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A Gesture Based Tool for Sterile Browsing of Radiology Images

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Abstract: The utilization of croaker-computer commerce bias in the operating room (OR) necessities the development of novel modalities that facilitate medical image manipulation while maintaining sterility, facilitating croaker's attention span, and enabling quick reaction times. This concept introduces "Gestix", a vision-based hand gesture recognition and prisoner system that can navigate and manipulate photos in an electronic medical record (EMR) database in real-time by interpretingthe gestures of stoners. Through picture input, navigation and other movements are translated to instructions based on their temporal circles. During a brain vivisection operation, "Gestix" is tried. This interface achieved a quick and intuitive reaction, simple commerce, and prevented the surgeon from shifting their posture or shifting their concentration throughout the in vivo experiment. Information gathered from two usability assessments.

Keywords: Gestrix, croaker-computer, Sterile, Navigation.

I. INTRODUCTION

The field of sanitariums is being increasingly penetrated by computer information technology. Providing croakers with efficient, user-friendly, precise, and secure methods of trade without compromising the caliber of their job is a significant difficulty in this process. Keyboards and pointing devices, such mice, are currently the most important components of computer commerce. However, a popular method for transmitting diseases among caregivers and nurses in intensive care units (ICUs) is the usage of computer keyboards and mouse. In the study, we propose to employ hand gestures as a voluntary interaction method that provides the primary benefits of sterility.[1] While voice control does offer sterility as well, its position in the operating room (OR) due to noise is problematic.[2] In this book, gestures are discussed as a basic type of hand-made nonverbal communication. Early children use gestures to communicate before they start to speak, according to brain research. People commonly employ manipulation as a type of gesture while converting about an object. Light heartedness of expression, unhindered commerce, intuitiveness, and high sterility are all valid arguments in favor of substituting other natural interfaces for the existing interface technology (such as keyboards, mice, and joysticks). The concept uses a graphical stoner interface to edit magnetic resonance imaging (MRI) using a video tap based hand gesture prisoner and recognition system. It was determined that a hand gesture language of instructions was natural in the sense that each motion is mentally connected to the idea or directive that is intended to serve as its representation. For example, an instruction to "turn left" is represented by moving the hand to the left.[2] The Washington Hospital Center in Washington, Dc, served as the testing ground for the gesture interface's functionality. Two procedures were seen in the neurosurgical section of the sanitariun, and a measure of a hand gesture system's felicity was obtained. To the best of out knowledge, this is the first "in vivo" neurosurgical vivisection in which a hand gesture recognition system has been effectively implemented. Because it allows the surgeon to maintain control over medical information while preventing contamination of the case, the operating room, and the surgeon themselves, a sterile human-machine interface is extremely important.

II. LITERATURE SURVEY

Gesture-controlled image system positioning for minimally invasive interventions.
Author: Benjamin Fritsch, Thomas Hoffmann, André Mewes and Georg Rose
Abstract: This paper represents the study investigates the efficacy of touchless interaction in streamlining CT-guided interventions, focusing on the design and comparison of two hand gesture sets for manipulating CT scanner components without compromising sterility. Results from a user study involving 10 participants demonstrate the feasibility of adjusting the gantry angle within an average of 10 seconds, with a preference for a straightforward hand

gesture over a pistol-inspired one. However, the sequential nature of the gestures led to user confusion, highlighting the importance of integrating activation and confirmation into a single gesture for a more intuitive interaction experience. [1]

Introducing a brain-computer interface to facilitate intraoperative medical imaging control
Authors: H. Esfandiari, Pascal Troxler et. al.
Abstract: This paper addresses the study introduces a novel medical image control concept utilizing Brain Computer Interface (BCI), enabling hands-free and direct manipulation of patient images during surgeries, eliminating the need for gesture recognition commands or voice commands. [2]

Gesture-Controlled Image Management for Operating Room: A Randomized Crossover Study to Compare Interaction Using Gestures, Mouse, and Third Person Relaying
Authors: Rolf Wipfli, V. Dubois-Ferriere, Sylvain Budry, P. Hoffmeyer, C. Lovis Psychology.
Abstract: This paper represents the study is to formally compare three distinct interaction methods for image manipulation suitable for surgical environments: 1) Gesture control via Kinect; 2) issuing oral instructions to a designated third party for image manipulation; and 3) direct manipulation using a mouse. [3]

A Gesture based tool for sterile browsing of radiology images. Authors: P. Wachs, Helman I. Stern, Yael Edan, a Michael Gillam, Jon Handler, Craig Feied, and Mark Smith.
Abstract: This paper introduces "Gestix," a real-time hand gesture recognition system designed for doctor-computer interaction in the operating room. Tested during a brain biopsy procedure, "Gestix" maintained surgeon focus and enabled intuitive, sterile interaction with medical images. Usability tests yielded valuable insights into human-computer interaction via nonverbal modalities. [4]

III. METHODOLOGY

The methodology employed in this study aims to achieve the better Doctor-Computer interaction. So that the time taken in the Operation Room (OR) will be reduced by using gestix for modulating the radiology images. The hardware components used in the proposed gesture-based tool for sterile browsing of radiology images include the ESP8266 Node MCU and the APDS 9960 sensor. The ESP8266 NodeMCU is a familiar microcontroller board based on the ESP8266 Wi-Fi connectivity, making it suitable for IoT applications. The ESP8266 Node MCU board provides GPIO pins for interfacing with external sensors and devices, as wellas USB connectivity for programming and power supply. Itscompact size and low cost make it ideal for prototyping and embedding into various projects, including digital RGB, ambient light, proximity, and gesture sensor. To detect the various gestures, the sensor uses digital signal processing which including swipes, taps, and directional movements. It communicates with the microcontroller via I2C interface, providing gesture data and ambient light readings in real- time. The APDS 9960 sensor is highly sensitive and it can operate effectively in various lighting conditions, making it suitable for use in medical environments. Together, the ESP8266 Node MCU and APDS 9960 sensor enabling hands- free navigation of radiology images in sterile environments.

A. Communication protocol

The communication between the ESP8266 Node MCU and the APDS9960 gesture sensor primarily occurs over the I2C (Inter-Integrated Circuit) protocol. I2C protocol is a serial communication between that allows communication betweenmany devices using two wires. They are a serial data line (SDA) and a serial clock line (SCL). It follows master- slave protocol, where the ESP8266 Node MCU acts as the master device for controlling the communication bus and initiating data transfers, while the APDS 9960 sensor acts as the slave device, responding to commands from the master. In order to initiate communication, the master (ESP8266 Node MCU) sends a start condition on the bus by pulling theSDA line low whose voltage pulls down to zero while the SCL line remains high having voltage of 3.3V or 5V. The master then sends the 7-bit address of the slave device it wants to communicate with, along with a read or write bit indicating the direction of data transfer. If the slave device acknowledges its address, communication is established, and data transfer can occur, during data transfer, the master (ESP8266 Node MCU) sends or receives data bytes to from the slave device (APDS 9960), with each byte followed by an acknowledgment from the receiving party. When the data transfer is completes, the master sends a stop condition on the bus by releasing the SDA line from low to high at the same time the SCL line remains high. The Node MCU serves as the master, sending commands to the sensor to request gesture data input. The sensor responds to these commands by sending back relevant data as ambient light levels. The ESP8266 Node MCU processes this data as programmed and may take further actions according to the received information data.

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B. Flow of data from the sensor to the microcontroller and display unit

Data flow from APDS 9960 Gesture Sensor to ESP8266 Node MCU Microcontroller is significant. The APDS 9960 sensor detects gestures with its integrated photodiodes and gesture recognition algorithms. When a gesture is detected, the sensor processes the input and gesture data. By using the I2C protocol, the APDS 9960 sensor communicates with the ESP8266 Node MCU microcontroller. It sends the gesture data to the Node MCU, which acts as the master device on the I2C bus. When the gesture data is received, the Node MCU microcontroller processes it to interpret the type and type of the gesture detected. It can also perform additional processing to ensure the accuracy and reliability of the gesture recognition. According to the interpreted gesture data, the Node MCU generates corresponding commands for controlling the display through the radiology images. The ESP8266 Node MCU sends the generated commands to the display unit, typically using a suitable communication interface such as SPI (Serial Peripheral Interface). The commands may include instructions like scrolling through images, zooming in/out, or performing other actions based on the detected gestures. The display unit, a monitor receives and interprets the commands from the ESP8266 Node MCU.It updates the display content accordingly, reflecting the changes requested by the user through the gesture-based input. As soon as the display unit updates its content, the user can visually perceive the changes and interact with the radiology images without direct physical contact, maintaining sterility in the medical environment. This flow of data enables seamless interaction between the APDS 9960 gesture sensor, the ESP8266 Node MCU microcontroller, and the display unit, allowing for sterile browsing of radiology images using intutive gesture-based controls.

C. Gesture recognition algorithm

Configure the APDS 9960 sensor with the desired settings, including gesture mode activation, integration time, and LED brightness. Initialize variables and data structures for storing raw sensor data and intermediate results. Continuously read sensor data from the APDS 9960, including reading s from the integrated photodiodes sensitive to ambient light and infrared light. Collect data samples over a predefined time window or until a sufficient amount of data is acquired for analysis. Preprocess the raw sensor data to enhance signal quality and remove noise. Apply techniques such as filtering, smoothing, or normalization to prepare the data for gesture recognition. Segment the preprocesses data into individual gesture frames or windows for analysis. Analyze the segmented data frames to detect patterns indicative of specific gestures. Implement algorithms for gesture recognition, such as template matching, machine learning classifiers, or pattern recognition techniques. Identify characteristic features or signatures associated with different gestures, such as swipe direction, speed, and duration. Compare the observed patterns against predefined gesture templates or models to determine the closest and their corresponding meanings. Assign semantic labels or identifiers to each recognized gesture, indicating the intended user action like scroll up, scroll down, zoom in, zoom out. Take into account contextual information or user preferences to refine the gesture classification process and improve accuracy. Provide feedback to the user regarding the recognized gestures, such as visual cues or haptic feedback. Translate the classified gestures into actionablecommands or controlling the display unit or interacting with the user interface. Execute the corresponding actions based on the recognized gestures, updating the display content or triggering other application-specific functions. Continuously monitor the sensor data stream and repeat the gesture detection and recognition process to enable real-time interaction with the system. Handle edge cases and error conditions gracefully, such as signal dropout, environmental interference, or ambiguous gesture inputs.

IV. FLOW CHART OF MODEL

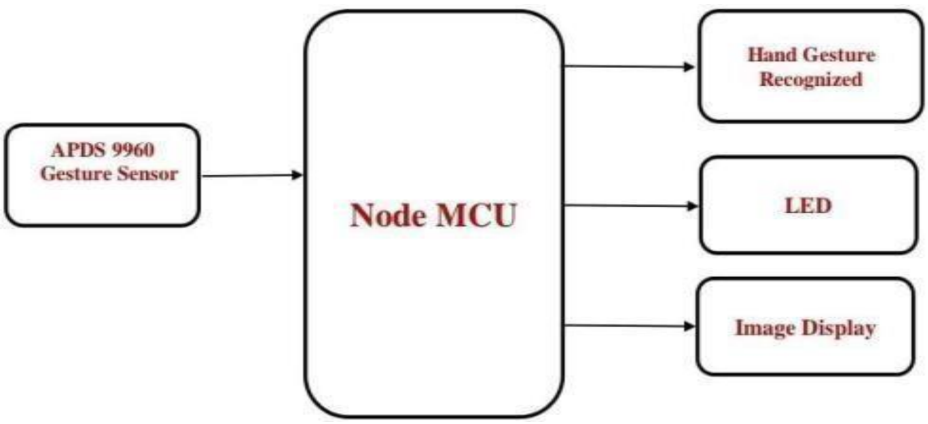

Fig. 1. Flowchart

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V. ADVANTAGES

- This Gesture based tool reduce the risk of contamination in sterile environments by eliminating need for physical contact with mouse and keyboard

- With Gesture based tool healthcare professionals can interact with images without interrupting their workflow to touch physical peripherals.

- Physicians can analyze and manipulate images without the need for physical devices, enabling hands free operation.

- This Gesture based tool contribute to maintaining a sterile field by eliminating the need for physical devices.

- Medical professionals can easily learn and use the system effectively since this Gesture based tool will provide user friendly interface.

VI. APPLICATIONS

- Operating rooms: Gesture based tool allow surgeons to analyze and navigate radiology images without physically touching physical peripherals.

- Emergency Room procedures: Quick access to radiology images without risk of contamination is crucial in emergency rooms.

- Labor and Delivery rooms: While reviewing obstetric ultrasound images Gesture based tool controls contact free reviewing.

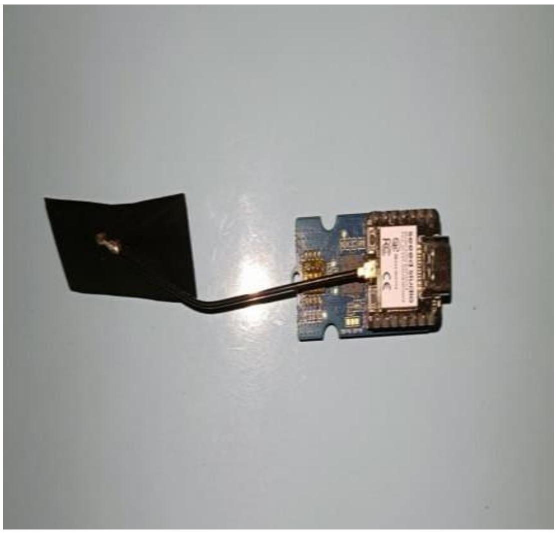
- Teaching and Training: Allowing health care instructors to navigate through radiology images during teaching session without physical contact.

- Consultations and Telemedicine: This will enable remote health care professionals to review and manipulate radiology images in real-time without compromisingsterility.

VII. RESULT

1. Configuring the Hardware

Figure shows the connection of IR camera sensor to the ESP32C3 microcontroller board. Ensure the connections are correct and the hardware is functioning properly. Placing the hardware setup in a suitable position to capture gestures effectively.



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2. Programming with Arduino IDE and VS Code

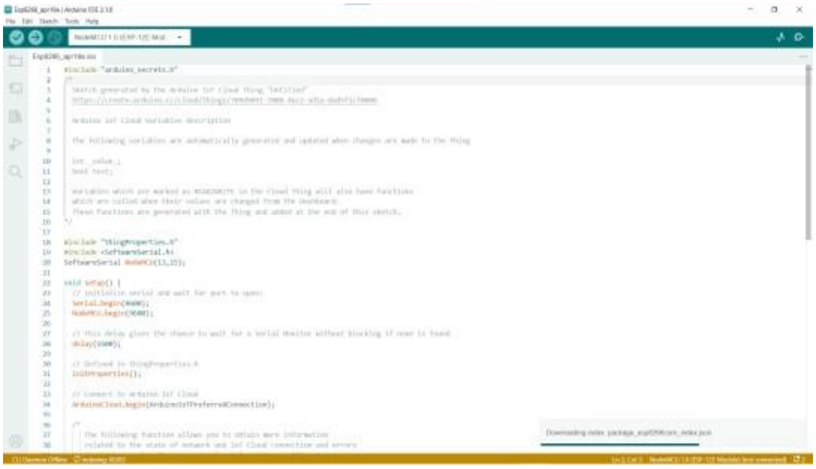
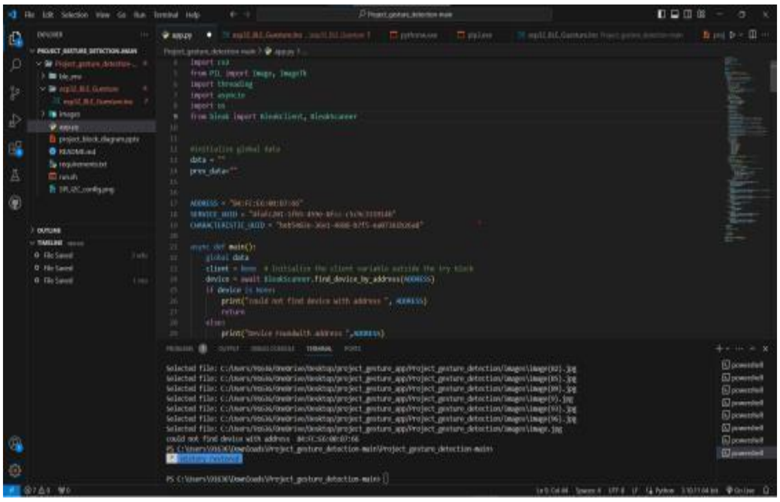


Figure shows Writing code in the Arduino IDE for the ESP32C3 to interface with the IR camera sensor. This code would involve capturing data from the sensor.



Using VS Code to develop the gesture recognition algorithm. Write code to process the data from the IR camera sensor and recognizespecificgestures

3. Integration and Communication

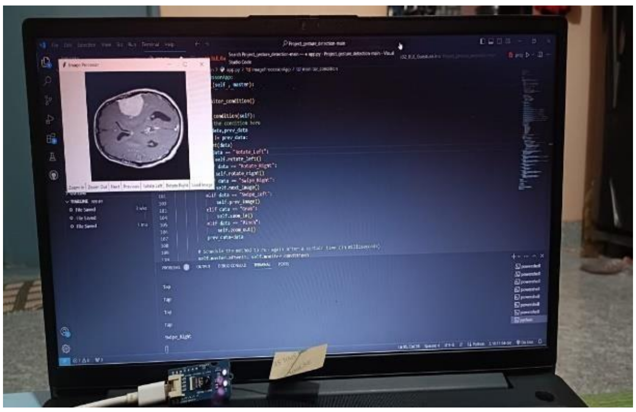


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Figure explains how the communication establishes between the ESP32C3 and the computer running VS Code. This communication is essential for transmitting data from the sensor to the gesture recognition algorithm. Ensure the data received by VS Code is processed accurately to interpret the gestures.

4. Testing and Calibration

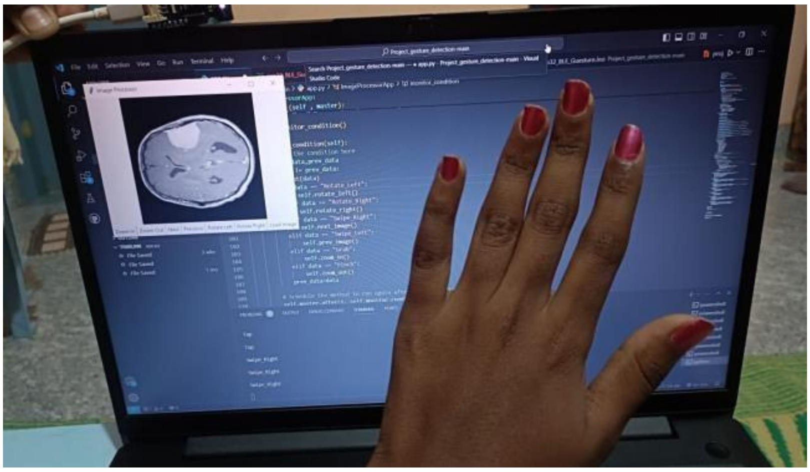
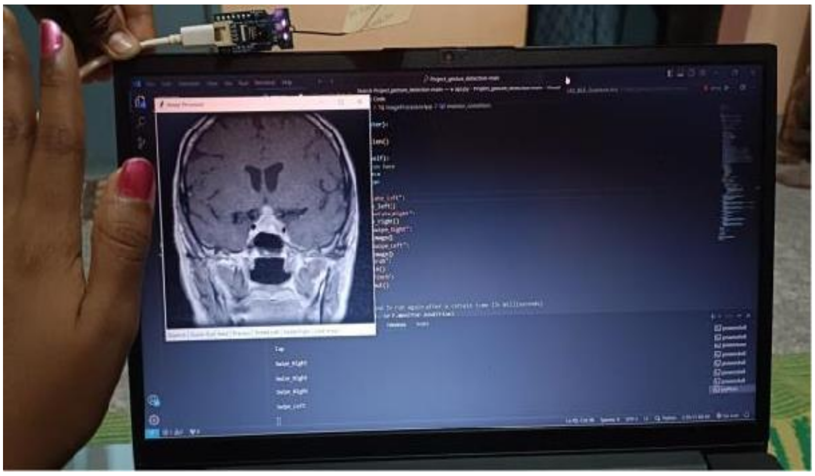


Figure explains test of the entire system to verify that gestures are being captured correctly by the IR camera sensor and interpreted accurately by the algorithm. Calibrate the system as needed to improve the accuracy of gesture recognition.

5. Fine-tuning and Optimization



ESP32C3 and the VS Code application to optimize performance and ensure smooth operation. Make adjustments based on testing results to enhance the overall functionality of thegesture-based tool.

VIII. CONCLUSION

This paper presents a powerful model which is focused on developing and evaluating gesture-based interfaces for manipulating medical imaging systems in sterile environments. The project aimed to create a touchless gestureinteraction system for browsing and analyzing of radiology images and tested a real time hand tracking gesture interfacecalled "Gestix" for manipulating an EMR image database during brain biopsy surgery. This interface provided ease of use, rapid reaction, unencumbered interface, and distance control, as indicated by usability tests and satisfaction questionnaires. The project considered adding visual trackingof both hands to expand gesture command capabilities and planned to assess the addition of a stereo camera for improved gesture recognition accuracy and compare the system with other human-machine interfaces in future work. This project contributes to the development of intuitive and efficient.

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REFERENCES

[1]. Benjamin Fritsch, T. Hoffmann, A. Mewes, G. Rose, "Gesture- controlled image system positioning for minimally invasive interventions", Computer Science Current Directions IEEE Biomedical Engineering. Vol.07, Issue 2021, pp. 268-271.

[2]. H. Esfandiari, Pascal Troxler et al., "Introducing a brain- computer interface to facilitate intraoperative medical imaging control a feasibility study", P. Furnstahl Medicine BMC Musculoskeletal Disorders, Current Directions in Biomedical Engineering. Vol.05, Issue 2022, pp. 268-271.

[3]. Rolf Wipfli, V. Dubois-Ferriere, et al., "One Gesture- Controlled Image Management for Operating Room: A Randomized Crossover Study to Compare Interaction Using Gestures, Mouse, aThird Person Relaying", National Center for 44-50.

[4]. "Third Person Relaying", National Center for Biotechnology Information, Vol. 04, Issue 2016, pp. 44-50.

[5]. Shahzad Ahmed, Karam Dad Kallu, Sarfaraz Ahmed, "Hand Gestures Recognition Using Radar Sensors for Human-Computer-Interaction",Vol. 03, Issue 2021, pp. 13.

Juan P. Wachs, Helman I. Stem, et al., "A Gesture Based Tool for Sterile Browsing of Radiology Images"

[6]. Benjamin Fritsch, T. Hoffmann, A. Mewes, G. Rose, "Gesture- controlled image system positioning for minimally invasive interventions", Computer Science Current Directions IEEE Biomedical Engineering. Vol.07, Issue 2021, pp. 268-271. H. Esfandiari, Pascal Troxler et al., "Introducing a brain- computer interface to facilitate intraoperative medical imaging control a feasibility study",P. Furnstahl Medicine BMC Musculoskeletal Disorders, Current Directions in Biomedical Engineering. Vol.05, Issue 2022, pp. 268-271.

[7]. Rolf Wipfli, V. Dubois-Ferriere, et al., "One Gesture- Controlled Image Management for Operating Room: A Randomized Crossover Study to Compare Interaction Using Gestures, Mouse, and Third Person Relaying", National Center for Biotechnology Information, Vol. 04, Issue 2016, pp. 44-50.

[8]. Shahzad Ahmed, Karam Dad Kallu, Sarfaraz Ahmed, "Hand Gestures Recognition Using Radar Sensors for Human-Computer-Interaction", Vol. 03, Issue 2021, pp. 13.

[9]. Juan P. Wachs, Helman I. Stem, et al., "A Gesture Based Tool for Sterile Browsing of Radiology Images" American medical informatics Association, Vol. 15, Issue 1, 2013, pp. 183-186.

[10]. A Mewes et al., "A Gesture-Controlled Projection Display for CT Guided Interventions Computer-Assisted Surgery Group", Faculty of Computer Science, University of Magdeburg, Germany, Visualization Group, Faculty of Computer Science. Int J Compute Assist Radial Surg, Vol 10, Issue 2015, pp. 64-157.

[11]. Juan et al., "A Gesture-based Tool for Sterile Browsing of Radiology Images". IEEE, Vol. 07 Issue 2020,pp. 155-130.

[12]. Khan, F Leem, S.K, Cho, S.H. "Hand-based gesture recognition for vehicular applications using IR-UWB radar sensor", IEEE, Vol. 17,Issue 2017, pp.833-850.

[13]. Sang Y et al, "Micro hand gesture recognition system using ultrasonic active sensing". IEEE, Vol. 06, Issue 2018, pp. 49339-49347.

[14]. Dekker, B et al., "Gesture recognition with a low power FMCW radar and a deep convolutional neural network". Nuremberg,Germany, Vol.22, Issue 10, 2017, pp. 10-13.

[15]. Ryu, et al., "Feature-based hand gesture recognition Using an FMC radar and its temporal featureAnalysis", IEEE, Vol. 18, Issue 2018, pp. 7593-7602.

[16]. Mithun George Jacob, Juan Pablo Wachs, Rebecca A Packer, "Hand-gesture-based sterile interface for the operating room using contextual cues for thenavigation of radiological images", IEEE, Vol. 20, Issue 2013, pp. 183-186.

[17]. D. Minnamma, G. Divya, J. Rajeswari, K. Nymish, "Gesture Based Tool for Sterile Browsing ofRadiology Images", The Ciencia & Engenharia – Science & Engineering Journal, Vol. 10, Issue 1,2022, pp. 116-121.

[18]. Ashwini R, Sudharsan V, Narmathi G P, Sandeep J, Madhan T,"AI Gesture Interface for Sterile Browsing of RadiologyImages