P ROJECT REPORT

A GESTURE BASED TOOL FOR STERILE BROWSING OF RADIOLOGY IMAGES

Submitted by
PNT2022TMID33174

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1)INTRODUCTION

1.1)OVERVIEW

In this project we use gestures to browse images obtained during radiology. Gestures refer to non verbal form of communication made using hands.

A major challenge involved in this process is to provide doctors with efficient, intuitive, accurate and safe means of interaction without affecting the quality of their work. Keyboards and pointing

devices, such as a mouse, are today's principal method of human—computer interaction. However, the use of computer keyboards and mice by doctors and nurses in intensive care units (ICUs) is a common method for spreading infections. Humans can recognize body and sign language easily. This is possible due to the combination of vision and synaptic interactions that were formed along brain development.

In order to replicate this skill in computers, some problems need to be solved: how to separate objects of interest in images and which image capture technology and classification technique are more appropriate, among others. In this project Gesture based Desktop automation, First the model is trained pre trained on the images of different hand gestures, such as a showing numbers with fingers as 1,2,3,4. This model uses the integrated webcam to capture the video frame. The image of the gesture captured in the video frame is compared with the Pre-trained model and the gesture is identified. If the gesture predicts is 0 - then images is converted into rectangle, 1 - image is Resized into (200,200), 2 - image is rotated by -45□, 3 - image is blurred, 4 - image is Resized into (400,400), 5 - image is converted into grayscale etc.

1.2)PURPOSE

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

2)LITERATURE SURVEY

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

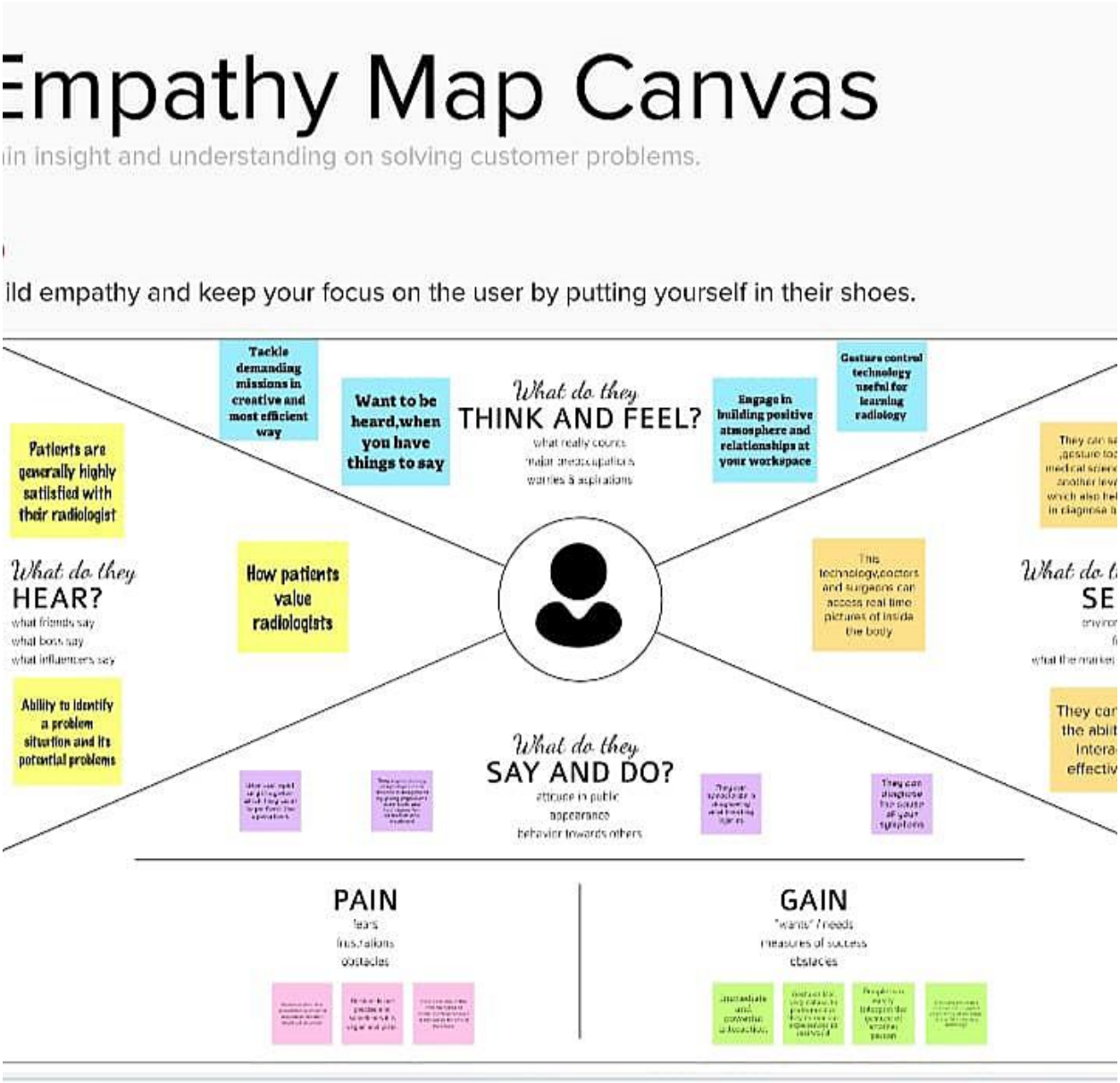
The hand gesture control system "*Gestix*" developed by the authors helped the doctor to remain in place during the entire operation, without any need to move to the main control wall since all the commands were performed using hand gestures.The sterile gesture interface consists of a Canon VC-C4 camera, 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.

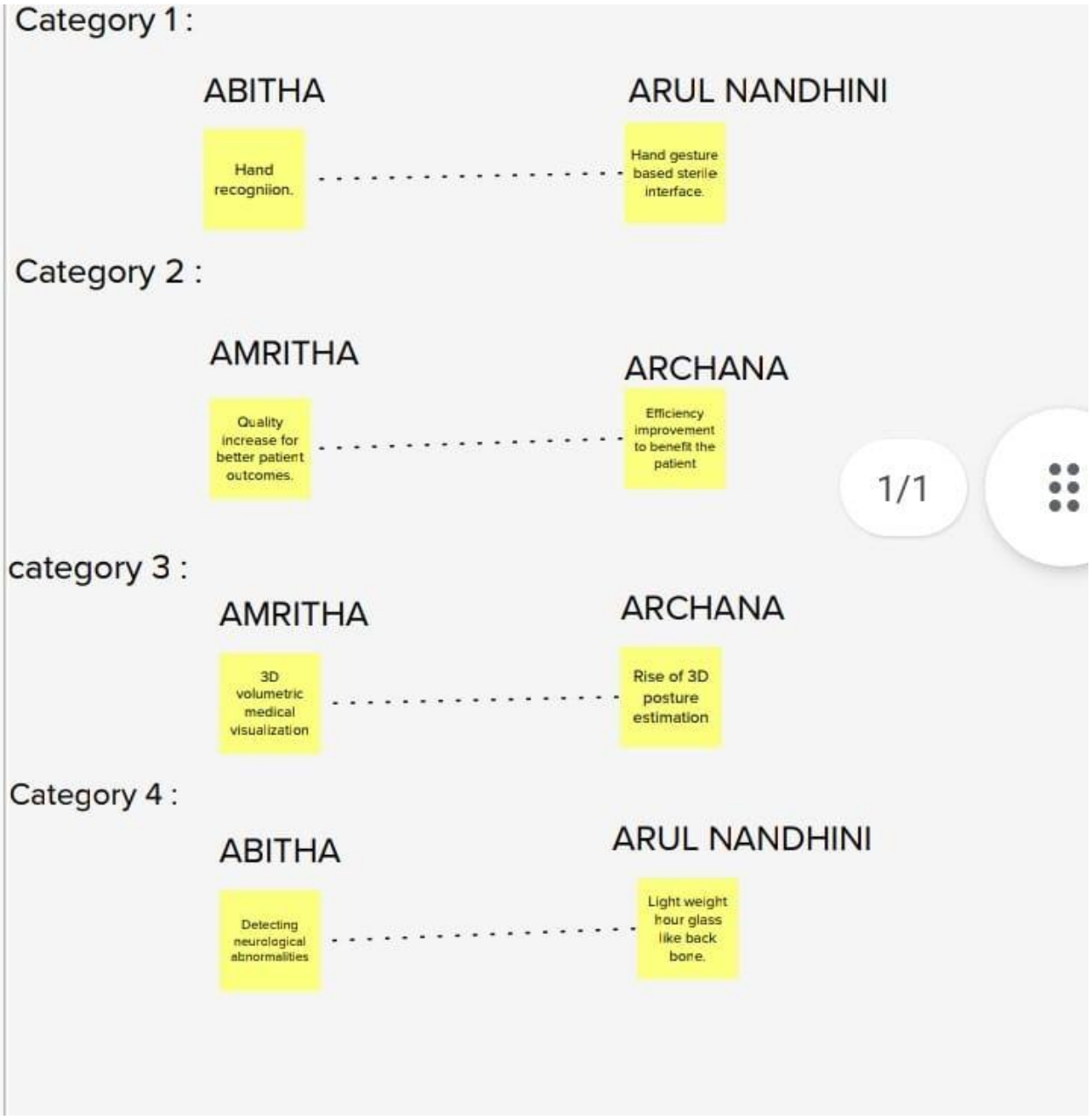
The "*Gibson*" image browser is a 3D visualization medical tool that enables examination of images, such as: MRIs, CT scans and X-rays. The images are arranged over a multiple layer 3D cylinder. The image of interest is found through rotating the cylinder in the four cardinal directions. To interface 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.

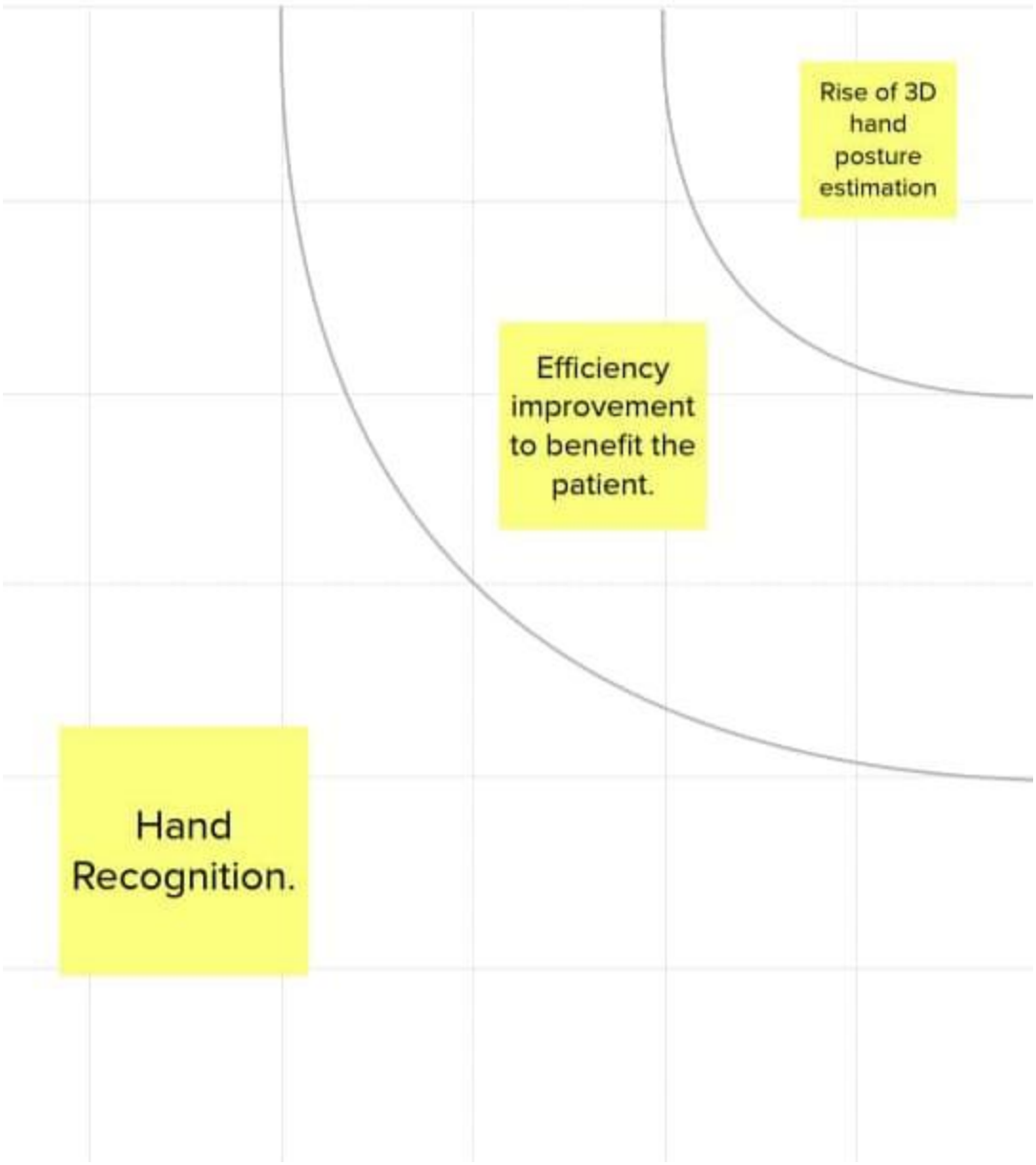
3)IDEATION AND PROPOSED SOLUTIONS

3.1)EMPATHY MAP CANVAS



3.2)IDEATION AND BRAINSTORMING


Category 1 :
ABITHA
ARUL NANDHINI
Hand recogniion.
Hand gesture based sterile interface.
Category 2 :
AMRITHA
ARCHANA
Quality increase for better patient outcomes.
Efficiency improvement to benefit the patient
1/1
category 3 :
AMRITHA
ARCHANA
3D volumetric medical visualization
Rise of 3D posture estimation
Category 4 :
ABITHA
ARUL NANDHINI
Detecting neurological abnormalities
Light weight hour glass like back bone.



3.3)PROPOSED SOLUTION

P ROJECT REPORT

Proposed Solution Template

Date	24 September 2022
Team ID	PNT2022TMID33174
Project Name	Project - A Gesture Based Tool for Sterile Browsing of Radiology Images
Maximum Marks	2 Marks

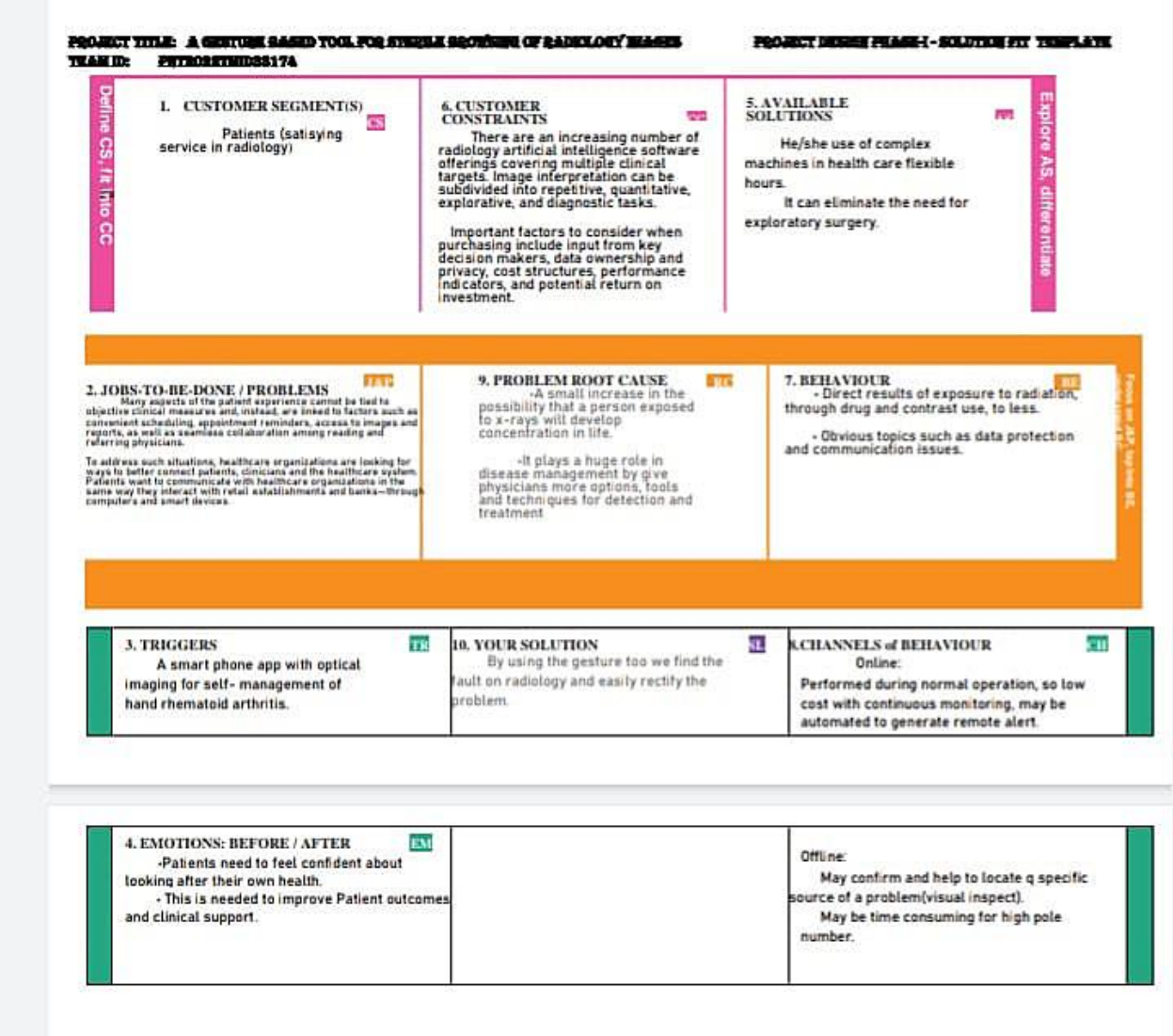
Proposed Solution Template:

Project team shall fill the following information in proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	• Human hand is very smaller with very complex articulations comparing with the entire human body and therefore errors can be easily affected. • To overcome this problem we detect a Hand gesture recognition is of great importance for human computer interaction (HCI) because of its extensive applications in virtual reality and sign language recognition etc.
2.	Idea / Solution description	• Imagine being able to check your home security camera as you drive home by simply making a hand gesture. • A gesture recognition system starts with a camera pointed at a specific three-dimensional zone within the vehicle, capturing frame-by-frame images of hand positions and motions. This camera is typically mounted in the roof module or other vantage point that is unlikely to be obstructed. The system illuminates the area with infrared LEDs or lasers for a clear image even when there is not much natural light. • Those images are analyzed in real time by computer vision and machine learning technologies, which translate the hand motions into commands, based on a predetermined library of signs.
3.	Novelty / Uniqueness	• Battery-free technology brings gesture recognition to all devices. • In contrast to such qualitative reasoning, AI excels at recognizing complex patterns in imaging data and can provide a quantitative assessment in an automated fashion. More accurate and reproducible radiology assessments can then be made when AI is integrated into the clinical workflow as a tool to assist physicians. • It is highly likely that in the future, the creative work of radiologists will be necessary to solve challenging problems and to oversee diagnostic procedures. AI will absolutely become part of their routine in diagnosing basic cases and helping to assist with repetitive jobs.
4.	Social Impact / Customer Satisfaction	• Gesture technology comes as a boon to society, providing contact-less, safe, and inclusive experiences. Still, the social and emotional impact of interacting through technology does need to be further explored. • Handwashing:The need of the hour may be found in "Handwash movement recognition Technology" to promote handwashing etiquette. Due to the pandemic, the general significance of handwashing as a measure to protect health has become more evident. • There is an urgent need to implement measures to ensure hygiene in food safety standards and ensure it is non-invasive. You can extend this technology to medical facilities, hospitals, schools, hotels, the foodservice industry, and event venues.

4.	Social Impact / Customer Satisfaction	• Gesture technology comes as a boon to society, providing contact-less, safe, and inclusive experiences. Still, the social and emotional impact of interacting through technology does need to be further explored. • Handwashing:The need of the hour may be found in "Handwash movement recognition Technology" to promote handwashing etiquette. Due to the pandemic, the general significance of handwashing as a measure to protect health has become more evident. • There is an urgent need to implement measures to ensure hygiene in food safety standards and ensure it is non-invasive. You can extend this technology to medical facilities, hospitals, schools, hotels, the foodservice industry, and event venues. Automated on-site handwashing recognition eliminates the need for intrusive, time-consuming visual confirmation and manual recording at worksites.
5.	Business Model (Revenue Model)	• Hand gesture software is used in commercial in-store displays which can be found in shopping malls to attract more visitor traffic. • The retail business is being increasingly digitized. This includes an introduction of multiple smart devices working together on a single IoT platform to deliver hyper-personalized, adaptive, and context-specific experiences. • Much of the technology is to be invisible to the consumer, shoppers will have the opportunity to interact digitally within the physical store environment to find out the information they are interested in and sometimes for entertainment purposes.
6.	Scalability of the Solution	• The consumer market is open for new experiences in HMI, and hand gesture recognition technology is a natural evolution from touchscreens. • Demand for smoother and more hygienic means of interaction with devices as well as a concern for driver safety are pushing the adoption of HGR in industries from healthcare to automotive and robotics. And while software development for gesture recognition systems is quite challenging, expertise in AI, deep learning, computer vision, and innovative hardware from top tech providers make HGR solutions more affordable than they were even a few years ago.

3.4)PROBLEM SOLUTION FIT



4)REQUIREMENT ANALYSIS

4.1)FUNCTIONAL REQUIREMENTS

Project Design Phase-II
Solution Requirements (Functional & Non-functional)

Date	16 October 2022
Team ID	PNT2022TMID33174
Project Name	Project – A Gesture based tool for sterile browsing of radiology images
Maximum Marks	4 Marks

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	NAME: Enter Name EMAIL: Enter Mail PASSWORD: Enter Password PHONE: Enter Phone
FR-2	User Confirmation	Thanks for your email We've received your support request, and someone from our team will be in touch soon. In the meantime, one of these articles from our Help centre might help get you an instant answer to your question.
FR-3	Product Features	• It provides real- time data to a computer to make it fulfill the user's commands.
		• various wearable devices have been developed and inertial sensors, gyro sensors, electromyography, force-sensitive resistots and others types of sensors have been used to identify gestures.
FR-4	Authentication	• A new method of authentication which will identify a person's hand gestures or fingers making a motion in the air to authenticate their identity • The system is also low on error rate because the gestures or finger motions in the air won't be exactly the same each time and with machine learning it can spot fraud. • The possible applications of the authentication system include VR applications, or operating theatre with touchless interface for doctors.
FR-5	External Interface	• The mouse and keyboard remain the most utilized user interfaces for radiologists. • Touchscreen, holographic, kinetic sensors and eye tracking offer new possibilities for interaction.
FR-6	Report	• The sum of a radiologist's highest level of synthesis and insight into a patient's condition and is the most important way that radiologists contribute to patient care. In most instances, it is the only communication with referrers.

4.2)NON - FUNCTIONAL REQUIREMENTS

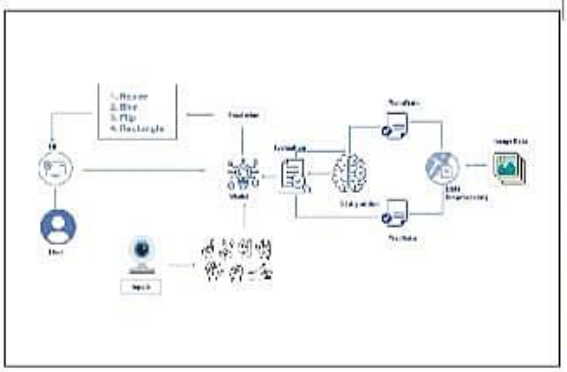
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	• Movement usually of the body or limbs that expresses or emphasizes an idea,
		sentiment or attitude raised his hand overhead in a gesture of triumph. • The use of motions of the limbs or body as a means of expression. • •Within an operating room, surgeons need to interact with a large amount of patients medical information and data. In order to avoid misunderstanding among the staff and protecting the patient safety, the medical staff may use a touchless interaction system that allows the surgeons to directly interact with digital devices that visualize digital images.
NFR-2	**Security**	• Controlling devices using facial expression identification and recognition for assisting physically disabled
NFR-3	**Reliability**	• Ideally, gesture recognition should be based on a photo of a still hand showing only a single gesture against a clear background in well-lit conditions. But real-life conditions are hardly ever like that. We don't always get the comfort to use solid, clear backgrounds when presenting gestures. • The role of machine learning in gesture recognition is, in part, to overcome some of the main technical issues associated with proper identification of gesture images.
NFR-4	**Performance**	• the statistical representation used to identify specific gestures of motion involving the hands, head, face, and/or body. The paper addresses Hand Gesture Recognition (HGR) using novel machine learning and deep learning approaches. Machine learning algorithms viz. Artificial Neural Network (ANN) and Support Vector Machine (SVM) was implemented using spatial features comprising of geometrical features and Fourier descriptors. The experimental results revealed that ANN is better compared with SVM results.

5)PROJECT DESIGN

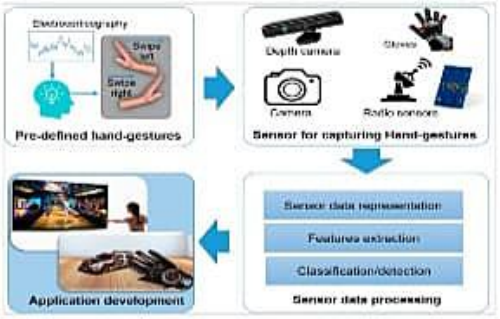
5.1)DATA FLOW DIAGRAM

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 right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

Example: (Simplified)



Example: Sterile Browsimg Of Radiology Images (Industry Standard)



User Stories

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Developer	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard.	High	Sprint-1
Assistant developer	Login	USN-2	Pre-defined hand gesture are given as the necessary data into the memory.	Data is feed into the system.	High	Sprint-1
Customer Care Executive	Worker	USN-3	For capturing the hand gestures sensors like depth camera,radio sensors are present in-order make the hand gesture effective.	Sensor play a major role in the hand gesture.	Low	Sprint-2
Customer care Executive	Worker	USN-4	Then sensor process the data to extract features and detect the hand gesture.	Data is processed.	Medium	Sprint-1
Customer (Web user)	Login	USN-5	Now, the application is developed and ready for use.	I get the respect images opened through hand gesture.	High	Sprint-1

5.2)SOLUTION AND TECHNICAL ARCHITECTURE

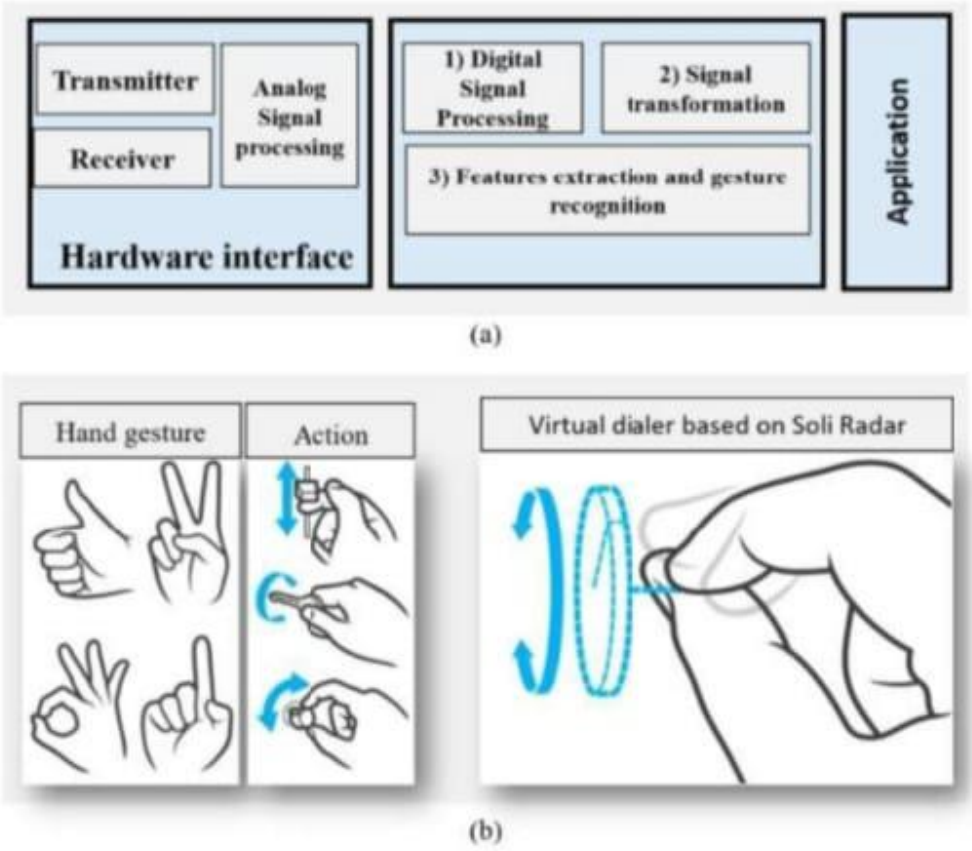


Figure 1: hand Gestures Recognition using Radar Sensors for Human – Computer - Interaction

Reference:

https://www.mdpi.com/2072-4292/13/3/527/htm

6)PROJECT PLANNING & SCHEDULING

6.1)MILESTONE AND ACTIVITY

Project Planning Phase
Milestone and Activity List

DATE	01 NOVEMBER 2022
TEAM ID	PNT2022TMID33174
PROJECT NAME	A Gesture Based Tool For Sterile Browsing Of Radiology Images.

Milestone and Activity List:

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by refering the, technical papers, research publications etc.	05 OCTOBER 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements	18 SEPTEMBER 2022
Ideation	List the by organizing the brainstorming session and Prioritize the top 3 ideas based on the feasibility & importance.	18 SEPTMBER 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	24 SEPTEMBER 2022
Problem Solution Fit	Prepare problem - solution Fit document.	07 OCTOBER 2022
Solution Architecture	Prepare solution Architecture document.	05 OCTOBER 2022
Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application	18 OCTOBER 2022
Data Flow Diagrams	Draw the data flow Diagrams and submit for review.	17 OCTOBER 2022
Technology Architecture	Architecture diagram	26 OCTOBER 2022
Prepare Milestone & Activity List	Prepare the milestones & Activity list of the project.	01 NOVEMBER 2022
Project Development Delivery of Sprint- 1, 2, 3 & 4	Develop & submit the developed code by testing it.	IN PROGRESS....

6.2)SPRINT DELIVERY SCHEDULE

PROJECT PLANNING

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

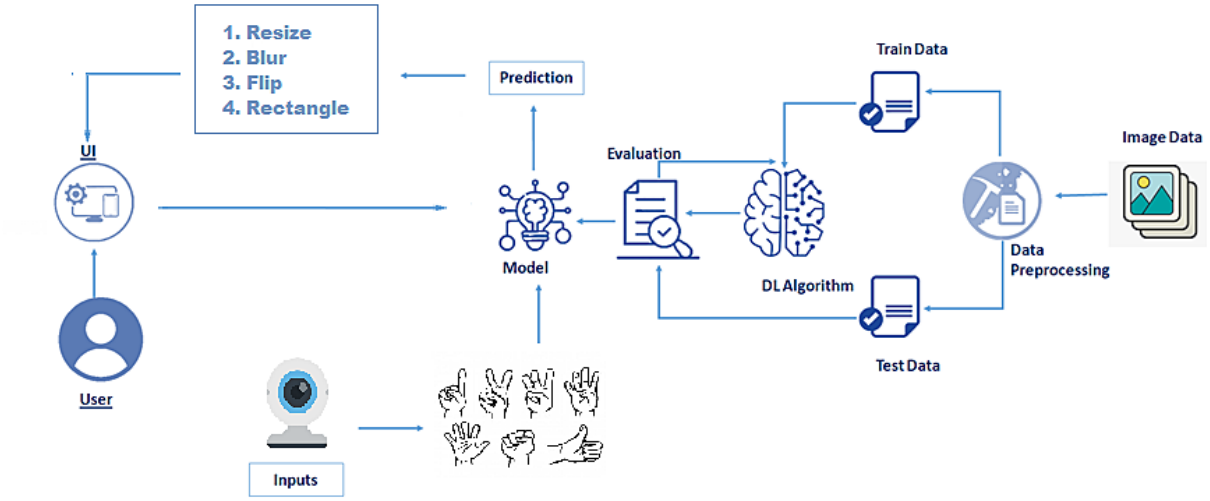
Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	20	High	ARCHANA ROY A ARUL NANDHINI R ABITHADEVADHAR SHINI AG AMRITHA M
Sprint-2	Login	USN-2	Pre-defined hand gesture are given as the necessary data into the memory.	20	High	ARCHANA ROY A ARUL NANDHINI R ABITHADEVADHAR SHINI AG AMRITHA M

Project Planning

Sprint-3	Worker	USN-3	For capturing the hand gestures sensors like depth camera,radio sensors are present in-order make the hand gesture effective.	20	High	ARCHANA ROY A ARUL NANDHINI R ABITHADEVADHAR SHINI AG AMRITHA M
Sprint-4	Worker	USN-4	**Then sensor process the data to extract features and detect the hand gesture.**	20	High	ARCHANA ROY A ARUL NANDHINI R ABITHADEVADHA SHINI AG AMRITHA M
Sprint-5	Login	USN-5	**Now, the application is developed and ready for use.**	20	High	ARCHANA ROY A ARUL NANDHINI R ABITHADEVADHAR SHINI AG AMRITHA M

7)THEORITICAL ANALYSIS



8)EXPERIMENTAL INVESTIGATIONS

We found that many hospitals rely on mouse and keyboard to browse the images that are obtained during different surgeries, scans, etc. This can contaminate the environment with various infections thus compromising the sterility.

Various technologies have been developed to overcome this issue and one such technology was called ‘Gestix’.

This hand gesture system for MRI manipulation in an EMR image database called “*Gestix*” was tested during a brain biopsy surgery. This system is a real-time hand-tracking recognition technique based on color and motion fusion. In an in vivo experiment, this type of interface prevented the surgeon's focus shift and change of location while achieving rapid intuitive interaction with an EMR image database. In addition to allowing sterile interaction with EMRs, the “*Gestix*” hand gesture interface provides:

1. ease of use—the system allows the surgeon to use his/her hands, their natural work tool;
2. rapid reaction—nonverbal instructions by hand gesture commands are intuitive and fast
3. an unencumbered interface—the proposed system does not require the surgeon to attach amicrophone, use head-mounted (body-contact) sensing devices or to use foot pedals
4. distance control—the hand gestures can be performed up to 5 meters from the camera and still be recognized accuratel

9)FLOW CHART

- 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 the UI. 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

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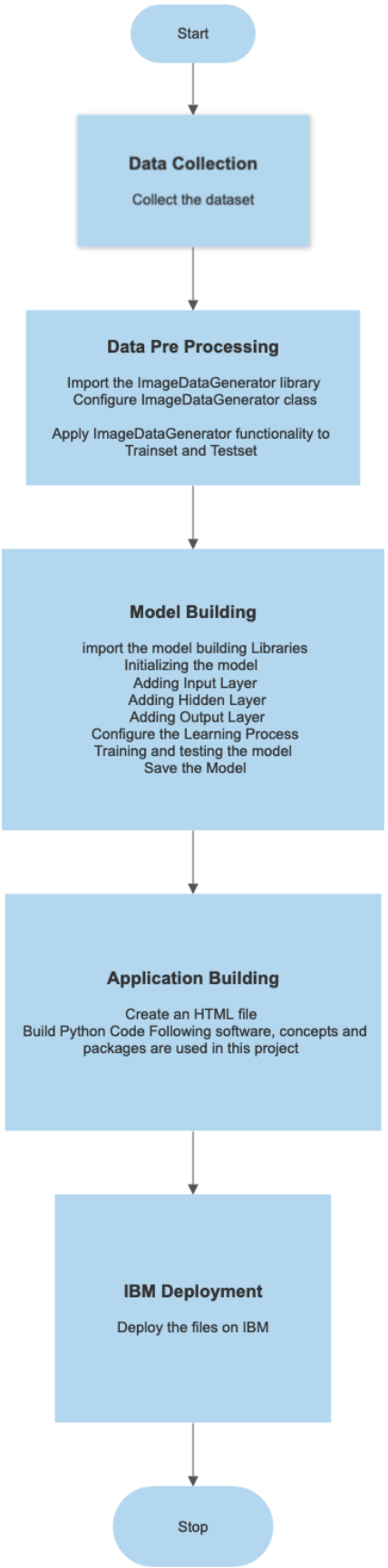

10)RESULT

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 users location since they don't have to be in contact with any device.
It also does not require the user to have any device on them to use it.
Further this technology can be extended to other industries like it can be used by presenters, by teachers for show images in the classroom, etc.

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)BIBILOGRAPHY

Research papers:
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2410001/
https://pubmed.ncbi.nlm.nih.gov/18451034/

https://www.researchgate.net/publication/5401674_A_Gesture?
based_Tool_for_Sterile_Browsing_of_Radiology_Images
Smartinternz Website:
https://smartinternz.com/Student/guided_project_workspace/

16)DEMONSTRATION LINK

https://drive.google.com/file/d/1Bd5zFefP6DBSHo4CZGbhDCB2OD1JK7LC/view?usp=drivesdk

17)**Appendix** source code

https://github.com/smartinternz02/Gesture-based-Tool-for-Sterile-Browsing-of-Radiology?Images-Using-IBM-Watson