AUTOMATED REAL-TIME BEVERAGE QUALITY INSPECTION MONITORING SYSTEM FOR SME INDUSTRIES

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AUTOMATED REAL-TIME BEVERAGE QUALITY INSPECTION MONITORING SYSTEM FOR SME INDUSTRIES

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A report submitted
in partial fulfillment of the requirements for the degree of
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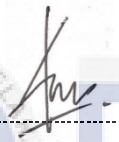
DECLARATION

I declare that this thesis entitled "AUTOMATED REAL-TIME BEVERAGE QUALITY INSPECTION MONITORING SYSTEM FOR SME INDUSTRIES" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

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APPROVAL

I hereby declare that I have checked this report entitled "AUTOMATED REAL-TIME BEVERAGE QUALITY INSPECTION MONITORING SYSTEM FOR SME INDUSTRIES"" and in my opinion, this thesis it complies the partial fulfillment for awarding the award of the degree of Bachelor of Electrical Engineering with Honours

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Date : 05.07.2021

DEDICATIONS

To my beloved mother, late father and not to forget my late grandmother.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my attitude to Allah the Almighty for his showering and blessings throughout my journey in completing this project. The strength was given by him for me to gloss this project.

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ABSTRACT

The need for product quality control in industries for a standardized product is contributing to the implementation of a quality control system. The issue relates to a research which Quality Control in the Beverage Industry stated that Many beverages are recalled for a variety of causes related to food safety, including packaging contamination, microorganism outbreaks, and deteriorating product quality features such as off-flavors, unpleasant taste and smell, or textural deformities [1]. This paper presents an automated monitoring system for real-time beverage quality inspection as a problem solver regarding a tedious and time-consuming manual inspection task, as well as reducing costs, particularly in small and medium-sized enterprises (SME). Soft drinks are used as the test product for consistency inspection in the proposed framework. 4 quality inspections which are color, turbidity, temperature, and pH level are used to inspect the system. The project is IoT (Internet of Things) based. Thus, explains the term real-time. The research starts with pre-processing, which involves the process of making a few water sample. Secondly, analytical method which includes the process of determining a chemical or physical property of the substance after being tested. This process will be done a few times to get all of the results needed. Lastly, experimental results will be obtained which applies the 4 quality inspections stated above.

ABSTRAK

Keperluan untuk kawalan kualiti produk dalam industri untuk produk standard menyumbang kepada pelaksanaan sistem kawalan mutu. Masalahnya berkaitan dengan kajian yang telah dilakukan oleh Rana Muhammad Aadil, Ghulam Muhammad Madni, Ume Roobab, Ubaid ur Rahman, Xin-An Zeng (2019), *Quality Control in the Beverage Industry* dimana banyak minuman dihantar semula ke industri atas beberapa sebab seperti pakej, pecahan microorganisma, dan kemerosotan kualiti termasuk rasa yang tidak konstan, rasa dan bau yang tidak elok atau kecacatan tekstur [1]. Makalah ini, menyajikan sistem pemantauan automatik untuk pemeriksaan kualiti penglihatan masa nyata sebagai penyelesai masalah untuk tugas pemeriksaan manual yang membosankan dan memakan waktu, serta mengurangi biaya, terutama di perusahaan kecil dan menengah (UKM). Minuman ringan digunakan sebagai produk ujian untuk pemeriksaan konsistensi dalam kerangka yang dicadangkan. 4 pemeriksaan kualiti iaitu warna, kekeruhan air, suhu air, dan tingkat pH digunakan oleh jaringan komputer untuk memeriksa sistem. Penyelidikan dimulakan dengan pra-pemprosesan, yang melibatkan proses membuat beberapa sampel air. Kedua, kaedah analisis yang merangkumi proses menentukan sifat kimia atau fizikal bahan setelah diuji. Proses ini akan dilakukan beberapa kali untuk mendapatkan semua hasil yang diperlukan. Terakhir adalah mendapatkan hasil eksperimen yang menerapkan 4 pemeriksaan kualiti yang dinyatakan di atas.

TABLE OF CONTENTS

PAGE

DECLARATION

APPROVAL

DEDICATIONS

ACKNOWLEDGEMENTS **iv**

ABSTRACT **v**

ABSTRAK **vi**

TABLE OF CONTENTS **vii**

LIST OF TABLES **ix**

LIST OF FIGURES **x**

LIST OF SYMBOLS AND ABBREVIATIONS **xii**

LIST OF APPENDICES **xiii**

CHAPTER 1 INTRODUCTION **1**
1.1 Background 1
1.2 Problem statement 2
1.3 Project Objectives 3
1.4 Project Scope 3
1.5 Report Structure 4
1.6 Conclusion 5

CHAPTER 2 LITERATURE REVIEW **6**
2.1 Introduction 6
2.2 Color 6
2.2.1 Color influence in beverages 7
2.3 Turbidity 7
2.3.1 Monitoring Turbidity 8
2.3.2 Nephelometric Turbidity Unit (NTU) 8
2.3.3 NTU Standards 8
2.4 Temperature 9
2.4.1 Quality Temperature Standards 9
2.4.2 Temperature effects on beverages 9
2.5 pH Value 10
2.5.1 pH effects on beverages 10
2.5.2 PH Value of Common Drinks 11
2.6 Conclusion 12

CHAPTER 3 METHODOLOGY **13**
3.1 Introduction 13

3.2 Components 13
3.2.1 Arduino Mega 2560 14
3.2.2 NodeMCU ESP8266 15
3.2.3 Blynk Application 17
3.2.4 Color Sensor 18
3.2.5 Turbidity Sensor 19
3.2.6 Temperature Sensor 21
3.2.7 pH Sensor 23
3.3 Project Development 25
3.3.1 Hardware Development 27
3.3.2 Software Development 29
3.4 Hardware Conections 32
3.5 Conclusion 33

CHAPTER 4 RESULTS AND DISCUSSIONS 34
4.1 Introduction 34
4.2 Hardware setup 34
4.3 Color Test 35
4.4 Turbidity Test 36
4.5 Temperature Test 40
4.6 pH Test 45
4.7 Full Test 50
4.8 Conclusion 53

CHAPTER 5 CONCLUSION 54

REFERENCES 56

APPENDICES 58

LIST OF TABLES

Table 2.1 pH Value of Common Drinks 11

Table 3.1 Main Components used 13

Table 3.2 NodeMCU Board Pinout Configurations and Pins 16

Table 3.3 Components connection 32

Table 4.1 Results of Color Sensor Tests 36

Table 4.2 Results of Turbidity Sensor Tests 37

Table 4.3 Standard Error of Mean for Turbidity Test Beaker A 39

Table 4.4 Standard Error of Mean for Turbidity Test Beaker B 39

Table 4.5 Standard Error of Mean for Turbidity Test Beaker C 40

Table 4.6 Result of Temperature Sensors Tests 42

Table 4.7 Standard Error of Mean for Temperature Test Beaker A 43

Table 4.8 Standard Error of Mean for Temperature Test Beaker B 44

Table 4.9 Standard Error of Mean for Temperature Test Beaker C 44

Table 4.10 Result of pH Sensors Tests 46

Table 4.11 Standard Error of Mean for pH Test Beaker A 48

Table 4.12 Standard Error of Mean for pH Test Beaker B 48

Table 4.13 Standard Error of Mean for pH Test Beaker C 49

Table 4.14 Result of All Sensors Tests 52

LIST OF FIGURES

Figure 3.1 Arduino Mega 2560 board picture. 14

Figure 3.2 NodeMCU ESP8266 picture. 15

Figure 3.3 Blynk Application Logo. 17

Figure 3.4 Color Sensor picture. 18

Figure 3.5 Turbidity Sensor picture. 19

Figure 3.6 Temperature Sensor picture. 21

Figure 3.7 pH Sensor picture. 23

Figure 3.8 Block Diagram of the Automated real-time beverage quality inspection monitoring system for SME industries. 26

Figure 3.9 Flowchart of Hardware Development 27

Figure 3.10 Flowchart of Software Coding 29

Figure 3.11Complete Flowchart of hardware building and software coding 31

Figure 3.12 Connections of product 32

Figure 4.1 Assembled Hardware 34

Figure 4.2 Color Test 35

Figure 4.3 Color Sensor Result Example on blynk 35

Figure 4.4 Turbidity Test 36

Figure 4.5 Turbidity Sensor Result Example on Blynk 37

Figure 4.6 X-Y Scatter of Turbidity Test 38

Figure 4.7 Temperature Test 41

Figure 4.8 Temperature Sensor Result Example on Blynk 41

Figure 4.9 X-Y Scatter of Temperature Test 42

Figure 4.10 pH Test **Error! Bookmark not defined.**

Figure 4.11 pH Sensor Result Example on Blynk 46

Figure 4.12 X-Y Scatter of pH Test 47

Figure 4.13 Full Test 50

Figure 4.14 All Sensor Result Example on Blynk 51

LIST OF SYMBOLS AND ABBREVIATIONS

1. UTeM – Universiti Teknikal Malaysia Melaka
2. SME – SmAll and Medium Enterprises
3. IoT – Internet of Things
4. NTU – Nephelometric Turbidity Unit
5. GSM – Global System for Mobile Communications
6. SMS – Simple Messaging System
7. IR – Infrared
8. UV – Ultraviolet
9. TSS – Total Suspended Solids
10. SEM – Standard Error of Mean

LIST OF APPENDICES

Appendix A Coding for Sensors to Arduino 58

Appendix B Coding for Arduino to NodeMCU and Blynk 65

CHAPTER 1

INTRODUCTION

1.1 Background

Water is an important resources to the human being. Since ancient times, beverages industry provides a pact of flavor of water in a pack to be enjoyed by many. In recent year, visual examination system has been improved from manual examination to an automatic system in a very bottle producing internal control. Product quality testing is the most common way of determining a product's standard in order to meet market demand. As a sub-item of the overall system, quality control is performed on the machine. The examination, on the other hand, makes a huge contribution to the production industry. Due to issues such as exhaustion, boredom, mood, and irrationality, automatic quality inspection is recommended. Furthermore, some applications required specific talents, necessitating the attendance of a coaching theme by an individual's inspector. As a coach, victimisation is restricted to a safe environment, and it might result in disadvantage if some of the tasks are delegated to a risky and contributing way.

Nowadays, the auto quality examination system is wide employed in trade as a result which gives shorter time and consistency in inspecting the product. Quality examination technology has improved quality product and management of trade. It provides an honest competitive to industries that employment on this technology. The technique of machine-driven visual examination has a loosely applied foreground in the most fashionable automatic examination of product quality. This technique uses integrated technology of exactness live and artificial intelligence to classify the product quality. As a result, an automatic visual examination is undergoing substantial growth in producing as a result of its price effectiveness, consistency, superior speed, and accuracy.

SME (Small and Medium Enterprise) is a growing business that has improved through time. SME, on the other hand, adopts a low-cost manufacturing process. SME still uses hand examination in its quality inspection procedure due to price constraints. Therefore, this paper is conducted to style associate machine-driven based examination of SME drink product that implements associate auto process technique for the detection and classification of color, turbidity, temperature, and pH level. The data is gathered from a few sensors system for conducting period of time acquisition throughout a internet of thing (IoT) system which implies on the smartphone of the owner.

Besides, high accuracy may be achieved once the variations between experiments reach to some extent. It additionally has high potency and easier numeric computation. Performance verification is verified based mostly on totally different colour concentration, turbidity, temperature, and pH level. Associate experimental result proves that projected system is healthier with 100 percent accuracy achieved.

1.2 Problem statement

Quality of beverages can be brought to the peak from quality monitoring system. Modernization includes higher number of small and medium size industries (SME). Buyers should be concerned of the quality of the products being sold by SME industries. Nowadays, the visual examination system is extensively used in business since it saves time and ensures consistency in product inspection. Quality inspection technology has enhanced product quality and corporate management. It gives industries that rely on this technology a level playing field. Machine-driven visual assessment is a technique that is widely used. The technique of machine-driven visual examination has a broadly speaking applied foreground in the most fashionable automatic examination of product quality.

There are a lot of automated monitoring system which uses various way in determining the quality of the beverage out there to be bought and used by entrepreneurs such as hyperspectral imaging, density and refractive index measurement, nutrient pad set by Sartorius, and a lot more which offers a variety of quality check but it is not suitable for SME as it costs a fortune to set it up including

hiring a worker to operate it. The products mentioned above are more suitable used in bigger company with larger quantity of product making. Some quality monitoring products does not have the complete instruments to inspect the crucial parameters needed for beverage quality monitoring. This includes the implementation of receiving live feed from anywhere in the world. The project in this paper will be more suitable used in smaller factories as it offers cheap but better quality control for SME products. One of the biggest advantage of this project against other automated quality monitoring system products is the perks of being able to detect 4 output which includes color, turbidity, temperature, and pH level values. Other than that, it uses IoT (internet of things) which it can continuously give out the recent quality value of the beverage. Last but not least, the product from this project does not cost much compared to other automated quality monitoring systems.

1.3 Project Objectives

The objectives of the proposed projects are:

1. To establish the desired quality standards for SME beverages companies
2. To design and develop an Automated Real-Time Beverage Quality Monitoring System for SME Industries that will be able to inspect the condition of the beverages based on color, turbidity, temperature, and pH level values.
3. To analyze and verify the performance of the monitoring system.

1.4 Project Scope

The project is an Automated Real-Time Beverage Quality Inspection Monitoring System for SME Industries. The product will be able to monitor the quality of beverage particularly for SME companies that produces beverage. It consists of 4 sensors and will be able to measure 4 different aspects which includes color, turbidity, temperature, and pH level values. The main component is the Arduino Mega 2560 which is a microcontroller. The commands will be given to Arduino Mega 2560 via Arduino software. The user of this product will be able to monitor the quality of the beverage using only smartphones via Blynk Application. NodeMCU acts as a bridge

between Arduino Mega 2560 and Blynk Application due to the perks of being able to receive Wi-Fi. Tests of the 4 sensors includes:

1. Color: 4 types of colour which are red, green and blue.
2. Turbidity: Range of 1–10 NTU given 1 as the clearest and 10 as the cloudiest.
3. Temperature: Range of 9°C – 78°C.
4. pH: Range of 1 – 14. Acidity and alkaline of water

Other than that, the product will also be low cost as the price of making the Automated Real-Time Beverage Quality Inspection Monitoring System should be lower than RM300.

1.5 Report Structure

Chapter 1 explains the introduction for this study. It includes background, problem statement, project objectives and project scopes. A thorough explanation of each sub-chapter will be placed here.

Chapter 2 will be the literature review. In this chapter, an explanation of the existing product on par with the product in this report is written. This chapter also includes the mandatory explanation of how the product works alongside the components used.

Chapter 3 is the methodology. Discussion about a way to answer the objective will be focused here. A deeper connection and explanation about the Automated Real-Time Beverage Quality Monitoring System for SME Industries is stated here.

Chapter 4 will be results and analysis. The results taken during and after the experiment will be stated here alongside with analytical method.

Lastly, Chapter 5. This will be a short chapter which is conclusion and recommendation. In this chapter, a concluded hypothesis based on the experimental design will be stated. The recommendation will be for future reference.

1.6 Conclusion

The problem statements are first, the available beverage monitoring products being high cost for SME industries. Secondly, some quality monitoring products does not have the complete instruments to inspect the crucial parameters needed for beverage quality monitoring. Lastly, the implementation of receiving live feed from anywhere. The objectives of the proposed projects are to establish the desired quality standards for SME beverages companies, to design and develop an Automated Real-Time Beverage Quality Monitoring System for SME Industries that will be able to inspect the condition of the beverages based on color, turbidity, temperature, and pH level values and to analyze and verify the performance of the monitoring system. The product will be able to monitor the quality of beverage particularly for SME companies that produces beverage. It consists of 4 sensors and will be able to measure 4 different aspects which includes color, turbidity, temperature, and pH level values.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, a glance of information through associated past studies that were done by other researchers are assembled. There are studies observed which investigated about monitoring systems and quality control. However, there is lack in studies on monitoring systems in Malaysia. A specific explanation will be filled in this chapter in order to understand the variable better. Whereby it had been observed isolate to its function towards color concentration, turbidity, temperature and pH value.

2.2 Color

Based on [2] color, also known as hue, lightness, and saturation, is the aspect of any material that is defined in terms of hue, lightness, and saturation. Color is explicitly related with no particle radiation of a specified range of wavelengths visible to the human eye in physics. The component of the spectrum referred to it as the color spectrum, for example, light, is made up of such wavelengths. Vision is clearly involved within the perception of color. An individual will see in dim lights, however, while not having the ability to differentiate colors. only if a lot of lights is gift do colors seem. Lights of some crucial intensity, therefore, is additionally necessary for color perception.

Finally, the manner in which the brain reacts to sensory elements should be considered. Even though the conditions are same, a constant item may appear red to one observer and orange to the other. Color perception is clearly influenced by eyesight, light, and individual interpretation, and a thorough understanding of colors requires knowledge of physics, physiology, and science.

2.2.1 Color influence in beverages

The flavour of beverages can be influenced by color. What is the significance of this? Scientists exploring how vision interacts with taste and odor will benefit from these experiments. According to a study conducted by Charles Spence, color can influence how foods and drinks are perceived. People are likely to learn and become familiar with specific color and flavor combinations. These learnt associations have the potential to change our perceptions and generate expectations about how food should smell and taste. [3]. It is unknown what processes underpin these relationships. The outcomes of these trials are also of great interest to food and beverage firms. It is critical for businesses to understand how their products are regarded by customers. Companies strive to make their foods and beverages the most appealing so that they can sell more stuff. Companies are constantly seeking for methods to improve the attraction of their products to consumers. If changing the colour of a meal or drink can increase sales, the corporation is likely to make the modification.

2.3 Turbidity

Based on past studies **[**4], The relative clarity of a liquid is referred to as turbidity or cloudiness. When a light is shone through a water sample, it's an optical property of the liquid and can be used to measure the amount of light scattered by the material within the liquid. The more scattered light there is, the more muddiness there is. Clay, silt, extremely minute inorganic and organic particles, algae, dissolved colored organic compounds, creatures, and other microscopic organisms are examples of materials that cause liquid to be opaque. Turbidity causes a hazy or opaque liquid. It is stated in Nephelometric (NTU) muddiness units and is measured by shining a light through the water. Several rivers turn a translucent inexperienced color during times of low flow (base flow), and turbidities are low, sometimes as low as ten NTU. During a rainstorm, particles from the surrounding land are carried into the stream, turning the water a muddy brown appearance and indicating greater muddiness levels. Furthermore, during high flows, water velocities are faster and water volumes are higher, which can easily arouse and suspend particles from the stream bed, resulting in higher turbidity.

2.3.1 Monitoring Turbidity

According to Stella Diamant [5] pH, total chlorine, free chlorine, conductivity, temperature, and flow are all often monitored parameters in water used in production, bottling, and cleaning activities. However, in such procedures, using a turbidity measuring standard to detect low turbidity is the most reliable sign of insoluble and undesired stuff in the water that cannot be detected by other methods.

2.3.2 Nephelometric Turbidity Unit (NTU)

According to [6], NTU stands for Nephelometric Turbidity Unit which denotes that the instrument quantifies scattered light from the sample at a 90◦ angle from the incident light. Higher NTU causes The suspended particles absorb heat from the daylight, creating cloudy waters become hotter, and then reducing the concentration of chemical element within the water (oxygen dissolves higher in colder water). Some organisms additionally can't survive in hotter water. The suspended particles scatter the sunshine, so decreasing the chemical action activity of plants and protoctist, that contributes to lowering the chemical element concentration even more. As a consequence of the particles subsiding to the lowest, shallow lakes fill in quicker, fish eggs and bug larvae area unit coated and suffocated, gill structures get clogged or damaged.

2.3.3 NTU Standards

Based on [7], according to WHO (World Health Organization), the established turbidity for drinking water should be between 1 to 5 NTU.

2.4 Temperature

Referring to past studies [8] Temperature of the water is defined in degrees Fahrenheit (F) or Celsius and is a measurement of the mechanical energy of water (C). Season, depth, and, in some situations, time of day all influence water temperature. Because most aquatic species are cold-blooded, they require a precise temperature range to live. Some creatures prefer colder temperatures, whereas others prefer warmer conditions. Temperature conjointly affects the water's ability to dissolve gases, as well as chemical element. The ability of water to dissolve gases and chemical elements is both affected by temperature. The higher the solubility, the lower the temperature. Pollution, or the erroneous warming of a body of water as a result of industrial waste or runoff from roadways and parking lots, is becoming a common environmental issue. This artificially heated water reduces the amount of dissolved chemical elements in the water and may be detrimental to cold water creatures.

2.4.1 Quality Temperature Standards

According to [9], a water bottled beverages should not be warmer than the room temperature which is 26-27℃. Stated by Michael Mascha, beverages are supposedly best served at 12℃ where it is the same of which it comes from the ground. Carbonated water ought to be slightly hotter, in order that the bubbles are less aggressive and therefore the mineral flavor profile shines through. However, soft drinks can be enjoyed in any temperature. Best at around 2-4℃.

2.4.2 Temperature effects on beverages

Stated by Barry G. Green [10], Smell, and Oral Sensation. Heat is believed to alter taste perception because all biological systems are temperature sensitive to some extent. Temperature, he added, can be an essential factor in flavor perception.