

**THE DEVELOPMENT OF AN UNDERWATER  
PLASTIC WASTE DETECTION PROTOTYPE  
WITH RASPBERRY PI**

**Bachelor Thesis**

**Conducted to fulfill some of the requirements  
to obtain a Bachelor of Science degree**



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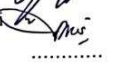




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FACULTY OF MATHEMATICS AND NATURAL SCIENCES  
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# APPROVAL OF BACHELOR THESIS

## APPROVAL OF BACHELOR THESIS

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## FOREWORD

Praise and gratitude are due to Allah SWT for His blessings and guidance, allowing the completion of this thesis titled “The Development of an Underwater Plastic Waste Detection Prototype with Raspberry Pi.” This thesis is submitted as a requirement to obtain a Bachelor of Science degree from the Physics Department of Universitas Negeri Jakarta. This thesis would not have been possible without the support, encouragement, and assistance of many individuals. I would like to extend my deepest gratitude to:

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The author acknowledges that the thesis may not be perfect and acknowledges its shortcomings. Hopefully this thesis be beneficial to its readers

Jakarta, 1 August 2024



Muhammad Fajrul Amin



## ABSTRACT

**MUHAMMAD FAJRUL AMIN.** The Development of an Underwater Plastic Waste Detection Prototype with Raspberry Pi. Supervised by MUTIA DELINA, TARYUDI

Underwater plastic waste can caused a serious impact on the environment. A computer algorithm for detecting underwater plastic waste has been developed by applying YOLOv3. For improvement, the study developed a prototype with Raspberry Pi through the Research and Development method. This prototype is like a submarine that operates in the water and integrated with a camera and a computer algorithm to detect plastic waste. The prototype was tested in a water environment with varying turbidity levels from 20 to 120 Nephelometric Turbidity Units (NTU). Turbidity levels were precisely measured using a calibrated turbidity sensor, which had been tested against several known turbidity samples to ensure accuracy. The turbidity sensor used is the TS-300B, which is controlled by an Arduino microcontroller. We use 24 plastic objects with 4 different types: straw, food packaging, bottle, and plastic bag. The result of the study presented the effective threshold for object detection is around 100 NTU. At 100 NTU, The camera can only capture 9 images on the surface, 7 images in the middle, and 5 images at the bottom, with the most frequently detected object is a bottle. The average confidence score for detection at turbidity levels below 100 NTU is 73%.

**Keyword.** Prototype, raspberry pi, underwater plastic waste

## ABSTRAK

**MUHAMMAD FAJRUL AMIN.** Pengembangan Prototipe Pendeteksi Sampah Plastik di Bawah Air dengan Raspberry Pi. Dibimbing oleh MUTIA DELINA, TARYUDI

Sampah plastik di bawah air dapat menyebabkan dampak serius terhadap lingkungan. Sebuah algoritma komputer untuk mendeteksi sampah plastik di bawah air telah dikembangkan dengan menerapkan YOLOv3. Untuk penyempurnaan, penelitian ini mengembangkan prototipe dengan Raspberry Pi melalui metode Research and Development. Prototipe ini berbentuk seperti kapal selam yang beroperasi di dalam air dan terintegrasi dengan kamera dan algoritma komputer untuk mendeteksi sampah plastik. Prototipe ini diuji coba di lingkungan air dengan tingkat kekeruhan yang bervariasi mulai dari 20 hingga 120 Nephelometric Turbidity Units (NTU). Tingkat kekeruhan diukur dengan tepat menggunakan sensor kekeruhan yang telah dikalibrasi, yang telah diuji terhadap beberapa sampel kekeruhan yang telah diketahui untuk memastikan keakuratannya. Sensor kekeruhan yang digunakan adalah TS-300B, yang dikendalikan oleh mikrokontroler Arduino. Kami menggunakan 24 benda plastik dengan 4 jenis yang berbeda: sedotan, kemasan makanan, botol, dan kantong plastik. Hasil dari penelitian ini menunjukkan bahwa ambang batas yang efektif untuk mendeteksi objek adalah sekitar 100 NTU. Pada ambang batas 100 NTU, kamera hanya dapat menangkap 9 gambar di permukaan, 7 gambar di tengah, dan 5 gambar di bagian bawah, dengan objek yang paling sering terdeteksi adalah botol. Nilai kepercayaan rata-rata untuk deteksi pada tingkat kekeruhan di bawah 100 NTU adalah 73%.

**Keyword.** Prototipe, raspberry pi, sampah plastik bawah air

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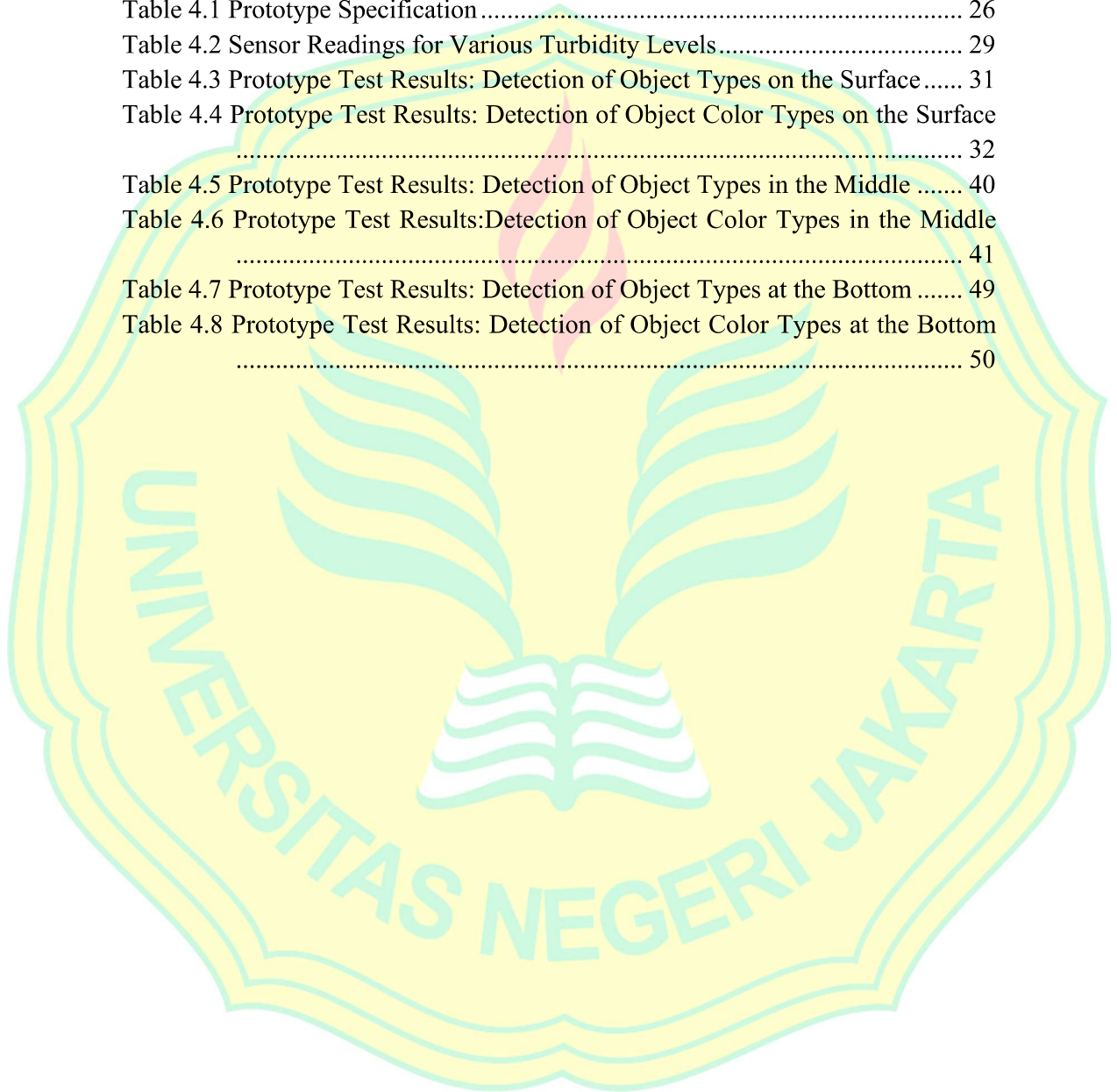


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## LIST OF ABBREVIATIONS



PET	: Polyethylene Terephthalate
HDPE	: High-Density Polyethylene
PVC	: Polyvinyl Chloride
LDPE	: Low-Density Polyethylene
PP	: Poly Propylene
PS	: Poly Styrene
AUV	: Autonomous Underwater Vehicle
ROV	: Remotely Operated Vehicle
YOLO	: You Only Look Once
CNN	: Convolutional Neural Network
MLP	: Multi Layer Perceptron
NTU	: Nephelometric Turbidity Units
PWM	: Pulse width Modulation
CPU	: Central Processing Unit
RAM	: Random-Access Memory
USB	: Universal Serial Bus
SSD	: Single Shot Detector



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