UNDERGRADUATE THESIS

DESIGN AND IMPLEMENTATION OF AN AUTOMATIC BICYCLE BRAKING SYSTEM USING YOLOV11N AND ESP32 BASED ON HG680P SET-TOP BOX

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UNIVERSITAS PEMBANGUNAN NASIONAL VETERAN JAWA TIMUR
FACULTY OF COMPUTER SCIENCE
INFORMATICS STUDY PROGRAM
SURABAYA
2026

APPROVAL SHEET

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Hereby declares that this undergraduate thesis contains no part of any other scientific work that has been submitted to obtain an academic degree at any higher education institution. Furthermore, it does not contain any work or opinions previously written or published by others, except for those which are explicitly cited in this thesis and listed completely in references.

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ABSTRACT

Student Name / NPM	:	Firzannabeel Aqila Rafid / 22081010285
Thesis Title	:	Design and Implementation of an Automatic Bicycle Braking System Using YOLOv11 and ESP32 Based on HG680P Set-Top Box
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Bicycle rider safety, particularly for young children, represents a highly significant concern due to the high risk of accidents caused by delayed human reaction times when encountering sudden obstacles on the road. To address this, this research successfully designs and implements an intelligent automatic braking system for bicycles using the advanced YOLOv11n object detection algorithm executed on a Set-top Box HG680P as a localized edge computing device, utilizing an ESP32 microcontroller for interfacing the hardware sensors and actuators. The system effectively employs a sensor fusion approach integrating a standard USB camera for visual input, an HC-SR04 ultrasonic sensor for distance measurement, and an MG-996R servo motor acting as the mechanical braking actuator. Comprehensive experimental results show the STB HG680P performs YOLOv11n inference in real-time at 3.9 FPS with a system latency of 312 ms. The detection system achieved an accuracy of 95.0%, precision of 95.96%, and recall of 92.24% based on confusion matrix evaluation, while the ultrasonic sensor recorded an average accuracy of 98.9% over a 20 to 250 cm range. This empirical study confirms that the STB HG680P is a viable, practical, and highly cost effective edge computing platform for running YOLO based artificial intelligence models in lightweight vehicle safety applications.

Keywords: Edge Computing, YOLO, Set-Top Box, Microcontroller, ESP32, Automatic Brake

ACKNOWLEDGEMENTS

Alhamdulillāhi rabbil ‘alamin, all praise be to Allah SWT, the Lord of all the worlds, the One who governs destiny in the most beautiful unfolding of His divine design. To Him alone belongs all gratitude, for through His mercy and will, the author was nurtured within the embrace of a loving family, raised with sincere affection, and guided along a life journey filled with meaning, lessons, and reflection, until finally being able to pursue an academic path at Universitas Pembangunan Nasional “Veteran” Jawa Timur. By His infinite grace and blessing, the thesis entitled “**Design and Implementation of an Automatic Bicycle Braking System Using YOLOv11 and ESP32 Based on HG680P Set-Top Box**” has ultimately been completed.

The author realizes that this journey was not solely shaped by personal effort, but also by prayers, support, and the presence of many precious individuals whose kindness has silently accompanied every step. Therefore, with utmost humility, the author would like to express sincere and deepest gratitude to:

1. Prof. Dr. Ir. Akhmad Fauzi, M.MT., IPU., Rector of Universitas Pembangunan Nasional “Veteran” Jawa Timur, for the invaluable opportunity and academic space that has allowed the author to grow, learn, and gain meaningful experiences.
2. Mrs. Prof. Dr. Ir. Novirina Hendrasarie, M.T. as the Dean of the Faculty of Computer Science, National Development University "Veteran" East Java.
3. Dr. Intan Yuniar Purbasari, S.Kom., M.Sc., as the Coordinator of Informatics Study Program, Faculty of Computer Science, National Development University of East Java.
4. Dr. Rr. Ani Dijah Rahajoe, S.T., M.Cs. and Dr. Ir. Mohammad Idhom, S.P., S.Kom., M.T., as thesis supervisors, who have continuously guided, shown immense patience, and facilitated the author as their advisee, dedicating their time to broaden the author’s academic perspective, which ultimately enabled the completion of this thesis.
5. To my beloved parents, Alm. Choliq and Mrs. Wiwik Sofia, who not only raised me but also instilled values, shaped my thoughts, and strengthened my heart.

Behind every step I have taken lies prayers that never ceased, exhaustion that was never fully revealed, and sacrifices that often remained unspoken yet always existed in the form of unconditional love. From the warmth of this family, I have learned the meaning of togetherness, patience, and hope that never fades. Moreover, I have come to realize that every achievement I hold today is truly a reflection of their prayers and struggles, which may never have been written, yet have always become the reason I am able to stand and continue this journey until this very point.

6. Author's younger brother and sister, who complete the journey of life in their own quiet yet meaningful way, bringing small laughter amid exhaustion and reminding me that home will always remain the warmest place to return to in the midst of life's struggles.
7. My college friend, Erlangga Putra Ramadhan, who greatly facilitated the research process and served as a major inspiration for this specific topic. Because of his invaluable support, I was able to continue my work and successfully complete this thesis.
8. To every soul who has ever crossed paths with me, whether briefly or for a long time, I extend my deepest gratitude. Every fall has become a lesson, every doubt has turned into wisdom, and every silent prayer has become unseen strength that has shaped me into who I am today. Even those who came and went have left traces that helped form this present moment.
9. The author's friends, Adventus Michael and Fadel Akbar, who successfully rescued the research hardware just prior to the defense day. Their timely intervention not only saved the project but also gave the author the immense motivation to persevere and finalize this thesis immediately.
10. The author expresses sincere gratitude to Daniel Prasetyo Budiman for his unwavering emotional support. Despite the daily interruptions to his own time, his constant willingness to listen and share the author's burdens has been a crucial source of comfort and strength throughout the completion of this research.
11. All fellow students of the Informatics Study Program, whose names cannot be mentioned individually, thank you for the shared journey throughout academic

life, for discussions, mutual assistance in understanding materials, and even simple laughter amidst heavy academic pressure. Your presence has added color to this growth process, making every step feel lighter and more meaningful.

12. And to all parties who have supported the author in any form, directly or indirectly, whose names may not be mentioned one by one but whose kindness is never forgotten, the author extends sincere gratitude. Every help, prayer, and small act of kindness has become an essential part of this journey until the completion of this thesis.

May Allah SWT grant abundant blessings in return for all kindness given, expand sustenance, bring peace to every heart, and strengthen all of us in facing life's trials. This thesis is not merely the result of personal effort, but a series of prayers, support, and divine decree beautifully arranged by Him. The author also realizes that this work is still far from perfect; therefore, constructive criticism and suggestions are highly expected for future improvement. Finally, may this thesis bring benefits not only to the author and readers, but also to the advancement of knowledge in general.

Surabaya, June 17, 2026

Authors

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