

**A Gesture-based Tool for Sterile Browsing of Radiology Images**

**NALAIYA THIRAN PROJECT BASED LEARNING**

**On**

**PROFESSIONAL READINESS FOR INNOVATION,**

**EMPLOYABILITY AND ENTREPRENEURSHIP**

**A PROJECT REPORT**

|  |  |
| --- | --- |
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**BACHELOR OF TECHNOLOGY**

**IN**

**INFORMATION TECHNOLOGY**

**HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY**

Approved by AICTE, New Delhi, Accredited with ‘A’ Grade by NAAC

**(An Autonomous Institution, Affiliated to Anna University, Chennai)**

# COIMBATORE – 641 032

November 2022

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**1.INTRODUCTION**

**1.1 Overview**

In this project we use gestures to browse images obtained during radiology. Gestures refer to non verbal 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 need 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. If the gesture predicts is 0 - then images is converted into rectangle, 1 - image is Resized into (200,200), 2 - image is rotated by -45॰, 3 - image is blurred, 4 - image is Resized into (400,400), 5 - image is converted into grayscale etc.

**1.2 Purpose**

It is used to browse through the images obtained using radiology using hand gestures rather than using mouse,keyboard,etc thereby maintaining sterility.

# 2.LITERATURE SURVEY

**2.1.Existing problem**

# LITERATURE SURVEY-1

# Impact of radiologic imaging on the surgical decision-making process in suspected appendicitis in children.

# Author: Sylvie Kesar MD, Hakan Jorulf MD, PhD

A prospective study including 593 children with suspected appendicitis was conducted. The surgeon’s initial clinical disposition was recorded, designating the patient for operation, observation, or discharge. Thereafter, the patients were randomized to undergo either ultrasound only or ultrasound and abdominal [computed tomography](https://www.sciencedirect.com/topics/medicine-and-dentistry/computer-assisted-tomography). The studies were evaluated by radiologists, who indicated if appendicitis was present or not. After [radiology](https://www.sciencedirect.com/topics/medicine-and-dentistry/radiology) was completed, the surgeon re-examined the patient and made the final disposition. The change of disposition pathway was recorded. Final diagnoses were established by means of surgical, histopathologic, and/or clinical follow-up findings.

# LITERATURE SURVEY-2

# Preference elicitation: Obtaining gestural guidelines for PACS in neurosurgery

# Author: Naveen Madapana ,Rahul Taneja

A gesture elicitation study was conducted with nine neurosurgeons. Initially, subjects were asked to outline the gestures on a drawing board for each of the PACS commands. Next, the subjects performed one of three imaging tasks using gestures instead of the keyboard and mouse.

Each gesture was annotated with respect to the presence/absence of gesture descriptors. Next, K-nearest neighbour approach was used to obtain the final lexicon that complies with the preferred/popular descriptors.

# LITERATURE SURVEY-3

# Investigating Clutching Interactions for Touchless Medical Imaging Systems

# Author: Sean Cronin, Euan Freeman, Gavin Doherty

Touchless input could transform clinical activity by allowing health professionals direct control over medical imaging systems in a sterile manner. Currently, users face the issues of being unable to directly manipulate imaging in aseptic environments, as well as needing to touch shared surfaces in other hospital areas. Unintended input is a key challenge for touchless interaction and could be especially disruptive in medical contexts. We evaluated four clutching techniques with 34 health professionals, measuring interaction performance and interviewing them to obtain insight into their views on clutching, and touchless control of medical imaging.

# LITERATURE SURVEY-4

# Touchless Interfaces in the Operating Room: A Study in Gesture Preferences

# Author: Naveen Madapana, Daniela Chanci,Glebys Gonazelez

Touchless interfaces allow surgeons to control medical imaging systems autonomously while maintaining total asepsis in the Operating Room. This is especially relevant as it applies to the recent outbreak of COVID-19 disease. The choice of the best gestures/commands for such interfaces is a critical step that determines the overall efficiency of surgeon-computer interaction. In this regard, usability metrics such as task completion time, memorability, and error rate have long-standing as potential entities in determining the best gestures. In addition, previous works concerned with this problem utilized qualitative measures to identify the best gestures.

**2.2 Reference**

<https://www.sciencedirect.com/science/article/abs/pii/S1076633204003514>

<https://www.sciencedirect.com/science/article/abs/pii/S1386505618308633>

<https://www.tandfonline.com/doi/abs/10.1080/10447318.2022.2041896?journalCode=hihc20>

<https://dl.acm.org/doi/10.1145/3491102.3517512>

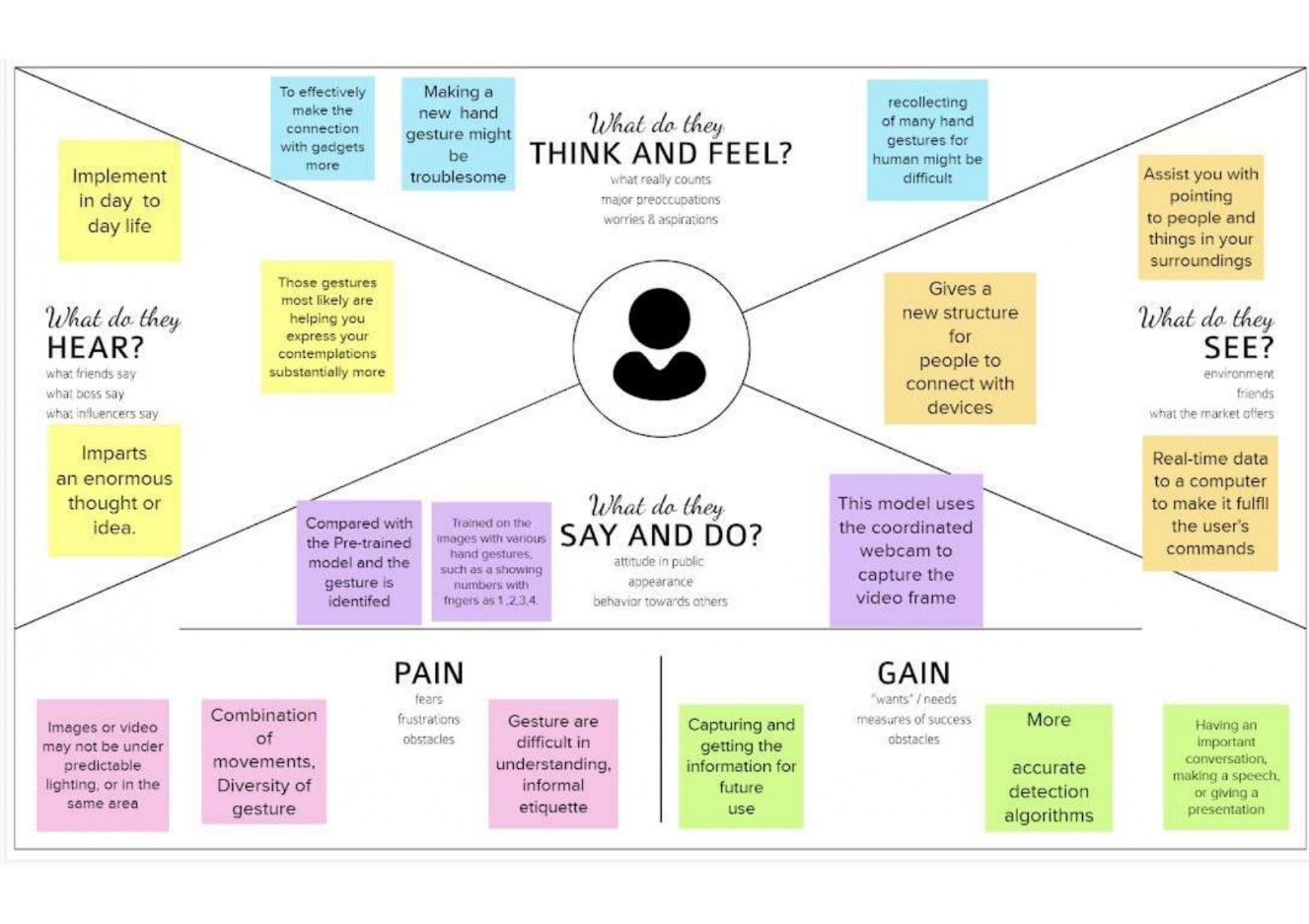
**2.3 Problem statement**

A major challenge involved is to provide doctors with efficient,initiative,accurate and safe means of interaction without affecting the quality of their work .However,the use ofcomputer key-boards and mouse by doctors and nurses in intensive care units is a common method for spreading infections. we suggest the use of hand gestures in medical field as an alternative to existing interface techniques offering the major advantages of sterility. In this project, In this project, we have used Convolutional Neural Network to first train the model on the images of different hand gestures, like showing numbers with fingers as 0,1,2,3,4,5. Then we made a web portal using Flask where user can input any image on which he wants to perform the operations. After uploading the image, our portal uses the integrated webcam to capture the video frame using OpenCV. The gesture captured in the video frame is compared with the Pre-trained model and the gesture is identified. If the prediction is 0 -then image is converted into a rectangle, 1 – the image is Resized into (200,200), 2 – the image is rotated by -45॰, 3 – the image is blurred, 4 – the image is Resized into (400,400) , 5 - image is converted into grayscale, but in real-time we use of doctor-computer interaction devices in the operation room (OR) requires new modalities that support medical imaging manipulation while allowing doctors' hands to remain sterile, supporting their focus of attention, and providing fast response times.

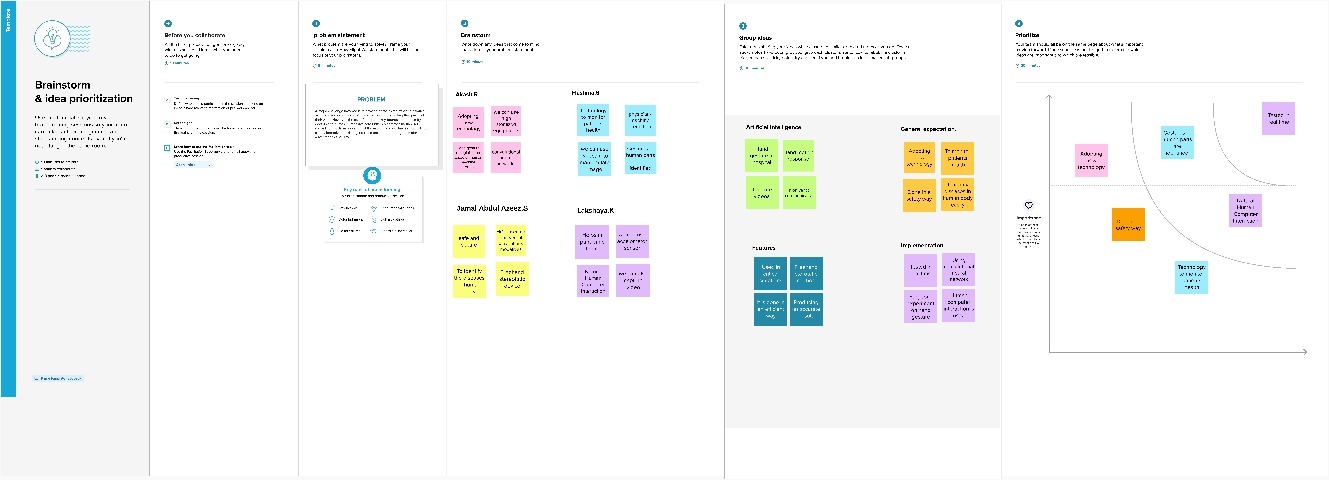
This paper presents "Gestix," a vision-based hand gesture capture and recognition system that interprets in real-time the user's gestures for navigation and manipulation of images in an electronic medical record (EMR) database. Navigation and other gestures are translated to commands based on their temporal trajectories, through video capture. "Gestix" was tested during a brain biopsy procedure. In the in vivo experiment, this interface prevented the surgeon's focus shift and change of location while achieving a rapid intuitive reaction and easy interaction. Data from two usability tests provide insights and implications regarding human-computer interaction based on nonverbal conversational modalities.

**3.IDEATION & PROPOSED SOLUTION**

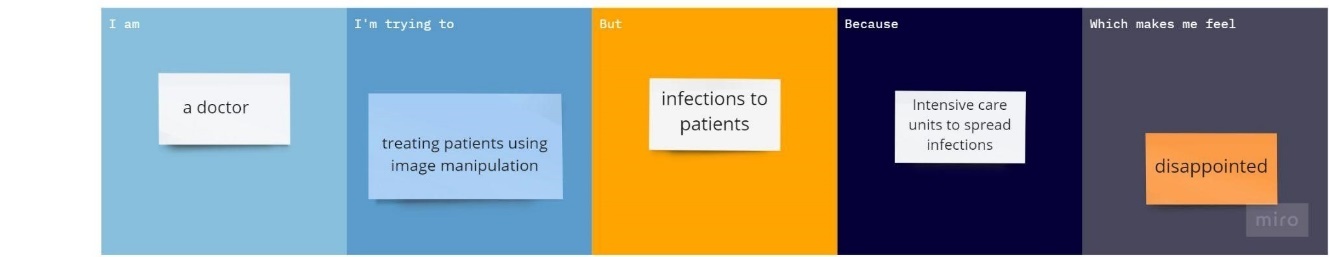
**3.1 Empathy Map canvas**

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**3.2 Ideation and Brain stroming**

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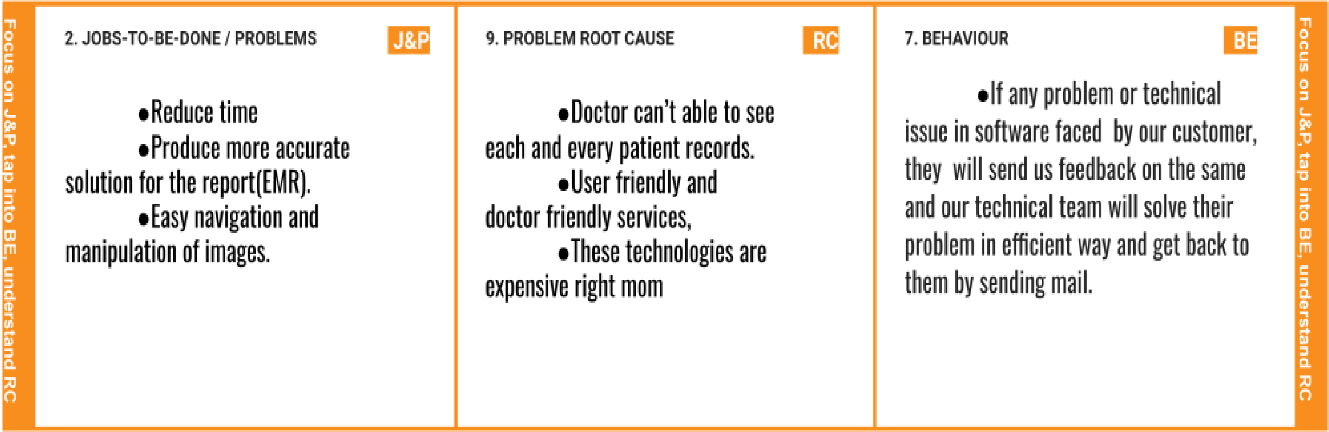
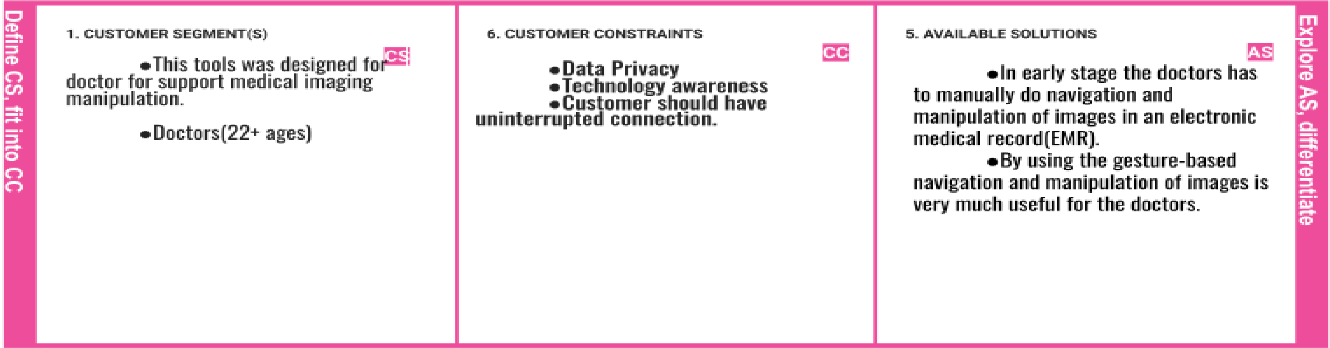
**Example:**



**3.3 Proposed Solution**

|  |  |  |
| --- | --- | --- |
| **S.No.** | **Parameter** | **Description** |
| 1. | Problem Statement (Problem to be solved) | A major challenge involved is to provide Doctors with efficient, intuitive, accurate and safe means of interaction without affecting the quality of their work. However,the use of computer keyboards and mouse by doctors in intensive care unit(ICU) is a common mean for spreading infections.We suggest the use of hand gestures in medical field as an to the existing interface techniques by offering maximum level of sterility. |
| 2. | Idea / Solution description | Doctor can make use of hand gesture to move or control the images in order to maintain sterility. |
| 3. | Novelty / Uniqueness | In this method unlike other methods of nonverbal communication, gesture do not cause loss of concentration in an operation theatre. It performs better in detecting patterns in images. |
| 4. | Social Impact / Customer Satisfaction | It co-operates social responsibility by providing better to patient's health and it also helps professionals to have control over images without having direct contact with a system which avoids harmful rays and infections. |
| 5. | Business Model (Revenue Model) | Cost efficient to deploy this Software for health care department as well as in hospitals and can collaborate with government for health awareness camps. |
| 6. | Scalability of the Solution | Better execution in accurate results, sensitivity, system architecture design and transparency and flexibility of software |

**3.4 Problem Solution Fit**



**4.REQUIREMENT ANALYSIS**

**4.1 Functional Requirements:**

Following are the functional requirements of the proposed solution.

|  |  |  |
| --- | --- | --- |
| **FR No.** | **Functional Requirement (Epic)** | **Sub Requirement (Story / Sub-Task)** |
| FR-1 | Launching the model | Launch the trained CNN model from the cloud |
| FR-2 | Capturing the images | After capturing the images in camera we have to upload the images in the system |
| FR-3 | Performing gestures | After classifying, identify the correct image by the gesture and it should perform the operation |
| FR-4 | Model rendering | After capturing the image the algorithm will start its processing task |
| FR-5 | Sterile browsing | The sterile browsing can be performed after identifying the gestures |
| FR-6 | Visibility of images | After completing all the processes,a user can be able to see the images |

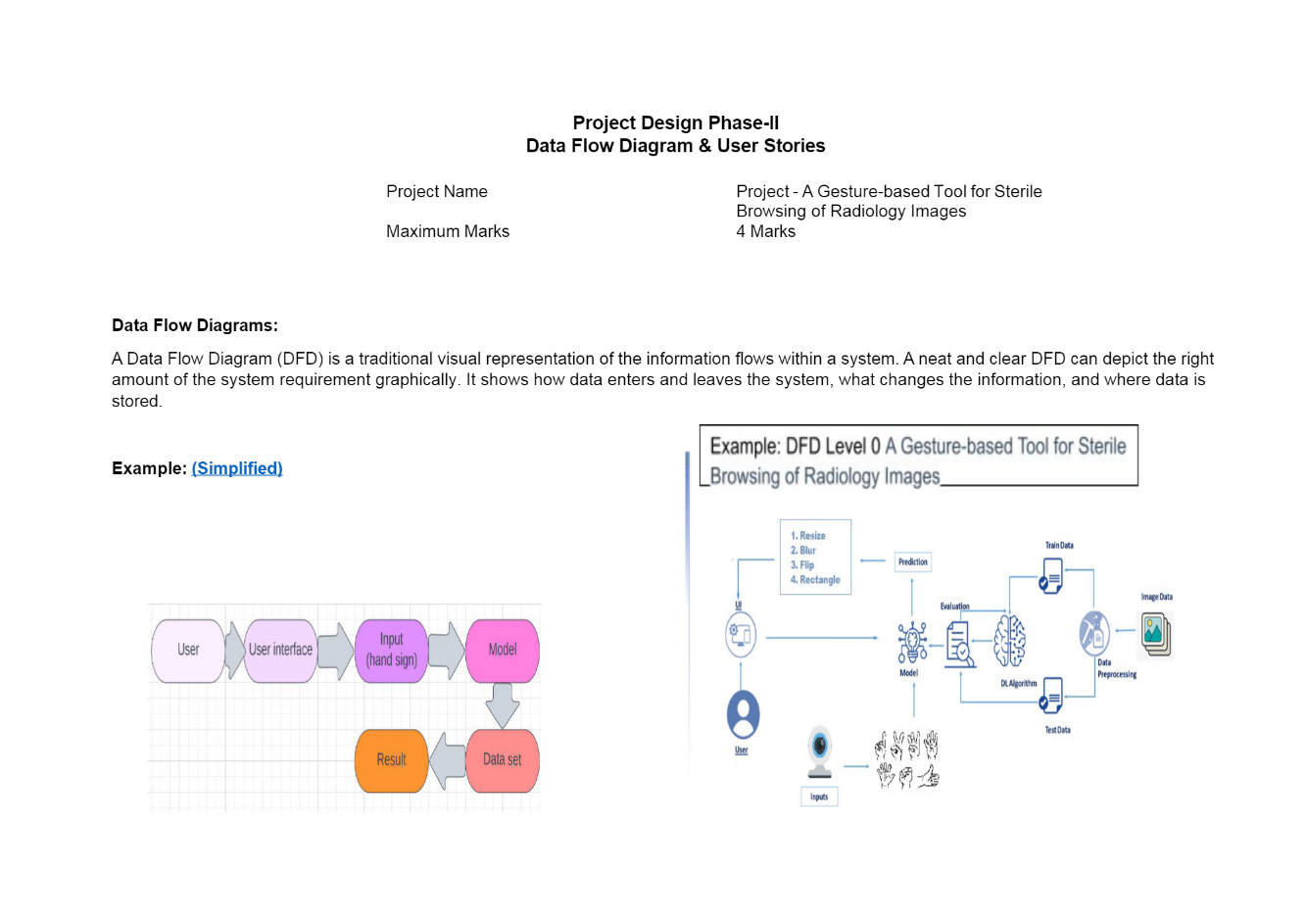
**4.2 Non-functional Requirements:**

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

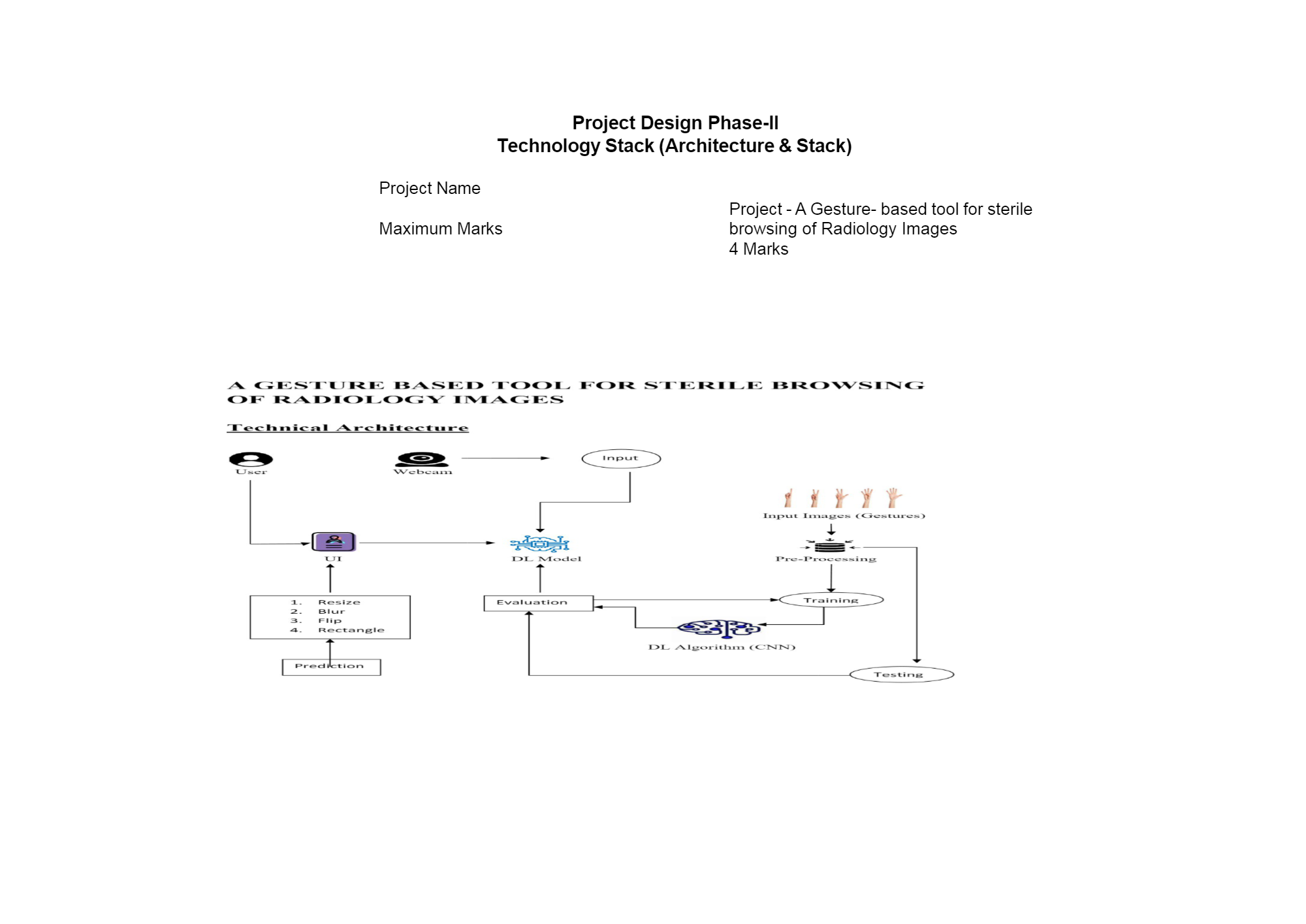
|  |  |  |
| --- | --- | --- |
| **FR No.** | **Non-Functional Requirement** | **Description** |
| NFR-1 | **Usability** | This system helps to have the control over images without having direct contact with system which avoids the harmful rays and is ease of use |
| NFR-2 | **Security** | This system is protected and only authorized users can access it |
| NFR-3 | **Reliability** | After installing the application,the system will predict the gesture and performs sterile browsing |
| NFR-4 |  | The system responds to a user in seconds and the hardware and software works well. |
|  | **Performance** | It is accessible by authorised user from anywhere at any time whenever there is an emergency. |
| **e** NFR-5 | **Availability** | This system allows more number of users at a time and there is no loss can be identified. |

**5. PROJECT DESIGN**

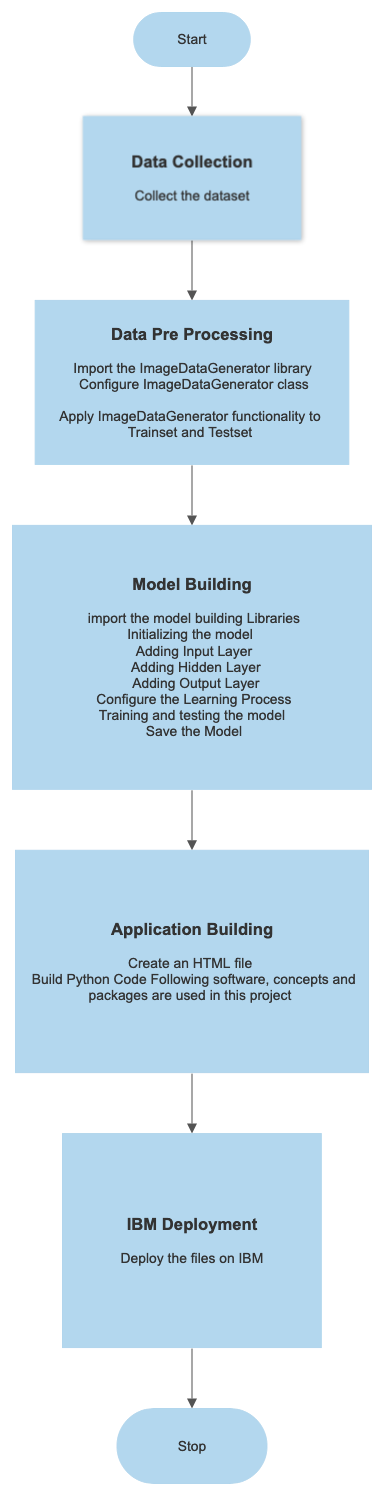
**5.1 Data flow diagrams**



**5.2 Solution and Technical architecture**



**5.3 User stories**



**6.PROJECT PLANNING & SCHEDULING**

**6.1 Sprint Planning &estimation**

|  |
| --- |
|  |

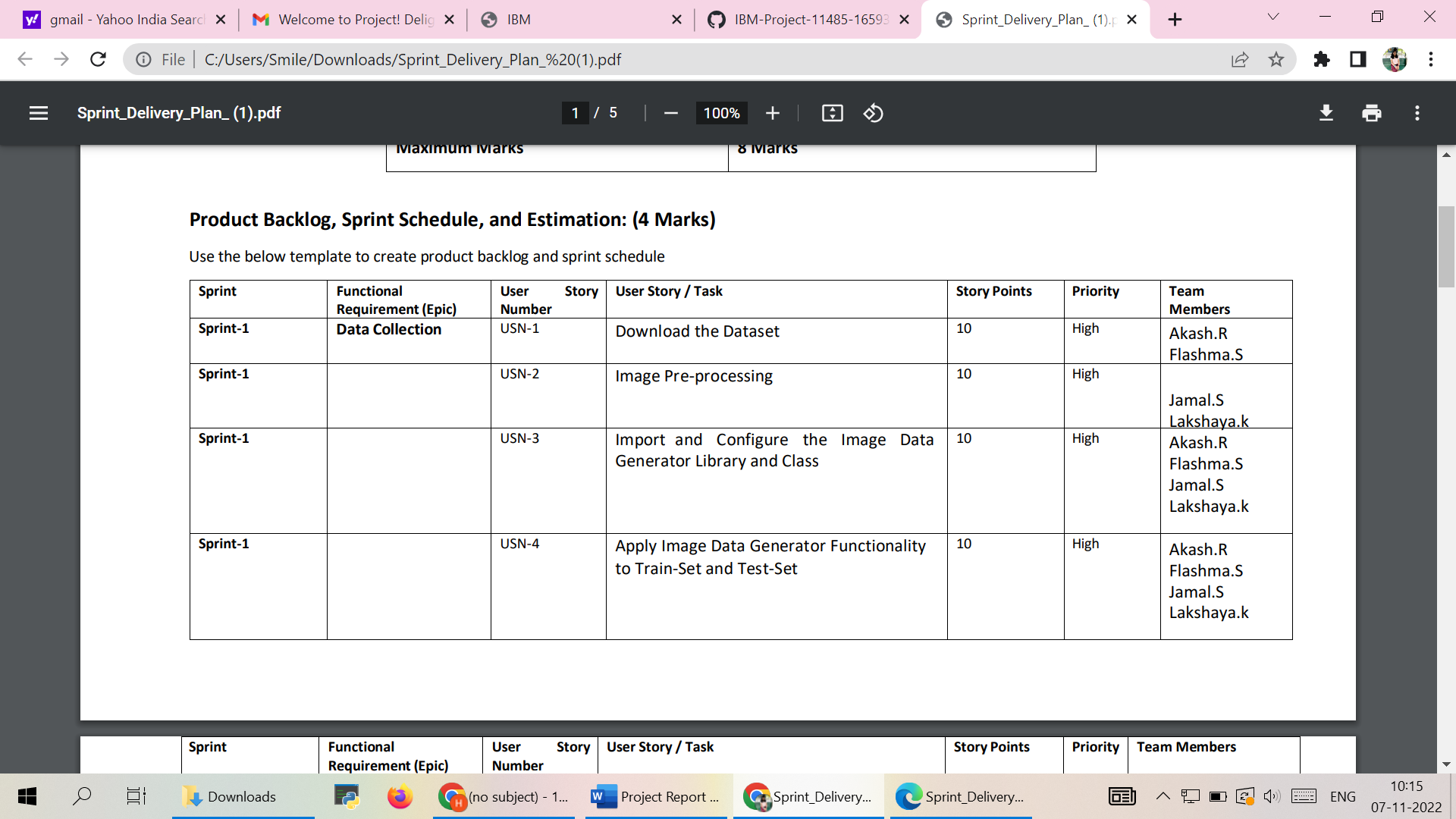
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.N O** | | **MILESTONE** | **ACTIVITIES** | **DATE** | | |
| **1** | | **Preparation phase** | Pre-requisites | 22 Aug -28 Aug 2022 | | |
| Prior knowledge |
| Project structure |
| Project Flow |
| Project Objectives |
| Registrations |
| Environment Set-up |
| 2 | | **Ideation phase** | Literature Survey | 30 Aug - 04 Sept 2022 | | |
| Empathy Map | 05 sept - 07 Sept 2022 | | |
| Problem Statement | 09 sept-11 sept 2022 | | |
| Ideation Phase | 13 sept - 16 sept 2022 | | |
| **3** | **Project**  **Design**  **Phase-I** | | Proposed Solution | | 19 sept - 24 sept 2022 |
| Problem Solution Fit | | 25 sept -27 sept 2022 |
| Solution Architecture | | 29 sept-01 oct 2022 |
| **4** | **Project**  **Design Phase-**  **II** | | Customer Journey | | 03 oct -07 oct 2022 |
| Requirement Analysis | | 08 oct -11 oct 2022 |
| Data Flow Diagrams | | 12 oct -14 oct 2022 |
| Technology Architecture | | 15 oct -17 oct 2022 |
| **5** | **Project Planning**  **Phase** | | Milestones and Tasks | | 18 oct -19 oct 2022 |
| Sprint Schedules | | 20 oct -23 oct 2022 |
| **6** | **Project**  **Development**  **Phase** | | Sprint-1 | | 25 oct-30 oct 2022 |
| Sprint-2 | | 02 oct -07 Nov 2022 |
| Sprint-3 | | 08 Nov -13 Nov 2022 |
|  |  | | Sprint-4 | | 15 Nov -19 Nov 2022 |

**6.2 Spring Delivery Schedule**

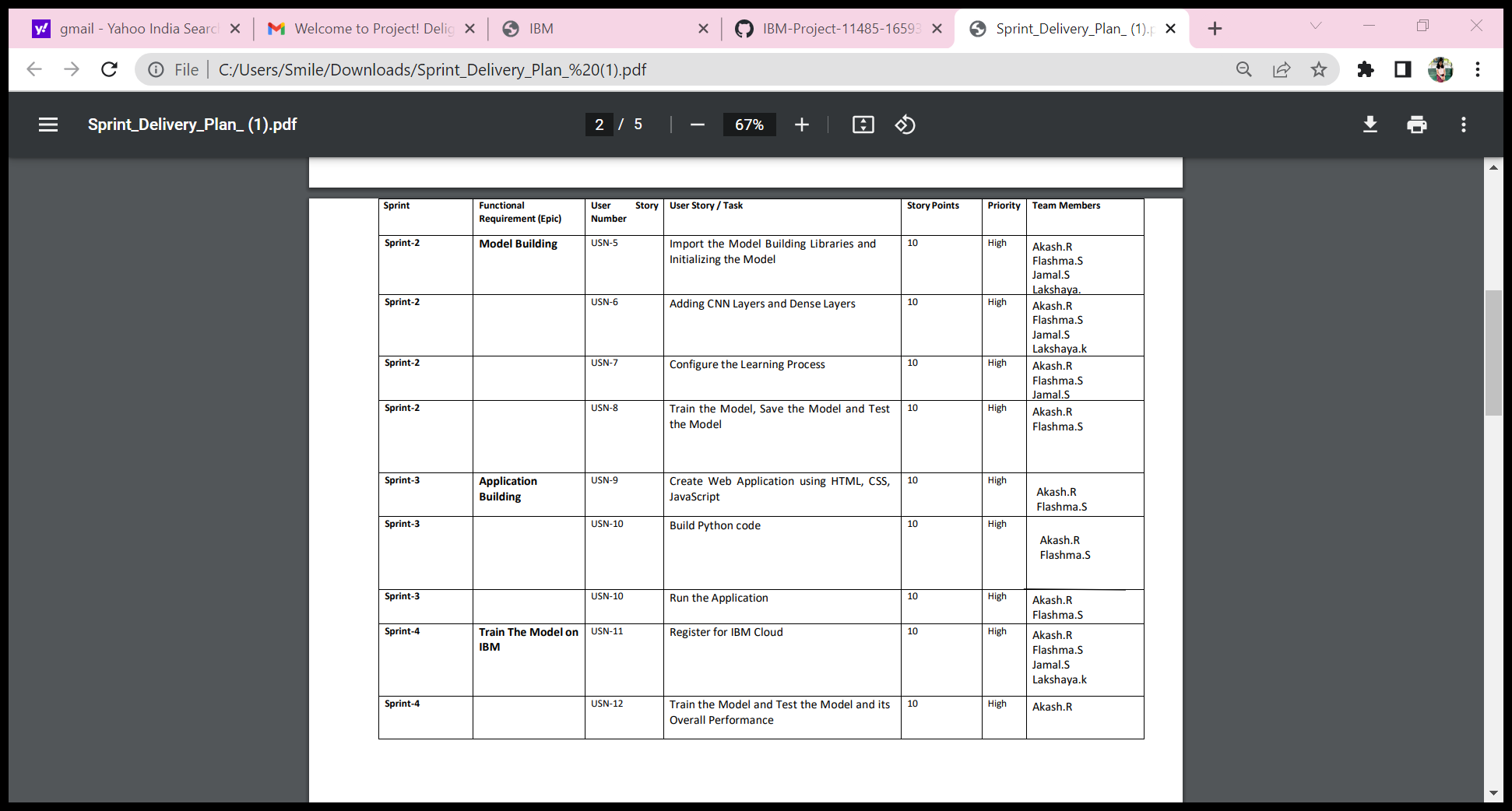
**SPRINT-1**

**Product Backlog, Sprint Schedule, and Estimation:**

Use the below template to create product backlog and sprint schedule



**SPRINT-2 ,3,4**



**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)



**6.3 Reports from JIRA**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sprint-1** | 10 |  | 6 Days | 24 Oct 2022 | 29 Oct 2022 |  | 10 | 29 Oct 2022 |  |
| **Sprint-2** | 10 |  | 6 Days | 31 Oct 2022 | 05 Nov 2022 |  | 10 | 05 Nov 2022 |  |
| **Sprint-3** | 10 |  | 6 Days | 07 Nov 2022 | 12 Nov 2022 |  | 10 | 12 Nov 2022 |  |
| **Sprint-4** | 10 |  | 6 Days | 14 Nov 2022 | 19 Nov 2022 |  | 10 | 19 Nov 2022 |  |

**7.CODING & SOLUTIONING**

**7.1 Feature 1**

|  |
| --- |
| <!DOCTYPE html> |
|  | <html> |
|  |  |
|  | <head> |
|  | <meta charset="utf-8"> |
|  | <meta name="viewport" content="width=device-width"> |
|  | <title>Gesture</title> |
|  | <link href="style.css" rel="stylesheet" type="text/css" /> |
|  | </head> |
|  |  |
|  | <body> |
|  | <div id="container"> |
|  | <span id="text1"></span> |
|  | <span id="text2"></span> |
|  | </div> |
|  |  |
|  | <svg id="filters"> |
|  | <defs> |
|  | <filter id="threshold"> |
|  | <feColorMatrix in="SourceGraphic" type="matrix" values="1 0 0 0 0 |
|  | 0 1 0 0 0 |
|  | 0 0 1 0 0 |
|  | 0 0 0 255 -140" /> |
|  | </filter> |
|  | </defs> |
|  | </svg> |
|  | <div class="wrapper"> |
|  | <a class="cta" href="#"> |
|  | <span class="but">GET STARTED</span> |
|  | <span> |
|  | <svg width="66px" height="43px" viewBox="0 0 66 43" version="1.1" xmlns="http://www.w3.org/2000/svg" |
|  | xmlns:xlink="http://www.w3.org/1999/xlink"> |
|  | <g id="arrow" stroke="none" stroke-width="1" fill="none" fill-rule="evenodd"> |
|  | <path class="one" |
|  | d="M40.1543933,3.89485454 L43.9763149,0.139296592 C44.1708311,-0.0518420739 44.4826329,-0.0518571125 44.6771675,0.139262789 L65.6916134,20.7848311 C66.0855801,21.1718824 66.0911863,21.8050225 65.704135,22.1989893 C65.7000188,22.2031791 65.6958657,22.2073326 65.6916762,22.2114492 L44.677098,42.8607841 C44.4825957,43.0519059 44.1708242,43.0519358 43.9762853,42.8608513 L40.1545186,39.1069479 C39.9575152,38.9134427 39.9546793,38.5968729 40.1481845,38.3998695 C40.1502893,38.3977268 40.1524132,38.395603 40.1545562,38.3934985 L56.9937789,21.8567812 C57.1908028,21.6632968 57.193672,21.3467273 57.0001876,21.1497035 C56.9980647,21.1475418 56.9959223,21.1453995 56.9937605,21.1432767 L40.1545208,4.60825197 C39.9574869,4.41477773 39.9546013,4.09820839 40.1480756,3.90117456 C40.1501626,3.89904911 40.1522686,3.89694235 40.1543933,3.89485454 Z" |
|  | fill="#FFFFFF"></path> |
|  | <path class="two" |
|  | d="M20.1543933,3.89485454 L23.9763149,0.139296592 C24.1708311,-0.0518420739 24.4826329,-0.0518571125 24.6771675,0.139262789 L45.6916134,20.7848311 C46.0855801,21.1718824 46.0911863,21.8050225 45.704135,22.1989893 C45.7000188,22.2031791 45.6958657,22.2073326 45.6916762,22.2114492 L24.677098,42.8607841 C24.4825957,43.0519059 24.1708242,43.0519358 23.9762853,42.8608513 L20.1545186,39.1069479 C19.9575152,38.9134427 19.9546793,38.5968729 20.1481845,38.3998695 C20.1502893,38.3977268 20.1524132,38.395603 20.1545562,38.3934985 L36.9937789,21.8567812 C37.1908028,21.6632968 37.193672,21.3467273 37.0001876,21.1497035 C36.9980647,21.1475418 36.9959223,21.1453995 36.9937605,21.1432767 L20.1545208,4.60825197 C19.9574869,4.41477773 19.9546013,4.09820839 20.1480756,3.90117456 C20.1501626,3.89904911 20.1522686,3.89694235 20.1543933,3.89485454 Z" |
|  | fill="#FFFFFF"></path> |
|  | <path class="three" |
|  | d="M0.154393339,3.89485454 L3.97631488,0.139296592 C4.17083111,-0.0518420739 4.48263286,-0.0518571125 4.67716753,0.139262789 L25.6916134,20.7848311 C26.0855801,21.1718824 26.0911863,21.8050225 25.704135,22.1989893 C25.7000188,22.2031791 25.6958657,22.2073326 25.6916762,22.2114492 L4.67709797,42.8607841 C4.48259567,43.0519059 4.17082418,43.0519358 3.97628526,42.8608513 L0.154518591,39.1069479 C-0.0424848215,38.9134427 -0.0453206733,38.5968729 0.148184538,38.3998695 C0.150289256,38.3977268 0.152413239,38.395603 0.154556228,38.3934985 L16.9937789,21.8567812 C17.1908028,21.6632968 17.193672,21.3467273 17.0001876,21.1497035 C16.9980647,21.1475418 16.9959223,21.1453995 16.9937605,21.1432767 L0.15452076,4.60825197 C-0.0425130651,4.41477773 -0.0453986756,4.09820839 0.148075568,3.90117456 C0.150162624,3.89904911 0.152268631,3.89694235 0.154393339,3.89485454 Z" |
|  | fill="#FFFFFF"></path> |
|  | </g> |
|  | </svg> |
|  | </span> |
|  | </a> |
|  | </div> |
|  | </style> |
|  | <script src="script.js"></script> |
|  |  |
|  | </body> |
|  |  |
|  | </html> |

**7.2 Feature 2**

|  |
| --- |
| if \_\_name\_\_ == '\_\_main\_\_': |
|  | app.run(debug=True) |
|  |  |

**8.TESTING**

**8.1 Test Cases**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test case ID** | **Feature Type** | **Component** | **Test Scenario** | **Pre-Requisite** | **Steps To Execute** | **Test Data** | **Expected Result** | **Actual Result** | **Status** |
| LoginPage\_TC\_OO1 | Functional | Home Page | Verify user is able to see the  Login/Signup popup when user clicked on My account button |  | 1.Enter URL and click go  2.Click on My Account dropdown button  3.Verify login/Singup popup displayed or not | <https://gesture.com/> | Login/Signup popup should display | Working as expected | Pass |
| LoginPage\_TC\_OO2 | UI | Home Page | Verify the UI elements in Login/Signup popup |  | 1.Enter URL and click go  2.Click on My Account dropdown button  3.Verify login/Singup popup with below UI elements: a.email text box  b.password text box  c.Login button  d.New customer? Create account link  e.Last password? Recovery password  link | <https://gesture.com/> | Application should show below UI elements:  a.email text box  b.password text box  c.Login button with orange colour  d.New customer? Create account link  e.Last password? Recovery password  link | Working as expected | Pass |
| LoginPage\_TC\_OO3 | Functional | Home page | Verify user is able to log into application with Valid credentials |  | 1.Enter URL(https://shopenzer.com/) and click go  2.Click on My Account dropdown button  3.Enter Valid username/email in Email text box  4.Enter valid password in password text box  5.Click on login button | Username: kspah@gmail.com password: bsnl123 | User should navigate to user account homepage | Working as expected | Pass |
| LoginPage\_TC\_OO4 | Functional | Login page | Verify user is able to log into application with InValid credentials |  | 1.Enter URL(https://shopenzer.com/) and click go  2.Click on My Account dropdown button  3.Enter InValid username/email in  Email text box  4.Enter valid password in password text box  5.Click on login button | Username: kspah@gmail password: bsnl123 | Application should show 'Incorrect email or password ' validation message. | Working as expected | Pass |
| LoginPage\_TC\_OO4 | Functional | Login page | Verify user is able to log into application with InValid credentials |  | 1.Enter URL(https://shopenzer.com/) and click go  2.Click on My Account dropdown button  3.Enter Valid username/email in Email text box  4.Enter Invalid password in password text box  5.Click on login button | Username: kspah@gmail.com password:  bsnl123678686786876876 | Application should show 'Incorrect email or password ' validation message. | Working as expected | Pass |
| LoginPage\_TC\_OO5 | Functional | Login page | Verify user is able to log into application with InValid credentials |  | 1.Enter URL(https://shopenzer.com/) and click go  2.Click on My Account dropdown button  3.Enter InValid username/email in  Email text box  4.Enter Invalid password in password text box  5.Click on login button | Username: kspah@gmail.com password: bsnl167865 | Application should show 'Incorrect email or password ' validation message. | Working as expected | Pass |

**8.2 User Acceptance Testing**

# 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).

# Defect Analysis

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

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 | 12 | 4 | 4 | 5 | 25 |
| Duplicate | 1 | 2 | 2 | 0 | 5 |
| External | 4 | 3 | 1 | 0 | 8 |
| 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 | 28 | 16 | 15 | 27 | 86 |

# Test Case Analysis

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 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. RESULT

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.

# 10.ADVANTAGES & DISADVANTAGES

**Advantages:**

Majoradvantage 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 useability 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.

# BIBILOGRAPHY

Research papers:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2410001/> <https://pubmed.ncbi.nlm.nih.gov/18451034/>[https://www.researchgate.net/publication/5401674\_A\_Gesturebased\_Tool\_for\_Sterile\_Browsing\_of\_Radiology\_Images](https://www.researchgate.net/publication/5401674_A_Gesture-based_Tool_for_Sterile_Browsing_of_Radiology_Images)

**Appendix** source code

https://github.com/IBM-EPBL/IBM-Project-11485-1659330923