Crime Investigation using Camera-Mounted Rover and VR with 5G
5G Innovation Hackathon 2025

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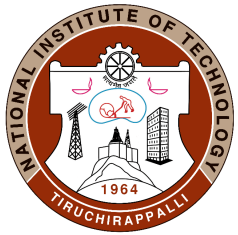

Mentored by

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Introduction

- **Shortage of forensic experts**: In many regions there are too few trained forensic investigators to attend every crime scene quickly. This scarcity creates delays in initial evidence collection and slows case progress.
- **Risk of contamination**: Multiple people entering a crime scene increases the risk of disturbing or contaminating physical evidence. Even well-intentioned actions can alter trace evidence or the original layout.
- **Need for remote, immersive, real-time investigation tools**: By combining a camera-mounted rover with a VR interface, experts can virtually inspect scenes in first-person, capture detailed imagery, and provide guidance to on-site personnel without physically entering the scene.

Problem Statement: Specific Objectives

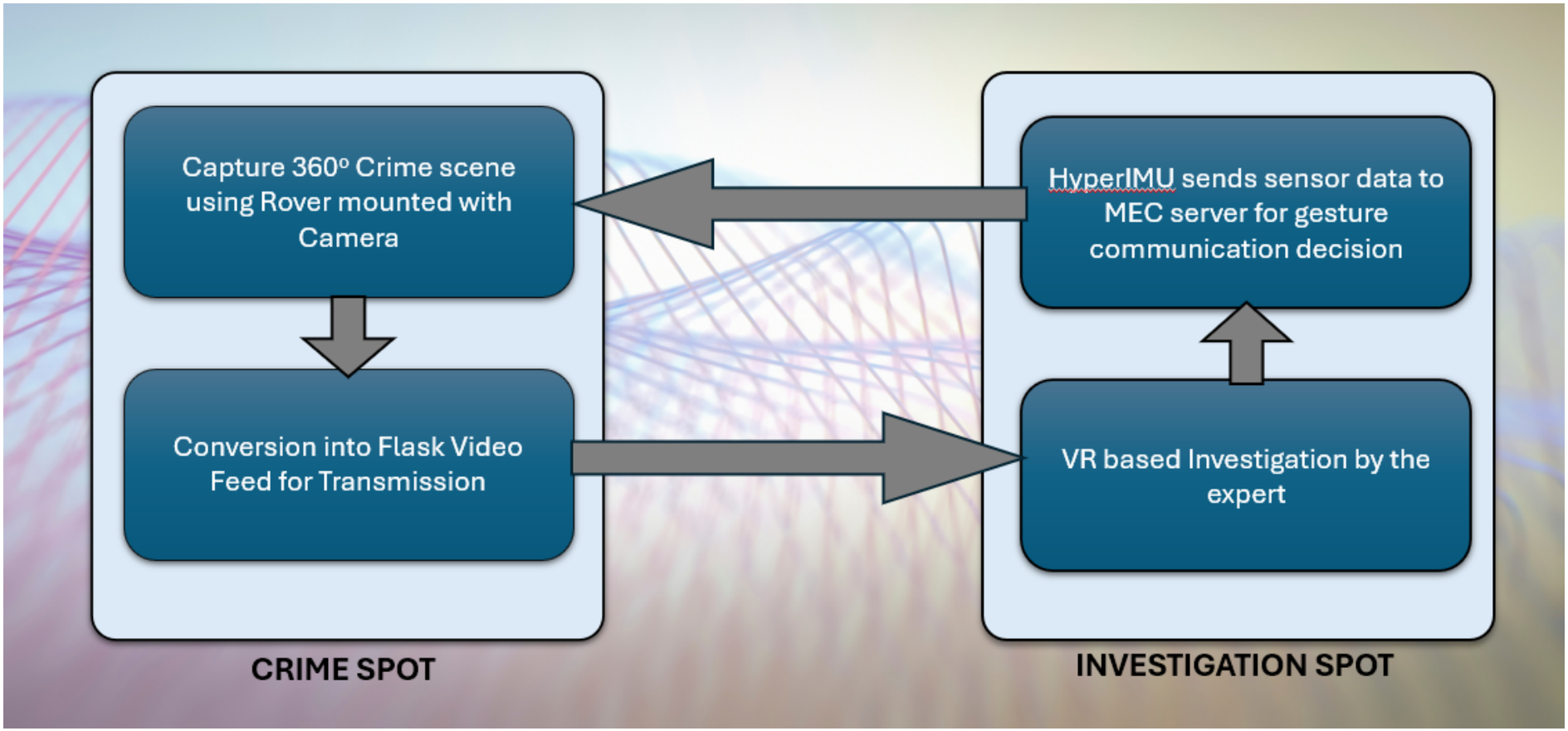
This project aims to build a preliminary prototype with the following objectives:

1. To design and assemble a prototype system that demonstrates robust, bidirectional communication over a **private 5G network**.
2. To validate the high-throughput data uplink by transmitting sensor data, simulating a live video feed.
3. To validate the low-latency command downlink by transmitting control signals to actuate a simulated rover response.
4. To establish this validated 5G communication link as the foundation for a future fully-featured remote investigation system using a VR headset and a camera-equipped rover.

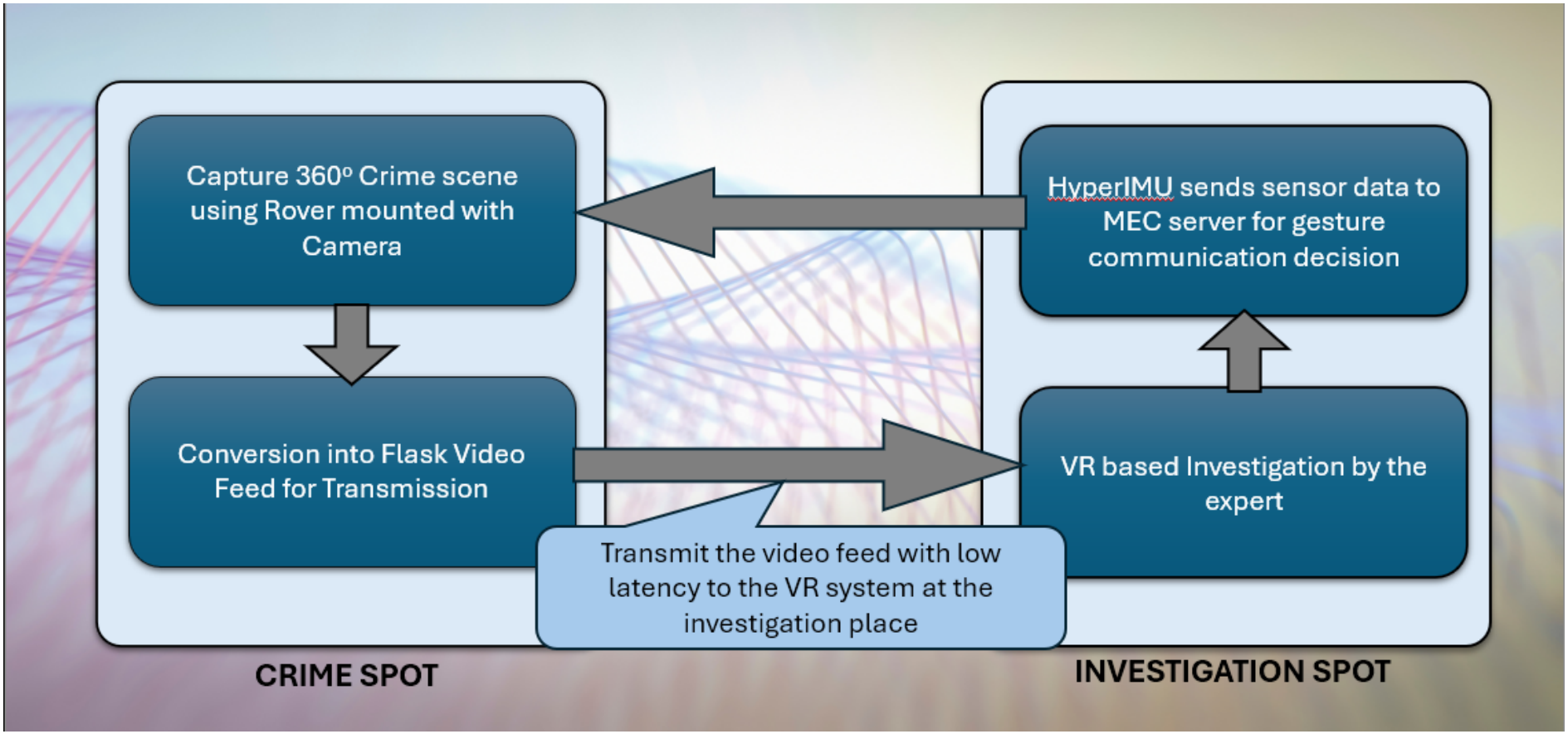
Proposed Solution

- **Rover with Mounted Camera**: Controlled via VR headset for immersive, intuitive navigation.
- **Gesture-based Control (HyperIMU)**: Smartphone sensors (gyro, accelerometer) map head movements to rover and camera actions.
- **Low-latency 5G MEC Communication**: Ensures smooth video streaming and instant response to commands.
- **Remote Expert Investigation**: Experts examine the crime scene virtually, reducing delays and contamination risk.

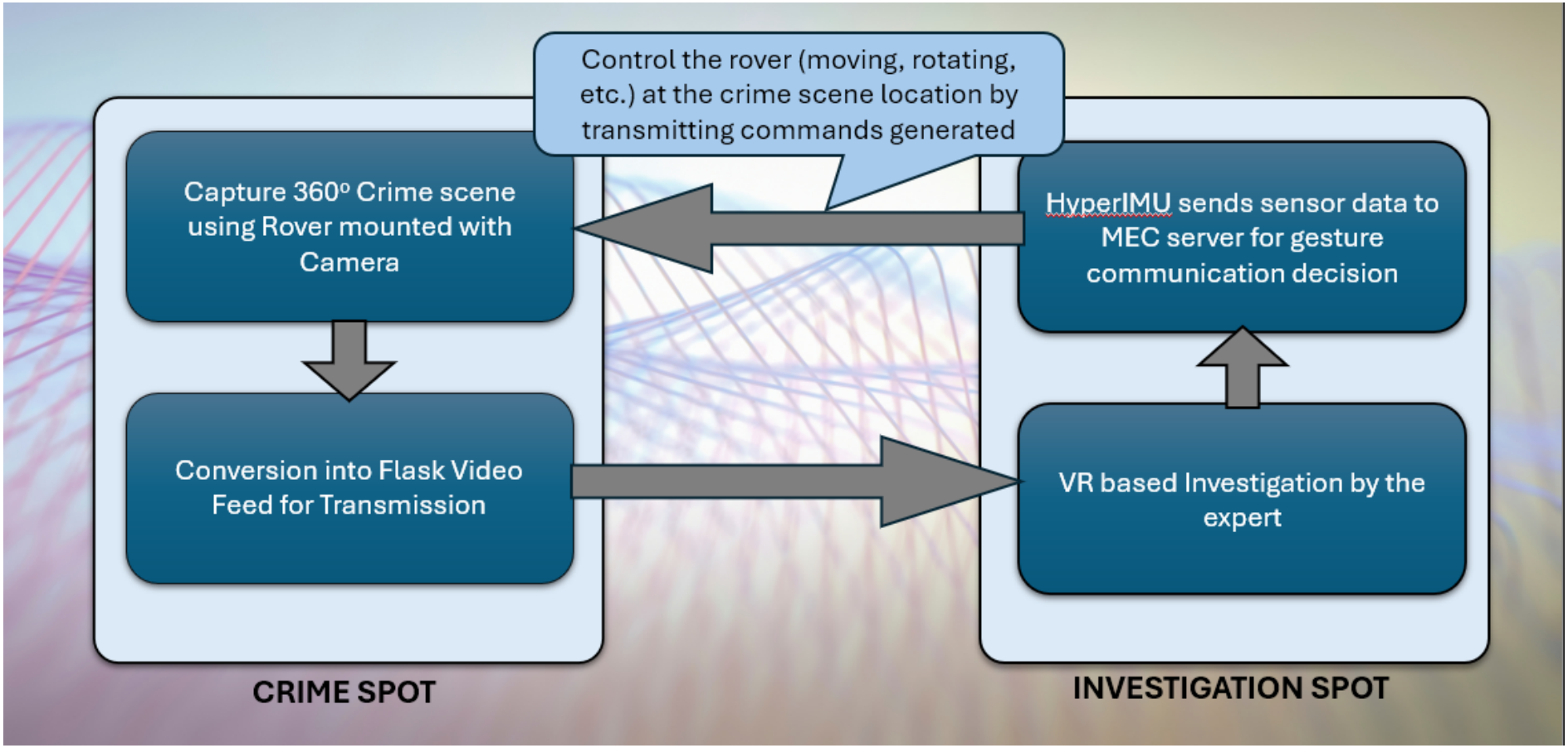
Proposed Solution



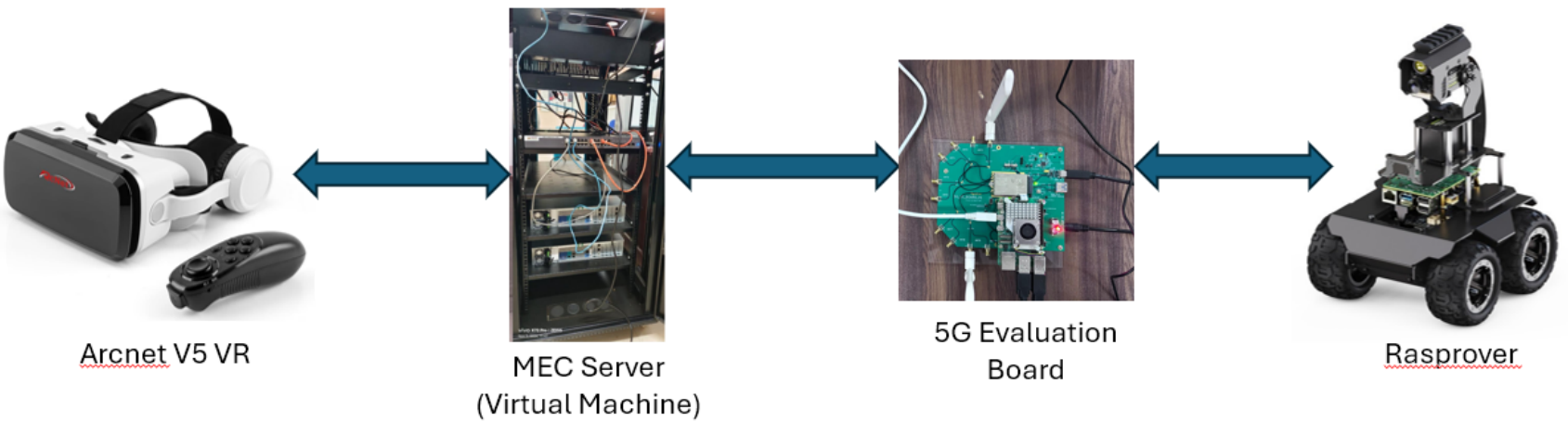
Proposed Solution



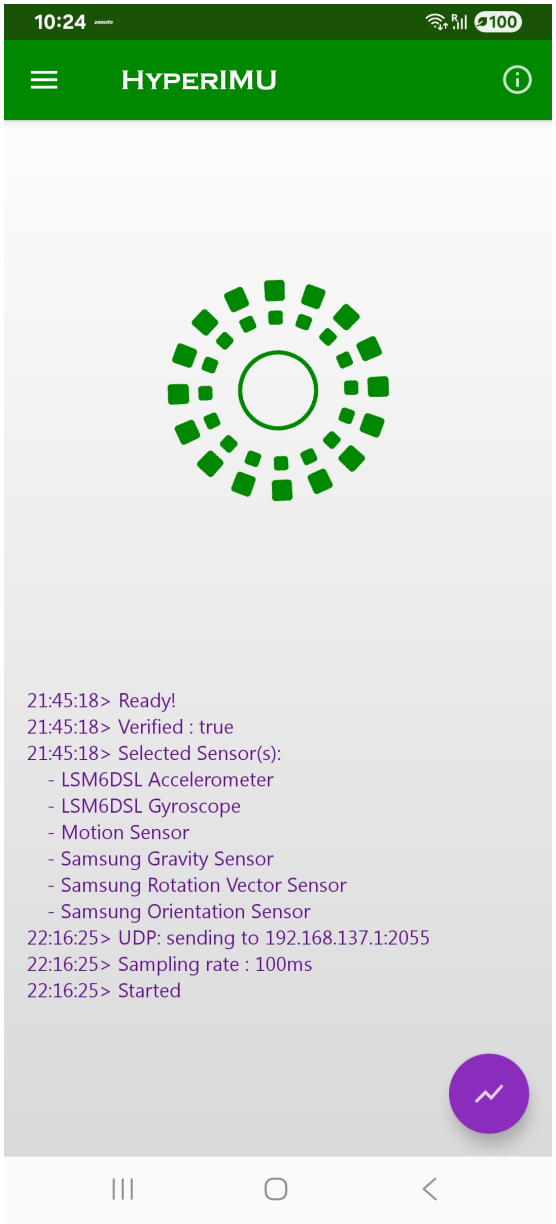
Proposed Solution

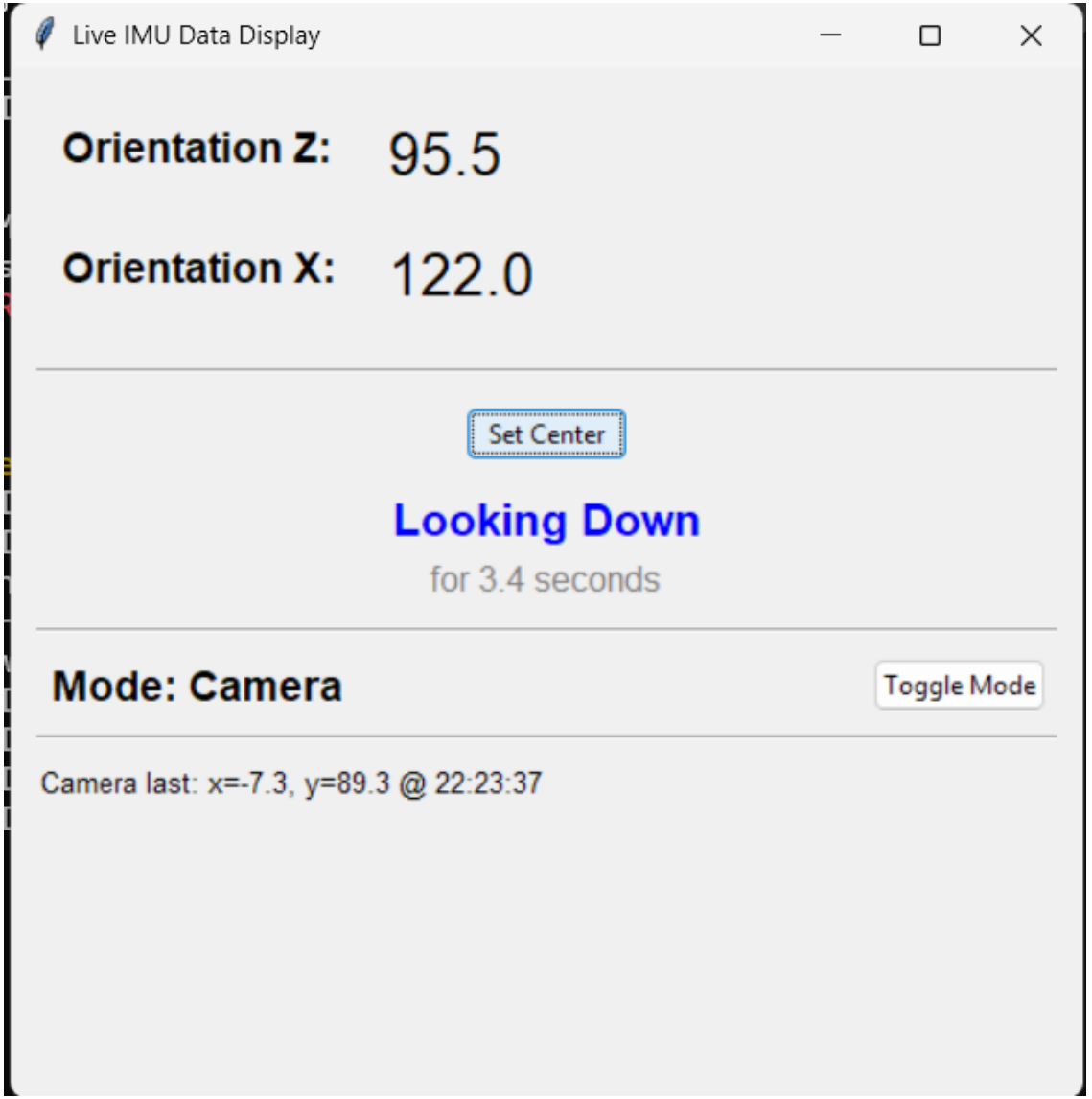


System Flow Diagram

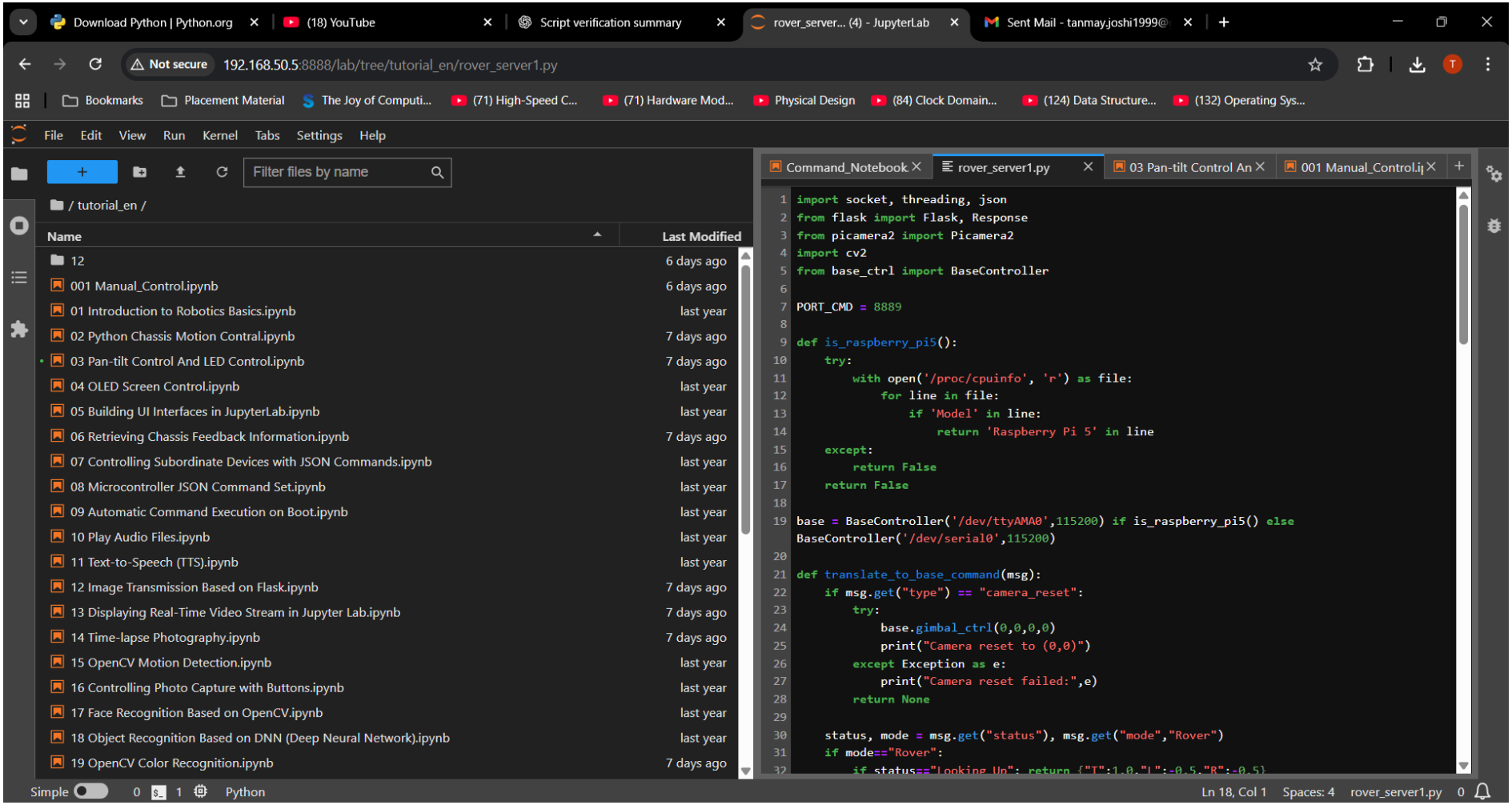


Gesture Communication and GUI

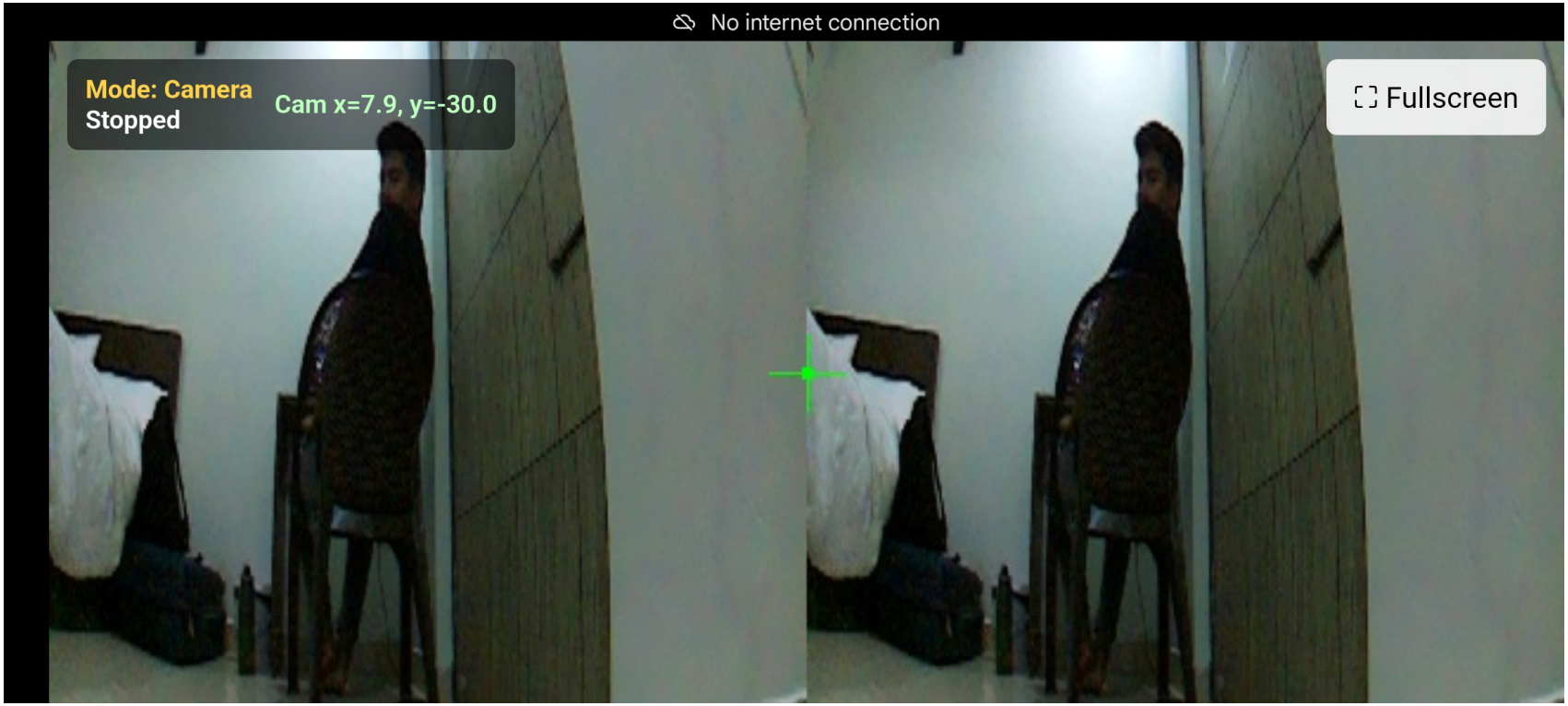




Rover Homepage and Server Script



Video Feeds


No internet connection
Mode: Camera
Stopped
Cam x=7.9, y=-30.0
Fullscreen

Demonstration

https://drive.google.com/file/d/
1cfebv1ZIKO8DT3IVsfPlri3VJTodSJRY/view?usp=sharing

Usage Scenarios

- Forensic crime scene investigation.
- Search and rescue operations in hazardous areas.
- Defense and border security surveillance.
- Remote inspection of inaccessible environments.

Future Work and Conclusion

- Enhance autonomy with AI-based evidence detection.
- Improve video quality with higher-bandwidth 5G slices.
- Expand multi-user VR collaboration.
- Conclusion: A scalable, secure, and immersive tool for forensic experts.

Thank You!