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APPLICATION OF ARTIFICIAL INTELLIGENCE TO MONITOR ENVIRONMENTAL POLLUTION

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ABSTRACT— Environmental pollution is always a matter of great concern in society. In Vietnam, there are policies to monitor emissions and discharge water remotely and transmit it to the Department of Natural Resources and Environment of the City/Province for monitoring. Sensor parameters and water quality images are brought back and monitored by humans; however, with many images from the camera, humans can't control them. From there, we propose a solution using AI to identify anomalies and pollution, helping to reduce the manager's load and easily manage multiple stations simultaneously. In this paper, we share a local experimental result from Vietnam.

KEYWORDS: surveillance, AIoT, Time series

1. INTRODUCTION

With the current status of monitoring water pollution in the locality, we have more than 120 CCTV cameras in 50 different industrial zones, densely packed cameras, and few observation personnel unable to monitor 24/7.

Figure 1. An observation center angle.

The requirement to detect the source of dirty discharge for punishment requires observers to work continuously but limiting the display frequency on the screen leads to missing a lot of data. Therefore, developing software using AI capable of replacing human observers is essential, helping to improve inspection quality and reduce labor waste, and is the trend of smart city and digital transformation in Vietnam.

Some studies in the world use the identification model instead of people:

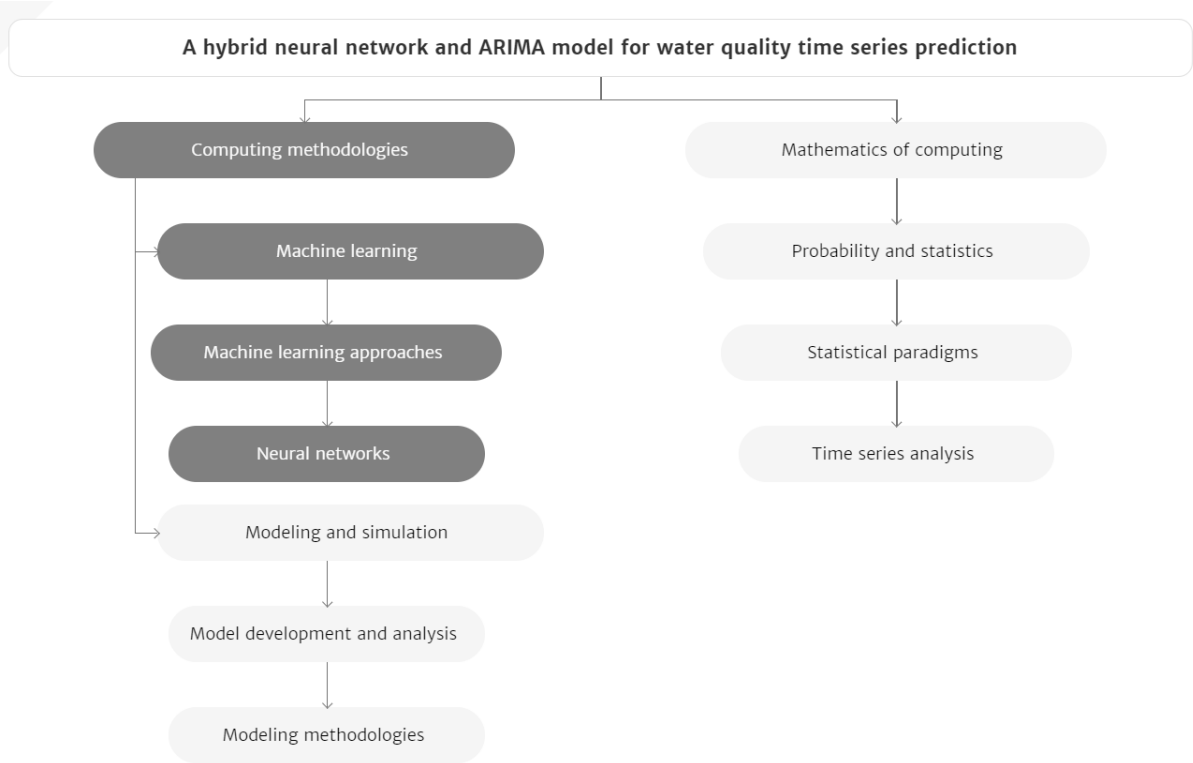


Figure 2. Hybrid Neural Network & ARIMA model predicting water quality [1]

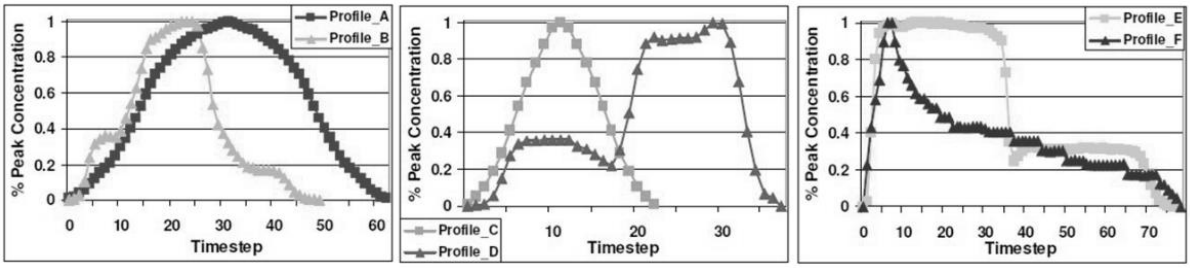


Figure 3. ADWICE algorithm model [2]

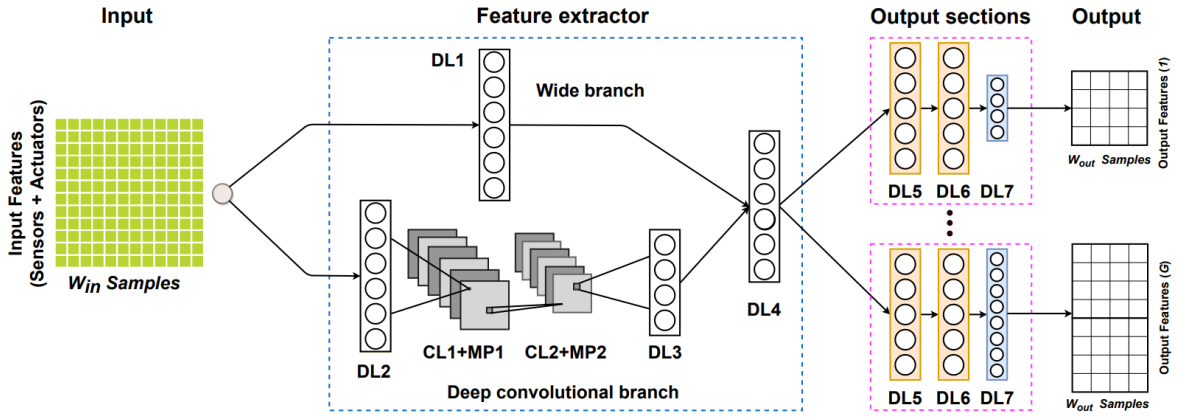


Figure 4. Deep learning model [3]

Other studies also use AI, ML, and DL models... this is an inevitable trend of technology; when problems have decision-making properties similar to humans, the strength of machine learning models is that they can

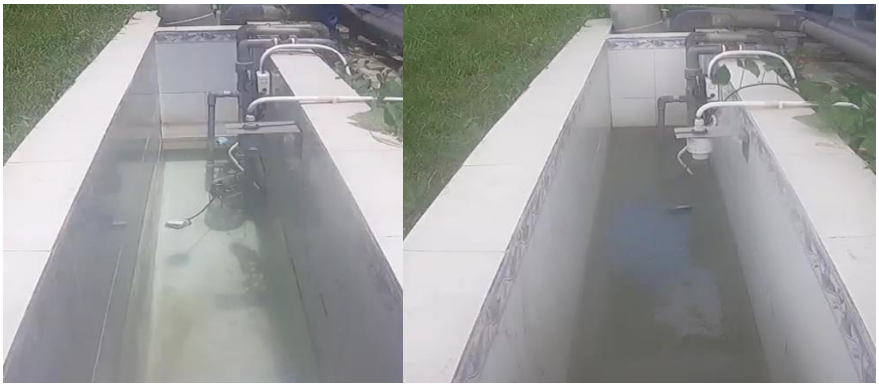
learn through facts, thorough assessment to produce accurate results.

2. Processing algorithms and experiments

1. Overview of the water discharge station

a) Each industrial park will have stations to discharge wastewater into rivers; before discharge, it will go through treatment and deposition tanks; These tanks always have IoT monitoring devices brought to the center, but these data are not synchronized with camera image data.

b) Each camera will monitor the treated water discharged into rivers, but people have to observe with the naked eye without direct measurement sensors, which is difficult to follow for a long time.



a) b)

Figure 5. An actual discharge station: a) Well treated water b) Contaminated water

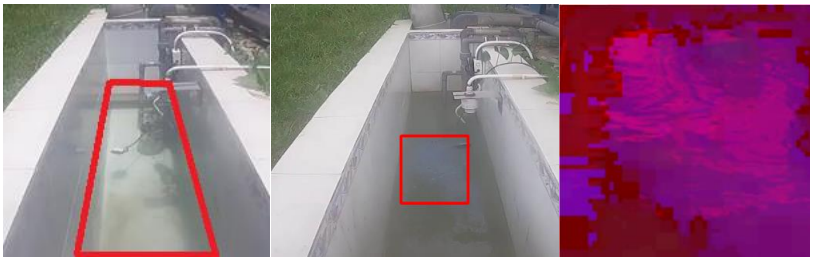
Realizing that there is a difference in the water surface before and after pollution, however, environmental light, cloud cover, rain, and high discharge volume ... will affect certain colors, so there will not be a specific standard for color threshold.

From here, we develop machine learning software that can handle the problem like an observer

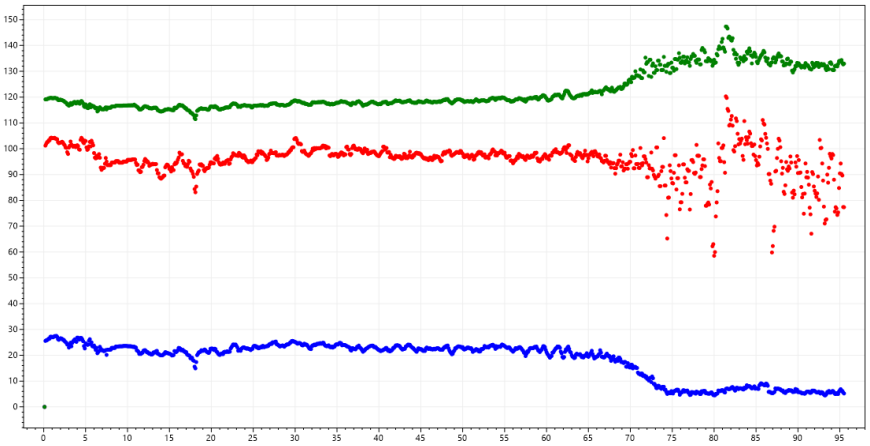
2. Pollution identification method

a) Analysis of the problem and its results

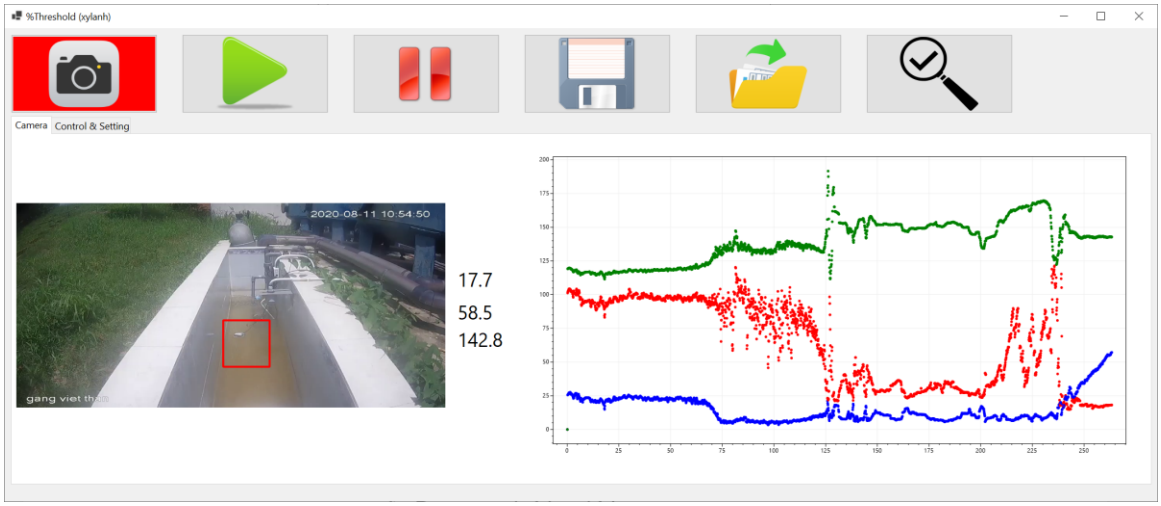
Analyze the problem from the observed water source so that we will calculate on the surface of the water tank. Below is a description of the processing.



a) Surface b) sample area c) Feature matrix



d) Graph of characteristic results over time



e) Real-time observation software interface

Figure 6. Algorithm analysis

a) Extraction of water surface
b) Extract features and bring them to training
c) Characterization of surface results
d) Graph of characteristic results
e) Real-time observation software interface

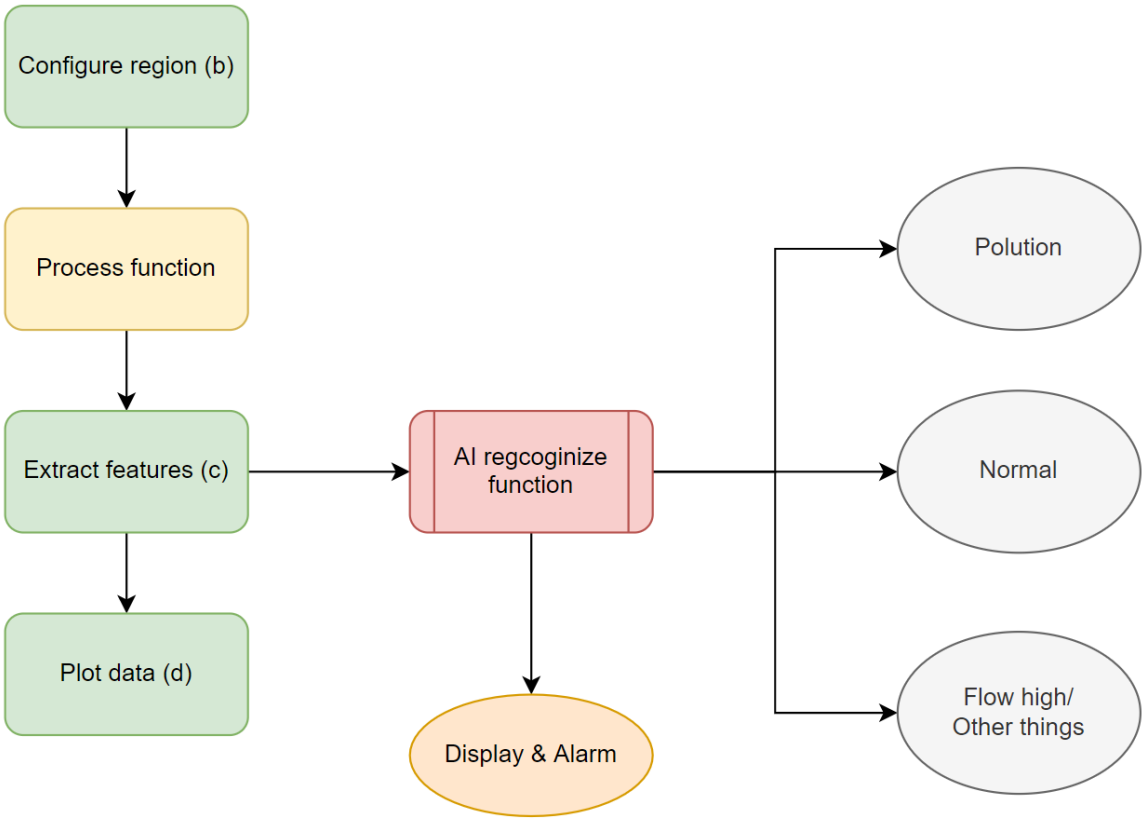


Figure 7. Algorithm Analysis Flowchart

b) Pollution identification algorithm:

There are many anomaly recognition algorithms with time-series data (3 d, e); here, we are based on the idea of Deep Learning for Time Series Classification (InceptionTime) because of the new method for environmental problems, easy to train different data types and diversify stations.

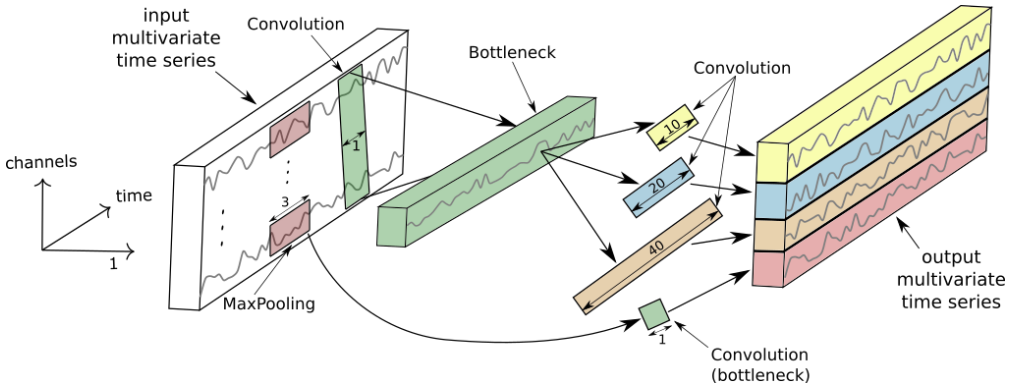


Figure 8. Deep Learning Method for Time Series Classification (InceptionTime)

c) Processing algorithm:

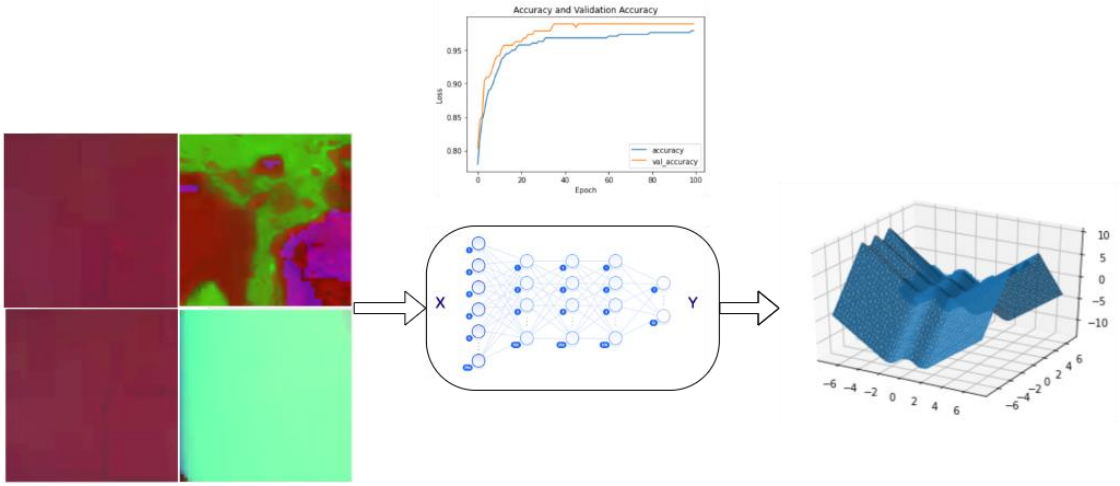


Figure 9. Flowchart of image data matrix processing algorithm.

3. Conclusion

• Data is extracted from the image matrix area.
• Pass through the training set, then deploy the training model on Colab with the available TensorFlow library.
• The training model is evaluated and put into practice.

The resulting data will be passed through the TSC to evaluate the event classification. Events in waste quality management: bubbling, watercolour, water disturbance, water evaporation, external impact...

With the development of artificial intelligence, monitoring problems are reduced, people do not have to be constantly on the screen, and objective results and monitoring efficiency are enhanced. This is a new direction in combining AI in the environmental field, so the team will research other methods, approaching human behaviour to optimize quality.

Acknowledgments

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