

A GESTURE-BASED TOOL FOR STERILE BROWSING OF RADIOLOGY IMAGES

Bonafide record of work done by

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CHAPTER 1

INTRODUCTION

1.1 PROJECT OVERVIEW

In this project, we will use gestures to browse images acquired in the radiology department. Gestures refer to non-verbal communication with hands. A major challenge in this process is to provide physicians with an efficient, intuitive, accurate and safe way to interact without compromising the quality of their work.

But in critical care units (ICUs), using computer keyboard and mouse is a typical way for medical professionals to transfer illnesses. In this article, we propose using hand gestures as an alternative to current interface techniques, with the key benefit of sterility. Humans are adept at deciphering both body and sign language. This may be a result of how the brain developed in conjunction with synaptic contacts and eyesight.

There are a few issues that need to be resolved in order to reproduce this ability in computers, including how to distinguish things of interest in photographs and which image capture method and classification technique are more suitable.

In this project A Gesture-based Tool for Sterile Browsing of Radiology Images, First the model is trained pre trained on the images of different hand gestures, such as a showing number 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. If the gesture predicts is 1; then images are blurred; 2, image is resized; 3, image is rotated etc.

1.2 PURPOSE

1. Without using the keyboard or mouse physically, the application can be used to interact with the application remotely.
2. The gesture tool can understand the natural way that a person and computer communicate by employing finger movements spread out over a brief period of time.
3. Many doctors can work more efficiently thanks to this gesture-based project.
4. Due to the fact that all commands were carried out using hand gestures, the doctors didn't need to move once during the whole procedure.

CHAPTER 2

LITERATURE SURVEY

2.1 EXISTING PROBLEM

1. Providing doctors with effective, intuitive, accurate, and safe ways of contact without compromising the caliber of their job is a significant problem.
2. Some problems with the system, such as slow performance, may arise when accessing the camera.
3. The user must be able to distinguish between objects of interest in images; capture technology and classification approach are more suitable among other things.

2.2 REFERENCES

1. Robust Part-Based Hand Gesture Recognition Using Kinect Sensor Zhou Ren, Jun song Yuan, Member, IEEE, Jingjing Meng, Member, IEEE, and Zheng you Zhang, Fellow, IEEE, 15, AUGUST 2013.
2. A Fast Gesture Recognition Scheme for Real-Time Human Machine Interaction Systems . Ching-Hao Lai* Smart Network System Institute for Information Industry Taipei City, Taiwan , 2010.
3. Intension, Context and Gesture Recognition for Sterile MRI Navigation in the Operating Room by Agency for Healthcare Research and Quality (AHRQ)
4. Hand Gestures Recognition Using Radar Sensors for Human-Computer Interaction Supported by the Bio ad Medical Technology Development Program of the National Research Foundation(NRF)

5. A Preliminary Study of Kinect-Based Real-Time Hand Gesture Interaction Systems for Touchless Visualizations of Hepatic Structures in Surgery by Medical Imaging and Information Sciences, Jiaqing LIU, Tomoko Tateyama.
6. Vision Based Hand Gesture Recognition by World Academy of Science, Engineering and Technology, Pragati Garg, Naveen Aggarwal, Sanjeev Sofat

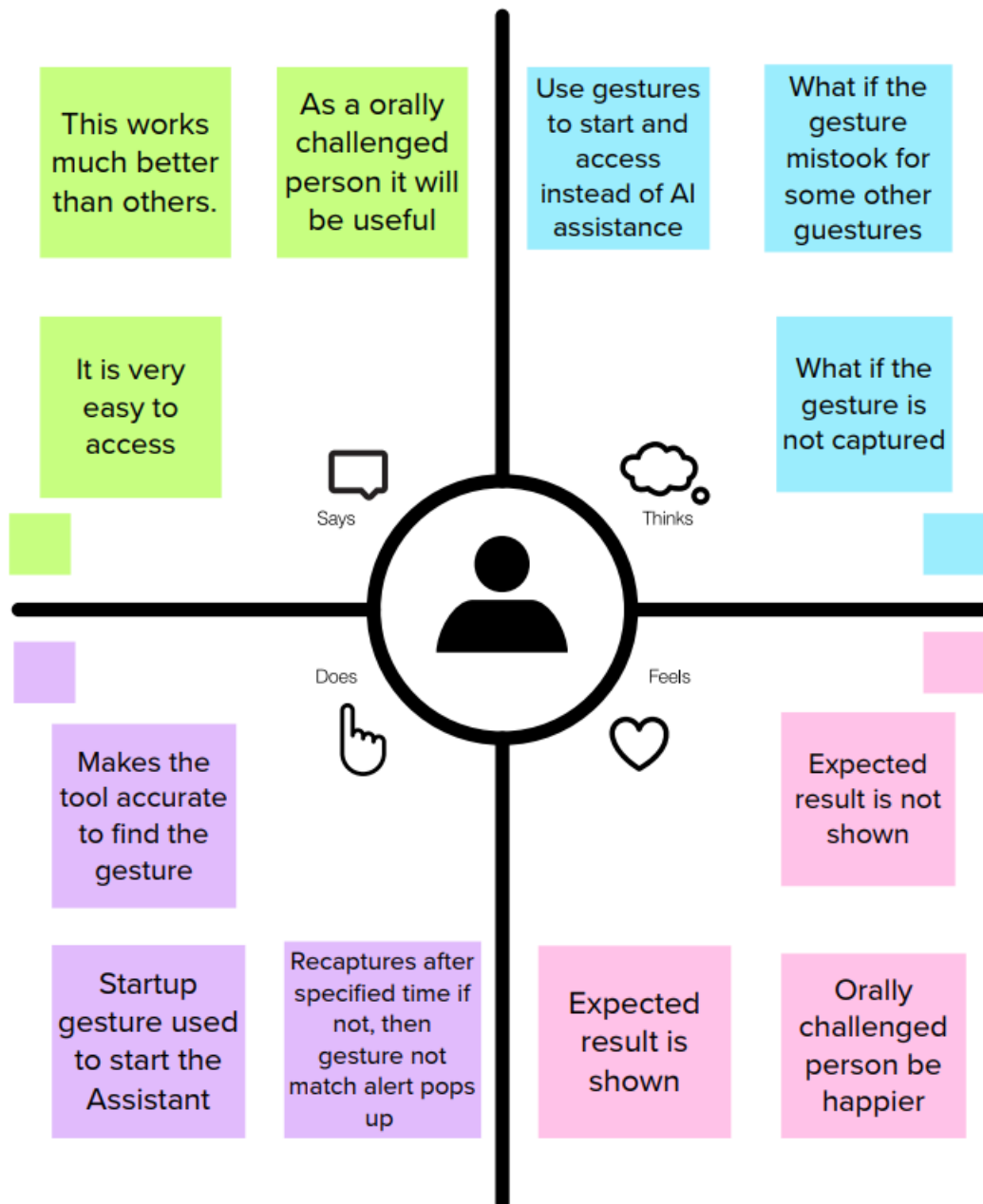
2.3 PROBLEM STATEMENT DEFINITION

1. The webcams must be capable of identifying motion gestures that have already been programmed into the system.
2. The program must be available to the user wherever they are and whenever they need it.
3. The user must be able to upload pictures of different sizes, blur them, resize them, and rotate them. This instrument needs to be able to communicate with people and comprehend symbols.
4. The machine must be able to run multiple tasks continuously, without interruption.

CHAPTER 3

IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



3.2 IDEATION & BRAINSTORMING

Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

10 minutes to prepare
1 hour to collaborate
2-4 people recommended

Show template feedback

Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

- Team gathering**
Order who should participate in the session and send an invite. Share relevant information or pre-work ahead.
- Set the goal**
Think about the problem you'll be focusing on solving in the brainstorming session.
- Learn how to use the facilitation tools**
Use the facilitation statements to set a happy and productive session.

Open facilitator

Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

Problem Statement

A Gesture-Based Tool For Sterile Browsing Of Radiology Images in the operation room, during operation the doctors need to access the radiology images in the system. If they use their hands to access the mouse or any other things to zoom or scroll the images there is a possibility to spread infection through these things. In corona time, the infection is spread from one person to another person by touching the objects.

Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

FOURMAY V

Device can able to identify the hand gestures without or with wearing white gloves in hands.

Use simple and easy gesture actions to access the radiology images.

Camera can predict the gesture action both in bright and dim background.

Easy navigation between scanned image

MICHAN RALI B

The device must recognize the movement of the person's hand in front of the camera to avoid making mistakes about what others are doing in the room.

Easy navigation between Applications

Does not make the workspace messy

Improve accuracy in distinguishing commands from other kinds of gestures

MCHAMBER FARI M

To endorse computers with the ability to understand the content in which gestures are made

Resolves the problem of buying hardware components like keyboard, mouse etc...

Improves the view of the problem in radiology images

Device should identify the hand gesture action of person who is in front of the camera to avoid mistakes of hand actions of others in the room.

VITHAN V C

Without using any sensors or wearing any gloves like devices or sensor head in gloves in hand to access the radiology images.

Device should identify and respond to gestures fastly.

As a time it detects only one hand to identify the gesture actions to avoid the confusion.

Can able to use both right and left hands to access and control the device.

Need some inspiration?

Open resources

Group ideas

Take turns sharing your ideas while listening similar or related ideas as you go. Once all ideas have been shared, give each other a thumbs up or a star. If a cluster is forming, discuss it and break it up into smaller sub-groups.

to exit full screen

The device can recognize handmovements without wearing white gloves or by wearing white gloves.

Improve accuracy by distinguishing controls from other types of gestures and the camera can predict gesture action both in the bright and dark background.

Easy to navigate

Resolves the problem of buying hardware components like keyboard, mouse etc...

Can able to use both right and left hands to access and control the device.

Use simple and easy gesture actions to access the radiology images.

The device must include the hand movement of the person in front of the camera to avoid making mistakes about the actions of other people in the room.

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on the grid to determine which ideas are important and which are feasible.

20 minutes

Importance

Feasibility

Participants can use their thumbs to point at ideas they want to move up on the grid. The facilitator can move the ideas for them. The idea points holding the ideas are the facilitator.

After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

Quick add-ons

- Share the mural**
Share a new link to the mural with stakeholders to keep them in the loop about the outcomes of the session.
- Export the mural**
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

Keep moving forward

- Strategic blueprint**
Outline the components of a new idea or strategy.
- Customer experience journey map**
Understand customer needs, motivations, and behaviors for an experience.
- Strengths, weaknesses, opportunities & threats**
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.

Show template feedback

3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	<ul style="list-style-type: none"> In order a computer to recognize a sign language (gesture) and perform the operation that are predefined for the specific gesture
2.	Idea / Solution description	<ul style="list-style-type: none"> For common operation simple gestures are predefined. The user can customise the gestures according to his wish. The user can create new gesture apart from the predefined gestures for new operations.
3.	Novelty / Uniqueness	<ul style="list-style-type: none"> Resolves the problem of buying hardware components except camera like keyboard, mouse etc... Camera can predict the gesture action both in bright and dim background. Require less usage of battery.
4.	Social Impact / Customer Satisfaction	<ul style="list-style-type: none"> Orally challenged persons can use gestures to perform operations like normal person uses personal assistant(virtual) Surgeons in operation theatre can use devices using gestures without physical contact
5.	Business Model (Revenue Model)	<ul style="list-style-type: none"> Orally challenged persons find devices with gesture-based tool more useful for them Kids and youngsters can be attracted by using gesture-based tools.
		<ul style="list-style-type: none"> By using gesture-based tools in public places like shopping mall, theatre can attract more customers.
6.	Scalability of the Solution	<ul style="list-style-type: none"> Demand for devices with gesture-based tools for orally challenged persons is more. Devices with gesture-based tools are highly in demand in places where hygiene plays a major role like hospital, infant care centres etc... Devices with gesture-based tools will be more attractive among youngsters.

3.4 PROBLEM SOLUTION FIT

Define CS, fit into CC	1. CUSTOMER SEGMENT(S) CS <ul style="list-style-type: none"> • People who wish to use "Hand Gestures" to access the application 	6. CUSTOMER CONSTRAINTS CC <p>Needed Devices :</p> <ul style="list-style-type: none"> • System with internet. • Webcam. 	5. AVAILABLE SOLUTIONS AS <ul style="list-style-type: none"> • Professionals may use other control devices like keyboards and joysticks to browse images, but this device also requires contact. • In early stage the doctors have to manually do navigation and manipulation of images through EMR, but while using the gesture-based navigation and manipulation is very much easy and useful for doctors. 	Explore AS, differentiate
	2. JOBS-TO-BE-DONE / PROBLEMS J&P <ul style="list-style-type: none"> • Provide the system with an understanding of hand gestures and execute them accordingly. • Be more precise when looking for hand movements. 	9. PROBLEM ROOT CAUSE RC <ul style="list-style-type: none"> • Imprecise and closely related gestures are ambiguous. • The navigation control requires the user to remember a number of gestures in order to access the application. 	7. BEHAVIOUR BE <ul style="list-style-type: none"> • If a customer encounters any software problems, they should provide us feedback on the issue, and our technical team will promptly address the issue and reply via email. 	
Focus on J&P, tap into BE, understand RC	3. TRIGGERS TR <ul style="list-style-type: none"> • The effective and easy navigation time trigger clients to switch to this technology. 	10. YOUR SOLUTION SL <ul style="list-style-type: none"> • For a common operation, simple gestures are pre-set. • The user can personalize the gestures according to their wishes. • The user can create new gestures in addition to pre-set gestures for new operations. 	8. CHANNELS of BEHAVIOUR CH <p>Online:</p> <ul style="list-style-type: none"> • A stable network connection is necessary for the active operation of the gesture control system. <p>Offline:</p> <ul style="list-style-type: none"> • Power availability for the display device and gesture capturing camera. 	Focus on J&P, tap into BE, understand RC
	4. EMOTIONS: BEFORE / AFTER EM <ul style="list-style-type: none"> • During a pandemic, people have a hard time using a public system because of the fear that the disease will spread. By using this application, individuals are assured of security against disseminated physical diseases, ensuring sterility. 			
Identify strong TR & EM				Identify strong TR & EM

CHAPTER 4

REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

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	Registration through Form Registration through Gmail Registration through LinkedIn
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Interface	The user-friendly interface, which helps to upload customised gesture images for easy Human Computer Interaction.
FR-4	Add image option	Add image through Device
FR-5	Gesture Operation	Dynamic navigation gestures are translated to commands based on their relative positions on the screen.

4.2 NON-FUNCTIONAL REQUIREMENT

Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

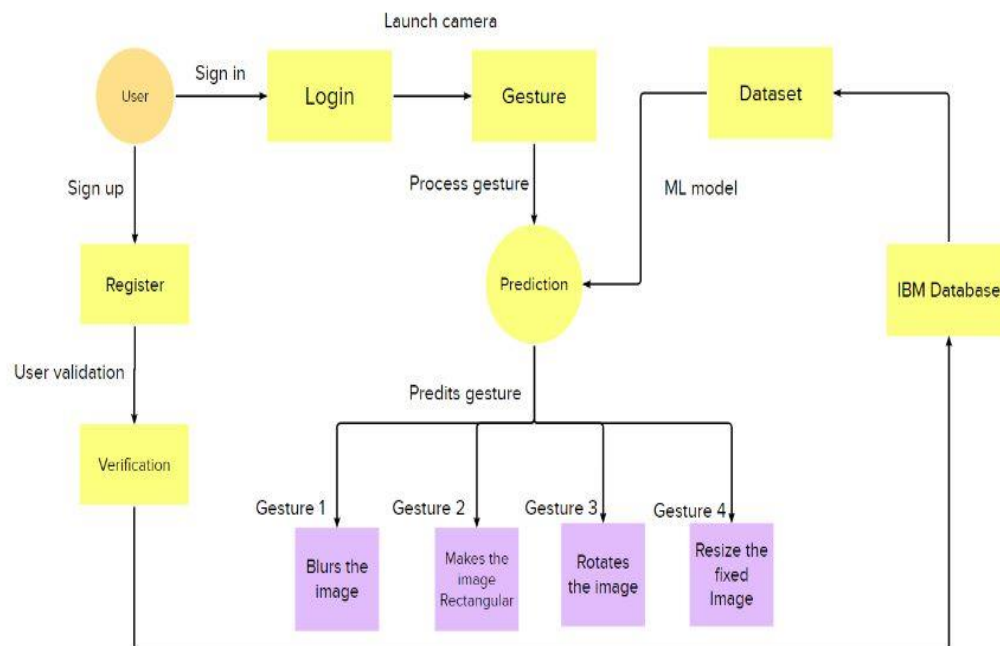
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The Application is easy to access since there is less physical contact with the system.
NFR-2	Security	The user will have unique credentials to sign in their account and further they can secure with two factor authentication if needed.
NFR-3	Reliability	The gestures are identified accurately by the application in all lighting conditions using ML and AI algorithms.
NFR-4	Performance	The application recognizes the gesture in few milliseconds and the corresponding operation is performed.
NFR-5	Availability	The new Application, which is free to download, requires no special hardware, just a standard web camera.
NFR-6	Scalability	As the Application is cloud based, ample amount of user can use them.

CHAPTER 5

PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS

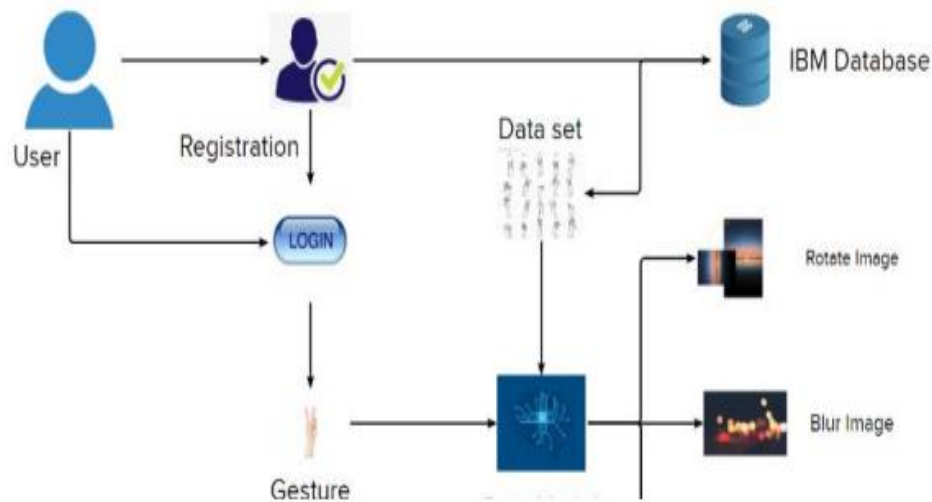
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



5.2 SOLUTION & TECHNICAL ARCHITECTURE

5.2.1 SOLUTION ARCHITECTURE:

1. Different operations are applied to the input image depending on the various gesture inputs.
2. You can crop, blur, flip, and resize the image.
3. After the model has analyzed the gesture, the prediction with the operation done to the image is displayed on the user interface.
4. Better execution in terms of accuracy, sensitivity, system architecture design, and software flexibility.



5.2.2 TECHNOLOGY ARCHITECTURE:

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application Web UI,.	HTML, CSS, JavaScript
2.	Application Logic-1	Logic for a process in the application	Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	NA	NA
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
7.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
8.	External API-1	NA	NA
9.	External API-2	NA	NA
10.	Machine Learning Model	Purpose of Machine Learning Model	Gesture Recognition Model,
11.	Infrastructure (Server / Cloud)	Cloud	IBM Cloud

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used FLASK	Technology of Opensource framework PYTHON
2.	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services) This improves scalability, because application servers can be deployed on many machines. The database does not make longer connections with every client – it only requires connections from a smaller number of application servers	Presentation Layer – FLASK (HTML, CSS) Application Layer – Flask (Python) Data Layer – IBM DB2
3.	Availability	Justify the availability of application (e.g. use of load balancers, distributed servers etc.)	-
4.	Performance	Design consideration for the performance of the application (number of requests per sec, use of Cache, use of CDN's) etc.	-

5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer		USN-1	As a user, I enter the home page, I face a welcoming sentence and there was also an intro button and launch button.		Low	Sprint-1
		USN-2	As a user, I click the intro button, it navigates to the intro page where I get a simple introduction about the application.		Medium	Sprint-2
		USN-3	As a user, I click the launch button, it navigates to the launch page where I can upload a picture.		High	Sprint-3
		USN-4	As a user, after I upload the picture, I click the predict button to for further process.		High	Sprint-3
		USN-5	As a user, after I click predict button, the camera opens and I show the gesture to modify the picture.		High	Sprint-4

CHAPTER 6

PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1		USN-1	As a user, I enter the home page, I face a welcoming sentence and there was also an intro button and launch button.	1	Low	PAVANSAI.V, VITHUN.V.C, MOHAN RAJ.S, MOHAMMED FAIS.M
Sprint-2		USN-2	As a user, I click the intro button, it navigates to the intro page where I get a simple introduction about the application.	1	Medium	PAVANSAI.V, VITHUN.V.C, MOHAN RAJ.S, MOHAMMED FAIS.M
Sprint-3	The user uploads a picture.	USN-3	As a user, I click the launch button, it navigates to the launch page where I can upload a picture.	2	High	PAVANSAI.V, VITHUN.V.C, MOHAN RAJ.S, MOHAMMED FAIS.M
Sprint-3		USN-4	As a user, after I upload the picture, I click the predict button to for further process.	2	High	PAVANSAI.V, VITHUN.V.C, MOHAN RAJ.S, MOHAMMED FAIS.M
Sprint-4	The user uses gestures to perform operations.	USN-5	As a user, after I click predict button, the camera opens and I show the gesture to modify the picture.	2	High	PAVANSAI.V, VITHUN.V.C, MOHAN RAJ.S, MOHAMMED FAIS.M

6.2 SPRINT DELIVERY SCHEDULE

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	06 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	06 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	15	20 Nov 2022

6.3 REPORTS FROM JIRA

Velocity:

Imagine we have a 10-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)

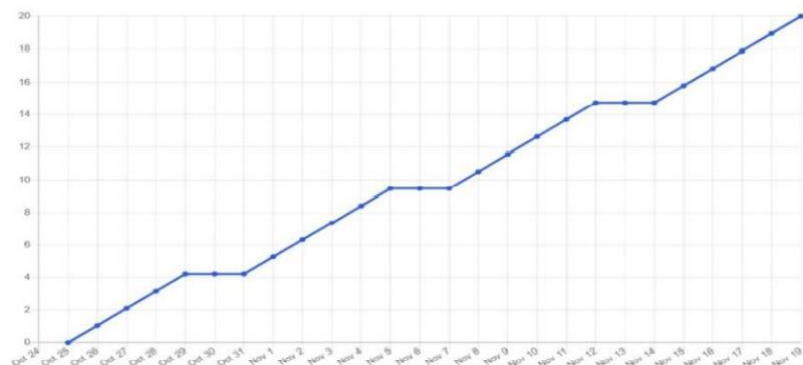
$$AV = \frac{\text{sprint duration}}{\text{velocity}} = \frac{20}{10} = 2$$

$$AV = 18.75/6$$

$$AV = 3.125$$

Burndown Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.

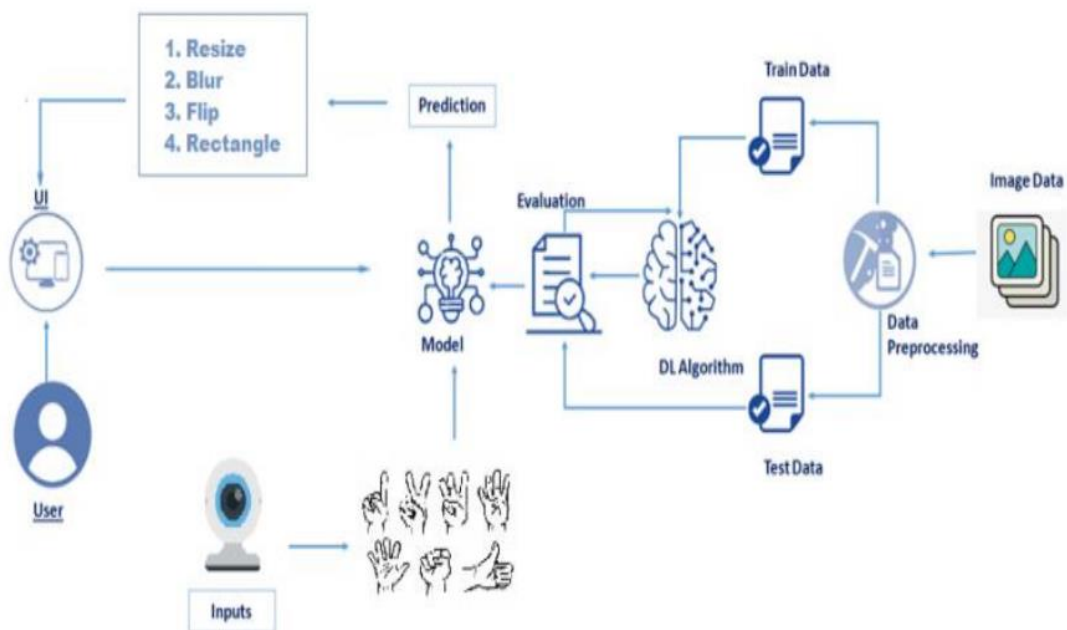


CHAPTER 7

CODING & SOLUTIONING

7.1 FEATURE

FR NO	Feature	Description
FR-1	Dataset	Sample Dataset for Training purpose
FR-2	Choose the Image	Can upload the image to be modified
FR-3	Prediction	Predicts the Hand Gesture
FR-4	Image Manipulation	Changes the input images based on the Gesture



CHAPTER 8 TESTING

8.1 TEST CASES

Section	Total Cases
Print Engine	9
Client Application	48
Security	3
Outsource Shipping	4
Exception Reporting	10
Final Report Output	4
Version Control	5

8.2 USER ACCEPTANCE TESTING

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [ProductName] 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	13	4	3	3	23
Duplicate	1	0	3	0	4
External	2	2	0	1	5
Fixed	15	4	4	20	4
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	31	29	14	26	47

3. Test Case Analysis


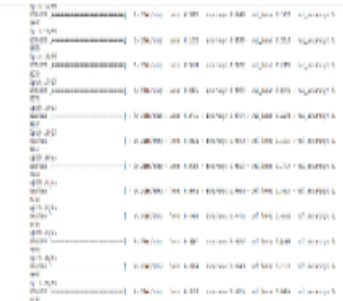
This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	9	0	0	9
Client Application	48	0	0	48
Security	3	0	0	3
Outsource Shipping	4	0	0	4
Exception Reporting	10	0	0	10
Final Report Output	4	0	0	4
Version Control	5	0	0	5

CHAPTER 9

RESULTS

9.1 PERFORMANCE METRICS

S.No.	Parameter	Values	Screenshot
1.	Model Summary	Detects the hand gesture shown by the user	
2.	Accuracy	Training Accuracy - 98% Validation Accuracy - 93%	
3.	Confidence Score (Only Yolo Projects)	Class Detected - Confidence Score -	NA

CHAPTER 10

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

1. This tool's ability to maintain the sterility of the environment is one of its main benefits.
2. Additionally, compared to the current methods of browsing images, it is quicker and easier to use.
3. Time can be saved by performing it even if the surgeon is a little distance from the system.
4. The individual using the tool does not need to have any equipment or other gadgets with them in order to use it. To browse the photographs, they only need to move their hands.

DISADVANTAGES:

1. The tool can be quite pricey because it needs expensive cameras and other equipment to capture and process images.
2. Such systems are challenging to create due to their complexity and high implementation costs.
3. This system is not platform independent because each gesture has a unique control command associated with it, and some control commands change depending on the operating system.

CHAPTER 11

CONCLUSION

In this project, we created a program that can recognize hand movements and let doctors use them to view radiography images. As they won't have to use a mouse or keyboard to browse the images, doctors and surgeons can keep their workspace sterile. In addition to being simple to use, this tool is quicker than the standard mouse/keyboard technique. Since the user doesn't need to be in contact with any equipment, it can be utilized wherever they are. Additionally, the user does not need to bring any equipment with them in order to use it. This technology can also be applied to other fields, such as those where presenters and teachers need to exhibit graphics in the classroom.

CHAPTER 12

FUTURE SCOPE

1. The tool can be made quicker by increasing the recognition speed.
2. The functionality and suitability of this tool for various uses can be increased by adding more gestures.
3. The number of commands can be expanded by adding tracking for both hands.
4. To further enhance the functionality, voice commands can be added.

APPENDIX

A.1 SOURCE CODE

PYTHON CODE:

```
1 from flask import Flask,render_template,request
2 # Flask-It is our framework which we are going to use to run/serve our application.
3 #request-for accessing file which was uploaded by the user on our application.
4 import operator
5 import cv2
6 import numpy as np
7
8 from tensorflow.python.keras.models import load_model#to load our trained model
9 import os
10 from werkzeug.utils import secure_filename
11
12
13 app = Flask(__name__,template_folder="templates") # initializing a flask app
14 # Loading the model
15 model=load_model('gesture.h5')
16 print("Loaded model from disk")
17
18 @app.route('/')# route to display the home page
19
20 def home():
21     return render_template('home.html')#rendering the home page
22
23
24 @app.route('/intro') # routes to the intro page
25 def intro():
26     return render_template('intro.html')#rendering the intro page
27
28 @app.route('/image1',methods=['GET','POST'])# routes to the index html
29 def image1():
30     return render_template("index6.html")
31
32
33 @app.route('/predict',methods=['GET','POST'])# route to show the predictions in a web UI
34 def predict():
35     if request.method == 'POST':
36         print("inside image")
37         f = request.files['image']
```

```

33 @app.route('/predict',methods=['GET', 'POST'])# route to show the predictions in a web UI
34 v def predict():
35 v     if request.method == 'POST':
36         print("inside image")
37         f = request.files['image']
38
39         basepath = os.path.dirname(__file__)
40         file_path = os.path.join(basepath, 'uploads', secure_filename(f.filename))
41         f.save(file_path)
42         print(file_path)
43         cap = cv2.VideoCapture(0)
44 v         while True:
45             _, frame = cap.read() #capturing the video frame values
46             # Simulating mirror image
47             frame = cv2.flip(frame, 1)
48
49             # Got this from collect-data.py
50             # Coordinates of the ROI
51             x1 = int(0.5*frame.shape[1])
52             y1 = 10
53             x2 = frame.shape[1]-10
54             y2 = int(0.5*frame.shape[1])
55             # Drawing the ROI
56             # The increment/decrement by 1 is to compensate for the bounding box
57             cv2.rectangle(frame, (x1-1, y1-1), (x2+1, y2+1), (255,0,0) ,1)
58             # Extracting the ROI
59             roi = frame[y1:y2, x1:x2]
60
61             # Resizing the ROI so it can be fed to the model for prediction
62             roi = cv2.resize(roi, (64, 64))
63             roi = cv2.cvtColor(roi, cv2.COLOR_BGR2GRAY)
64             _, test_image = cv2.threshold(roi, 120, 255, cv2.THRESH_BINARY)
65             cv2.imshow("test", test_image)
66             # Batch of 1
67             result = model.predict(test_image.reshape(1, 64, 64, 1))
68 v             prediction = {'ZERO': result[0][0],

```

```

67     result = model.predict(test_image.reshape(1, 64, 64, 1))
68     prediction = {'ZERO': result[0][0],
69                  'ONE': result[0][1],
70                  'TWO': result[0][2],
71                  'THREE': result[0][3],
72                  'FOUR': result[0][4],
73                  'FIVE': result[0][5]}
74     # Sorting based on top prediction
75     prediction = sorted(prediction.items(), key=operator.itemgetter(1), reverse=True)
76
77     # Displaying the predictions
78     cv2.putText(frame, prediction[0][0], (10, 120), cv2.FONT_HERSHEY_PLAIN, 1, (0, 255, 255), 1)
79     cv2.imshow("Frame", frame)
80
81     #loading an image
82     image1=cv2.imread(file_path)
83     if prediction[0][0]=='ONE':
84
85         resized = cv2.resize(image1, (200, 200))
86         cv2.imshow("Fixed Resizing", resized)
87         key=cv2.waitKey(3000)
88
89         if (key & 0xFF) == ord("1"):
90             cv2.destroyAllWindows("Fixed Resizing")
91
92     elif prediction[0][0]=='ZERO':
93
94         cv2.rectangle(image1, (480, 170), (650, 420), (0, 0, 255), 2)
95         cv2.imshow("Rectangle", image1)
96         cv2.waitKey(0)
97         key=cv2.waitKey(3000)
98         if (key & 0xFF) == ord("0"):
99             cv2.destroyAllWindows("Rectangle")
100
101     elif prediction[0][0]=='TWO':
102         (h, w, d) = image1.shape

```

```

101 elif prediction[0][0]== TWO :
102     (h, w, d) = image1.shape
103     center = (w // 2, h // 2)
104     M = cv2.getRotationMatrix2D(center, -45, 1.0)
105     rotated = cv2.warpAffine(image1, M, (w, h))
106     cv2.imshow("OpenCV Rotation", rotated)
107     key=cv2.waitKey(3000)
108     if (key & 0xFF) == ord("2"):
109         cv2.destroyAllWindows("OpenCV Rotation")
110
111 elif prediction[0][0]=='THREE':
112     blurred = cv2.GaussianBlur(image1, (21, 21), 0)
113     cv2.imshow("Blurred", blurred)
114     key=cv2.waitKey(3000)
115     if (key & 0xFF) == ord("3"):
116         cv2.destroyAllWindows("Blurred")
117
118 elif prediction[0][0]=='FOUR':
119
120     resized = cv2.resize(image1, (400, 400))
121     cv2.imshow("Fixed Resizing", resized)
122     key=cv2.waitKey(3000)
123     if (key & 0xFF) == ord("4"):
124         cv2.destroyAllWindows("Fixed Resizing")
125
126 elif prediction[0][0]=='FIVE':
127     '''(h, w, d) = image1.shape
128     center = (w // 2, h // 2)
129     M = cv2.getRotationMatrix2D(center, 45, 1.0)
130     rotated = cv2.warpAffine(image1, M, (w, h))'''
131     gray = cv2.cvtColor(image1, cv2.COLOR_RGB2GRAY)
132     cv2.imshow("OpenCV Gray Scale", gray)
133     key=cv2.waitKey(3000)
134     if (key & 0xFF) == ord("5"):
135         cv2.destroyAllWindows("OpenCV Gray Scale")
136

```

```
132         cv2.imshow("OpenCV Gray Scale", gray)
133         key=cv2.waitKey(3000)
134         if (key & 0xFF) == ord("5"):
135             cv2.destroyAllWindows("OpenCV Gray Scale")
136
137         else:
138             continue
139
140
141         interrupt = cv2.waitKey(10)
142         if interrupt & 0xFF == 27: # esc key
143             break
144
145
146         cap.release()
147         cv2.destroyAllWindows()
148     return render_template("home.html")
149
150 if __name__ == "__main__":
151     # running the app
152     app.run(debug=False)
```


HTML CODE:

```

1 <!DOCTYPE html>
2 <html>
3 <head>
4   <meta charset="utf-8">
5   <meta name="viewport" content="width=device-width, initial-scale=1">
6   <link rel="stylesheet" type="text/css" href="{{ url for('static' , filename='css/home.css') }}">
7   <link rel="preconnect" href="https://fonts.googleapis.com">
8   <link rel="preconnect" href="https://fonts.gstatic.com">
9   <link href="https://fonts.gstatic.com" crossorigin>
10  <link href="https://fonts.googleapis.com/css2?family=Dancing+Script:wght@700&family=Poor+Story&display=swap" rel="stylesheet">
11  <link rel="preconnect" href="https://fonts.gstatic.com">
12  <link href="https://fonts.gstatic.com" crossorigin>
13  <link href="https://fonts.googleapis.com/css2?family=Dancing+Script:wght@700&family=Pacifico&family=Poor+Story&display=swap" rel="stylesheet">
14  <title>Home</title>
15
16
17 </head>
18 <body>
19 <div class="topnav">
20   <span>Hand Gesture System</span>
21   <a href="/image1">Launch</a>
22   <a href="/intro">Intro</a>
23   <a class="active" href="/">Home</a>
24 </div>
25
26 <div class="box">
27   <div class="gesture">
28     <p>A <br><br>Gesture Based Tool <br><br>for Sterile Browsing Of <br><br>Radiology Images</p>
29   </div>
30
31   <!-- <div class="frame">
32     <iframe width="420" height="220" src="https://www.youtube.com/embed/nD621G8u6oc?start=3&loop=1&autoplay=1&mute=1&controls=0">
33     </iframe>
34     <p class="demo">Demonstration Video</p>
35   </div> -->
36 </div>

```

```

1 |<!DOCTYPE html>
2 |<html>
3 |<head>
4 |  <meta charset="utf-8">
5 |  <meta name="viewport" content="width=device-width, initial-scale=1">
6 |  <link rel="stylesheet" type="text/css" href="{{ url_for('static' , filename='CSS/intro.css') }}">
7 |  <link rel="preconnect" href="https://fonts.googleapis.com">
8 |  <link rel="preconnect" href="https://fonts.googleapis.com">
9 |  <link rel="preconnect" href="https://fonts.gstatic.com" crossorigin>
10 |  <link href="https://fonts.googleapis.com/css2?family=Dancing+Script:wght@700&family=Poor+Story&display=swap" rel="stylesheet">
11 |  <link rel="preconnect" href="https://fonts.googleapis.com">
12 |  <link rel="preconnect" href="https://fonts.gstatic.com" crossorigin>
13 |  <link href="https://fonts.googleapis.com/css2?family=Dancing+Script:wght@700&family=Pacifico&family=Poor+Story&display=swap" rel="stylesheet">
14 |  <title>Intro</title>
15 |</head>
16 |
17 |<body>
18 |<div class="topnav">
19 |  <span>Hand Gesture System</span>
20 |  <a href="/image1">Launch</a>
21 |  <a class="active" href="/intro">Intro</a>
22 |  <a href="/">Home</a>
23 |</div>
24 |
25 |<div class="title">
26 |  <p class="intro">INTRODUCTION</p>
27 |</div>
28 |
29 |<div class="container">
30 |  <span class="content">
31 |    Humans are able to recognize body and sign language easily. This is possible due to the combination of vision and
32 |    synaptic interactions that were formed along brain development.In order to replicate this skill in computers, some problems
33 |    need to be solved: how to separate objects of interest in images and which image capture technology and classification technique
34 |    are more appropriate, among others.In this project Gesture based Desktop automation ,First the model is trained pre trained on the
35 |    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
36 |    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.
37 |    If the gesture predices is 1 then images is blurred;2, image is resized;3,image is rotated etc.
38 |
39 |  </span>
40 |</div>
41 |
42 |
43 |<center>

```

```

278 </style>
279 </head>
280
281 <body>
282 <div class="header">
283 <div style="width:50%;float:left;font-size:2vw;text-align:left;color:■ #c1e2d9; padding-top:1%;padding-left:5%;>Hand Gesture System</div>
284 <div class="topnav-right" style="padding-top:0.5%;>
285
286 <a href="home.html">Home</a>
287 <a href="/intro">Introduction</a>
288 <a class="active" href="/image1"><u>Launch</u></a>
289 </div>
290 </div>
291 <br>
292
293 <div1 style=""><h1><font color="Black" size="6" font-family="Roboto">Hand Gesture Recognition</h1><br>
294 <p><i><font color="Black" size="4" font-family="sans-serif"></i>Provide an image for which you want to perform various operations</p>
295 <br>
296 <div>
297 <h4>Upload Image Here</h4>
298 <form action = "http://localhost:5000/" id="upload-file" method="post" enctype="multipart/form-data">
299 <label for="imageUpload" class="upload-label">
300 Choose...
301 </label>
302 <input type="file" name="image" id="imageUpload" accept=".png, .jpg, .jpeg, .pdf">
303 </form>
304 <center>
305 <div class="image-section" style="display:none;>
306 <div class="img-preview">
307 <div id="imagePreview">
308 </div>
309 </div>
310 <div>
311 <button type="button" class="btn btn-info btn-lg " id="btn-predict">Predict!</button>
312 </div>
313 </div>
314 <div class="loader" style="display:none;"></div>
315 </center>
316 </div>
317 </div1>
318
319 <footer>
320 <!-- <script src="main.js" type="text/javascript"></script> -->
321 </footer>

```


ipynb CODE:

```

import numpy as np
import tensorflow as tf
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

[36]

train_datagen = ImageDataGenerator(rescale=1./255,
    shear_range=0.2,
    zoom_range=0.2,
    horizontal_flip=True)
#Image Data agumentation to the testing data
test_datagen=ImageDataGenerator(rescale=1./255)

[37]

PMD

[38]

... '/home/wsuser/work'

import os, types
import pandas as pd
from botocore.client import Config
import ibm_boto3

def __iter__(self): return 0

# @hidden_cell
# The following code accesses a file in your IBM Cloud Object Storage. It includes your credentials.
# You might want to remove those credentials before you share the notebook.
cos_client = ibm_boto3.client(service_name='s3',
    ibm_api_key_id='yp-JSa18ZvAHgZS3g6JxHMTj10854SmzR5mKprZhgK_S',
    ibm_auth_endpoint="https://iam.cloud.ibm.com/oidc/token",
    config=Config(signature_version='auth'))

```

```

import os, types
import pandas as pd
from botocore.client import Config
import ibm_boto3

def __iter__(self): return 0

# @hidden_cell
# The following code accesses a file in your IBM Cloud Object Storage. It includes your credentials.
# You might want to remove those credentials before you share the notebook.
cos_client = ibm_boto3.client(service_name='s3',
                              ibm_api_key_id='yp-JSai8ZvAHgZS3g6JxtMTj1D854SmzR5mKprZhgK_S',
                              ibm_auth_endpoint="https://iam.cloud.ibm.com/oidc/token",
                              config=Config(signature_version='oauth'),
                              endpoint_url='https://s3.private.us.cloud-object-storage.appdomain.cloud')

bucket = 'ageaturebasedtoolforsterilebrowsi-donotdelete-pr-rpcywafuepgm9v'
object_key = 'drive-download-20221029T044045Z-001.zip'

streaming_body_1 = cos_client.get_object(Bucket=bucket, Key=object_key)['Body']

# Your data file was loaded into a botocore.response.StreamingBody object.
# Please read the documentation of ibm_boto3 and pandas to learn more about the possibilities to load the data.
# ibm_boto3 documentation: https://ibm.github.io/ibm-cos-sdk-python/
# pandas documentation: http://pandas.pydata.org/

```

```

from io import BytesIO
import zipfile
unzip=zipfile.ZipFile(BytesIO(streaming_body_1.read()), 'r')
file_paths=unzip.namelist()
for path in file_paths:
    unzip.extract(path)

```

```

import numpy as np
#open source used for both ML and DL for computation
import tensorflow as tf

```

```

import numpy as np
#open source used for both ML and DL for computation
import tensorflow as tf
#it is a plain stack of layers
from tensorflow.keras.models import Sequential
#Dense layer is the regular deeply connected neural network layer
from tensorflow.keras.layers import Dense, Flatten, Dropout
#Flatten-used for flattening the input or change the dimension,
from tensorflow.keras.layers import Convolution2D, MaxPooling2D
#Its used for different augmentation of the image
from tensorflow.keras.preprocessing.image import ImageDataGenerator

```

```

train_datagen = ImageDataGenerator(rescale=1./255,
shear_range=0.2,
zoom_range=0.2,
horizontal_flip=True)
#Image Data augmentation to the testing data
test_datagen=ImageDataGenerator(rescale=1./255)

```

```

x_train=train_datagen.flow_from_directory(r'/home/wsuser/work/drive-download-20221029T044045Z-001/train',
target_size=(64, 64),
batch_size=3,
color_mode='grayscale',
class_mode='categorical')
#performing data augmentation to test data
x_test = test_datagen.flow_from_directory(r'/home/wsuser/work/drive-download-20221029T044045Z-001/test',
target_size=(64, 64),
batch_size=3,
color_mode='grayscale',
class_mode='categorical')

```

Found 594 images belonging to 6 classes.

Found 30 images belonging to 6 classes.

```

# Initializing the CNN
model = Sequential()
# 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)))
# Second convolution layer and pooling
model.add(Convolution2D(32, (3, 3), activation='relu'))
# input_shape is going to be the pooled feature maps from the previous
# convolution layer
model.add(MaxPooling2D(pool_size=(2,2)))
# Flattening the layers i.e. input layer
model.add(Flatten())
# Adding a fully connected layer, i.e. Hidden Layer
model.add(Dense(units=512 , activation='relu'))
# softmax for categorical analysis, Output Layer
model.add(Dense(units=6, activation='softmax'))
model.summary()

```

Model: "sequential_1"

Layer (type)	Output Shape	Param #
=====		
conv2d_2 (Conv2D)	(None, 62, 62, 32)	320
max_pooling2d_2 (MaxPooling 2D)	(None, 31, 31, 32)	0
conv2d_3 (Conv2D)	(None, 29, 29, 32)	9248
max_pooling2d_3 (MaxPooling 2D)	(None, 14, 14, 32)	0
flatten_1 (Flatten)	(None, 6272)	0
dense_2 (Dense)	(None, 512)	3211776
dense_3 (Dense)	(None, 6)	3078

```

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

```

```

model.compile(optimizer='adam', loss='categorical_crossentropy',
metrics=['accuracy'])

```

```

model.fit_generator(x_train,
steps_per_epoch = 594/3 ,
epochs = 25,
validation_data = x_test,
validation_steps = 30/3 )

```

Epoch 1/25

/tmp/ksuser/ipykernel_289/238739696.py:1: UserWarning: 'Model.fit_generator' is deprecated and will be removed in a future version. Please use 'Model.fit', which supports generators.

```
model.fit_generator(x_train,
```

Output exceeds the [size limit](#). Open the full output data [in a text editor](#)

```
198/198 [=====] - 13s 65ms/step - loss: 1.2816 - accuracy: 0.5219 - val_loss: 0.5961 - val_accuracy: 0.7667
```

Epoch 2/25

```
198/198 [=====] - 13s 63ms/step - loss: 0.6114 - accuracy: 0.7660 - val_loss: 0.4151 - val_accuracy: 0.8667
```

Epoch 3/25

```
198/198 [=====] - 13s 64ms/step - loss: 0.4101 - accuracy: 0.8215 - val_loss: 0.3007 - val_accuracy: 0.9333
```

Epoch 4/25

```
198/198 [=====] - 12s 63ms/step - loss: 0.2901 - accuracy: 0.8906 - val_loss: 0.2353 - val_accuracy: 0.9333
```

Epoch 5/25

```
198/198 [=====] - 13s 64ms/step - loss: 0.2714 - accuracy: 0.9057 - val_loss: 0.2561 - val_accuracy: 0.9000
```

Epoch 6/25

```
198/198 [=====] - 12s 62ms/step - loss: 0.1690 - accuracy: 0.9360 - val_loss: 0.2412 - val_accuracy: 0.9333
```

Epoch 7/25

```
198/198 [=====] - 13s 63ms/step - loss: 0.1146 - accuracy: 0.9529 - val_loss: 0.3441 - val_accuracy: 0.9333
```

Epoch 8/25


```
model.save('gesture.h5')
```

```
!tar -zcvf Gesture-based-Radiology-Images.tgz gesture.h5
```

```
gesture.h5
```

```
ls
```

```
drive-download-202210297044045Z-001/ gesture.h5
```

```
Gesture-based-Radiology-Images.tgz  model-bw.json
```

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

```
!pip install watson-machine-learning-client
```

```
Requirement already satisfied: watson-machine-learning-client in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (1.0.391)
```

```
Requirement already satisfied: ibm-cos-sdk in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2.11.0)
```

```
Requirement already satisfied: boto3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.18.21)
```

```
Requirement already satisfied: tabulate in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (0.8.9)
```

```
Requirement already satisfied: pandas in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.3.4)
```

```
Requirement already satisfied: urllib3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.26.7)
```

```
Requirement already satisfied: tqdm in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (4.62.3)
```

```
Requirement already satisfied: requests in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2.26.0)
```

```
Requirement already satisfied: certifi in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2022.9.24)
```

```
Requirement already satisfied: lomond in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (0.3.3)
```

```
Requirement already satisfied: s3transfer<0.6.0,>=0.5.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learning-client) (0.5.0)
```

```

from ibm_watson_machine_learning import APIClient
wml_credentials={
    "url": "https://us-south.ml.cloud.ibm.com",
    "apikey": "dL5ELlnJpa8ZQeS1xU5c6xqeXA8K6dIXMjH17IQ8JLsy"
}
client=APIClient(wml_credentials)
client

```

<ibm_watson_machine_learning.client.APIClient at 0x7f1cc4461250>

```

def guid_space_name(client,Gesture):
    space=client.spaces.get_details()
    return(next(item for item in space['resources'] if item['entity']['name']==Gesture)['metadata']['id'])
space_uid=guid_space_name(client,'Gesture')

```

```
client.set.default_space(space_uid)
```

'SUCCESS'

```
client.software_specifications.list(100)
```

Output exceeds the [size limit](#). Open the full output data [in a text editor](#)

```

-----
NAME                ASSET_ID                TYPE
default_py3.6       0062b8c9-8b7d-44a0-a9b9-46c416adcbd9 base
kernel-spark3.2-scala2.12  020d69ce-7ac1-5e68-ac1a-31189867356a base
pytorch-onnx_1.3-py3.7-edt  069ea134-3346-5748-b513-49120e15d288 base
scikit-learn_0.20-py3.6     09c5a1d0-9c1e-4473-a344-eb7b665ff687 base
spark-mllib_3.0-scala_2.12  09f4cff0-90a7-5899-b9ed-1ef348aebdee base
pytorch-onnx_rt22.1-py3.9   0b848dd4-e681-5599-be41-b5f6fccc6471 base
ai-function_0.1-py3.6       0cdb0f1e-5376-4f4d-92dd-da3b69aa9bda base
shiny-r3.6               0e6e79df-875e-4f20-8ae9-62dcr2108306 base

```

```

software_space_uid=client.software_specifications.get_uid_by_name('tensorflow_rt22.1-py3.9')
software_space_uid

'acd9c798-6974-5d2f-a657-ce06e986df4d'

model_details=client.repository.store_model(model='Gesture-based-Radiology-Images.tgz',meta_props={
client.repository.ModelMetaNames.NAME:"CNN Model Building",
client.repository.ModelMetaNames.TYPE:'tensorflow_2.7',
client.repository.ModelMetaNames.SOFTWARE_SPEC_UID:software_space_uid
})

model_id=client.repository.get_model_id(model_details)
model_id

'88cad567-a954-4bc8-93c0-0ec586942a86'

client.repository.download(model_id,'gestureproject.tar.gb')

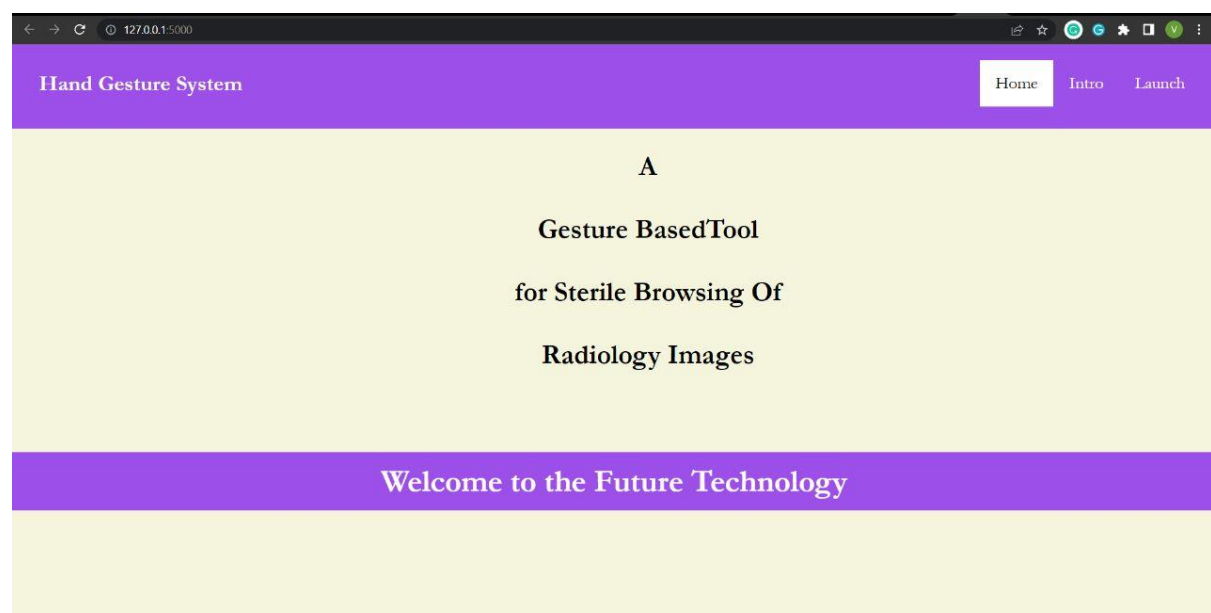
Successfully saved model content to file: 'gestureproject.tar.gb'

'/home/wsuser/work/gestureproject.tar.gb'

```

OUTPUT:

HOME PAGE:



INTRODUCTION PAGE:

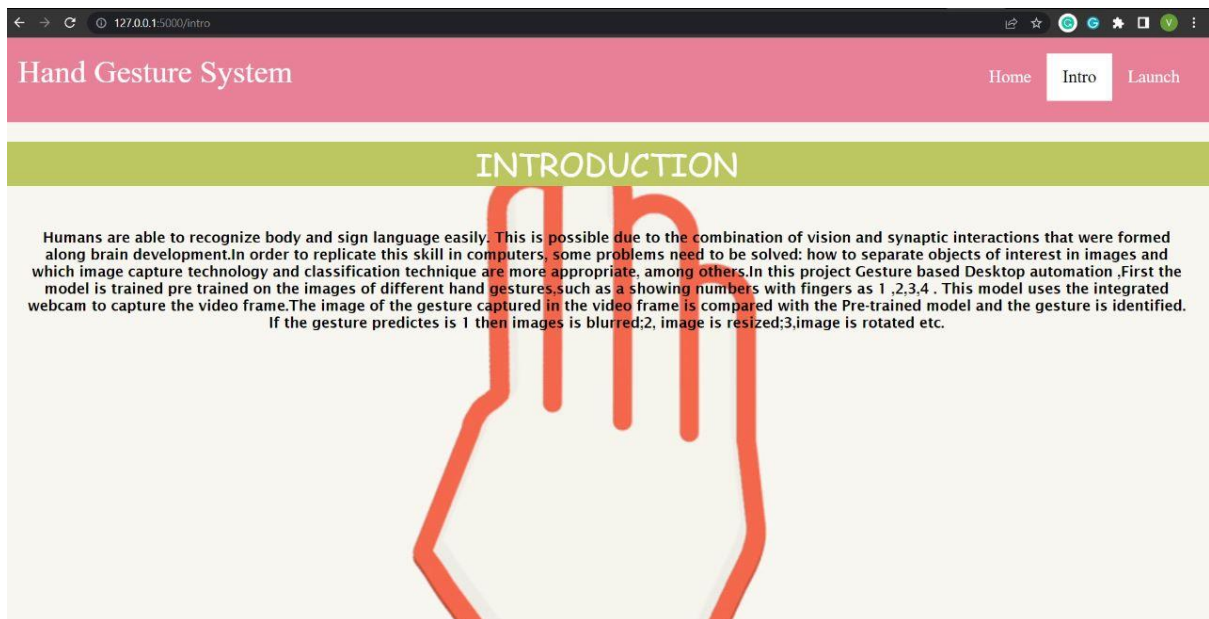
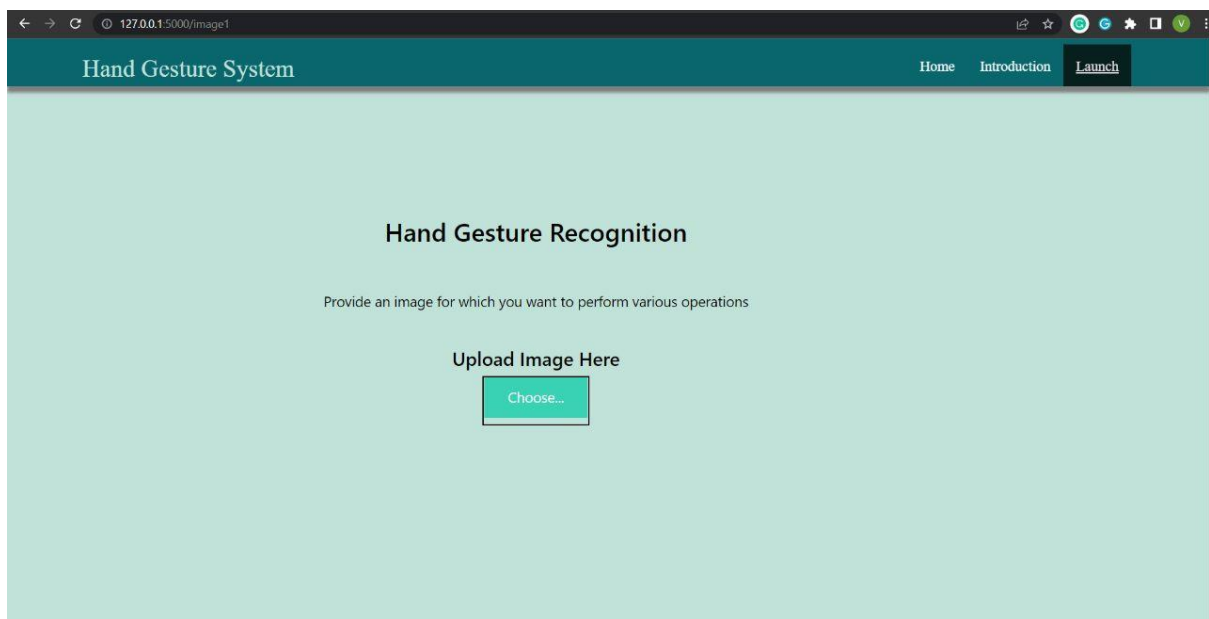
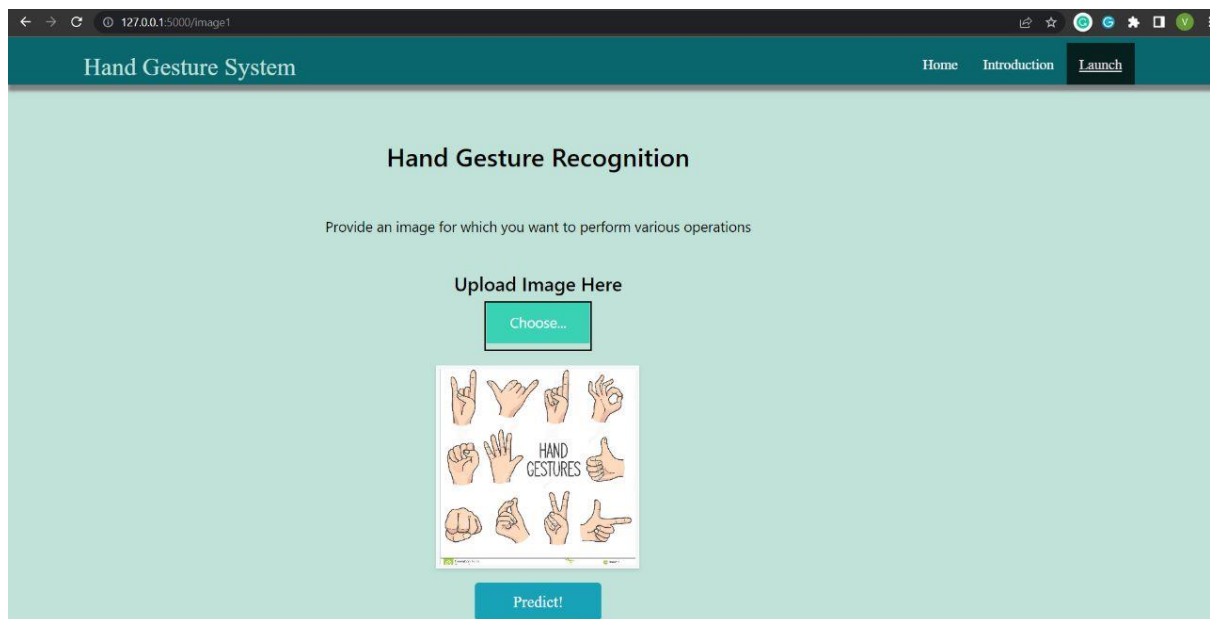


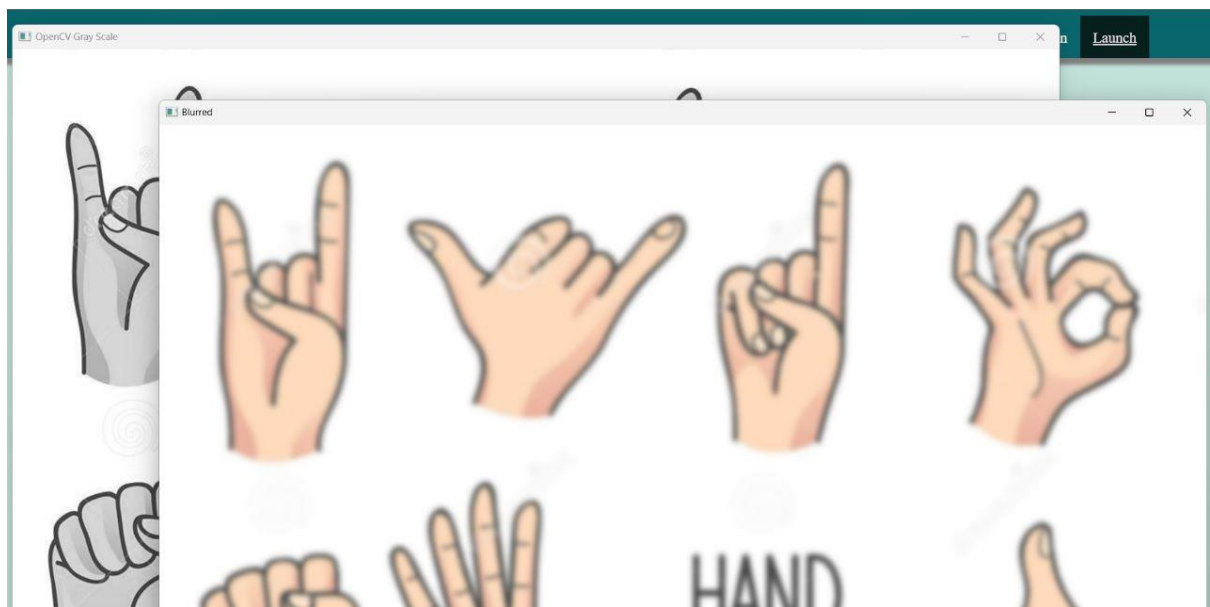
IMAGE UPLOAD PAGE:



AFTER IMAGE UPLOADED:



MODIFIED IMAGES AFTER USING HAND GESTURES:





A.2 GitHub & PROJECT DEMO LINK

GitHub Link

<https://github.com/IBM-EPBL/IBM-Project-9361-1658997954>

Project Demo Link

<https://www.youtube.com/watch?v=a4Fgl91z2uA>