WATER LEVEL GAUGING USING IMAGE RECOGNITION II

CONTROL SYSTEMS AND INSTRUMENTATION ENGINEERING

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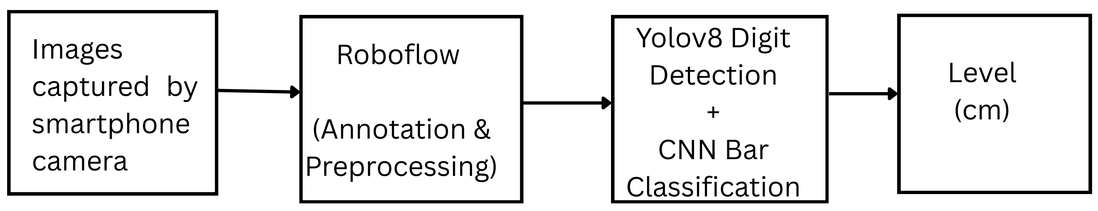
Abstract

Water level sensing system is one of the necessities in preventing flood and environmental management. Although there are several methods of measuring, traditional staff-gauge measurement had to rely on manual reading ,leading to human error and inconsistency. This project presents the development of automatic water level monitoring system using image recognition. The system integrates YOLOv8 and convolutional neutral network to estimate final water level.YOLOv8 is utilized to detect meter and centimeter digits on the staff-gauge. CNN is also applied to evaluate the bar segments of the staff-gauge.

Project Overview



This project presents an automated water level estimation system using image processing and deep learning. Images from a smartphone are processed using Roboflow and a YOLOv8 model to detect and crop gauge and digit regions. Thresholding enhances bar structures, and a CNN classifies segments into centimetres. The final water level is obtained by combining detected digits and bar classifications.

Method

- Capture staff gauge images with a smartphone under varied conditions.
- Annotate & preprocess data using Roboflow.
- Detect gauge and digits using YOLOv8.
- Crop detected regions automatically.
- Apply thresholding to enhance bar structures.
- Classify bar segments (0–9 cm) using a CNN.
- Estimate final water level by combining digits and bar results.

Results

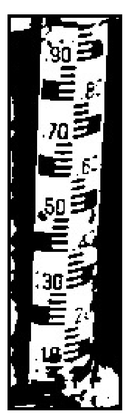
Gauge Detection

Cropping and Image Enhancing

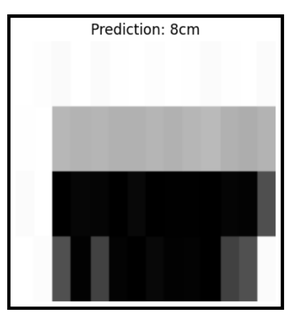
(cm) Digit Detection

number	conf_mean
50	0.922049
80	0.90152
10	0.918288
70	0.899435
40	0.863362
60	0.892601
20	0.872528
30	0.874826
90	0.639211

(m) Digit Detection



Binarization

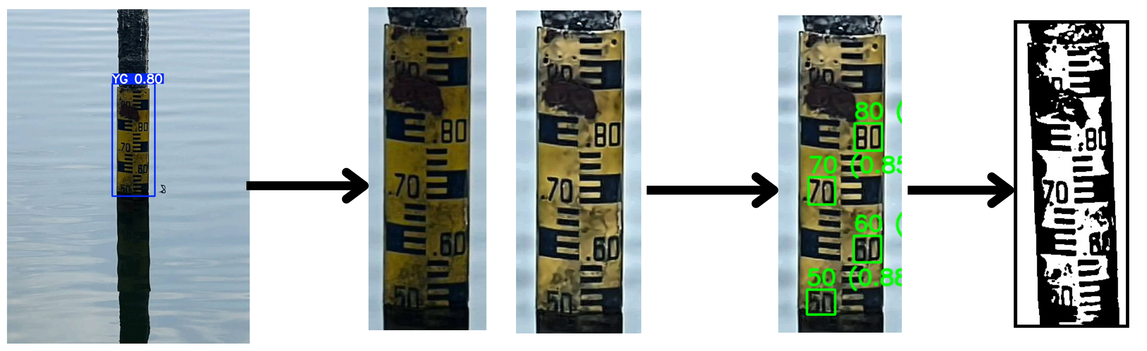


CNN Classification

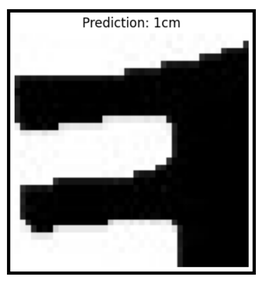
With a confidence of: 35.50%
--- All Class Scores ---
5cm: 0.02%
6cm: 0.34%
7cm: 13.74%
8cm: 83.28%
9cm: 2.62%

Water Level Calculation:
YOLO (Lowest Mark) : 10
CNN Prediction: 8
YOLO Single Digit: 2
Formula:
Final level= LOWEST − 10 + CNN
=10 − 10 + 8 = 8 cm
Final Result: 1.08 m

YOLOv8 identifies the meter and centimeter digits (10 and 2), and the CNN predicts the bar value as 8 cm.



Gauge Detection | Cropping and Image Enhancing | (cm) Digit Detection | Binarization

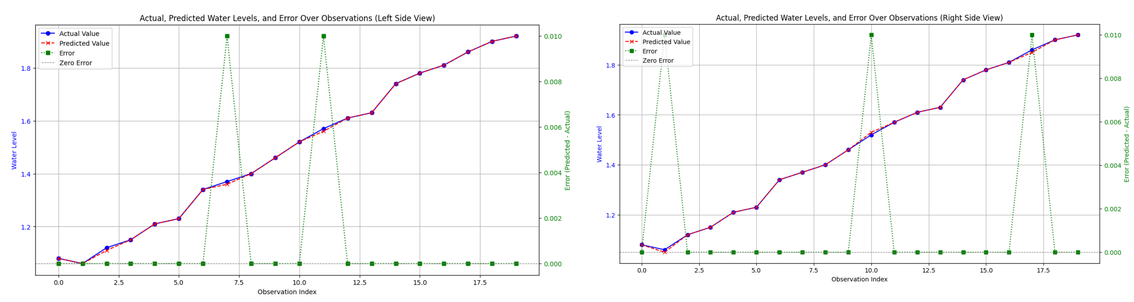


CNN Classification

With a confidence of: 40.46%
--- All Class Scores ---
0cm: 0.00%
1cm: 100.00%
2cm: 0.00%
3cm: 0.00%
4cm: 0.00%

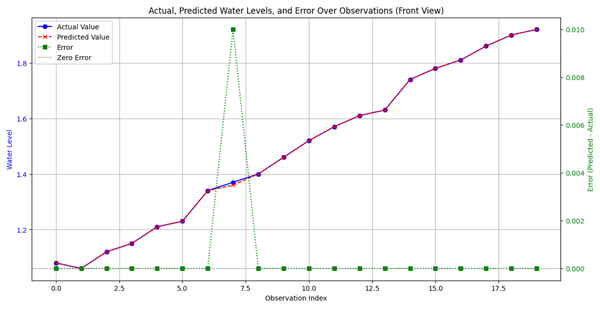
Water Level Calculation:
YOLO (Lowest Mark): 50 cm
CNN Prediction: 1 cm
Formula:
Final Level = Lowest + CNN
= 50 + 1 = 51 cm
Final Result: 0.51 m

Water-Level Estimation Results Across Different Viewing Angles (Left, Right, and Front)



(Left Side View)

(Right Side View)



(Front View)

Evaluation Metric	Result
Total Images	60
Correct Prediction	54
Incorrect Prediction	6
Average Error	0.1
Average Accuracy	90.00%

The predicted values closely match the actual water levels with minimal error, demonstrating high accuracy and consistent performance across different views.

Conclusion

This model estimates water level using YOLOv8 and CNN. Performance may be affected by limited data and environmental factors (e.g., angle, distance). Future work will focus on improving robustness in practical situations.

Reference

J. Li, C. Tong, H. Yuan, and W. Huang, “A Complex Environmental Water-Level Detection Method Based on Improved YOLOv5m,” Sensors, vol. 24, no. 5235, 2024.
G. Qiao, M. Yang, and H. Wang, “A Water Level Measurement Approach Based on YOLOv5s,” Sensors, vol. 22, no. 3714, 2022.