pHym: Python pH Meter using K-means Algorithm

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**ABSTRACT**

This project aims to have a program called *“pHym: Python pH Meter using K-means Algorithm”* that will aid the user to test the pH level of the water for household and schoolwork’s purposes. It also aims to provide an accurate and understandable information about the pH level readings. Lack of knowledge about pH levels, inaccessibility of pH meters and unnoticeable polluted water has led this project to implementation that will answer the Sustainable development goals which is “Good Health and Well-being”, “Quality Education” and “Clean Water and Sanitation”.

# INTRODUCTION

1 million bottles of water are being sold globally per minute [1] and it is the manufacturers’ job to process this water to be safe for drinking. Alkaline water were also manufactured and undergoes a process of ionization, or the process of replacing soluble acids in our drinking water to taste great and said to be healthy [2].

According to The Daily Star News, a drinking water must have a pH value of 6.5 – 8.5. An excessively acidic or alkaline water can be harmful as said by the Environmental Protection Agency [3].

Some people are very concern with the composition of their intakes. A good example of this are the people who undergo a diet, therapy and moms with babies. Health conscious people often read the labels in the bottles to make sure that it will not be harmful for them and in the case water pH value is the most important composition.

pH level is not only an indicator for human water usability, this can also be used to determine whether aquatic life can use the tested water [4]. Majority of aquatic life prefer a pH value of 6.5 – 9.0. Higher or lower than this level can cause death [5].

## Statement of the Problem

The proponents of the study notice the importance of the pH levels in various industries and environments that prompt the researcher to make a program that can address the following problem:

### Lack of knowledge about pH levels

There is a lack of knowledge about the risks and benefits of pH level of the water that we intake, most people tend to disregard this information since most of these are explained in a scientific way that most of the people avoid.

### Inaccessibility of pH meters and testers

Understanding pH values and pH testing is usually done in the laboratories by the students and researchers. Due to the price of the instruments that can test the pH values of a substance, it is limited for the people who frequently need this instruments. However, people are becoming more conscious on their water usage and intake that they require an accurate measurement that is not very scientific to fit their basic knowledge.

### Unnoticeable polluted water

Unlike air pollution, water pollution is less visible. Which means that people are less likely to notice the water pollution [6]. One way to test the water for the aquatic life is the use of pH values. There is a certain range of pH value that is suitable for aquatic life which is important to be monitored [7].

The project will be suitable for students’ study about pH related topics and for people who is concern on the use of safe water. This can be connected to the Sustainable Development Goals which are *“Good Health and Well-being”*, *“Quality Education”* and *“Clean water and Sanitation”*.

## Objectives

To address the stated problems observed by the researcher, this project seeks to attain the following objectives:

• To provide and identify the pH level of the water and provide results in a way that the user can easily understand.

• To make an accurate pH meter program that is accessible and easy to use for the inexperienced user.

• To make a program that can take the color of the water as an input to test the pH level of the water.

## Significance of the Study

The result of the project *pHym: Python pH Meter using K-means Algorithm* will benefit the following:

### Student

Student’s curriculum includes science subjects such as biology and chemistry. Basics of this subject contain topics and experiments that is related to understanding pH. The success of this project will be beneficial for the students since they will have an accessible pH tester through the program.

### Environment and health concerned people

pH plays an important role on identifying polluted and unhealthy water for people and for aquatic life. However, common people who is concern about environment and health usually doesn’t have a deep knowledge on how pH should be tested. With the success of the project, this people don’t have to invest on learning and buying expensive pH tester kits and instruments.

### Future researchers and software developer

The success of the project can contribute to the ideation of future researchers. With the project future researchers can consider applying digital innovation on the instruments that is usually found on laboratories like pH meters.

for color in levels.keys():

cr, cg, cb = color

color\_diff = math.sqrt(abs(r - cr)\*\*2 + abs(g - cg)\*\*2 + abs(b - cb)\*\*2)

color\_diffs.append((color\_diff, color))

# RELATED APPLICATIONS AND METHODS

Measuring pH levels are done for different purposes and the following are the different types of instruments to test pH level in a substance. The following will also be the basis of the project for improvement and modification.

## Portable and Bench-top pH meters

In There are pH meters that is portable and bench-top pH meters. According to their definition, the main difference is the power supply and dimension of the instrument. Portables are smaller and can use battery while bench-top pH meters have bigger display and very useful in laboratory work because of its accuracy [8].

## pH electrodes

pH electrodes are in variety of styles of laboratory and industrial applications that is usually used for aqueous media. To use a pH electrode, after calibrating the pH meter the glass part should be dip in the substance. Since pH electrodes are composed of glass that is subject to breakage it is advisable to be used only in a laboratory [9].

## pH tester kits

pH tester kits are a non-power source instrument that include a special paper strips that is dip in the substance. These strips are to be read and compared to the given table through the use of color and each color stands for a value of a pH level. pH tester kits are meant for non-laboratory use which is easier to use and to read the result for those who have a limited knowledge about measuring the pH level of the substance [10].

This related applications/systems became the basis of the project that is meant for pH level measuring. The project was mostly based on the concept of the pH tester kits which uses color variations to identify the pH level of the substance. However, the project will be a software-based process unlike the pH tester kits that is done manually. The project also includes providing accurate information according to the tested substance result.

# COMPLEXITY ANALYSIS

The program *pHym: Python pH Meter using K-means Algorithm* were written using the Python 3.7 language.

Abstract data type such as dictionary, numPy array, wx.App, wx.Frame, and wx.Panel of wxPython were implemented in the program. Data dictionary were used for storing pH scales and the related sample for each level. For numPy array, it contains the color range of the pH represented in floating point numbers. And for wx.App, wx.Frame, wx.Panel, this abstract data types were used for the GUI of the program.

Algorithms such as K-means, Euclidian distance and generic linear function are utilized in the program.

The K-means algorithm runs on ) while Euclidian distance generic linear function runs on ).

Figure 3.1 Euclidian functions

Euclidian functions have a running time of Ɵ(n), since it only undergoes n number of iterations.

# THE APPLICATION

Initial running of the program will produce the initial window *Figure 4.1*. This window will ask for an import image to be read by the program.

A screenshot of a cell phone

Description automatically generated

***Figure 4.1 Initial Window***

\*note: water image to be tested should undergo or should be mixed with anthocyanin solution. A great example of this is red cabbage, berries and eggplant.

A screenshot of a cell phone

Description automatically generated

***Figure 4.2 Import image***

To import an image, click on the menu bar *File* and *Import image* shown on the *Figure 4.2.*

A screenshot of a cell phone

Description automatically generated

***Figure 4.3 Select image (sample)***

Sample image to be selected on *Figure 4.3*. Water image is advisable to be taken a picture inside a clear glass to avoid misreading.

***A screenshot of a cell phone

Description automatically generated***

***Figure 4.4 Result of image***

After reading the image, the program will classify the image between 0 and 14 which is the range of the pH levels. The program will provide its classification and sample substance to guide the user.

# CONCLUSION AND RECOMMENDATIONS

This chapter discusses the conclusion drawn from the project implementation and recommendations for future researchers.

## Conclusion

The researchers come up with the idea of *pHym: Python pH Meter using K-means Algorithm* because of the observation that pH meters and testers are only limited for laboratory and manufacturing use. The researchers also discover that the pH levels of a water were used as an indicator for water pollution, that lead to implementing a project that can be used to measure accurate pH levels that is not limited inside the laboratories and its results were explain in the simplest way.

Moreover, this project is written to encourage inexperience people to explore the use of pH tester without the fear of losing resources unlike the old testers that is pricey enough to be in limited use. In the long run, this project is expected to be used by the people to protect the bodies of water from pollution and for the safe use of water that can contribute to the Sustainable Development goals of the United Nations.

## Recommendations

Based on the observation in the implementation of the project *pHym: Python pH Meter using K-means Algorithm*, the following recommendations are proposed for the improvement of the program:

1. The readings or the result that the project provide should have a strong basis coming from the experts.

2. There are some factors that can affect the pH level of a substance (e.g. temperature), it is recommended to have a part of the program that can measure these factors to have a better result.

3. It is recommended to have a better implementation of the program that can have a wider scope of color.

4. It is also recommended to have an object classification that will verify if the image is qualified for processing.

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