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Introduction

Key Problems

-Doctor’s physical unavailability

-Time-sensitive operations

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Purpose

-To enable remote surgical control via robotic arm for doctors

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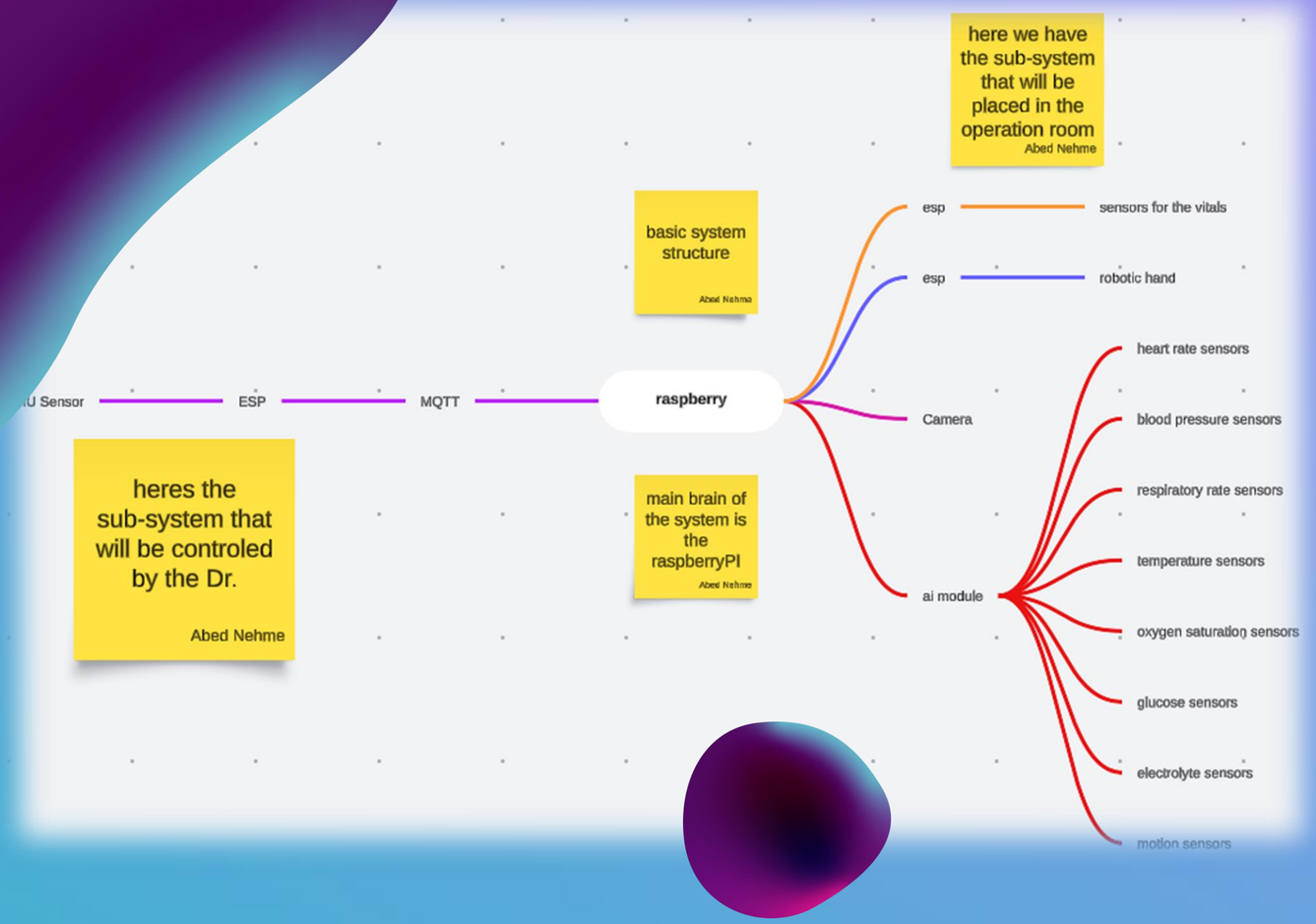
Key solutions

-Real-time gesture control with the IMU sensors
-Patient monitoring and AI integration

Objectives

1. Remote control of robotic arm
2. Gesture-based motion control
3. Real-time feedback with patient vitals
4. Integration of data inputs
5. Addressing doctor unavailability



System architecture

Components

IMU sensors

We used the 10DOF version to control the tilt, rotation and movement of the hand

ESP8266

We used it to ensure good communication and ensure a good data logging and good control

Raspberry Pi

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camera

Key components

Controlling side

- IMU sensors on glove
- ESP8266 for Wi-Fi communication

Controlled side

- Raspberry Pi for processing
- Servo motors for arm movement
- Camera for live video
- Virtual sensors (Hear-Rate, Bp ,etc...)

Data Transmission and MQTT

Why MQTT?

- Optimized for IoT
- Low latency and lightweight

Role

Sends IMU sensor data and receives video/vital feedback

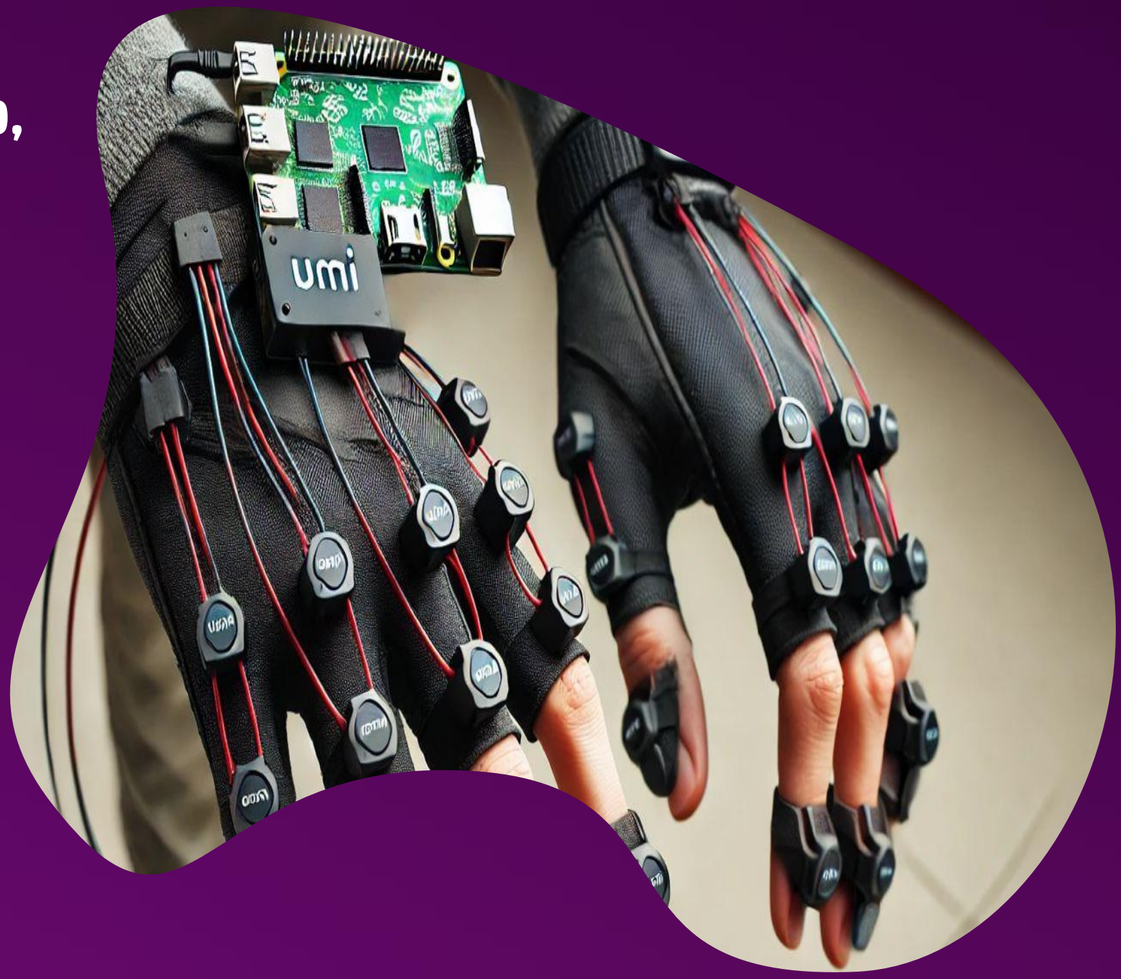
MQTT

Lightweight protocol for IoT

Software Development

Programming tools:

- Python Libraries
- Motor Control : RPI , GPIO, Pigpio.



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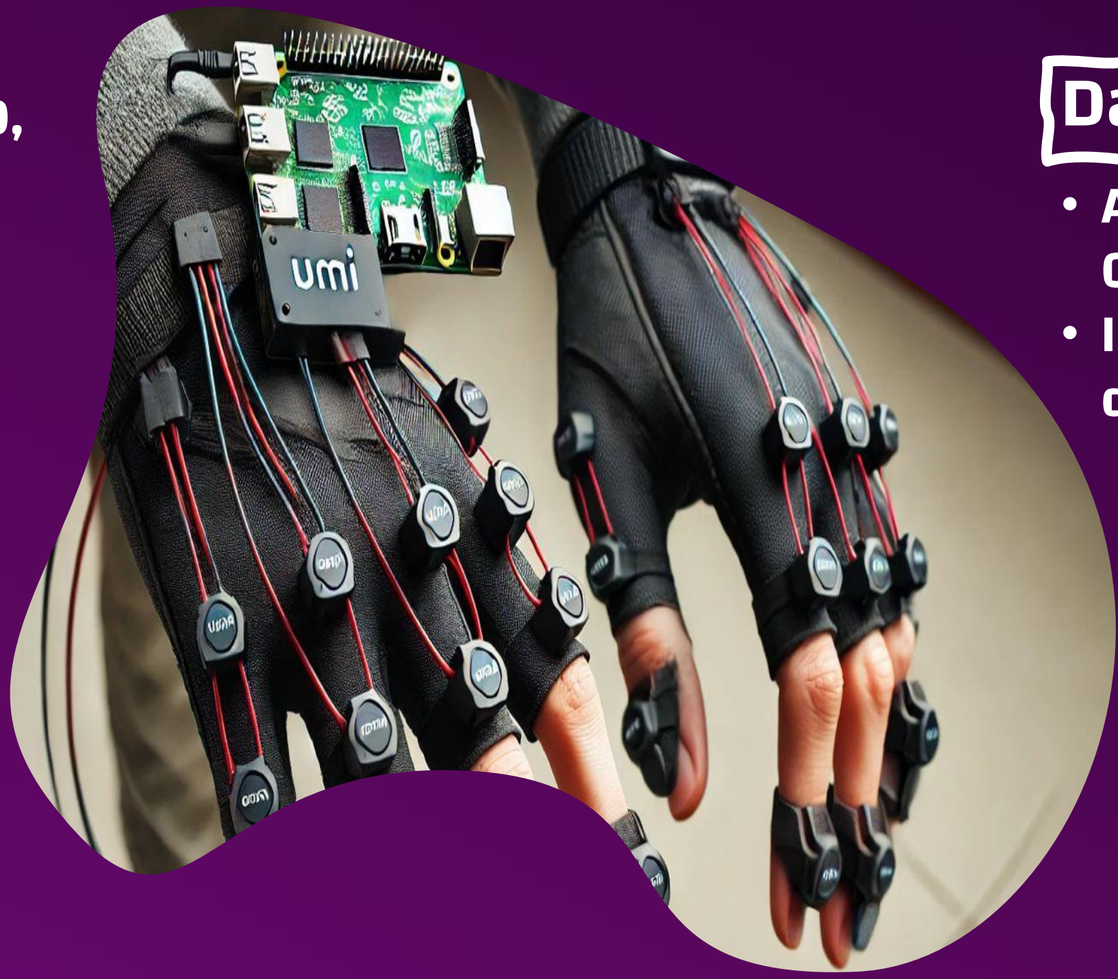

Data Processing

- Analyze IMU data -> Control servo motors
- Integrate Ai insights for doctor assistance

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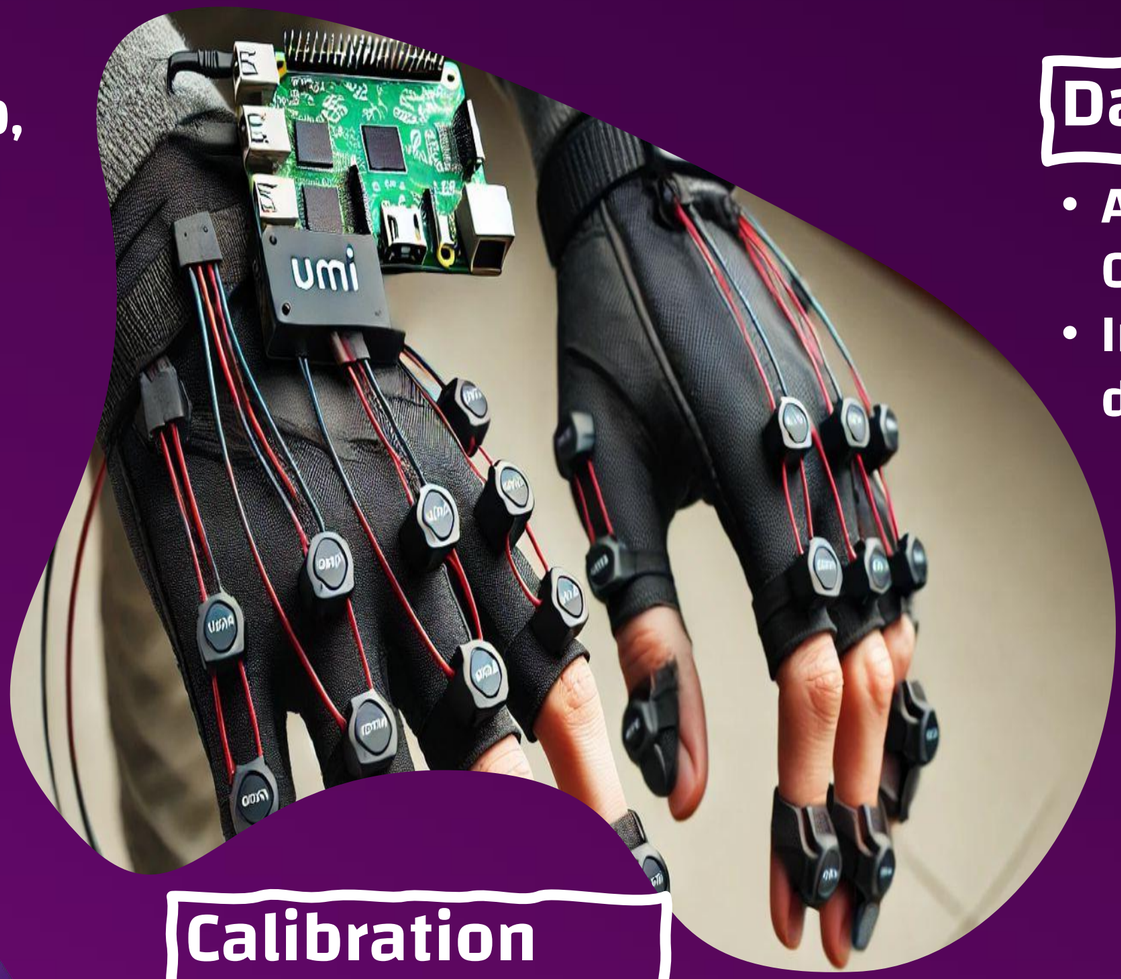

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Calibration

Ensures precision of sensors

Results and Evaluation

System Accuracy

- 95% motion detection accuracy

Results and Evaluation

Key achievements

- Gesture control and motor Operation successful
- Integration of data and real-time feedback

Results and Evaluation

Data transmission

- The connection between the raspberry pi and the ESP was successful to a certain level

Technical Challenges

- Sensor drift and inaccuracy
- Network latency issues
- Power supply stability

Challenges

Challenges

Mitigation

- Identify and Assess Risks
- Implement Preventive Measures
- Monitor and Adjust

Future Work

enhancements

- Use high-definition camera
- Optimize motors and robot arm design
- Use dedicated servers for communication

Future Work

Integration Options

-Combine IMU sensors with camera-based gesture recognition

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Future Work

Broader Applications

-Manufacturing, Healthcare, Robotics, Research

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Practical Applications

Biomedical Field

Remote surgeries, rehabilitation

Industrial use

Material handling, precision tasks

Research

Automation in various sectors

Conclusion

-The project successfully demonstrated the integration of hardware and software to remotely control a robotic arm, achieving its primary objectives.

-The challenges faced provided valuable learning experiences, enhancing technical and problem-solving skills.

-Future improvements will focus on increasing precision, optimizing communication, and exploring real-world applications in fields like automation and manufacturing.