Ruigang CHEN

ruigang.chen@campus.technion.ac.il | https://ruigangchen2.github.io

EDUCATION

- **Guangdong Ocean University (GDOU), P.R.C** *Sep. 2018 - Jun. 2022*
  - **Major:** Automation, B.E.
  - **Academic Performance:** GPA: 83.5/100; **Rank: Top 10%**
  - **Graduation Thesis:** Quadcopter Design Based on Real-time Operating System
- **Technion - Israel Institute of Technology, Israel** *Sep. 2023 - Current*
  - **Major:** Mechanical Engineering, Ph.D.
  - **Academic Performance:** GPA: 91.2/100

RESEARCH EXPERIENCE

- **Design of electromagnetic car based on Cortex-M4 core.** *Dec. 2018 - Jun. 2019*

  In order to meet the development requirements of modern informatization and intelligence, we propose a motion control of the smart car based on the microcontroller of the Cortex-M4 core. This project uses NXP's K66 chip as the main control chip. We design the PCB of the main control circuit and the PCB of the driver circuit by ourselves, and use the op-amp chip to collect the electromagnetic line data of the track, obtain the track information in real-time through information fusion, and combine the PID algorithm for real-time control and obstacle avoidance to realize the intelligence of the car.

- **A portable glasses for obstacle detection based on YOLOV2.** *Jun. 2020 - Mar. 2021*

  This project is an innovation and entrepreneurship project for college students. The purpose is to design portable smart glasses to assist people in their daily activities. We use the K210 chip as the main control chip. The K210 chip combined with the YOLOV2 detection algorithm is used for real-time detection of the vehicle, and the information is sent to the LabVIEW host computer through the Wi-Fi module so that the user can know the specific situation of the vehicles on both sides in real-time.

- **A smart home system based on UCOSIII** *Mar. 2021 - Jun. 2021*

  The whole project is built by STM32CubeMX, using STM32F103C8T6 as the main control chip, using UCOSIII for thread control, judging the current environment by getting each sensor measurement value, and using the pre-set algorithm for the next action. The system can be set in automatic mode and manual mode, and the manual mode is operated by the user's cell phone APP with a Wi-Fi control system. Provides some convenience for home life.

- **Quadcopter Design Based on Real-time Operating System.** *Nov. 2021 - Jun. 2022*

  "Quadcopter Design Based on Real-time Operating System" belongs to software and hardware design and is also my graduation design paper. I designed a quadcopter which is based on UCOSIII that can be controlled by a wireless remote. I designed the main control PCB by Altium Designer and validated the feasibility of the hardware. By acquiring the acceleration data and angular velocity data from the MPU6050, the real-time angle is obtained by using the quaternion method, combined with the cascade PID algorithm to control the stable flight of the aircraft.

- **Design of a passive ankle-thigh exoskeleton.** *Sep. 2022 - Jan. 2023*

  In this research, we proposed shifting the leg swing force to the ankle toe-off phase by an exoskeleton and hence decreases the metabolic cost of human walking by 6.7%. The exoskeleton is mounted on the thigh and extends beyond the low leg. A rubber band connects the extended bar and the back of the shoe, passing the torque from the thigh to the ankle. This reduces the ankle torque during the toe-off phase, in which most of the positive energy input from the muscle to the skeleton happens. We have finished the concept, design, and prototype of the exoskeleton and carried out the initial test. Test results show that the metabolic cost of walking with the exoskeleton is 351.1W, about 6.7% decrease compared with that of normal human walking (376.6 W).

- **A mechanism to improve the energy efficiency of actuator** *Jan. 2023 - Oct. 2023*

  In this research, we present a new concept of actuators enabled by passive dynamics and energy recycling. The proposed actuator is especially suitable for the rest-to-rest motions work, such as pick-and-place tasks. Compared with the conventional actuators, the advantages of the proposed actuator are: 1. With angle-triggered close-loop control, the actuator can reach a predefined arbitrary target angle in the desired time with 1° of standard deviation in rest-to-rest motions. 2. After the whole working cycle is ended, 76 % of the energy is recaptured and is ready to be used for the next working cycle. Compared to conventional actuators, only 10.4 % of the electric energy is consumed while the same motion task is achieved.

INTERN&WORKING EXPERIENCE

- **Linux Embedded Development Engineer,**

  Guangzhou Yueqian Communication Technology Co., Ltd. May. 2021 - Jun. 2021

  Develop an intelligent garage management system based on a Cortex-A53 chip using Linux. The entire system is cross-compiled under Linux with the make statement. Users can watch the current garage information in real-time through the LCD screen and can enter the garage with an ID card or password. The whole system runs stably and has certain expandability and maintainability.

- **Hardware and Software Test Engineer,**

  Shenzhen Silicon Speed Technology Co., Ltd. Apr. 2022 - Jun. 2022

  Write the python program to test whether the function API works, or has any bugs. Write QR code recognition, barcode recognition, and dynamic 3D coordinates axis code.

- **Research Assistant, Mechanical Engineering (Robotics) Program,**

  Guangdong Technion-Israel Institute of Technology Jun. 2022 - Sep. 2023

  Mainly research wearable passive exoskeleton and energy-saving robot. Read related papers, and demonstrate the feasibility of the method through experiments. For the exoskeleton part. Design a preliminary model of passive exoskeleton, which can reduce human metabolism by 6.7% at a walking speed of 1.5m/s through the initial test. For the energy-saving robot part. Design a new Energy-Saving architecture for industrial robots which can increase efficiency by a large margin. The energy utilization efficiency can be greatly improved by precisely controlling the timing of the stuck spring.

HONORS AND AWARDS

- **The First Class Scholarship for 2020.** *Oct. 2020*

  Comprehensive quality ranks the first among all people in the major

- **"Smart Manufacturing in Shunde" Academic Scholarship for 2020.** *Nov. 2020*

  NO.1 in the major

- **The First Class Scholarship for 2021.** *Oct. 2021*

  Comprehensive quality ranks the third among all people in the major

- **The Honourable Mention of National Undergraduate "NXP" Smart Car Competition** *Jul. 2019*

PATENTS AND PUBLICATIONS

C=COPYRIGHT, S=IN SUBMISSION

[C.1] Ruigang Chen, Tongchen Lin, Yizhar Or, Mingyi Liu. (2025). **Improving the Energy Efficiency by Using Quasi-Passive-Dynamics-Based Elastic Actuator**. Published in *IEEE Robotics and Automation Letters*. DOI = https://doi.org/10.1109/LRA.2025.3546098.

[C.2] **Home monitoring system based on Tuya Smart and STM32**. (2021). National Copyright Administration, Copyright No. 2021SR1162165.

[C.3] **Electromagnetic gun simulation system based on STM32 and OpenMV**. (2021). National Copyright Administration, Copyright No. 2021SR1162164.

[C.4] **The software of obstacle detection portable glasses interactive based on Deep Learning**. (2021). National Copyright Administration, Copyright No. 2021SR0388035.

[C.5] **Fish intelligent sorting system based on YOLOv3**. (2021). National Copyright Administration, Copyright No. 2021SR0138899.

[C.6] **Three-wheeled vehicle control system based on K60**. (2022). National Copyright Administration, Copyright No. 2022SR0906190.

SKILLS

- **Programming Languages:** C, Python, M
- **Operating System:** UCOSII UCOSIII, Linux
- **Software Application:** SOLIDWORKS, Altium Designer, Keil MDK, STM32CubeMX
- **Specialized Area:** Circuit Board Design, Embedded System Design, Embedded programming

THE PROJECT DETAILS

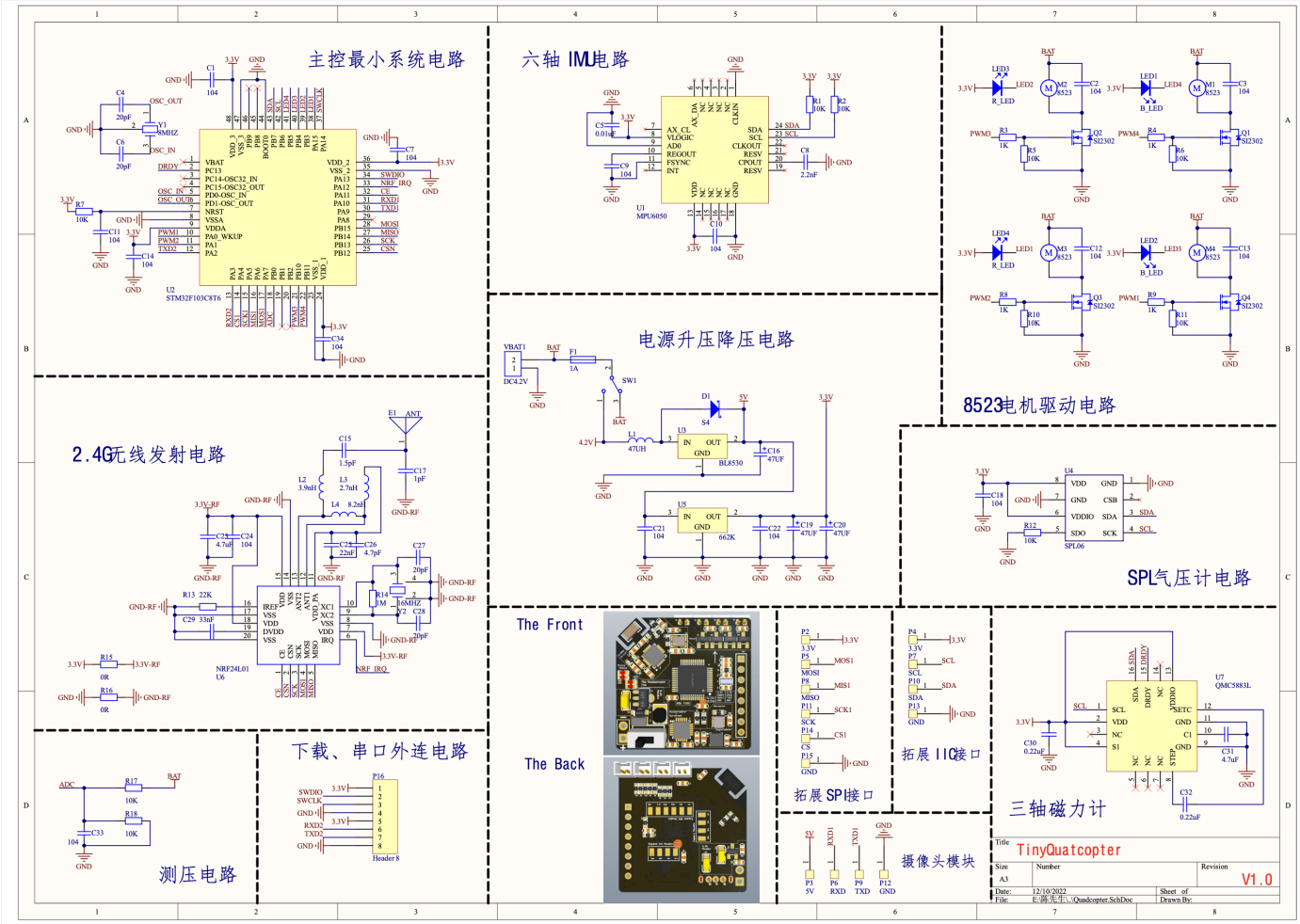
- **Quadcopter Design Based on Real-time Operating System.**

This project is a mini small flight controller designed which is integrated with a 2.4GHz wireless transmitter module, accelerometer gyroscope, barometer, and magnetometer. For a better experience, the USART expansion interface, SPI expansion interface and IIC expansion interface are added.

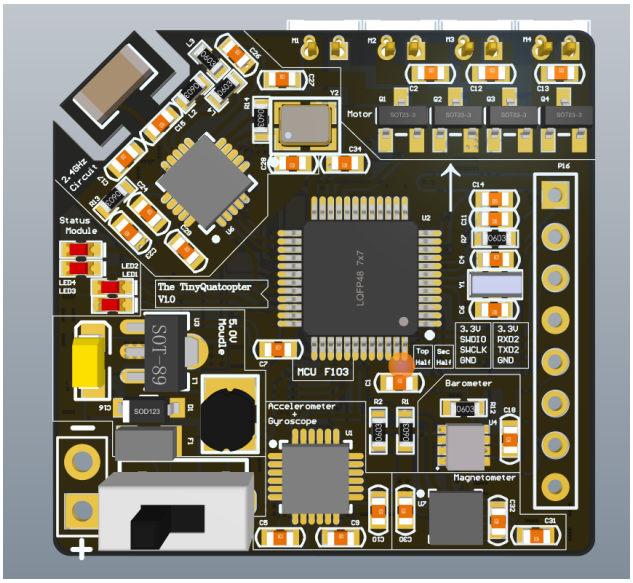
The hardware control circuit of the flight control system is mainly composed of the following five parts: STM32F103C8T6 main control chip and peripheral circuits, power supply step-up and step-down circuit, sensor module, motor drive circuit, and NRF signal transmission module. Since it is a small quadcopter, for the barometer, the strong cyclone of the propeller will affect the reading of the barometer value, so only the hardware interface is reserved for the barometer, and the software does not write the relevant code. As for the magnetometer, since the small quadcopter will not stay in the air for too long, its YAW angle will not fluctuate very much, so only the interface is reserved for the hardware, and no relevant codes have been written for the software.

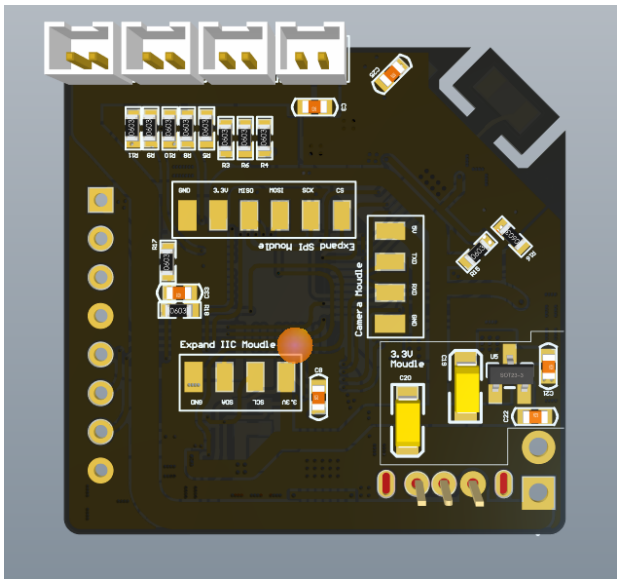
For the software part, the system mainly includes three parts: reading and filtering MPU6050 sensor data, attitude calculation through quaternion, and attitude control through cascade PID. It can be said that each part is very important for the stable operation of the flight control system. The filtering algorithm uses the first-order Kalman filtering algorithm, and the attitude calculation uses the complementary filtering algorithm plus the quaternion to inverse solve the angle got from IMU to obtain the current attitude angle of the flight control, and the attitude control uses cascaded PID control.

- **The schematic.**



- **The front and back views.**





- **The actual demonstration**