete button.
Expected Results:

The video should be successfully uploaded and displayed on the video upload page.
The video should be able to be played and deleted without any errors.

Actual Results: video successfully uploaded and displayed on the video upload page.

Status: Pass

Test Case 2: Video Format Test

Test Objective: To verify that the application is able to handle different video formats correctly.

Test Steps:

Open the application in a web browser.
Navigate to the video upload page.
Try to upload a video in .mp4 format.
Try to upload a video in .mov format.
Try to upload a video in .avi format.

Expected Results:

The application should be able to handle .mp4, .mov, and .avi video formats without any errors.
Videos in different formats should be successfully uploaded and displayed on the video upload page.

Actual Results: The application is able to handle .mp4, .mov, and .avi video formats without any errors.
Videos in different formats successfully uploaded and displayed on the video upload page.

Status: Pass

Test Case 3: File Size Test

Test Objective: To verify that the application can handle large video files and has a maximum file size limit.

Test Steps:

Open the application in a web browser.
Navigate to the video upload page.
Try to upload a video that is within the maximum file size limit.
Try to upload a video that is larger than the maximum file size limit.

Expected Results:

The application should be able to handle large video files within the maximum file size limit without any errors.
If a video larger than the maximum file size limit is attempted to be uploaded, an error message should be displayed.
Actual Results The application is able to handle large video files within the maximum file size limit without any errors.

If a video larger than the maximum file size limit is attempted to be uploaded, an error message is displayed.

Status: Pass

5.1.1 Unit testing

<u>Code:</u>

```
import org.junit.Test;
import org.junit.Assert;
import org.mockito.Mockito;

public class VideoUploadTest {

  @Test
  public void testFileTypeValidation() {
    VideoUpload videoUpload = new VideoUpload();
    boolean isValidFileType = videoUpload.isValidFileType("test.mp4");
    Assert.assertTrue(isValidFileType); // assert that the file is a valid video file type
  }

  @Test
  public void testFileSizeValidation() {
    VideoUpload videoUpload = new VideoUpload();
    boolean isValidFileSize = videoUpload.isValidFileSize(104857600); // 100MB
    Assert.assertTrue(isValidFileSize); // assert that the file is within the acceptable size
limit
  }

  @Test
  public void testUploadProgress() {
    VideoUpload videoUpload = new VideoUpload();
    VideoUploadService videoUploadService = Mockito.mock(VideoUploadService.class);
    Mockito.when(videoUploadService.getUploadProgress()).thenReturn(50);
    videoUpload.setVideoUploadService(videoUploadService);
    int progress = videoUpload.getUploadProgress();
    Assert.assertEquals(50, progress); // assert that the upload progress is correctly
returned
  }
```

```
  @Test
  public void testVideoEncoding() {
    VideoUpload videoUpload = new VideoUpload();
    boolean isVideoEncoded = videoUpload.encodeVideo("test.mp4");
    Assert.assertTrue(isVideoEncoded); // assert that the video is correctly encoded
  }

  @Test
  public void testVideoMetadata() {
    VideoUpload videoUpload = new VideoUpload();
    VideoMetadata metadata = videoUpload.getVideoMetadata("test.mp4");
    Assert.assertNotNull(metadata); // assert that the video metadata is correctly extracted
  }

  @Test
  public void testVideoSecurity() {
    VideoUpload videoUpload = new VideoUpload();
    boolean hasAccess = videoUpload.hasAccess("test.mp4", "user1");
    Assert.assertTrue(hasAccess); // assert that the user has the correct access to view the
video
  }

  @Test
  public void testVideoPlayback() {
    VideoUpload videoUpload = new VideoUpload();
    boolean canPlay = videoUpload.canPlay("test.mp4");
    Assert.assertTrue(canPlay); // assert that the video can be played back correctly
  }
}
```

Result: unit test is passed successfully.

5.1.2 Integration testing

Code:

```
@RunWith(JUnit4.class)
public class VideoUploadAndIcdDetectionTest {

  @Test
  public void testUploadAndIcdDetection() {
    // setup test variables
    File videoFile = new File("testVideo.mp4");
    IcdDetector detector = new IcdDetector();
    String expectedOutput = "Impulse Control Disorder detected";

    // upload video and pass it to the detector
    detector.detect(videoFile);

    // assert that the output matches expected output
    assertEquals(expectedOutput, detector.getOutput());
  }
}
```

Result: integration test is passed successfully

5.2 Automation Testing

Code:

```
public class VideoUploadTest {

   private WebDriver driver;

   @Before
   public void setUp() {
      // Initialize the webdriver
      driver = new ChromeDriver();
   }

   @Test
   public void testVideoUpload() {
      // navigate to the website
      driver.get("https://www.example.com/upload");

      // locate the file upload input field and send the path of the video file
      WebElement uploadInput = driver.findElement(By.id("fileInput"));
      uploadInput.sendKeys("path/to/testVideo.mp4");

      // click on the upload button
      driver.findElement(By.id("uploadButton")).click();
      // wait for the video to be uploaded
      new WebDriverWait(driver,
10).until(ExpectedConditions.visibilityOfElementLocated(By.id("uploadedVideo")));

      // assert that the video is present in the video list
      assertTrue(driver.findElement(By.id("uploadedVideo")).isDisplayed());
   }

   @After
   public void tearDown() {
      // Close the browser
      driver.quit();
   }
}
```

Result: automation test case is passed successfully

Chapter 6

Performance Evaluation

Performance evaluation of a machine learning model for impulse control disorders (ICD) would involve measuring the model's accuracy, precision, recall, and F1-score on a holdout dataset. Other evaluation metrics such as specificity, sensitivity, AUC-ROC, and precision-recall curves could also be used.

Additionally, the model's performance could be evaluated using real-world clinical data, if available, to determine its effectiveness in a real-world setting. This could involve comparing the model's predictions to the actual diagnosis made by a clinician, and measuring the model's accuracy and other performance metrics in this context.

It's important to note that performance evaluation should be conducted on multiple datasets and with multiple evaluation metrics to obtain a comprehensive understanding of the model's performance.

The model's performance should also be evaluated over time as new data becomes available, to ensure that it continues to perform well as the underlying data patterns change.

It is also important to evaluate the model in terms of its explainability and interpretability. This is important for medical applications as the ability to explain the model's predictions to clinicians and patients is crucial for its adoption and trust.

The accuracy of this model was found to be 68.35% with a loss of 24.28%. The graph 11 shows training and validity accuracy while graph 12 shows training and validity loss during the testing

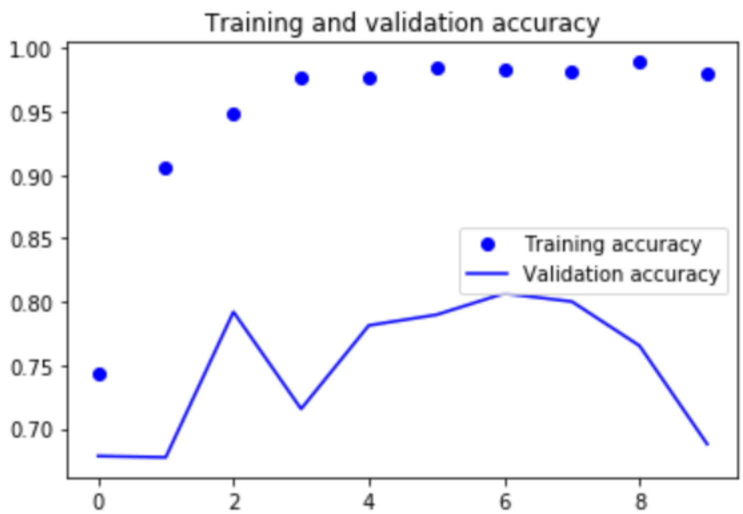


Figure 1

Figure 2

Chapter 7

Future Directions and Conclusion

Impulse control disorders (ICD) are a group of mental health conditions characterized by the inability to resist impulses or urges that may be harmful to oneself or others. These disorders can have a significant impact on an individual's quality of life and can lead to a range of negative outcomes, including social isolation, financial problems, and legal issues.

Recent years have seen a growing interest in the development of machine learning models for the detection and diagnosis of ICDs. These models have the potential to improve the accuracy and timeliness of diagnosis, as well as to reduce the burden on healthcare professionals. However, there are also significant challenges that need to be addressed, including the need for large, high-quality datasets and the development of appropriate evaluation metrics.

One of the main future directions in this field is the development of models that can detect ICDs in a range of settings, including in primary care and community settings. This will require the development of models that are robust to variability in the data and that can be easily integrated into existing healthcare systems. Additionally, there is a need to develop models that can detect ICDs in diverse populations, as these disorders are known to disproportionately affect certain groups, such as individuals from low-income backgrounds or those with a history of trauma.

Another important direction is to develop models that can be used in real-time, such as in virtual reality or mobile applications. This will enable individuals to receive a diagnosis and receive treatment as soon as possible. Additionally, the development of real-time models will also help to reduce the burden on healthcare professionals, as they will not need to review large amounts of data to make a diagnosis.

A key challenge in the field of ICDs is the availability of high-quality data. In order to develop accurate models, large datasets that include a diverse range of individuals and a wide range of symptoms are required. Additionally, these datasets must be well-annotated, so that the models can accurately identify the relevant symptoms.

Another important issue is the lack of standard evaluation metrics for ICD detection models. Currently, there is no consensus on the best way to evaluate the performance of these models, which makes it difficult to compare the performance of different models and to assess the overall progress of the field.

In conclusion, the field of machine learning for the detection and diagnosis of ICDs is an exciting and rapidly developing area. There are a number of important challenges that need to be addressed, including the need for large, high-quality datasets and the development of appropriate evaluation metrics. However, with continued research and development, it is likely that we will see significant progress in this field in the coming years. This will not only improve the diagnosis and treatment of ICDs but also help in reducing the burden on healthcare professionals, and improve the quality of life of affected individuals.

Appendix A - User Manual

Introduction
The Impulse Control Disorder (ICD) Detection and Recommender System is a tool that helps individuals with ICDs to manage their disorder and improve their quality of life. The system utilizes machine learning algorithms to detect and diagnose ICDs, as well as provide personalized recommendations for treatment and management.

Getting Started
To begin using the ICD Detection and Recommender System, you will first need to create an account and provide some basic information about yourself, including your age, gender, and any relevant medical history.

Data Input
Once your account has been set up, you will be prompted to input data about your symptoms and behaviors related to your ICD. This can include information about your thoughts, emotions, and physical sensations, as well as details about any triggers or situations that make your symptoms worse.

ICD Detection
The system will then use the data you have provided to detect and diagnose any ICDs that you may have. The system will provide you with a detailed report that includes information about your diagnosis, as well as the confidence level of the diagnosis.

Recommendations
Based on your diagnosis, the system will provide you with personalized recommendations for treatment and management. This may include information about therapy, medication, and lifestyle changes that can help you manage your disorder.

Monitoring Progress
The system will also allow you to monitor your progress over time, by tracking your symptoms and behaviors. You can input data regularly, and the system will provide you with feedback and updates on how your treatment is working.

Conclusion
The ICD Detection and Recommender System is a powerful tool that can help individuals with ICDs to manage their disorder and improve their quality of life. With its advanced machine learning algorithms, personalized recommendations, and monitoring tools, the system offers a comprehensive approach to ICD management.

Note
It is important to note that the system is not a substitute for professional medical advice and treatment. If you suspect that you have an ICD or have any other medical concerns, you should consult with a qualified healthcare professional for further evaluation and treatment.

Appendix B- Software Requirement Specification (SRS)

Department of Software Engineering Department
Sir Syed University of Engineering & Technology
Karachi, Pakistan

SOFTWARE REQUIREMENTS SPECIFICATION

Project name: ICD Detection and Recommender system

Version 1.0

Prepared by Group # 56

Supervised By:

Sir Danish Jameel

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6.6 Reports (Feedback, Invoice, User, Usage, Balance Sheet, Executive Summary etc
7 Appendix A: Glossary

1 Introduction:

1.1 Purpose

The purpose of this project is to design a machine that can analyze, monitor, and alert Impulse Control Disorder and Body-Focus Repetitive Behavior to analyse the cause of performing that gesture and recommend a possible therapy.

1.2 Scope

With the ever-rising mental illnesses and disorders around the world, we aim to detect the symptoms of such illnesses through the machine, which will work by detecting the Body-Focus Repetitive Behavior that might be the cause of such illnesses. So that they can be identified and treated. The device will make use of Artificial Intelligence which is on the rise and machine learning is one of the most successful fields with great success in face recognition, image classification and so on.

As we know, the world is still learning the importance of mental health and how it is so important to address the issue so that it can be treated instead of silently suffering from it and taking any extreme step when it becomes unbearable.

Especially in our region where there is very little awareness regarding the importance of mental health and how to address and detect it. This device aims to play a major role in raising awareness and detecting the illness and suggesting a possible remedy.

Table 1. Percentages of people affected by respective BRFBs

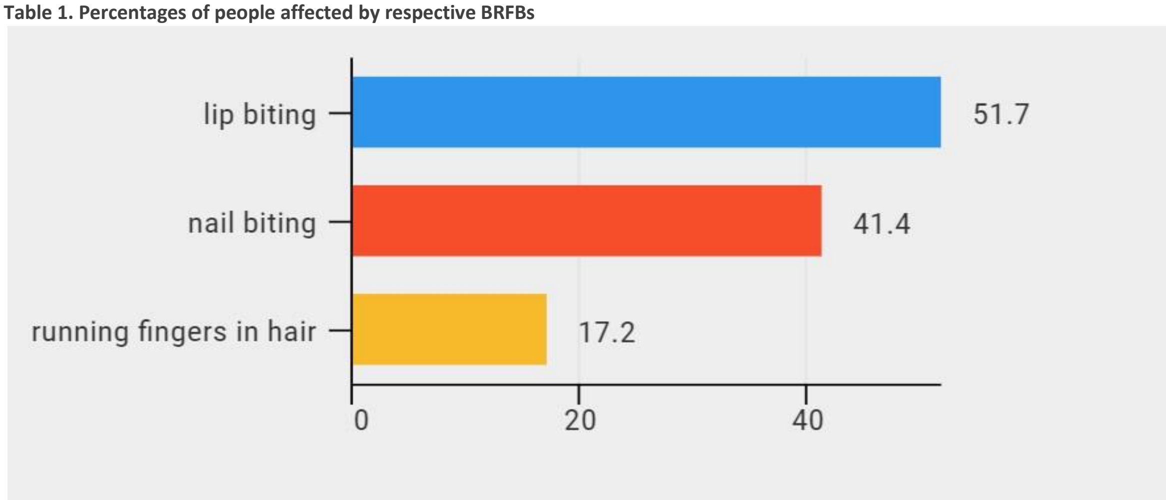
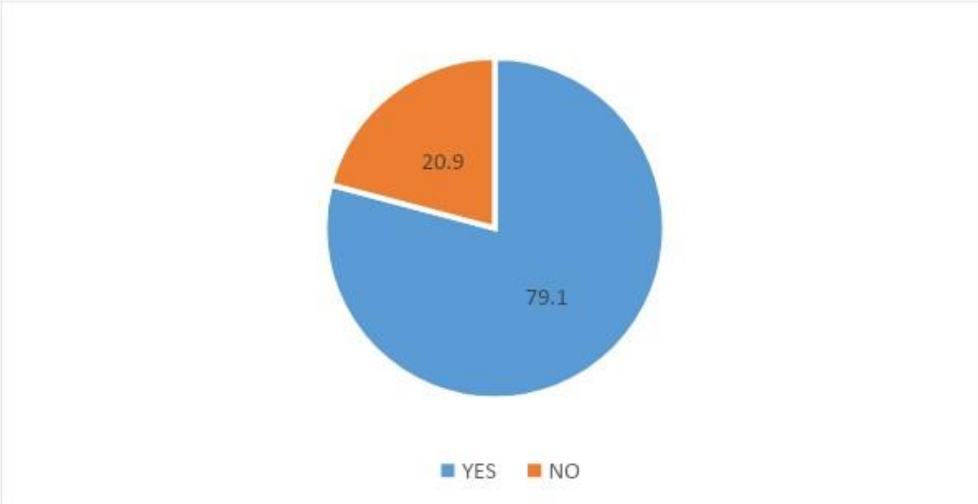


Table 2. Representation of people willing to get rid of ICD



1.3 Definition, Acronyms and Abbreviations

Definition

Impulse Control Disorder (ICD) and Body-Focus Repetitive Behavior (BFRBs) are unwanted habits and actions that can produce self-harming. These conditions trigger stress situations and most of the time are subconscious, making the person unable to control their execution. ICDs are prevalent in the younger population of children and adolescents and can be controlled by continuous monitoring and nursing.

Acronyms and Abbreviations

- ICD (Impulse Control Disorder)
- BRFB (Body-Focus Repetitive Behavior)
- CNN (Convolutional Neural Network)

1.4. References

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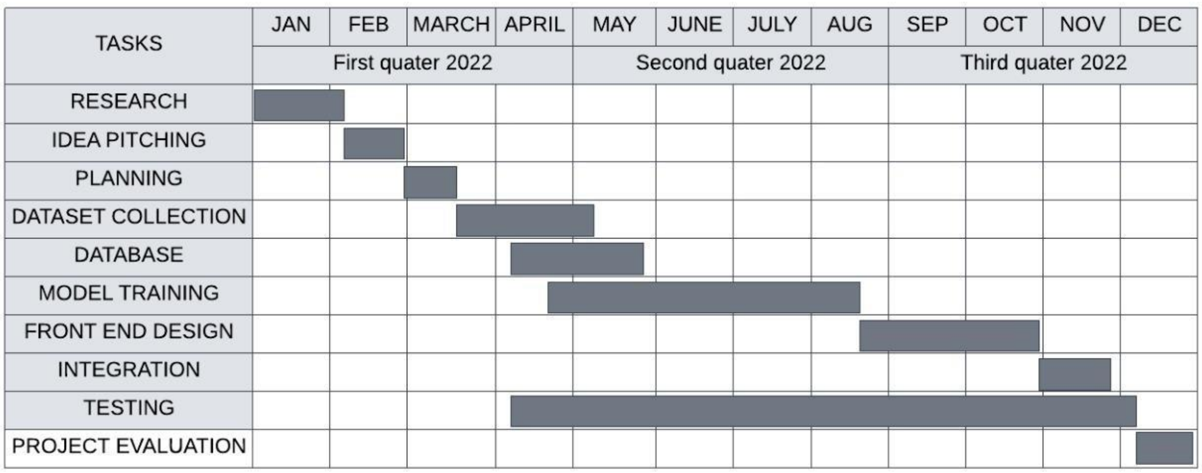
2 Project Planning and Management:

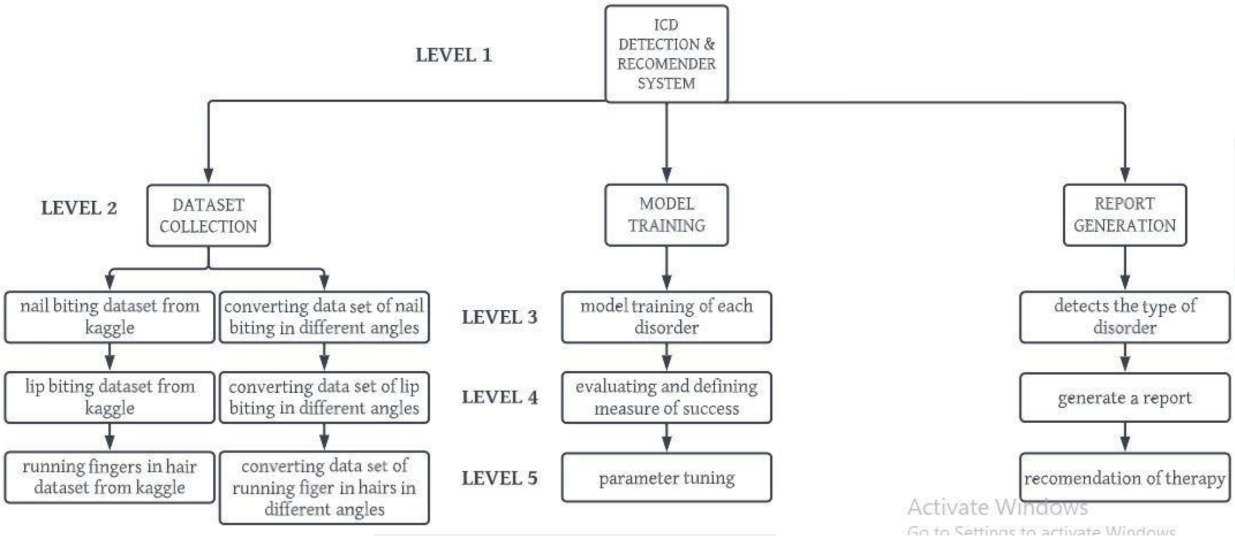
2.1 SWOT Analysis

- To create an application that can identify body-focused repetitive behaviours.
- To classify classes of ICD
- To identify the probable reason for performing gestures
- To recommend possible therapy to prevent the disorders.

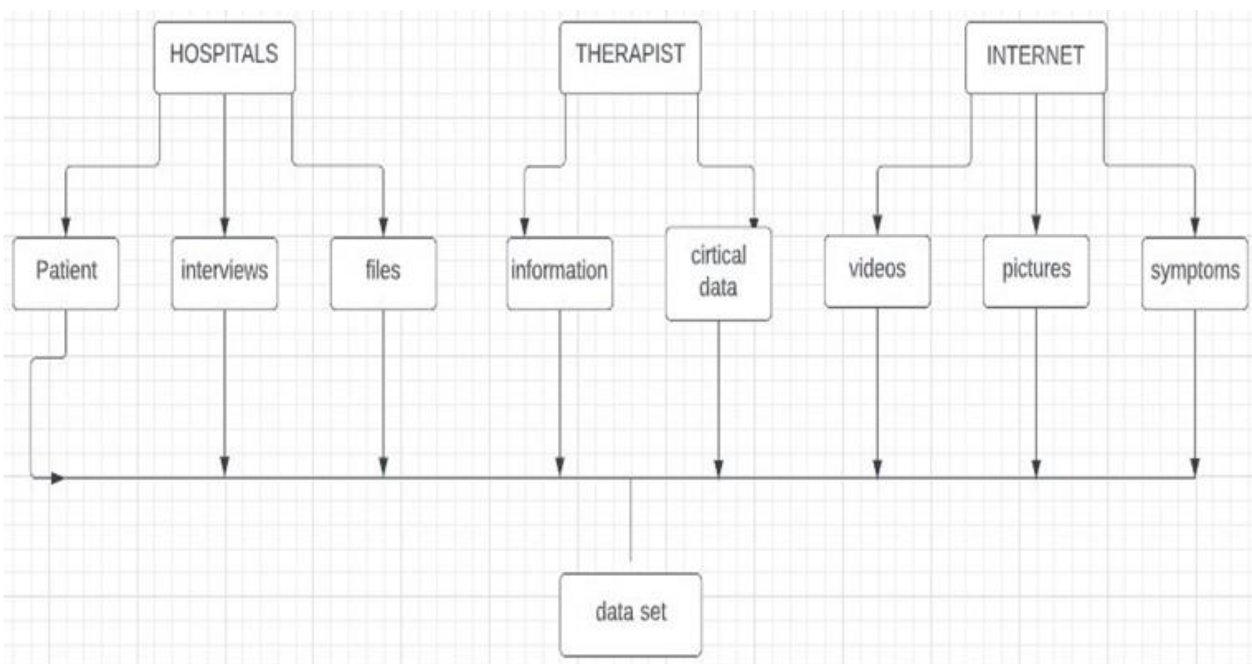
2.2 Gantt Chart



2.3 Work Breakdown Structure [WBS]



2.4 Activity Diagram



3. Overall Description of Product:

3.1 Product Perspective:

Individuals with co-occurring impulse control disorders and other psychiatric disorders have more serious symptoms, implying that unresolved impulse control disorders can make treating the diagnosed psychiatric condition more difficult. Psychiatrists need to diagnose and support patients with impulse control problems now that empirically proven therapies are available. The diseases of skin picking and nail biting and other factors like playing with fingers and running fingers in the hair are our main concerns. The research is relatively new, and little work has been undertaken in terms of developing tools to aid in the treatment of these fundamental disorders. This model will be helpful for the use of psychologists because this is also the reason behind the lack of research in this field when a person knows that someone is observing his movements then obviously he will not do such things and will remain conscious, so with the help of this model professionals of the respective field can remotely monitor the movements of the person and this will be very helpful for the professionals to research more in this field, moreover, they can treat affected people with the help of this system.

3.2Product Functions:

1. This system will process the video and split it into the 0.05-sec frame.
2. Then the system will compare the input with the dataset.
3. CNN Algorithm will be used for image processing.
4. For all three factors, we will prepare our dataset and train the system on those factors' datasets.
5. This system will then analyze the reason for performing those gestures.
6. Moreover, the system will also recommend the therapies (for example Psychoanalysis and psychodynamic therapies, Behavior therapy, Cognitive therapy, Humanistic therapy, Integrative or holistic therapy) considering the reason for performing those gestures.
7. The Report comprising of Analysis and therapy recommendations will be generated.

3.3 User Classes and Characteristics

- **Tensor Flow:** The Object Detection API from Tensor Flow has been acknowledged as a useful tool for quickly developing and implementing picture recognition algorithms. As a result, it was chosen to train CNN in this thesis.

- Convolutional Neural Network(CNN)

The term NN is quite broad and encompasses a wide range of models. NN is a distributed and parallel model capable of approximating complicated nonlinear functions in this setting. The network is made up of several computational components known as neurons that are arranged in a topology.

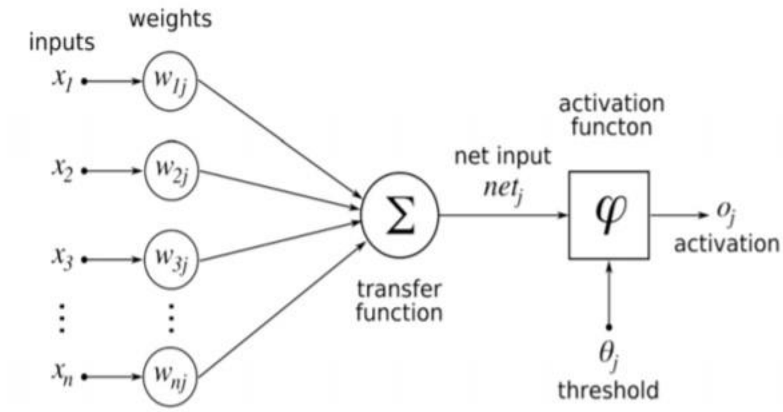


Figure 3. Structure of a neuron

A Convolutional Neural network (CNN) is a type of Neural Network that was first used in image processing applications. They're perhaps the most successful bio-inspired AI models. Although they were shown in a variety of domains, the majority of design ideas came from neuroscience. They've been extremely effectively implemented in language and video processing applications since their success in image processing.

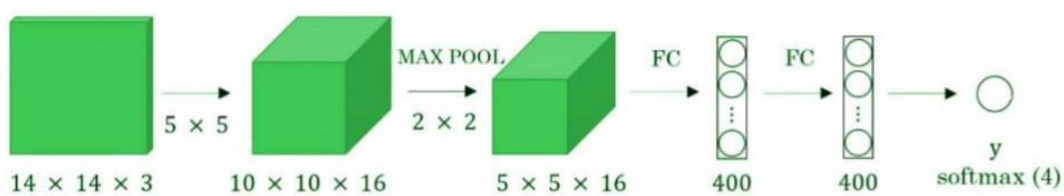


Figure 4. A Convolutional Neural Network

The scientific work of David Hubel and Torstein Wiesel in biology aided stimulation. Hubel and
Wesel, neurophysiologists, researched the mammalian visual system for several years beginning in late 1950. They connected electrodes into the brain of an anaesthetised cat and analysed brain reaction to visual stimuli in the study, which was a little nasty by today's standards. They discovered that a very tiny line of sunlight flashed at a specific angle on a

screen for the cat to determine the activated feedback of neurons in the cortical area. They discovered that certain neurons in the cortical area respond exclusively to extremely precise patterns in the input picture. In 1981, Hubel and Wiesel were awarded the Nobel Prize in Physiology and Medicine for their discovery.

3.4 Operating Environment:

- **Operating system:** Any window in an operating system.
- Language: Python
- **Software:** Tensor flow, Collab, CNN

3.5 Design and Implementation Constraints:

- **Software used:** The system is developed in python language and is supposed to work only on a window OS system that has tenser flow or collab installed on it.
- **Desktop-based:** The application shall be desktop based.

3.6 User Documentation:

It will provide specific guidelines to a user for using the **ICD Detection and Recommender system.**

3.7 Assumptions and Dependencies

In the first scenario, once the image processing is done, different disorders will be predicted accordingly, or in the second case consultancy from the doctor will be recommended if the system flunks to catch sight of any malady!

There are some factors that we should take care of while the surveillance is being done. There should not be noise in the Image input, the room should be empty, or not have any toys and objects that resemble human beings since they can be detected as a human because of the system error.
There should be no screen (TV/ monitor, LCD) in front of the camera displaying human images or such images that can resemble a human being.

4.1 Domain Information

The programming of this model will be done by using Python, and most importantly TensorFlow which is an end-to-end open source platform for machine learning. It has a comprehensive, flexible ecosystem of tools, libraries, and community, Colab which can harness the full power of popular Python libraries to analyze and visualize data will be used because of the various features that it provides like cloud storage and online GPUs.

Anaconda which is an open-source package and environment management system and jupyterlab IDE will also be used.

4.2 Project Architecture:

Software architecture refers to the fundamental structures of a software system and the discipline of creating such structures and systems. Each structure comprises software elements, relations among them, and properties of both elements and relations.

4.2.1 Web:

After performing the whole process the result of the analysis will be displayed on the Web and Flask will be used to make the results visible on the Web while connecting the backend to the frontend.

4.2.1.2 Architecture:

The system architecture is distributed in 4 major stages, in the first stage, the system takes data input in the form of video. The second stage is of processing the data which includes, breaking the video into images then the segmentation, filtration, and padding occurred. In the third stage, training occurs which includes object detection followed by object training. Then the last performance of the system is evaluated.

4.2.2 Database Module:

In the database module after breaking down the video into images, Images are converted into matrices, and matrices are compiled to be converted into weights!

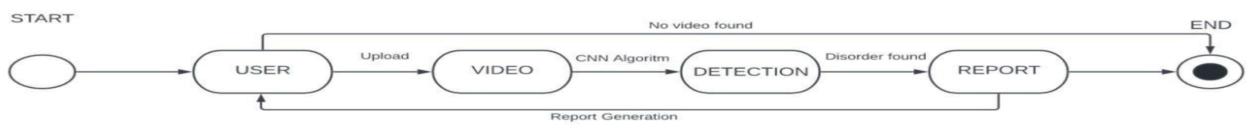
4.2.3 Administration Module:

In the administration module, the admin will have the right to see the analysis reports and all the research data collected, Also he will be able to alter the Weights. The admin will have all the rights to control the accesses and to block and unblock the MAC addresses of those who are availing of the services and using our software.

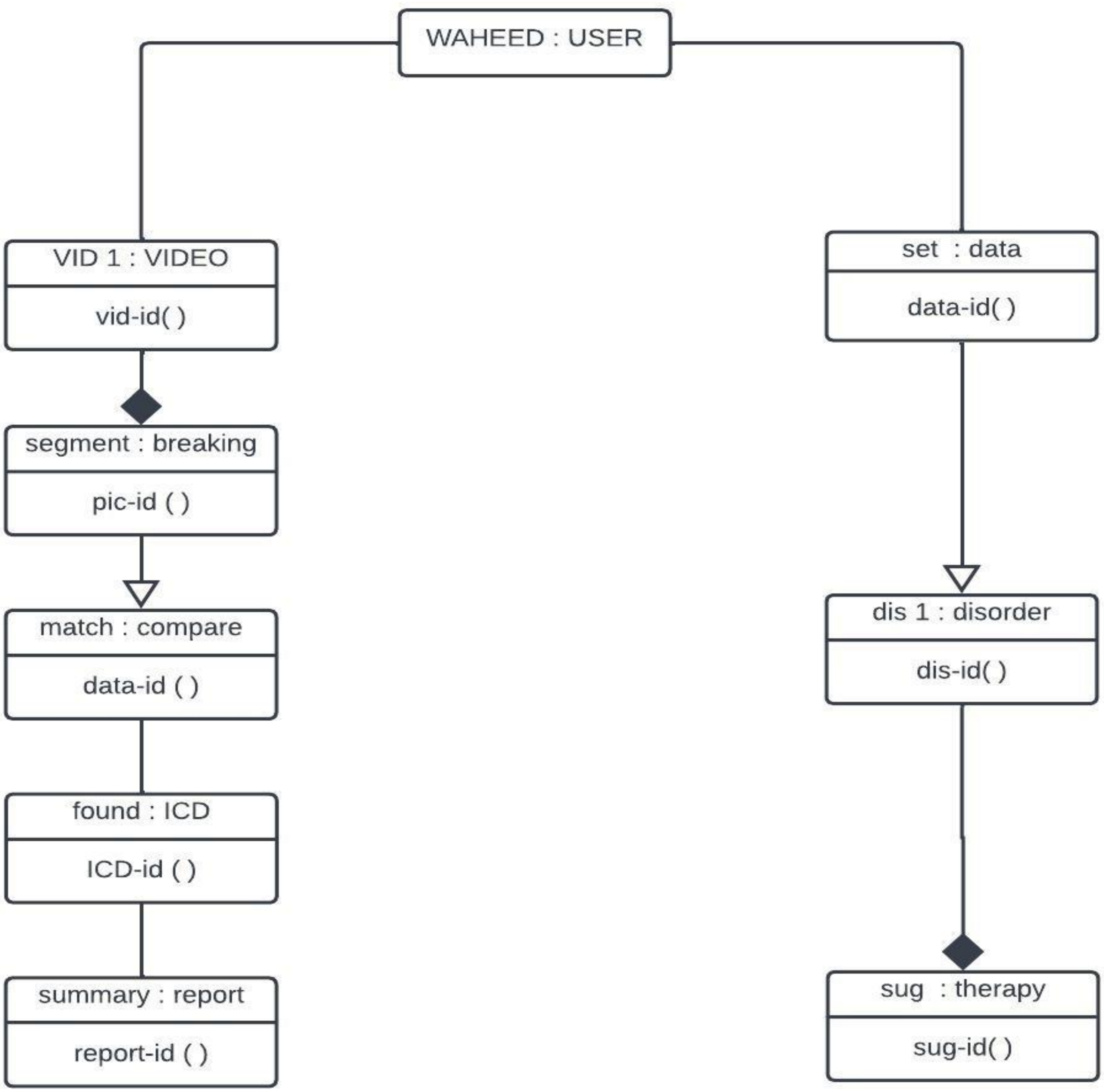
4.3 System Analysis and Design Overview

In this section, we will briefly introduce the important ideas and terms of system analysis and design overview.

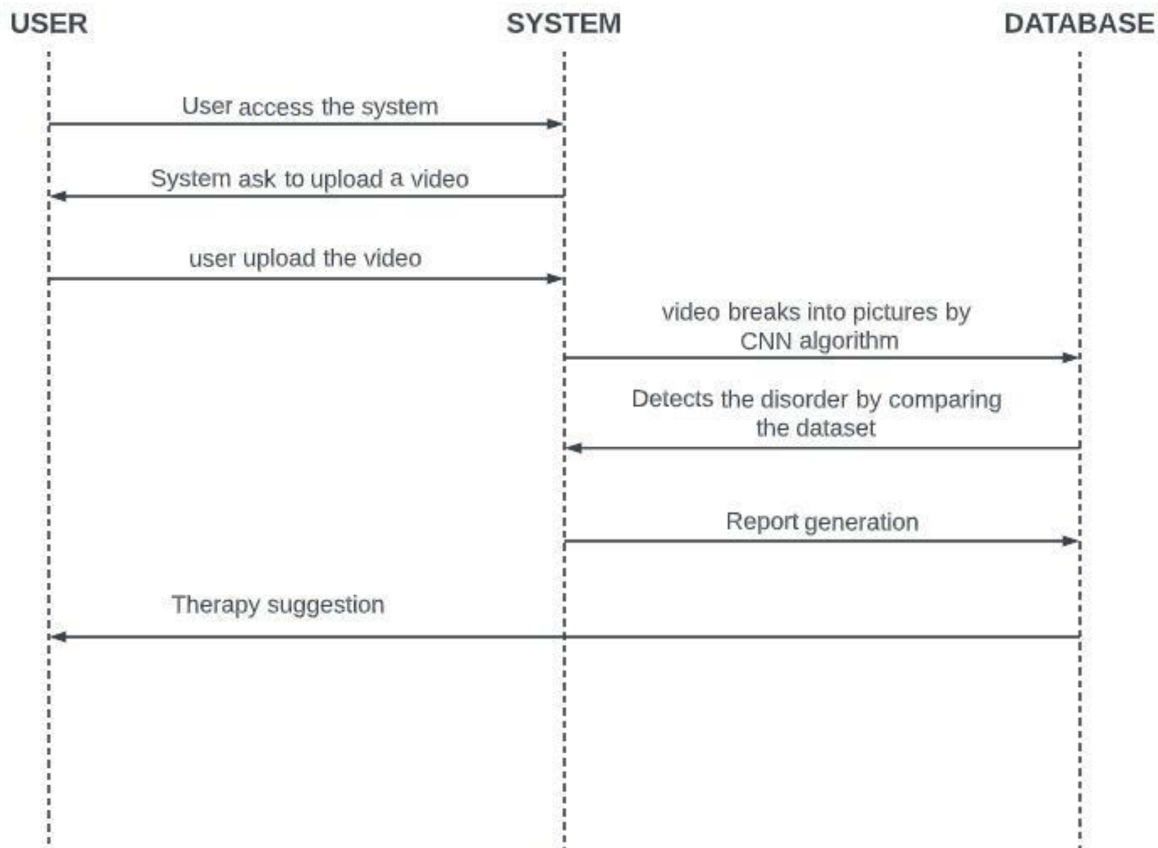
4.3.1 Object Oriented Modelling Technique

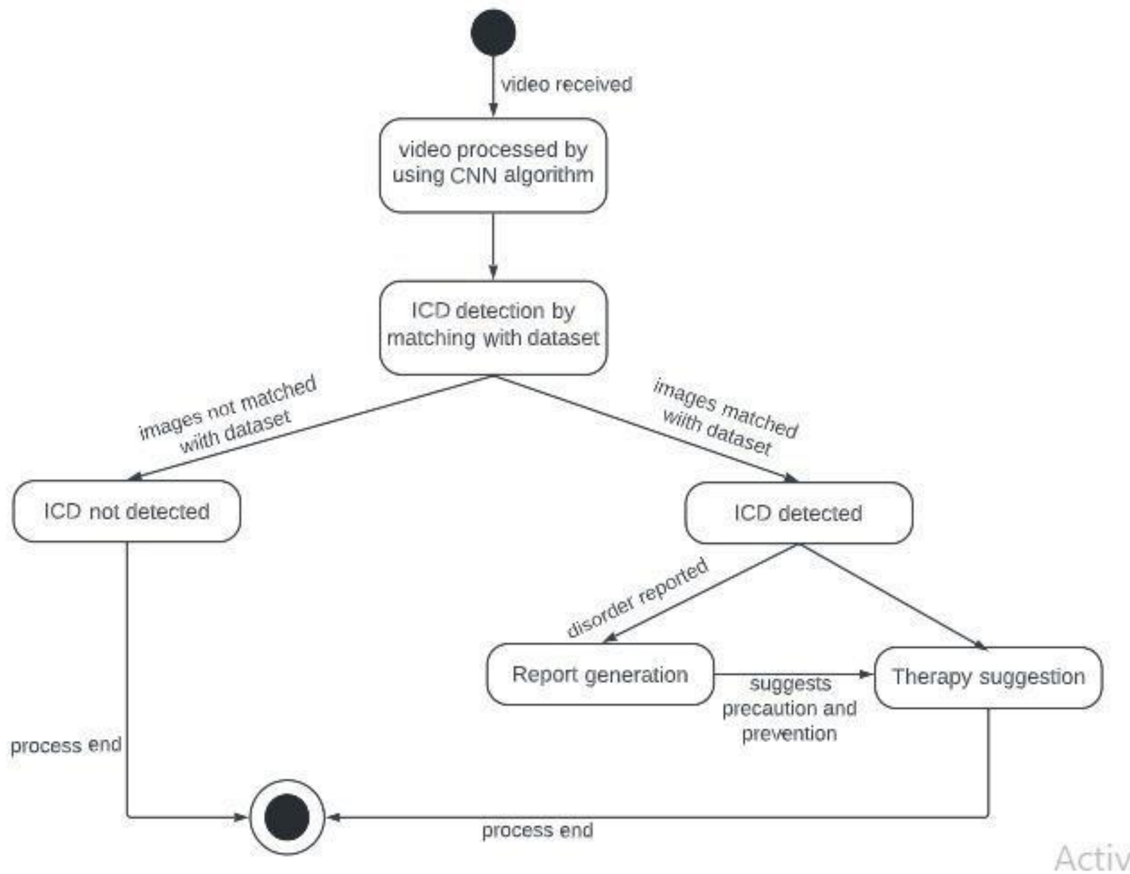


4.3.1.2 Object Model

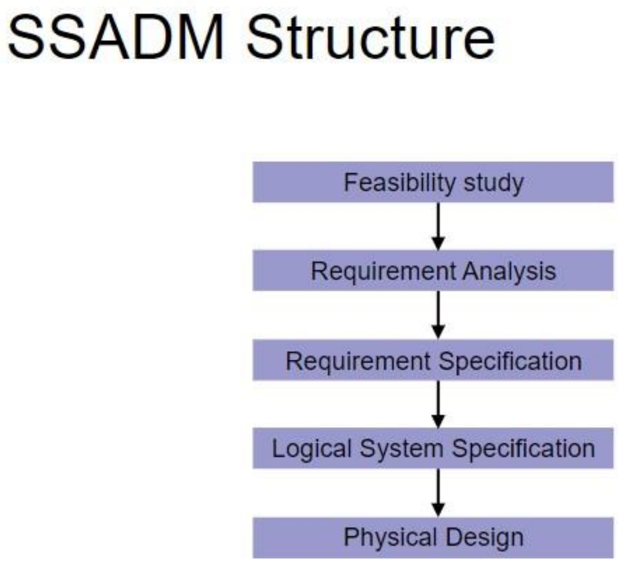


4.3.1.3 Dynamic Model: Event Trace Diagram and State Diagram

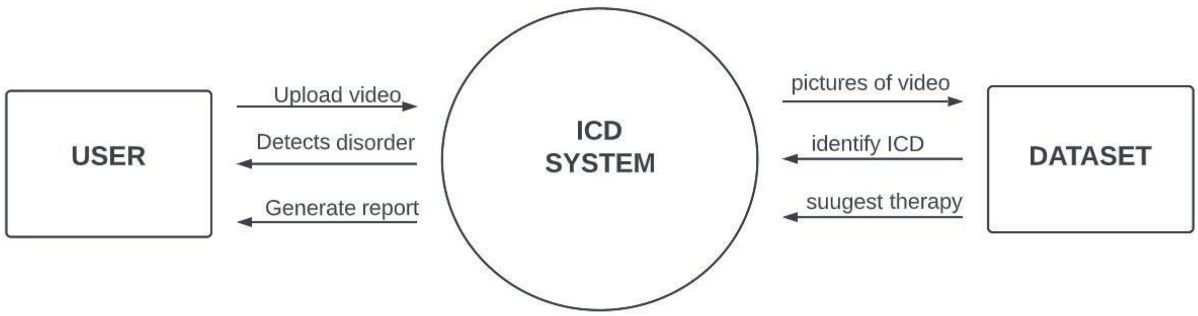



video received
video processed by using CNN algorithm
ICD detection by matching with dataset
images not matched with dataset
images matched wiith dataset
ICD not detected
ICD detected
disorder reported
Report generation
suggests precaution and prevention
Therapy suggestion
process end
process end

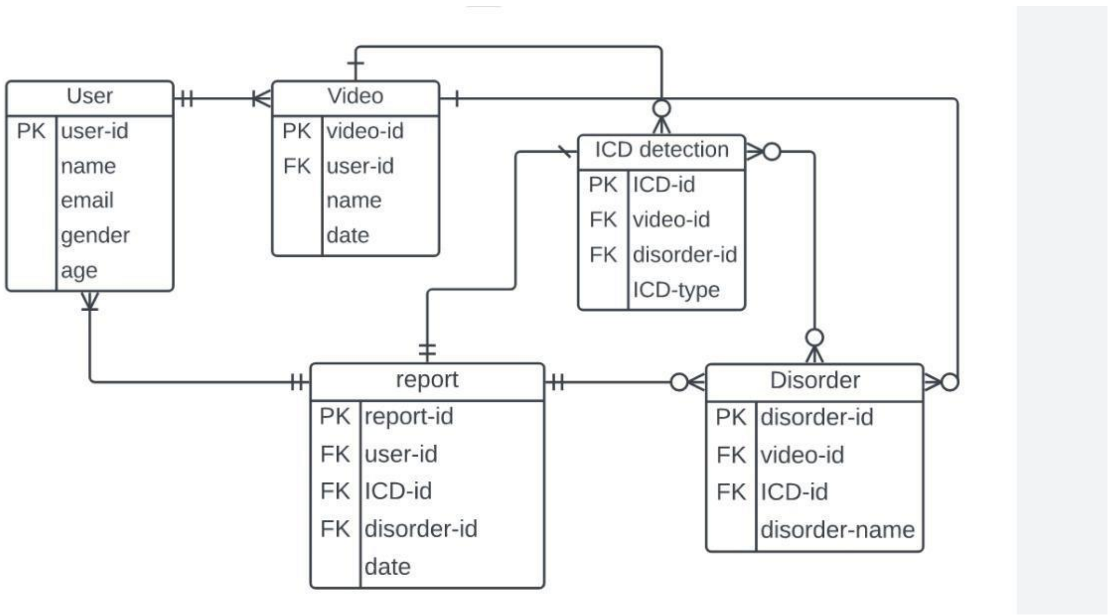
4.3.2 Structured System Analysis & Design Method

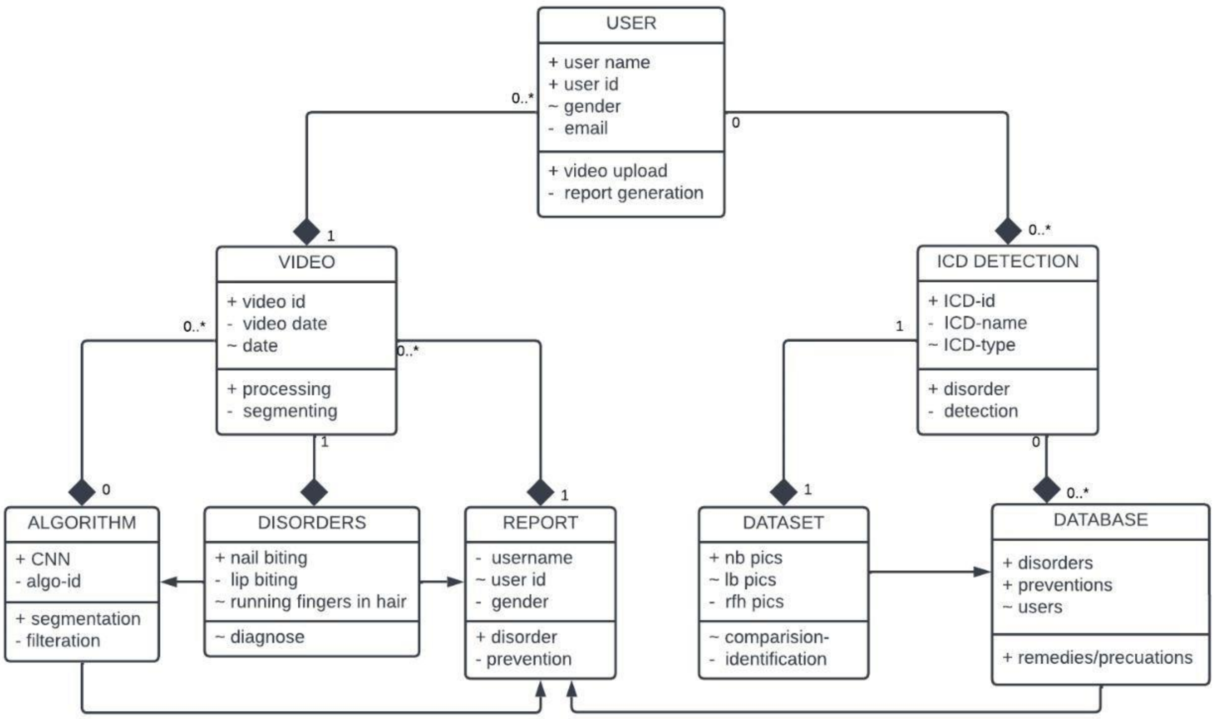


4.3.2.1 Data Flow Diagram

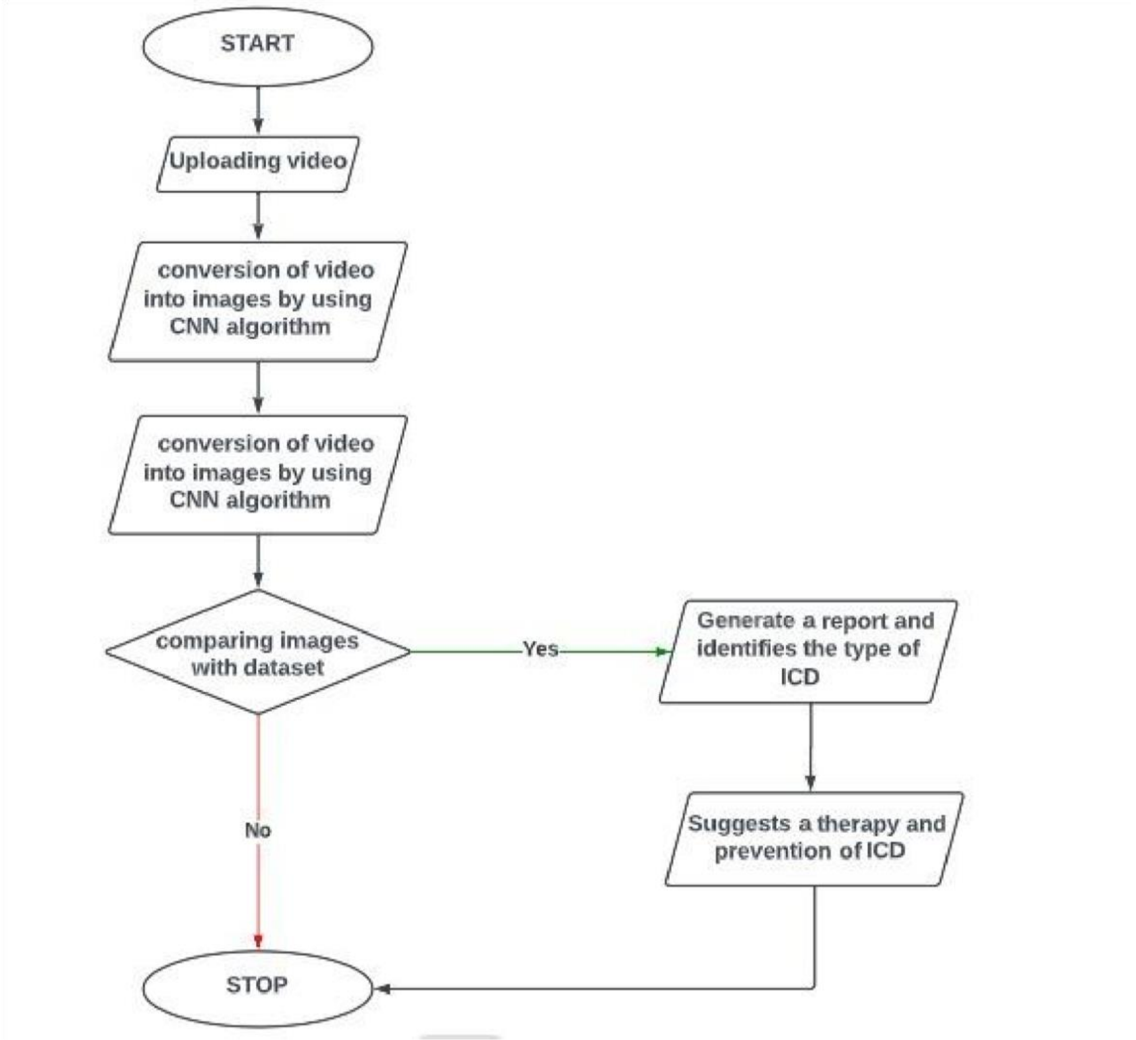


4.3.2.2 Entity Relationship Diagram



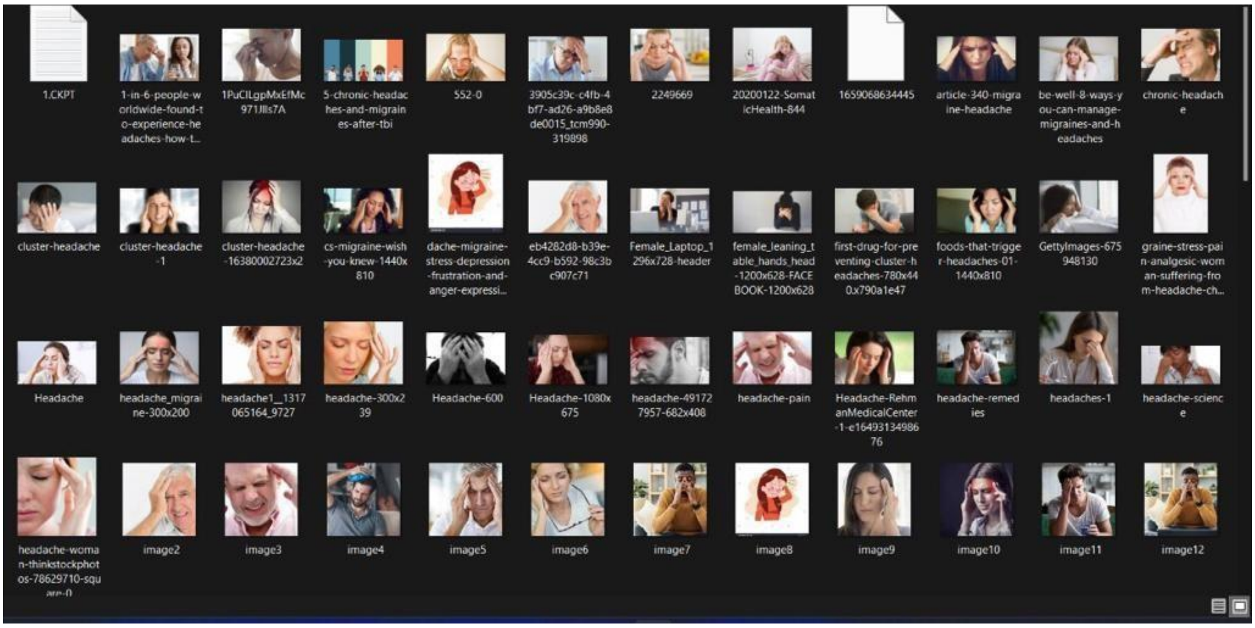


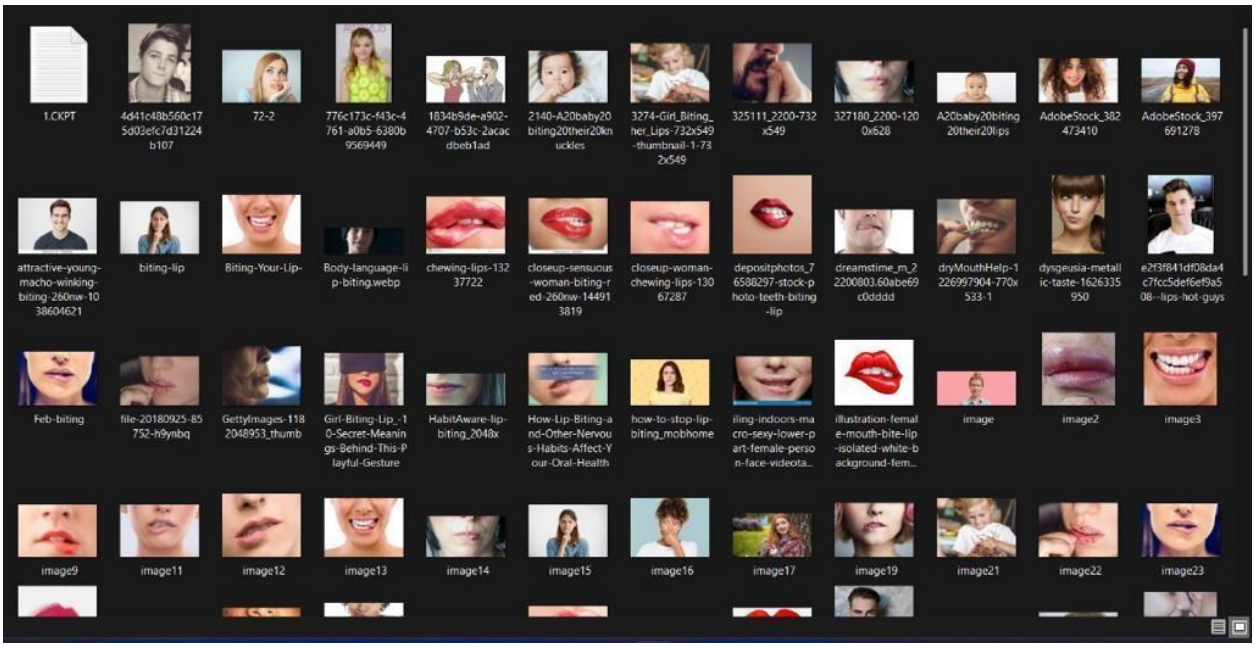
4.3.2.3 Flow chart

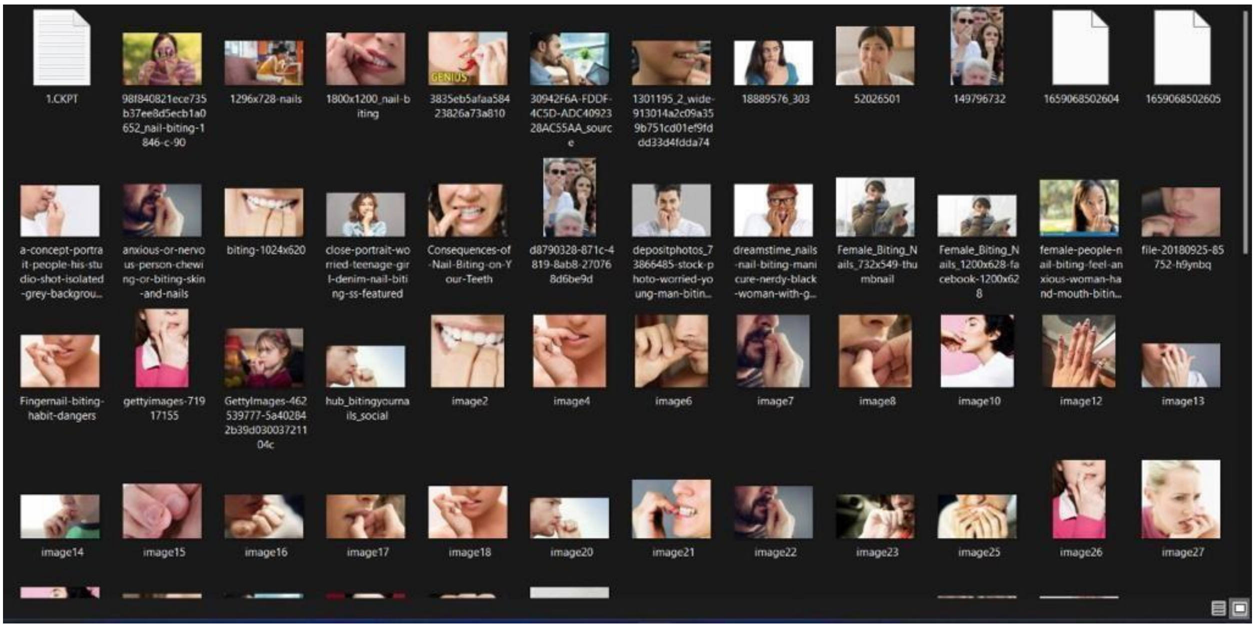


4.4 Data Requirements

4.4.1 Data dictionary







4.4.2 Reports

Data and analysis reports will be created after the experiments and those analysis reports will be sold to the organizations working in the same fields or the scientists/psychologists/psychiatrists.

4.4.3 Data acquisition, Data integrity, Retention, Disposal.

The reports and all other data will be transferred through safe channels mitigating the risk of data leaks. All the research and all video feeds will be disposed of after the research (primarily within 24 hours)

4.5 External Interface Requirements:

4.5.1 Interfaces:

There are many types of interfaces as such supported by the ICD detection & recommender system namely; User Interface, Software Interface and Hardware Interface.

The protocol used shall be HTTP.

There shall be logical address of the system in IPv4 format.

4.5.1.1 User Interfaces:

The user interface for the software shall be compatible to any browser such as Internet Explorer, Mozilla or Chrome by which user can access to the system.

The user interface shall be implemented using flask

4.5.1.2 Hardware Interfaces:

Since the application must run over the internet, all the hardware shall require to connect internet will be hardware interface for the system. As for e.g. Modem, WAN – LAN, Ethernet Cross-Cable.

4.5.1.3 Software Interfaces:

The ICD detection & recommender system shall communicate with the user to verify and accept the terms and conditions before proceeding to use the system.

The ICD detection & recommender system shall communicate with the user to input the video feed to be processed.

The ICD detection & recommender system shall communicate with the user to be patient while the system process the given input.

The ICD detection & recommender system shall communicate with the user to provide the output in the form of report.

1.5.1.4 Communication Interfaces:

The ICD detection & recommender system shall use the HTTP protocol for communication over the internet and for the intranet communication will be through TCP/IP protocol suite.

1.5.2 Design Constraints:

Camera resolution can be a big constraint at the beginning of the process as noise can minimize the accuracy of the results. In the stage of data set collection, it is to make sure that the collected data should be as it is required to meet the accurate results so that there should be no constraints in the prediction phase.

4.5.2.1 Standard Development Tools:

- Tensor flow
- Colab
- Anaconda
- Jupyterlab
- Affinity

4.5.2.2 Web / Android-based Projects

The only Constraint that could occur in a web project is Server hang-up or link-down the issue.

5 Non Functional Requirements

5.1 Performance Requirements

For this project, the most important performance requirement would be storage because video feeds require lots of storage. The system should be of high speed because accuracy is important.

5.2 Safety Requirements

We have to mitigate the risks such as full memory which might stop the software from running.

5.3 Security Requirements

There should be authorization and end-to-end protection because the system is taking the life of a person. After all, the leak of the medical records of a person might cause a bad impact on anyone on whom the experiments are taking place. Especially the video feeds should be taken care and only the research data should be accessible instead of the person's video feed.

5.4 Software Quality Attributes

The integrity of the data is important, data should not duplicate so that the software starts predicting inaccurately. The interface should be user-friendly and should be fast processing.

5.5 Business Rules

There will be limitations in terms of the number of people in the video feed so that the system works more accurately.

5.6 Interoperability

Even though the system can share research information and analysis with other medical software and can interact with those software but won't share any personal information of the subject/ research participants.

5.7 Extensibility

We can do third-party integrations to make the results and research analysis appear to the other medical application so that it could benefit the psychiatrists and other related medical practitioners moreover the model is designed currently for a single person to detect, it can be advanced with the feature to handle more people and detect all the people and provide analysis report of all the people at once.

5.8 Maintainability

After some while, it is recommended to train the software again to get better and more accurate results.

5.9 Portability

Yes, it will be portable. The trained model would be able to run on any machine after the setup.

5.10 Reusability

Elements that can be reusable are the neural network, searching techniques, and prediction techniques.

5.11 Installation

There will be several things that need to be installed such as a camera, memory storage devices, and the server on which the data processing will take place.

6 Other Requirements

6.1 On-line User Documentation and Help System Requirements

As the product is medical/psychological research system, On-line help system becomes a critical component of the system which shall provide –
It shall provide specific guidelines to a user for using theICD detection and recommender system and within the system.

To implement online user help, link and search fields shall be provided.

6.2 Purchased Requirements

Not Applicable

6.3 Licensing Requirements

As the system is a model and currently in the development phase and need to be improved before extensibility of the software so for now the software is Open source, that is freely licensed to use, copy, study, and change the software in any way, and the source code is openly shared so that people are encouraged to voluntarily improve the design of the software.

6.4 Legal, copyright and other Notices

System should display the disclaimers, copyright, word mark, trademark and product warranties of the ICD detection and recommender system.

6.5 Applicable Standards

- ISO 13485 – Medical devices – Quality management system,
- IEC 62304 – Medical device software – Software life cycle processes,
- ISO TS 25238 Health informatics – Classification of safety risks from health software,
- ISO 14971 – Medical devices — Application of risk management to medical devices,
- IEC 62366 – Medical devices — Application of usability engineering to medical devices.

6.6 Reports (Feedback, Invoice, User, Usage, Balance Sheet, Executive Summary etc)

Data and analysis reports will be created after the experiments and those analysis reports will be sold to the organizations working in the same fields or the scientists/psychologists/psychiatrists. Data and analysis reports will be created after the experiments and those analysis reports will be sold to the organizations working in the same fields or the scientists/psychologists/psychiatrists.

7 Appendix A: Glossary:

ICDDRS: IMPULSE CONTROL DISORDER Detection and Recommender system

Definitions of common machine learning terms.

Accuracy

Percentage of correct predictions made by the model.

Algorithm

A method, function, or series of instructions used to generate a machine learning model. Examples include linear regression, decision trees, support vector machines, and neural networks.

Attribute

A quality describing an observation (e.g. color, size, weight). In Excel terms, these are column headers.

Bias metric

What is the average difference between your predictions and the correct value for that observation?

Low bias could mean every prediction is correct. It could also mean half of your predictions are above their actual values and half are below, in equal proportion, resulting in low average difference.

High bias (with low variance) suggests your model may be underfitting and you're using the wrong architecture for the job.

Bias term

Allow models to represent patterns that do not pass through the origin. For example, if all my features were 0, would my output also be zero? Is it possible there is some base value upon which my features have an effect? Bias terms typically accompany weights and are attached to neurons or filters.

Categorical Variables

Variables with a discrete set of possible values. Can be ordinal (order matters) or nominal (order doesn't matter).

Classification

Predicting a categorical output.

Binary classification predicts one of two possible outcomes (e.g. is the email spam or not spam?)

Multi-class classification predicts one of multiple possible outcomes (e.g. is this a photo of a cat, dog, horse or human?)

Classification Threshold

The lowest probability value at which we're comfortable asserting a positive classification. For example, if the predicted probability of being diabetic is > 50%, return True, otherwise return False.

Clustering

Unsupervised grouping of data into buckets.

Confusion Matrix

Table that describes the performance of a classification model by grouping predictions into 4 categories.

True Positives: we correctly predicted they do have diabetes

True Negatives: we correctly predicted they don't have diabetes

False Positives: we incorrectly predicted they do have diabetes (Type I error)

False Negatives: we incorrectly predicted they don't have diabetes (Type II error)

Continuous Variables

Variables with a range of possible values defined by a number scale (e.g. sales, lifespan).

Convergence

A state is reached during the training of a model when the loss changes very little between each iteration.

Deduction

A top-down approach to answering questions or solving problems. A logic technique that starts with a theory and tests that theory with observations to derive a conclusion. E.g. We suspect X, but we need to test our hypothesis before coming to any conclusions.

Deep Learning

Deep Learning is derived from a machine learning algorithm called perceptron or multi layer perceptron that is gaining more and more attention nowadays because of its success in different fields like computer vision to signal processing and medical diagnosis to self-driving cars. Like other AI algorithms, deep learning is based on decades of research. Nowadays, we have more and more data and cheap computing power which makes this algorithm really powerful in achieving state-of-the-art accuracy. In the modern world, this algorithm is known as an artificial neural network. Deep learning is much more accurate and robust compared to traditional artificial neural networks. But it is highly influenced by machine learning's neural network and perceptron networks.

Dimension

Dimension for machine learning and data science is different from physics. Here, the dimension of data means how many features you have in your data ocean(data-set). e.g in the case of an object detection application, flattening image size and colour channel(e.g 28*28*3) is a feature of the input set. In case of house price prediction (maybe) house size is the data-set so we call it 1 dimensional data.

Epoch

An epoch describes the number of times the algorithm sees the entire data set.

Extrapolation

Making predictions outside the range of a dataset. E.g. My dog barks, so all dogs must bark. In machine learning, we often run into trouble when we extrapolate outside the range of our training data.

False Positive Rate

Defined as

$$FPR=1-Specificity=FalsePositivesFalsePositives+TrueNegatives$$

The False Positive Rate forms the x-axis of the ROC curve.

Feature

With respect to a dataset, a feature represents an attribute and value combination. Color is an attribute. “Color is blue” is a feature. In Excel terms, features are similar to cells. The term feature has other definitions in different contexts.

Feature Selection

Feature selection is the process of selecting relevant features from a data-set for creating a Machine Learning model.

Feature Vector

A list of features describing an observation with multiple attributes. In Excel, we call this a row.

Gradient Accumulation

A mechanism to split the batch of samples—used for training a neural network—into several mini-batches of samples that will be run sequentially. This is used to enable using large batch sizes that require more GPU memory than available.

Hyperparameters

Hyperparameters are higher-level properties of a model such as how fast it can learn (learning rate) or the complexity of a model. The depth of trees in a Decision Tree or nthe umber of hidden layers in a Neural network are examples of hyperparameters.

Induction

A bottoms-up approach to answering questions or solving problems. A logic technique that goes from observations to theory. E.g. We keep observing X, so we infer that Y must be True.

Instance

A data point, row, or sample in a dataset. Another term for observation.

Label

The “answer” portion of observation in supervised learning. For example, in a dataset used to classify flowers into different species, the features might include the petal length and petal width, while the label would be the flower’s species.

Learning Rate

The size of the update steps to take during optimization loops like Gradient Descent. With a high learning rate, we can cover more ground with each step, but we risk overshooting the lowest point since the slope of the hill is constantly changing. With a very low learning rate, we can confidently move in the direction of the negative gradient since we are recalculating it so frequently. A low learning rate is more precise, but calculating the gradient is time-consuming, so it will take us a very long time to get to the bottom.

Loss

Loss = true_value(from data-set)- predicted value(from ML-model) The lower the loss, the better a model (unless the model has over-fitted to the training data). The loss is calculated on training and validation and its interpretation is how well the model is doing for these two sets. Unlike accuracy, the loss is not a percentage. It is a summation of the errors made for each example in training or validation sets.

Machine Learning

Mitchell (1997) provides a succinct definition: "A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E." In simple language machine learning is a field in which human made algorithms have the ability to learn by themselves or predict the future for unseen data.

Model

A data structure that stores a representation of a dataset (weights and biases). Models are created/learned when you train an algorithm on a dataset.

Neural Networks

Neural Networks are mathematical algorithms modelled after the brain's architecture, designed to recognize patterns and relationships in data.

Normalization

Restriction of the values of weights in regression to avoid overfitting and improve computation speed.

Noise

Any irrelevant information or randomness in a dataset which obscures the underlying pattern.

Null Accuracy

Baseline accuracy can be achieved by always predicting the most frequent class ("B has the highest frequency, so let's guess B every time").

Observation

A data point, row, or sample in a dataset. Another term for instance.

Outlier

An observation that deviates significantly from other observations in the dataset.

Overfitting

Overfitting occurs when your model learns the training data too well and incorporates details and noise specific to your dataset. You can tell a model is overfitting when it performs great on your training/validation set, but poorly on your test set (or new real-world data).

Parameters

Parameters are properties of training data learned by training a machine learning model or classifier. They are adjusted using optimization algorithms and are unique to each experiment.

Examples of parameters include:

weights in an artificial neural network

support vectors in a support vector

machine coefficients in a linear or

logistic regression

Precision

In the context of binary classification (Yes/No), precision measures the model's performance at classifying positive observations (i.e. "Yes"). In other words, when a positive value is predicted, how often is the prediction correct? We could game this metric by only returning positive for the single observation we are most confident in.

$P{=}TruePositivesTruePositives{+}FalsePositives$

Recall

Also called sensitivity. In the context of binary classification (Yes/No), recall measures how "sensitive" the classifier is at detecting positive instances. In other words, for all the true observations in our sample, how many did we "catch." We could game this metric by always classifying observations as positive.

$R{=}TruePositivesTruePositives{+}FalseNegatives$

Recall vs Precision

Say we are analyzing Brain scans and trying to predict whether a person has a tumor (True) or not (False). We feed it into our model and our model starts guessing.

Precision is the % of True guesses that were actually correct! If we guess 1 image is True out of 100 images and that image is actually True, then our precision is 100%! Our results aren't helpful however because we missed 10 brain tumours! We were super precise when we tried, but we didn't try hard enough.

Recall, or Sensitivity provides another lens through which to view how good our model is. Again let's say there are 100 images, 10 with brain tumors, and we correctly guessed 1 had a brain tumor. Precision is 100%, but recall is 10%. Perfect recall requires that we catch all 10 tumours!

Regression

Predicting a continuous output (e.g. price, sales).

Regularization

Regularization is a technique utilized to combat the overfitting problem. This is achieved by adding a complexity term to the loss function that gives a bigger loss for more complex models

Reinforcement Learning

Training a model to maximize a reward via iterative trial and error.

ROC (Receiver Operating Characteristic) Curve

A plot of the true positive rate against the false positive rate at all classification thresholds. This is used to evaluate the performance of a classification model at different classification thresholds. The area under the ROC curve can be interpreted as the probability that the model correctly distinguishes between a randomly chosen positive observation (e.g. “spam”) and a randomly chosen negative observation (e.g. “not spam”).

Segmentation

It is the process of partitioning a data set into multiple distinct sets. This separation is done such that the members of the same set are similar to each other and different from the members of other sets.

Specificity

In the context of binary classification (Yes/No), specificity measures the model’s performance at classifying negative observations (i.e. “No”). In other words, when the correct label is negative, how often is the prediction correct? We could game this metric if we predict everything as negative.

$S=TrueNegativesTrueNegatives+FalsePositives$

Supervised Learning

Training a model using a labeled dataset.

Test Set

A set of observations is used at the end of model training and validation to assess the predictive power of your model. How generalizable is your model to unseen data?

Training Set

A set of observations is used to generate machine learning models.

Transfer Learning

A machine learning method where a model developed for a task is reused as the starting point for a model on a second task. In transfer learning, we take the pre-trained weights of an already trained model (one that has been trained on millions of images belonging to 1000’s of classes, on several high power GPU’s for several days) and use these already learned features to predict new classes.

True Positive Rate

Another term for recall, i.e.

$TPR=TruePositivesTruePositives+FalseNegatives$

The True Positive Rate forms the y-axis of the ROC curve.

Type 1 Error

False Positives. Consider a company optimizing hiring practices to reduce false positives in job offers. A type 1 error occurs when a candidate seems good and they hire him, but he is actually bad.

Type 2 Error

False Negatives. The candidate was great but the company passed on him.

Underfitting

Underfitting occurs when your model over-generalizes and fails to incorporate relevant variations in your data that would give your model more predictive power. You can tell a model is underfitting when it performs poorly on both training and test sets.

Universal Approximation Theorem

A neural network with one hidden layer can approximate any continuous function but only for inputs in a specific range. If you train a network on inputs between -2 and 2, then it will work well for inputs in the same range, but you can't expect it to generalize to other inputs without retraining the model or adding more hidden neurons.

Unsupervised Learning

Training a model to find patterns in an unlabeled dataset (e.g. clustering).

Validation Set

A set of observations is used during model training to provide feedback on how well the current parameters generalize beyond the training set. If training error decreases but validation error increases, your model is likely overfitting and you should pause training.

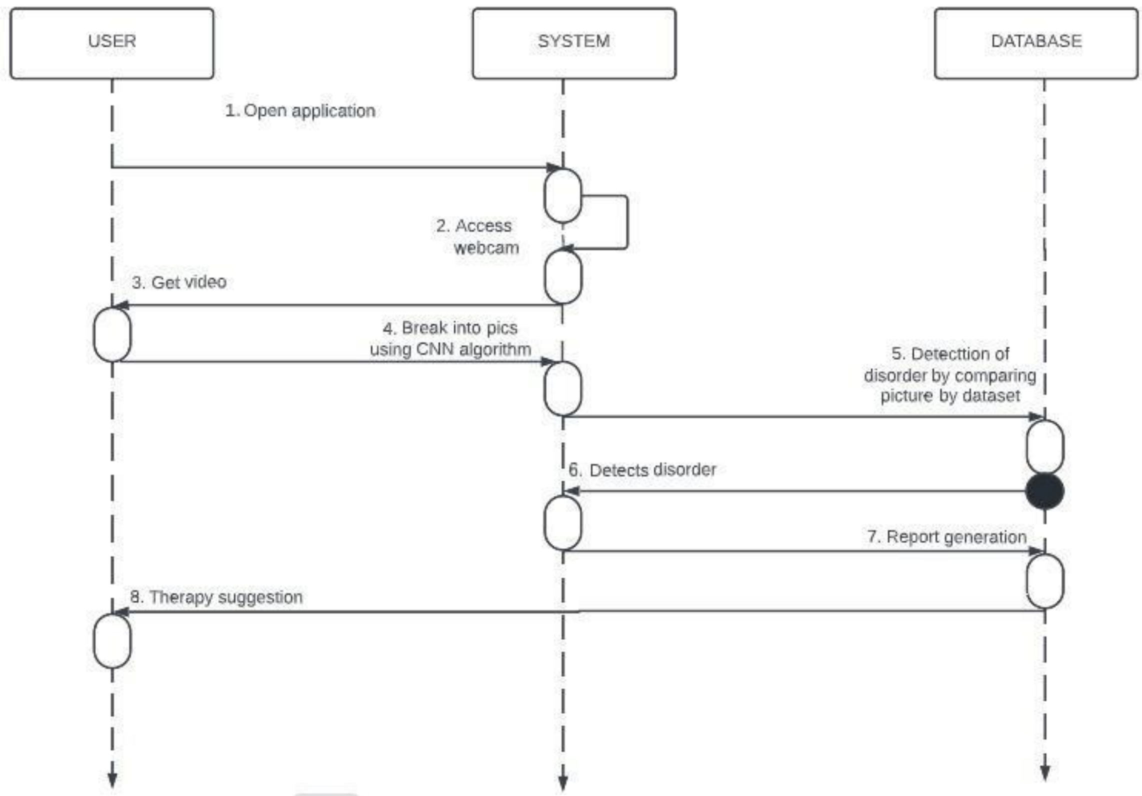
Variance

How tightly packed are your predictions for a particular observation relative to each other?

Low variance suggests your model is internally consistent, with predictions varying little from each other after every iteration.

High variance (with low bias) suggests your model may be overfitting and reading too deeply into the noise found in every training set

Appendix B: Analysis models:



Appendix C- Dissemination Activity

Dissemination activities for an ICD detection and recommender system would likely involve a variety of methods to share information about the system and its benefits to different audiences.

- **Scientific publications:** Research findings and technical details of the system can be published in peer-reviewed scientific journals or conference proceedings. This will help to disseminate the information to researchers and professionals in the field.

- **Press releases:** Press releases can be issued to inform media outlets about the system and its potential impact. This can help to generate news coverage and raise awareness among the general public.

- **Online presence:** A website or social media platforms can be used to provide information and updates on the system, as well as to engage with stakeholders and the public.

- **Conferences and workshops:** Conferences and workshops can be organized to present the system and its capabilities to professionals, researchers, and stakeholders in the field.

- **User Manuals:** User manual for the ICD detection and recommender system can be provided to the end users so that they can get the maximum benefit out of the system.

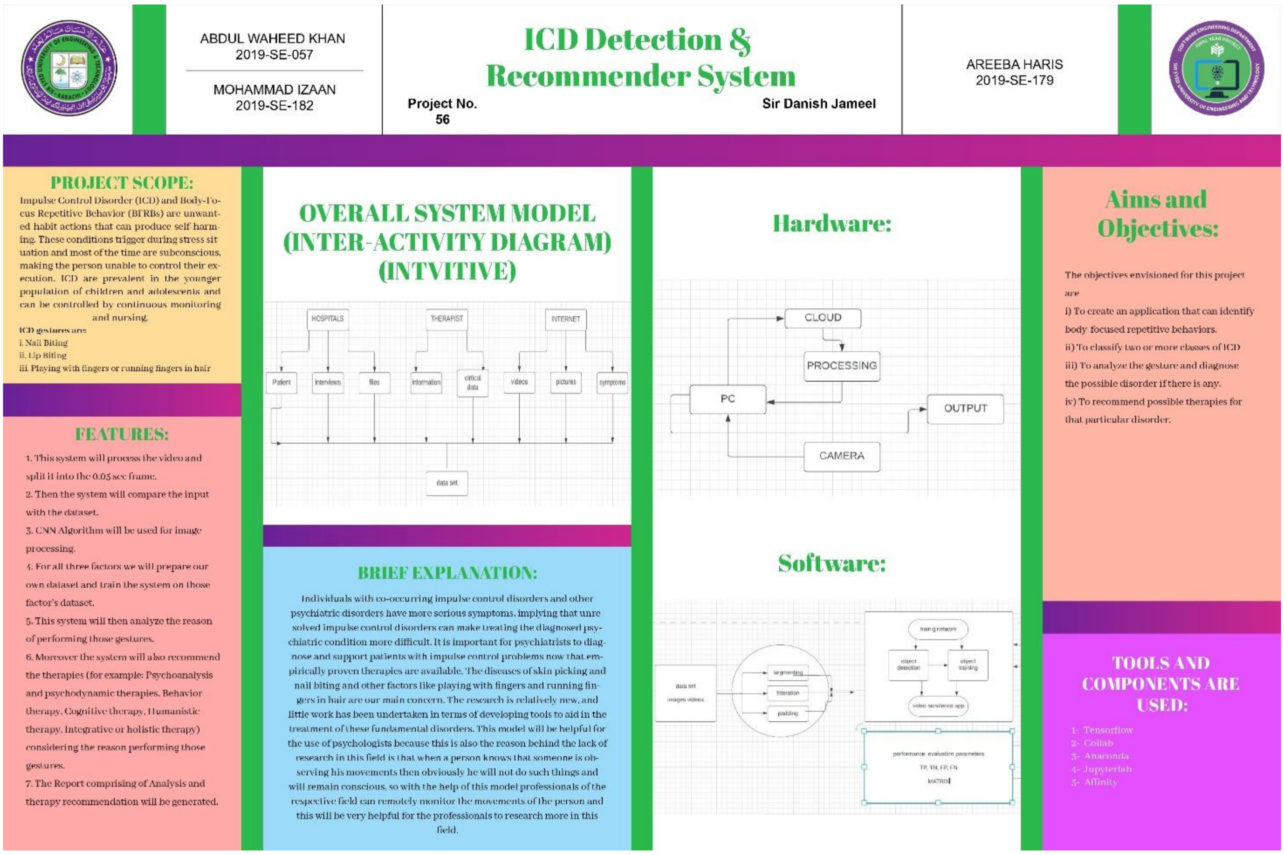
- **Training and support:** Training and support can be provided to ensure that end users are able to effectively use the system, and to address any issues that may arise.

- **Collaboration:** The system can be collaborated with other organizations or institutions to expand its reach and impact.

Overall, dissemination activities should be tailored to the specific needs and characteristics of the target audience and should aim to maximize the impact of the system and its potential benefits.

Appendix D- Marketing / Promotional Material

Poster



Standee

SIR SYED UNIVERSITY OF ENGINEERING & TECHNOLOGY

A remedy to expel cerebral chaos and be calm as a convent.

" Put a stop to the anxiety disorders before it even begins by detecting several unconventional reactions performed unconsciously through your gestures, though undetectable for you but lucid to the trouble free mental health counsellors. "

- This system will process the video and split it into the 0.05 sec frame.
- Then the system will compare the input with the dataset.
- CNN Algorithm will be used for image processing.
- For all three factors we will prepare our own dataset and train the system on those factor's dataset.
- This system will then analyze the reason of performing those gestures.
- Moreover the system will also recommend the therapies (for example: Psychoanalysis and psychodynamic therapies, Behavior therapy, Cognitive therapy, Humanistic therapy, Integrative or holistic therapy) considering the reason performing those gestures.
- The Report comprising of Analysis and therapy recommendation will be generated.

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Boucher


ICD Detection & Recommender System
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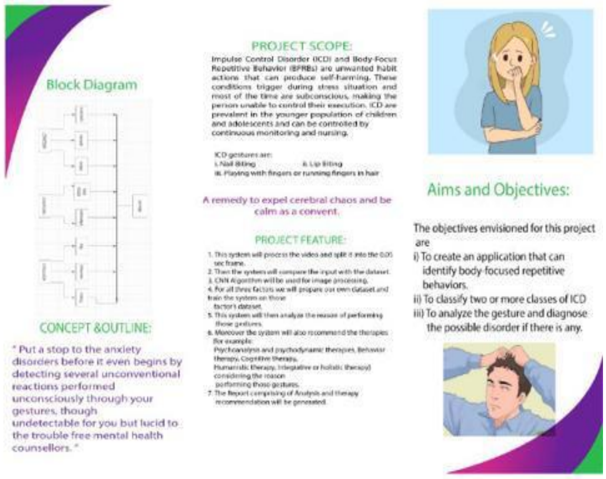
ICD DETECTION & RECOMMENDER SYSTEM


Block Diagram
CONCEPT &OUTLINE:
" Put a stop to the anxiety disorders before it even begins by detecting several unconventional reactions performed unconsciously through your gestures, though undetectable for you but lucid to the trouble free mental health counsellors. "
PROJECT SCOPE:
Impulse Control Disorder (ICD) and Body-Focus Repetitive Behavior (BFRBs) are unwanted habit actions that can produce self-harming. These conditions trigger during stress situation and most of the time are subconscious, making the person unable to control their execution. ICD are prevalent in the younger population of children and adolescents and can be controlled by continuous monitoring and nursing.
ICD gestures are:
i. Nail Biting
ii. Lip Biting
iii. Playing with fingers or running fingers in hair
A remedy to expel cerebral chaos and be calm as a convent.
PROJECT FEATURE:
Aims and Objectives:
The objectives envisioned for this project are
i) To create an application that can identify body focused repetitive behaviors.
ii) To classify two or more classes of ICD
iii) To analyze the gesture and diagnose the possible disorder if there is any.

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