2020/2024

ENGINEERING PORTFOLIO

NIGEL TAN JIN CHUN

BACHELOR OF ELECTRICAL AND COMPUTER SYSTEMS ENGINEERING

Tan Jin Chun - Monash Project Portfolio

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Summary

As a final year Electrical and Computer System Engineering student at Monash University Malaysia, I have a deep interest in creating impactful software and hardware solutions. My curiosity extends beyond my main discipline, making me a well-rounded team player. I'm looking forward to using these skills and perspective to contribute to your team while fully realizing my potential.

Engineering Projects

Final Year Project
Real-Time Implementation for On-Load Tap Changer (OLTC) Tranformer Operation using Typhoon HIL

- Developed a high-fidelity real-time simulation model for the OLTC transformer using the Typhoon HIL platform, focusing on capturing the dynamic behaviour and response to variable load conditions.
- Analyzed the impact of OLTC operations on voltage regulation and power system stability within a modeled power distribution network, identifying potential improvements in efficiency and reliability.
- Implemented and validated the OLTC transformer model within a real-time simulation environment, utilizing the Typhoon HIL software to ensure accuracy and performance alignment with actual operational conditions.

Sustainable Energy Technologies
Evaluation of Renewable Energy Systems: PV, Biomass, Wind, and Geothermal Applications

- Evaluated the performance of Mitsubishi PV modules and calculated the energy generation for various conditions, including array configurations and MPPT-type charge controller specifications.
- Assessed biomass gasification efficiency, wind turbine payback periods, and the feasibility of converting waterfall energy for village electrification.
- Analyzed the revenue generation potential of a geothermal heating system for residential districts during winter, based on energy output and operational hours.

Sustainable Energy Technologies
Design and Sizing of a PV-Battery Solar System for Residential Application

- Developed a complete PV-battery solar system for a residential application, considering worst-case scenarios.
- Chose and sized key components, including the charge controller, inverter, batteries, and PV modules, based on technical calculations.
- Conducted technical and economic evaluations, accounting for system efficiency, battery autonomy, voltage drop, and other design factors.

Internet of Things: Communication, data and security
Smart Lab System with IoT, Machine Learning, and Enhanced Security Features

- Developed a smart lab system with ultrasonic sensors to detect presence and send alerts via Telegram.
- Implemented algorithms to classify movements for accurate access control and enhance system intelligence.
- Utilized encryption for password protection and secure data transmission during user authentication.

Internet of Things: Communication, data and security
Machine Learning and Encryption System for Vehicle Detection and Data Security

- Developed a machine learning-based velocity and lane deviation detection system using ultrasonic sensors and Raspberry Pi.
- The system collected data on vehicle movements, categorized them by velocity and direction, and applied classification models (KNN, CART, SVM) to detect lane departures and speed, with real-time results visualized on ThingSpeak.
- Designed a hybrid encryption and decryption system combining Caesar and Vigenère Ciphers.
- The system encrypts text by applying a custom shift with Caesar Cipher followed by Vigenère encryption for enhanced security.

Internet of Things: Communication, data and security
Lane Departure Warning and Velocity Monitoring System with Real-Time Alerts

- Developed a Lane Departure Warning and Velocity Measurement System using ultrasonic sensors and Raspberry Pi, with real-time data visualization via ThingSpeak.
- The prototype detects lane deviation and vehicle speed, sending alerts through Telegram for timely safety interventions.
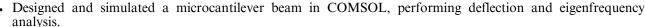
Microsystems and Semiconductor Fabrication
Smart Goggle Design for Environmental Monitoring Using Integrated Sensors and Custom-Fabricated AlN Sensor

- Developed a wearable smart goggle with integrated humidity, temperature, UV and light sensors for comprehensive environmental monitoring.
- Used the BME280 sensor for accurate detection and a custom Aluminum Nitride sensor with interdigital transducers, leveraging piezoelectric and conductive properties for enhanced sensing.

Microsystems and semiconductor fabrication
COMSOL Lab Reports

- Designed and simulated a microcantilever beam in COMSOL, performing deflection and eigenfrequency analysis.
- Modeled capacitive pressure sensors to simulate deformation and stress under loads, enhancing MEMS behavior.
- Optimized material performance by simulating electric potential in microstructures for improved sensor efficiency.

Microsystems and semiconductor fabrication
Wafer Fabrication Report

- Fabricated comb structures on lithium niobate substrate using microfabrication techniques.
- Applied S1805 photoresist via spin coating, exposed with UV light for 30 seconds, and developed with OCG 809 developer.
- Performed soft and hard baking, followed by acid-based wet etching, and observed the fabricated structure under a microscope.

Energy Efficiency and Sustainability Engineering
Energy Efficiency Assessment

- Conducted energy analysis comparing fluorescent to LED lighting in a commercial building, achieving notable reductions in energy, costs, and CO_2 emissions.
- Analyzed residential electricity tariffs in Malaysia against global rates, highlighting cost efficiency.
- Performed an energy audit of a factory, demonstrating significant savings by switching from mercury lamps to LEDs under Malaysia's industrial tariff.

Sustainable Energy Technologies
Engaging with IGEM 2024: Actionable Steps Toward Net-Zero Solutions

- Attended keynote presentations on the latest innovations in green technologies, focusing on energy efficiency and sustainability.
- Drafted a brief report summarizing the key takeaways from discussions on renewable energy policies and net-zero targets, integrating them into your assignment.
- Collected data from case studies presented by leading organizations showcasing successful green technology implementations in Southeast Asia.
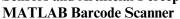
Sensors and Artificial Perception
Embedded Systems Lab Report (PSoC)

- Developed digital circuits from simple LED blinkers to advanced systems involving clocks, switches, and debouncers using PSoC Creator.
- Gained expertise in setting up, simulating, and programming digital systems, emphasizing practical application of embedded system concepts.
- Utilized APIs and debugging tools to enhance system functionality and reliability.

Sensors and Artificial Perception
MATLAB Barcode Scanner

- Implemented C programming and image processing techniques to decode EAN-13 barcodes.
- Captured images with a USB camera, converted them to greyscale, and applied thresholding for binary image analysis.
- Scanned barcodes, counted pixel widths, and decoded characters, enhancing understanding of image processing fundamentals.

Sensors and Artificial Perception
Blob Statistics Calculation in Image Processing

- Developed MATLAB code to detect and analyze blobs in binary images.
- Calculated 0th, 1st, and 2nd order moments to determine blob centers and axes of inertia.
- Superimposed statistical calculations on original images to provide a visual representation of blob properties.

Sensors and Artificial Perception
Ultrasonic Distance Meter

- Evaluated the feasibility of two installation alternatives for a 300km fiber optic cable project.
- Analyzed financial, operational, and environmental factors to recommend the best installation method.
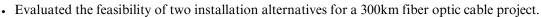- Outlined comprehensive project management plans for the chosen installation alternative.

Energy Efficiency and Sustainability Engineering
Energy Audit for Residential Property

- Conducted an in-depth assessment of a house's energy consumption to identify efficiency improvements.
- Analyzed the efficiency of household appliances and systems, providing actionable recommendations.
- Proposed upgrades and behavioral changes to enhance energy efficiency and reduce costs.

Professional Practice
Project Evaluation

- Evaluated the feasibility of two installation alternatives for a 300km fiber optic cable project.
- Analyzed financial, operational, and environmental factors to recommend the best installation method.
- Outlined comprehensive project management plans for the chosen installation alternative.

Professional Practice
Financial Analysis and Strategic Business Planning

- Analyzed financial transactions and prepared financial statements for Pioneer Engineering Ltd.
- Developed a strategic plan outlining financial strategies and growth opportunities for the next three years.
- Delivered findings in a detailed report and a presentation, demonstrating financial analysis and strategic planning skills.

Professional Practice
Managerial Roles in Engineering

- Analyzed managerial roles and organizational structures in engineering companies.
- Conducted interviews to gain insights into managerial effectiveness and organizational contexts.
- Compiled findings into a detailed report and presentation, integrating management theory with practical insights.

Professional Practice
Analysis of Challenges in Engineering Practices

- Examined complex legal, ethical, and contractual scenarios within engineering contexts.
- Analyzed cases involving product liability, contractual disputes, and negligence in engineering environments.
- Compiled findings into a 2000-word report outlining legal frameworks, ethical dilemmas, and contractual obligations.

Engineering Integrated Design
Monash Malaysia Color Bowl 2023

- Engineered a self-sufficient autonomous robot capable of detecting and moving colored pucks to displace bowling pins using a flicking mechanism, responding to color signals for targeted actions within a designated playing field.
- Integrated advanced sensor technology, including ultrasonic modules for navigation and obstacle avoidance, color sensors for puck detection, and Bluetooth communication for receiving and executing commands from a host.
- Developed a robust design strategy incorporating durability with lightweight construction, a precision flicking mechanism for targeted pin displacement, and an adaptive pathfinding algorithm to navigate efficiently across different levels of the competition.

Control System Design
System Identification and Control for a Cruise Control System Design

- Created a mathematical model for a cruise control system to maintain vehicle speed under varying conditions.
- Designed controllers to handle speed and incline changes with high precision and minimal error.
- Refined the system through iterative testing, optimizing PID controller settings for stability and responsiveness.

Power Systems Analysis
Power System Analysis Lab Report

- Conducted load flow studies on a small-scale power system to assess performance.
- Simulated voltage stability and system behavior during outages using a simulation tool.
- Identified corrective measures to optimize system performance.

Engineering Electromagnetics
Engineering Electromagnetics Lab Report

- Used MATLAB to analyze electrostatic fields for various charge configurations.
- Visualized and calculated fields around single charges, dipoles, and quadrupoles.
- Applied theoretical principles to practical scenarios, enhancing understanding of electrostatics.

Engineering Electromagnetics
Electromagnetism in Vacuum Cleaners

- Explored the role of electromagnetism in the operation of vacuum cleaner motors.
- Used Biot-Savart's Law to explain magnetic field creation and motor function.
- Provided a comprehensive study of electromagnetism in everyday appliances.

Engineering Electromagnetics

Electromagnetic Brewing: Unpacking xBloom's Solid-State Pouring Technology

- Investigated xBloom's innovative coffee machine, employing MATLAB simulations to understand the electric field's influence on water stream deflection during the brewing process.
- Explored the electrohydrodynamics (EHD) and dielectrophoresis effects in fluid manipulation, contributing to the machine's ability to mimic a barista's precise pouring technique.
- Analyzed the impact of electrode voltage and spacing on the water molecule's movement, revealing the significance of electric field strength in the device's functionality.

Computer Vision

Computer Vision Lab Report

- Implemented edge detection and image stitching tasks in computer vision.
- Applied Gaussian blur and calculated image gradients for edge detection.
- Demonstrated practical applications such as panoramic image stitching and object recognition.

Analogue Electronics

Digital Controlled Oscillator for Piano Synthesizer

- Led the design of a digital controlled oscillator for a piano synthesizer, focusing on sound quality and minimal frequency distortion with cost-effective components.
- Engineered complex circuits including RC tank circuits and class AB amplifiers, incorporating microcontroller-based frequency control for precise audio output.
- Executed simulations and tests to optimize synthesizer performance, achieving below 0.3% distortion and stable audio output through advanced noise reduction techniques.

Analogue Electronics

Analogue Electronics Lab Report

- Analyzed performance characteristics of various op-amp setups.
- Examined op-amp behavior under different feedback and loading conditions.
- Conducted experiments to understand practical applications of analog electronics.

Electrical Energy Systems

Electrical Energy Systems Lab Report

- Designed and tested a Nios processor system for enhanced I/O operations.
- Programmed the Nios processor using assembler and C code.
- Conducted tests to measure response times and functional accuracy of configurations.

Computer Systems

Computer Systems Lab Report

- Designed and tested a Nios processor system for enhanced I/O operations.
- Programmed the Nios processor using assembler and C code.
- Conducted tests to measure response times and functional accuracy of configurations.

Introductory Macroeconomics

East Asian Economic Growth Analysis

- Examined significant economic advancements in East Asia for the World Bank.
- Identified factors contributing to growth and challenges for sustainable development.
- Evaluated the Asian development model's applicability to newer economies.

Introductory Macroeconomics

Macroeconomic Impact of COVID-19 in the Asia-Pacific Region

- Analyzed the macroeconomic effects of COVID-19 on a selected country.
- Evaluated the effectiveness of policy responses to economic disruptions.
- Provided a comprehensive analysis grounded in reputable data and literature.

Information and Networks

Downsampling Research Project

- Conducted in-depth analysis of audio and image downsampling effects, using MATLAB simulations to highlight audio aliasing and the importance of Anti-Aliasing Filter (AAF) techniques.
- Experimented with various methods, determining the most effective approaches for maintaining optimal audio/image integrity, especially under higher downsampling rates.
- Acquired comprehensive knowledge of the technologies and architectures underpinning modern telecommunications systems, including digital signal representation, multiplexing, and modulation.

Information and networks
Information and Network Lab Report

- Investigated the impact of quantization on signal-to-noise ratio and audio quality.
- Explored various quantization functions and their effects on signal representation.
- Provided practical insights into digital signal representation trade-offs.

Electrical Circuits
Lab Reports

- Mastered the fundamentals of linear electronic circuit analysis and design, including sinusoidal steady-state analysis with phasors and complex impedances. Developed proficiency in utilizing state-of-the-art prototyping and measurement tools for circuit design and analysis.
- Gained in-depth knowledge of solid-state electronics, focusing on diodes, field-effect transistors (FET), bipolar junction transistors (BJT) and operational amplifiers, applying these components in practical circuit designs.
- Strengthened understanding of circuit theory through node and mesh analysis, simulation, and AC analysis using Laplace transform techniques for frequency and time response in electrical networks.

Algorithms and Programming Fundamentals in Python
Sudoku Solver and Generator

- Acquired foundational skills in Python programming, focusing on program design, algorithm implementation, and solving simple problems through effective use of control structures and data types.
- Developed proficiency in basic input/output operations, modular program structure, and essential data structures to enhance code modularity and maintainability.
- Explored problem-solving strategies including iteration, recursion, and algorithm efficiency, gaining insights into the limitations and capabilities of various algorithms.

Algorithms and Programming Fundamentals in Python
Python Lab Reports

- Covered data structures, control structures, functions, and modules.
- Applied data structures to solve real-world problems.
- Explored file operations, error handling, and object-oriented programming.

Probability Models in Engineering
Medical Data Handling and Analysis in MATLAB

- Processed and analyzed heart diagnosis data using MATLAB.
- Applied statistical methods to identify patterns in medical data.
- Demonstrated practical applications of data analysis in medical contexts.

Probability Models in Engineering
Statistical Modelling of Covid-19 Patients and Public Transportation

- Mastered core principles of probability theory, including conditional probability, independence, and combinatorics, enhancing my ability to apply these concepts to engineering problems with both intuitive and mathematical approaches.
- Gained a deep understanding of discrete and continuous random variables, exploring common distributions like Gaussian, Exponential, Chi-square, and Rayleigh, crucial for applications in diverse engineering fields.
- Studied advanced topics such as transform methods, limit theorems, and Markov chains, applying these to real-world engineering scenarios like wireless communications, queuing theory, image processing, and electrical insulation.

Signals and Systems
Advanced Gait Analysis using MATLAB

- Conducted in-depth analysis of audio and image downsampling effects, using MATLAB simulations to highlight audio aliasing and the importance of Anti-Aliasing Filter (AAF) techniques.
- Experimented with various methods, determining the most effective approaches for maintaining optimal audio/image integrity, especially under higher downsampling rates.
- Developed foundational skills in electrical engineering with a focus on control, signal processing, and communications, mastering concepts of continuous and discrete-time signals, complex numbers, Fourier series, and transforms.

Signals and Systems
Signals and Systems Lab Report

- Explored discrete-time and continuous-time signals using MATLAB.
- Gained proficiency in manipulating complex numbers.
- Applied filters to sound files, enhancing understanding of signals and systems.

Digital Systems

Digital Systems Lab Report

- Familiarized with TTL logic gates through design and testing of combinational circuits.
- Designed and tested half adders, decoders, and multiplexers.
- Gained a solid foundation in digital logic design and testing.

Digital Systems

FSM-Based BCD Counter Design and Optimization Project

- Mastered modern logic design techniques and computer architecture, focusing on combinational logic, finite state machines, and microprocessor systems through extensive laboratory practice.
- Developed proficiency in implementing and testing digital circuits using essential components like registers, counters, and programmable logic devices, applying hardware description languages for synthesis.
- Acquired knowledge in interfacing techniques and communication protocols such as RS232, CAN bus, and i2C, alongside foundational concepts in real-time systems and process scheduling.

Leadership and Innovation

Hybrid Solar Lighting System

- Directed a 5-member team in pioneering a solar hybrid lighting system, integrating the innovative Kanawa Tsugi concept and TRIZ (Theory of Inventive Problem Solving).
- Collaborated closely with Germany-based Professor Eckert for expert guidance, culminating in a prototype's successful construction.
- Proud nominee of the esteemed James Dyson Award 2021.

Computer organisation and programming

PLC Lab Report

- Covered basic operations, programming, and troubleshooting of Siemens PLCs.
- Implemented control systems for pumps, motors, and emergency lights.
- Gained practical experience in industrial automation using PLCs.

Computer organisation and programming

C Programming Lab Report

- Covered basic programming techniques and debugging practices in C.
- Tackled tasks like thermistor temperature calculation and phase conversion in power systems.
- Reinforced understanding of essential programming concepts and tools.

Computer organisation and programming

MIPS Lab Report

- Explored fundamental MIPS programming techniques using MARS.
- Covered arithmetic operations, memory access, and control flow mechanisms.
- Enhanced skills in low-level computer organization and programming.

Engineering mobile apps

Taxi Booking Web App

- Developed a mobile app for taxi booking using a hybrid waterfall-agile methodology.
- Adhered to development milestones with tools like Trello and Git.
- Demonstrated teamwork and project management skills in software development.

Engineering mobile apps

Room Booking Web App

- Developed a room booking application using HTML and JavaScript.
- Created functions for booking, status checking, and display updating.
- Ensured progressive work with regular commits to a Git repository.

Engineering mobile apps

Student Queue Management Web App

- Enhanced a web application for managing student queues using HTML, JavaScript, and MDL.
- Implemented functionalities for dynamic student registration and session tracking.
- Emphasized data persistence with local storage and rigorous coding practices.

Engineering design: Cleaner, safer, smarter
Feasibility Report on LED Array Configurations

- Conducted a study on various LED array configurations for sustainable lighting.
- Evaluated configurations for practicality and cost-effectiveness.
- Developed an optimized LED array design for affordable and reliable lighting.

Engineering design: Cleaner, safer, smarter
Wastewater Treatment Plant

- Designed an efficient plant for addressing water quality issues in Klang Valley.
- Incorporated solar power for self-sustainability and reduced reliance on the power grid.
- Contributed to clean water and sanitation efforts in line with the United Nations SDGs.

Computing for Engineers
Data Analysis, Numerical Integration And Differential Equations

- Applied MATLAB to solve engineering problems involving data analysis, numerical integration, and differential equations.
- Modeled COVID-19 spread and analyzed data for multiple countries.
- Solved second-order ODEs for an RLC circuit, demonstrating proficiency in engineering computations.

Computing for Engineers
MATLAB Lab Report

- Covered plotting, matrix manipulation, and computational methods for engineering problems.
- Worked in teams to solve practical problems using MATLAB.
- Emphasized data visualization and analysis techniques.

Physics for Engineering
Excitation of Neon Atoms in Helium-Neon Lasers

- Explored the excitation of neon atoms within helium-neon lasers.
- Examined energy transfer from electrons to helium and neon atoms.
- Provided insights into the fundamental mechanisms of laser operation.

Physics for Engineering
CD Spectrometer Project

- Built a simple spectrometer using a CD to analyze light sources.
- Studied properties of light such as wavelength and frequency.
- Gained practical experience in building and using scientific instruments.

Physics for Engineering
Egg Drop Project

- Designed a device to protect an egg from breaking when dropped.
- Applied principles of gravity, impact force, and momentum.
- Encouraged creative thinking and practical application of theoretical concepts.

Engineering Design: Lighter, faster, stronger
Materials Design

- Analyzed stress-strain properties of aluminum samples.
- Investigated the impact of work hardening and annealing on dislocation density.
- Designed a structural beam considering dimensions, mass, cost, and carbon footprint.

Engineering Design: Lighter, faster, stronger
Trebuchet Design

- Created a highly efficient trebuchet using modern materials and technologies.
- Analyzed and refined variables to achieve optimal launch conditions.
- Demonstrated skills in structural analysis and mechanical design.

Engineering Design: Lighter, faster, stronger
Truss Bridge Design

- Developed a truss footbridge to address student convenience during rainy days.
- Conducted force calculations using the Method of Joints (MOJ) and Method of Sections (MOS).
- Demonstrated skills in material selection, teamwork and project management.