MUHAMMAD LABIYB AFAKH

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SUMMARY

Last-year PhD student in Robotics with hands-on experience in developing autonomous robotic systems. Currently combining academic research with industry experience as a part-time robotics engineer. Demonstrated experience in building complete robotic solutions from mechanical design to system integration.

- Experience in developing complete robotic platforms from scratch, including mechanical structure, embedded systems, and navigation
- Implemented embedded systems and sensor integration achieving up to 500Hz sampling rate using C and C++. Sometimes, Python is used for prototyping.
- Ability in system integration both with ROS1/ROS2 and native implementations for autonomous navigation and control
- Experience in developing various robotic platforms including aerial, mobile, and water surface vehicles

PROFESSIONAL EXPERIENCES

Robotics Engineer April 2024 - now
QibiTech Inc. (Part-Time)

- Developed ROS2 packages for manipulator including hardware interface (using position, velocity and effort controllers), actions and test.
- Developed robot description (URDF), visualization, and simulation on pybullet/gazebo.
- Improved the system integration between Kachaka AMR and HATS.
- Investigating the manipulability of a mobile manipulator robot using a Gazebo simulation.

Research and Development Engineer Jan 2022 - March 2024
Shanghai Micro Ears Ingeniousness Intelligent Technology Co., Ltd. (Part-Time)

- Designed and manufacture the robot structure.
- Built the software for the embedded system.
- Optimized serial communication and visualize the data on Graphical User Interface(GUI) in 200Hz sampling rate.
- Developed and integrated system with a manipulator robot (myCobot 320).

Freelance Robotics and Embedded System Engineer 2018-2019

- Built an embedded system for solar tracker to move the solar panel by given position that sent from base-station.
- Built a small-device for weighting system used in a gas company.
- Built embedded system for pull and press machine including monitoring of the pressure.

SKILLS

Programming	C, C++ and Python
Robotics	ROS1/ROS2, Robot Navigation, Real-time Control Systems, Embedded Systems, Serial Communication and Sensor Integration
Tools	Git, CI(Github Actions), CAD, CAM, EDA, Gazebo, MuJoCo, PyBullet and Docker
Languages	Indonesian(Fluent), English(Fluent) and Japanese(Beginner)

EDUCATION

Doctor of Mechanical Systems Engineering, Tokyo Metropolitan University — Sept'2025(Expected)
Master of Mechanical Systems Engineering, Tokyo Metropolitan University — Oct'2019 - Sept'2021

- Relevant Courses : Robotic System Design, Intelligent Robot, Ubiquitous Robotics

Bachelor of Computer Engineering, Electronics Engineering Polytechnic Institute of Surabaya — 2014 - 2018

- Relevant Courses: Embedded System, Robot System Control, Computer Vision, Intelligent System, Robotic and Automation, and Real-Time Operating System.

HONOR AND MEMBERSHIP

- Institute of Electrical and Electronics Engineers (IEEE) Society — now
- IEEE Robotics and Automation Society Membership — now
- The Japan Society of Mechanical Engineers — now
- Second Runner-up Customer Interaction Task Category, World Robot Summit FCSC @IFAC — 2023
- Runner Up Toilet Cleaning Robot Category, World Robot Summit FSCS Trial Competition — 2019
- Second Runner Up of ABU Robocon 2016 — 2016
- Winner ABU Robocon Indonesia Contest — 2016

ACADEMIC EXPERIENCES

Research Assistant (Part-Time) — Jan 2025 - Mar 2025
Tokyo Metropolitan University — *Japan*

Tokyo Metropolitan University Arena Reframing (AR) Research Fellow — Apr 2023 - Sept 2024
Tokyo Metropolitan University — *Japan*

Research Assistant (Part-Time) — Oct 2021 - Mar 2023
Tokyo Metropolitan University — *Japan*

Student Intern — Jan 2017 - Feb 2017
BRIN-Aviation and Space Research Organization — *Indonesia*

PUBLICATIONS

Journals

- **Study Towards a Flapping Robot Maintaining Attitude During Gliding.** International Journal on Advance Science, Engineering, Information, and Technology (IJASEIT) · Jan 22, 2023
- **Performance Evaluation and Wing Deformation Analysis of Flapping-Wing Aerial Vehicles with Varying Flapping Parameters and Patterns**, Journal of Robotics and Mechatronics, Vol.36, No.5, pp. , 2024/10. (in press)

Conferences

- **Servo-Driven Flapping-Wing Aerial Vehicle (FWAV) Payload Capacity and Navigation Performance.**The 2025 IEEE/SICE International Symposium on System Integration (SII).
- **Development of Flapping Robot with Self-Takeoff from The Ground Capability.** IEEE International Conference on Robotics and Automation (ICRA) · Oct 18, 2021
- **Bicycle Path Planning on Omnidirectional Mobile Robot Using Fuzzy Logic Controller.** IEEE · Aug 7, 2018

- **Implementation of PID Controller in Active Ball Handling System of Middle Size Robot Soccer.** IEEE · Aug 7, 2018
- **Aksara Jawa Text Detection in Scene Images using Convolutional Neural Network.** IEEE · Sep 27, 2017

PROJECTS

Sixleg Robot Locomotion. January 2025 - Present
Contribution:

- Develop its reinforcement learning inside MuJoCo physical simulation environment.

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Ornibibot, an agile flapping micro aerial vehicle (FMAVs). Oct 2019 - Present.
This project develops an ornithopter that can be a helpful robot for future in the society. This project is a part of my academic path from master student to PhD student(now).

Contribution:

- Developed several robot's mechanical structure including design and manufacture.
- Developed robot's hardware utilizing several kinds of micro-controller(ARM based and ESP32) and single board computer(ARM based).
- Developed robot's low-level and high-level system and controller with or without ROS1/ROS2.
- Implemented PID controller with given Inertial Measurement data to perform attitude control using tail mechanism.
- Improved the performance serial communication by optimizing the packet data so it could work in above 500Hz.
- Conducted comprehensive system analysis by integrating force sensors and motion capture cameras to measure wing deformation and thrust generation.
- Improved system capabilities through mechanical optimization achieving 100g payload capacity, while implementing on board collision avoidance utilizing 8x8 ToF and 50Hz UDP communication with base station.
- Currently working on enhancement collision avoidance performance by changing the visual information from 8x8 ToF to higher pixel depth information and developing visual odometry to localize robot position.

- Skills: C, C++(ROS1/ROS2), Python, CAM, CAM, EDA
- Repositories:

- https://github.com/labiybafakh/OrnibiBot
- https://github.com/labiybafakh/OrnibiBotMicro
- https://github.com/labiybafakh/OrnibiBotObstacleAvoidance

Customer Interaction Service Robot. May - July 2023.
This project aims to handle some problems that can happen at the convenience store such as a large queue size and object returned to its shelf. This project is a part of WRS competition held during IFAC2023. A Seed R7 which is a service mobile robot platform is used to handle the tasks. In our system, we were trying to offer self-payment and returning the cancelled products. A kinect camera is mounted to estimate the grasping position and type of the object that will be returned to its shelf. To monitor the queue, another camera is also placed on the environment. A lidar is also mounted to the robot for simultaneous localization and mapping(SLAM). It is used for robot to navigate to the desired position and avoid the obstacle. The data distribution is handled by using ROS.

Contribution:

- Lead programmer team.
- Integrate several sub-system to perform autonomous task.

- Debug and optimize robot system and computer vision performance.

- Skills: Python(ROS, PyTorch)
- Project's repository: https://github.com/labiybafakh/WRS2023

Navigation of Omnidirectional Mobile Robot(Robot Soccer). 2017-2018.
This bachelor thesis project is triggered by an idea to recover a navigation when there is an obstacle or hits another robot. A robot simulation(V-REP) was used to simulate the robot locomotion to implement bicycle path tracking. **PID controller** are used to control the speed of each motor on its low-level hardware and to control the robot orientation. **A fuzzy logic controller** is used to change or improve some parameters during navigating such as look-ahead of robot during performing path tracking and velocity of the robot. By using a given path and gave a force to the robot, the robot was succeeded to back to its right path smoothly. The performance is better after the fuzzy was implemented because it can reduce the overshoot. **Robotics Operating System(ROS)** utilize the robustness of system through the data distribution.

Contribution:

- Developed and implemented bicycle path tracking algorithm with improved performance using fuzzy controller.
- Implemented real-time PID controller for precise motor speed control.
- Integrated wheel odometry and IMU data for robot position estimation/odometry.
- Develop robot's system to communicate between low-level and high-level controller.
- Successfully achieved smooth path recovery after obstacle interference.

- Skills: C, C++, STM32, Arduino, Embedded System, ROS, PID and Fuzzy Controller, Qt.
- Repository: https://github.com/labiybafakh/FuzzyBicyclePathTracking

Unmanned Fast Boat PENShip. Oct 2016 - Dec 2016.
This project worked with an unmanned water vehicle to complete a task. I became the head of this project to manage or to organize the team working as the desired. It participated in Unmanned Surface Vehicle(USV) Contest 2016. We built catamaran and monohull boats using balsa wood. The USVs navigate autonomously using a feedback information from a camera. It used a basic concept of computer vision to detect the color and calculate theta of colored balls. There are color-coded balls arranged on the edges of the path. These balls serve as boundary markers for autonomous navigation using cameras. By using the visual servoing, the robot can navigate to stay on the track.

- Lead programmer and team.
- Integrate and optimize embedded system and computer vision on visual servoing.
- Develop vehicle's structure.

- Skills: C, C++, Computer Vision (OpenCV).

ABU Robocon 2016
In this project, I and my team were trying to build mobile robot to handle or to solve the tasks. We built 2 autonomous robot with different size, the small robot could not move by itself and has only a steering mechanism. Several iteration of robot development from scratch were done.The bigger robot has to drive the small robot without making contact. After the robot is succeeded to drive the small robot, the bigger robot should pick the propeller that is mounted on small robot, climb a pole, and place the propeller on the pole.

Contribution:

- Build the embedded system.
- Integrate several feedback sensor and testing.
- Build robot navigation algorithm using odometry feedback data.
- Test and optimize robot performance. The robot's performance increased up to 70

- Skills: C, STM32, Embedded System, Navigation.