PROJECT REPORT

A GESTURE BASED TOOL FOR STERILE BROWSING OF RADIOLOGY IMAGES

TEAM ID: PNT2022TMID37038

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ABSTRACT:

The use of doctor-computer interaction devices in the operation room (OR) requires new modalities that support medical imaging manipulation while allowing doctors' hands to remain sterile, supporting their focus of attention, and providing fast response times. This paper presents "*Gestix*," a vision-based hand gesture capture and recognition system that interprets in real-time the user's gestures for navigation and manipulation of images in an electronic medical record (EMR) database. Navigation and other gestures are translated to commands based on their temporal trajectories, through video capture. "*Gestix*" was tested during a brain biopsy procedure. In the in vivo experiment, this interface prevented the surgeon's focus shift and change of location while achieving a rapid intuitive reaction and easy interaction. Data from two usability tests provide insights and implications regarding human-computer interaction based on nonverbal conversational modalities.

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1. INTRODUCTION

1.1 Project Overview

The following interactions must be supported by the system:
● 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 the model analyzes the gesture, the prediction with operation applied on the image is showcased on the UI. To accomplish this, we have completed all the activities and tasks listed below:
● Data Collection.
● Collect the dataset
● Data Preprocessing.
● Import the *ImageDataGenerator* library
● Configure *ImageDataGenerator* class
● Apply *ImageDataGenerator* functionality to Train Set and Test Set
● Import the model building Libraries
● Initializing the model
● Model Building

1.2 Purpose

Humans are able to 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 inimages and which image capture technology and classification techniques 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 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 pretrained model and the gesture is identified. If the gesture prediction is 1 then images are blurred; 2, image is resized; 3, image is rotated etc.

2. LITERATURE SURVEY

2.1 Existing problem

A comprehensive literature survey was performed to understand and critically evaluate the current state of research on gesture recognition software for non-intrusive image browsing. The findings
are listed below.

[1] Analyzed and classified hand gestures for HCI applications using computer vision-based techniques. Supervised feed-forward neural network with backpropagation for classifying hand gestures.

[2] Introduced the skin model, applied the above to the calibrated position and orientation of the hand used to classify gestures. Gaussian Mixture Model (GMM), filters out non-skin colors of an image and removes lighting bias.

[3] Classified hand gestures using skin color and hand feature cues, used optical flow techniques for hand tracking Image segmentation model based on skin color, finger and palm features. Image segmentation model based on skin color, finger and palm features.
[4] Implemented a vision-based gesture recognition system by clustering hand features, and deployed the model sterile browsing of images. Haar features to represent the hand, fuzzy c-means clustering for classifying the gestures.

[5] Superposed the hand skeletons for each posture into a single dynamic signature for the image, relative positions of features used for gesture classification. Two-dimensional skeleton representation of the human hand, Baddeley's distance as a measure of dissimilarities between
model parameters.

3. IDEATION

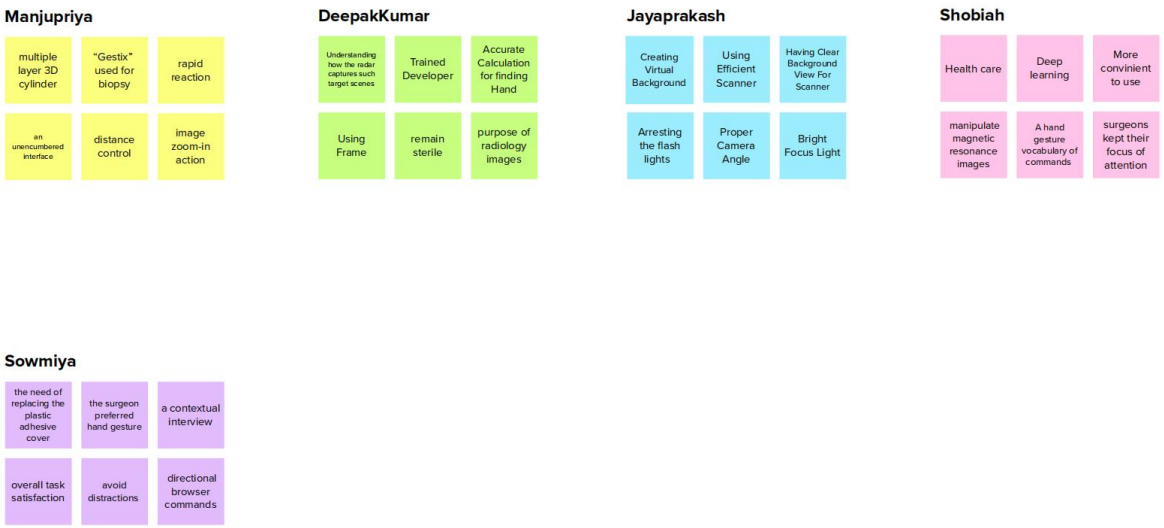
3.1 Empathy Map Canvas

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 challenge

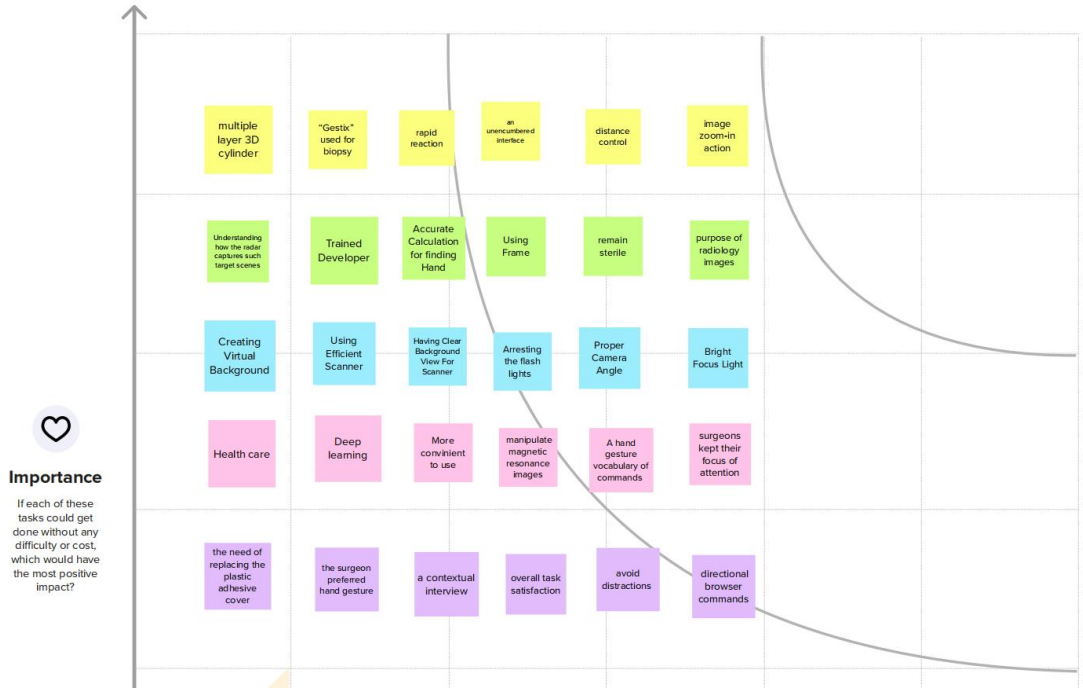
3.2 Ideation & Brainstorming

Brainstorm



Grouping the ideas

Prioritize the ideas



3.3 Problem Statement

With a wave of our hand, there are a lot of things that we can achieve in our daily lives. But there is only a limit that is possible with technology. This is because Humans can recognize sign language with the combination of vision and synaptic interactions with the brain. Computers are unable to do the same thus limiting their capabilities. We wish to push the boundary. With the help of information such as shape, alignment and position of the palm we can obtain certain information.The gestures are of 2 types namely static and dynamic. By examining the contour of the hand, static hand movements can be determined. Analysis of hand motions yields dynamic hand gestures. The issue is the inability to instantly recognise motions without a pause in hand motion. We solve these issues using real-time hand gesture detection is real-time hand gesture detection makes use of various identification algorithms, processing speed, and picture processing approaches. In this project, the model is first trained on pictures of various hand motions, such as showing the numbers 1, 2, 3, and 4 with the fingers. The video frame is captured by this model using the built-in webcam.
The gesture is recognised by comparing the image captured in the video frame with the pretrained model. We are going to use a robust deep learning model capable of making predictions quickly. Our system shall be able to recognize gestures at various hand angles. It shall also work whether the hand is close to or far away from the camera. The system as a whole shall be very responsive.

4.PROJECT DEVELOPMENT PHASE I

4.1 Problem Solution Fit

Project Title: A Gesture-based Tool for Sterile Browsing of Radiology Images **Project Design Phase-I - Solution Fit Template** **Team ID:** PNT2022TMID37038

1. CUSTOMER SEGMENT(S) CS

Doctors or Nurses Working in private or public hospitals.

Age-20 to 50

6. CUSTOMER CONSTRAINTS CC

Customer Needs Fastest System and Quality Camera To scan the hand movements.

5. AVAILABLE SOLUTIONS AS

If there any problem in scanning and uploading the images then they can have a separate scanner connected with system.

2. JOBS-TO-BE-DONE / PROBLEMS J&P

Scan and Upload the image file of radiology images to run the program, after program execution use the hand patterns to zoom in or zoom out.

9. PROBLEM ROOT CAUSE RC

Customer needs to upload the image file then only the system gets input for sterile browsing.

7. BEHAVIOUR BE

Get good quality system , OS and camera to capture the hand movement.

3. TRIGGERS TR

Watch the videos or new related to sterile browsing radiology images to access the images faster.

4. EMOTIONS: BEFORE / AFTER

Have Confident in Reaching and getting more customers before start.

10. YOUR SOLUTION SL

Provide all the guide details about the software and advertise the software only medical related persons to reach good.

8. CHANNELS OF BEHAVIOUR CH

8.1 ONLINE

Extract the social media platforms to reach online.

8.2 OFFLINE

Extract television channels for offline reach.

4.2 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement	At present Doctors are interacting with system via hands which will be infection via germs during the operation , thus we are going to the contactless navigation of radiology images for treatment using ML model to identify the gestures.
2.	Idea / Solution description	To avoid the contact gesture based communication is implemented using CNN and Cameras which detects the gestures ,Which will be absolutely sterile.
3.	Novelty / Uniqueness	We are going to use the CNN for recognizing the gestures. We are going to train the model with hand Gestures. Even we may use AI for Recognizing the clear image even with Bad background. We are providing the various features in Image viewing with Interaction module.
4.	Social Impact / Customer Satisfaction	Our model will help the doctors in OT via contactless interaction which gives Germ free communication and it will reduce the sterilizing process in operation .Which ensures the infections to the patients.
5.	Business Model (Revenue Model)	We will provide our model for subscription based Manner we could generate revenue though this method.
6.	Scalability of the Solution	In future we can expand our project via more additional gestures for browsing. Even we may implement the multiple inputs a time.

4.3 Solution Architecture

- User interacts with the UI (User Interface) to upload the image as input.

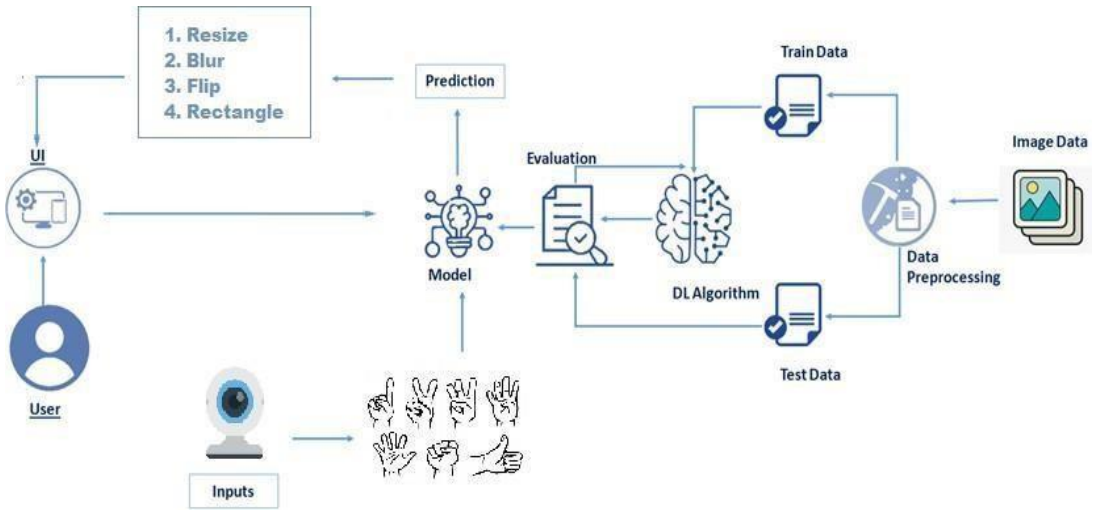
- Depending on the different gesture inputs different operations are applied to the input image.

- The image can be resize, blur, flip and rectangle.

- Once model analyses the gesture, the prediction with operation applied on image is showcased on the UI.

- Better execution in accurate results ,sensitivity ,system architecture design and flexibility of the software.

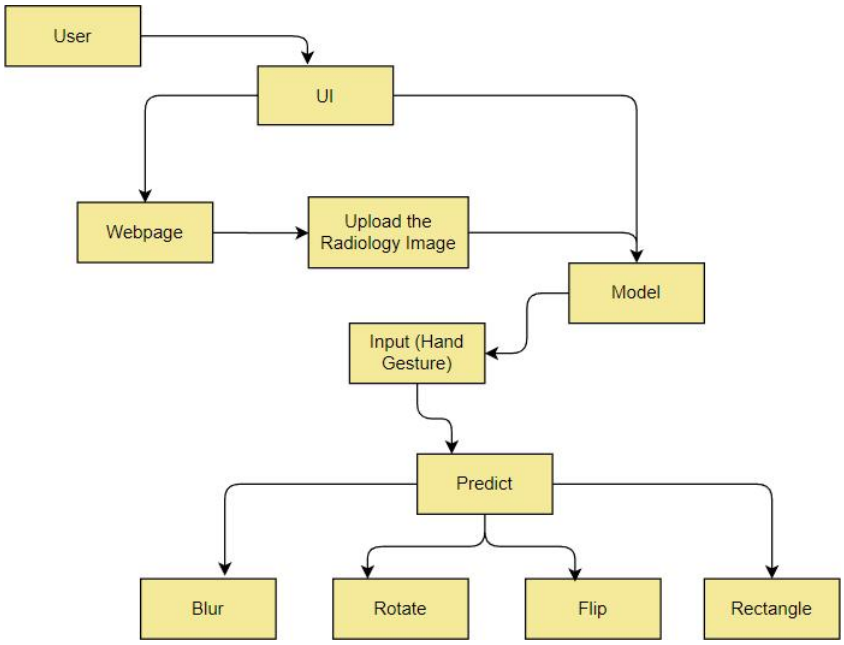
Solution Architecture Diagram:



5. PROJECT DEVELOPMENT PHASE II

5.1Data Flow Diagram

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



5.2 Solution Requirements

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Experience	A UI/UX shall be designed to help users interact with the system by using hand gestures
FR-2	Cloud Deployment	Deploy the trained CNN on the cloud.
FR-3	Hand Gesture Identification	Classify the images of hand gestures captured by a camera
FR-4	Application Domain	The CNN used by the system shall be trained on data that is relevant to the application domain.

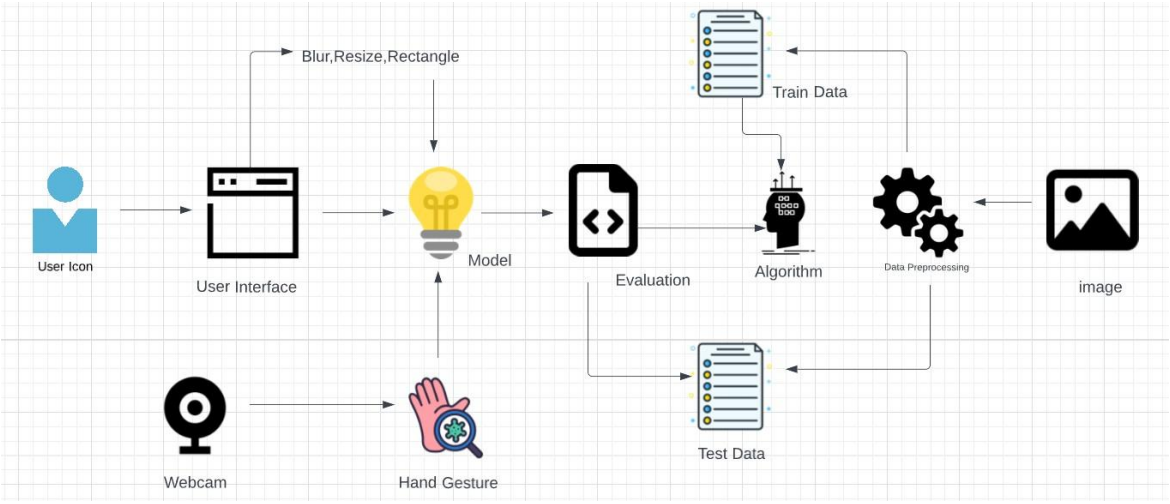
Non-functional Requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	This software shall be easy to use for all users with minimal instructions
NFR-2	**Security**	The Application shall permit users to access the system who are able to use it.
NFR-3	**Reliability**	The Application shall be in the operational mode for at least 5 months after it may be Updated.
NFR-4	**Performance**	It will be able to respond to a user gesture in few milliseconds or 3 seconds
NFR-5	**Availability**	The model shall be available for HealthCare use if it remains operational
NFR-6	**Scalability**	The system shall be accessible to over thousands of concurrent users without any loss of performance

5.3 Technology Stack

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2



S.No	Component	Descripion	Technology
1.	User Interface	Web UI Application	HTML, CSS, JavaScript
2.	Dataset	Collect or create the hand gesture	Hand Gesture Images

		dataset	
3.	Data pre-processing	Import the library files	Python
4.	Model building	Build the CNN model	Python-IBM Watson Studio
5.	Application building	Create HTML file	HTML, CSS, JavaScript
6.	File storage	Store the code files and datasets	Local Filesystem
7.	Deep learning	Used to analyse visual imagery, image processing,video capture	CNN, OpenCV

Table-2: Application Characteristics:

S.no	Characteristics	Description	Technology
1.	Open-Source Frameworks	Application development, data pre-processing.	Visual studio code, anaconda navigator
2.	Security Implementations	It identifies the gesture only when the hand is infront of the camera.	OpenCV
3.	Scalable Architecture	It can be used in any environment and is able toidentify the gesture	OpenCV
4.	Availability	It is used to reduce the possibility of spreading infections	AI
5.	Performance	Rapid response to the gesture.	CNN

6.ADVANTAGES & DISADVANTAGES

Advantages

● Lets users perform transformations to static images according to recognized gestures without needing to know what happens under the hood.

● Lets users upload images of any file type and of any dimension.

● Provides users with a help page to get them acquainted with the application.

● Lets users modify their account details as and when required.

● Gives users information about the number of times they have accessed the application for billing purposes.

Disadvantages

● Email verification before registration is not supported.
● The frame processing rate is higher than expected.
● The model can predict gestures very accurately only if the background is not cluttered and the arm isn't very far away from the camera.
● The model sometimes confuses the gestures for two and three.

7. CONCLUSION

A Gesture Based Tool for Sterile Browsing of Radiology Images supporting myriad features has been designed and implemented using IBM's cloud based tools viz. IBM DB2 Cloud Database, IBM Object Storage, IBM Watson Studio and IBM Cloud Pak for Watson Studio. Simple Mail Transfer Protocol was used to send emails to registered users. The application was deployed locally by downloading the weights for the deep learning model using the IBM Watson Machine Learning Client.

8. FUTURE SCOPE

Future avenues of work in this application would include,

1. Deploying the entire application on the cloud by using IBM's cloud services.
2. Developing more complex deep learning models for gesture recognition. These models would take into account various environmental conditions, user limitations and physical anatomy of the hand.
3. Supporting an increased application inference time by using multi-threading or other methods to speed up model inference and frame processing.
4. Converting the tool into an enterprise solution by billing users according to their usage of the tool.