POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH.

SMART WATER TURBIDITY ANALYSER.

NAME **MATRIX NUM**

PRAKASH KUMAR A/L ARUMUGAM **08DJK17F1152**

DEPARTMENT OF ELECTRICAL ENGINEERING

JUNE 2019

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This report is submitted to the Department of Electrical Engineering in fulfillment of the requirements of the Diploma in Electronic Engineering (Control).

DEPARTMENT OF ELECTRICAL ENGINEERING

JUN 2019

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TITLE : SMART WATER TURBIDITY ANALYSER

SESSION : JUNE 2019

a) WE, 1. PRAKASH KUMAR A/L ARUMUGAM
2. SRIDHARAN A/L RAMAKRISHNAN

are last semester students pursuit Diploma in Electrical Engineering (control), Department of Electrical Engineering, Polytechnic Sultan Salahuddin Abdul Aziz Shah, which located at Persiaran Ushawan, 40150, Shah Alam, Selangor Darul Ehsan

b) We acknowledge that 'The project above' and the intellectual property therein is the work of our original works / creations without taking and imitating any intellectual property from the other parties.

c) We agree to transfer the intellectual property ownership of 'The Project' to 'the Polytechnic' in order to fulfill the requirement for us to confer a Diploma in Electronic Engineering (Control) upon us.

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a) PRAKASH KUMAR A/L ARUMUGAM (NRIC:- 970718-10-5045 **) ……. PRAKASH KUMAR**

)

)

)

b) SRIDHARAN A/L RAMAKRISHNAN (NRIC:- 991119-10-6591 **) …… SRIDHARAN**

)

at…….. on……..

In front of, MARDIANA BINTI HARUN (NRIC:-790829-01-6362) **) …… MARDIANA BINTI HARON**

as a supervisor project on date …….

CONFIRMATION.

I declare that this report entitled “Water Quality Monitoring System Using IOT” is the result of my own research except as cited in the references. The report has not been accepted for any diploma and is not concurrently submitted in candidature of any other diploma.

Signature : …….

Name : PRAKASH KUMAR S/O ARUMUGAM

Date : ……

DECLARATION

"I hereby declare that I have read through this report entitle "Smart Water turbidity Analyser" and found that it has comply the partial fulfilment for awarding the Diploma in Electronic Engineering (Control).

Signature : ……

Supervisor's Name : PN. MARDIANA BT HARON

Date : ……

ACKNOWLEDGEMENT

I hereby would like to take this opportunity to thank all persons who has involved generously in helping me and assisting me while I was completing the Final Year Report (FYP) which is a compulsory to all Polytechnic Sultan Salahuddin Abdul Aziz Shah (PSA) students in order to complete our diploma.

I would firstly to express my deepest gratitude and thanks to my project supervisor, Madam Mardiana Binti Haron for her undivided support morally and physically, assistance, guidance, tolerance, which proved to be invaluable as to completion my Final Year Project (FYP).

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Last but not least, i also would like to thank all those helping and supporting me during my Final Year Project (FYP).

Abstract.

Turbidity is an important indicator of the amount of suspended sediment in water, which can have many negative effects on aquatic life. The suspended sediments that cause turbidity can block light to aquatic plants, smother aquatic organisms, and carry contaminants and pathogens, such as lead, mercury, and bacteria. The initiative is to introduce the new smart water turbidity analyser which is capable to identify turbidity value of the water. The smart water turbidity analyser is usually designed to send backwash alert to the customer that it need to be backwash when the water quality is unhealthy to consume. The World Health Organization, establishes that the turbidity of drinking water should not be more than 5 NTU, and should ideally be below 1 NTU. The perception behind the research is to identify the vitality of clean water usage through this monitoring device among the community and also to prevent the water filter customers to backwash only when the water is unhealthy to consume. Hence, this devices plays an important role among the community.

TABLE OF CONTENTS.

CHAPTERS **TOPICS** **PAGES**

LISTS OF TABLES

LISTS OF FIGURES OF DIAGRAM

LISTS OF SYMBOLS AND ABREVIATIONS.

1.	Arduino	Arduino nano
2.	LCD	Liquid crystal display
3.	NTU	Nephelometeric Turbidity Unit
4.	IOT	Internet Of Things
5.	WM	Wifi-Modulator.

1.0 Project Plan.

1.1 Introduction.

Turbidity is measured by evaluating the amount of light scattered in water. This can be done with simple visual assessments, such as the original Jackson Candle turbidity meter, or more accurate, technological methods, such as the *nephelometric* method. Turbidity is an indicator of suspended matter or sediment. By itself, the greater the turbidity, the less the ability of sunlight to percolate to aquatic plants. The suspended sediments can also smother the different forms of aquatic life.
If the suspended sediment contains pathogens and/or toxic chemicals, that will affect aquatic life too. Turbidity in fresh water also affects those non-aquatic life forms who consume that water. Suspended materials in water, such as clay, silt, and algae, reduce water clarity and cause turbidity.

The benefits of using a water quality monitoring system using IOT, since this device is placed after the filter it can avoid customers using unclean water by sending customers alert with its NTU (Nephelometric Turbidity units). This notification is acts as a reminder to the customer to backwash. The attached LCD screen shows the NTU values which the customers can check the water quality manually. Moreover this brings a major advantage for the individual whom faced difficulty in remembering the backwash day of their water filter. It is because once the water quality is unhealthy, the device sends alert to customer for backwash the water filter instantly.

1.2 Problem statement

We had a survey regarding the water filter and the backwash of the filter in certain residential areas. Throughout the investigation we we able to find the most of the water filter users facing trouble in remembering the backwash day of a filter. They Often forget the backwash day due to their busy schedule. Furthermore they themselves cannot predict the backwash day approximately. Regarding this issue the customers were had a way to backwash their water filter regularly for 2 till 4 weeks. However there's no visible differences between the filtrate water. In this case they have to spend money for the backwash of the water filter.

In addition to that the insufficient knowledge of customer on water quality is one of the major problem. It's because the individuals

nowadays willing to spend money on their health related issues but they're lack of health science knowledge. Similarly the individuals were financially able to fix water filter at their residences but their knowledge based on the quality is a quite lacking.

1.3 OBJECTIVE OF RESEARCH

- ✓ Send customers an alert through message via sms and mail with its (**NTU**) Nephelometric Turbidity units.
- ✓ Attached LCD screen shows the NTU values which enables customers to check out manually.
- ✓ Avoid customers using the unclean water.

1.4 ISSUES REVOLVED

I. The mechanical structure must be capable for transfusion of water molecules. So that easy to detect the water quality spontaneously.
II. The sensor must be efficient as well as its programs were work according to its input commands and the expected output were portrays using IOT mechanism.
III. The materials must be free from corrosion. So that the manufacturing components were free from corrosion and the particles disallowed into water molecules though chemically.

1.5 SCOPE OF RESEARCH

The scope were defined into the customers who used water treatment and purifier system at their house. The limitations were referred to its software programming where it only sense the turbidity of water. The sensing elements made of eco-friendly substances and materials. The pre-filter portions consists of sensing elements were it act as signal generator.

1.6 FUNDAMENTALS OF RESEARCH.

I. Alerts the customers and educate them with a basic knowledge of water treatment and purify methods.
II. Prevents customers from using the polluted water for their domestic uses.

III. Implementation of internet off things (IOT) in heath science sectors.

1.7 OPERATION OF RESEARCH

The turbidity sensor is used to detect the haziness of water in form of NTU value and it send the signal through the electronic connections of arduino circuit. When the haziness were cross or reach the limit programmed the system were detect the signal from sensor and send it to customers phone through message or mail.

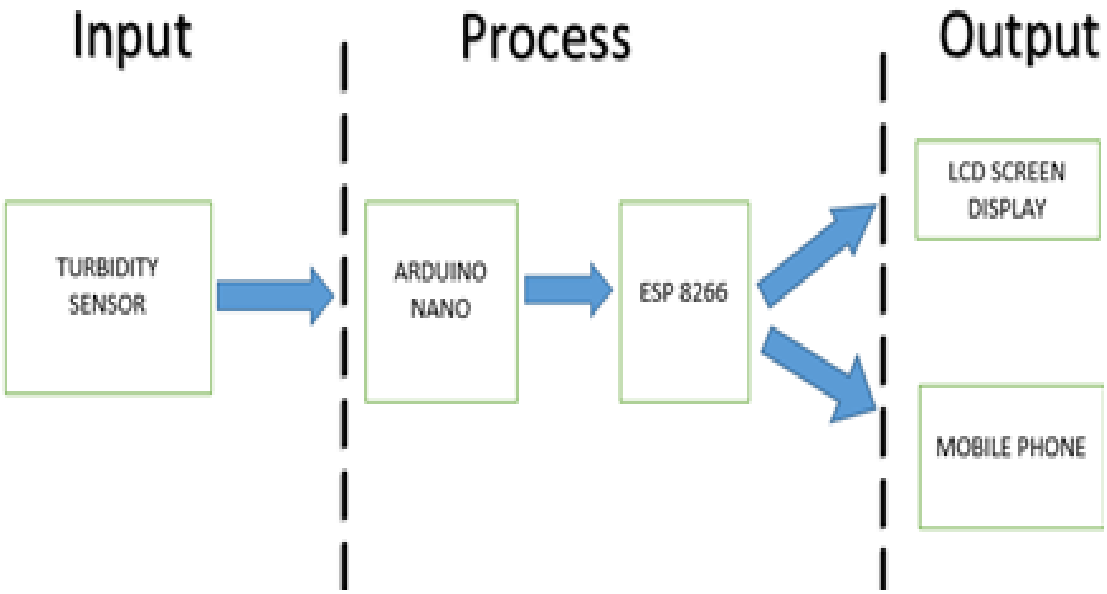


Diagram 1. Flow chart of operation

SUMMARY

The backwash alert mechanism was aid to send remember messages to the customers that the water used was still contains dirt and haziness.

2.0 LITEREATURE REVIEW.

2.1 INTRODUCTION.

A smart system of high-precision water quality analyser that include turbidity meters, accompanied by effective methods of chemical dosing and filtration as well as a sophisticated alert system, municipal water treatment systems are able to correct the water quality and make it safe for drinking and other uses. In some cases of particularly high turbidity registered in the water, a decision might be made to halt pumping from the river or lake source, not to treat water that does not meet minimal standards or to terminate treatment that is not cost effective.

2.2 CONCEPT OR THEORY

A **Closed-loop Control System**, also known as a *feedback control system* is a control system which uses the concept of an open loop system as its forward path but has one or more feedback loops (hence its name) or paths between its output and its input. The reference to "feedback", simply means that some portion of the output is returned "back" to the input to form part of the systems excitation.

Closed-loop systems are designed to automatically achieve and maintain the desired output condition by comparing it with the actual condition. It does this by generating an error signal which is the difference between the output and the reference input. In other words, a "closed-loop system" is a fully automatic control system in which its control action being dependent on the output in some way.

2.3 PREVIOUS RESEARCH

The measurement of turbidity is a key test of water quality. Nephelometers, or nephelometric turbidimeters, measure the light scattered at an angle of 90° by one detector from the incident light beam generated by an incandescent light bulb. Readings are reported in Nephelometric Turbidity Units, or NTUs

2.3.1 Nephelometers applocations and researches.

Figure 1. Water quality analyser system

Figure 2: Stationary nephelometers for industry purpose

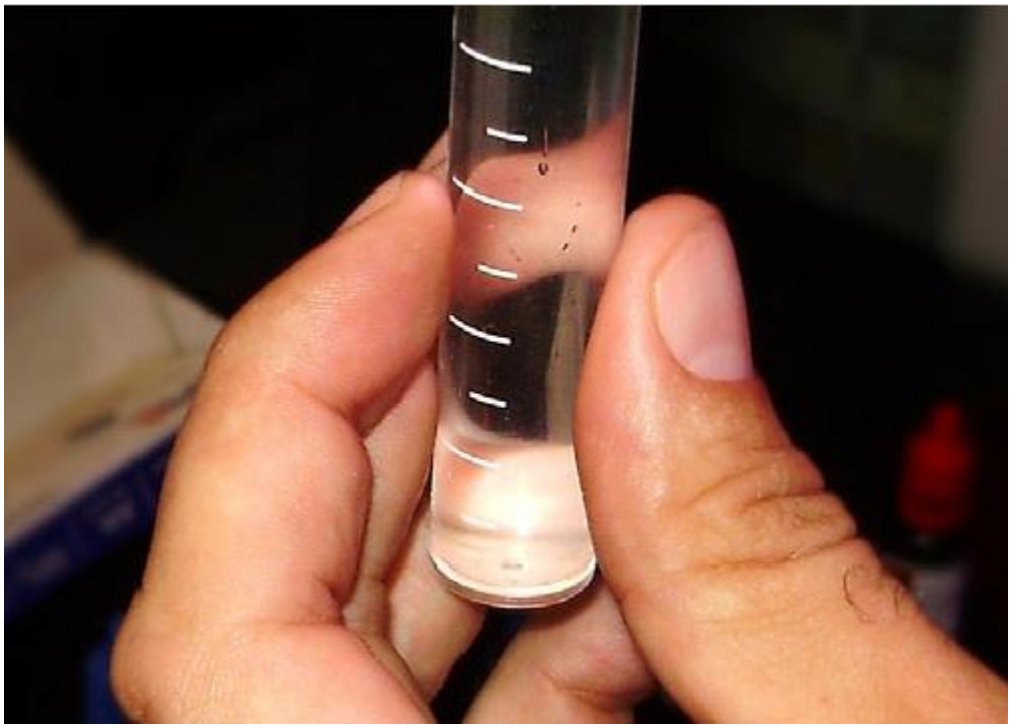


Figure 3. Water sample before tested

Figure 4: Water quantity and quality monitoring prototype

Figure 5: Nephelometer in water treatment centre.

Figure 6: Portable Nephelometer.

2.4 TOPIC SUMMARY

The working operation of the turbidity sensor alert for backwash was illustrated in form of basic flow chart and block diagram. Those mechanisms were described as well as it’s theoretical statements. The previous research or inventions found on market were shown as an example for reference purpose.

3.0 Methodology of research

3.1 Introduction.

A system of method used in the project was the basic knowledge of turbidity which portrays, the water which used for domestic uses must have 5 NTU value or less. Turbidity of more than it would be noticed by the turbidity sensor and send alert to customer's mobile by e-mail and sms. The NTU/JTU value on a filter cylinder is changed when it never backwash or delay in backwash.

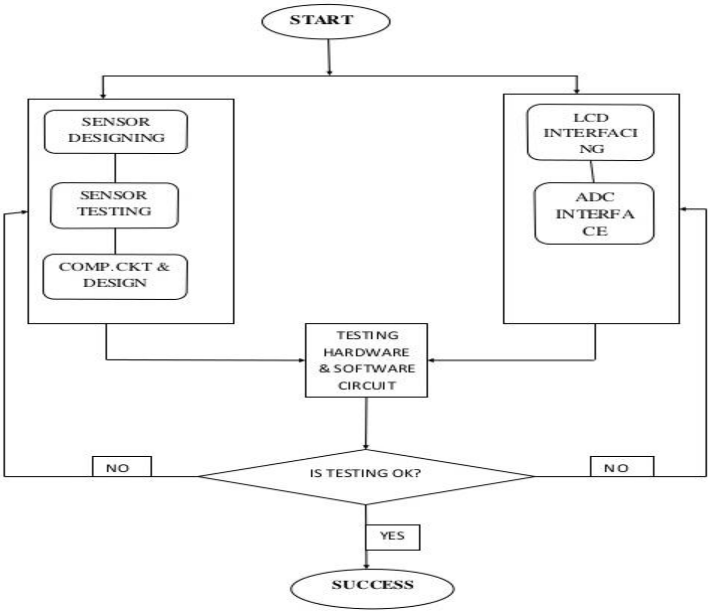


Diagram 2: Flow Chart Of system

3.1.1 HARDWARE DESIGN OF THE RESEARCH.

There are internal and external parts of the devices were sketched. The combination of the sensor with filter also attached.

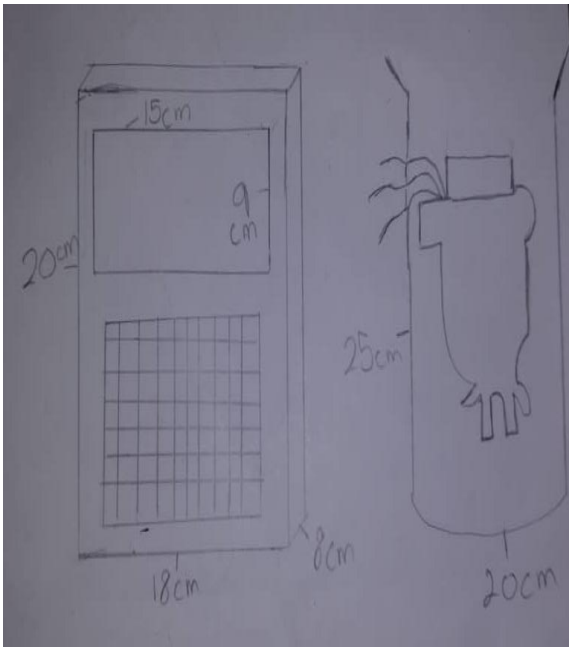


Figure 7 & 8 Hardware prototype with its sketch.


Figure 8 & 9: Hardware working mechanism

Components used for hardware design

1. Title : Turbidity sensor

Description : System includes the capability to detect the NTU values and give a digital output of suspended particles when it is placed on water

2. Title : Arduino Nano

Description : System includes the microcontroller which usually

comes with Arduino Uno. This microcontroller reads the reading from the sensor and controls the overall system.

Version : Version 1.0

3. Title : Hitachi LCD 16x2

Description : System includes the LCD interface for the user, which displays the reading taken by the different sensors in the system.

Version : Version 1.0

Hardware design

- ✓ use 12volt battery to operate the entire turbidity sensor and the system

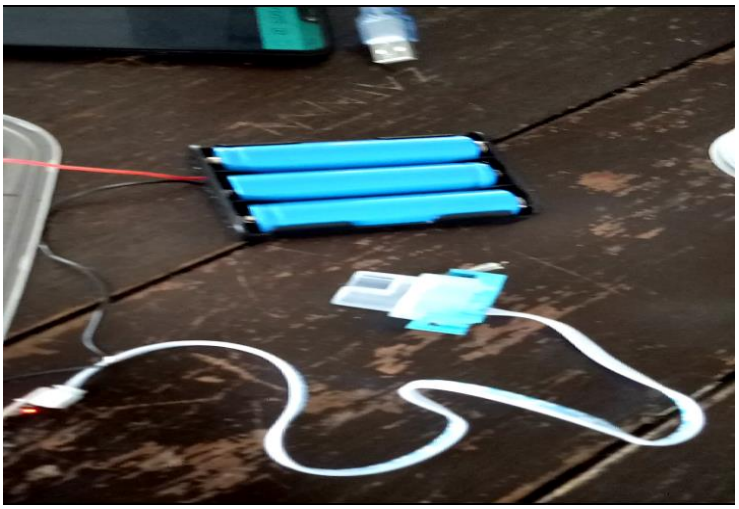
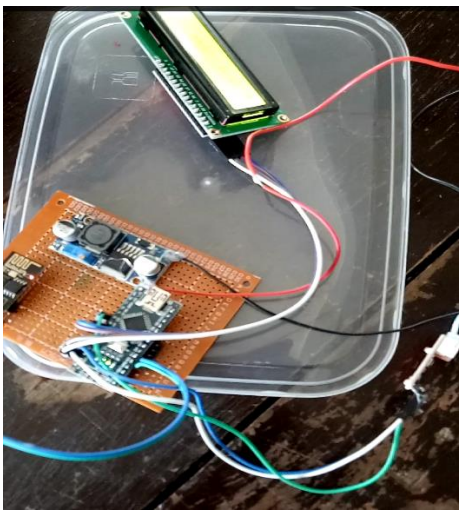


Figure 10: Connections of Battery

Connecting LCD to Arduino

- ✓ Connect LCD GND to GND.
- ✓ Connect LCD SCL to Arduino A5.
- ✓ Connect LCD SDA to Arduino A4.
- ✓ LCD VCC to Arduino 5V



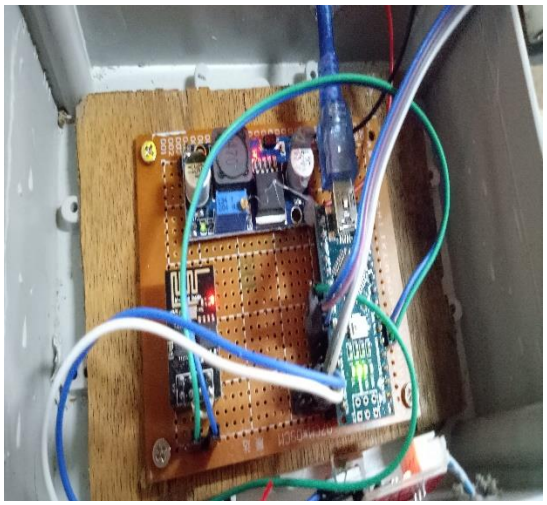


Figure 11 & 12: connections of LCD and Arduino

- Connecting turbidity sensor to the arduino.

I. Connect the two pins from the Sensor to the two pins on the Amplifier circuit via hook up wires.

Figure 13: Connection of turbidity sensor

Casing connections.

- ✓ The casing was all fitted to the arduino and GSM board.
- ✓ The Sensor is Set up to partially floated in water in order to get correct NTU values

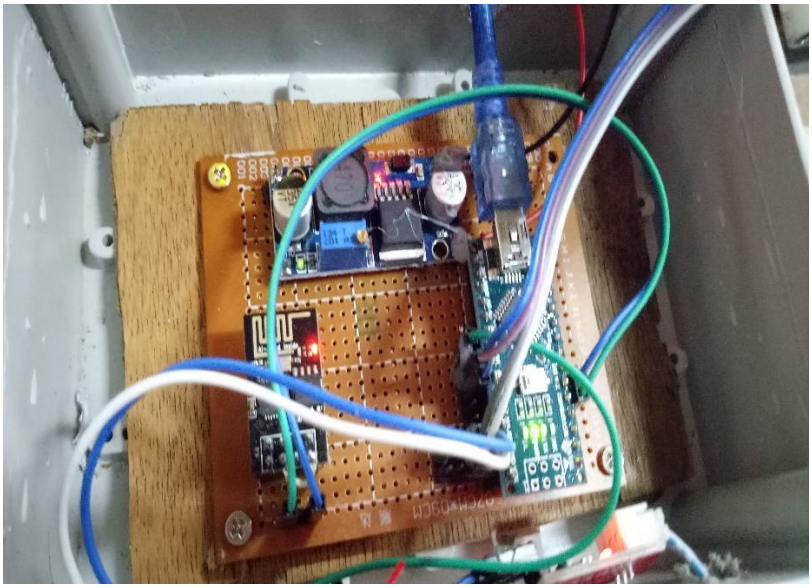


Figure 14: Internal View

Figure 15: External View

3.2. METHODS OF GAINING INFORMATION.

A close observation and analysis was made by myself and my group member regarding this issue. We clearly compare it ourself of the water quality before and after backwash. We also able to gain information from other reliable sources like newspapers, internet news, in form of bar charts and graphs. Furthermore we, often do discussion with supervisor and the project's specifications were modified.

3.3. INSTRUMENT OF RESEARCH.

A sample polling was carried out among the customer who having the water filter and nearly we found 69% of them often forget the deadline of the backwash day and some said they frequently backwash and it costs expensive. Some said only when the water odour or colour change.

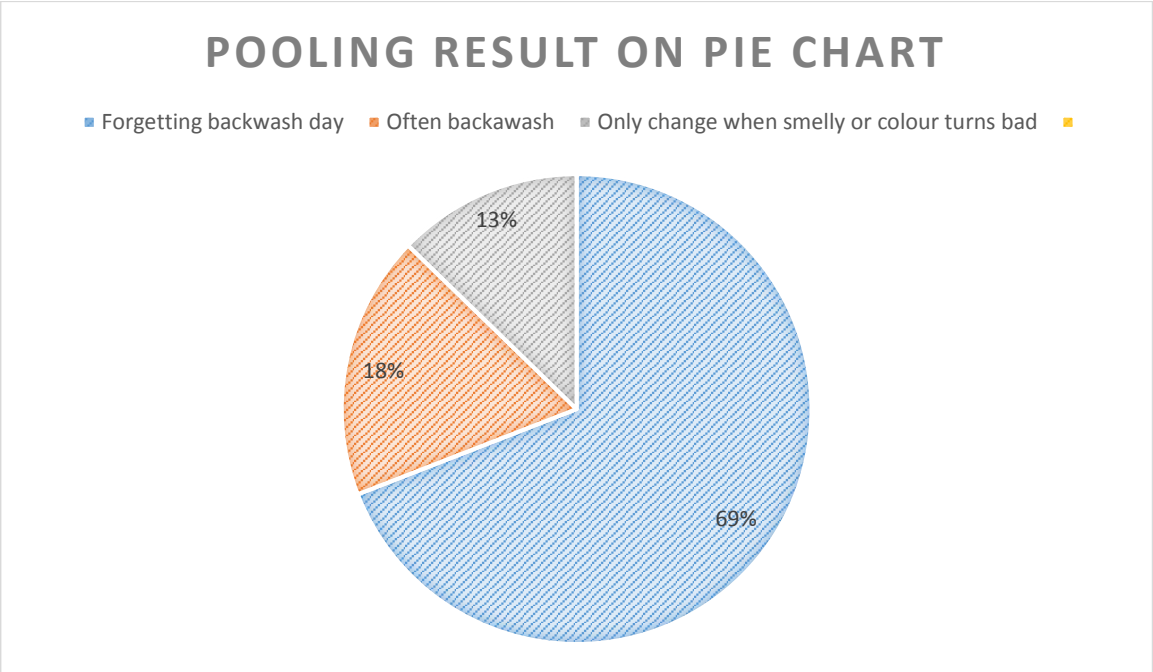


Diagram 3: Pooling results on Pie chart

3.4. SAMPLING TECHNIQUE

The main target for the device were the customers who using water filter and purifier and also for those who having the water storage tank. The probability of the device marketing is obviously very high and demanding. Its because some dangerous illness were results of un-treated water.

3.5. DATA ANALYSIS METHOD.

To make easier and convenient we use the flow chart and graphical items in order to capture and analyse the improvisation of the device. Its easier to understand the progress and manage to predict the output easier. The interviews and polling were taken and assume in form of percentage so that we able to demonstrate in form of graphics.

3.6. SUMMARY

Through this methodological research we were able to understand the demand or the hype for the device and the potential this turbidity alert system for filter backwash in water resource sector.

4.0 Results and discussion.

4.1 Introduction.

Analysis and discussion were carried out to ensure the project results are in the desired state without causing any problems along the final year project. Determining, identifying, selecting and producing an optimal design in terms of material specifications, criteria, cost and perfect designing with manufacturing methods were categorised in terms of project analysis.

These analysis is more focused on project functionality, errors obtained and delay in operations with its way to reduce were identified. The cost of materials such as the price of components, equipment, and software costs used were involved and stated.

4.2 RESULT AND ANALYSIS

1. GSM Module can connects and sends notifications to mobile phones.
2. Sensor works and detects the NTU of the water
3. Arduino Nano performs at its good.
4. LCD can display the voltage or potential difference with the NTU value.
5. If the NTU value is optimal or <5.2 there’s no notification send.
6. If the NTU value is beyond 5.2 the notification of "NTU VALUE IS HIGHER. YOUR FILTER HAVE TO BACKWASH!" is shown.

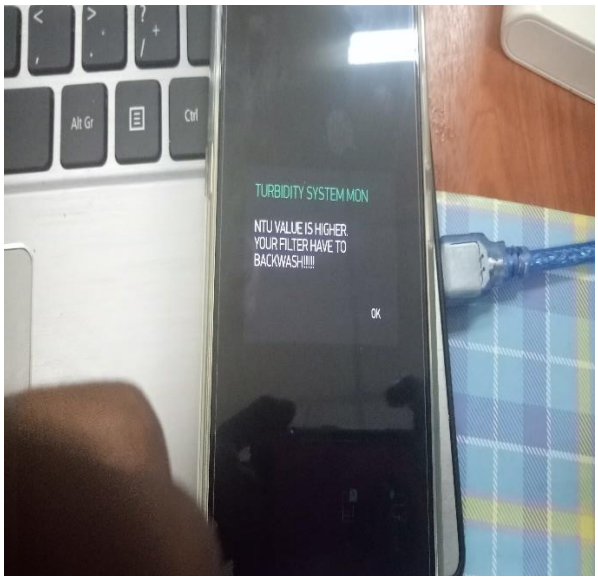


Figure 16 & 17: Results shown during result and analysis portion.

Figure 18: Picture during tested session.

4.3 SUMMARY.

Throughout the results obtained we can see the whole system is operating as it designed. Although there's a little delay in displaying the readings but there's no error obtained along the project analysis and presentations.

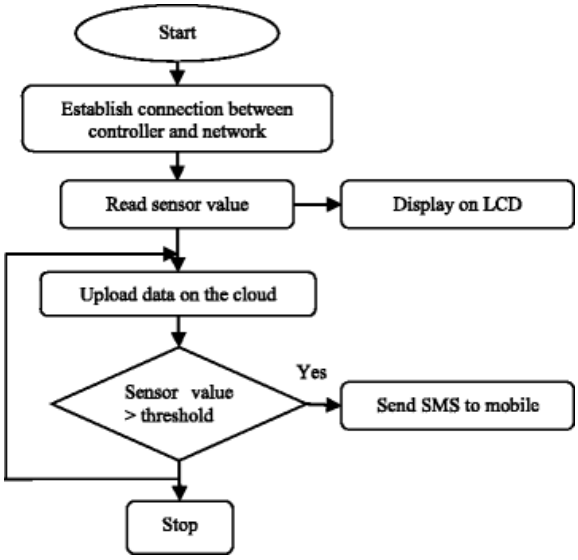


Diagram 4: Block Diagram

5.0. DISCUSSION AND COCLUSION.

5.1. INTRODUCTIONS

The discussions were made in order to search and provide further evidences that support our project results. Not only that we were decided to enhance the its performance as it designated for the future generations.

5.2 DISCUSSIONS

As a discussions we can say that according to the World Health Organisation's Standard Drinking water should have a turbidity of 5 NTU/JTU or less. Turbidity of more than 5 NTU/JTU would be noticed by users and may cause rejection of the supply. Where water is chlorinated, turbidity should be less than 5 NTU/JTU and preferably less than 1 NTU/JTU for chlorination to be effective. Hence this Smart Water Turbidity Analyser able to triggers when the NTU Value is beyond 5.2 (0.2 considered as an uncertainty) is able to use in existing days.

S. No.	Parameters	Standard value based on IS (Sn)	Unit Weight (Wn)
1	pH	8.5	0.025899
2	Turbidity, NTU	5	0.044028
3	Total Dissolved Solids	500	0.00044
4	Total Alkalinity	200	0.001101
5	Total Hardness	300	0.000734
6	Nitrate	45	0.004892
7	Chloride	250	0.000881
8	Calcium	75	0.002935
9	Magnesium	30	0.007338
10	Iron	0.3	0.733805
11	Fluoride	1	0.220142

TABLE 1.0

Parameters	WHO – standard		BIS -Standard
	HDL	MPL	
Odour	Unobjectionable		Unobjectionable
Turbidity NT units	5	10	1
Total dissolved solids mg/L	500	2000	500
Electrical conductivity in µS/cm	Nil	Nil	Nil
Chemical parameters			
pH	6.5-9.5	No relaxation	6.5-8.5
Alkalinity total as $CaCO_3$ (mg/L)	200	600	200
Total hardness as $CaCO_3$ (mg/L)	300	600	200
Calcium as Ca^{2+} mg/L	75	200	75
Magnesium as Mg^{2+} mg/L	30	150	30
Sodium as Na^{+} mg/L	Nil	Nil	Nil
Potassium as K^{+} mg/L	Nil	Nil	Nil
Iron as Fe^{2+} mg/L	0.3	1.0	0.1
Manganese as Mn^{2+} mg/L	0.1	0.1	0.05
Chromimum as Cr^{3+} mg/L	Nil	Nil	Nil
Nitrite as NO_2 mg/L	Nil	Nil	Nil
Nitrate as NO_3^- mg/L	50	No relaxation	45
Chloride as Cl^- mg/L	250	1000	200
Fluoride as F^- mg/L	1	1.5	1
Sulphate as SO_4^{2-} mg/L	200	400	200

TABLE 2.0

Quality of acceptable drinking water			
Property	**Recommended operational limit**	**Maximum allowable for limited duration**	**Consumption period,[a] maximum**
Conductivity µS/m	< 150 000	150 000 – 370 000	7 years
pH	5.0 – 9.5	4.0 – 10.0	No limits
Turbidity NTU	<1	1 – 5	No limit[d]
DOC mgℓ^{-1} C	<10	10 – 70	No limit[e]

[a] *Limits based on consumption of 2 ℓ of water per day by a person of mass 70 kg over a period of 70 years*
[d] *Process efficiency and risks associated with pathogens*
[e] *When DOC is deemed of natural origin, the consumption period can be extended*

TABLE 3.0

5.3 CONCLUSION

This paper has presented the overall instruments for water turbidity measurement. This paper has also shown a design which can be developed through a very simple circuitry which can be implemented as effective as possible. However, this is achieved by compromising the resolution of the measurement. A more comprehensive design of Smart Water Turbidity Analyser has more scope in domestic uses of water.

5.5 IMPLICATIONS OF RESEARCH

The implications of Smart Water Turbidity analyser is vast and sensible. This is due to nearly all the sectors and industry required water sources for their daily routine either in domestic or for productions. Thus, the quantity of water used in daily routine was huge. As long as there's demands for clean water, our project holds a place in determining the NTU values.

5.6 SUGGESTIONS OR IDEAS

As a suggestion we can say that in future, there will be a quality and motion controller device itself where it automatically control the movement of water when the water quality is unclean and unhealthy for daily routine. Hence, the water quality and motion monitoring controller is a future

5.7 SUMMARY

As a summary we can say that the device is effective in obtaining the results. The whole system is operating with respect to its design and program. Although there's a little delay in displaying the readings but there's no error obtained along the project analysis and presentations.

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Pricing details.

NAME	QUANTITY	PRICE (RM)
Screwdriver	1	(Rm 6.20)
Cutter	1	(Rm 8.00)
Plier	1	(Rm 6.00)
Wire stripper	1	(Rm 9.90)
Soldering iron	1	(Rm 17.00)
3-way corner elbow pvc fitting connector (1/2”)	4	(Rm 16.00)
4 x 245 mm long of ½” pvc pipes	4	(Rm 10.00)
Saw	1	(Rm 3.00)
DIY plastic tub	1	(Rm 2.00)
Casing	1	(Rm 19.00)
Scissors	1	(Rm 3.00)
4 x 2-way corner elbow pvc fitting connector (1/2”)	4	(Rm 3.80)
Hot glue	1	(Rm 15.00)

Table 4.0

Components.	Quantity.	Price.
Wifi module esp8266	1	RM 11.00
Arduino Nano	1	RM 50
Hitachi 16×2 LCD	1	RM 10.50
Turbidity sensor	1	RM 35.00
Battery 12V	1	RM 22.00

Table 5.0

SAFETY PRECAUTIONS

- During the project, we make sure that all the wires are connected tightly.
- When testing turbidity sensor we made sure the sensor was placed properly in order to get the right reading.
- We ensure that the circuit diagram is keep away from water to avoid any errors.
- We make sure that the casing was closed properly so it is user friendly.

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