

Gesture Based Tool for Sterile Browsing of Radiology Images

Team ID: PNT2022TMID49719

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1. INTRODUCTION

1.1 Overview

In this project we use gestures to browse radiology images. Gestures refer to non-verbal form of communication.

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 common method of human—computer interaction. However, the use of computer keyboards and mouse 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 , 2 - image is rotated, 3 - image is blurred.

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 A Gesture-based Tool for Sterile Browsing of Radiology Images - research paper by national library of medicine

The hand gesture control system “Gestix” developed by the authors helped the doctor to remain in place during the entire operation, without any need to move to the main control wall since all the commands were performed using hand gestures. The sterile gesture interface consists of a Canon VC-C4 camera, whose pan/tilt/zoom can be initially set using an infrared (IR) remote.

This camera is placed just over a large flat screen monitor .

Additionally, an Intel Pentium IV, (600MHz, OS: Windows XP) with a Matrox Standard II video-capturing device is used.

The “Gibson” image browser is a 3D visualization medical tool that enables examination of images, such as: MRIs, CT scans and X-rays. The images are arranged over a multiple layer 3D cylinder. The image of interest is found through rotating the cylinder in the four cardinal directions. To interface the gesture recognition routines with the “Gibson” system, information such as the centroid of the hand, its size, and orientation are used to enable screen operations in the “Gibson” graphical user interface.



Fig 2. Radiology image browsing using hand gesture in hospital.

3. THEORITICAL ANALYSIS

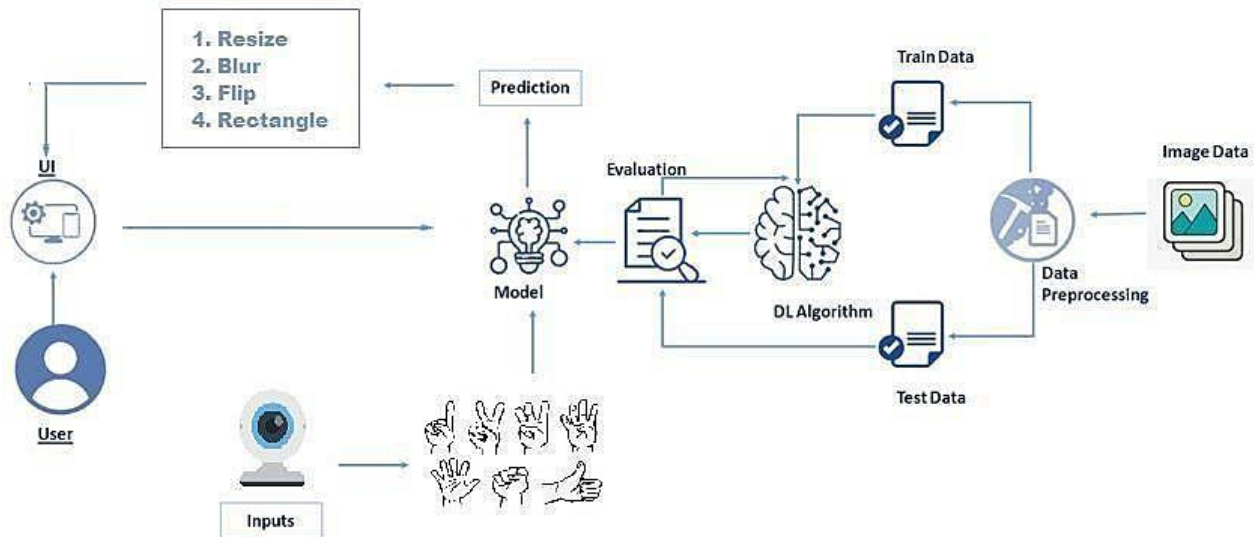
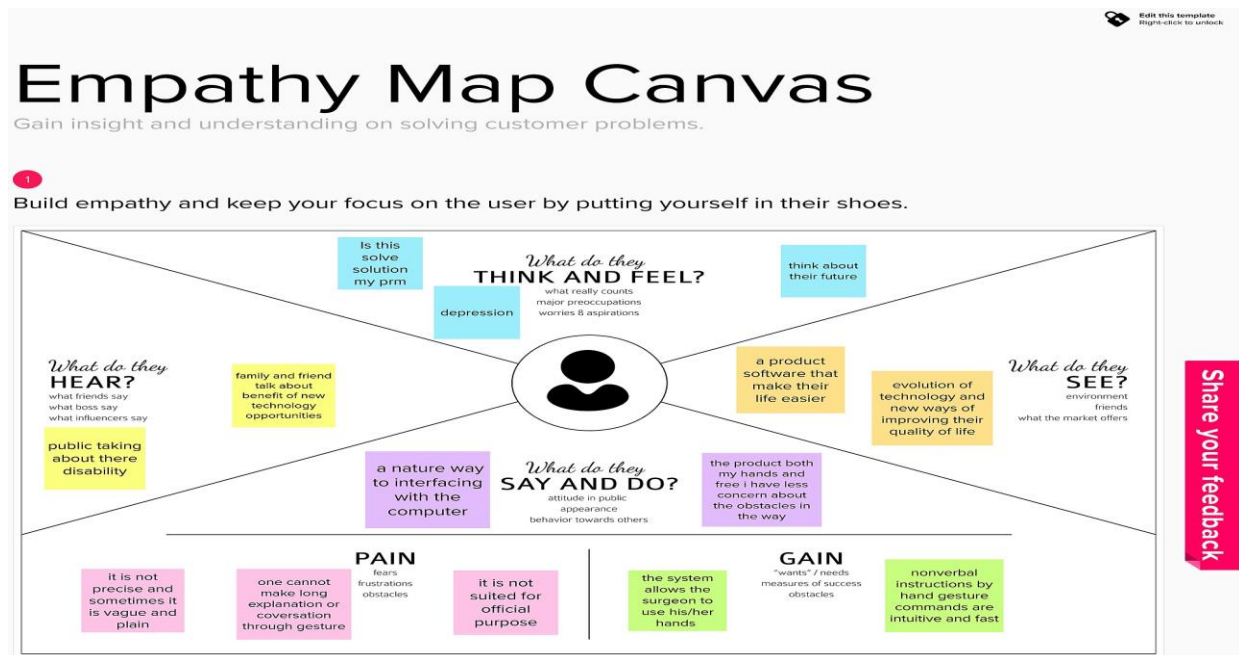


Fig 3. Architecture of Gesture Based Tool for Sterile Browsing of Radiology Images

4. IDEATION & PROPOSED SOLUTION

4.1. Empathy Map:



4.2. Ideation & Brainstorming:

In order to provide surgeons with a more efficient, comfortable, precise, and sterile interaction technique, the feet and hands can be an effective means of accomplishing this goal in comparison to other modalities, such as voice or gaze interaction or using Radar Sensor.

Touch-less gesture interaction is an option to interact with imaging systems, displays, and controllers without breaking the sterility barrier. The system utilizes nothing but a camera with good quality and can follow the hand of the user in 2 dimensions and identify up to four mouse-defined hand motions. Recent progress in gaming technologies provides innovative opportunities for motion tracking and human-machine interaction. In the field of healthcare, sensors like Microsoft® Kinect (2015) have been used for detecting postures. Using electromyography technology to capture gesture instead of the camera, therefore it is less affected by the external factors such as light and obstruction. The disadvantage of high computational cost.

Voice command is another type of touchless communication but its commands are discrete rather than hand gestures which are able to perform analog commands. On the other hand, voice command has other disadvantages such as its low accuracy due to existence of noise in surgery rooms.

**Project Design Phase-
IProposedSolutionTemplate**

Date	13 October 2022
TeamID	PNT2022TMID50884
ProjectName	Project-AGesture-basedToolforSterileBrowsingofRadiology Images
MaximumMarks	2Marks

ProposedSolutionTemplate:

Projectteamshallfillthefollowinginformationinproposedsolutiontemplate.

S.No.	Parameter	Description
1.	ProblemStatement(Problemto besolved)	The use of doctor-computer interaction devicesintheoperationroomrequiresnew modalities that support medical imagingmanipulationwhileallowingdoctors’ha ndstoremainsterile, supporting their focus of attention, and providing fastresponse times. Therefore, a gesturerecognition system that interprets user’sgesturesformanipulationofmedical imagesis proposed.
2.	Idea/Solutiondescription	The data is to be collected by observingintuitive gestures in different lightingenvironments by video capture. The data isthen sampled, cleaned and segmented andpassed into a Convolutional Neural Networkwhich then identifies the gestures. Followingthis,stackingisperformedtogivehigh er accuracyusingalgorithmssuchasSVMsandG MMs.
3.	Novelty/Uniqueness	The project proposes classification of hand images depicting aparticularnumberforanoperation,ex.,2forzoomout.Instead, a temporal model, depicting real time gesture for an operation, ex.movingindexfingerleftforleftswipe,canbeimplementedtoease theinteractionwhichthusformsascopeforuniquenessforthe project.
4.	SocialImpact/CustomerSatisfaction	Theabilitytointeractthroughpatientmedicalimagesinasterileformataugmentsthe attentionofthesurgeontowardssurgery.The surgeon neednotchange locationinorderto browseimages, butcandoitremotely. Further,inconveniencescausedinphysicalinteraction,beingpossiblemo deforinfectionspread, isnow solved.
5.	BusinessModel(RevenueModel)	The systemwhendevelopedandtestedforaccuracy, canbegivento varioushospitalsforpracticaltestingforaparticularperiod. Theycanlaterbepersuadedto purchaseonce theperiodisdone. Further, tocapitaliseand marketitasasoftwareproduct, directsalestohospitalsandsurgeonsmustbemade. Revenuesourcesinclude directsales viademoandsales via purchaseaftertesting.

4.4. Problem Solution Bit:

ProjectTitle:AGesture-basedToolforSterileBrowsingofRadiologyImages
SolutionFitTemplateTeamID:
PNT2022TMID50884

ProjectDesignPhase-I-

Define CS, fit into CC	1. CUSTOMER SEGMENT(S) CS: <ul style="list-style-type: none">•This tools was designed for doctor for support medical imaging manipulation.•Doctors(22+ ages)	6. CUSTOMER CONSTRAINTS CC <ul style="list-style-type: none">•Data Privacy•Technology awareness•Customer should have uninterrupted connection.	5. AVAILABLE SOLUTIONS AS <ul style="list-style-type: none">•In early stage the doctors has to manually do navigation and manipulation of images in an electronic medical record(EMR).•By using the gesture-based navigation and manipulation of images is very much useful for the doctors.	Explore AS, differentiate
Focus on J&P, tap into BE, understand RC	2. JOBS-TO-BE-DONE / PROBLEMS J&P <ul style="list-style-type: none">•Reduce time•Produce more accurate solution for the report(EMR).•Easy navigation and manipulation of images.	9. PROBLEM ROOT CAUSE RC <ul style="list-style-type: none">•Doctor can't able to see each and every patient records.•User friendly and doctor friendly services,•These technologies are expensive right mom	7. BEHAVIOUR BE <ul style="list-style-type: none">•If any problem or technical issue in software faced by our customer, they will send us feedback on the same and our technical team will solve their problem in efficient way and get back to them by sending mail.	Focus on J&P, tap into BE, understand RC

<p>3. TRIGGERS TR</p> <ul style="list-style-type: none"> • Thetime-efficientandeasybrowsingtriggerthecustomerstoswitchtothistechnology. 	<p>10. YOURSOLUTION SL</p> <ul style="list-style-type: none"> • Whenthiskindofsoftwareislaunchedworldwide this will be very much useful for doctors. • Itwillmakeworkeasierandfaster. • Thisgesture-basedtechnologyismainlybased on hand signs in video frames andrecognizes the images and performs a correspondingaction. 	<p>8.CHANNELsofBEHAVIOUR CH</p> <ul style="list-style-type: none"> • ONLINE: Extractchannelsfrombehviorkblock. • OFFLINE: Extract channels from behavior block andisusedforcustomer'sdeployment.
<p>4. EMOTIONS:BEFORE/AFTER EM</p> <ul style="list-style-type: none"> • Sometimes doctors have to be there with theemotional situations of patients, which sometimesmakedoctor disturbed. • Butnowadaysdoctorusesgesturetooltosave theirwork. 		

5. REQUIREMENT ANALYSIS

5.1. Non Functional Requirements

Let us see some of the non functional requirements:

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	Performance	The system responds to a user in seconds and the hardware and software works well
NFR-5	Availability	It is accessible by authorised user from anywhere at any time whenever there is an emergency
NFR-6	Scalability	This system allows more number of users at a time and there is no loss can be identified

4.2.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

5.PROJECT DESIDN

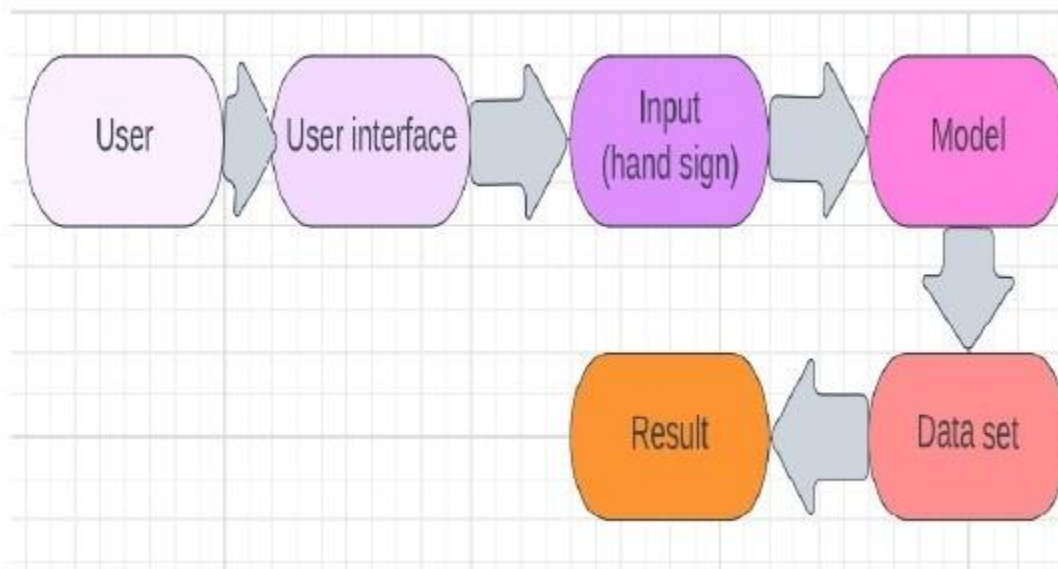
5.1.. FLOWCHART

- 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 theUI.

To accomplish this, we have to complete all the activities and tasks listed below:

- 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
 - Adding Input Layer
 - Adding Hidden Layer
 - Adding Output Layer
 - Configure the Learning Process
 - Training and testing the model
 - Save the Model
- Application Building
 - Create an HTML file
 - Build Python Code Following software, concepts and packages are used in this project
- Anaconda navigator
- Python packages:
 - open anaconda prompt as administrator
 - Type “pip install TensorFlow” (make sure you are working on python 64 bit)
 - Type “pip install opencv-python”
 - Type “pip install flask.”



5.2. Solution Architecture Diagram:

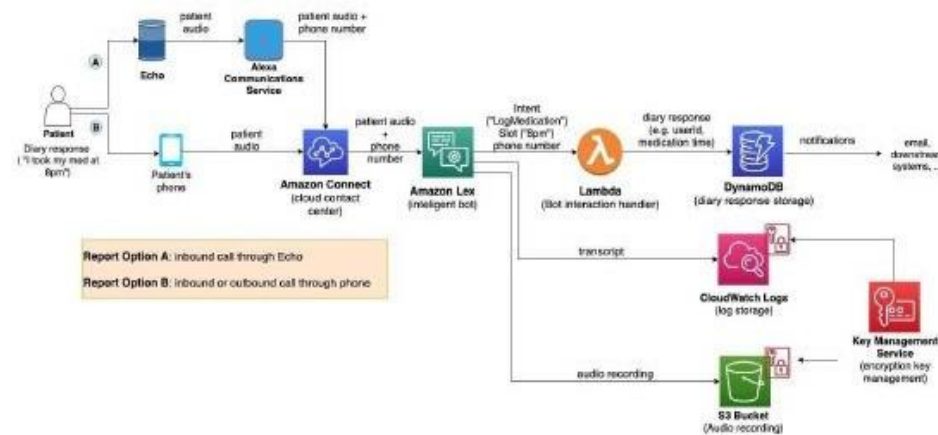
Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

Find the best tech solution to solve existing business problems.

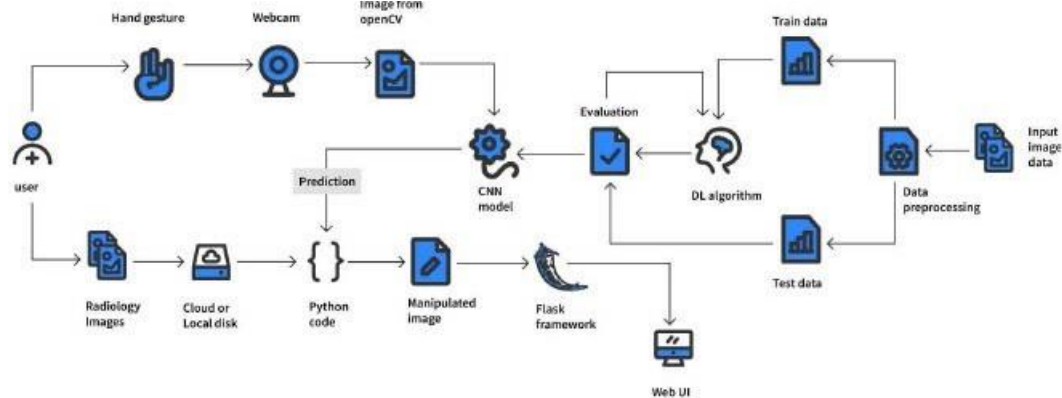
Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.

Define features, development phases, and solution requirements.

Provide specifications according to which the solution is defined, managed, and delivered.



A Gesture Sterile Tools For Radiological Images



5.3. User Stories:

A GESTURE BASED TOOL FOR STERILE BROWSING OF RADIOLOGY IMAGES	Entice How does someone initially become aware of the process?	Enter What do people experience as they begin the process?	Engage In the core moments in the process, what happens?	Exit What do people typically experience as the process finishes?	Extend What happens after the experience is over?
Steps What does the person or group typically experience?	Find solutions To avoid infection for patient, the surgeon tries to find a solution Found the product based tool The user found that, the gesture based tool is optimal to solve the problem Listing requirements and installation The surgeon needs the computer with a good webcam at their installing the software	Showing the UI The user using the browsing interface of our software Learning The surgeon learns to use our Software	Starting to use the tool The user tracks the software and use that in real scenario Experiencing The surgeon feels comfortable and convenient	Prompt for feedback After the user does the feedback prompt will be shown to the customer Writing and submitting feedback The user writes and gives good feedback and submitting the feedback	Making his routine The user will use the Software again when the needs
Interactions What interactions do they have at each step along the way? • People: Who do they see or talk to? • Places: Where are they? • Things: What digital touchpoints or physical objects would they use?	Asking for suggestions from other surgeons Visit the website Download our software	Interact to the UI Getting knowledge about software	Customize the settings changing the actions (e.g. image resize...) for specific gesture	Again changing the settings that worked wrong Verifies that the settings has changed	Recommend this Software to other Surgeons
Goals & motivations At each step, what is a person's primary goal or motivation? (What do they want to achieve?)	To avoid spreading of infection To find a good solution for the sterile browsing of radiology images	To learn about our software To practice to give gesture inputs	To complete his reading/browsing of radiology images To avoid complexity	To verify the accuracy of the software Trying to improve the software by giving different input gestures	Tweaking some configurations
Positive moments What steps does a typical person find enjoyable, satisfying, fun, motivating, insightful or exciting?	Work can be easily done Prevents infection Computer with simple webcam is enough	Good and friendly UI No big configurations needed	Mostly accurate Best performance	Work done easily	It is productive applicable in various departments Worth to suggest for other surgeons
Negative moments What steps does a typical person find frustrating, confusing, upsetting, costly or time-consuming?	The question arises: Is it better than manual browsing? The question arises: Does it work with any webcam and computer?	The user has to remember the various gestures It is not precise and sometimes it is vague	It is less accurate sometimes Focus issues occur sometimes while scanning gesture with low quality webcam	The user should make some settings in order to make the software accurate in real time The user should close the software properly this may take some time	The user will feel inconvenient without this software
Areas of opportunity How might we make each step better? What ideas do we have? What have others suggested?	Increase awareness Adding more details and procedures in the website	To increase the support for almost all devices Increase the support for low quality webcams	To increase the performance To make the UI better We can improve the software to work with low lighting conditions	The feedback can be captured We can collect the input and output data that obtained during process	We can improve the software with the feedback obtained from the user We can increase reliability with the collected data

7. PROJECT PLANNING AND SCHEDULING

7.1. Sprint Planning & Estimation

SI. NO	MILESTONE	ACTIVITIES	DATE
1	Preparation Phase	Pre-requisites	22 - 27 Aug 2022
		Prior knowledge	
		Project Structure	
		Project Flow	
		Project Objectives	
		Registrations	
		Environment Set-up	
2	Ideation Phase	Literature Survey	29 Aug - 3rd Sept 2022
		Empathy Map	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	Customer Journey	3 - 8 Oct 2022
		Requirement Analysis	10 - 15 Oct 2022
		Data Flow Diagrams	
		Technology Architecture	
5	Project Planning Phase	Milestones & Tasks	17 - 22 Oct 2022
		Sprint Schedules	
6	Project Development Phase	Sprint-1	24 - 29 Oct 2022
		Sprint-2	31 Oct - 5 Nov 2022
		Sprint-3	7 - 12 Nov 2022
		Sprint-4	14 - 19 Nov 2022

7.2. Sprint Deliver Schedule:

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement(Epic)	User Story Number	User Story/Task	Story Points	Priority	Team Members
Sprint-1	Application/Software Launch	USN-1	As a user, I can launch the developed application/software	1	Medium	NarayananM JasperA ManikandanS Anish BellS
Sprint-1	Accessing the User Interface(UI)	USN-2	As a user, I can interact with software and operate the application with the help of UI	1	Medium	NarayananM JasperA ManikandanS Anish BellS
Sprint-2	Launching the webcam/camera	USN-3	As a user, I can open the webcam/camera from the application to perform gestures	1	Low	NarayananM JasperA ManikandanS Anish BellS
Sprint-2	Upload images from local system for manipulation	USN-4	As a user, I can upload images to the application from local system for manipulation	2	Low	NarayananM JasperA ManikandanS Anish BellS
Sprint-3	Manipulating images through gestures	USN-5	As a user, I can perform various gestures with respect to system specification to manipulate the images	2	Medium	NarayananM JasperA ManikandanS Anish BellS

Sprint	Functional Requirement(Epic)	User Story Number	User Story/Task	Story Points	Priority	Team Members
Sprint-4	Display the result/output	USN-6	As a user, I can see the sterile browsed/manipulated image on the screen with respect to the gesture performed	2	High	NarayananM JasperA ManikandanS Anish BellS

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

7.3. Reports from Jira

IBM Project Tracking dashboard

Introduction

Welcome to Jira

Not sure where to start? Check out the Jira 101 guide and Atlassian training course.

You can customise this text in the Administration section.

Just now

Assigned to Me

You currently have no issues assigned to you. Enjoy your day!

Just now

Activity Streams

Your Company JIRA

Today

- SK** Sujan Karthi updated the Sprint of IPT-1 - it is not still integrated with front end
1 minute ago Comment

Yesterday

- SK** Sujan Karthi changed the status to To Do on IPT-1 - it is not still integrated with front end
Yesterday Comment
- Sujan Karthi changed the status to In Progress on IPT-1 - it is not still integrated with front end
Yesterday Comment
- Sujan Karthi updated the Sprint of IPT-1 - it is not still integrated with front end

Projects

- IBM Project Tracking (IPT)**
Lead: Sujan Karthi
1-1 of 1
Just now

Jira Software Your work Projects Filters Dashboards People Apps Create

Search

Does your team need more from Jira? Get a free trial of our Standard plan.

Projects / IBM Project Tracking

Backlog

Search SK Epic

Insights

IPT Sprint 4 14 Nov – 21 Nov (1 issue) 0 0 0 Start sprint

Complete the UAT and performance Testing Final documentation should need to be done with the appropriate format

- IPT-1** it is not still integrated with front end TO DO

+ Create issue

Backlog (0 issues) 0 0 0 Create sprint

Your backlog is empty.

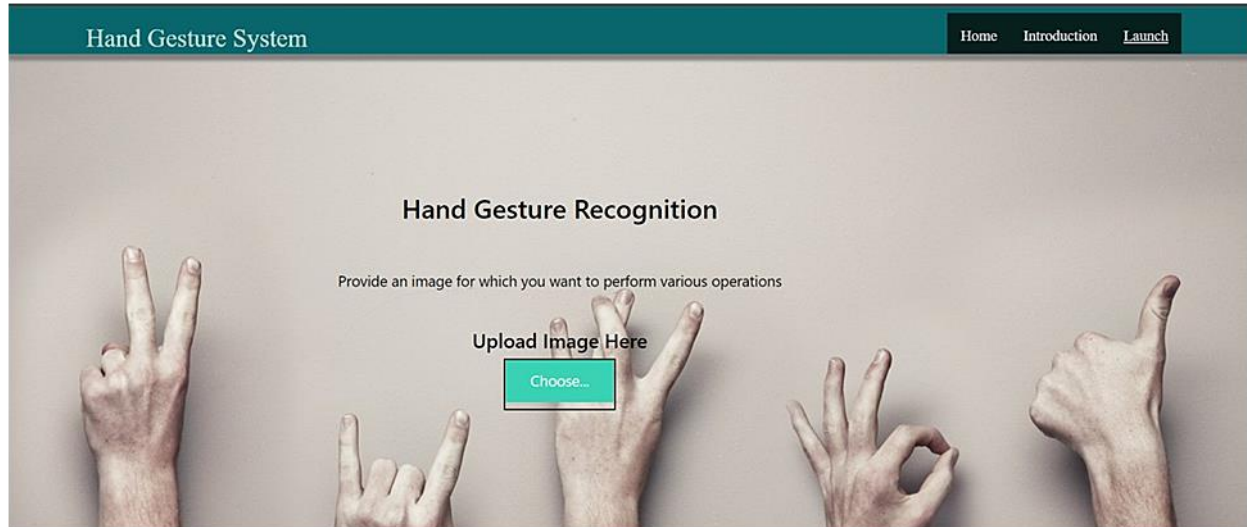
+ Create issue

Quickstart

The tasks are assigned to everyone for every sprint and completed the tasks successfully.

8. FEATURES

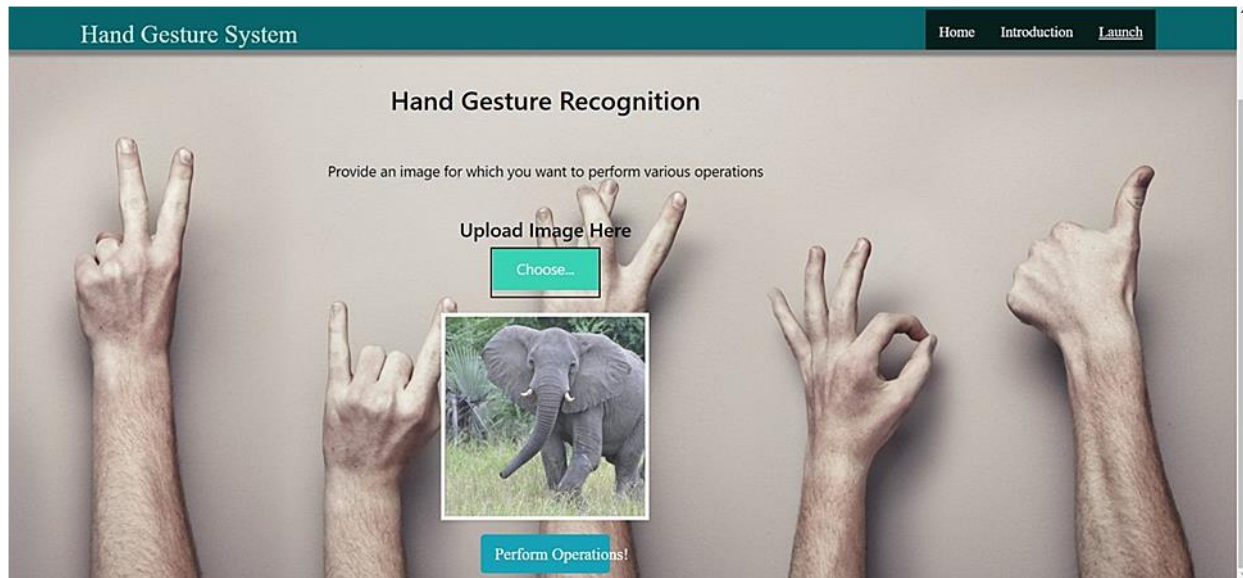
8.1. Feature 1



This is the most important and notable feature of our project where we can choose the images for hand gesture recognition.

8.2. FEATURE 2

After selecting the images we will upload the images after that with the help of the trained model and developed code using flask and Open CV we can predict our results.



9. TESTING

9.1. Test Case

Test Scenarios
NavigationBar
Verify the title in the Navigator Bars
Validate all the tabs in the Navigator bars
Verify the User is not redirected to the wrong page
Home Page
Verify the visibility of the video should be true in Homepage
Validate the description of the video in the homepage
Verify the user is able to Navigate to the introduction page
Introduction Page
Verify the user is in the introduction page
Verify the page title and introduction description.
Launch Page
Verify the User is in the launch page
Verify the upload image option in the launch page
Verify the choose button is enabled
Verify the user is able to access the files from their PC
Verify the user is unable to upload no files.
Validate the selected image is same as uploaded image

9.2. Use Acceptance Testing:

they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	7	4	2	3	16
Duplicate	1	2	2	2	7
External	2	3	0	1	6
Fixed	8	1	4	8	21
Not Reproduced	0	0	1	0	1
Skipped	0	1	1	1	3
Won't Fix	0	5	2	1	8
Totals	18	16	13	16	63



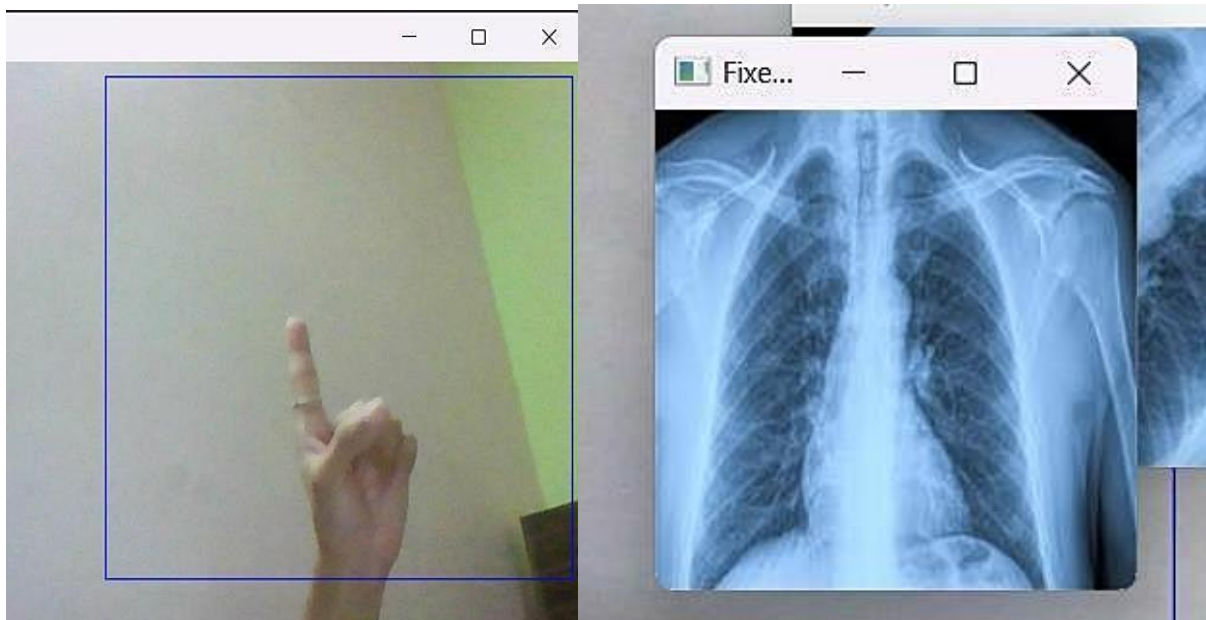
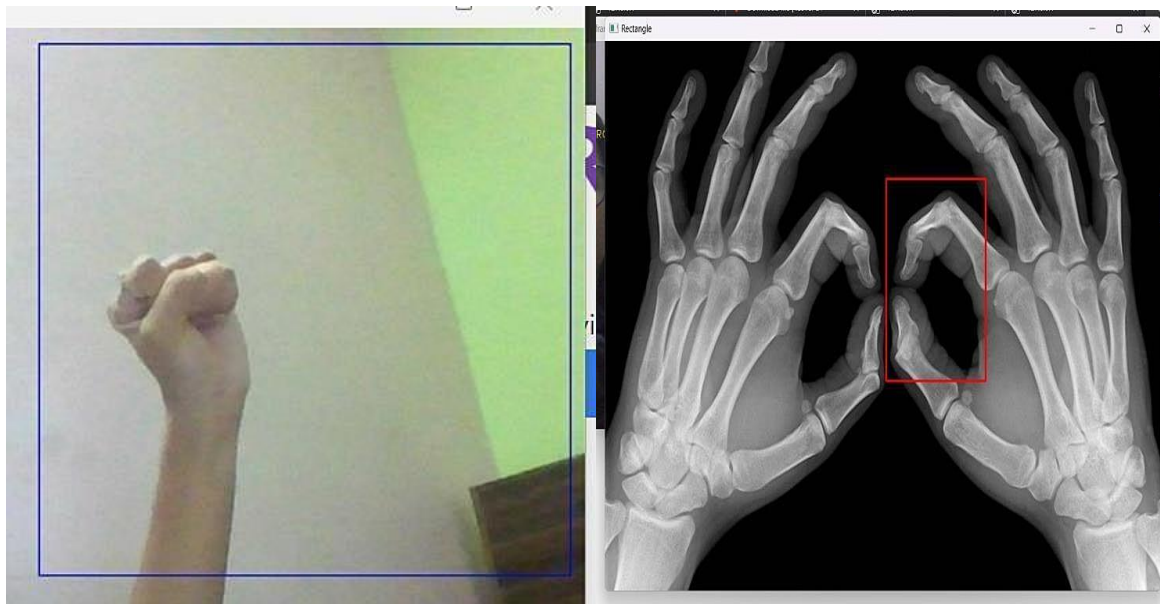
Section	Total Case.s	Not Tested	fail	Pass
Navigation Bar	3			3
Home page			3	3
Launch page	6	1	1	5

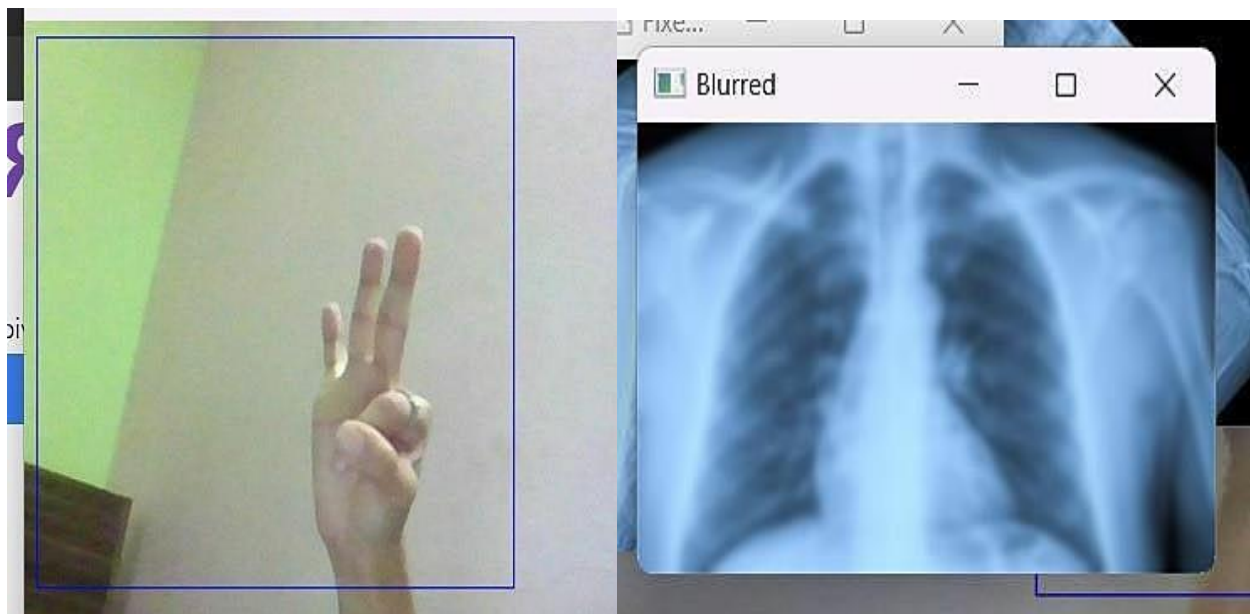
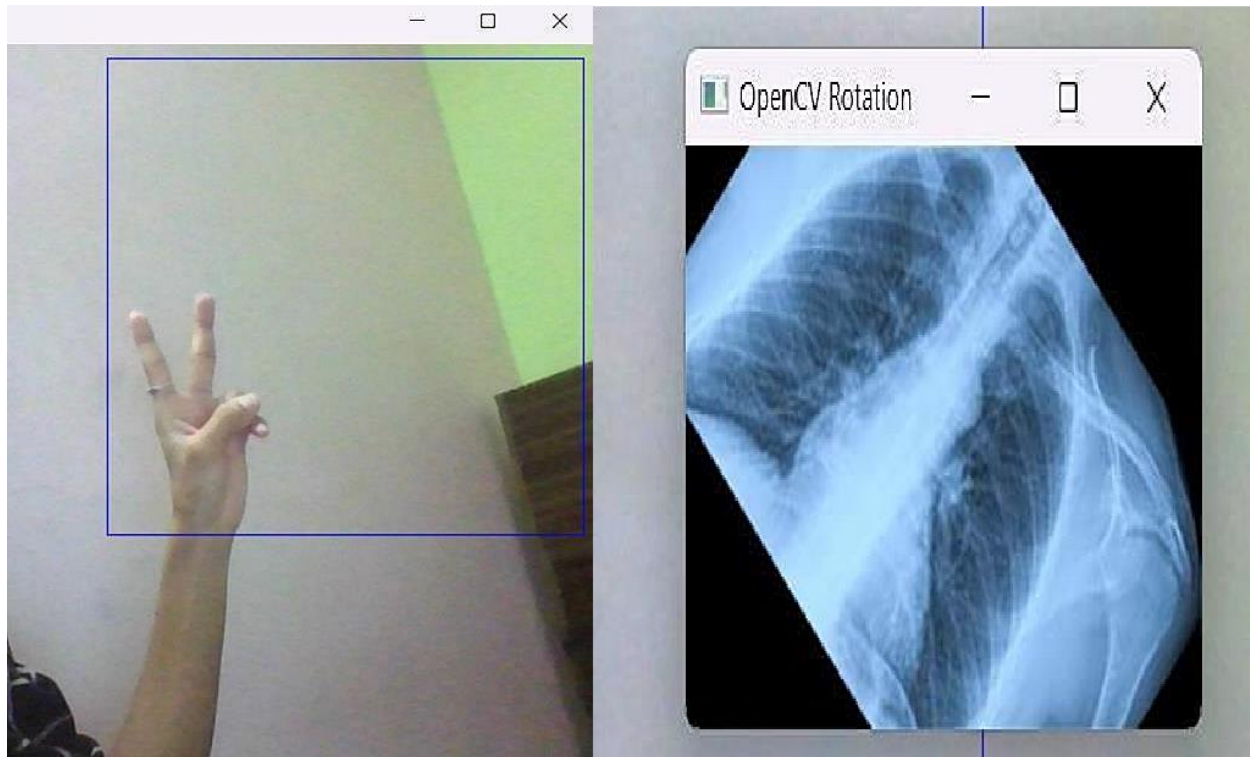
Introduction page	2	0	0	2
Final Report Output	4	0	0	4
Version Control	2	0	0	2



10. 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.

11. ADVANTAGES & 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.

12. APPLICATIONS:

- This hand based gesture tool developed can be mainly used in the medical industry to browse images without compromising the sterility.
- However it can also be used in different industries while presenting certain ideas, during meetings, and can be used by teachers while teaching

13. 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 user's 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 to show images in the classroom, etc.

14. 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.

15. REFERENCE

1. Qing Chen Nicolas, D. Georganas, and Emil M. Petriu "Hand Gesture Recognition Using Haar- Like Features And A Stochastic Context-Free Grammar" IEEE ,Vol. 57, No. 8, August 2008
2. Anupam Agrawal, Rohit Raj and Shubha Porwal "Vision-based Multimodal HumanComputer Interaction using Hand and Head Gestures" IEEE Conference on Information and Communication Technologies ICT 2013
3. Kenji Oka and Yoichi Sato "Real-Time Fingertip Tracking and Gesture Recognition" IEEE proceeding on Computer Graphics and Applications Nov/Dec 2002
4. S. Ioffe and C. Szegedy, "Batch normalization: Accelerating deep network training by reducing internal covariate shift," in International Conference on Machine Learning, 2015, pp. 448–456.
5. Juan Wachs, Helman Stern, Yael Edan, Michael Gillam, Jon Handler, Craig Feied, Mark Smith
6. Professor. Juan P. Wachs,
7. Professor. Benjamin Fritsch
11. Appendix

Source Code:

<https://github.com/IBM-EPBL/IBM-Project-37798-1660325295>