A GESTURE-BASED TOOL FOR STERILE BROWSING OF RADIOLOGY IMAGES

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1.INTRODUCTION:

1.1Project Overview:

The creation of novel modalities that facilitate medical picture modification while allowing doctors hands to stay sterile, retaining their focus, and permitting quick reactions is required by the usage of doctor-computer interface devices in operating rooms

An electronic medical record (EMR) database can be navigated and used to manipulate images using a real-time gesture capture and recognition system.

Through video capture, navigation and other movements are converted to commands based on their temporal trajectories. This interface enabled a quick, intuitive response and simple engagement while preventing the surgeon's focus shift and change of position in the in vivo trial. Data from two usability tests provide insights and implications regarding human-computer interaction based on nonverbal conversational modalities.

The healthcare industry is being significantly impacted by computer information technology. Providing doctors with effective, intuitive, precise, and safe ways of

contact without compromising the calibre of their job is a significant problem involved in this process. The primary means of interaction between humans and computers nowadays are keyboards and pointing devices like mice. But in critical care units (ICUs), using computer keyboards and mice is a typical way for medical professionals to transfer illnesses. 1 In this article, we propose using hand gestures as an alternative to current interface techniques, with the key benefit of sterility. Voice control offers sterility as well, however it is unreliable in the OR due to the noise level.

1.2 Purpose:

In this work, we refer to hand gestures as a fundamental type of non-verbal communication. Psychological research has shown that before they can speak, young children communicate through gestures. When people talk to one another about an object, manipulation is a common form of gesticulation. There are several compelling reasons to switch from the current interface technology (such as the keyboard, mouse, and joystick) to more natural interfaces, including naturalness of expression, unrestricted interaction, intuitiveness, and high sterility.

This paper presents a video-based hand gesture capture and recognition system used to manipulate magnetic resonance images (MRI) within a graphical user interface. A hand gesture vocabulary of commands was selected as being natural in the sense that each gesture is cognitively associated with the notion or command that is meant to represent it. For example, moving the hand left represents a “turn left” command.

Two surgeries in the hospital's neurosurgery department were watched while the gesture interface was being evaluated at the Washington Hospital Center in Washington, DC, and insights into the applicability of a hand gesture system were gained. This is the first instance that we are aware of where a hand gesture recognition system has been effectively used in neurosurgical biopsy. A sterile

human-machine interface is crucial because it allows the surgeon to control medical information without contaminating the patient, the operating room, or themselves.

2. LITERATURE SURVEY:

2.1 Existing Problem:

2.1.1 Deaf Mute Communication Interpreter:

This paper aims to cover the various prevailing methods of deaf-mute communication interpreter system. The two broad classification of the communication methodologies used by the deaf –mute people are - Wearable Communication Device and Online Learning System. Under Wearable communication method, there are Glove based system, Keypad method and Handicom Touch-screen. All the above mentioned three sub-divided methods make use of various sensors, accelerometer, a suitable micro-controller, a text to speech conversion module, a keypad and a touch-screen. The need for an external device to interpret the message between a deaf –mute and non-deaf-mute people can be overcome by the second method i.e online learning system. The Online Learning System has different methods. The five subdivided methods are- SLIM module, TESSA, Wi-See Technology, SWI_PELE System and Web-Sign Technology.

2.1.2 An Efficient Framework for Indian Sign Language Recognition Using Wavelet Transform:

The proposed ISLR system is considered as a pattern recognition technique that has two important modules: feature extraction and classification. The joint use of Discrete Wavelet Transform (DWT) based feature extraction and nearest neighbour classifier is used to recognize the sign language. The experimental results show that the proposed hand gesture recognition system achieves maximum 99.23% classification accuracy while using cosine distance classifier.

2.1.3 Hand Gesture Recognition Using PCA:

In this paper authors presented a scheme using a database driven hand gesture

recognition based upon skin color model approach and thresholding approach along with an effective template matching which can be effectively used for human robotics applications and similar other applications.. Initially, hand region is segmented by applying a skin color model in YCbCr color space. In the next stage thresholding is applied to separate foreground and background. Finally, template based matching techniques are developed using Principal Component Analysis (PCA) for recognition.

2.1.4 Hand Gesture Recognition System For Dumb People:

Authors presented the static hand gesture recognition system using digital image processing. For hand gesture feature vector SIFT algorithm is used. The SIFT features have been computed at the edges which are invariant to scaling, rotation, addition of noise.

2.1.5 An Automated System for Indian Sign Language Recognition:

In this paper a method for automatic recognition of signs on the basis of shape based features is presented. For segmentation of the hand region from the images, Otsu's thresholding algorithm is used, that chooses an optimal threshold to minimize the within-class variance of thresholded black and white pixels. Features of segmented hand region are calculated using Hu's invariant moments that are fed to the Artificial Neural Network for classification. Performance of the system is evaluated on the basis of Accuracy ,Sensitivity and Specificity.

2.1.6 Hand Gesture Recognition for Sign Language Recognition:

Authors presented various methods of hand gesture and sign language recognition proposed in the past by various researchers. For deaf and dumb people, Sign language is the only way of communication. With the help of sign language, these physically impaired people express their emotions and thoughts to other people.

2.1.7 Design Issue and Proposed Implementation of Communication Aid for

Deaf & Dumb People:

In this paper author proposed a system to aid communication of deaf and dumb people communication using Indian sign language (ISL) with normal people where hand gestures will be converted into appropriate text message. Main objective is to design an algorithm to convert dynamic gestures to text at real time. Finally after testing is done the system will be implemented on android platform and will be available as an application for smartphone and tablet pc.

2.1.8 Real Time Detection And Recognition Of Indian And American Sign Language Using Sift:

Author proposed a real time vision based system for hand gesture recognition for human computer interaction in many applications. The system can recognize 35 different hand gestures given by Indian and American Sign Language or ISL and ASL at a faster rate with virtuous accuracy. RGB-to-GRAY segmentation technique was used to minimize the chances of false detection. Authors proposed a method of improvised Scale Invariant Feature Transform (SIFT) and the same was used to extract features. The system is modeled using MATLAB. To design an efficient user friendly hand gesture recognition system, a GUI model has been implemented.

2.1.9 A Review on Feature Extraction for Indian and American Sign Language:

Paper presented the recent research and development of sign language based on manual communication and body language. Sign language recognition system typically elaborate three steps pre processing, feature extraction and classification.Classification methods used for recognition are Neural Network(NN), Support Vector Machine(SVM), Hidden Markov Models(HMM), Scale Invariant Feature Transform(SIFT),etc.

2.1.10 SignPro-An Application Suite for Deaf and Dumb:

Author presented application that helps the deaf and dumb person to communicate with the rest of the world using sign language. The key feature in this system is the real time gesture to text conversion. The processing steps include: gesture extraction, gesture matching and conversion to speech. Gesture extraction involves use of various image processing techniques such as ISSN No.: 2454- 2024 (online) International Journal of Technical Research & Science pg. 433 www.ijtrs.com www.ijtrs.org Paper Id: IJTRS-V2-I7-005 Volume 2 Issue VII, August 2017 @2017, IJTRS All Right Reserved histogram matching, bounding box computation, skin color segmentation and region growing. Techniques applicable for Gesture matching include feature point matching and correlation based matching. The other features in the application include voicing out of text and text to gesture conversion.

2.1.11 Offline Signature Verification Using Surf Feature Extraction and Neural Networks Approach:

In this paper, off-line signature recognition & verification using neural networks is proposed, where the signature is captured and presented to the user in an image format.

2.2 References:

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2.3 Problem Statement Definition:

We use gestures in this project to browse images acquired through radiology. Gestures are hand motions used in nonverbal communication. The primary means of interaction between humans and computers nowadays are keyboards and pointing devices like mice. However, doctors and nurses in intensive care units (ICUs) frequently transfer infections through the use of computer keyboards and mice. Humans are adept at deciphering both body and sign language. This is conceivable because of how vision and synaptic contacts developed throughout the course of brain development.

During a surgical procedure, it is necessary to examine patient specific image data

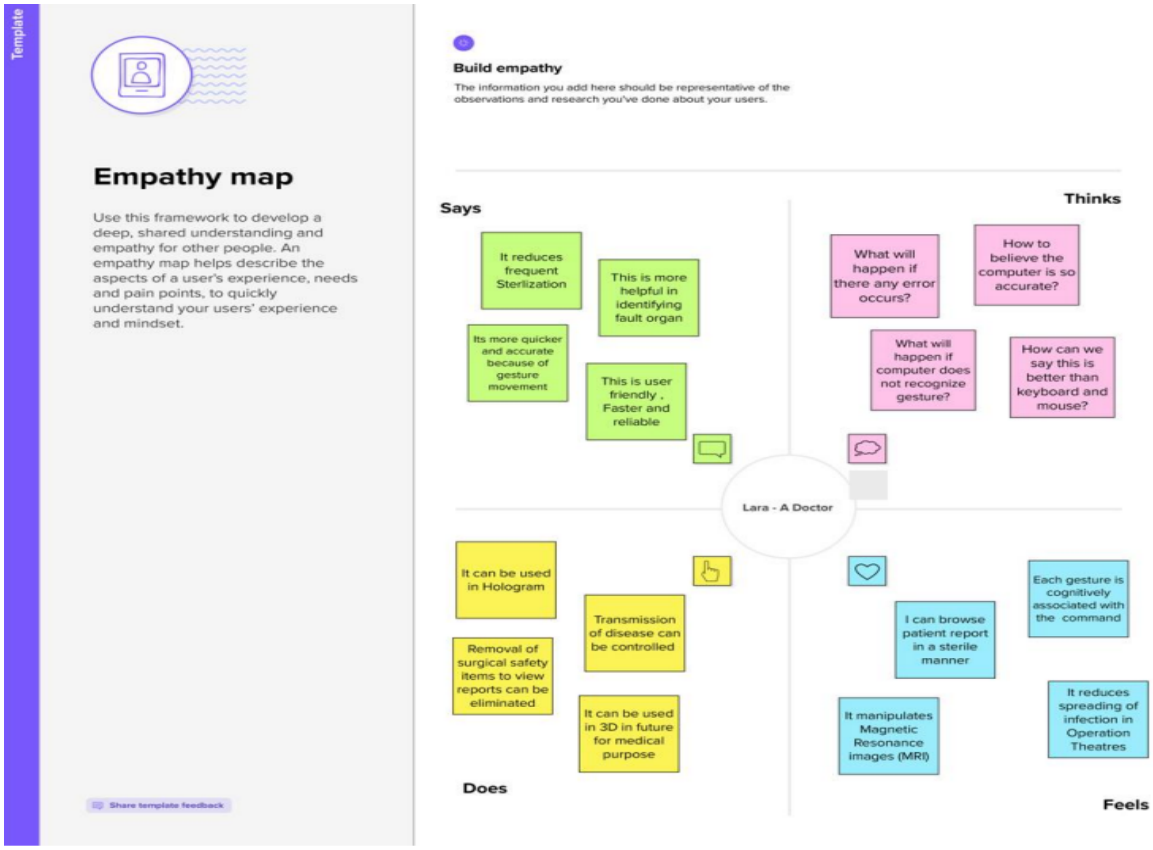
obtained from computed tomography and magnetic resonance imaging scans using doctor-computer interface that allows medical imaging manipulation while allowing doctors' hands to stay sterile. Traditional approaches to human-computer interaction, however, fall short of offering a productive way to manipulate medical images while supporting users' attention. Gesture-based interaction is a new style of communication made possible by the development of artificial intelligence. Gesture-Based interaction provides efficiency, intuitiveness, and accuracy. Without compromising the quality of the work, gesture-based interaction offers an effective, intuitive, accurate, and safe mode of interaction.

It has been suggested that surgeons can communicate with medical image viewers while performing surgery using a vision-based hand gesture recognition system. This system analyzes the hand motions of the real-time user and converts them into the proper commands that are subsequently used to manipulate radiological images. The suggested model is first trained using pictures of various hand gestures, such as hands holding the numerals 1, 2, 3, and 4. A builtin web camera is used to record real-time photos, which are then matched with training images of hand movements and the corresponding activities. According to the hand gesture directions, it is permitted to resize, blur, and flip the radiological photographs. In order to maintain sterility and ensure patient safety in the operating room, the vision-based hand gesture system does away with direct physical touch between the surgeon and the computer interfaces.

3. IDEATION & PROPOSED SOLUTION:

3.1 Empathy Map Canvas:

Empathy Map Canvas: An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviors and attitudes. It is a useful tool to help teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.



3.2 Ideation & Brainstorming:

3.3 Proposed Solution:

S NO	PARAMETER	DESCRIPTION
1.	Problem Statement	To design an ML model to identify and classify the hand gestures.
2.	Idea / Solution description	To develop a CNN based classifier model, which would be trained on our training data.

3.	Novelty / Uniqueness	We train a CNN based model to recognize the hand gesture. The training data include images that captures the hand gestures of 1,2,3,4,5 and 0. The image is resized without much loss of information and used for training a CNN based model. We use Python Flask to provide an interactive platform for our model.
4.	Social Impact / Customer Satisfaction	This project would help the doctors in operation theaters where physical contact between persons should be avoided in order to be sterilized and also prevent from any infections.
5.	Business Model (Revenue Model)	It can be sold as an open-source service to all the hospitals as a non-profitable work.
6.	Scalability of the Solution	The model could also be extended to other real world classifying problems like cancer detection from X-ray, COVID detection using X-ray images, mask detection, face detection etc.

3.4 Problem Solution Fit:

Project Title: A Gesture-based Tool for Sterile Browsing of Radiology Images **Project Design Phase-I** - Solution Fit Template **Team ID:** PNT2022TMID26953

4.REQUIREMENT ANALYSIS:

4.1 Functional Requirement:

FR NO	FUNCTIONAL REQUIREMENT	SUB REQUIREMENT (story/subtask)
FR 1	Identifying User Gestures	The user gestures are identified using the images of gestures captured by the camera
FR 2	Deployment in Cloud	The trained Deep Learning Model is deployed in cloud, which could be accessed anywhere around the world
FR 3	User Interface	The user interface, which helps in the Human Computer Interaction is designed
FR 4	Gestures related to the Application Domain	The model should be trained with the gestures related to the application domain

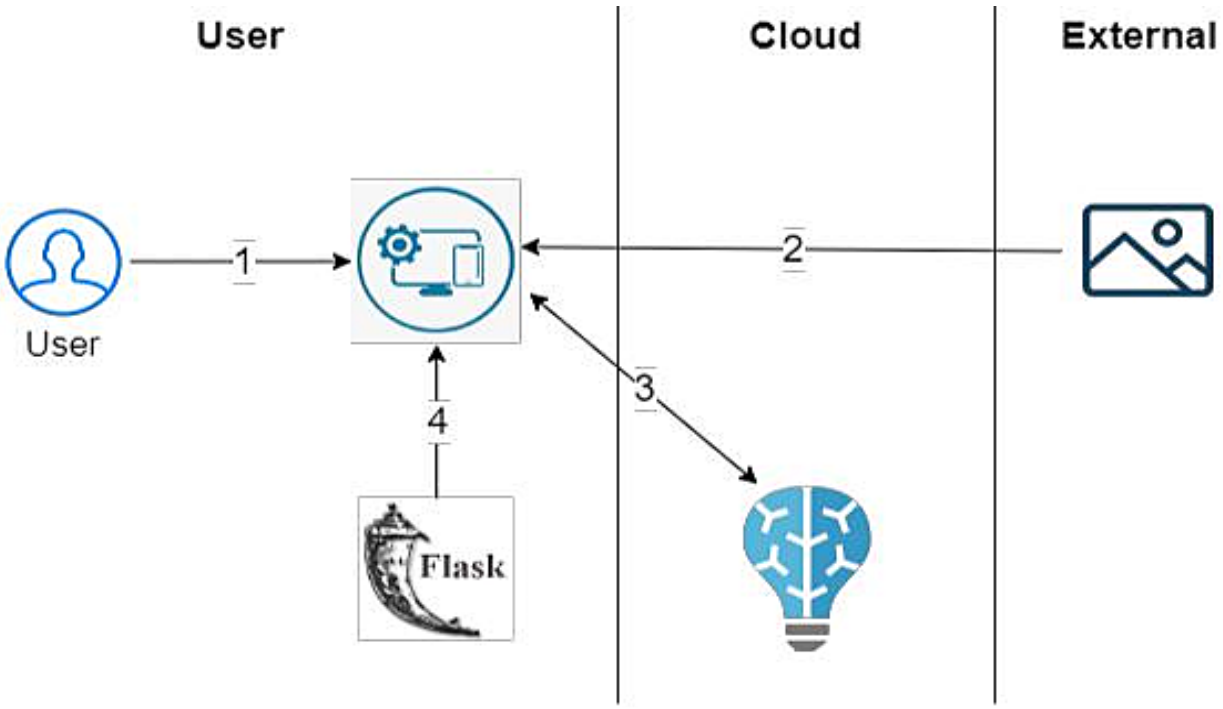
4.2 Non-Functional Requirements:

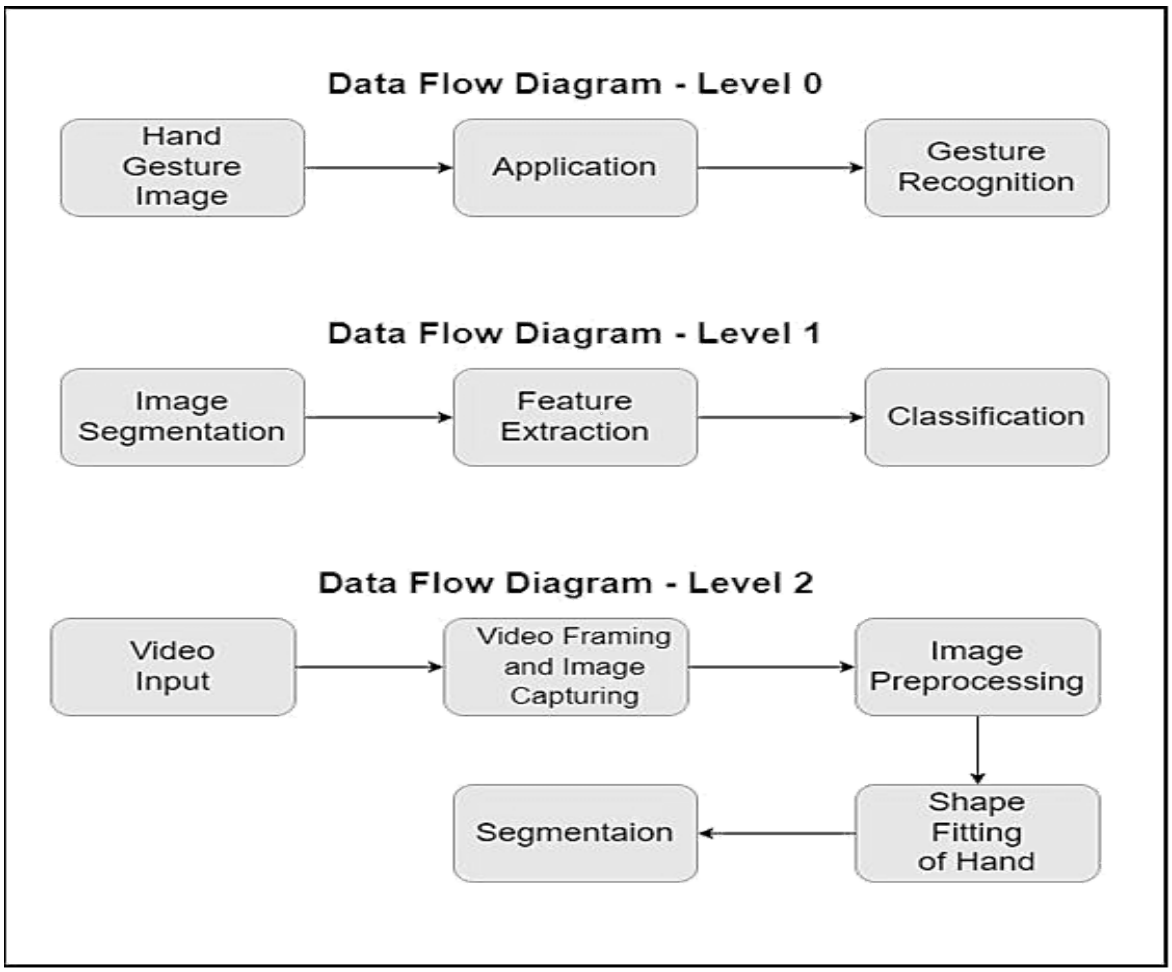
FR NO.	NON FUNCTIONAL REQUIREMENT	DESCRIPTION
NFR 1	Usability	The user interface which acts as an intermediate between the user and the DL Model which is deployed in the cloud

NFR 2	Security	The model deployed in the cloud should be accessible only by the approved users and it should be inaccessible by the attackers or the terrorists
NFR 3	Reliability	The tool or the systemis 95% reliability for a year
NFR 4	Performance	The tool or the system should respond with the accurate response within 4-5 seconds
NFR 5	Availability	The model deployed in the cloud must be available to 99.8% of the people over a month during working hours
NFR 6	Scalability	The model deployed in the cloud must be accessible by over 10,00,000 people trying to access it using the user interface

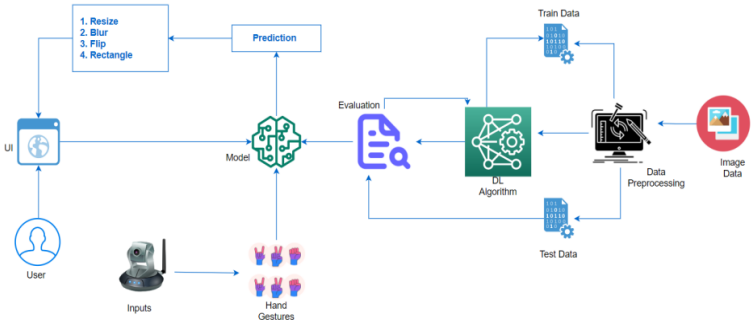
5.PROJECT DESIGN:

5.1 Data Flow Diagram:





5.2 Solution And Technical Architecture:



5.3 User Stories:

USER TYPE	FUNCTIONAL REQUIREMENT (EPIC)	USER STORY NUMBER	USER STORY/ TASK	ACCEPTANCE CRITERIA	PRIORITY	RELEASE
Customer (Web user)	Launch web app deployed in cloud	USN-1	I can utilize the webapp to upload my images for recognition as a user.	I can submit the images for classification.	High	Sprint - 4
	Prediction	USN-2	I can use the model that is installed on the cloud to obtain the anticipated results.	I can flip the image depending on a hand gesture ,blur the image, and resize radiological images.	High	Sprint - 4

	Deployment of web app in the cloud	USN-3	I require global access to the web application as a user.	I can get to the web application running on the IBM cloud.	Medium	Sprint - 3
	Deployment of AI model in the cloud	USN-4	I require global accessibility of the AI model as a user.	I can go to the model that's been set up on the IBM cloud.	Medium	Sprint - 3
	Model building	USN-6	As a user, I require an AI model that can categorize or identify hand gestures.	I can use the AI model to forecast things.	Medium	Sprint - 1
	User interface building	USN-7	I require a web application for user-	To communicate with the model ,I receive the user interface.	Medium	Sprint - 2

			computer interaction.			

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	Data Collection	USN-1	As a User (Doctor), I need to collect all required data	3	High	Darunya S
	Data Preprocessing	USN-2	As a User (Doctor), I need to preprocess all the data collected.	2	Medium	Madhumitha K P

	Accessing the User Interface(UI)	USN-3	As a user, I need to interact with software and operate the application with the help of UI.	3	High	Nagul Pranav V S
	Application/Software Launch	USN-4	As a user, I can launch the developed application/software.		Medium	Nidharshini M

Sprint	**Functional Requirement (Epic)**	**User Story Number**	**User Story / Task**	**Story Points**	**Priority**	**Team Members**
Sprint-2	Launching the webcam/camera	USN-1	As a user, I need to open the webcam/camera from the application to perform gestures.	3	High	Nidharshini M
	Upload images from local system for manipulation	USN-2	As a user, I need upload images to the application from the local system for manipulation.	1	Low	Darunya S

	Upload images from local system for training	USN-3	As a user, I need to upload images to the application from the local system for manipulation, training.		High	Madhumitha K P
	Upload images from local system for testing	USN-4	As a user, I need to upload images to the application from the local system for testing.		High	Nagul Pranav V S

Sprint	**Functional Requirement (Epic)**	**User Story Number**	**User Story / Task**	**Story Points**	**Priority**	**Team Members**
Sprint-3	Development	USN-1	As a User (Doctor), I develop a model for training and testing.	3	High	Darunya S
	Flask Integration	USN-2	As a user, I need to integrate with Flask.	2	Medium	Nidharshini M

	Upload images from local system for training	USN-3	As a user, I need to upload images to the application from the local system for manipulation, training and testing.	2	Medium	Madhumitha K P
	Local Deployment	USN-4	As a user, I can deploy the model locally and see the output.	3	High	Nagul Pranav V S

Sprint	**Functional Requirement (Epic)**	**User Story Number**	**User Story / Task**	**Story Points**	**Priority**	**Team Members**
Sprint-4	Cloud Account	USN-1	As a user, I need to create IBM Cloud Account to train model.	1	Low	Madhumitha K P
	Model Training	USN-2	As a user, I need train and test model in cloud to deploy it.	3	High	Nidharshini M

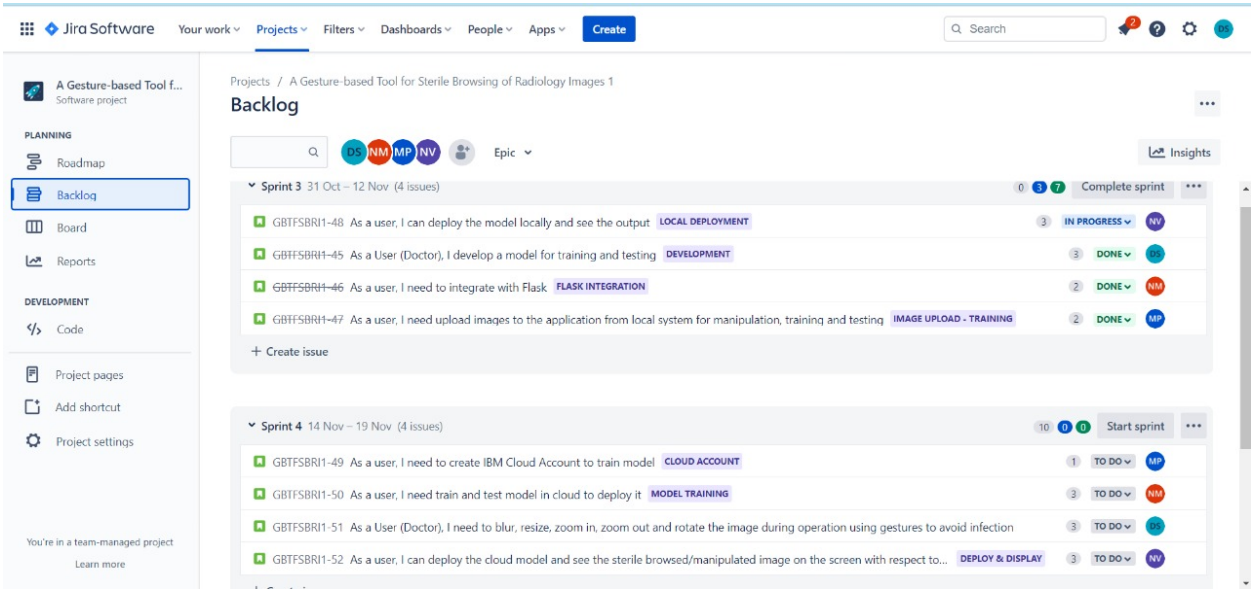
	Manipulating images through gestures	USN-3	As a User (Doctor), I need to blur, resize, zoomin, zoom out and rotate the image during operation using gestures to avoid infection.	3	High	Darunya S Nagul Pranav V S
	Deploy & Display	USN-4	As a user, I can deploy the cloud model and see the sterile browsed/manipulated image on the screen withrespect to the gesture performed.	3	High	Nagul Pranav V S Darunya S Madhumitha K P Nidharshini M

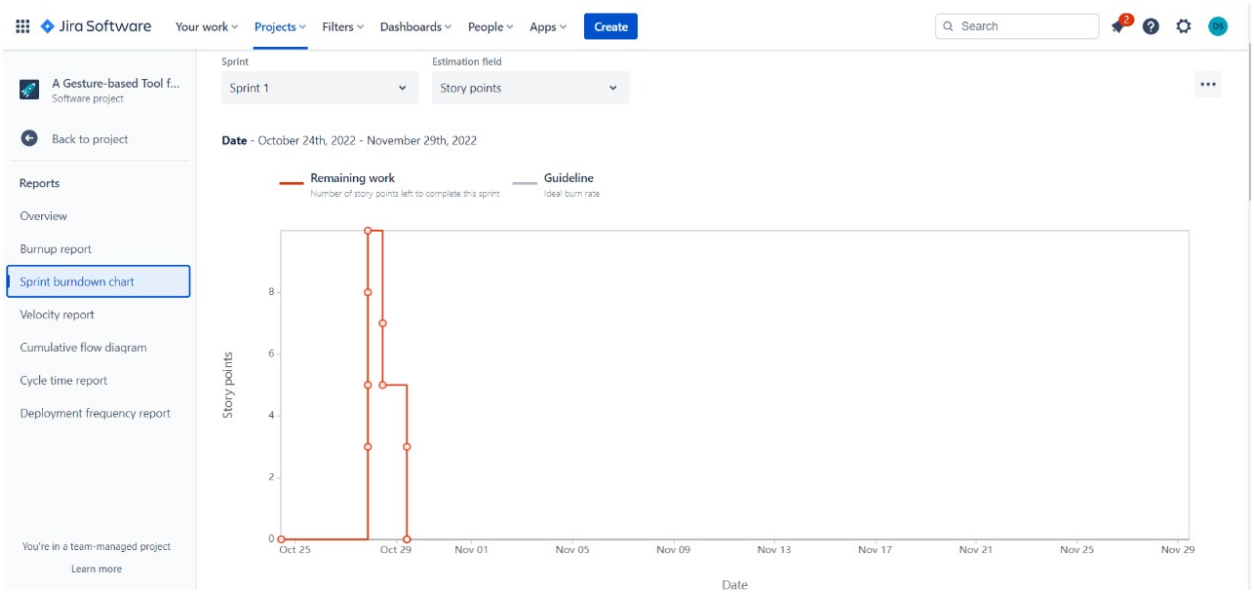
6.2 Sprint Delivery Schedule:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned	Sprint Release Date (Actual)

					End Date)	
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	14 Nov 2022

6.3 Reports From JIRA:

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Your work
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A Gesture-based Tool f...
Software project
Back to project
Reports
Overview
Burnup report
Sprint burndown chart
Velocity report
Cumulative flow diagram
Cycle time report
Deployment frequency report
You're in a team-managed project
Learn more
Sprint
Sprint 1
Estimation field
Story points
Date - October 24th, 2022 - November 29th, 2022
Remaining work
Number of story points left to complete this sprint
Guideline
Ideal burn rate
Story points
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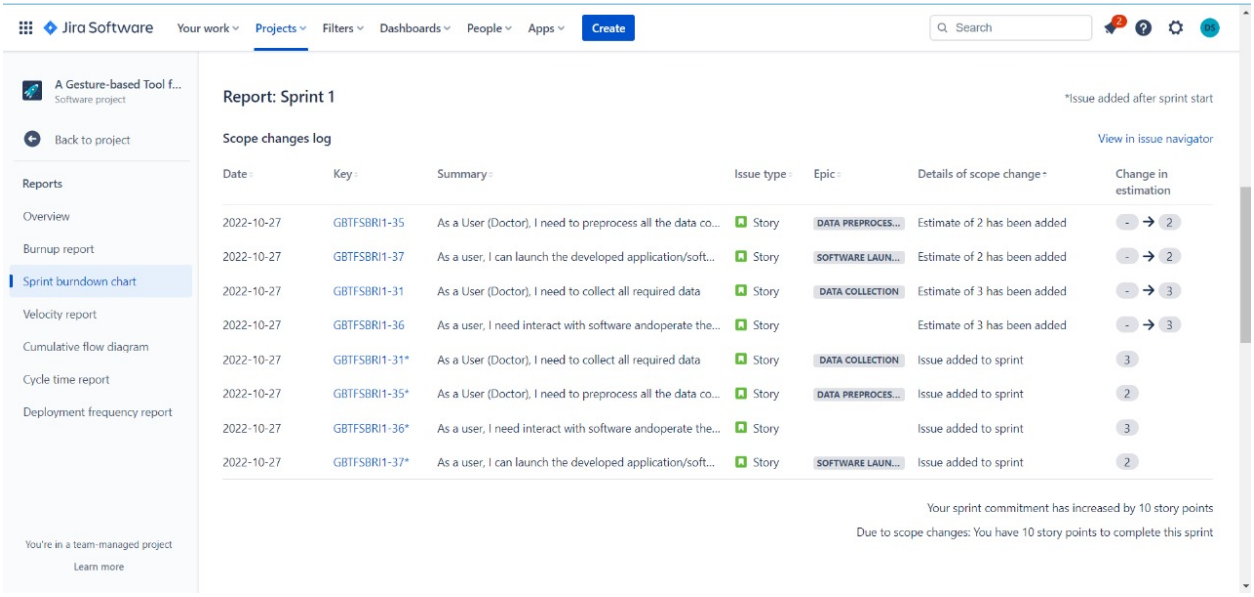
Jira Software
Your work
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Filters
Dashboards
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A Gesture-based Tool f...
Software project
Back to project
Reports
Overview
Burnup report
Sprint burndown chart
Velocity report
Cumulative flow diagram
Cycle time report
Deployment frequency report
You're in a team-managed project
Learn more
Report: Sprint 1
*Issue added after sprint start
Scope changes log
View in issue navigator
Date
Key
Summary
Issue type
Epic
Details of scope change
Change in estimation
2022-10-27 GBTFSBRI1-35 As a User (Doctor), I need to preprocess all the data co... Story DATA PREPROCES... Estimate of 2 has been added - → 2
2022-10-27 GBTFSBRI1-37 As a user, I can launch the developed application/soft... Story SOFTWARE LAUN... Estimate of 2 has been added - → 2
2022-10-27 GBTFSBRI1-31 As a User (Doctor), I need to collect all required data Story DATA COLLECTION Estimate of 3 has been added - → 3
2022-10-27 GBTFSBRI1-36 As a user, I need interact with software andoperate the... Story Estimate of 3 has been added - → 3
2022-10-27 GBTFSBRI1-31* As a User (Doctor), I need to collect all required data Story DATA COLLECTION Issue added to sprint 3
2022-10-27 GBTFSBRI1-35* As a User (Doctor), I need to preprocess all the data co... Story DATA PREPROCES... Issue added to sprint 2
2022-10-27 GBTFSBRI1-36* As a user, I need interact with software andoperate the... Story Issue added to sprint 3
2022-10-27 GBTFSBRI1-37* As a user, I can launch the developed application/soft... Story SOFTWARE LAUN... Issue added to sprint 2
Your sprint commitment has increased by 10 story points
Due to scope changes: You have 10 story points to complete this sprint

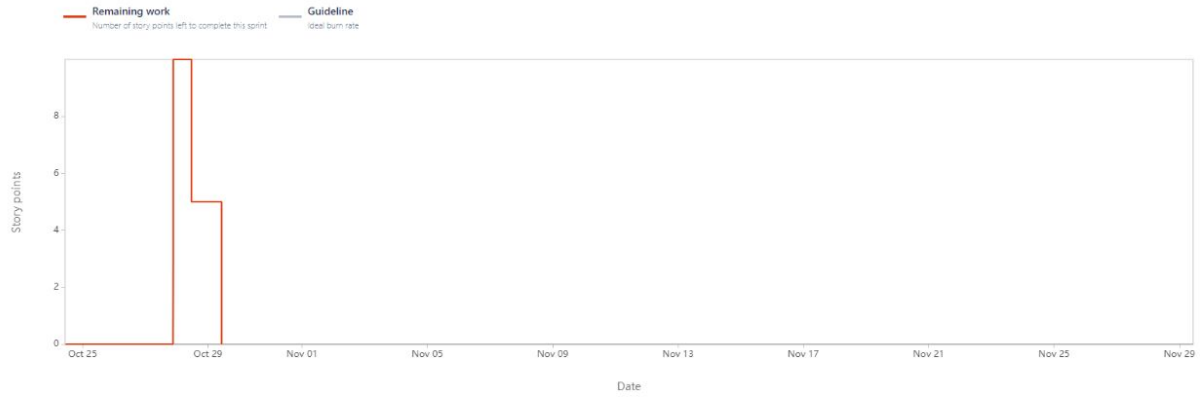
Projects / A Gesture-based Tool for Sterile Browsing of Radiology Images 1 / Reports

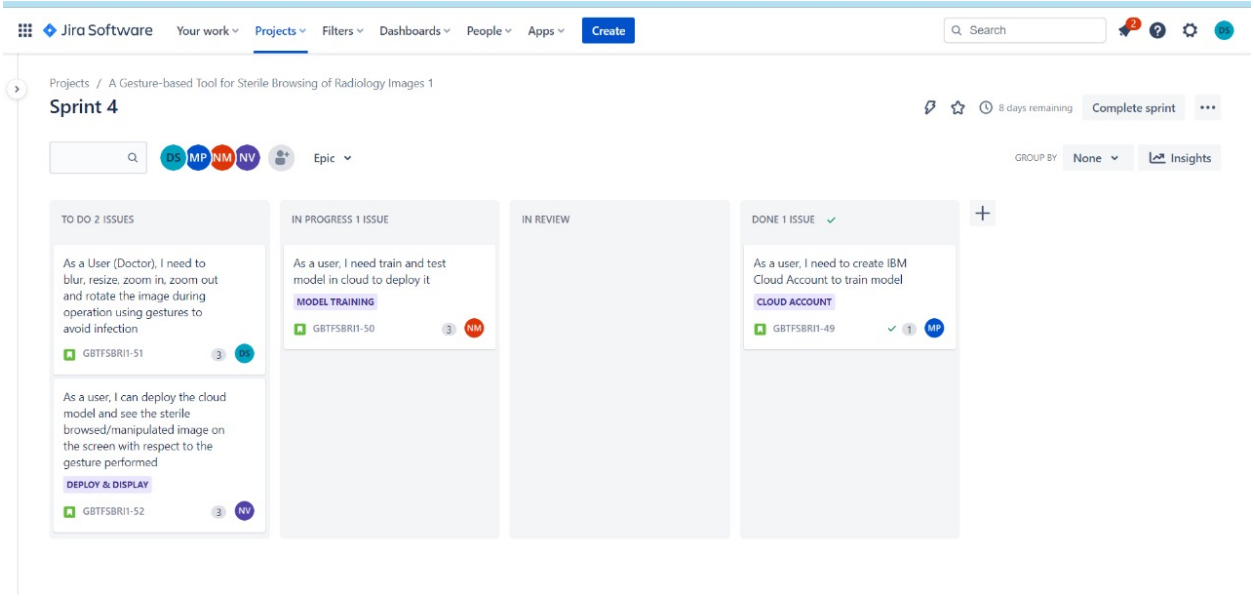
Sprint burndown chart

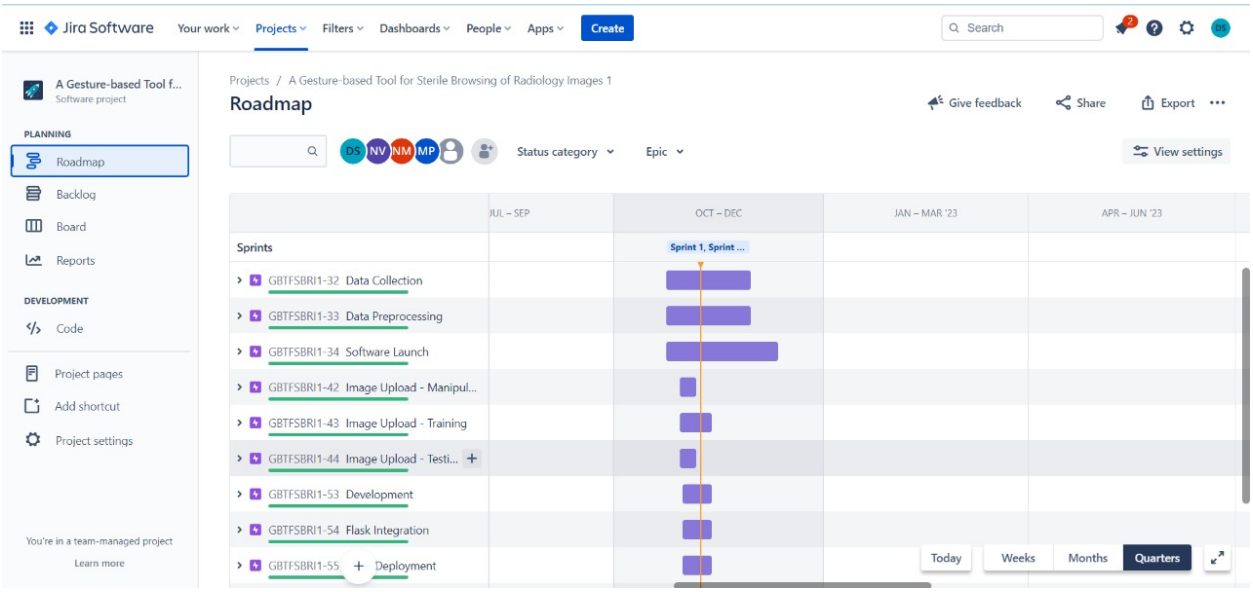
› How to read this report

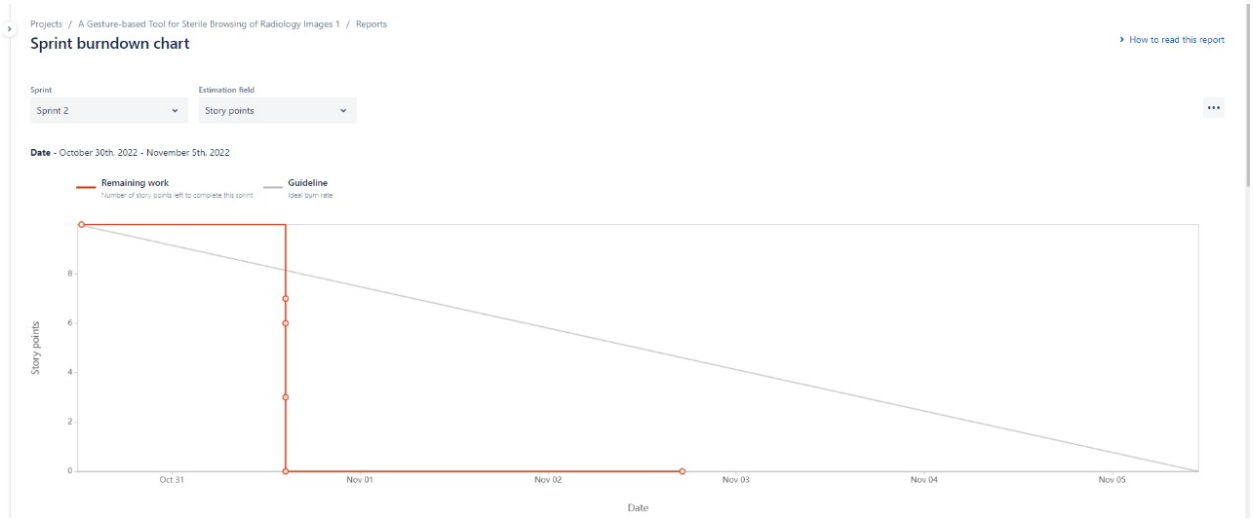
Sprint: Sprint 1 | Estimation field: Story points

Date - October 24th, 2022 - November 29th, 2022



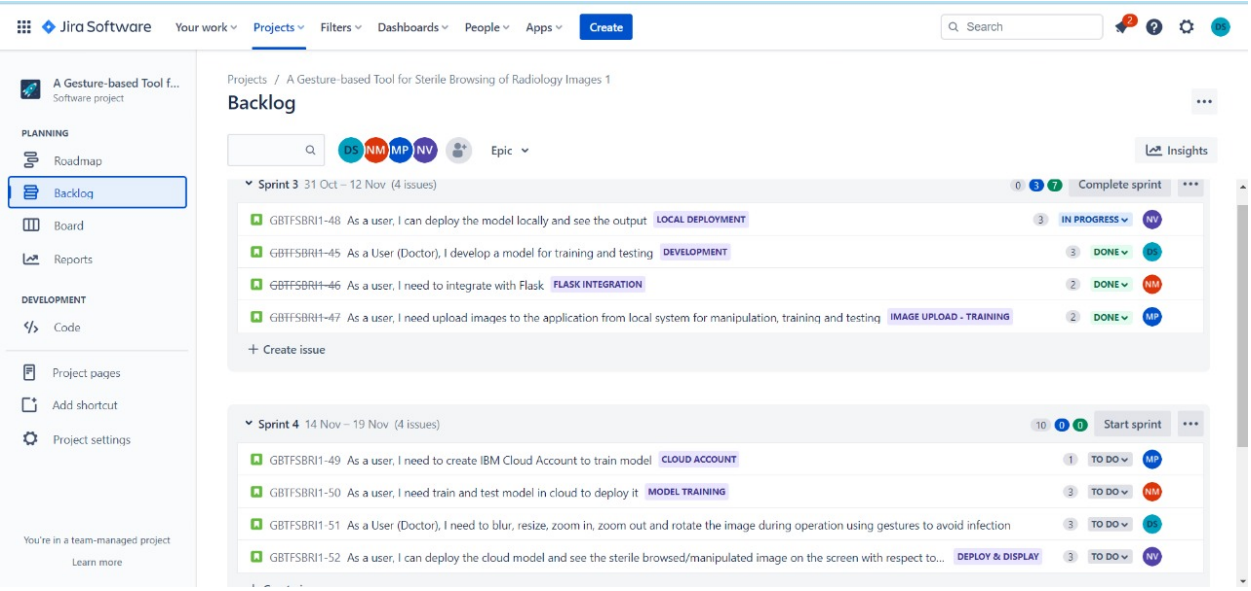


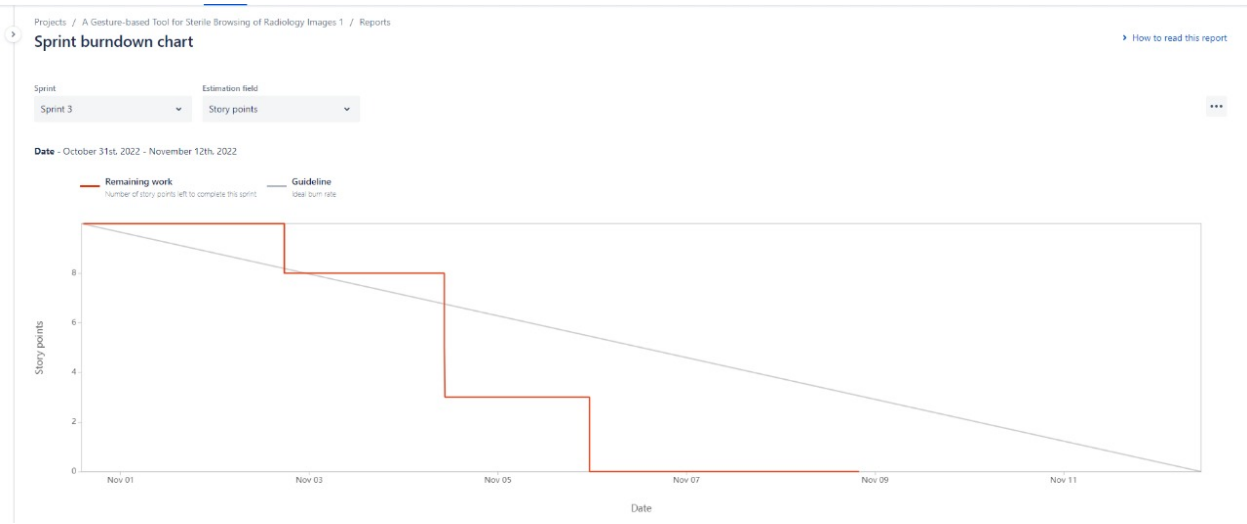




Completed issues View in issue navigator

Key	Summary	Issue type	Epic	Status	Assignee	Story points
GBTFSBRI1-38	As a user, I need to open the webcam/camera from the application to perfor...	Story		DONE	NM	3
GBTFSBRI1-39	As a user, I need upload images to the application from local system for man...	Story	IMAGE UPLOAD - ...	DONE	DS	1
GBTFSBRI1-40	As a user, I need upload images to the application from local system for man...	Story	IMAGE UPLOAD - T...	DONE	MP	3
GBTFSBRI1-41	As a user, I need upload images to the application from local system for testi...	Story	IMAGE UPLOAD - T...	DONE	NV	3

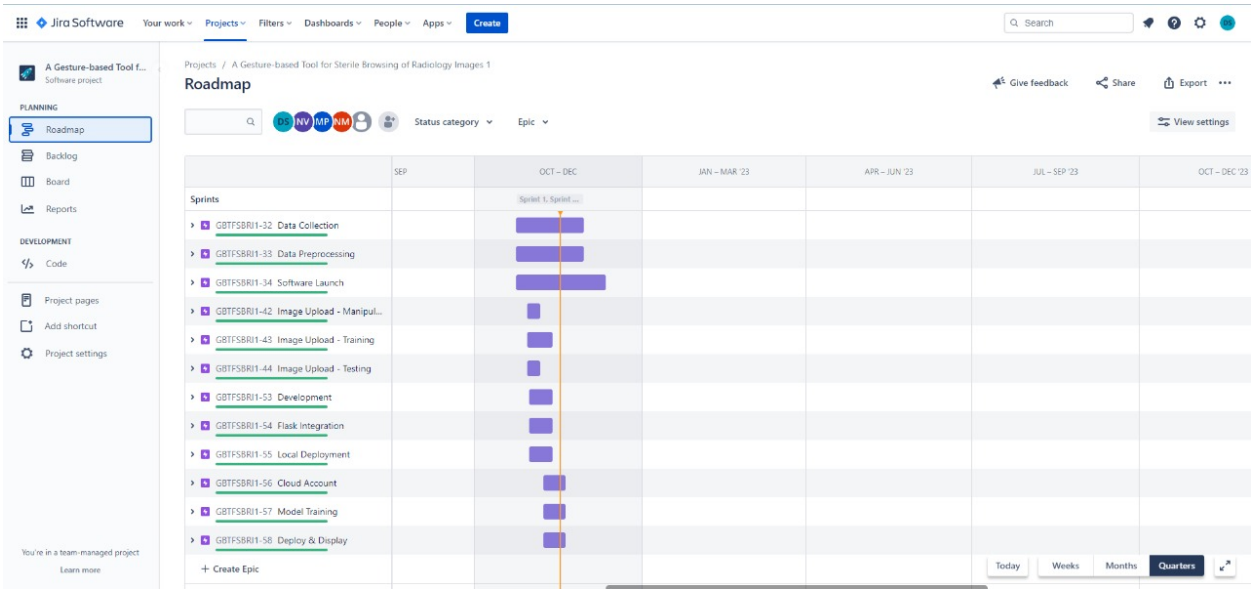




Completed issues

View in issue navigator

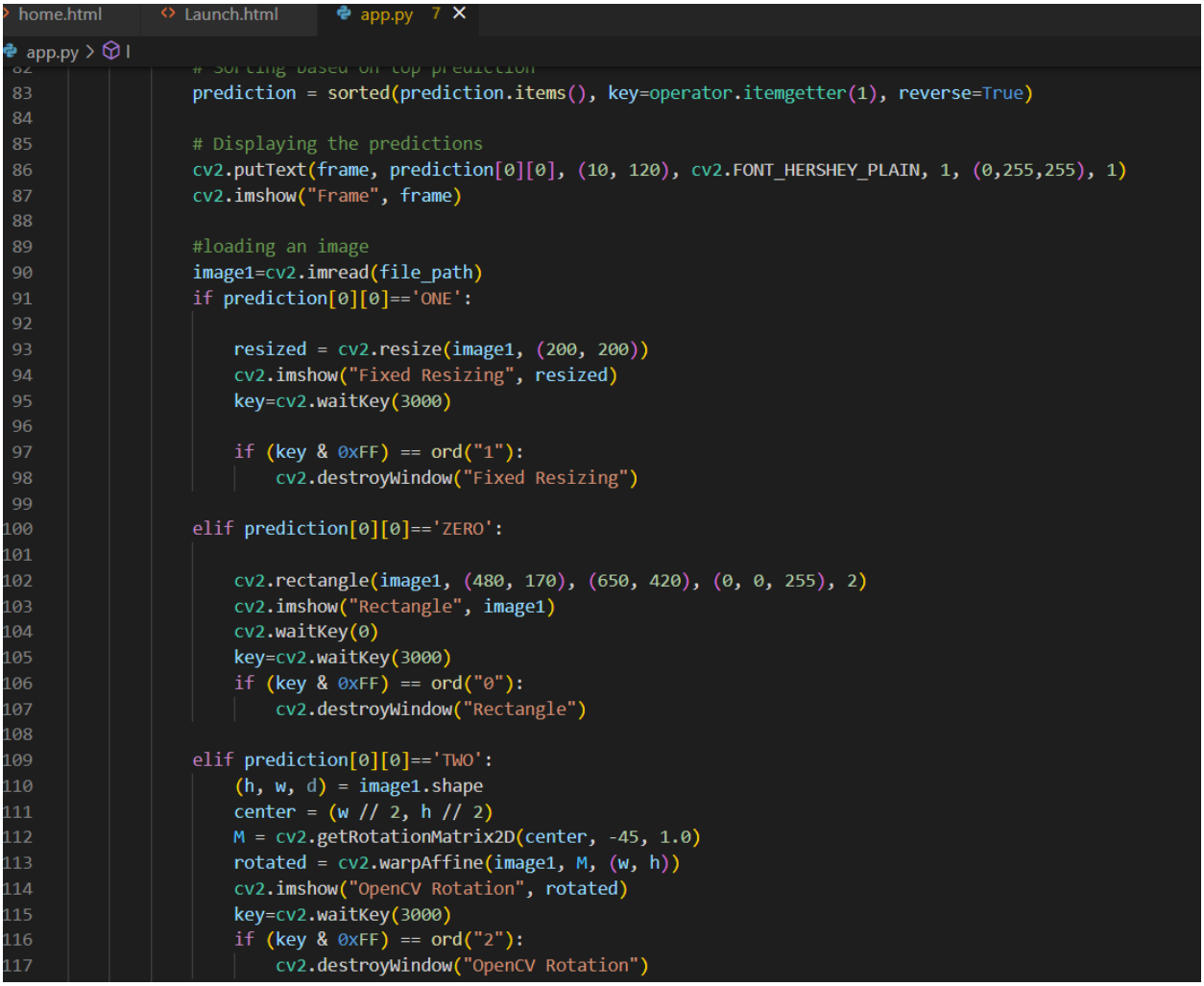
Key	Summary	Issue type	Epic	Status	Assignee	Story points
GBTFSBRI1-45	As a User (Doctor), I develop a model for training and testing	Story	DEVELOPMENT	DONE	DS	3
GBTFSBRI1-46	As a user, I need to integrate with Flask	Story	FLASK INTEGRATION	DONE	NM	2
GBTFSBRI1-47	As a user, I need upload images to the application from local system for manipulation, training an...	Story	IMAGE UPLOAD - T...	DONE	MP	2
GBTFSBRI1-48	As a user, I can deploy the model locally and see the output	Story	LOCAL DEPLOYMENT	DONE	NV	3


Jira Software
Your work
Projects
Filters
Dashboards
People
Apps
Create
Search
A Gesture-based Tool f...
Software project
PLANNING
Roadmap
Backlog
Board
Reports
DEVELOPMENT
Code
Project pages
Add shortcut
Project settings
You're in a team-managed project
Learn more
Projects / A Gesture-based Tool for Sterile Browsing of Radiology Images 1
Roadmap
Give feedback
Share
Export
Status category
Epic
View settings
SEP
OCT – DEC
JAN – MAR '23
APR – JUN '23
JUL – SEP '23
OCT – DEC '23
Sprints
GBTFSBRI1-32 Data Collection
GBTFSBRI1-33 Data Preprocessing
GBTFSBRI1-34 Software Launch
GBTFSBRI1-42 Image Upload - Manipul...
GBTFSBRI1-43 Image Upload - Training
GBTFSBRI1-44 Image Upload - Testing
GBTFSBRI1-53 Development
GBTFSBRI1-54 Flask Integration
GBTFSBRI1-55 Local Deployment
GBTFSBRI1-56 Cloud Account
GBTFSBRI1-57 Model Training
GBTFSBRI1-58 Deploy & Display
+ Create Epic
Today
Weeks
Months
Quarters

7. CODING AND SOLUTIONING:

7.1 Feature 1:

Some of the features in Feature 1 are Fixed Resizing , Rectangle and OpenCV Rotation. Below is the screenshot of the code snippet for the above mentioned features.



7.2 Feature 2:

Some of the features in Feature 2 are Fixed Resizing , Blurring and OpenCV GrayScale. Below is the screenshot of code snippet for the above mentioned features.

8.TESTING:

8.1 Test Cases:

				Date	17-Nov-22								
				Team ID	PNT2022TMID17973								
				Project Name	A Gesture Based Tool for Sterile								
				Maximum Marks	4 marks								
Test case ID	**Feature Type**	**Component**	**Test Scenario**	**Pre-Requisite**	**Steps To Execute**	**Test Data**	**Expected Result**	**Actual Result**	**Status**	**Comments**	**TC for Automation(Y/N)**	**BUG ID**	**Executed By**
LoginPage_TC_001	Functional	Login Page	Verify that the user is able to login successfully on entering appropriate credentials.	User must have already been registered.	1. Enter the URL for the Application. 2. Click on the existing user option. 3. Enter the credentials for logging in.	Email ID: ani07.anand@gmail.com Password: 123	User should be able to submit the login request and be redirected to the landing page.	Working as expected	Pass				Darunya S
LoginPage_TC_002	UI	Login Page	The UI elements, such as the card for the login, the button to submit etc are functional and are rendered properly in all devices.	User must have already been registered.	1. Enter the URL for the Application. 2. Click on the Sign In option. 3. The following UI elements must be found: a. Card for Login b. Link to the registration page c. Textbox for email ID d. Textbox for password e. Submit button	N/A	The following UI elements should be rendered properly on the device: a. Card for Login b. Link to the registration page c. Textbox for email ID d. Textbox for password e. Submit button	Working as expected	Pass				Nagul Pranav V S
LoginPage_TC_003	Functional	Login Page	Registered users who enter an incorrect password will not be redirected to the landing page.	User must have already been registered.	1. Enter the URL for the Application. 2. Click on the existing user option. 3. Enter the credentials for logging in.	Email ID ani07.anand@gmail.com Password: 123123123	User should not be redirected to the landing page. The application should prompt the user to enter the correct password.	Working as expected	Pass				Nidharshini M
LoginPage_TC_004	Functional	Login Page	Unregistered users who attempt to log in to the application will not be redirected to the landing page.	-	1. Enter the URL for the Application. 2. Click on the existing user option. 3. Enter some invalid credentials.	Email ID: newuser@gmail.com Password: 1234	User should not be redirected to the landing page. The application should prompt the user to register.	Working as expected	Pass				Madhu Mitha K P
RegistrationPage_TC_005	Functional	Registration page	Verify user is able to register themselves to the application.	-	1. Enter the URL for the application. 2. Enter the following details: a. Email ID b. Username c. Actual Name d. Password e. Confirm Password	Email ID: test@gmail.com Username: tester Name: Anirudh Password: 123! Confirm password: 123!	User should be directed to the landing page.	Working as expected	Pass				Nagul Pranav V S
RegistrationPage_TC_006	UI	Registration page	The UI elements, such as the card for the registration, the button to submit etc are functional and are rendered properly in all devices.	-	1. Enter the URL for the Application. 2. Click on the sign up option. 3. The following UI elements must be found: a. Card for Registration b. Textbox for email ID c. Textbox for username d. Textbox for actual name e. Textbox for password d. Textbox for confirm password e. Go back to home page button f. Submit button	N/A	The application should show below UI elements: a. Card for Registration b. Textbox for email ID c. Textbox for username d. Textbox for actual name e. Textbox for password d. Textbox for confirm password e. Go back to home page button f. Submit button	Working as expected	Pass				Darunya S

Test case ID	**Feature Type**	**Component**	**Test Scenario**	**Pre-Requisite**	**Steps To Execute**	**Test Data**	**Expected Result**	**Actual Result**	**Status**	**Comments**	**TC for Automation(Y/N)**	**BUG ID**	**Executed By**
SMTPEmailService_TC_009	Functional	Registration page	Post successful registration, the user should receive an email from anirudh19015@cse.ssn.edu.in with the user's username and password.	User must have completed the registration process.	1. Enter the URL for the Application. 2. Click on the sign up option. 3. Enter valid inputs for the following: b. email ID c. username d. actual name e. password d. confirm password	Email ID: test@gmail.com Username: tester Name: Anirudh Password: 123! Confirm password: 123!	User receives the mail from anirudh19015@cse.ssn.edu.in.	Working as expected	Pass				Nagul Pranav V S
SMTPEmailService_TC_010	Functional	Registration page	The application should check if a user's email ID exists before completing the registration process.	User must have completed the registration process.	1. Enter the URL for the Application. 2. Click on the sign up option. 3. Enter valid inputs for the following: b. email ID c. username d. actual name e. password d. confirm password	Email ID: notvalid@gmail.com Username: tester Name: Anirudh Password: 123! Confirm password: 123!	The application prompts the user to enter a valid email ID.	The application attempts to send an email to an invalid address	Failed			B01	Darunya S
Dashboard_TC_011	UI	Landing Page	The UI part of the dashboard, the side navbar, the sign out option, help page link and gesture prediction link must be functioning and rendered properly	User must have logged in to the application using valid credentials.	1. Enter the URL for the application. 2. Login to with user credentials. 3. View the dashboard.	Email ID: ani07.anand@gmail.com password: 123	Application should show below UI elements: a. Side navbar b. Help page button c. Gesture prediction button d. Sign out button	Working as expected	Pass				Nagul Pranav V S
Dashboard_TC_012	UI	Landing Page	The user should be able to view the number of times he/she has logged in to the application as well as when the current session started. The value for all-time logins for new users should be one.	User must have logged in to the application using valid credentials.	1. Enter the URL for the application. 2. Login to with user credentials. 3. View the dashboard.	Email ID: ani07.anand@gmail.com password: 123	The application should show the below details: a. Number of times the user has accessed the application b. Date and time when the current session started.	Working as expected	Pass				Nidharshini M
AccountDetails_TC_013	UI	Account Details Page	The user should be able to modify his/her account details	User must have logged in to the application using valid credentials.	1. Enter the URL for the application. 2. Login to with user credentials. 3. View the dashboard. 4. Click on the user icon at the bottom of the page. 5. The following UI elements must be found: a. Password change card	Email ID: ani07.anand@gmail.com password: 123	The application should render the following UI elements: a. Password change card b. Textbox for new password c. Textbox for confirming password	Working as expected	Pass				Madhu Mitha K P

8.2 User Acceptance Testing:

8.2.1 Purpose Of Document:

The purpose of this document is to briefly explain the test coverage and open

issues of the [A Gesture based hand recognition system] project at the time of the release to User Acceptance Testing (UAT).

8.2.2 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	5	4	2	1	12
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	5	2	4	1	12
Not Reproduced	0	0	1	0	1
Skipped	2	0	1	1	4
Won't Fix	1	2	2	1	6
Totals	16	11	13	5	45

8.2.3 Test Case Analysis:

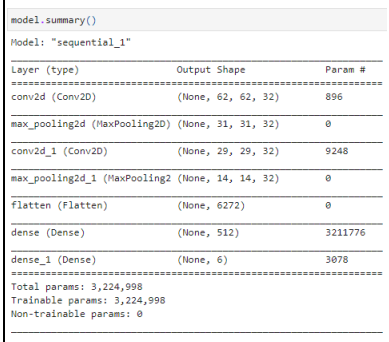
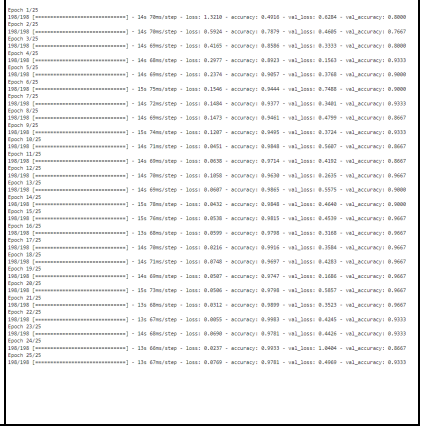
This report shows the number of test cases that have passed, failed, and untested.

SECTION	TOTAL CASES	NOT TESTED	FAIL	PASS
Web UI	7	0	0	7
Launching Camera	10	1	0	9
Training Set	14	0	2	12
Flask Integration	6	0	0	3
Cloud Deployment	10	0	1	9
Final Report Output	5	0	0	5
Version Control	2	0	0	2

9.RESULTS:

9.1 Performance Metrics:

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

S. No	Parameter	Values	Screenshot
1.	Model Summary	conv2d (Conv2D)- 896 max_pooling2d - 0 conv2d_1 (Conv2D) - 9248 max_pooling2d_1 - 0 flatten (Flatten) - 0 dense (Dense) - 3211776 dense_1 (Dense) - 3078 ========== Total params: 3,224,998 Trainable params: 3,224,998 Non-trainable params: 0	
2.	Accuracy	Training Accuracy - 97.81% Validation Accuracy - 93.33%	

3.	Confidence Score (Only Yolo Projects)	Class Detected – N/A Confidence Score – N/A	N/A

9.1.1 Model Summary:

```
model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 62, 62, 32)        896
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 31, 31, 32)        0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 29, 29, 32)        9248
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 14, 14, 32)        0
_________________________________________________________________
flatten (Flatten)            (None, 6272)              0
_________________________________________________________________
dense (Dense)                (None, 512)               3211776
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 3078
=================================================================
Total params: 3,224,998
Trainable params: 3,224,998
Non-trainable params: 0
_________________________________________________________________
```

9.1.2 Model Accuracy:

```
Epoch 1/25
198/198 [==============================] - 14s 70ms/step - loss: 1.3210 - accuracy: 0.4916 - val_loss: 0.6284 - val_accuracy: 0.8000
Epoch 2/25
198/198 [==============================] - 14s 70ms/step - loss: 0.5924 - accuracy: 0.7879 - val_loss: 0.4605 - val_accuracy: 0.7667
Epoch 3/25
198/198 [==============================] - 14s 69ms/step - loss: 0.4165 - accuracy: 0.8586 - val_loss: 0.3333 - val_accuracy: 0.8000
Epoch 4/25
198/198 [==============================] - 14s 68ms/step - loss: 0.2977 - accuracy: 0.8923 - val_loss: 0.1563 - val_accuracy: 0.9333
Epoch 5/25
198/198 [==============================] - 14s 69ms/step - loss: 0.2374 - accuracy: 0.9057 - val_loss: 0.3768 - val_accuracy: 0.9000
Epoch 6/25
198/198 [==============================] - 15s 75ms/step - loss: 0.1546 - accuracy: 0.9444 - val_loss: 0.7488 - val_accuracy: 0.9000
Epoch 7/25
198/198 [==============================] - 14s 72ms/step - loss: 0.1484 - accuracy: 0.9377 - val_loss: 0.3401 - val_accuracy: 0.9333
Epoch 8/25
198/198 [==============================] - 14s 69ms/step - loss: 0.1473 - accuracy: 0.9461 - val_loss: 0.4799 - val_accuracy: 0.8667
Epoch 9/25
198/198 [==============================] - 15s 74ms/step - loss: 0.1207 - accuracy: 0.9495 - val_loss: 0.3724 - val_accuracy: 0.9333
Epoch 10/25
198/198 [==============================] - 14s 71ms/step - loss: 0.0451 - accuracy: 0.9848 - val_loss: 0.5607 - val_accuracy: 0.8667
Epoch 11/25
198/198 [==============================] - 14s 69ms/step - loss: 0.0638 - accuracy: 0.9714 - val_loss: 0.4192 - val_accuracy: 0.8667
Epoch 12/25
198/198 [==============================] - 14s 70ms/step - loss: 0.1058 - accuracy: 0.9630 - val_loss: 0.2635 - val_accuracy: 0.9667
Epoch 13/25
198/198 [==============================] - 14s 69ms/step - loss: 0.0607 - accuracy: 0.9865 - val_loss: 0.5575 - val_accuracy: 0.9000
Epoch 14/25
198/198 [==============================] - 15s 78ms/step - loss: 0.0432 - accuracy: 0.9848 - val_loss: 0.4640 - val_accuracy: 0.9000
Epoch 15/25
198/198 [==============================] - 15s 76ms/step - loss: 0.0538 - accuracy: 0.9815 - val_loss: 0.4539 - val_accuracy: 0.9667
Epoch 16/25
198/198 [==============================] - 13s 68ms/step - loss: 0.0599 - accuracy: 0.9798 - val_loss: 0.3168 - val_accuracy: 0.9667
Epoch 17/25
198/198 [==============================] - 14s 70ms/step - loss: 0.0216 - accuracy: 0.9916 - val_loss: 0.3584 - val_accuracy: 0.9667
Epoch 18/25
198/198 [==============================] - 14s 71ms/step - loss: 0.0748 - accuracy: 0.9697 - val_loss: 0.4283 - val_accuracy: 0.9667
Epoch 19/25
198/198 [==============================] - 14s 69ms/step - loss: 0.0507 - accuracy: 0.9747 - val_loss: 0.1686 - val_accuracy: 0.9667
Epoch 20/25
198/198 [==============================] - 15s 73ms/step - loss: 0.0506 - accuracy: 0.9798 - val_loss: 0.5857 - val_accuracy: 0.9667
Epoch 21/25
198/198 [==============================] - 13s 68ms/step - loss: 0.0312 - accuracy: 0.9899 - val_loss: 0.3523 - val_accuracy: 0.9667
Epoch 22/25
198/198 [==============================] - 13s 67ms/step - loss: 0.0055 - accuracy: 0.9983 - val_loss: 0.4245 - val_accuracy: 0.9333
Epoch 23/25
198/198 [==============================] - 14s 68ms/step - loss: 0.0690 - accuracy: 0.9781 - val_loss: 0.4426 - val_accuracy: 0.9333
Epoch 24/25
198/198 [==============================] - 13s 66ms/step - loss: 0.0237 - accuracy: 0.9933 - val_loss: 1.0404 - val_accuracy: 0.8667
Epoch 25/25
198/198 [==============================] - 13s 67ms/step - loss: 0.0769 - accuracy: 0.9781 - val_loss: 0.4969 - val_accuracy: 0.9333
```

10.ADVANTAGES AND DISADVANTAGES:

The following are some benefits of using a hand gesture interface for doctors and surgeons: I Simple to use: The technique permits the use of hands, which are the surgeons' natural work tools. (ii) Quick response: Hand gesture commands for nonverbal instructions are simple and quick. In actual use, this technology can gesture-interface in operating rooms with both bright and dim lighting. Views of a gesture interface system installed in an operating room, which processes images and tracks hands in real-time, are shown in the bottom pair. (iii) Unencumbered: - the suggested system does not call for the surgeon to use foot pedals, a microphone, or head-mounted sensing devices, (iv) Sterile interface: Using a sterile, non-contact interface in operating rooms has many benefits, (v) Hand motions can be done up to 5 meters.

Vision-based gesture interfaces do, however, come with a number of drawbacks, such as user fatigue, cultural differences, the need for high-speed processing, and noise sensitivity. However, it is more challenging to use because of the limitations of current computer vision algorithms in processing highly articulated, non-convex, and flexible objects like the human hand.

Vision-based recognition is incredibly challenging, not only because of the variety of locations, translations, and spatio-temporal variations, but also because of the complex, non-unbending characteristics of the human hand. The classifiers currently used for vision-based motion recognition are ill-equipped to deal with all the motion characterisation problems at once. Each of them has at least one drawback that limits the application of motion recognition techniques generally.

11.CONCLUSION:

We offer a vision-based system that can alter windows and objects in a medical data visualization environment in real-time by interpreting user gestures. Because the user's hand or glove's color range is established at the beginning of each session, the system is user independent. Utilizing an unique adaptive color-motion fusion mechanism, hands are segmented and tracked. Along with zoom, rotation, and system sleep motions, dynamic navigation gestures are also recognised.

We evaluated the performance of the system using three different metrics: rotation accuracy, task learning, and gesture recognition accuracy.
The ergonomic features of the system, such as comfort and intuitiveness, were also asked about by the subjects. Additionally, the system was put to the test in a real hospital environment by surgeons performing a neurological procedure. Neurosurgeons used this hand gesture interface to browse through MRI scans of the patient's brain during a live biopsy procedure in an OR at Washington Hospital Center in Washington, DC, as part of a system test. A post-op satisfaction survey given to surgeons found good marks for task completion speed, ease of use, and overall satisfaction.

12.FUTURE SCOPES:

Compared to other glove-based methodologies used in HCI, the vision-based hand gesture approach is more natural and appropriate because it may be applied anywhere and at any moment in the camera's field of view. It is simpler to deploy because the operator does not need to be an expert with any specialized gear. A strategy that relies on vision also makes it possible to utilize a number of motions that may be changed in the software.

Computer vision techniques can make HCI possible in ways that are challenging or impractical with other modalities. Since meaning is communicated through identification, facial expression, posture, gestures, and other visually observable features, visual information is crucial in human-to-human communication.

Therefore, intuitively it is possible to have natural HCI by sensing and perceiving these visual cues from video cameras placed appropriately in the environment. Furthermore, the expense of image processing equipment can be minimized since most computers now have a central processing unit and graphics processing unit fast enough to perform these computer vision tasks.Camera-based computer vision techniques are flexible enough to offer an entire range of conceivable future applications in a human-computer association, including user validation, video conferencing, and distance learning, whereas other information devices like a mouse, joystick, and trackpad are constrained to a specific capacity.The fact that computer vision is non-intrusive is another important benefit. Cameras are open information devices that can record activity without coming into contact with the user. The user can interact with the computer without the usage of wires or remote-control devices.

13.APPENDIX:

Source Code:

Below is the link of our project source code,

https://github.com/IBM-EPBL/IBM-Project-39748-1660496109

Github Link and Demo Video Link:

https://github.com/IBM-EPBL/IBM-Project-39748-1660496109