

# MUHAMMAD LABIYB AFAKH

Tokyo, Japan

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## SUMMARY

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I am a last-year PhD Student and Tokyo Metropolitan University Arena Reframing(AR) Research Fellow. Enthusiastically engage in building and programming custom robotics projects, enhancing hands-on skills in software integration. I am motivated to utilize my expertise in Embedded Systems, Robotics, and Mechatronics to solve real-world problem to enhance the society.

- Experience in developing mechanical, hardware, and software of a robot from scratch.
- Experience in C/C++/Python to build some Embedded/Robot System and data processing.
- Experience in integrating systems with and without the use of the Robotics Operating System (ROS1/ROS2).

## PROFESSIONAL EXPERIENCES

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### Robotics Engineer

April 2024 - now

QibiTech Inc. (Part-Time)

- Working on robot system design
- Developing ROS2 packages for manipulator including hardware interface (using position, velocity and effort controllers), actions and test.
- Developing robot description (URDF), visualization and simulation on pybullet/gazebo.

### Research and Development Engineer

Jan 2022 - March 2024

Shanghai Micro Ears Ingeniousness Intelligent Technology Co., Ltd. (Part-Time)

- Design and manufacture the robot structure.
- Build the software for the embedded system.
- Optimize the serial communication and visualize the data on Graphical User Interface(GUI) in 200Hz sampling rate.
- Develop and integrate system with a manipulator robot (myCobot 320).

### Freelance Robotics and Embedded System Engineer

2018-2019

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

## SKILLS

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### Technical Skills Languages

C, C++, Python, Rust, ROS1/ROS2, CI(Github Actions), CAD, CAM, EDA.  
Indonesian(Fluent), English(Fluent), Japanese(Beginner).

## EDUCATION

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**Doctor of Mechanical Systems Engineering**, Tokyo Metropolitan University

March'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

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- 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

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- Tokyo Metropolitan University Arena Reframing (AR) Research Fellow** now  
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

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### 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

- **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

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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:

- Develop robot's structure for mid-size and bird-size.
  - Develop robot's hardware using Arduino Nano 33 BLE with Raspberry for the previous version and Teensy 4.1 for the current version.
  - Develop robot's system and visualization utilizing ROS1/ROS2.
  - Implement PID controller with given Inertial Measurement data to perform attitude control using tail mechanism.
  - Improve the performance serial communication by optimizing the packet data so it could work in above 500Hz.
  - Integrate force sensor and motion capture camera to support its analysis.
  - Test the performance native system using shared-memory and compare with ROS2 performance.
  - Currently, developing robot vision system and control to perform obstacle avoidance using point cloud data.
- Skills: C, C++(ROS1/ROS2), Python, CAM, EDA
- Repository for High-Level(Desktop): <https://github.com/labiybafakh/OrnibiBot>
- Repository of low-level(Microcontroller): <https://github.com/labiybafakh/OrnibiBotMicro>

### **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:

- Develop embedded system to measure robot position or odometry by given rotary encoder data and Inertial data.
- Develop embedded system to control motor speed by using PID controller.
- Develop robot's system to communicate between low-level and high-level controller.
- Develop robot navigation using the proposed bicycle path tracking and compare with pure pursuit.
- Improve the performance of bicycle path tracking by implementing fuzzy controller.

- 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.