

**DESIGN AND IMPLEMENTATION OF A PID BASED DUAL TANK LEVEL
AND TEMPERATURE CONTROL SYSTEM FOR EDUCATIONAL
LABORATORY USE**

By

Gede Auvinda Ranindya
12101014

BACHELOR'S DEGREE
in
MECHANICAL ENGINEERING- MECHATRONICS CONCENTRATION
FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY



SWISS GERMAN UNIVERSITY
The Prominence Tower
Jalan Jalur Sutera Barat No. 15, Alam Sutera
Tangerang, Banten 15143 - Indonesia

Revision after the Thesis Defense on June 2026

STATEMENT BY THE AUTHOR

Name of Student : Gede Auvinda Ranindya
Student ID : 12101014
Faculty : Engineering & Information Technology
Study Program : Mechanical Engineering – Mechatronics concentration
Date of Defense : 10 June 2026
Thesis Title : DESIGN AND IMPLEMENTATION OF A PID BASED DUAL
TANK LEVEL AND TEMPERATURE CONTROL SYSTEM FOR
EDUCATIONAL LABORATORY USE

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.

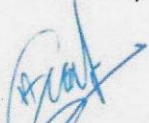
A handwritten signature in blue ink, appearing to read 'Gede Auvinda Ranindya'.

Gede Auvinda Ranindya
(Name of Student)

Approved by:
Date: 24 June 2026

A handwritten signature in blue ink, appearing to read 'Edward Boris P. Manurung'.

Edward Boris P. Manurung, M.Eng
(Thesis Advisor)

A handwritten signature in blue ink, appearing to read 'Hartono'.

Hartono, S.T., M.T.
(Thesis Co-Advisor)

Acknowledged by:
Date:

Dr. Maulahikmah Galinium, S.Kom, M.Sc.
(Dean of Faculty of Engineering & Information Technology)

ABSTRACT**DESIGN AND IMPLEMENTATION OF A PID BASED DUAL TANK LEVEL
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By

Gede Auvinda Ranindya

Edward Boris P. Manurung

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The growing emphasis on Industry 4.0 has increased the demand for cost-effective and accessible educational platforms that can teach modern process control concepts. Traditional laboratory setups using Programmable Logic Controllers (PLCs) are often prohibitively expensive, limiting hands-on experience for undergraduate students. This research presents the design and implementation of a Proportional-Integral-Derivative (PID) based dual tank level and temperature control system using the ESP32 microcontroller as a low-cost alternative to industrial PLCs, with integrated real-time monitoring through Wi-Fi connectivity. The mechanical structure was constructed using glass tanks to withstand the thermal stresses generated by the heater. Mathematical modeling using Laplace transforms was performed to derive the system's transfer functions, which were then validated against experimental data. The performance of the implemented PID controller was evaluated based on rise time, overshoot, settling time, and steady-state error. The results show that the ESP32 based system is capable of replicating the behavior of conventional industrial controllers with acceptable accuracy, making it a viable and affordable platform for undergraduate process control education.

Keywords: *PID Control, ESP32, Process Control, Liquid Level Control, Temperature Control*



DEDICATION

I dedicate this work to my family, advisors, and to the future students of
Mechanical Engineering at Swiss German University
who will continue to explore the field of process control.



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I would like to express my sincere gratitude to my thesis advisor, Edward Boris P. Manurung, for his continuous guidance, patience, and valuable feedback throughout the development of this thesis. His expertise in mechatronics and process control has been instrumental in shaping both the technical direction and the academic rigor of this work.

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I would like to acknowledge the previous work of Raharja Dion Ariesto, whose 2020 thesis served as the foundation for this research and provided a clear baseline against which the present system could be designed and evaluated.

Finally, I am deeply grateful to my family and friends for their unwavering support, encouragement, and patience during the long hours of design, testing, and writing. Their belief in my abilities provided the motivation to overcome the technical challenges encountered throughout this project.

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