CHI-SHENG CHEN

Embedded System Developer

Phone: +886-979-931-001
Email: johnny1001s000602@gmail.com
GitHub: rota1001

Education

National Cheng Kung University (Sep 2023 – Jun 2027)

- B.S. in Computer Science and Engineering
- Academic Excellence Award (**Top 5%** for 3 semesters, **GPA 4.26**)

Competitions

Programming Contests

- 2025 ICPC Taichung Regional — Bronze Medal
- 2025 Asia Taiwan Online Programming Contest — Silver Medal
- 2024 ICPC Taichung Regional — Bronze Medal
- 2024 National Collegiate Programming Contest — 4th Place Award
- 2024 Asia Taiwan Online Programming Contest — Silver Medal

CTF Contests (Security)

- HITCON CTF 2025 Quals — Ranked 2nd (Taiwan) / Ranked 22nd (Global), write-up[1]
- Crypto CTF 2025 — Ranked 38th (Solo, Global), write-up[2]

Side Projects

Run Linux 6.19 on STM32H750 (Cortex-M7, no-MMU)

Description: Run **Linux 6.19** on a microcontroller with only **1MB SRAM**
Links: Github[3] Hackmd[4]

- Developed a **QEMU SoC model** with a core peripheral subset (UART, Memory Mapping, Timer), enabling **kernel debug via GDB**
- Developed a **minimal bootloader (only 12KB)** to load the Linux kernel
- Reduced Linux kernel .bss and .data usage to 100KB via custom kernel config
- Used **SPARSEMEM memory model** to utilize non-contiguous memory regions
- Used **romfs** to keep rootfs in flash
- **uClibc-ng** and toolchain integration for the portability of user program
- Used **bFLT** instead of ELF executables to run it without virtual memory support (no-MMU)
- User programs are **executed in place**, not using any RAM for text segment
- Linux kernel was successfully booted and run **toybox**, which is a lightweight busybox

Linux Kernel Instrumentation Framework (HITCON 2025)

Description: Kernel module for dynamic instrumentation capable of intercepting kernel execution paths **without kallsyms or kprobes**. Presented at *HITCON 2025*.
Links: Github[5] Hackmd[6]

- Inspected and modified **procfs** file operations by parsing its internal tree structure
- Resolved syscall function addresses by dynamically analyzing the **syscall handler** in the Linux kernel (without relying on exported syscall table)
- Performed runtime kernel patching via **PTE flag manipulation**
- Achieved process concealment by manipulating the internal **PID hash** structure used by the scheduler

- Patched the **ELF header and entry point** to embed a minimal payload that invokes the kernel's module-loading syscall during systemd startup

Port DOOM to STM32H750 (SITCON 2026)

Description: Run 3D game on STM32H750 with **only 1MB SRAM** and **without STM32 HAL**.
Links: Github[7] Hackmd[8]

- Pure register-level programming
- Used **LTDC** and DAC to output 640x480@64Hz **VGA** signal with only 320x200 bytes framebuffer
- XIP code execution on **QSPI** external flash
- Modified the memory management system to support non-contiguous memory allocation in DOOM
- Implemented libc support for DOOM

Operating System running on STM32F103

Description: A preemptive multitasking OS running on STM32F103 without the STM32 HAL.
Links: Github[9] Hackmd[10]

- Reduced instruction fetch latency by executing the kernel entirely in SRAM
- Implemented **privilege separation** between kernel and user tasks with control register
- Built a **preemptive scheduler** supporting round-robin scheduling and **cooperative yielding**
- Implemented context switch using **setjmp/longjmp**
- Designed syscall mechanism scheduled as kernel tasks instead of running in handler mode

Microcomputer with Custom OS and Peripheral Integration

Description: Built a microcomputer using PIC18F integrating keyboard, SRAM, UART, and USB storage.
Links: Github[11] Hackmd[12]

- Developed **USB Host driver** for CH375 supporting **HID keyboard** and USB flash drive
- Built external memory interface enabling **1-byte-per-instruction** block access using **only an 8-bit GPIO** with latch/counter/D-trigger
- Implemented **DMA mechanism** using 512KB SRAM as disk cache

Presentation

- HITCON 2025 — *A Kernel Rootkit That Works Without Kallsyms*[13]
- SITCON 2026 — *STM32 Bare-metal DOOM Challenge (Up Coming)*[14]

Links

[1] https://hackmd.io/@rota1001/hitcon-ctf-quals-2025
[2] https://hackmd.io/@rota1001/crypto-ctf-2025
[3] https://github.com/rota1001/stm32h7-linux
[4] https://hackmd.io/@rota1001/stm32h750-linux
[5] https://github.com/rota1001/ksymless
[6] https://hackmd.io/@sysprog/r1l3i4_Zge
[7] https://github.com/rota1001/stm32h7-baremetal-doom
[8] https://hackmd.io/@rota1001/stm32-doom
[9] https://github.com/rota1001/arm-os-101
[10] https://hackmd.io/@rota1001/stm32-os
[11] https://github.com/beautiful-fruit/picos
[12] https://hackmd.io/@weiso131/picos
[13] https://hitcon.org/2025/en-US/agenda/f679c826-4c37-4989-bf27-6e44ea4726ce/
[14] https://sitcon.org/2026/agenda/91836d