

# **Nabil Karim Abdurrahman**

## **Engineering Portofolio**

### **Preface**

As an Engineering Physics undergraduate at ITB, I present this portfolio for your consideration. This collection of projects is more than a display of technical skills; it is a narrative of continuous growth, resilience, and maturation forged through direct, hands-on experience and a persistent dedication to my craft.

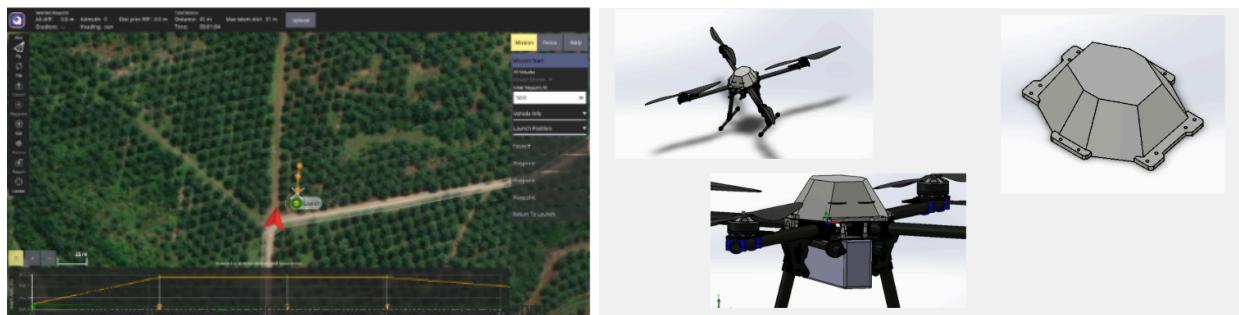
My work is intentionally focused on the intersection of IoT Systems and Robotics Engineering. You will see projects that demonstrate a full-stack understanding of IoT, from designing embedded, RTOS-based sensor nodes with the ESP32 to architecting multi-layered IIoT platforms using Node-RED, HMIs, PLCs, and cloud databases. In robotics, my experience spans the entire development lifecycle—from mechanical design and FEA in Solidworks and building embedded controllers with STM32, to implementing autonomous navigation and control systems on a Jetson platform using ROS, Pymavlink, and MAVSDK.

However, what this portfolio doesn't explicitly show are the numerous unmentioned setbacks and imperfect iterations that paved the way for these successes. Each technical hurdle has been a critical turning point. These challenges pushed me to learn from my shortcomings, master new technologies, and develop the problem-solving maturity essential for real-world engineering. This journey has taught me that innovation is built not only on successful outcomes, but on the perseverance to push through complexity.

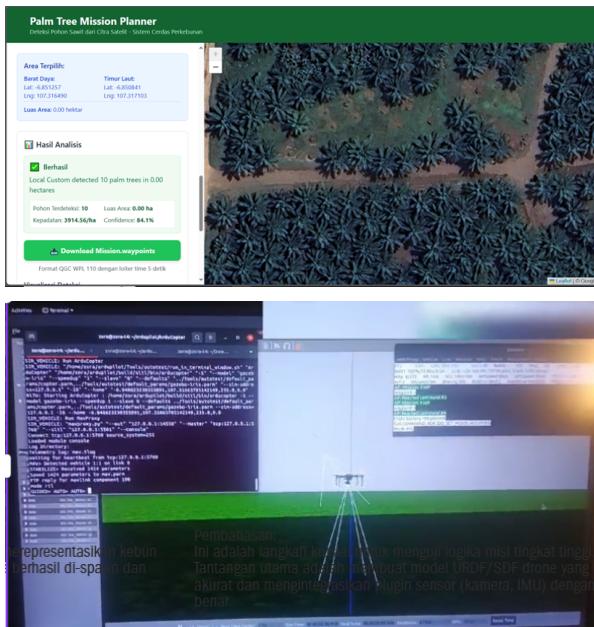
I am confident that the engineer I am today is significantly more prepared, capable, and resilient. I am eager to bring not just my technical skillset, but also this hard-won perspective to the hands-on environment at **Makerindo Prima Solusi**. Thank you for your consideration; I look forward to the opportunity to demonstrate my commitment and contribute to your team.

## #1 Autonomous Oil Palm Pollination Drone

Topics: Pixhawk, Jetson, ROS, YOLOv11, Digital Twin, SITL-HIL Testing, STM32, Solidworks



I am developing an end-to-end autonomous drone system for precision oil palm pollination, with its core flight control and mission execution built directly on Pymavlink and MAVSDK for high-performance, low-latency control. In my development workflow, ROS serves as a powerful logical architecture validation platform, where I use a Digital Twin to simulate and verify complex algorithms before implementation. This ongoing project has successfully achieved autonomous waypoint missions with integrated obstacle avoidance, real-time STM32-based payload actuation, and full-duplex communication for telemetry and command input via a web data interface. The project also encompasses my mechanical design work in Solidworks and the embedded payload system.



### Drone Sawit Mission Dashboard

#### Live Status

2.34 m	87 %
Jarak Lidar	Baterai
15.2 m	3.5 m/s
Altitude	Kecepatan
-2.12345	111.12345
Latitude	Longitude
45 °	10
Heading	Satellites

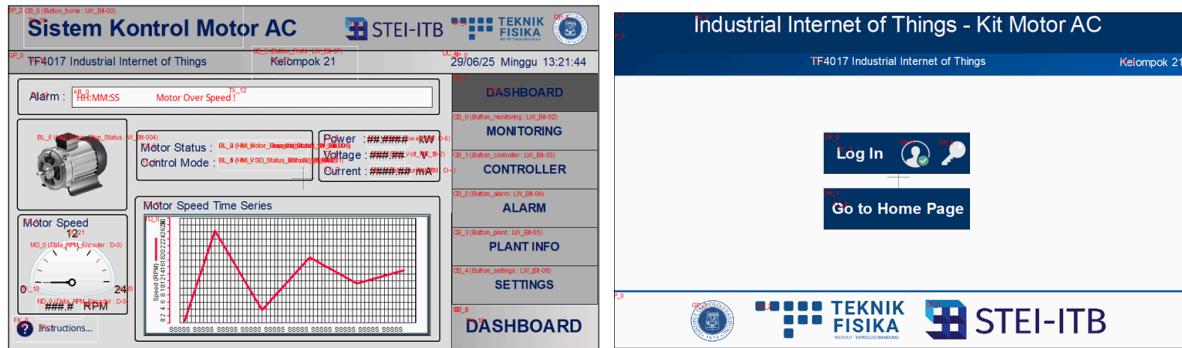
**FLYING**

#### Spraying Status

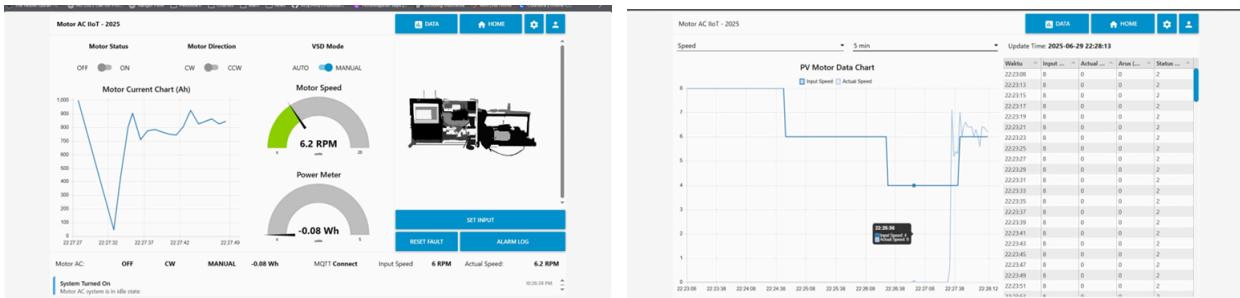
ON	3
Status Penyemprotan	Waypoint Saat Ini
12	25 %
Total Waypoint	Progress Penyemprotan
8 s	Durasi Penyemprotan (waypoint ini)

## #2 IIoT Capstone Project

Topics: IIoT, Nodered, HMI Weintek, CX Designer, NextJS, MongoDB

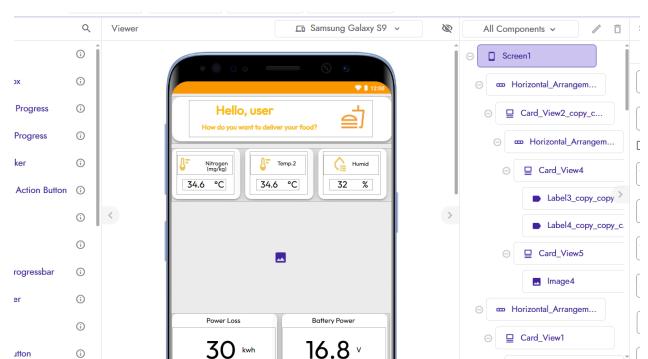
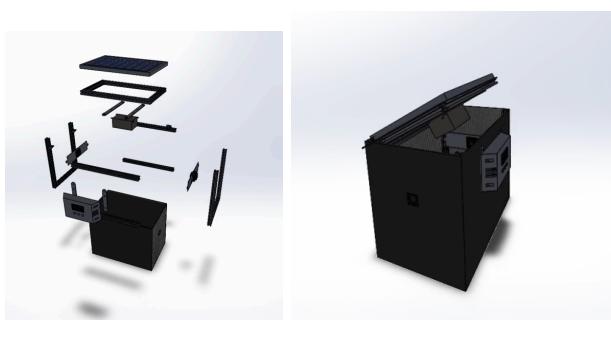


For my IIoT capstone project, I developed and configured a multi-layered data visualization system. My primary role involved designing an offline-capable HMI dashboard in Node-RED that utilized MQTT for real-time data acquisition and a local database for storage. I also contributed to the development of a cloud-based web application using Next.js connected to a MongoDB online database. Additionally, I assisted in configuring the on-premise HMI Weintek, managing its communication protocols and screen elements with an Omron PLC through CX Designer.



## #3 Control Temperature Food Delivery Box

Topics: IoT, ESP32, RTOS, Electrical System, Physics

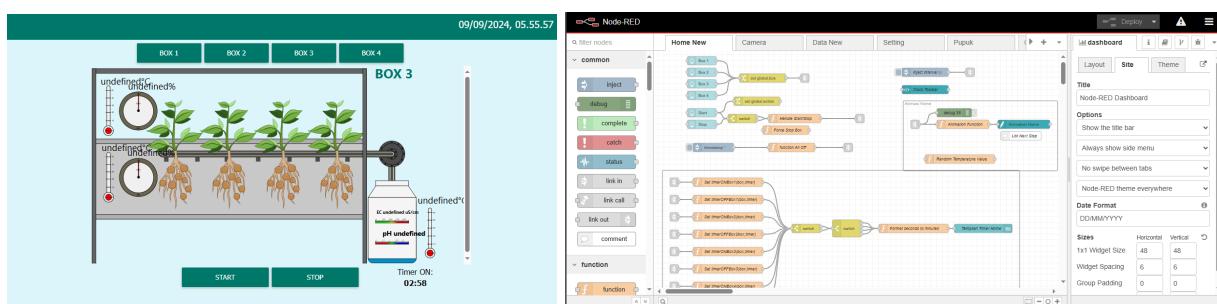


In this project, I engineered an advanced temperature control box, leveraging a dual-core ESP32 microcontroller to ensure high performance and reliability. By implementing a Real-Time Operating System (RTOS), the system efficiently manages simultaneous tasks: one core executes a precise control loop to maintain stable 23°C cooling and 45°C heating setpoints, while the other handles wireless communications. The integration of a hardware watchdog timer guarantees robust, fail-safe operation. The thermal system utilizes a PTC air heater and a TEC Peltier module, each paired with a fan for uniform temperature distribution within the 40x30x27 cm enclosure.

To deliver a seamless user experience, I developed a custom IoT solution for remote management. The ESP32 hosts a Wi-Fi access point, enabling a direct connection to a user-friendly Android application I built using Kodular. This app allows for real-time monitoring of temperature, humidity, and battery levels, as well as remote switching between heating and cooling modes. The project showcases my skills in embedded systems (C++/Arduino, ESP32, RTOS), power management with supplementary solar charging, and full-stack IoT development, from hardware control to the mobile user interface.

#### #4 Aeroponik HMI with MQTT Connection

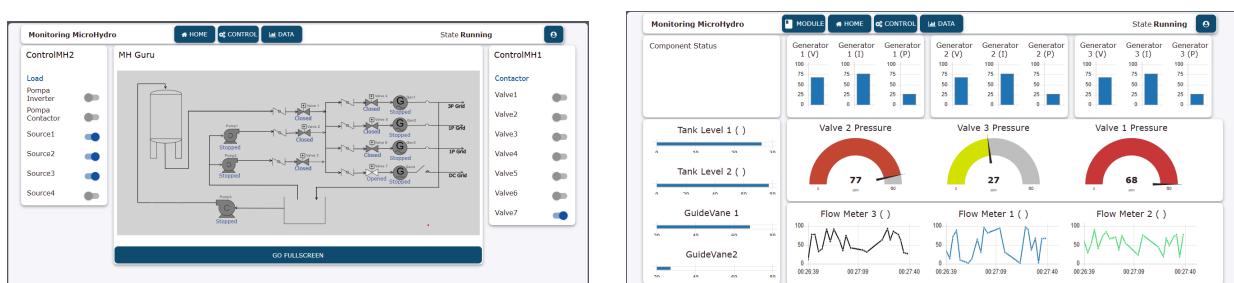
*Topic: HMI, Node-red, MQTT*



As part of my MBKM project at Kedaireka.id, I successfully implemented several features, including local file CRUD operations, SVG animation functions, and a settings tab. This was my first experience with Node-RED, where I learned by doing and quickly adapted to troubleshooting various issues independently, significantly enhancing my problem-solving skills.

#### #5 Micro HydroPower Integrated Learning System HMI with MQTT Connection

*Topic: HMI, Node-red, MQTT, mySQL*

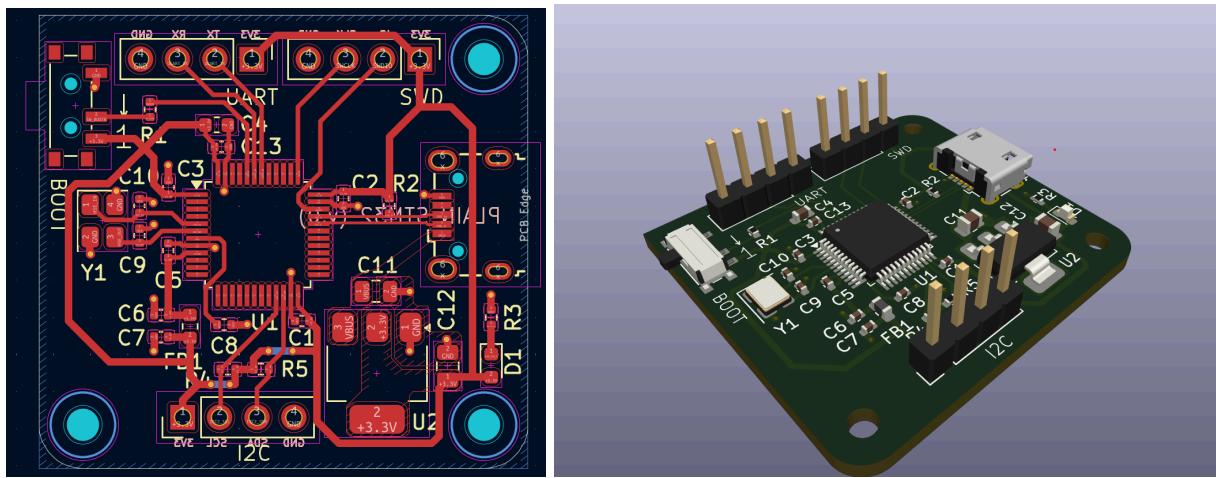


As part of my MBKM project with Kedaireka.id, I initially joined the Aeroponic team, but due to various challenges, I adapted to multiple teams by applying my skills across projects. I designed the HMI system from scratch for a student and teacher learning module, which included login pages, module settings, control functions, data management, and functional overviews. As part of assisting my partner, I also help to create the MQTT function and implement RTOS core system to deliver real time acquisition with high reliability data acquisition.

I utilized MySQL for the database and MQTT to connect the system to a PLC. Throughout the process, I adhered to industrial standards by adopting ISA101 and ISO 11064-5 to ensure the system met the latest requirements.

## #6 Custom Mini STM32 PCB Design

Topic: Microcontroller Design, Layout, Simulation



In this project, I engineered a custom microcontroller development board based on the **STM32F103C8T6** (ARM Cortex-M3) using **KiCad 6**, executing the full hardware design lifecycle from schematic capture to final PCB layout. Technically, I implemented a robust power management system utilizing an **AMS1117 LDO** regulator and designed a precision clock subsystem with a **16MHz external crystal oscillator**, applying specific load capacitance calculations for timing accuracy. The 2-layer PCB layout prioritized signal integrity and EMC compliance through **differential pair routing** for the USB 2.0 interface, strategic **decoupling capacitor placement** to minimize power rail inductance, and the utilization of a solid **bottom ground plane** for noise suppression. Additionally, I incorporated a **Serial Wire Debug (SWD)** interface to facilitate efficient hardware debugging and firmware flashing, culminating in the generation of production-ready Gerber files and BOM for manufacturing.

## #7 Intelligent EV Station with RFID & Load Forecasting

Topic: ReactJS, FastAPI, XGBoost

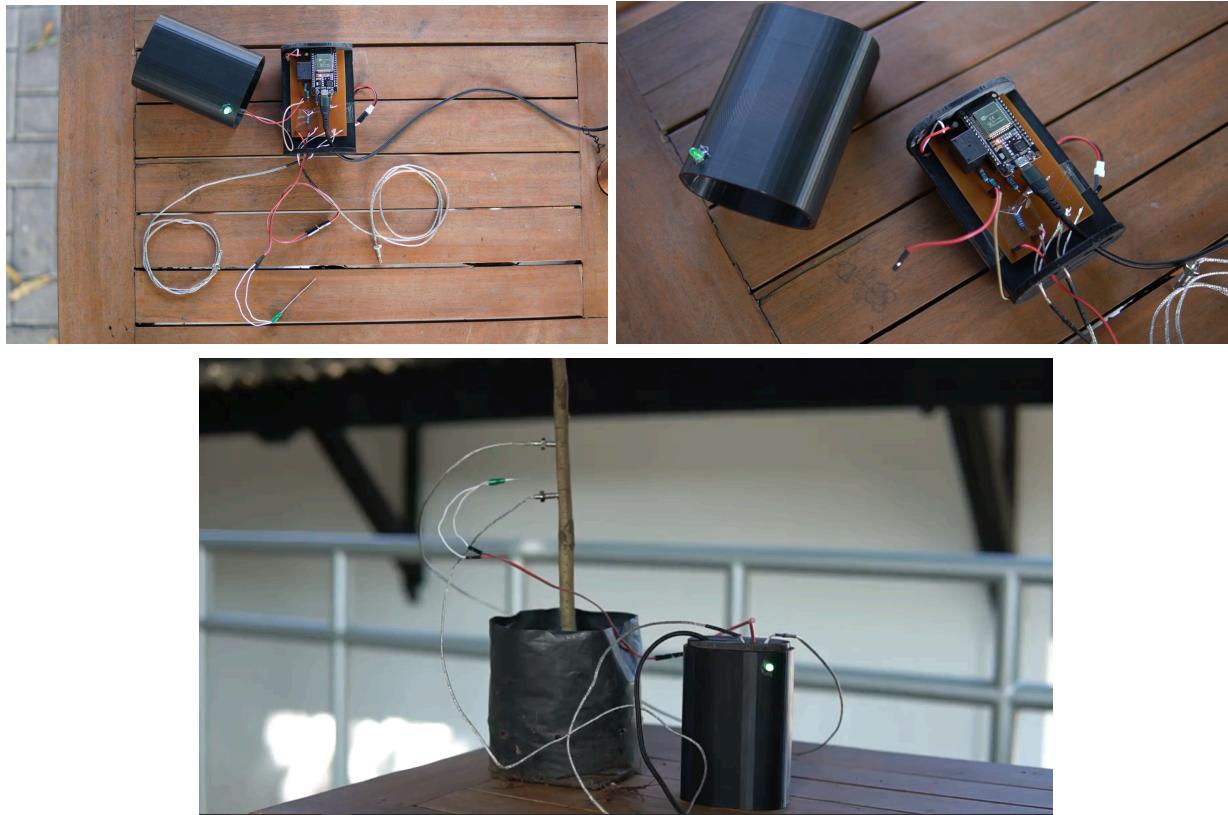
I engineered a comprehensive, full-stack Central System Management Software (CSMS) for EV charging infrastructure, featuring an intelligent **Admin Webapp** powered by Machine Learning for predictive analytics. The backend, built with FastAPI, orchestrates a pipeline that aggregates historical charging session data to train a XGBoost model using a standard industrial approach for time-series

forecasting. This model autonomously updates via background workers to predict future peak demand and energy consumption, visualizing actionable insights on the dashboard to assist operators in grid load management. The system ensures data consistency through a MySQL database, while the frontend uses ReactJS to render dynamic charts that refresh automatically as new predictions are generated.

On the hardware side, I revitalized the charging station controller using an industrial Raspberry Pi integrated with a PN532 RFID reader for secure authentication. This edge device hosts a local 'Onboard Panel' webapp in kiosk mode, providing users with immediate, low-latency feedback on charging status and connector availability. Simultaneously, the architecture supports remote accessibility; users can log in via their mobile browsers to track their charging progress, view session history, and receive completion notifications in real-time. This decoupled frontend design serving both the physical station display and personal mobile devices ensures a seamless, user-centric experience across physical and digital touchpoints.

## #8 SAP Flow Sensor

*Topic: Analog Electrical Circuit, 3D Design*

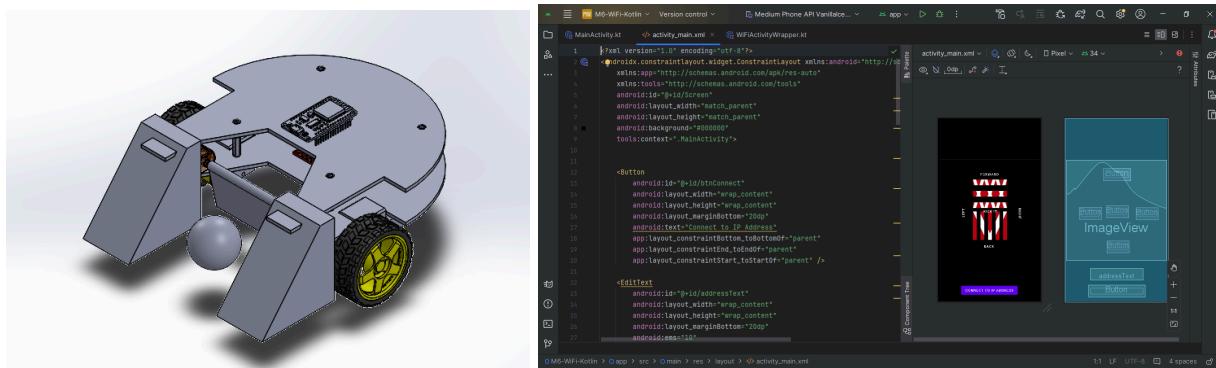


I designed a compact SAP Flow Sensor system using a microcontroller and analog circuit to amplify thermocouple signals for tracking plant health. By customizing the data acquisition formula, my team and I were able to detect plant health within specific ranges. I also created a 3D model for efficient circuit

placement. Although the GPS module for long-range monitoring wasn't fully implemented, this project provided significant experience in designing quick, compact, and functional sensor solutions.

## #9 Soccer Robot

*Topic: Embedded System, Kotlin, C++, 3D Design*

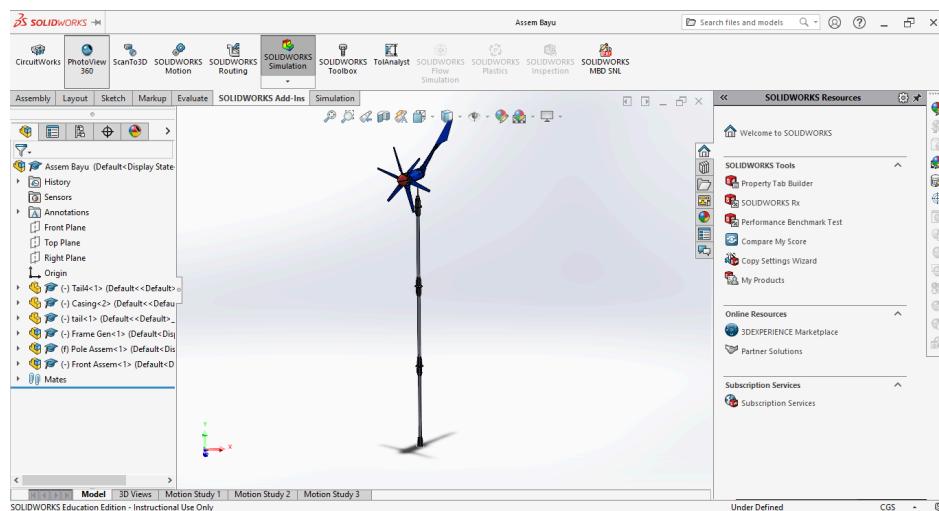


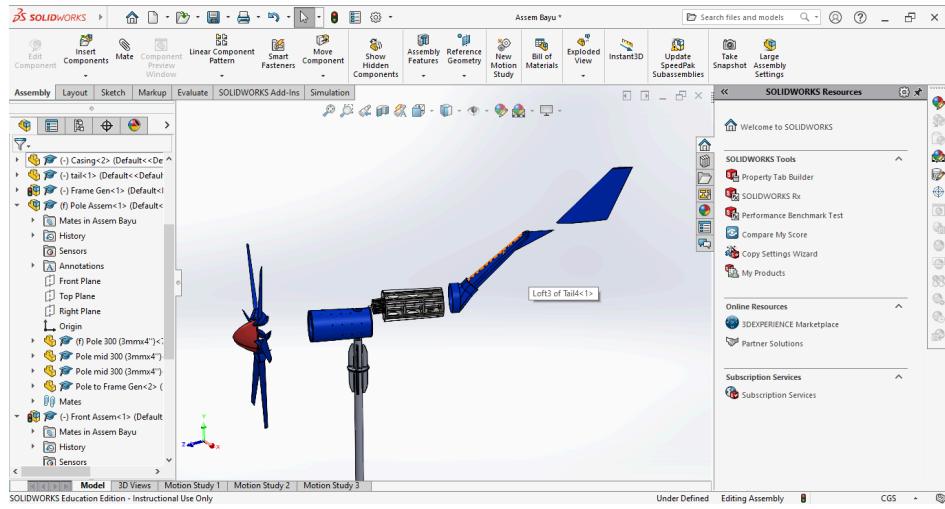
For my final course project in Engineering Physics Laboratory II, I was tasked with designing a competitive robot for a soccer competition. I designed the 3D model, developed the UI control using Android Studio, and connected it to the Arduino code I created. Although it was a team effort, I took the initiative to lead the integration of the system, ensuring the robot moved smoothly based on control inputs via a Wi-Fi connection to my mobile app. This project deepened my interest in embedded systems and strengthened my hands-on experience.

## #10 3D Design Model of Wind Turbine at PT. Telenentina

*Topic: 3D Design, 3D Model, Solidworks*

As part of my MBKM project at Kedaireka.id, I was responsible for documenting various product components and assisting in the assembly process to ensure the 3D model's accuracy compared to the real model. Additionally, I rendered an animation video for company purposes, enhancing the project's visual communication and presentation.



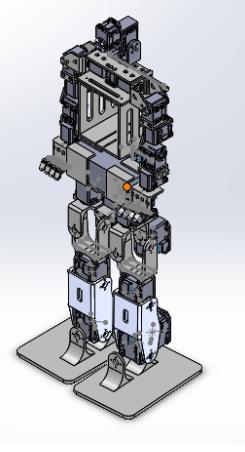
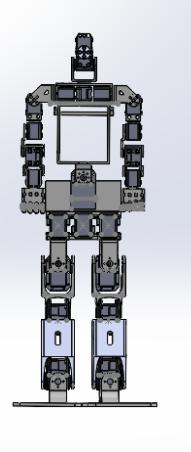


\*I can't give the full file because it's quite sensitive for the company

## #11 Humanoid Robot for Robot Dance Art Contest (KRSTI)

*Topic: 3D Design Model, FEA Analysis*

During my second year of undergraduate studies, I was recruited as a mechanical crew member for the Dago Concordia Team (Robot Dance Art Contest). My responsibilities included conducting in-depth research on the latest humanoid robot movements and 3D design to meet competition requirements while ensuring the robot's functionality. I was also tasked with designing support structures and performing FEA analysis on the waist component to ensure it could support the robot's upper body weight. This role allowed me to apply my mechanical engineering skills in a competitive environment.



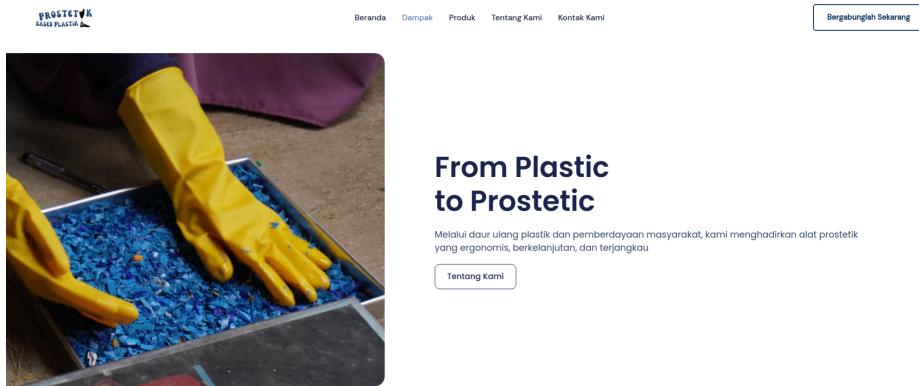
## #12 Webapp Free Healthy Meal Management

*Topic: VueJs, MySQL, Web2py*

I developed the client-side application using the **Vue.js** framework to create a dynamic and responsive user interface. The backend was engineered on **Web2py** to handle server-side logic, including user authentication and data processing. For data persistence, I designed and implemented the relational database schema using **MySQL**.

### #13 Recycle Plastic Prosthetic ([probaplas.id](http://probaplas.id))

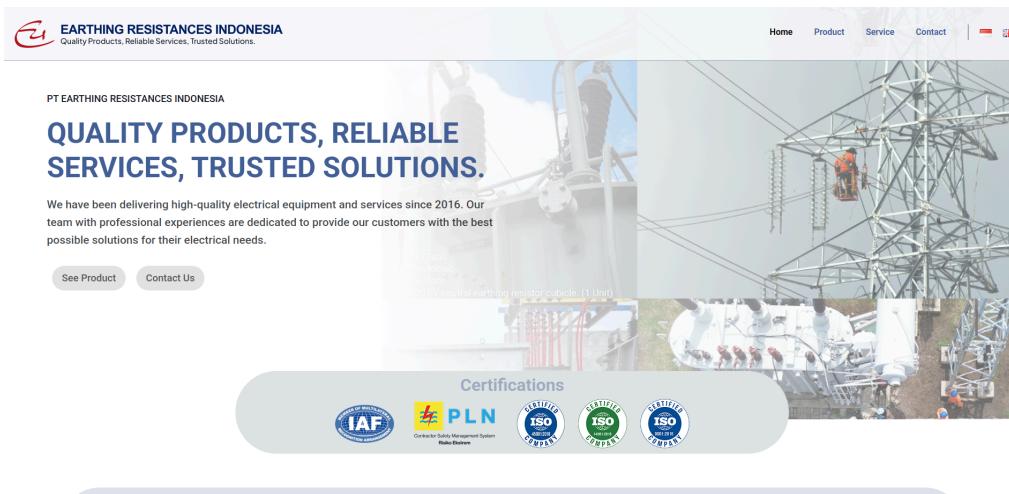
*Topic: Wordpress Web Development*



I developed a WordPress platform for this social engineering initiative, utilizing the Elementor builder for dynamic page layouts and custom post types for project showcases. The site integrates specialized plugins for gallery management and user contact forms. Custom CSS was written to override template styles, ensuring unique branding and a responsive user interface that aligns with the project's innovative mission.

### #14 Professional Company Landing Page ([earthing-resistances.com/](http://earthing-resistances.com/))

*Topic: Wordpress Web Development*

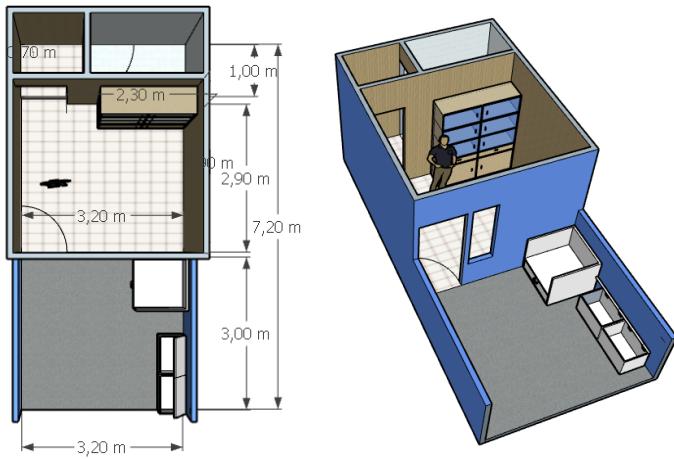


I engineered a responsive, single-page corporate website using WordPress and the Elementor Pro page builder. The site was built with a focus on lead generation, incorporating a customized contact form plugin and a filterable project portfolio. My primary technical contribution involved writing custom CSS

to achieve pixel-perfect UI/UX refinement and ensure absolute brand consistency across the mobile-first design.

### #15 Development of Local Prosthetic Workshop (Social Project)

*Topic: Sketchup, Blocplan*



I was invited by several senior colleagues from my appropriate technology development unit to participate in a social project focused on empowering a prosthetic product workshop created by a person with a disability. In this project, I was responsible for designing ergonomic storage solutions and tools tailored to the needs of individuals with disabilities. Additionally, I developed 3D models and layouts for the entire workshop to ensure an effective and efficient production setup. I also contributed to creating a simple landing page website for YKDM to expand the market reach for the workshop's products.