IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

# IOT BASED GESTURE CONTROLLED ROBOTIC ARM FOR SURGERY: A RESEARCH

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## *ABSTRACT*

Nowadays, Robotics be an apace developing field. Robotics involves the construction, operation, and use of robots. The goal of robotics is to construct machines that will facilitate and assist humans. Robotics integrates fields of engineering science, data engineering, mechatronics, physical science, computer engineering, control engineering, software engineering, arithmetics, etc... A robot be an mechanical device that will perform physical tasks, using human superintendence and management. many robots are designed to do dangerous work that's not possible done by humans directly. One sort of them that's very hip is the robotic arm. Robot-assisted minimally invasive surgery (RMIS) is currently well established in clinical application as a way of enhancing surgical instrumentation and engineering about typical laparoscopic approaches. Surgical specializations like gynecology and urogenital medicine have driven the adoption of RMIS, however, diffusion of the robotic approach is increasing as hospitals become equipped with surgical robotic systems. Robotic surgery is a sophisticated type of minimally invasive or laparoscopic (small incision) surgery wherever surgeons use a computer-controlled robot to help them with inbound surgical procedures. The robot's "hands" have a high degree of facility, permitting surgeons the flexibility to control tight areas in the body that will otherwise solely be accessible through open (long incision) surgery. Compared to open surgery (traditional surgery with incisions), robotic and minimally invasive surgery leads to smaller incisions leading to less pain and scarring. Robotic surgery permits surgeons to perform complicated surgical tasks through small incisions mistreatment robotic technology. Surgical robots square measure self-powered, computer-controlled devices which will be programmed to assist in the positioning and manipulation of surgical instruments. This provides surgeons with higher accuracy, flexibility, and management. Our project aims at developing such a system wherever a surgical automaton is meant whose movement will be controlled completely by different hand gesture, created employing a wearable glove. The device is connected to the network and thus may be controlled from any place around the globe.

# 1. INTRODUCTION

Surgical robots assist throughout surgical procedures. They need been used since the mid-1980s. Robotic surgeries are generally minimally invasive. This feature has been around long before the introduction of robots. It's a broad thought that encompasses several procedures, like a cholecystectomy, or gall bladder excisions. The procedure refers to a way that avoids long cuts by in operation on the body through little (usually one cm) entry incisions. Surgeons use long instruments to control the tissue inside the body. Such operations are guided by viewing instrumentality known as endoscopes. These are the tubes with a camera hooked up to the top of it that permits the doctor to look at extremely increased period three-dimensional pictures of the operation through any place around the globe employing a monitor. The current advantages of robotic surgery embody higher accuracy, precision, dexterity, tremor corrections, scaled motion, and additional recently tactile corrective feedback. These advantages lead to additional victorious surgeries and smaller necessary incision cuts. Overall, robotic systems have higher accuracy and preciseness than unaided surgeons. Researchers are formulating new ways to handle motion and tissue resistance. for instance, the surgical robots might synchronically move with a beating heart such their relative speed is near zero. Another attainable improvement is the ability for the robot to mechanically adapt to the resurgent tissue resistance over time because the sensitivity scale of these processes goes on the far side of human capabilities.

This project aims at developing a system wherever a surgical robot is intended whose movements are often controlled by mistreatment and different hand gesture, created employing a wearable glove. The foremost wide used clinical robotic surgical system includes a camera arm and mechanical arms with surgical instruments attached up to them. The doctor can be controls the arms whereas seated ahead of a computer around anyplace round the globe for controlling the robotic arm throughout the surgery. The console offers the doctor a high-definition, magnified, 3D read of the surgical operation. The doctor leads different team members to assist throughout the operation. Robotic surgery includes a way whereby surgery is performed with the assistance of terribly little tools that are fastened to a robotic arm. The surgeon doesn't physically operate during a robotic surgery but controls the movements of the robotic arm via a computer monitor.

# 2. PROPOSED METHODOLOGY

## 2.1: Software Requirements :

- Operating System - Arduino IDE
- Version - 1.8.16
- Programming Language- Embedded C++

Arduino is an open source operating system. The board is equipped with sets of digital and analog input/output (I/O) pins which will be interfaced to varied enlargement boards or breadboards (for prototyping) and alternative circuits. The microcontrollers will be programmed exploitation the C and C++ programming languages, employing a customary API that is additionally called the Arduino language.

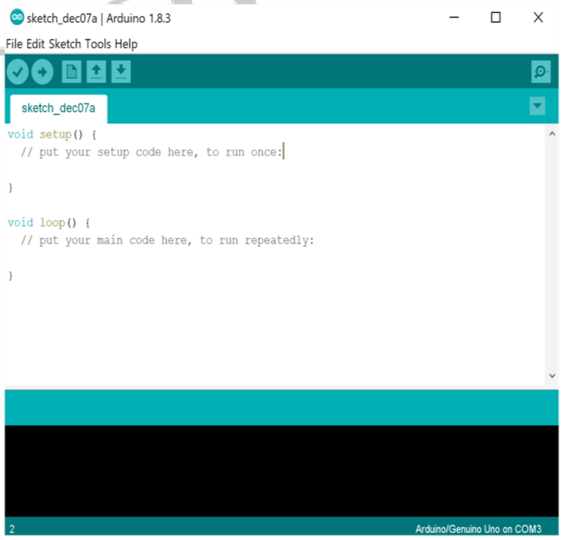


**Fig.1. Arduino IDE interface**

## 2.2: Hardware Requirements:

### *2.2.1.* ESP 32

**Fig.2. ESP 32**

***Specifications***

1. Ultra-low-power management.
2. 4 MB Flash.
3. Current: 80 mA.
4. Supply Voltage: 2.2 V ~ 3.6 V.
5. Data Rate: 54 Mbps.
6. Frequency: 2.4 GHz.

### *2.2.2.* ESP 8266


**Fig.3. ESP 8266**

***Specifications***

1. Open-source, Interactive, Programmable, Low cost, Simple, Smart, WI-FI enabled
2. Arduino-like hardware IO
3. Integrated TR switch, balun, LNA, power amplifier and matching network
4. Integrated PLL, regulators, DCXO and power management units
5. Onboard USB to serial chip to easily program and upload codes from the Arduino IDE
6. Embeds logic level converter circuits
7. Has onboard 3.3V regulator to ensure enough power to function as your go-to WiFi chip!
8. Easy access to the GPIO pins for easy prototyping
9. ESP-12E Processor
10. Easy to use breadboard friendly form factor

### *2.2.3.* ESP 32 CAM

**Fig.4. ESP 32 Cam**

***Specifications***

1. Module Model:ESP32-CAM
2. Custom IO Port:9
3. SPI Flash:Default 32Mbit
4. RAM:520KB SRAM +4M PSRAM
5. WIFI:802.11 b/g/n/e/i
6. Bluetooth Version:4.2
7. Antenna Type:IPEX and PCB
8. Input Supply Range (VDC):3.6 ~ 5
9. Current Dissipation (mA):180-310

### *2.2.4* MPU 6050


**Fig.5. MPU 6050**

***Specifications***

1. Chip built-in 16bit AD converter, 16-bit data output
2. Driver Chip: MPU6050
3. Operating Voltage: 3-5V DC

4. Communication: I2C/IIC Protocol
5. Gyro Range: ± 250, 500, 1000, 2000 °/s
6. Accelerometer Range: ± 2 ± 4 ± 8 ± 16 g

### *2.2.5* FLEX SENSOR

**Fig.6. Flex Sensor**

***Specifications***

1. Flex length: 5.6 cm.
2. Total Length: 2.2″ (7 cm).
3. Life Cycle : >1 million.
4. Height : 0.43mm (0.017″),
5. Flat Resistance: 10K Ohms ±30%.
6. Power Rating: 0.5 Watts.

### *2.2.6* SERVO MOTOR (HIGH TORQUE)

**Fig.7. Servo Motor**

***Specifications***

1. Model: MG995
2. Weight: 55 gm
3. Operating voltage: 4.8V~ 7.2V
4. Servo Plug: JR
5. Stall torque @4.8V : 13kg-cm
6. Stall torque @6.6V : 15kg-cm

### *2.2.7.* BUCK CONVERTER

**Fig.8. Buck Converter**

***Specifications***

1. Input voltage: 3-40V
2. Output voltage: 1.5-35V(Adjustable)
3. Output current: Rated current is 2A, maximum 3A
4. Switching Frequency: 150KHz
5. Operating temperature:Industrial grade (-40 to +85 )
6. Conversion efficiency: 92%(highest)

### *2.2.8.* 3.7V BATTERY

**Fig.9. 3.7V Battery**

***Specifications***

1. Capacity (mAh): 2500
2. Output Voltage: 3.6V
3. Charge Rate: 2C
4. High working voltage for single battery cells.
5. Long cycle life

### *2.2.9.* 7.4V LI-ION BATTERY

**Fig.10. 7.4V Li-ion Battery**

***Specifications***

1. Nominal Capacity (mAh): 2500
2. Charging Connector: female DC jack connector
3. Discharging Connector: Male DC jack
4. Nominal Voltage (v): 7.4
5. Max Charging Voltage (v): 8
6. Inbuilt (BMS) battery protection circuit

### *2.2.10.* 9V ADAPTER

**Fig.11. 9V Adapter**

***Specifications***

1. Input Voltage (V): 100 ~ 280 VAC @50 ~ 60Hz.
2. Input current (mA): 100.
3. Output Power: 9V 2A.
4. Input Plug: 2-Pin EU type.
5. Output Plug: 5.5mm DC plug.

### *2.2.11.* GLOVE

**Fig.12. Glove**

## 2.3: EXPERIMENTATION AND IMPLEMENTATION:

### 2.3.1. Block Diagram

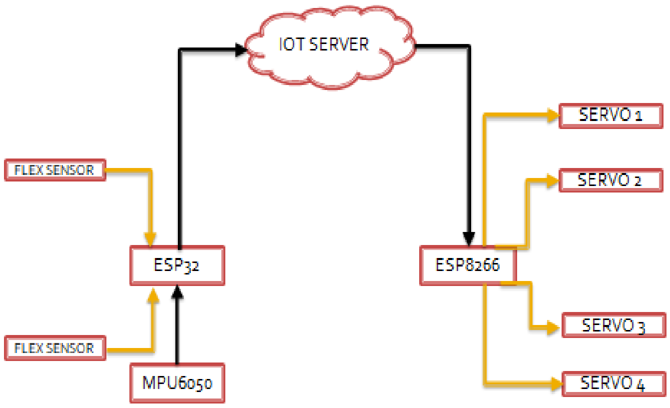


**Fig.13. Proposed Methodology of Glove & Robotic Arm**

On the glove side, the flex sensor on the human hand detects the curvature of the user's finger. The MPU-6050 sensor detects the tilt of the robot hand controller and also controls the angle of the direction of robot movements. These two components are connected to the ESP 32 module and then connected to the IoT server. Similarly the robotic arm side, four Servo motors are together connected to ESP 8266 for providing either rotational or linear displacement of the segments in the robotic arm. The number of linkages in the structure defines how many freedom degrees (DOF). Also connected to the IoT server.

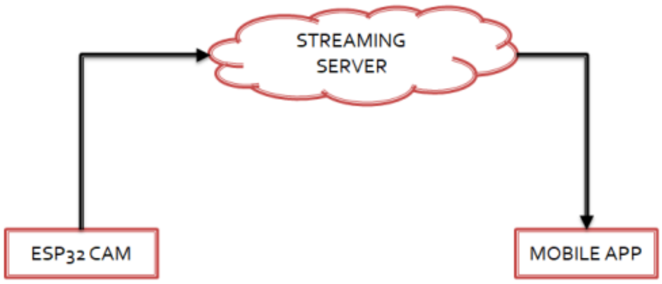


**Fig.14. Proposed methodology of webcam**

The expected outcome is screened using the ESP Cam, which is connected to the robotic arm for surgical view between
doctor & robot through Mobile /another application.

### 2.3.2. Circuit Diagram

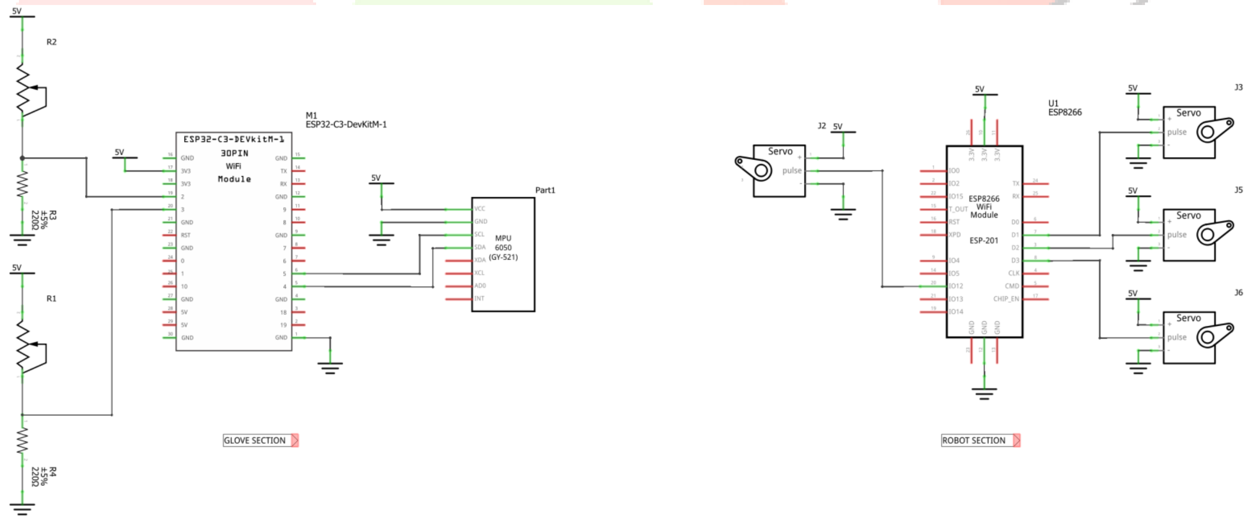


**Fig.15. Circuit diagram of proposed methodology**

The circuit diagram of the proposed methodology shows two sections. One is the Glove section and the other is the Robot section. The glove section acts as a transmitter & Robot section act as a receiver.

# 3. RESULTS

## *3.1*. Thingiverse Design Models of Robotic Arm

**Fig.16. Side view**

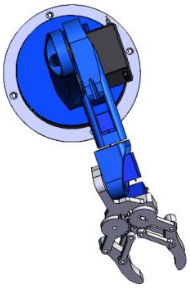

**Fig.18. Top view**

**Fig.19. Side view**

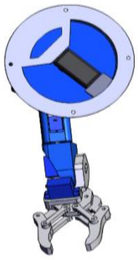

**Fig.17. Bottom view**

## *3.2*. Proposed model of 3D Printed Robotic Arm

**Fig.20. 3D printed Arm**

## *3.3*. Proposed model of Robotic Hand Controller

**Fig.21. Robotic hand controller**

## *3.4.* Different modes of Robotic Hand Controller

| Mode | Hand movement | The part which movement is possible |
|---|---|---|
| 1 | Fully Closed | Shoulder |
| 2 | Index finger stretched & thumb closed | Base |
| 3 | Thumb stretched & index finger closed | Wrist |
| 4 | All fingers are stretched | Gripper |

**Table.1. Modes of Robotic hand controller**

# 4. CONCLUSION

This paper develops an intelligent robotic arm system supported by gesture management. This takes a lot of experiment results to show that the right-hand control and management of the robotic arm is completed beneath the mixture of system hardware and package. The robotic arm will follow the right-hand arm's up, downswing, left-right swing motion, palm up-and-down swing, palm left-right flipping motion, and grasping movement through gestures.Surgery is a medical specialty based mostly on manual procedures and applied technical tools to patients, and with advanced technologies, it’s straightforward to perform a patient-assisted golem surgery. The technology develops the system of human and machine interaction by creating the golem that helps the physician to perform surgery accurately and versatile. There are many areas in the medical field, where the doctor will use assistant robots such as Open-Heart Surgery, Ophthalmology, urinary organ surgical process, etc.

During this paper, we are aiming toward the employment of the golem in the operating area constitutes an outsized part of the successful operation with great accuracy. The objective of this paper is to check the standing of the assessment of robot-assisted surgery. During this analysis, we are targeting medical teams and patients. And also here suggests that robot-assisted surgical analysis could facilitate working out the amount of expertise of playing advanced surgical tasks with the assistance of surgical robots. Although in its infancy, robotic surgery has established values in areas of accessible standard laparoscopic procedures.

Advantages include less scary and also help in faster recovery. It also reduces the loss of healthy tissues and large surgical precision. Less blood loss and transfusion is the major advantage along with which less physiological state is needed. It also helps in smaller risk of infection and turns cheap for hospitals.

## 5. FUTURE SCOPE

Will you get surgery from a robot?' may be a question that also makes us unsure whether it's okay or not okay. If we tend to snap out of the thought and appearance at it much, robotic surgeons are already taking on the tending trade by storm. several robots are of huge use to the doctors in each aiding and performing the surgeries. The longer term of robotics is anticipated to contour robotic surgeons and telesurgery ways.

Alike however manufacturers place confidence in robots to scale back human errors, maintain product quality and nullify human loss. Robotic surgery or robot-assisted surgery, permits doctors to perform many sorts of complicated procedures with additional exactitude, flexibility, and management than is feasible with typical techniques. Initially, robotic surgery was used related to minimally invasive procedures performed through a little incision. However, as technology evolved and robotics in tending has reached an explicit extent of innovation; rising trends like robotic arms and micro-robots are increasing the role of robots within the sector. Even supposing the high price of surgical robots may be a barrier to adoption, the tending trade continues to be dedicating a neighborhood of its revenue to staying at the sting. The world marketplace for surgical robots was valued at US$3.9 billion in 2018 and is anticipated to achieve US$6.5 billion with a CAGR of 10.4%. With additional Tending facilities clasp robots for surgeries, the longer term of robots in tending is predicted to be behind several revolutionary changes within the coming back years. The sculpture surgical system is the market leader in innovating and distributing extraordinary robots to perform difficult surgeries. With additional firms rising to leverage surgical robots with advanced technologies, the longer term of AI can grow exponentially within the tending trade.

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