RASPBERRY PI-POWERED UNIFIED AIOT SYSTEM FOR STORAGE, SECURITY & AUTOMATION

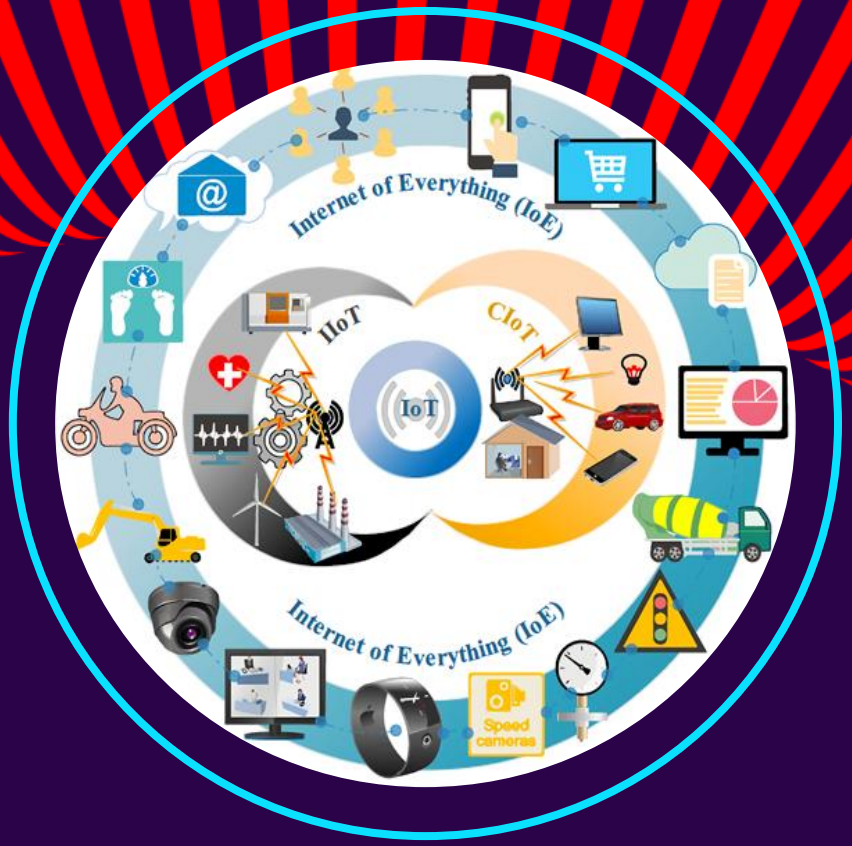
Subject Name: Intelligent Systems and Security
Subject Code: CTMTAIDS SII P4
Guided By: Ms. Dristi Garadhari

School of Cyber Security & Digital Forensics
M.Tech Artificial Intelligence & Data Science
(Specialization in Cyber Security)
Year / Sem: 1st / 2nd
Session Year: 2024 -26

Presented by: Pratham Badge
Enrolment No.: 2401003007003

INTRODUCTION

- What is IoT?
  - IoT (Internet of Things) refers to interconnected physical devices that collect and exchange data over the internet..
- Why AI + IoT in Cybersecurity?
  - The integration of AI with IoT enhances system intelligence through real-time monitoring, autonomous threat detection, adaptive security measures and automation.
- Motivation:
  - As a tech enthusiast I am aiming to create an efficient, low-powered multifunctional pocket system, physical prototyping on Raspberry Pi is costly and time consuming, making virtual simulation an ideal, cost-effective, and agile solution for early stage testing.



PROBLEM STATEMENT

Designing a compact IoT system that integrates NAS/media server, AI-driven IDS/IPS with firewall, virtualization, an AI chatbot, and home automation—entirely on a Raspberry Pi—presents several challenges:

- Limited hardware resources restrict multi-function integration.
- Real-time AI tasks need lightweight, low-latency and optimized models.
- Safe and Secure development demands sandboxed simulation and testing before real-world implementation.
- Must be user-friendly and easily deployable.

PROJECT OBJECTIVE

Simulate Raspberry Pi virtually

Build and test AI/ML and cybersecurity tools efficiently.

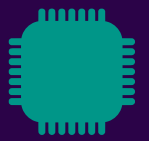
Ensure feasibility before hardware deployment.

Easy to use and deploy

TOOLS & TECHNOLOGIES

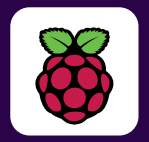
Software

- QEMU (ARM Emulator)
- Raspberry Pi OS (Legacy or Lite for performance)
- OpenMediaVault (for NAS & media server)
- OpenVPN (open-source VPN protocol for secure and encrypted connections)
- pfSense or Proxmox (for firewall/virtualization)
- Python, OpenCV, Scikit-learn, TensorFlow, MQTT



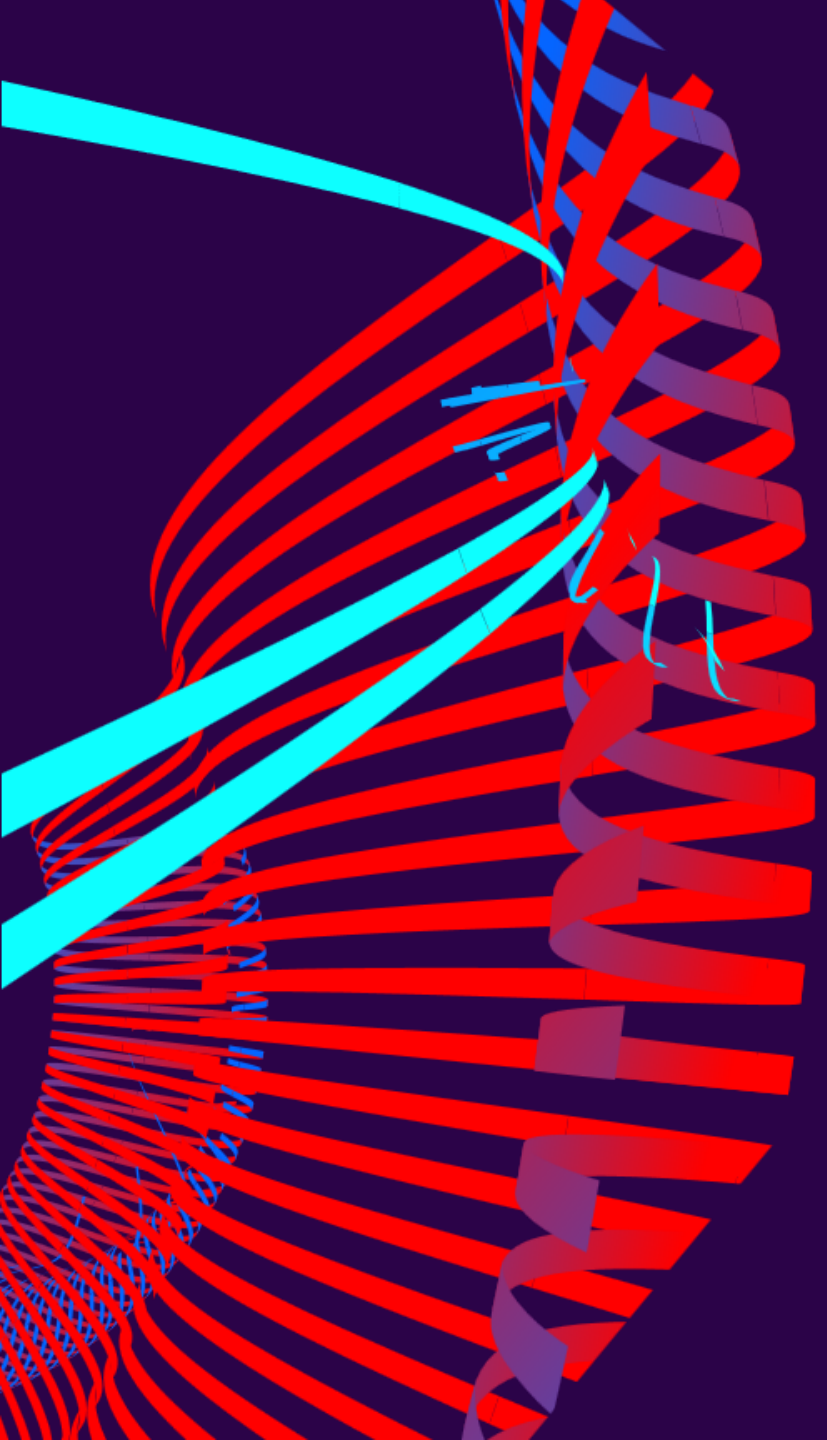
Hardware (Future Stage)

- Raspberry Pi 5
- Modules (WiFi, 5G, SSD)
- SD Card, Power Adapter







SIMULATION POV

SIMULATION SETUP

1. Install **QEMU v10.0+**
2. Download **Raspberry Pi OS (Full Image)**
3. Fetch compatible **kernel** and **dtb file**
4. Run using PowerShell/Terminal:

```
& "qemu-system-arm" -kernel [kernel-path] -M versatilepb -cpu arm1176 -m 256 \ -drive file=[img-path],format=raw -dtb [dtb-path] \ -append "root=/dev/sda2 panic=1 console=ttyAMA0" -nographic -net user -net nic
```

BENEFITS OF SIMULATION

- No need to purchase hardware initially.
- Safe testing environment for exploits and AI models.
- Debug, patch, and iterate quickly.
- Easily deployable and portable.

USE CASES & APPLICATIONS

- AI-Enhanced Smart Home Automation (Face Recognition, Intrusion Detection)
- Lightweight AI-Powered IDS/IPS with Real-Time IoT Traffic Analysis
- Unified Device Authentication System
- ML-Driven Anomaly Detection for Home Sensors
- Secure Mini Media & Storage Server

MORE USE CASES & APPLICATIONS

Identification

Smart Home Security (Face Recognition, Intrusion Detection)

Analysis

5G-based IoT Traffic Analysis

Authentication

AI-Powered Device Authentication

PROJECT OUTCOME

1. Successfully emulated Raspberry Pi OS.
2. Demonstrated potential for AI + IoT testing.
3. Explored GPIO simulation capabilities (future step).

CONCLUSION

BASED ON THE RESEARCH

- Simulation enables safe, cost-effective prototyping and testing.
- Accelerates development of AI-integrated IoT systems.
- Establishes a foundation for secure, smart, and user-friendly edge solutions

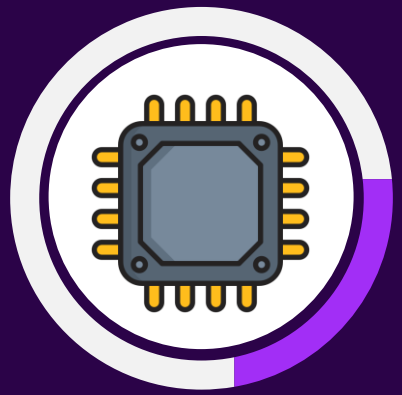
FUTURE SCOPE

Virtual GPIO Simulation

Simulate GPIO operations using tools like PiGPIO, GPIOZero.

Cloud AI Integration

Use cloud-hosted AI (e.g., Hugging Face) for advanced inference.

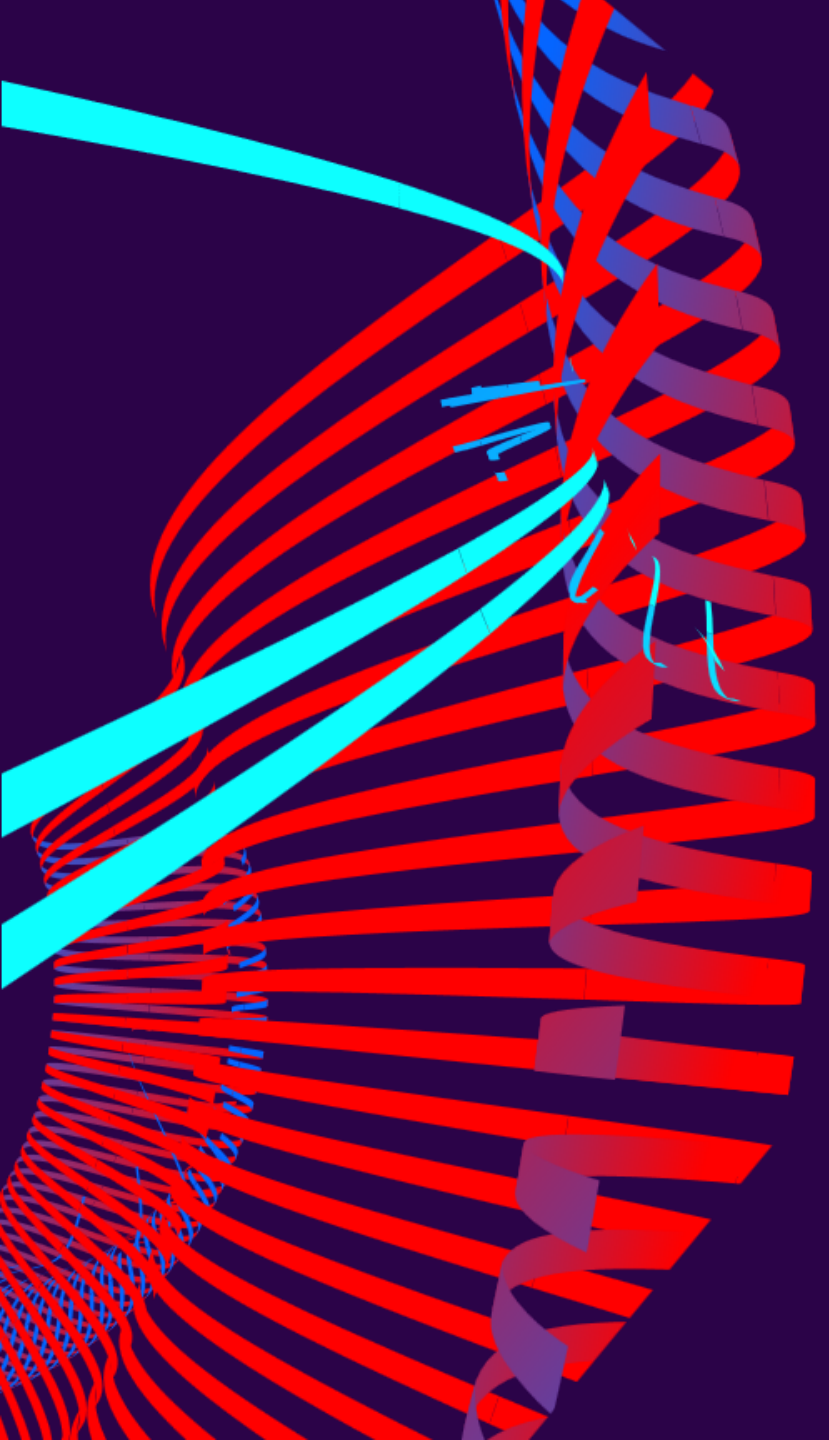


Real Hardware Deployment

Transition to physical Raspberry Pi 5 after virtual validation.

Security Testing

Expand into Red Team vulnerability assessments for IoT environments.



SUMMARY

- ✓ **Project Title:** Raspberry Pi-Powered Unified AIoT System
- ✓ **Core Idea:** All-in-one compact, low-power solution for storage, security, AI, and automation.
- ✓ **Key Features:** NAS/media server, AI-powered IDS/IPS with firewall, virtualization, chatbot, smart home automation.
- ✓ **Approach:** Developed and tested via Raspberry Pi OS emulation using QEMU before real deployment.
- ✓ **Technologies Used:** QEMU, OpenMediaVault, pfSense/Proxmox, Python, AI/ML libraries.
- ✓ **Outcome:** Validated the concept, architecture, and feasibility in a simulated environment.

THANK YOU

Q & A Session