Thesis pH draft

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Chapter 1

Introduction

1.1 Importance of water pH

1.2 Limitations of traditional methods

1.3 NIR Spectroscopy as a Solution

1.4 Previous research

1.5 Thesis objectives

Chapter 2

Methodology

Chapter 3

Hardware Implementation

3.1 Proposed experiment setup

3.2 Water sample preparation

Each water sample was collected by adding tap water from the sink into a transparent mica box measuring 46x124x62 mm, with a thickness of 2 mm. This results in each sample containing 280 ml of water, which has a standard pH of 7.5. To change the pH of the water, 2 ml of a pH change solution, containing Bacillus licheniformis with a concentration of 1.0 x 10^6 CFU/ml, was diluted with 1.2 liters of water. This solution was then gradually added to the water samples at a rate of 1 ml at a time, allowing for a pH range adjustment from 3 to 9.

3.3 Reference pH measuring

Reference pH values of the water samples were obtained using a pH meter that has a resolution of 0.01 and a precision of ± 0.05. Additionally, the pH meter was calibrated with a pH 4.00 buffer solution at each measurement to ensure precision.

3.4 NIR Spectral Data Acquisition

A halogen light source was used to emit light through the water quartz to a multi-spectral sensor, which spans 18 wavelengths ranging from 410 nm to 910 nm. The setup was accurately designed and constructed using black mica, which allowed only the light from the halogen bulb to pass through. Additionally, all components were positioned to maintain a fixed and controlled arrangement, ensuring the reliability and consistency of data acquisition.

Chapter 4

Software Implementation

Chapter 5

Results and Analysis

5.1 Spectral Characteristics and Wavelength Selection Impact

5.2 Machine Learning Model Performance

5.3 Performance Metrics

Chapter 6

Conclusion and Future Work

Chapter 7

References