Gesture Based Tool For Sterile Browsing Of Radiological Images

Team Id:PNT2022TMID48554

Report by:

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INTRODUCTION

1.1 Project Overview

In this project we use gestures to browse images obtained during radiology. Gestures refer to nonverbal form of communication made using hands.

A major challenge involved in this process is to provide doctors with efficient, intuitive, accurate and safe means of interaction without affecting the quality of their work. Keyboards and pointing devices, such as a mouse, are today's principal method of human—computer interaction. However, the use of computer keyboards and mice by doctors and nurses in intensive care units (ICUs) is a common method for spreading infections. Humans can recognize body and sign language easily. This is possible due to the combination of vision and synaptic interactions that were formed along brain development. In order to replicate this skill in computers, some problems ne ed to be solved: how to separate

objects of interest in images and which image capture technology and classification technique are more appropriate, among others. In this project Gesture based Desktop automation, First the model is trained pre trained on the images of different hand gestures, such as a showing numbers with fingers as 1,2,3,4. This model uses the integrated webcam to capture the video frame. The image of the gesture captured in the video frame is compared with the Pre-trained model and the gesture is identified.

1.2 Purpose

- To know fundamental concepts and techniques of Convolutional Neural Network.
- To gain a broad understanding of image data.
- To know how to pre-process/clean the data using different data preprocessing techniques.
- To know how to build a web application using Flask framework.

LITERATURE SURVEY

2.1 Existing Problem

A doctor needs a way to browse the radiological images during surgery so that he/she does not need to reach main control every time and also maintain sterility.

2.2 References

S.no	Title of the paper	Author name	Year of Publication	Implementation	Pros	Cons
1	Gesture based tools for sterile browsing of	Juan P.Wachs PhD Helman L.Stern	2008	This paper presents "Gestix," a vision-based hand gesture	(I)ease of use (ii) rapid reaction (iii) an unencumbere d interface	(i)visual tracking of both hands to provide a richer set of

	radiological images	PhD Y.Edan PhD M Gillam MD		capture and recognition system that interprets in real-time the user's gestures for navigation and manipulation of images in an electronic medical record (EMR) database.		gesture commands. (ii) addition of a body posture recognition system to increase the functionality of the system
2	FAceMOUSe:	N. Nishikava T.Hosai K.Koaro D.Negoro A.Hikita S.Nasaro	October 2003	The proposed human interface is an image-based system which tracks the surgeon's facial motions robustly in real time and does not require the use of any body-contact devices, such as headmounted sensing devices.	Our system allows nonintrusive, nonverbal, hands off and feet off laparoscope operations, which seem more convenient for the surgeon	An vivo experiment, in which the surgeon used the system to perform a laparoscopic cholecystectom y on a pig was only performed.
3	Bacterial contaminatio n of computer keyboards in teaching hospital	Maureen Schultz J.Gill S.Zubairi R.Huber	2003	100 keyboards in 29 clinical areas for bacterial contaminatio n. Ninety five were positive for microorganis ms. Streptococcu s, Clostridium perfringens, Enterococcus (including one vancomycinresistant Enterococcus), Staphylococc us aureus, fungi, and gramnegative organisms were isolated.	100 keyboards in 29 clinical areas for bacterial contaminatio n. Ninety five were positive for microorganis ms. Streptococcu s, Clostridium perfringens, Enterococcus (including one vancomycinresistant Enterococcus), Staphylococc us aureus, fungi, and gramnegative were isolated.	Computer equipment must be kept clean so it does not become another vehicle for transmission of pathogens to patients.
4	A non - contact mouse for surgeon - computer interaction	Graetzel C, Fong TW, Grange S, Baur C.	2004	2004 A computer vision system that enables surgeons to perform standard mouse functions with	(i)Avoids unintentional cursor control (by explicitly having to engage the system) is	. i)Adding static hand posture recognition was not felt to be a necessary,

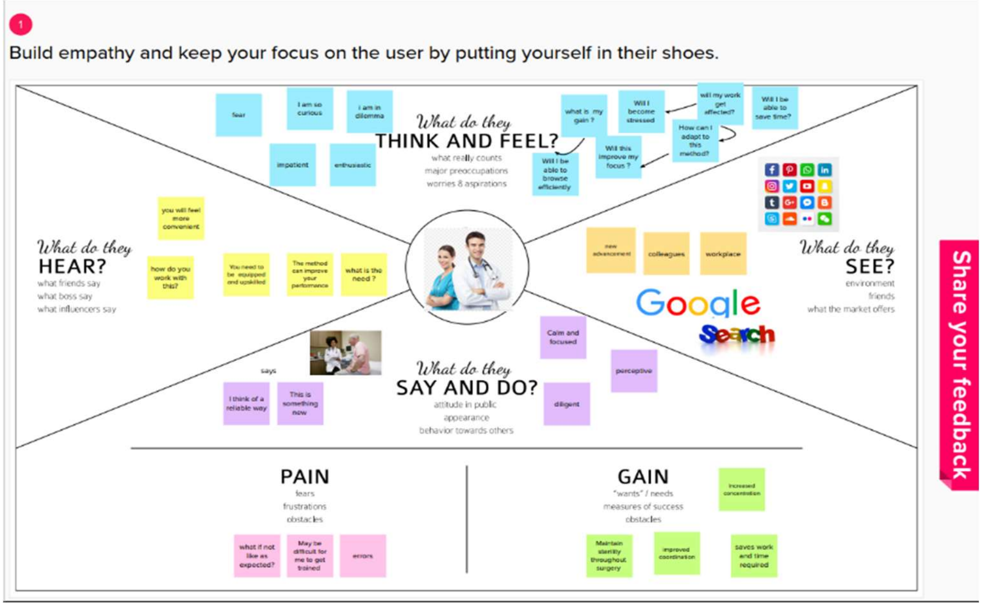
				hand gestures. The system uses color stereo cameras to detect 3D motion in a user-specified workspace and interprets hand gestures as mouse commands design feature.	considered to be an important	nor beneficial, change. (ii)The possibility of a dynamic workspace, which would follow the surgeon’s body, was also not seen as a necessary improvement.
5	Intelligent Wheelchair Remotely Controlled by Interactive Gestures.	Kuno Y, Murashima T.Shimada Shirai Y		an intelligent wheelchair whose motion can be controlled by the user's face direction. We propose to add intelligence to our wheelchair when the user is not riding. It can recognize the user's face and can move according to the gestures	guess-action observation cycle is repeated until the wheelchair can understand the user's intention	environments where wheelchairs are used cannot be controlled. This makes gestures recognition difficult.

2.3 Problem Statement Definition

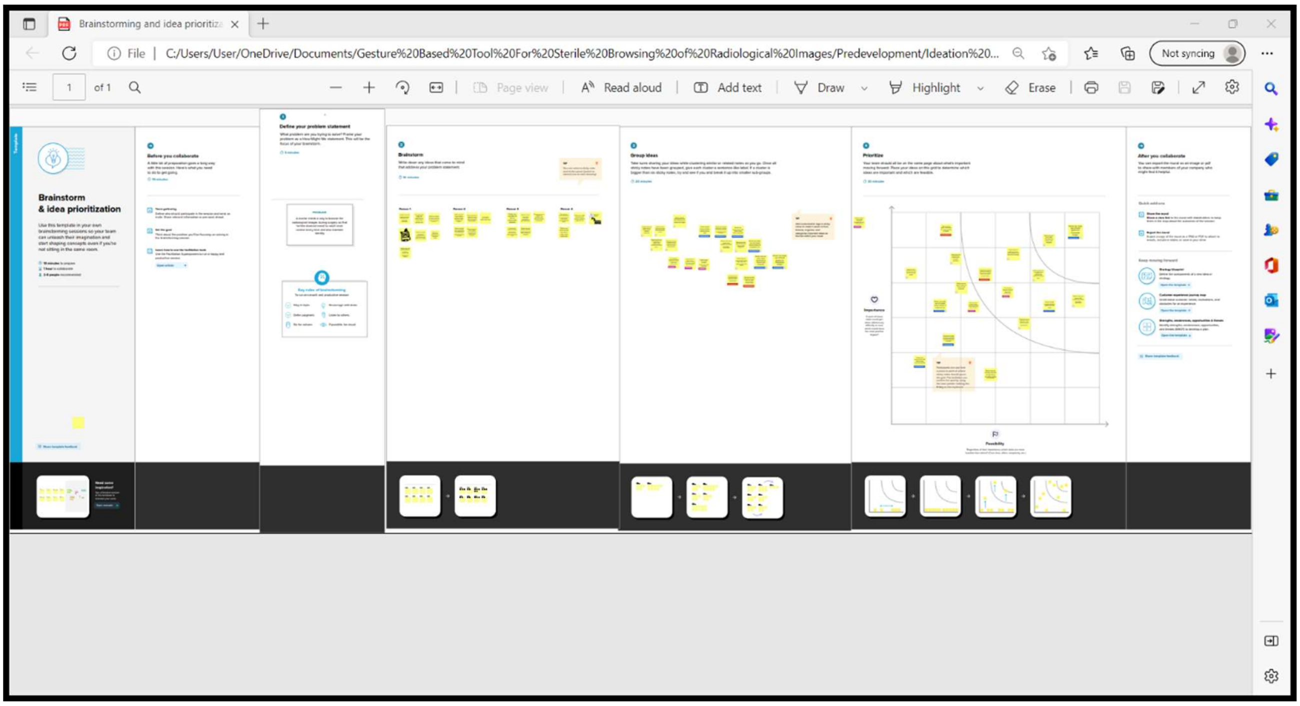
A doctor needs a way to browse the radiological images during surgery so that he/she does not need to reach main control every time and also maintain sterility

3.Ideation and Proposed Solution

3.1 Empathy Map Canvas



3.2 Ideation and Brainstorming

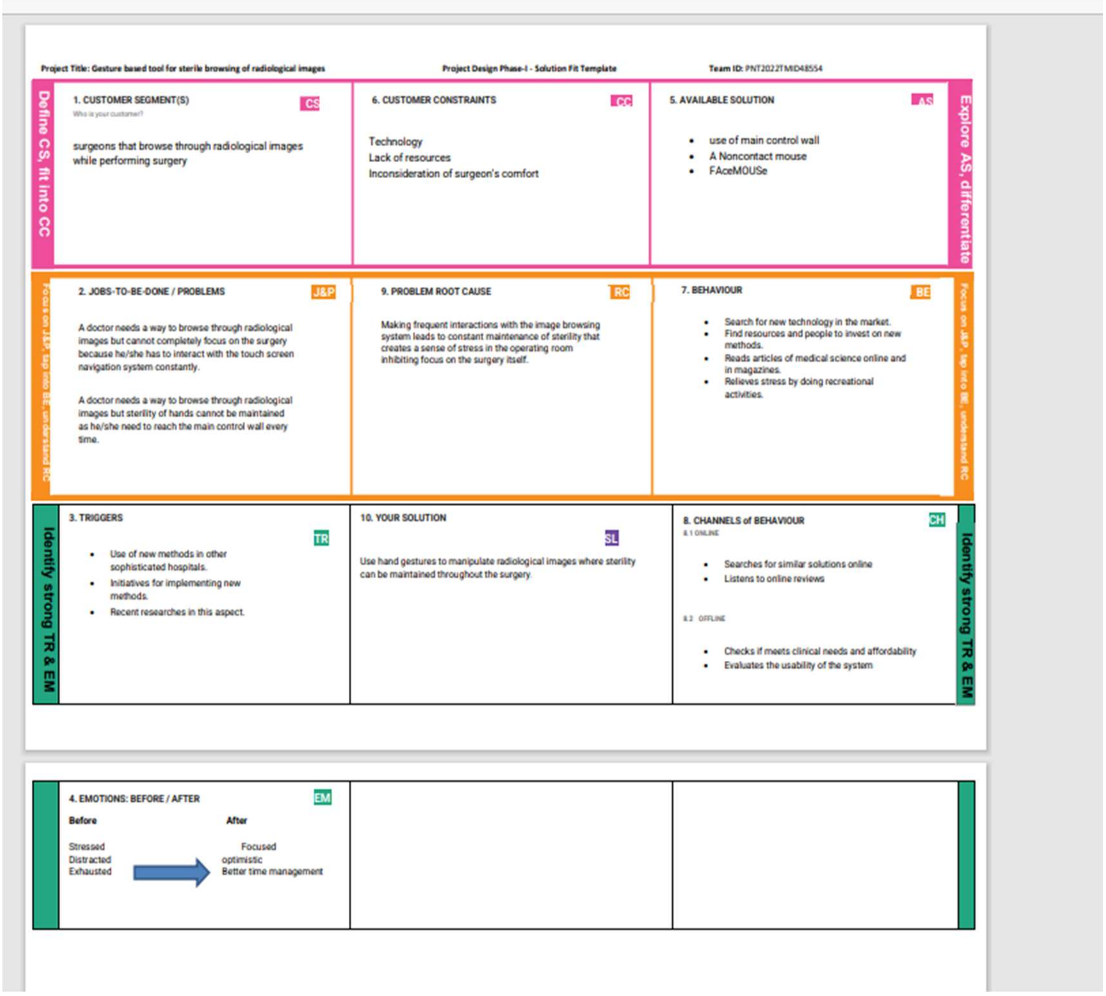

Brainstorming and idea prioritiz
File
C:/Users/User/OneDrive/Documents/Gesture%20Based%20Tool%20For%20Sterile%20Browsing%20of%20Radiological%20Images/Predevelopment/Ideation%20...
Not syncing
1
of 1
Page view
Read aloud
Add text
Draw
Highlight
Erase
Brainstorm
& idea prioritization
Before you collaborate
Define your problem statement
Brainstorm
Group ideas
Prioritize
After you collaborate

3.3 Proposed solution

S.NO	PARAMETER	DESCRIPTION
1	Problem Statement (Problem to be solved)	A doctor needs a way to browse the radiological images during surgery so that he/she does not need

		to reach main control every time and also maintain sterility.
2	Idea/ Solution description	Doctor can make use of hand gestures to manipulate images.
3	Novelty/ Uniqueness	Unlike other methods of nonverbal communication, gestures do not cause loss of concentration in OT.
4	Social Impact/ Customer Satisfaction	Contributing the corporate social responsibility by providing better solutions to the healthcare and to patients.
5	Business Model (Revenue Model)	(I)It can be collaborated with diagnosis centres and hospitals. (ii)It can be collaborated with government for health awareness camps
6	Scalability of the solution	It can be of great use in most in vivo operations of multiple specialities.

3.4 Problem Solution Fit


Define CS, fit into CC
CS
CC
AS
Explore AS, differentiate
Focus on J&P, tap into BE, understand RC
J&P
RC
BE
Focus on J&P, tap into BE, understand RC
Identify strong TR & EM
TR
SL
CH
Identify strong TR & EM
EM

Project Title: Gesture based tool for sterile browsing of radiological images

Project Design Phase-I - Solution Fit Template

Team ID: PNT2022TMID48554

1. CUSTOMER SEGMENT(S)

Who is your customer?

surgeons that browse through radiological images while performing surgery

6. CUSTOMER CONSTRAINTS

Technology
Lack of resources
Inconsideration of surgeon's comfort

5. AVAILABLE SOLUTION

- use of main control wall
- A Noncontact mouse
- FAceMOUSe

2. JOBS-TO-BE-DONE / PROBLEMS

A doctor needs a way to browse through radiological images but cannot completely focus on the surgery because he/she has to interact with the touch screen navigation system constantly.

A doctor needs a way to browse through radiological images but sterility of hands cannot be maintained as he/she need to reach the main control wall every time.

9. PROBLEM ROOT CAUSE

Making frequent interactions with the image browsing system leads to constant maintenance of sterility that creates a sense of stress in the operating room inhibiting focus on the surgery itself.

7. BEHAVIOUR

- Search for new technology in the market.
- Find resources and people to invest on new methods.
- Reads articles of medical science online and in magazines.
- Relieves stress by doing recreational activities.

3. TRIGGERS

- Use of new methods in other sophisticated hospitals.
- Initiatives for implementing new methods.
- Recent researches in this aspect.

10. YOUR SOLUTION

Use hand gestures to manipulate radiological images where sterility can be maintained throughout the surgery.

8. CHANNELS of BEHAVIOUR

8.1 ONLINE

- Searches for similar solutions online
- Listens to online reviews

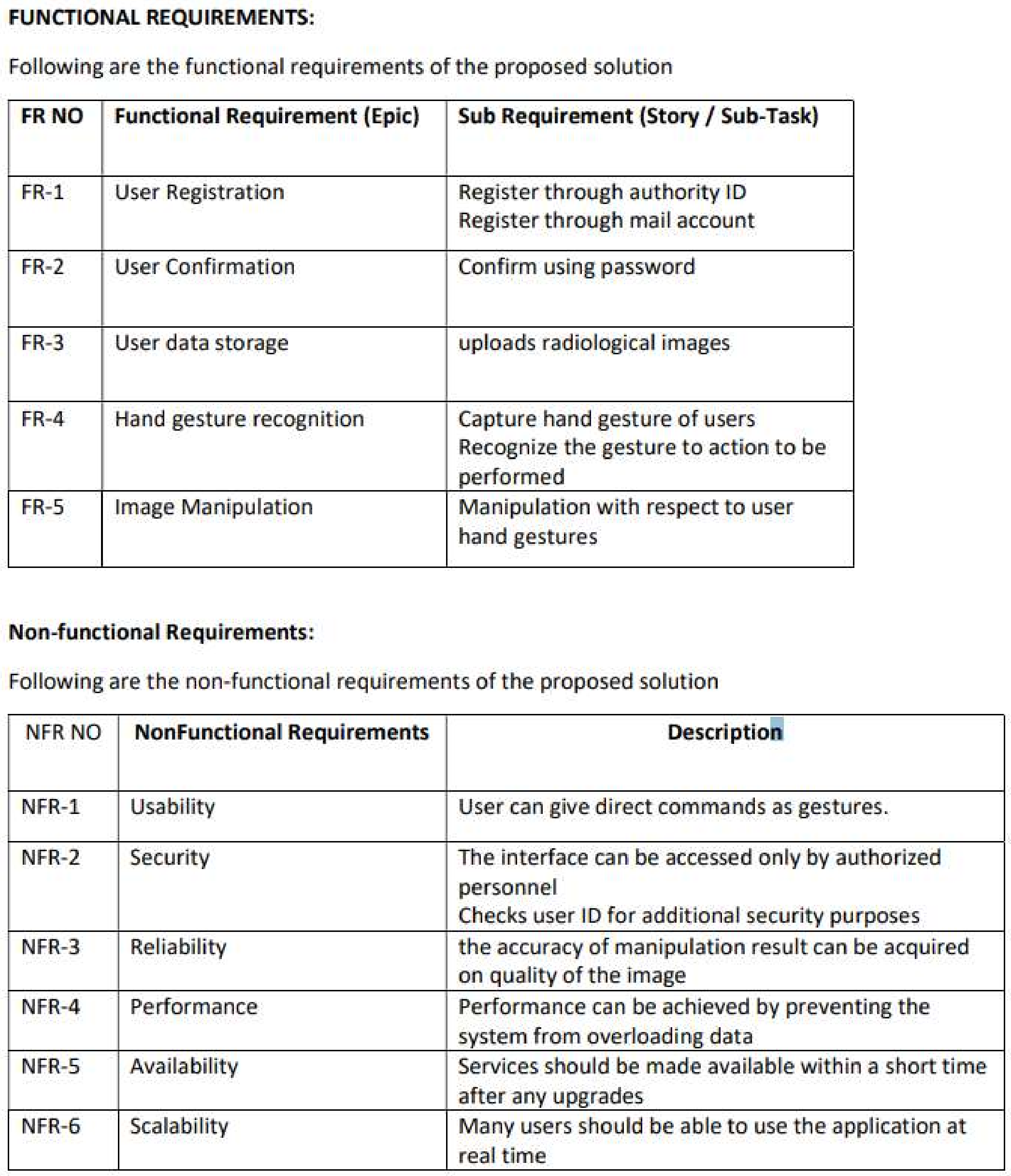
8.2 OFFLINE

- Checks if meets clinical needs and affordability
- Evaluates the usability of the system

4. EMOTIONS: BEFORE / AFTER

Before	After
Stressed	Focused
Distracted	optimistic
Exhausted	Better time management

4. REQUIREMENT ANALYSIS



FUNCTIONAL REQUIREMENTS:

Following are the functional requirements of the proposed solution

FR NO	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Register through authority ID Register through mail account
FR-2	User Confirmation	Confirm using password
FR-3	User data storage	uploads radiological images
FR-4	Hand gesture recognition	Capture hand gesture of users Recognize the gesture to action to be performed
FR-5	Image Manipulation	Manipulation with respect to user hand gestures

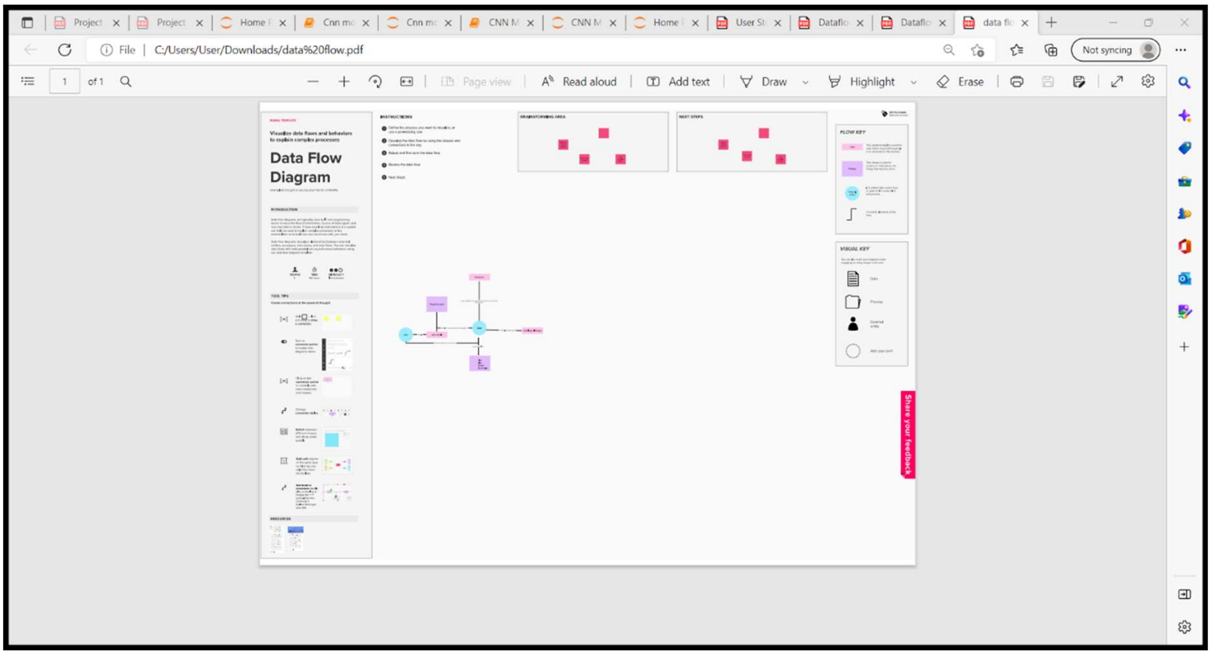
Non-functional Requirements:

Following are the non-functional requirements of the proposed solution

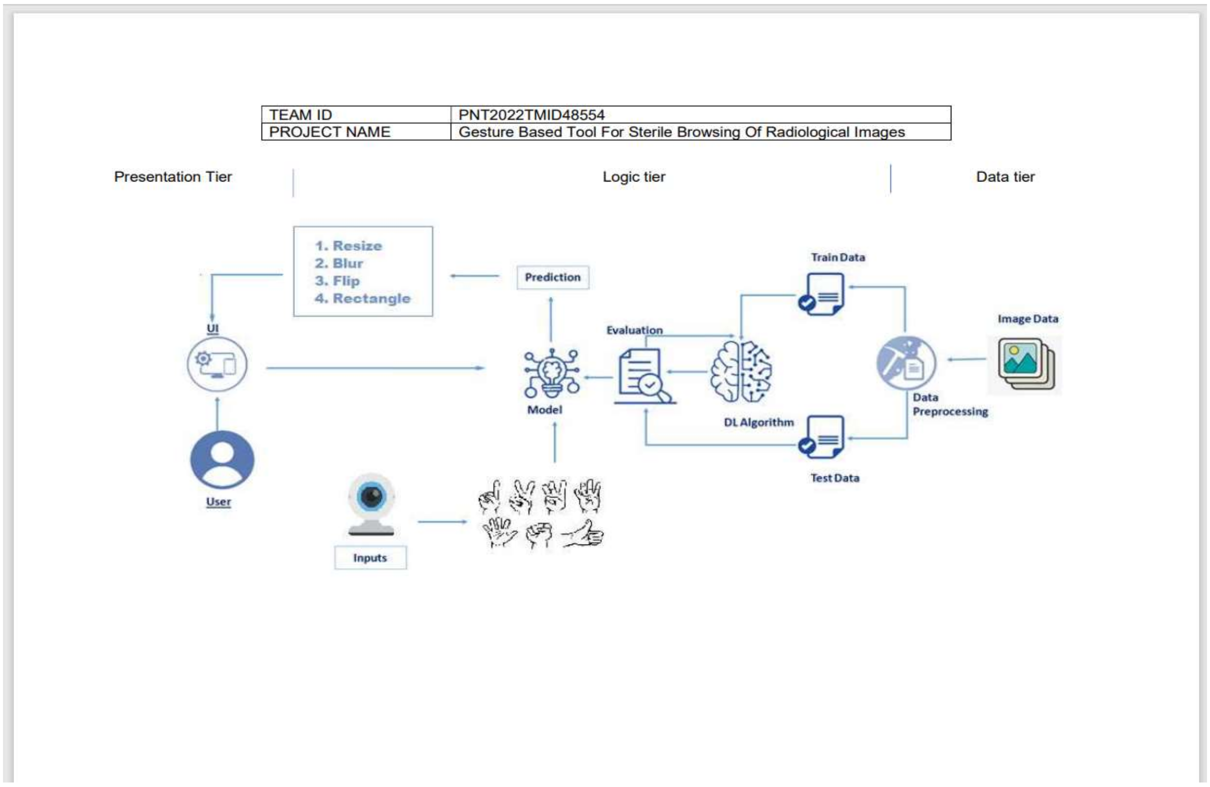
NFR NO	NonFunctional Requirements	Description
NFR-1	Usability	User can give direct commands as gestures.
NFR-2	Security	The interface can be accessed only by authorized personnel Checks user ID for additional security purposes
NFR-3	Reliability	the accuracy of manipulation result can be acquired on quality of the image
NFR-4	Performance	Performance can be achieved by preventing the system from overloading data
NFR-5	Availability	Services should be made available within a short time after any upgrades
NFR-6	Scalability	Many users should be able to use the application at real time

5. PROJECT DESIGN

5.1. Dataflow Diagram

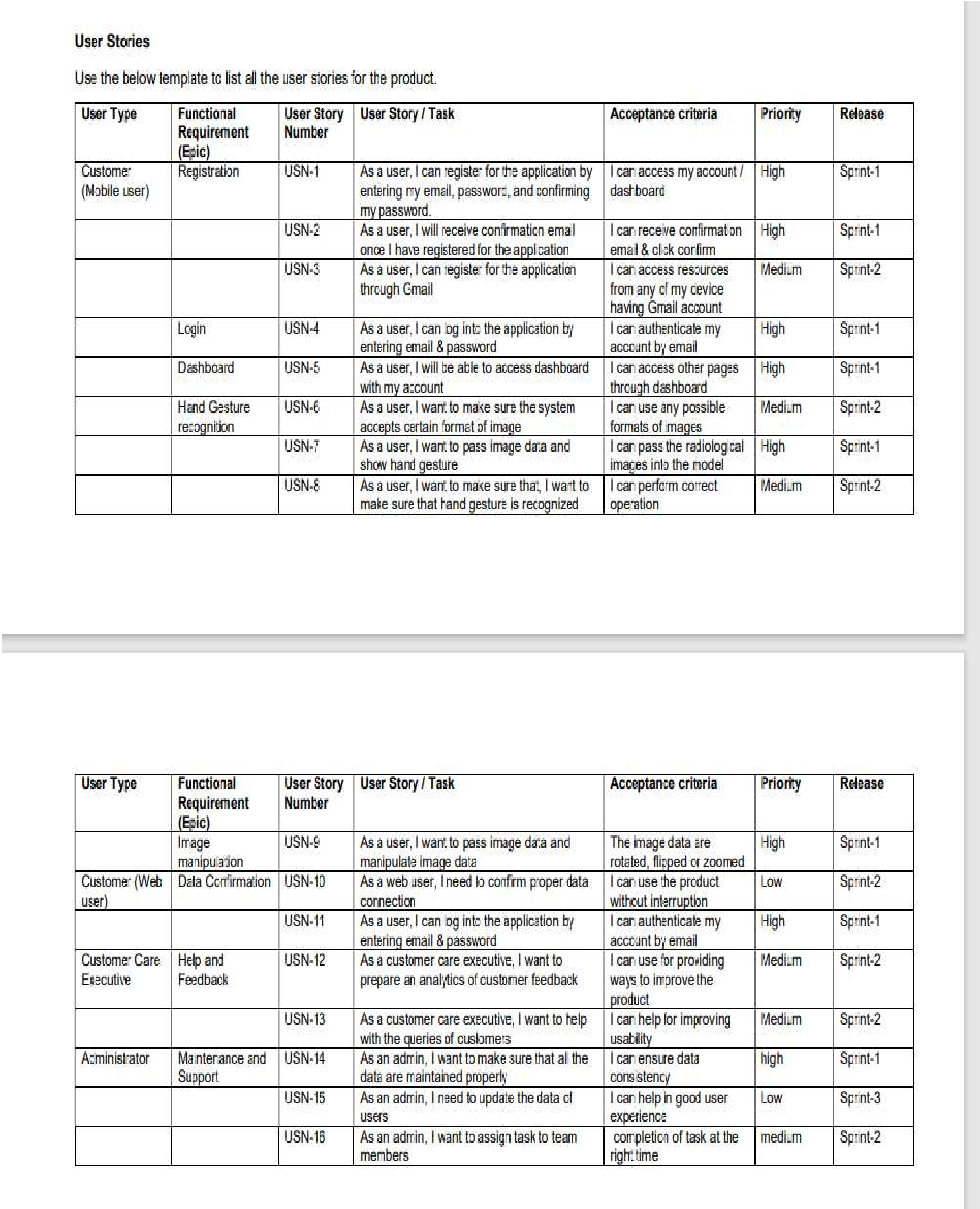


5.2 Solution and Technical Architecture



TEAM ID	PNT2022TMID48554
PROJECT NAME	Gesture Based Tool For Sterile Browsing Of Radiological Images

5.3 User Stories



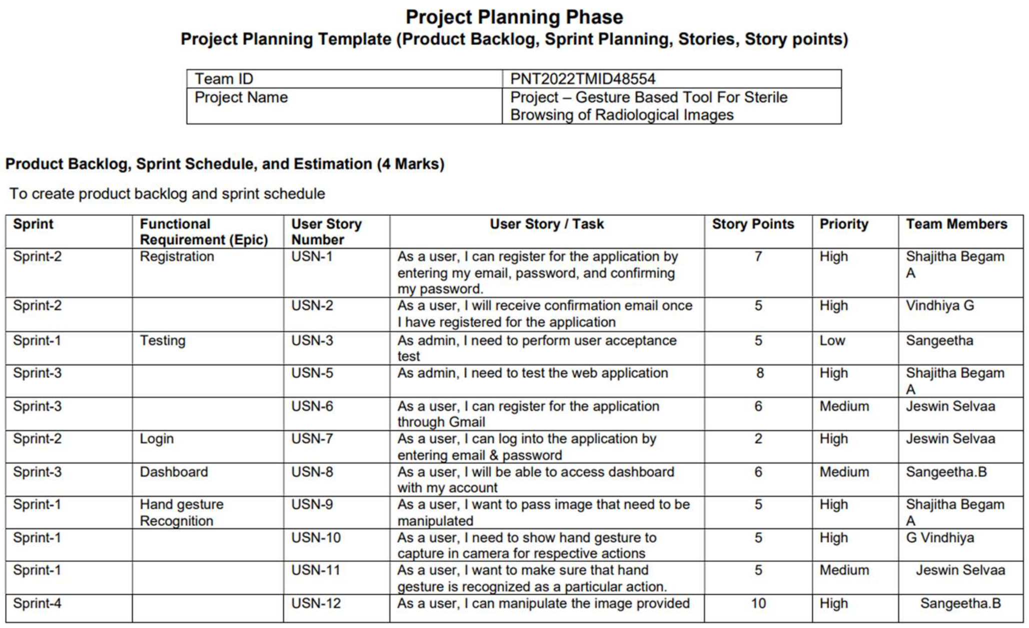
User Stories

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Gmail	I can access resources from any of my device having Gmail account	Medium	Sprint-2
	Login	USN-4	As a user, I can log into the application by entering email & password	I can authenticate my account by email	High	Sprint-1
	Dashboard	USN-5	As a user, I will be able to access dashboard with my account	I can access other pages through dashboard	High	Sprint-1
	Hand Gesture recognition	USN-6	As a user, I want to make sure the system accepts certain format of image	I can use any possible formats of images	Medium	Sprint-2
		USN-7	As a user, I want to pass image data and show hand gesture	I can pass the radiological images into the model	High	Sprint-1
		USN-8	As a user, I want to make sure that, I want to make sure that hand gesture is recognized	I can perform correct operation	Medium	Sprint-2
	Image manipulation	USN-9	As a user, I want to pass image data and manipulate image data	The image data are rotated, flipped or zoomed	High	Sprint-1
Customer (Web user)	Data Confirmation	USN-10	As a web user, I need to confirm proper data connection	I can use the product without interruption	Low	Sprint-2
		USN-11	As a user, I can log into the application by entering email & password	I can authenticate my account by email	High	Sprint-1
Customer Care Executive	Help and Feedback	USN-12	As a customer care executive, I want to prepare an analytics of customer feedback	I can use for providing ways to improve the product	Medium	Sprint-2
		USN-13	As a customer care executive, I want to help with the queries of customers	I can help for improving usability	Medium	Sprint-2
Administrator	Maintenance and Support	USN-14	As an admin, I want to make sure that all the data are maintained properly	I can ensure data consistency	high	Sprint-1
		USN-15	As an admin, I need to update the data of users	I can help in good user experience	Low	Sprint-3
		USN-16	As an admin, I want to assign task to team members	completion of task at the right time	medium	Sprint-2

6.PROJECT PLANNING AND SOLUTIONING

6.1 Sprint Planning and Estimation



Project Planning Phase

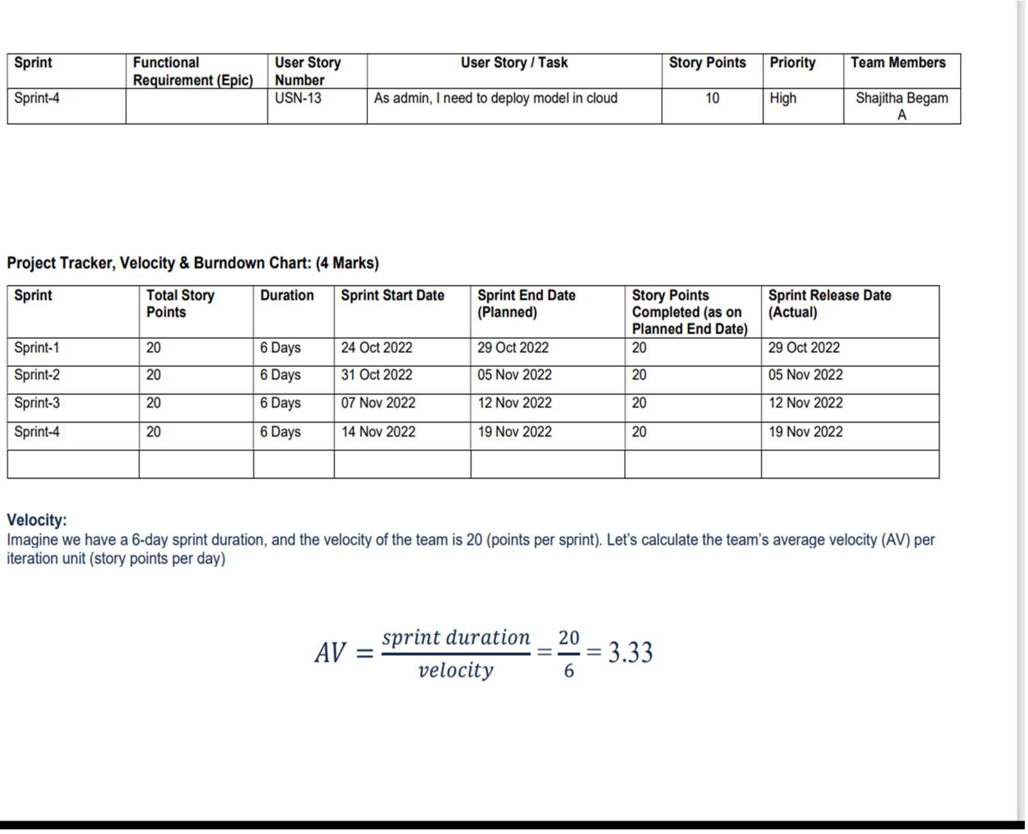
Project Planning Template (Product Backlog, Sprint Planning, Stories, Story points)

Team ID	PNT2022TMID48554
Project Name	Project – Gesture Based Tool For Sterile Browsing of Radiological Images

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

To create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	7	High	Shajitha Begam A
Sprint-2		USN-2	As a user, I will receive confirmation email once I have registered for the application	5	High	Vindhiya G
Sprint-1	Testing	USN-3	As admin, I need to perform user acceptance test	5	Low	Sangeetha
Sprint-3		USN-5	As admin, I need to test the web application	8	High	Shajitha Begam A
Sprint-3		USN-6	As a user, I can register for the application through Gmail	6	Medium	Jeswin Selvaa
Sprint-2	Login	USN-7	As a user, I can log into the application by entering email & password	2	High	Jeswin Selvaa
Sprint-3	Dashboard	USN-8	As a user, I will be able to access dashboard with my account	6	Medium	Sangeetha.B
Sprint-1	Hand gesture Recognition	USN-9	As a user, I want to pass image that need to be manipulated	5	High	Shajitha Begam A
Sprint-1		USN-10	As a user, I need to show hand gesture to capture in camera for respective actions	5	High	G Vindhiya
Sprint-1		USN-11	As a user, I want to make sure that hand gesture is recognized as a particular action.	5	Medium	Jeswin Selvaa
Sprint-4		USN-12	As a user, I can manipulate the image provided	10	High	Sangeetha.B



Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-4		USN-13	As admin, I need to deploy model in cloud	10	High	Shajitha Begam A

Project Tracker, Velocity & Burndown Chart: (4 Marks)

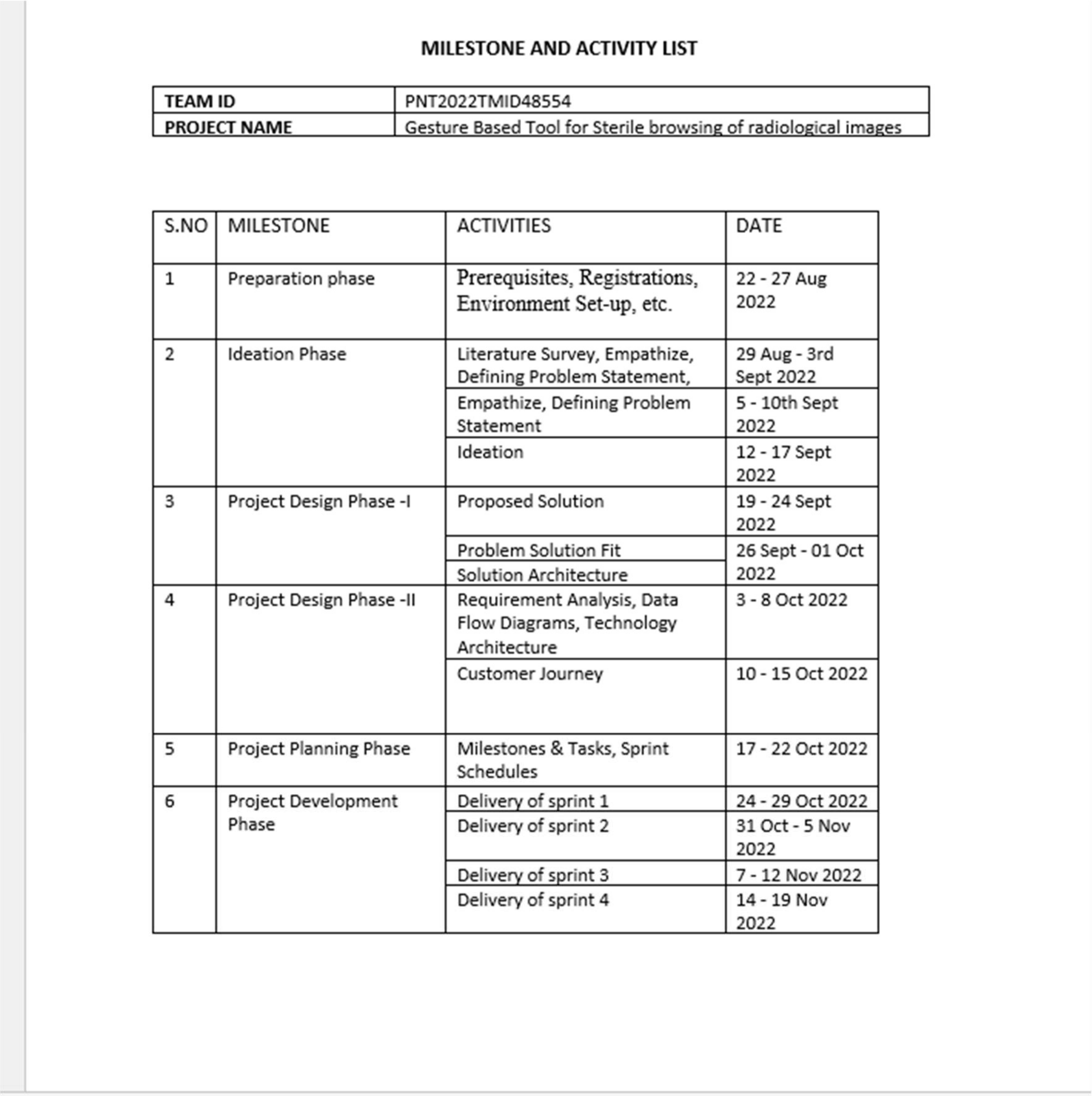
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

Velocity:

Imagine we have a 6-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{6} = 3.33$$

6.2 Sprint Delivery Schedule

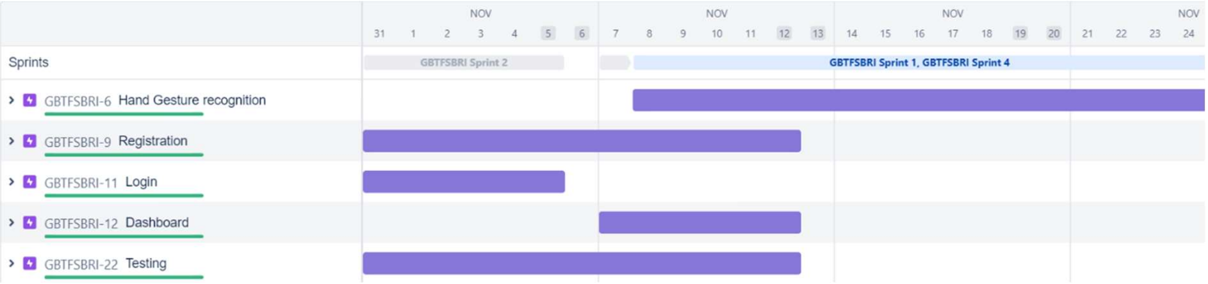


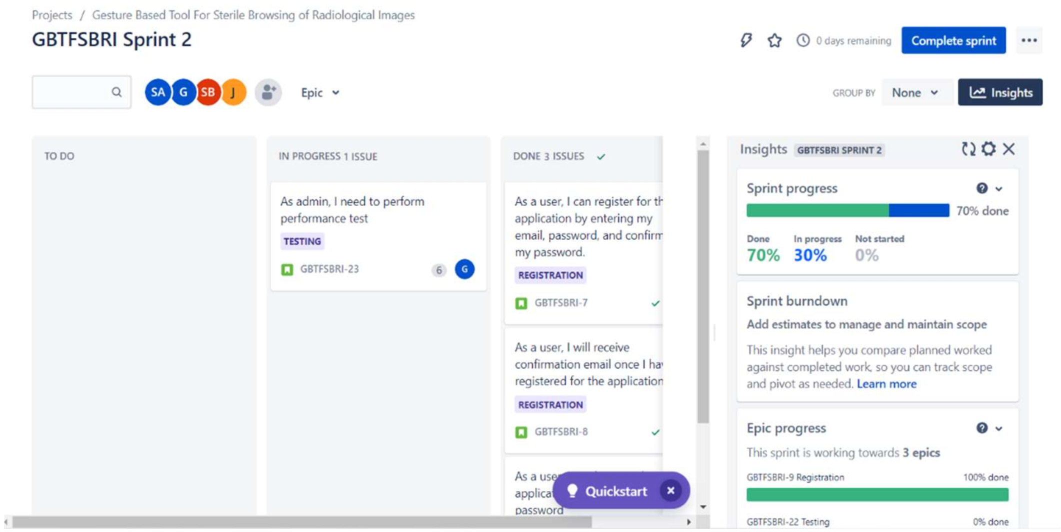
MILESTONE AND ACTIVITY LIST

TEAM ID	PNT2022TMID48554
PROJECT NAME	Gesture Based Tool for Sterile browsing of radiological images

S.NO	MILESTONE	ACTIVITIES	DATE
1	Preparation phase	Prerequisites, Registrations, Environment Set-up, etc.	22 - 27 Aug 2022
2	Ideation Phase	Literature Survey, Empathize, Defining Problem Statement,	29 Aug - 3rd Sept 2022
		Empathize, Defining Problem Statement	5 - 10th Sept 2022
		Ideation	12 - 17 Sept 2022
3	Project Design Phase -I	Proposed Solution	19 - 24 Sept 2022
		Problem Solution Fit	26 Sept - 01 Oct 2022
		Solution Architecture	
4	Project Design Phase -II	Requirement Analysis, Data Flow Diagrams, Technology Architecture	3 - 8 Oct 2022
		Customer Journey	10 - 15 Oct 2022
5	Project Planning Phase	Milestones & Tasks, Sprint Schedules	17 - 22 Oct 2022
6	Project Development Phase	Delivery of sprint 1	24 - 29 Oct 2022
		Delivery of sprint 2	31 Oct - 5 Nov 2022
		Delivery of sprint 3	7 - 12 Nov 2022
		Delivery of sprint 4	14 - 19 Nov 2022

6.3. Reports From Jira





As admin, I need to perform performance test
TESTING
GBTFSBRI-23 6 G

As a user, I can register for th application by entering my email, password, and confirm my password.
REGISTRATION
GBTFSBRI-7

As a user, I will receive confirmation email once I hav registered for the application
REGISTRATION
GBTFSBRI-8

As a use applica password

Sprint progress
70% done
Done 70% In progress 30% Not started 0%

Sprint burndown
Add estimates to manage and maintain scope
This insight helps you compare planned worked against completed work, so you can track scope and pivot as needed. Learn more

Epic progress
This sprint is working towards **3 epics**
GBTFSBRI-9 Registration 100% done
GBTFSBRI-22 Testing 0% done

7. CODING AND SOLUTIONING

7.1 Feature 1

User interacts with the UI (User Interface) to upload the image as input.

Depending on the different gesture inputs different operations are applied to the input image.

Once model analyses the gesture, the prediction with operation applied on image is showcased on the UI. To accomplish this, we have to complete all the activities and tasks listed below:

- Create an HTML file
- Build Python Code Following software, concepts and packages are used in this project
- Data Collection
  - Collect the dataset or Create the dataset
- Data Pre processing
  - Import the ImageDataGenerator library
  - Configure ImageDataGenerator class
  - Apply ImageDataGenerator functionality to Trainset and Testset
- Model Building
  - Import the model building Libraries
  - Initializing the model o Adding Input Layer
  - Adding Hidden Layer o Adding Output Layer
  - Configure the Learning Process o Training and testing the model
  - Save the Model
- Application Building

○ Create an HTML file

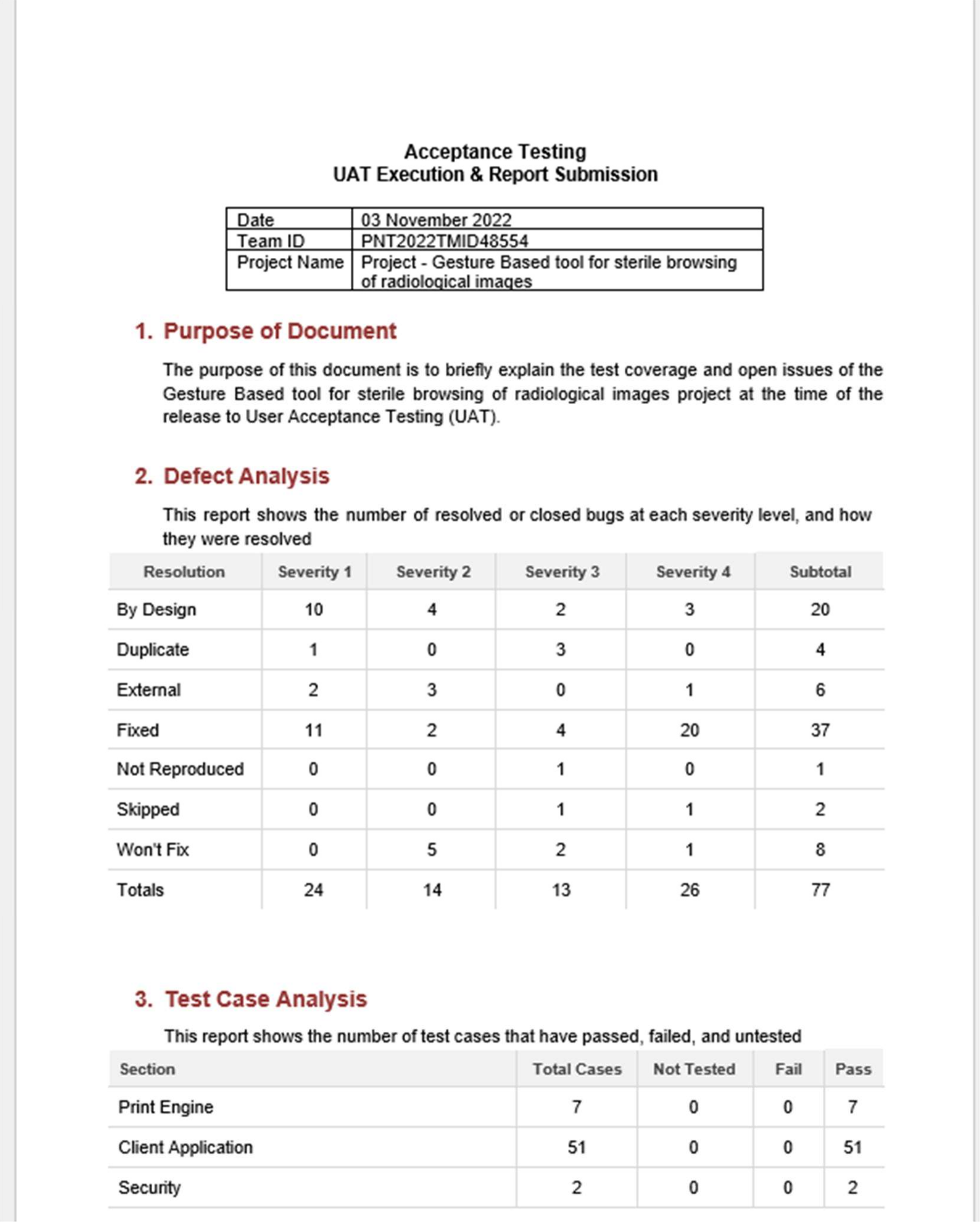
○ Build Python Code software, concepts and packages are used in this project

7.2 Feature 2

8. TESTING

8.1 Test Cases

8.2 User Acceptance Testing



Acceptance Testing
UAT Execution & Report Submission

Date	03 November 2022
Team ID	PNT2022TMID48554
Project Name	Project - Gesture Based tool for sterile browsing of radiological images

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Gesture Based tool for sterile browsing of radiological images project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

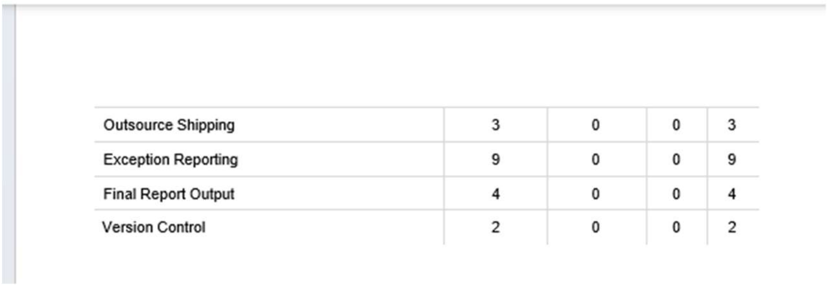
This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

3. Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

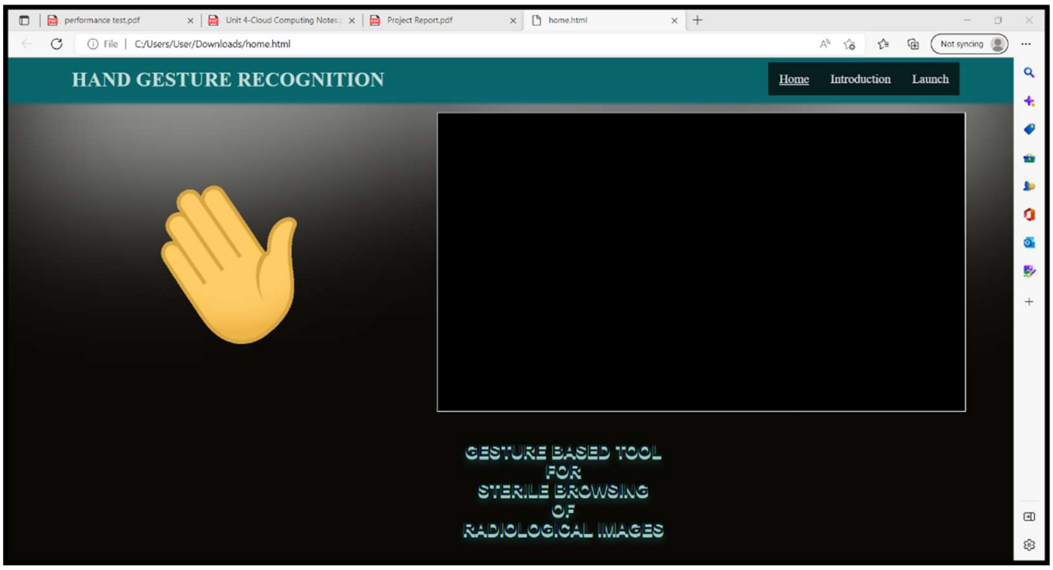
Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	51	0	0	51
Security	2	0	0	2



Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

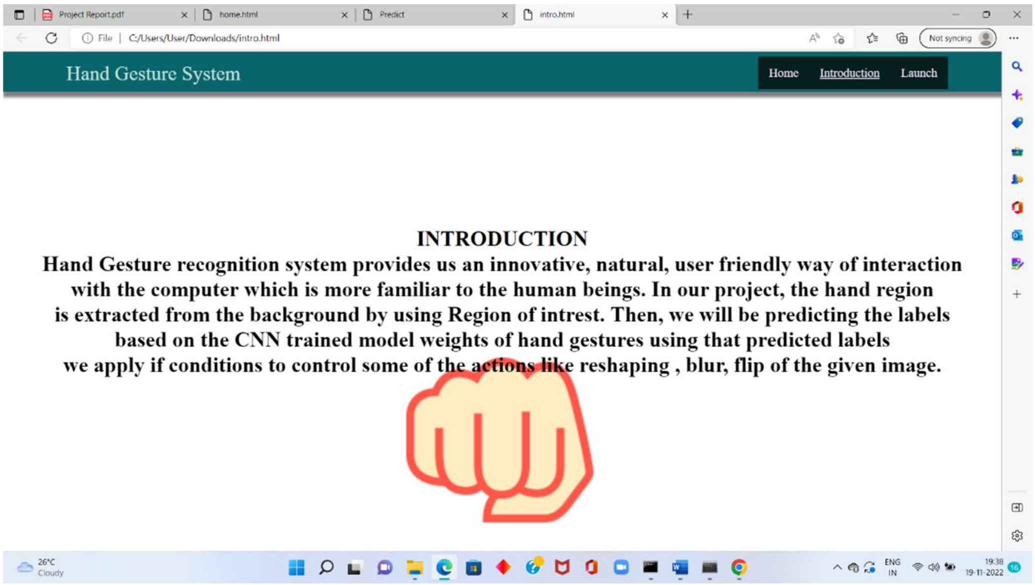
9.RESULTS

Final findings (Output) of the project along with screenshots. Through this project we found that we can maintain the sterility of an operation theater, etc by using hand based gesture tools to browse the images obtained.



HAND GESTURE RECOGNITION

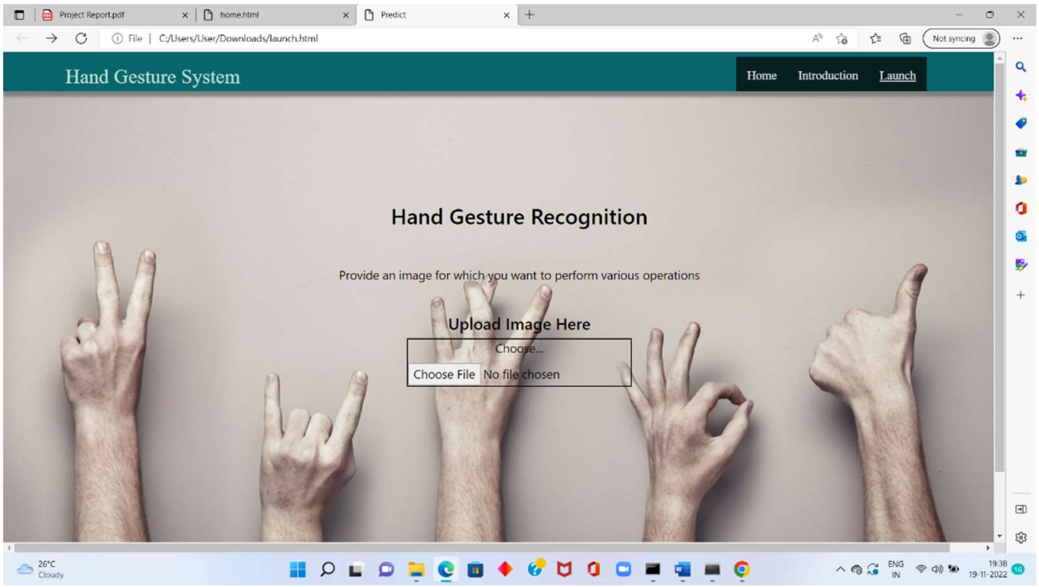
GESTURE BASED TOOL
FOR
STERILE BROWSING
OF
RADIOLOGICAL IMAGES



Hand Gesture System

INTRODUCTION

Hand Gesture recognition system provides us an innovative, natural, user friendly way of interaction with the computer which is more familiar to the human beings. In our project, the hand region is extracted from the background by using Region of intrest. Then, we will be predicting the labels based on the CNN trained model weights of hand gestures using that predicted labels we apply if conditions to control some of the actions like reshaping , blur, flip of the given image.



Hand Gesture System

Home Introduction Launch

Hand Gesture Recognition

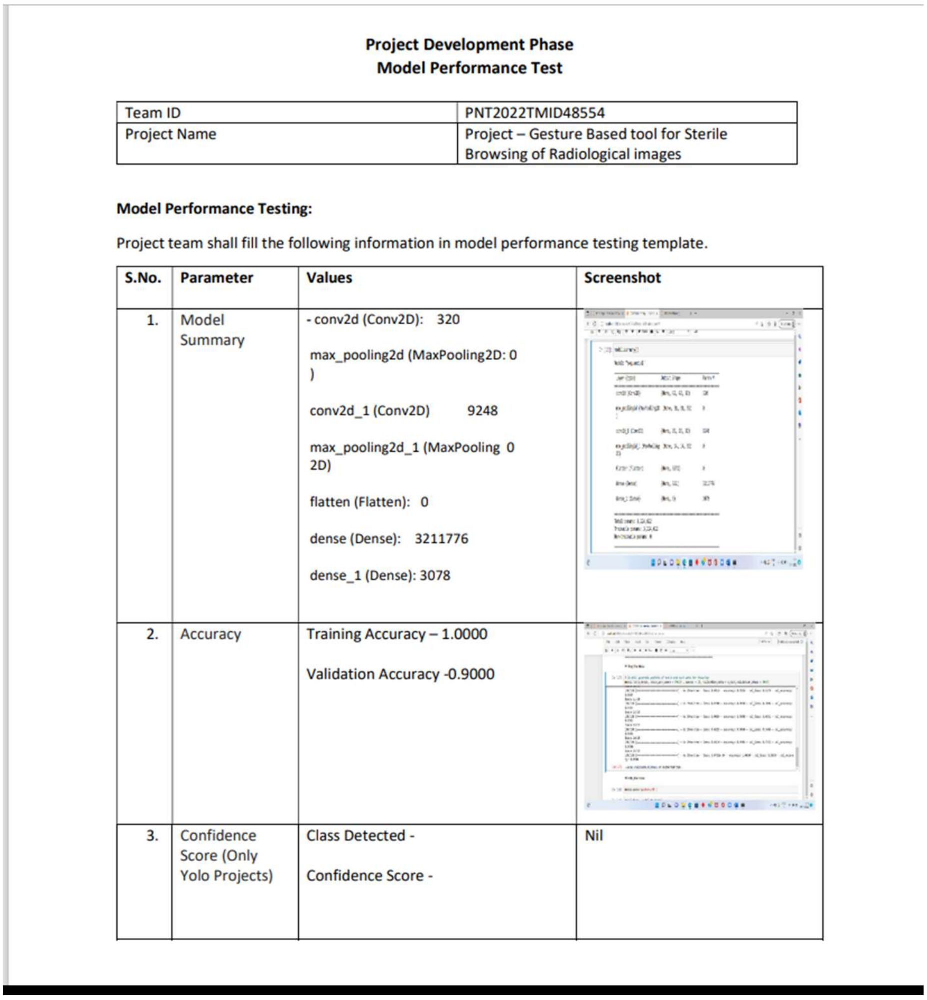
Provide an image for which you want to perform various operations

Upload Image Here

Choose...

Choose File No file chosen

9.1 Performance Metrics



Project Development Phase
Model Performance Test

Team ID	PNT2022TMID48554
Project Name	Project – Gesture Based tool for Sterile Browsing of Radiological images

Model Performance Testing:

Project team shall fill the following information in model performance testing template.

S.No.	Parameter	Values	Screenshot
1.	Model Summary	- conv2d (Conv2D): 320 max_pooling2d (MaxPooling2D: 0) conv2d_1 (Conv2D) 9248 max_pooling2d_1 (MaxPooling 0 2D) flatten (Flatten): 0 dense (Dense): 3211776 dense_1 (Dense): 3078	
2.	Accuracy	Training Accuracy – 1.0000 Validation Accuracy -0.9000	
3.	Confidence Score (Only Yolo Projects)	Class Detected - Confidence Score -	Nil

10.ADVANTAGES AND DISADVANTAGES

Advantages:

Major advantage of this tool is that it helps to maintain the sterility of the environment.
It is also easy to use and is quicker than the existing methods to browse images.
It can also be performed even if the surgeon is a bit far away from the system, this helps to save time.
The tool does not need the person using it to have an apparatus or any devices on them to use it. They can simply move their hands to browse through the images.

Disadvantages:

The tool can be quite expensive as it requires cameras and other expensive devices to capture images and process it.

11. CONCLUSION

In this project we developed a tool which recognises hand gestures and enables doctors to browse through radiology images using these gestures. This enables doctors and surgeons to maintain the sterility as they would not have to touch any mouse or keyboard to go through the images. This tool is also easy to use and is quicker than the regular method of using mouse/keyboard. It can be used regardless of the users location since they don't have to be in contact with any device. It also does not require the user to have any device on them to use it. Further this technology can be extended to other industries like it can be used by presenters, by teachers for show images in the classroom, etc

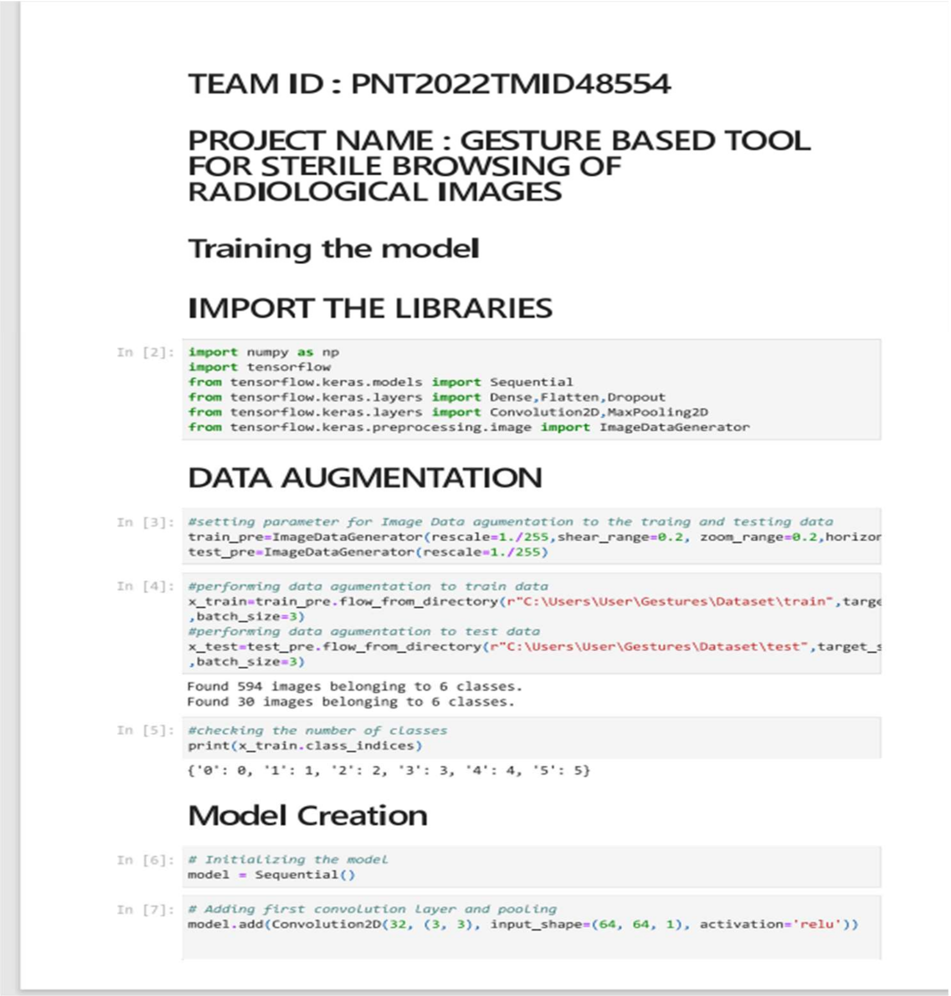
12. FUTURE SCOPE

The tool can be made quicker by increasing the recognition speed.
More number of gestures can be added thereby increasing this tool's functionality and usability for different purposes.
Tracking of both hands can be added to increase the set of commands.
Voice commands can also be added to further increase the functionality**.**

13. APPENDIX

Source Code

Model Building



TEAM ID : PNT2022TMID48554

PROJECT NAME : GESTURE BASED TOOL FOR STERILE BROWSING OF RADIOLOGICAL IMAGES

Training the model

IMPORT THE LIBRARIES

```
In [2]: import numpy as np
        import tensorflow
        from tensorflow.keras.models import Sequential
        from tensorflow.keras.layers import Dense,Flatten,Dropout
        from tensorflow.keras.layers import Convolution2D,MaxPooling2D
        from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

DATA AUGMENTATION

```
In [3]: #setting parameter for Image Data agumentation to the traing and testing data
        train_pre=ImageDataGenerator(rescale=1./255,shear_range=0.2, zoom_range=0.2,horizor
        test_pre=ImageDataGenerator(rescale=1./255)
```

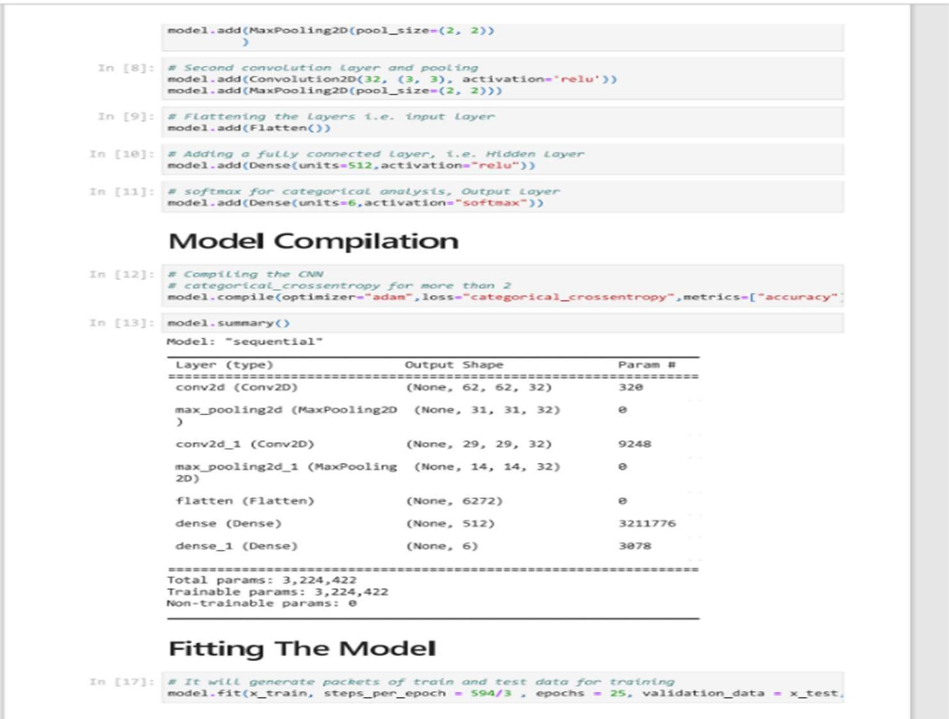
```
In [4]: #performing data agumentation to train data
        x_train=train_pre.flow_from_directory(r"C:\Users\User\Gestures\Dataset\train",targe
        ,batch_size=3)
        #performing data agumentation to test data
        x_test=test_pre.flow_from_directory(r"C:\Users\User\Gestures\Dataset\test",target_s
        ,batch_size=3)

        Found 594 images belonging to 6 classes.
        Found 30 images belonging to 6 classes.
```

```
In [5]: #checking the number of classes
        print(x_train.class_indices)

        {'0': 0, '1': 1, '2': 2, '3': 3, '4': 4, '5': 5}
```

Model Creation

```
In [6]: # Initializing the model
        model = Sequential()
```

```
In [7]: # Adding first convolution layer and pooling
        model.add(Convolution2D(32, (3, 3), input_shape=(64, 64, 1), activation='relu'))
```



```
        model.add(MaxPooling2D(pool_size=(2, 2))
              )
```

```
In [8]: # Second convolution layer and pooling
        model.add(Convolution2D(32, (3, 3), activation='relu'))
        model.add(MaxPooling2D(pool_size=(2, 2)))
```

```
In [9]: # Flattening the layers i.e. input layer
        model.add(Flatten())
```

```
In [10]: # Adding a fully connected layer, i.e. Hidden layer
         model.add(Dense(units=512,activation="relu"))
```

```
In [11]: # softmax for categorical analysis, Output Layer
         model.add(Dense(units=6,activation="softmax"))
```

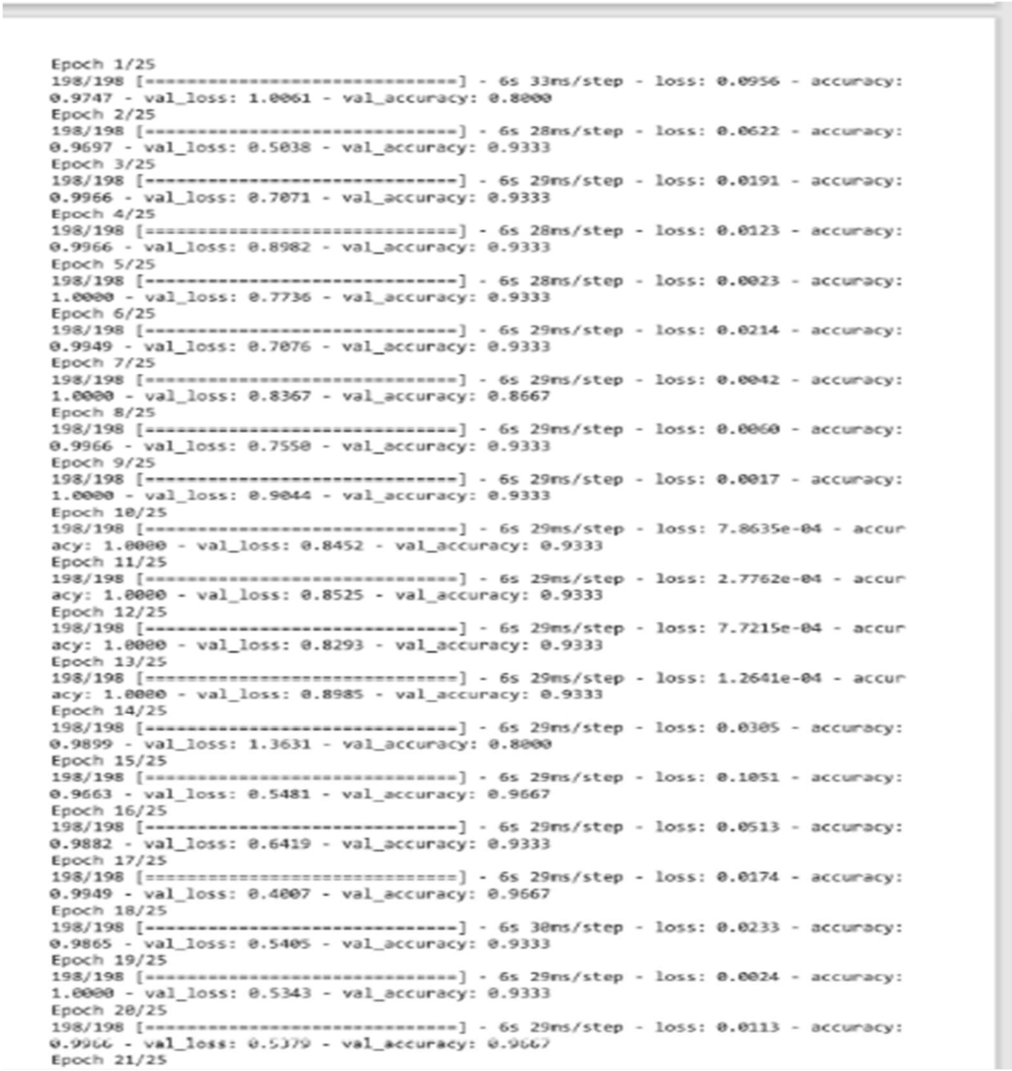
Model Compilation

```
In [12]: # Compiling the CNN
         # categorical_crossentropy for more than 2
         model.compile(optimizer="adam",loss="categorical_crossentropy",metrics=["accuracy"
```

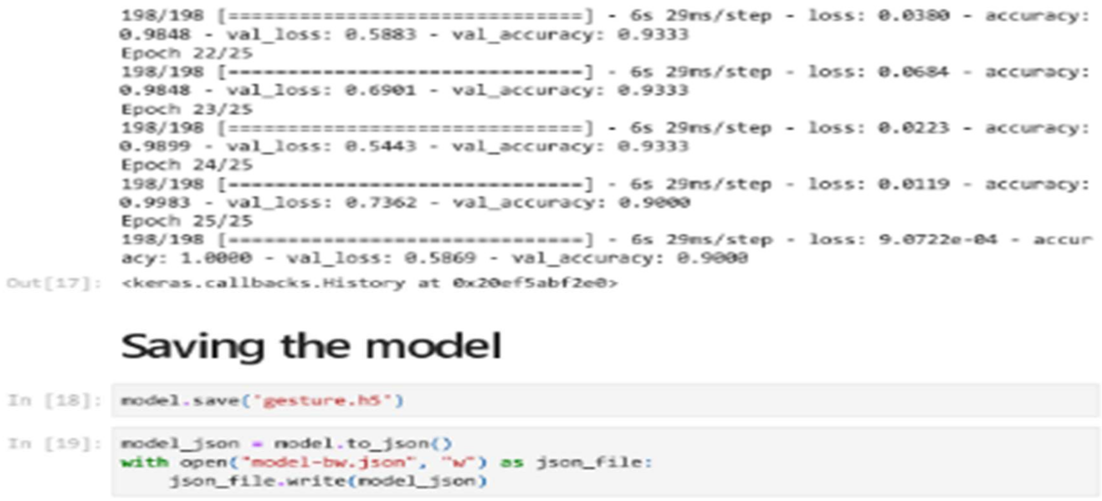
```
In [13]: model.summary()

         Model: "sequential"
         _________________________________________________________________
          Layer (type)                Output Shape              Param #
         =================================================================
          conv2d (Conv2D)             (None, 62, 62, 32)        320

          max_pooling2d (MaxPooling2D  (None, 31, 31, 32)       0
          )

          conv2d_1 (Conv2D)           (None, 29, 29, 32)        9248

          max_pooling2d_1 (MaxPooling  (None, 14, 14, 32)       0
          2D)

          flatten (Flatten)           (None, 6272)              0

          dense (Dense)               (None, 512)               3211776

          dense_1 (Dense)             (None, 6)                 3078

         =================================================================
         Total params: 3,224,422
         Trainable params: 3,224,422
         Non-trainable params: 0
         _________________________________________________________________
```

Fitting The Model

```
In [17]: # It will generate packets of train and test data for training
         model.fit(x_train, steps_per_epoch = 594/3 , epochs = 25, validation_data = x_test,
```



```
Epoch 1/25
198/198 [==============================] - 6s 33ms/step - loss: 0.0956 - accuracy:
0.9747 - val_loss: 1.0061 - val_accuracy: 0.8000
Epoch 2/25
198/198 [==============================] - 6s 28ms/step - loss: 0.0622 - accuracy:
0.9697 - val_loss: 0.5038 - val_accuracy: 0.9333
Epoch 3/25
198/198 [==============================] - 6s 29ms/step - loss: 0.0191 - accuracy:
0.9966 - val_loss: 0.7071 - val_accuracy: 0.9333
Epoch 4/25
198/198 [==============================] - 6s 28ms/step - loss: 0.0123 - accuracy:
0.9966 - val_loss: 0.8982 - val_accuracy: 0.9333
Epoch 5/25
198/198 [==============================] - 6s 28ms/step - loss: 0.0023 - accuracy:
1.0000 - val_loss: 0.7736 - val_accuracy: 0.9333
Epoch 6/25
198/198 [==============================] - 6s 29ms/step - loss: 0.0214 - accuracy:
0.9949 - val_loss: 0.7076 - val_accuracy: 0.9333
Epoch 7/25
198/198 [==============================] - 6s 29ms/step - loss: 0.0042 - accuracy:
1.0000 - val_loss: 0.8367 - val_accuracy: 0.8667
Epoch 8/25
198/198 [==============================] - 6s 29ms/step - loss: 0.0060 - accuracy:
0.9966 - val_loss: 0.7550 - val_accuracy: 0.9333
Epoch 9/25
198/198 [==============================] - 6s 29ms/step - loss: 0.0017 - accuracy:
1.0000 - val_loss: 0.9044 - val_accuracy: 0.9333
Epoch 10/25
198/198 [==============================] - 6s 29ms/step - loss: 7.8635e-04 - accur
acy: 1.0000 - val_loss: 0.8452 - val_accuracy: 0.9333
Epoch 11/25
198/198 [==============================] - 6s 29ms/step - loss: 2.7762e-04 - accur
acy: 1.0000 - val_loss: 0.8525 - val_accuracy: 0.9333
Epoch 12/25
198/198 [==============================] - 6s 29ms/step - loss: 7.7215e-04 - accur
acy: 1.0000 - val_loss: 0.8293 - val_accuracy: 0.9333
Epoch 13/25
198/198 [==============================] - 6s 29ms/step - loss: 1.2641e-04 - accur
acy: 1.0000 - val_loss: 0.8985 - val_accuracy: 0.9333
Epoch 14/25
198/198 [==============================] - 6s 29ms/step - loss: 0.0305 - accuracy:
0.9899 - val_loss: 1.3631 - val_accuracy: 0.8000
Epoch 15/25
198/198 [==============================] - 6s 29ms/step - loss: 0.1051 - accuracy:
0.9663 - val_loss: 0.5481 - val_accuracy: 0.9667
Epoch 16/25
198/198 [==============================] - 6s 29ms/step - loss: 0.0513 - accuracy:
0.9882 - val_loss: 0.6419 - val_accuracy: 0.9333
Epoch 17/25
198/198 [==============================] - 6s 29ms/step - loss: 0.0174 - accuracy:
0.9949 - val_loss: 0.4007 - val_accuracy: 0.9667
Epoch 18/25
198/198 [==============================] - 6s 30ms/step - loss: 0.0233 - accuracy:
0.9865 - val_loss: 0.5405 - val_accuracy: 0.9333
Epoch 19/25
198/198 [==============================] - 6s 29ms/step - loss: 0.0024 - accuracy:
1.0000 - val_loss: 0.5343 - val_accuracy: 0.9333
Epoch 20/25
198/198 [==============================] - 6s 29ms/step - loss: 0.0113 - accuracy:
0.9966 - val_loss: 0.5379 - val_accuracy: 0.9667
Epoch 21/25
```

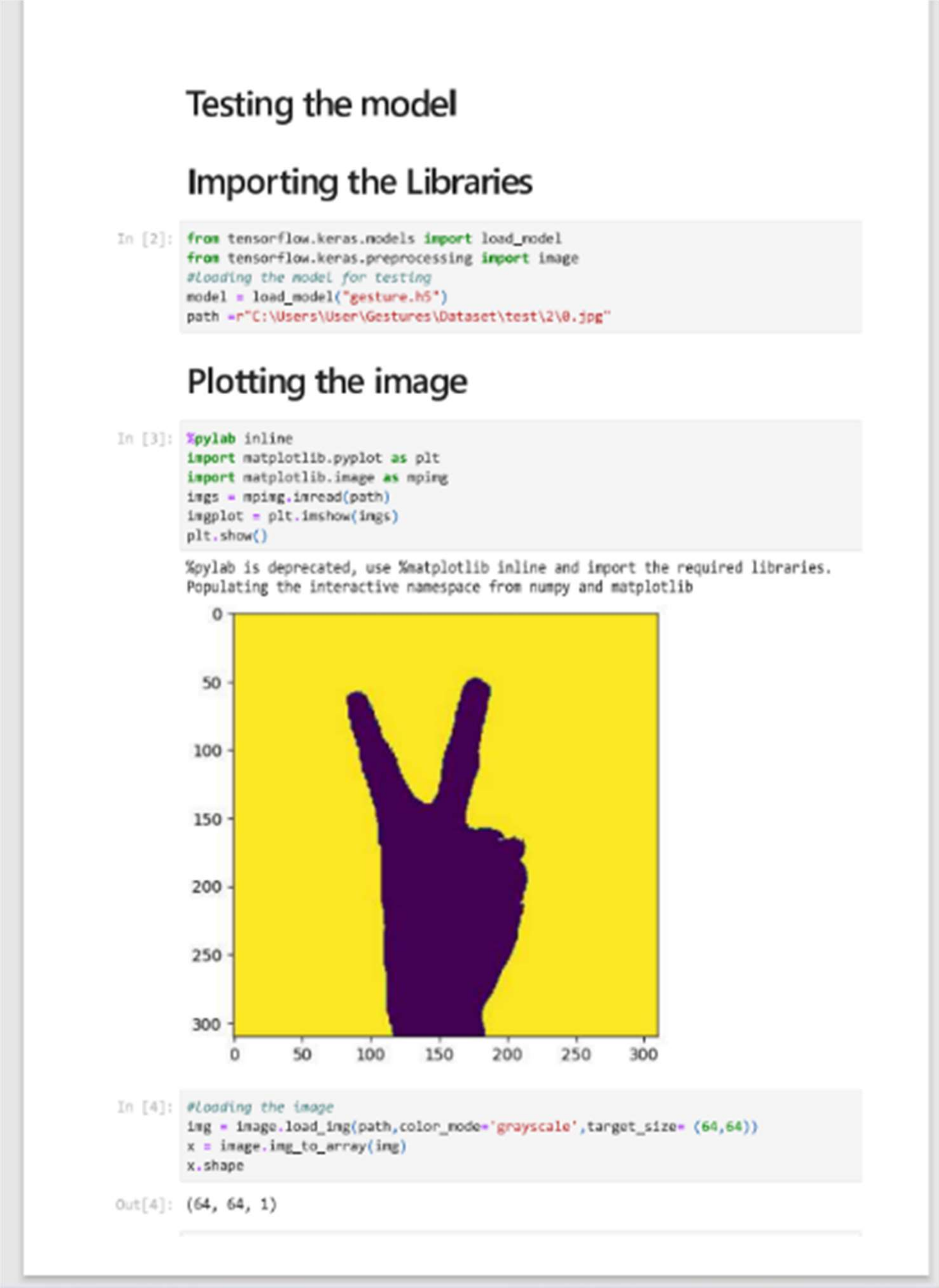


```
          198/198 [==============================] - 6s 29ms/step - loss: 0.0380 - accuracy:
          0.9848 - val_loss: 0.5883 - val_accuracy: 0.9333
          Epoch 22/25
          198/198 [==============================] - 6s 29ms/step - loss: 0.0684 - accuracy:
          0.9848 - val_loss: 0.6901 - val_accuracy: 0.9333
          Epoch 23/25
          198/198 [==============================] - 6s 29ms/step - loss: 0.0223 - accuracy:
          0.9899 - val_loss: 0.5443 - val_accuracy: 0.9333
          Epoch 24/25
          198/198 [==============================] - 6s 29ms/step - loss: 0.0119 - accuracy:
          0.9983 - val_loss: 0.7362 - val_accuracy: 0.9000
          Epoch 25/25
          198/198 [==============================] - 6s 29ms/step - loss: 9.0722e-04 - accur
          acy: 1.0000 - val_loss: 0.5869 - val_accuracy: 0.9000
Out[17]:  <keras.callbacks.History at 0x20ef5abf2e0>
```

Saving the model

```
In [18]:  model.save('gesture.h5')
```

```
In [19]:  model_json = model.to_json()
          with open("model-bw.json", "w") as json_file:
              json_file.write(model_json)
```



Testing the model

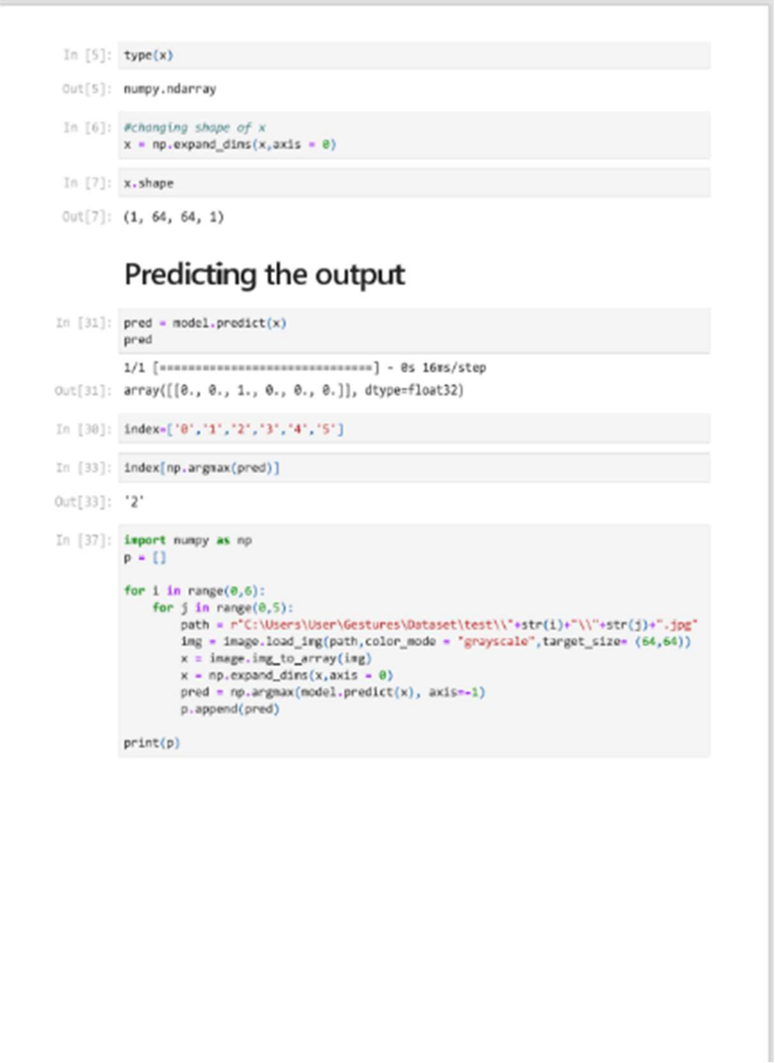
Importing the Libraries

```
In [2]: from tensorflow.keras.models import load_model
        from tensorflow.keras.preprocessing import image
        #Loading the model for testing
        model = load_model("gesture.h5")
        path =r"C:\Users\User\Gestures\Dataset\test\2\0.jpg"
```

Plotting the image

```
In [3]: %pylab inline
        import matplotlib.pyplot as plt
        import matplotlib.image as mpimg
        imgs = mpimg.imread(path)
        imgplot = plt.imshow(imgs)
        plt.show()

        %pylab is deprecated, use %matplotlib inline and import the required libraries.
        Populating the interactive namespace from numpy and matplotlib
```

```
In [4]: #Loading the image
        img = image.load_img(path,color_mode='grayscale',target_size= (64,64))
        x = image.img_to_array(img)
        x.shape

Out[4]: (64, 64, 1)
```



```
In [5]: type(x)

Out[5]: numpy.ndarray

In [6]: #changing shape of x
        x = np.expand_dims(x,axis = 0)

In [7]: x.shape

Out[7]: (1, 64, 64, 1)
```

Predicting the output

```
In [31]: pred = model.predict(x)
         pred

         1/1 [==============================] - 0s 16ms/step
Out[31]: array([[0., 0., 1., 0., 0., 0.]], dtype=float32)

In [30]: index=['0','1','2','3','4','5']

In [33]: index[np.argmax(pred)]

Out[33]: '2'

In [37]: import numpy as np
         p = []

         for i in range(0,6):
             for j in range(0,5):
                 path = r"C:\Users\User\Gestures\Dataset\test\\"+str(i)+"\\"+str(j)+".jpg"
                 img = image.load_img(path,color_mode = "grayscale",target_size= (64,64))
                 x = image.img_to_array(img)
                 x = np.expand_dims(x,axis = 0)
                 pred = np.argmax(model.predict(x), axis=-1)
                 p.append(pred)

         print(p)
```

Application Building

app.py

from flask import Flask,render_template,request

import numpy as np

import os

import operator

import cv2

from tensorflow.keras.models import load_model

from tensorflow.keras.utils import load_img, img_to_array

from werkzeug.utils import secure_filename

app = Flask(__name__,template_folder="templates")

model=load_model('../Cloud Model/gesture.h5')

```
print("Model is loaded from local system")

@app.route("/")
def root():
        return render_template("home.html")

@app.route("/home")
def home():
        return render_template("home.html")

@app.route("/intro")
def intro():
        return render_template("intro.html")

@app.route("/launch")
def launch():
        return render_template("launch.html")



@app.route('/index',methods=['GET','POST'])
def index():
    return render_template("launch.html")

@app.route('/predict',methods=['GET','POST'])
def predict():
    #Getting input and storing it
    if request.method == 'POST':
        print('inside launch function')
        f=request.files['image']

        basepath=os.path.dirname(__file__)
        file_path=os.path.join(basepath,'uploads',secure_filename(f.filename))
        f.save(file_path)
        print('img saved successfully')
        print(file_path)
        # test_image=cv2.imread(file_path,cv2.IMREAD_COLOR)
        # test_image=cv2.resize(test_image,(64,64))
        # result= model.predict(test_image.reshape(1,64,64,1))

        # img = load_img(file_path, grayscale=True, target_size=(64, 64))
        # x = img_to_array(img)
        # x = np.expand_dims(x, axis = 0)

    cap=cv2.VideoCapture(0)
    image1=cv2.imread(file_path)
    cv2.imshow("Output",image1)
    prev='NULL'
    while True:
        _, frame=cap.read()
        frame=cv2.flip(frame,1)

        x1=int(0.5*frame.shape[1])
        y1=10
        x2=frame.shape[1]-10
        y2=int(0.5*frame.shape[1])
```

Github:

https://github.com/IBM-EPBL/IBM-Project-42037-1660647835

Demo Video Link:

https://youtu.be/CKg2BBm10ck