



UNDERGRADUATE THESIS

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

FIRZANNABEEL AQILA RAFID
NPM 22081010285

THESIS ADVISORS

Dr. Rr. Ani Dijah Rahajoe, S.T., M.Cs.
Dr. Ir. Mohammad Idhom, S.P., S.Kom., M.T.

**MINISTRY OF HIGHER EDUCATION, SCIENCE, AND TECHNOLOGY
UNIVERSITAS PEMBANGUNAN NASIONAL VETERAN JAWA TIMUR
FACULTY OF COMPUTER SCIENCE
INFORMATICS STUDY PROGRAM
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2026**

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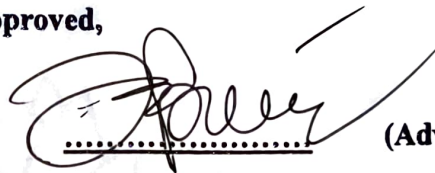
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SET-TOP BOX**

By:
FIRZANNABEEL AQILA RAFID
NPM. 22081010285

Has been defended before, and accepted by, the Board of Assessors of the Thesis Examination of the Informatics Study Program, Faculty of Computer Science, Universitas Pembangunan Nasional Veteran Jawa Timur, on June 12, 2026:

Approved,

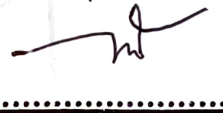
Dr. Rr. Ani Dijah Rahajoe, S.T., M.Cs.
NIP. 19730512 200501 2003



.....

(Advisor I)

**Dr. Ir. Mohammad Idhom, S.P., S.Kom.,
M.T.**
NIP. 19830310 202121 1 006



.....

(Advisor II)

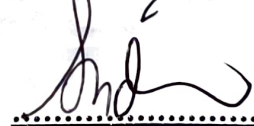
**Dr. Firza Prima Aditiawan, S.Kom, M.T.I,
M.C.F, M.O.S.**
NIP. 19860523 2021211 003



.....

(Head Assessor)

**Andreas Nugroho Sihananto, S.Kom.,
M.Kom.**
NIP. 19900412 202406 1 003



.....

(Assessor I)

Acknowledge by,

Dean of the Faculty of Computer Science



.....

Prof. Dr. Ir. Novirina Hendrasarie, MT.
NIP. 19681126 199403 2 001

APPROVAL SHEET

DESIGN AND IMPLEMENTATION OF AN AUTOMATIC BICYCLE BRAKING SYSTEM USING YOLOv11 AND ESP32 BASED ON HG680P SET-TOP BOX

By:
FIRZANNABEEL AQILA RAFID
NPM. 22081010285

Approved by,

Coordinator of Informatics Study Program
Faculty of Computer Science



Dr. Intan Yuniar Purbasari, S.Kom. MSc.
NIP. 19800602 202521 2 029

STATEMENT OF ORIGINALITY

I am the undersigned:

Student Name : Firzannabeel Aqila Rafid
NPM : 22081010285
Degree Program : Bachelor (S1)
Study Program : Informatics
Faculty : Faculty of Computer Science

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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Declarant,



FIRZANNABEEL AQILA RAFID
NPM.22081010285

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
Advisor : 1. Dr. Rr. Ani Dijah Rahajoe, S.T., M.Cs.
2. Dr. Ir. Mohammad Idhom, S.P., S.Kom., M.T.

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

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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:

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Surabaya, June 17, 2026

Authors

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