Gesture Based Tool for Sterile Browsing of
Radiology Images

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1. INTRODUCTION

1.1 Overview

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

A major challenge involved in this process is to provide doctors with efficient, intuitive, accurate and safemeans 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 thanusing 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 remainin 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 inthe “Gibson” graphical user interface.

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

3. THEORITICAL ANALYSIS

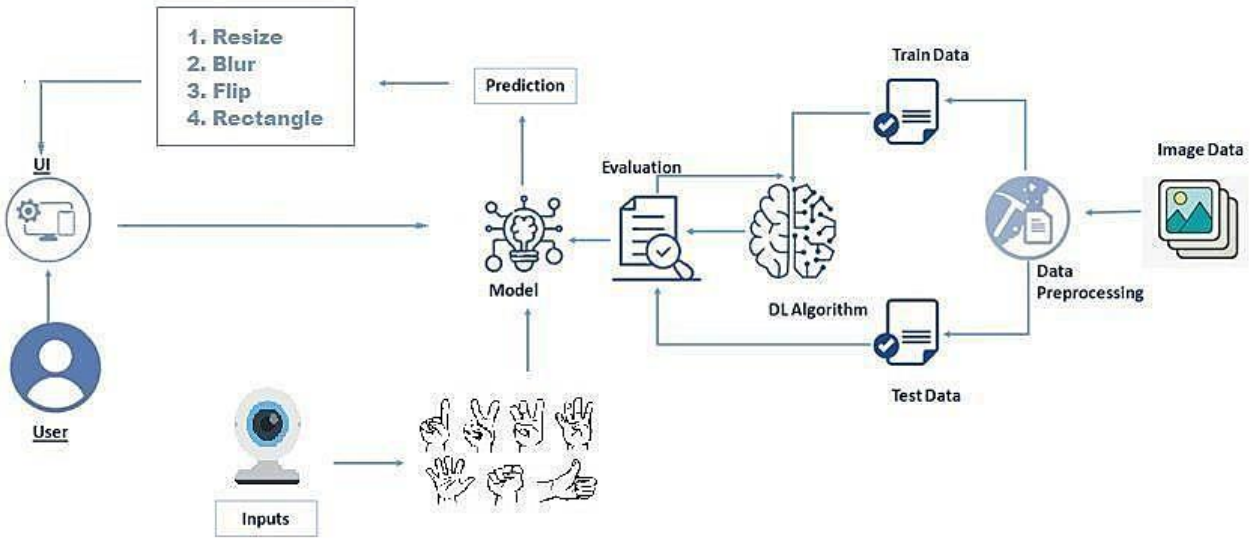
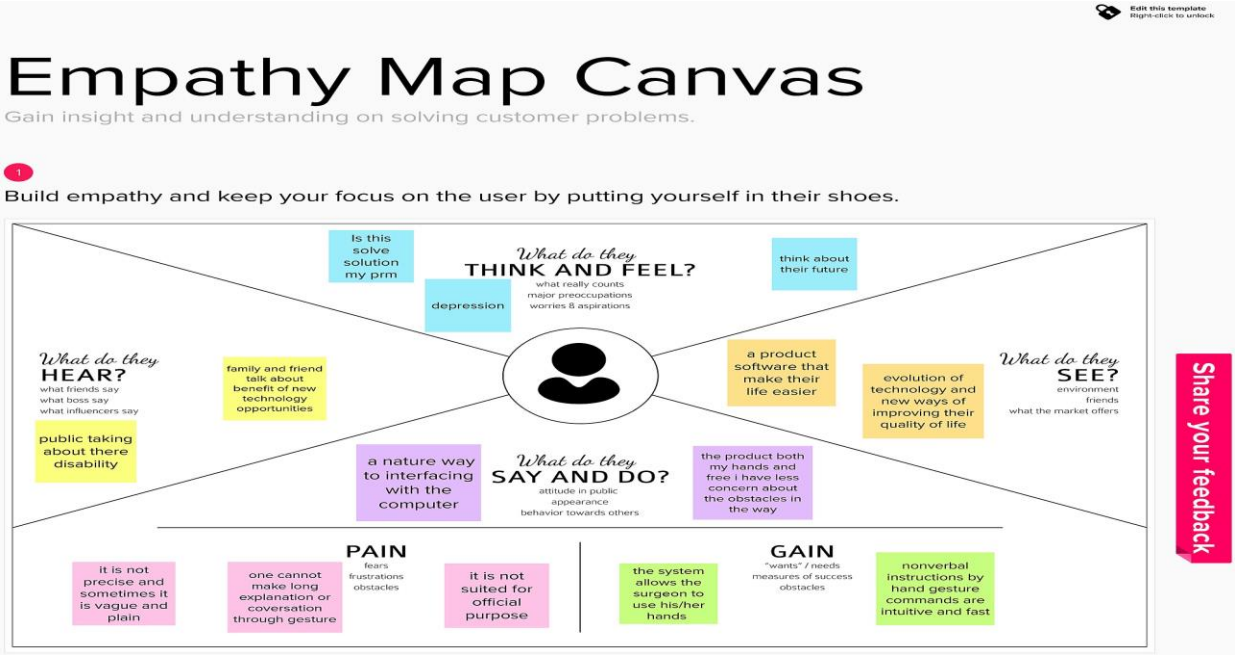


Fig 3. Architecture of Gesture Based Tool for Sterile Browsing of Radiology Images

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 accomplishingthis 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 technologiesprovides innovative opportunities for motion tracking and human-machine interaction. In the field of healthcare, sensors likeMicrosoft® Kinect (2015) have been used for detecting postures.

Using electromyography technology to capture gesture instead of the camera, thereforeit 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 theother hand, voice command has other disadvantages such as its low accuracy due to existence of noise in surgery rooms.

4.3. Proposed solution:

Project Design Phase-
IProposedSolutionTemplate

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

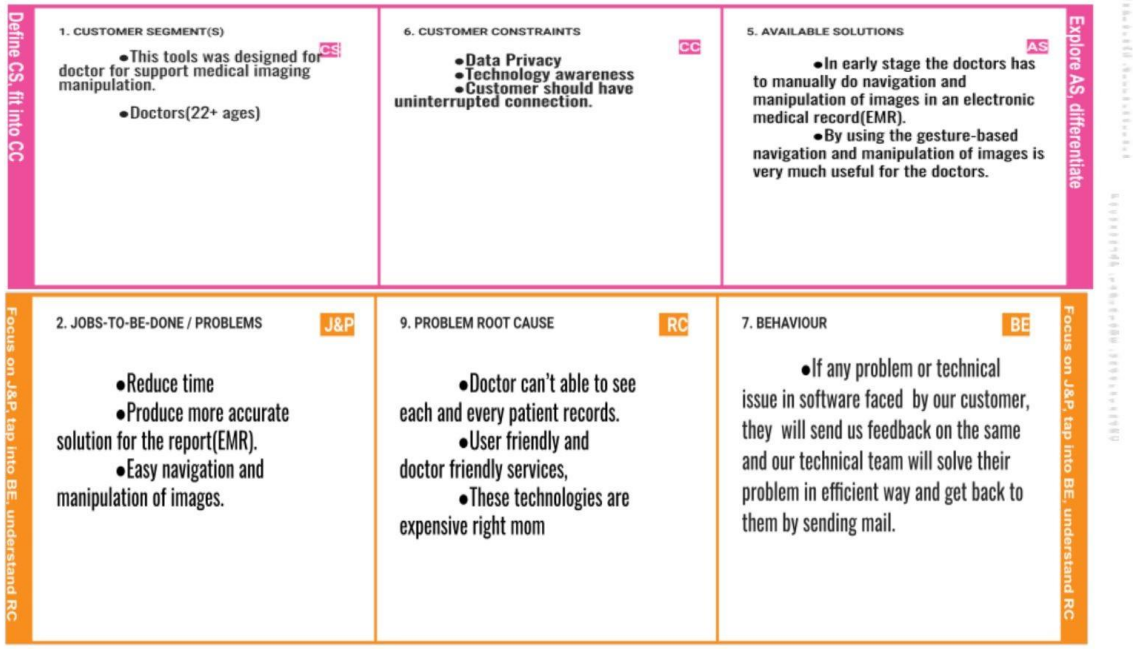
ProposedSolutionTemplate:

Projectteamshallfillthefollowinginformationinproposedsolutiontemplate.

S.No.	Parameter	Description
1.	ProblemStatement(Problemtobesolved)	The use of doctor-computer interaction devicesintheoperationroomrequiresnew modalities that support medical imagingmanipulationwhileallowingdoctors'handstoremainsterile, 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,stackingisperformedtogivehigher accuracyusingalgorithmssuchasSVMsandGMMs.
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 theinteractionwhichthusformsascopeforuniquenessfortheproject.
4.	SocialImpact/CustomerSatisfaction	Theabilitytointeractthroughpatientmedicalimagesinasterileformataugmentsthe attentionofthesurgeontowardssurgery.Thesurgeon neednotchangelocationinordertobrowseimages,butcandoitremotely. Further,inconveniencescausedinphysicalinteraction,beingpossiblemodeforinfectionspread,isnowsolved.
5.	BusinessModel(RevenueModel)	Thesystemwhendevelopedandtestedforaccuracy,canbegivento varioushospitalsforpracticaltestingforaparticularperiod.Theycanlaterbepersuadedtopurchaseoncethetestperiodisdone.Further,tocapitaliseand marketitasasoftwareproduct,directsalestohospitalsandsurgeonsmustbemade.Revenues ourcesincludedirectsalesviademoandsalesviapurchaseaftertesting.

4.4. Problem Solution Bit:

ProjectTitle:AGesture-basedToolforSterileBrowsingofRadiologyImages **ProjectDesignPhase-I-**
SolutionFitTemplateTeamID:
PNT2022TMID50884



3. TRIGGERS TR

● Thetime-efficientandeasybrowsingtriggerthecustomerstoswitchtothistechnology.

4. EMOTIONS: BEFORE/AFTER EM

● Sometimes doctors have to be there with theemotional situations of patients, which sometimesmakedoctordisturbed.

● Butnowadaysdoctorusesgesturetooltosave theirwork.

10. YOURSOLUTION SL

● Whenthiskindofsoftwareislaunchedworldwide this will be very much useful fordoctors.

● Itwillmakeworkeasierandfaster.

● Thisgesture-basedtechnologyismainlybased on hand signs in video frames andrecognizes the images and performs acorrespondingaction.

8. CHANNELSofBEHAVIOUR CH

● ONLINE:

Extractchannelsfrombehsviorblock.

● OFFLINE:

Extract channels from behavior block andisusedforcustomer'sdeployment.

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

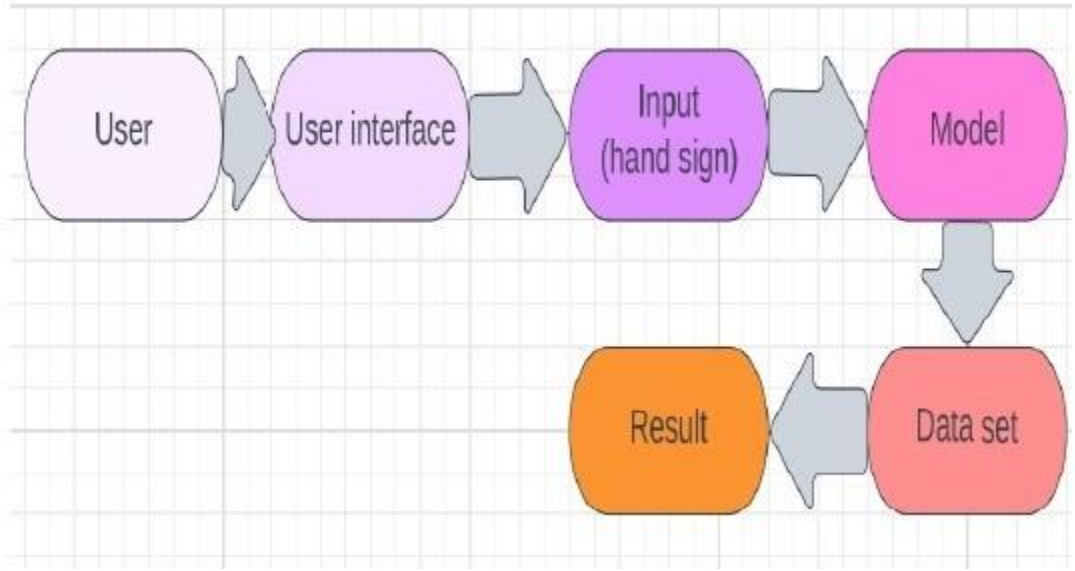
5.1.. FLOWCHART

- 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:

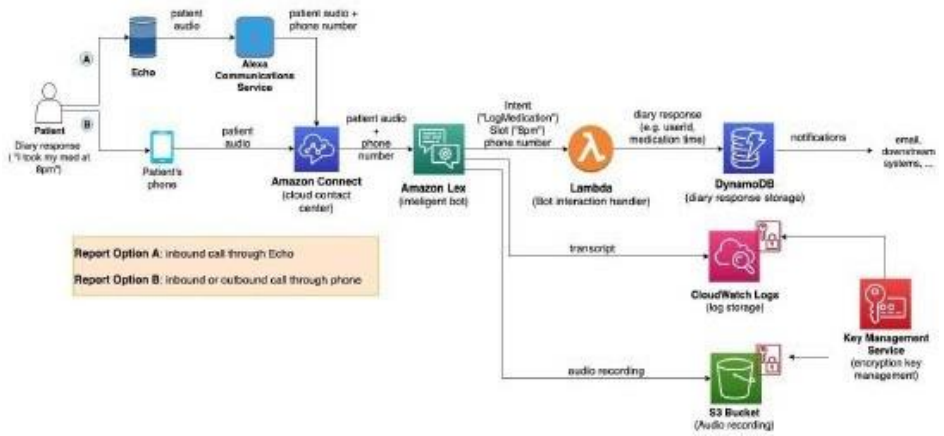
Solutionarchitecture is acomplex process – with many sub-processes– that bridgesthegapbetweenbusinessproblemsandtechnologysolutions.Itsgoalsareto:

Findthebesttechsolutiontosolveexistingbusinessproblems.

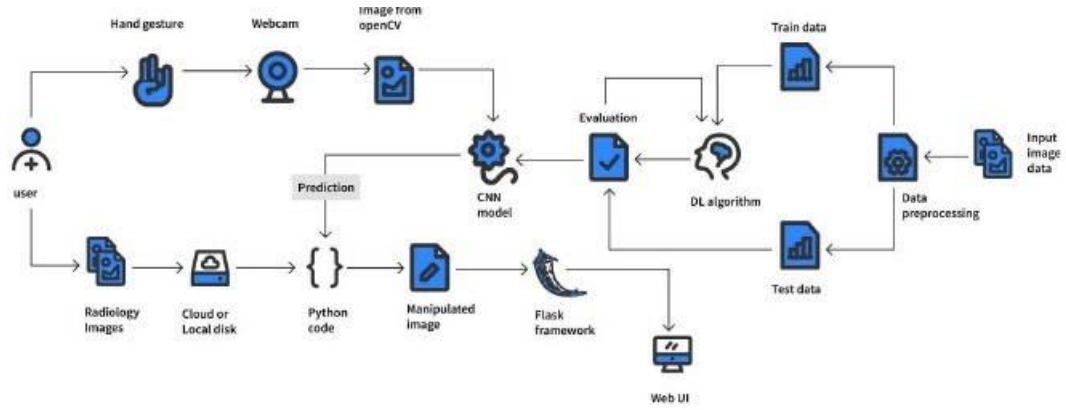
Describethestructure,characteristics,behavior,andotheraspectsofthesoftwaretoprojectstakeholders.

Definefeatures,developmentphases,andsolutionrequirements.

Providespecificationsaccordingtowhichthesolutionisdefined,managed,anddeli vered.



A Gesture Sterile Tools For Radiological Images



5.3. User Stories:

7. PROJECT PLANNINGAND 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:

Usethebelowtemplatetocreate productbacklogandsprintschedule

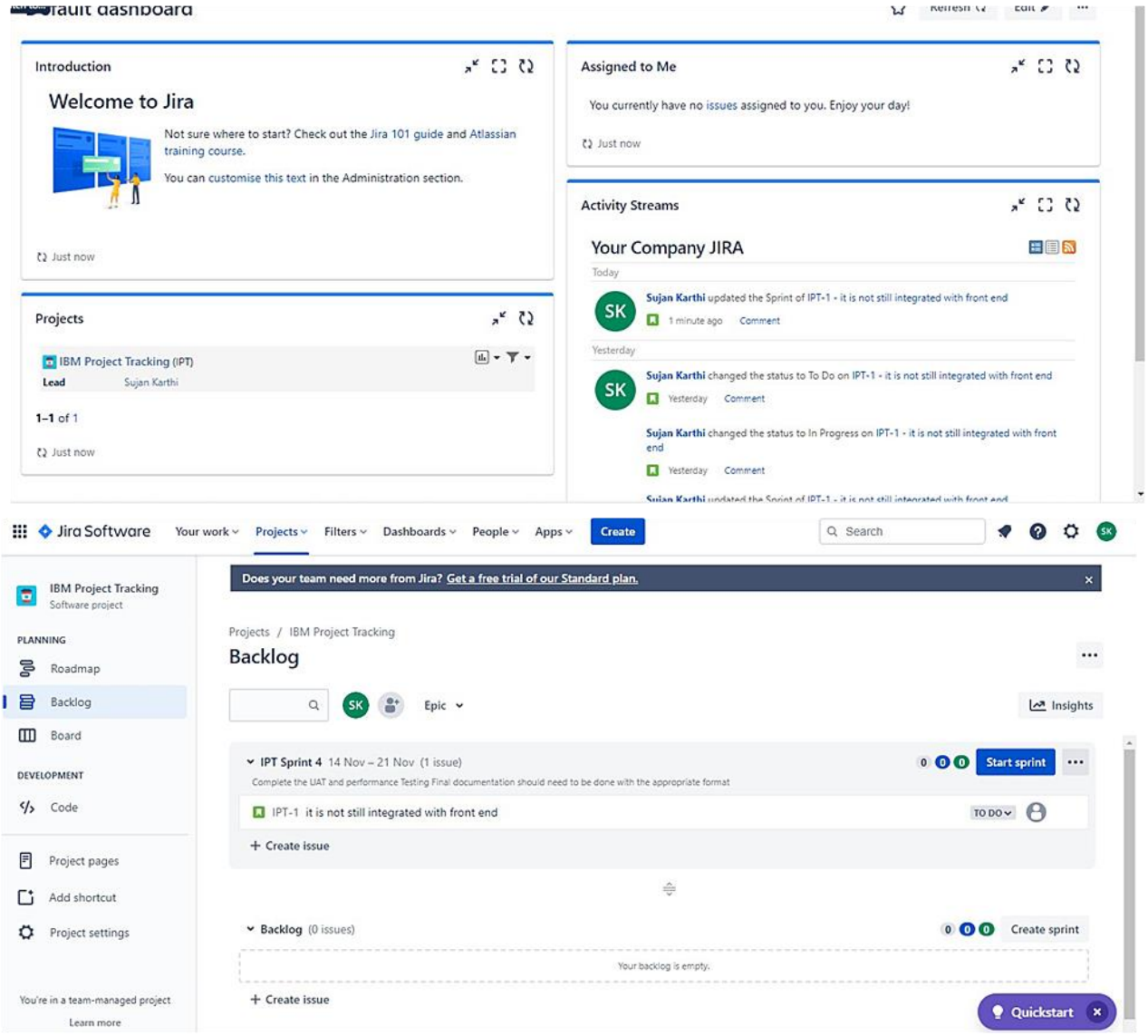
Sprint	Functional Requirement(Epic)	UserStory Number	UserStory/Task	StoryPoints	Priority	TeamMembers
Sprint-1	Application/SoftwareLaunch	USN-1	Asauser, Ican launchthe developedapplication/software	1	Medium	NarayananM JasperA manikandanS Anish BellS
Sprint-1	AccessingtheUserInterface(UI)	USN-2	Asauser, Icaninteractwithsoftwareandoperatetheapplication withthehelpofUI	1	Medium	NarayananM JasperA ManikandanS Anish bellS
Sprint-2	Launching thewebcam/camera	USN-3	Asauser,Icanopenthewebcam/camerafromtheapplicationto performgestures	1	Low	NarayananM JasperA ManikandanS Anish bellS
Sprint-2	Uploadimagesfromlocalsystemformanipulation	USN-4	As a user, I can upload images to theapplicationfromlocalsystemformanipulation	2	Low	NarayananM JasperA ManikandanS Anish bellS
Sprint-3	Manipulating imagesthroughgestures	USN-5	Asauser,Icanperform variousgestureswithrespect to system specification to manipulatethe images	2	Medium	NarayananM JasperA ManikandanS Anish bellS

Sprint	Functional Requirement(Epic)	UserStory Number	UserStory/Task	StoryPoints	Priority	TeamMembers
Sprint-4	Display theresult/output	USN-6	As a user, I can see the sterilebrowsed/manipulatedimageonthescreen withrespecttothegestureperformed	2	High	NarayananM JasperA ManikandanS Anish bellS

Project Tracker,Velocity&BurndownChart:(4Marks)

Sprint	TotalStory Points	Duration	SprintStartDate	SprintEndDate(Planned)	StoryPoints Completed (asonPlannedEndDate)	SprintReleaseDate(Actual)
Sprint-1	20	6Days	24Oct2022	29Oct2022	20	29Oct2022
Sprint-2	20	6Days	31Oct2022	05Nov2022	20	05Nov2022
Sprint-3	20	6Days	07Nov2022	12Nov2022	20	12Nov2022
Sprint-4	20	6Days	14Nov2022	19Nov2022	20	19Nov2022

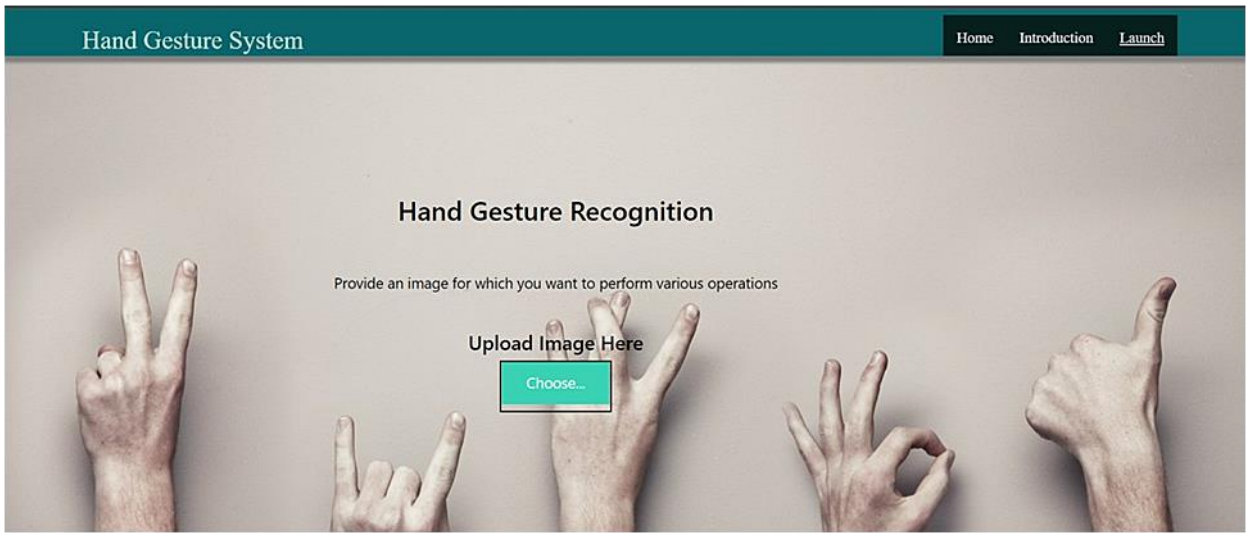
7.3. Reports from Jira



The tasks are assignedto everyone for every sprint and completedthe tasks successfully.

8. FEATURES

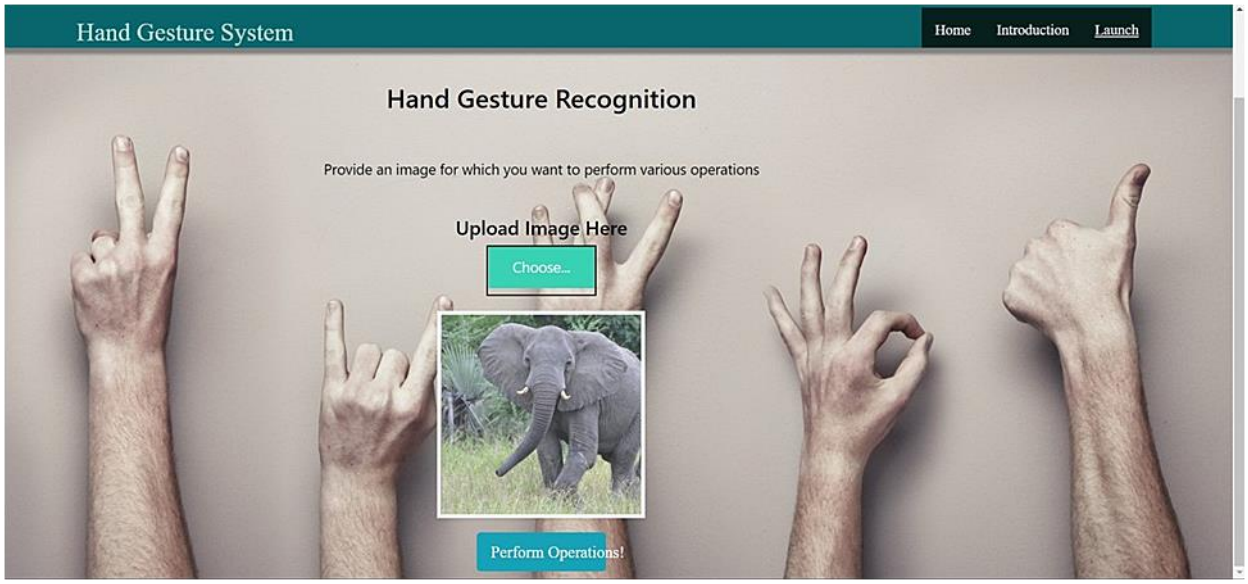
8.1. Feature 1



This is the most important and notable featureof 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 modeland developed code using flask and Open CV we can predictour results.



9. TESTING

9.1. Test Case

Test Scenarios
NavigationBar
Verify the titlein the Navigator Bars
Validate all thetabs in theNavigator bars
Verify the User is not redirected to the wrongpage
Home Page
Verify the visibility of the videoshould be truein Homepage
Validate the description of the videoin the homepage
Verify the useris able to Navigate to the introduction page
Introduction Page
Verify the useris in the introduction page
Verify the page title and introduction description.
Launch Page
Verify the Useris in thelaunch page
Verify the uploadimage option in the launchpage
Verify the choosebutton is enabled

Verify the user is able to access thefiles from their PC
Verify the user is unable to upload no files.
Validate the selected image is sameas uploaded image

9.2. Use Acceptance Testing:

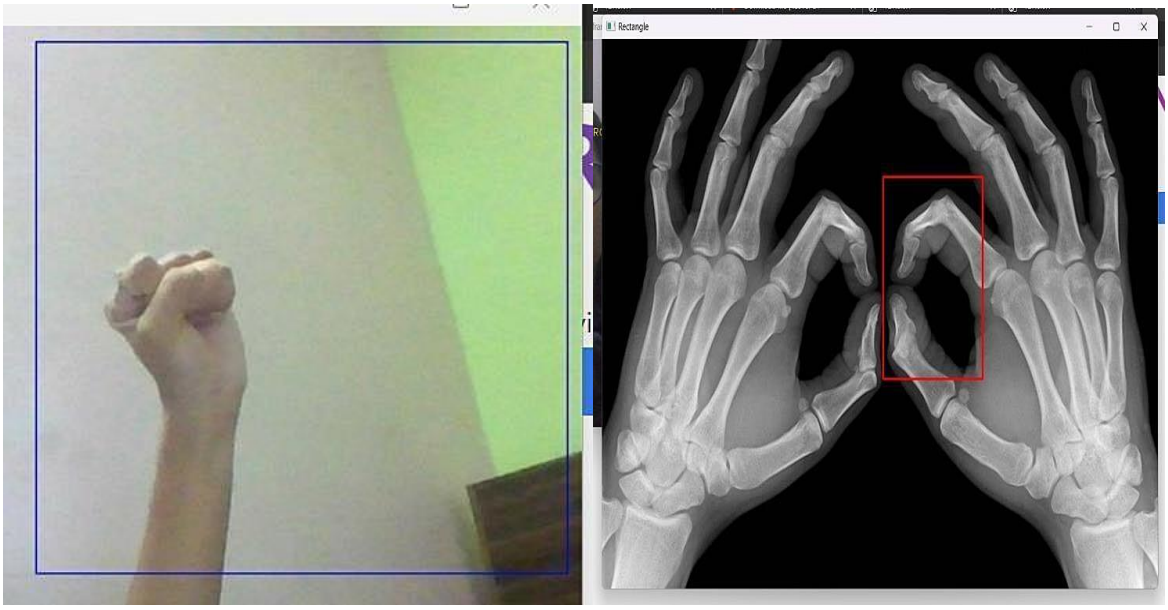
they were resolved

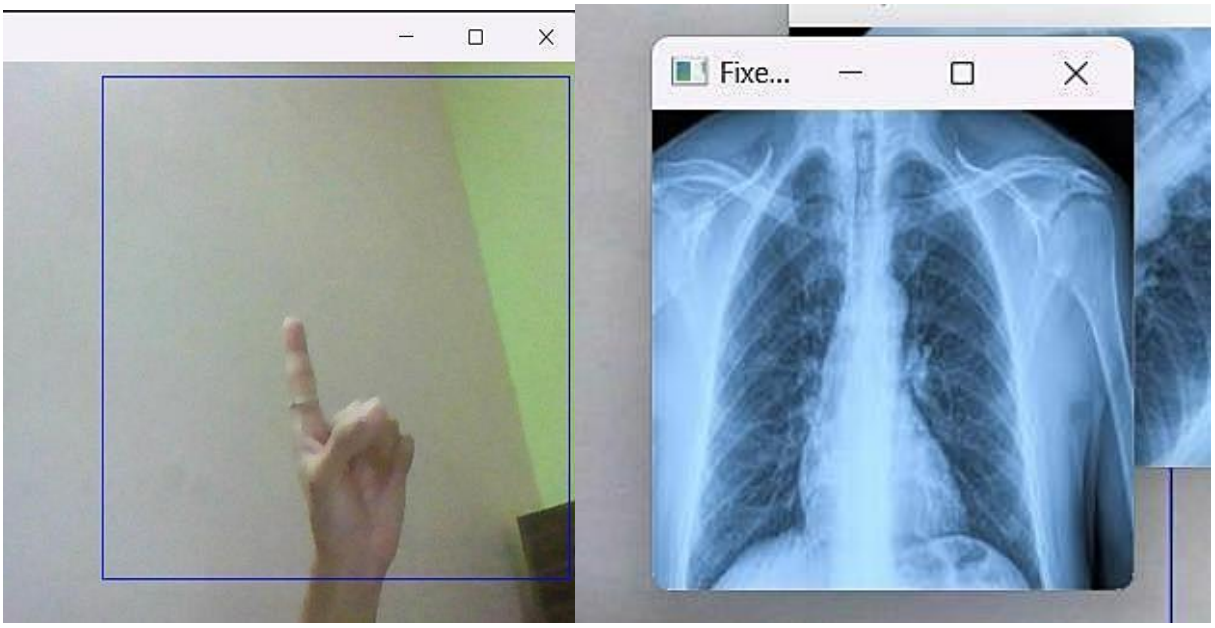
Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	7	4	2	3	16
Duplicate	1	2	2	2	7
External	2	3	0	1	6
Fixed	8	1	4	8	21
Not Reproduced	0	0	1	0	1
Skipped	0	1	1	1	3
Won't Fix	0	5	2	1	8
Totals	18	16	13	16	63

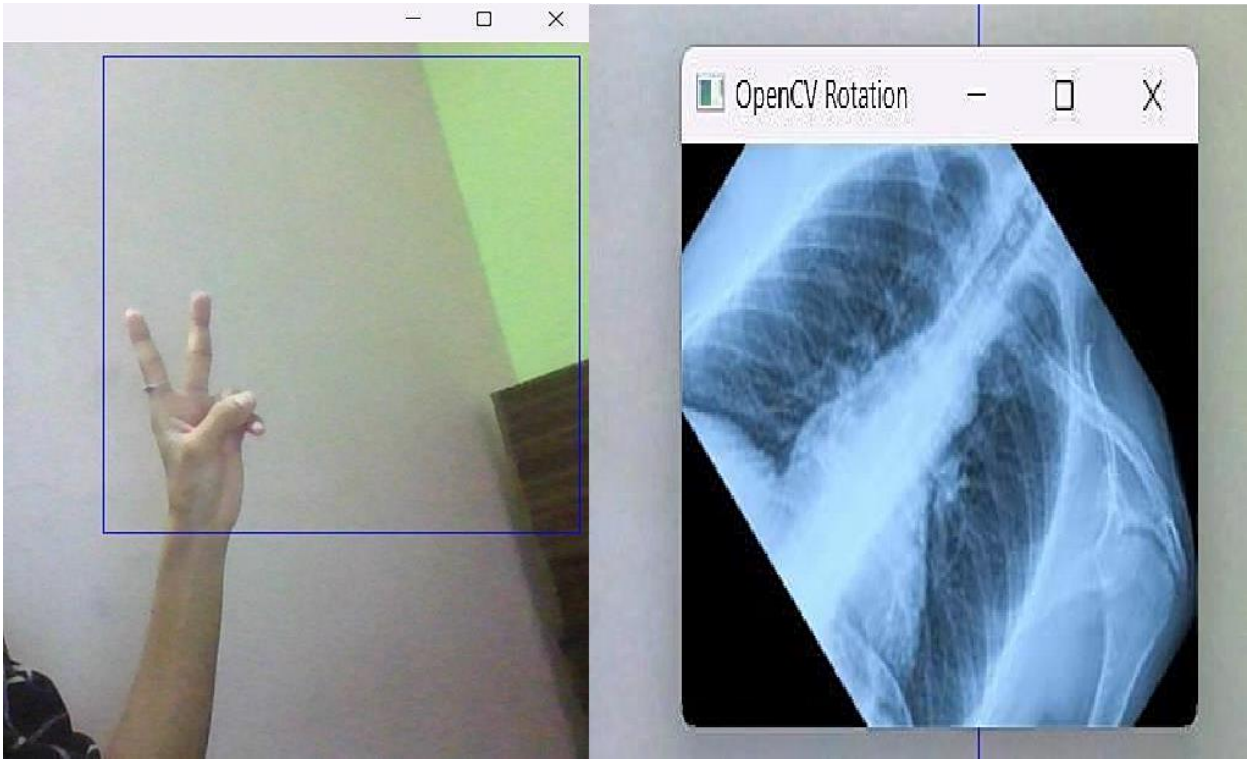
Section	Total Cases	Not Tested	fail	Pass
Navigatio11 Bar	3			3
Home page			3	3
Launch page	6	1	1	5
I11troduction page	2	0	0	2
Final Report Output	4	0	0	4
Version Control	2	0	0	2

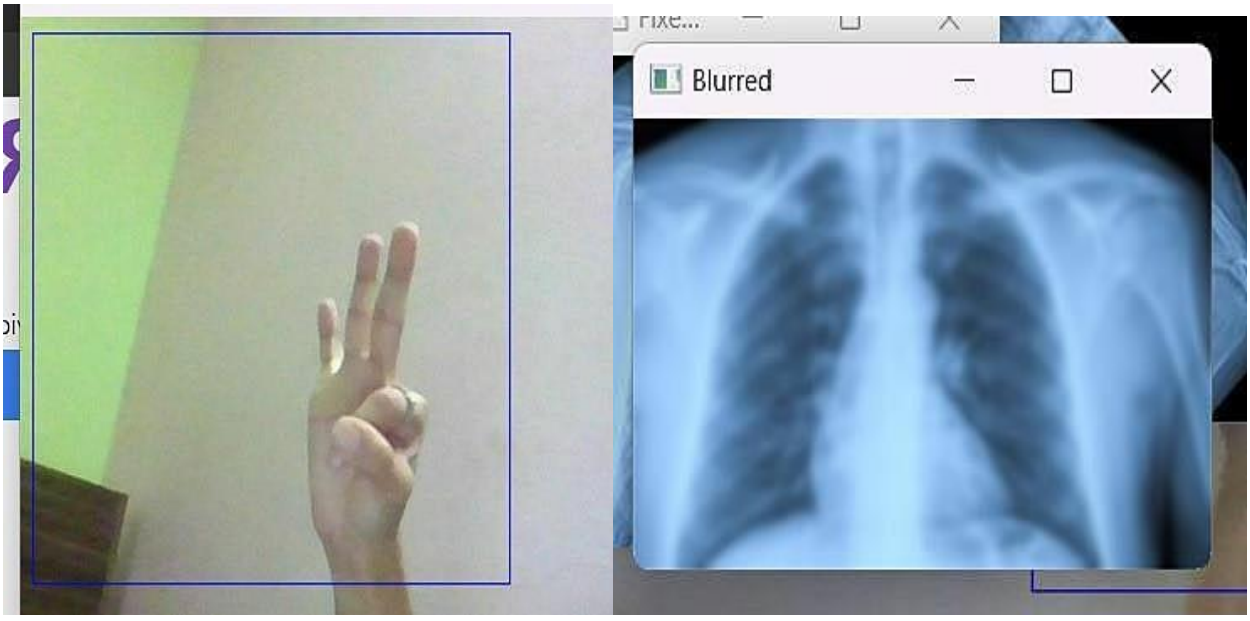
10. RESULT

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 helpsto save time.
- The tool does not need the person using it to have an apparatus or any devices on themto 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 tocapture images and process it.

12. APPLICATIONS:

- This hand based gesture tool developed can be mainly used in the medical industry tobrowse images without compromising the sterility.
- However it can also be used in different industries while presenting certain ideas, duringmeetings, 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 throughradiology images using these gestures. This enables doctors and surgeons to maintain the sterility as theywould not have to touch any mouse or keyboardto 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 withany 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 forshow 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 anduseability 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