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Water Quality Monitoring

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Abstract: Water quality testing is an inevitable part of environmental monitoring. There are various parameters that affect the quality of water in the environment that can be physical, chemical or biological. Physical properties of water quality are temperature and turbidity. Chemical properties of water include parameters such as pH and dissolved oxygen. Biological parameters of water quality include algae and phytoplankton. Various papers suggest various methods for measuring the quality of water even though some are theoretical methods. For example the quality of water can be measured with the help of solar power or wireless sensor network. Depending up on the parameters monitored the accuracy of the result produced by each method may vary. This increases the scope of this topic since it consist of machine learning and data mining applications. In the suggested method, there are two components- hardware and software. Hardware component is used to collect data from various water bodies. Data collected from each water body will be saved to the database with the corresponding location. Software component is a mobile application through which users gets information about the quality of water in their surrounding area.

Keywords: Image processing, Water born diseases, Water quality monitoring, Machine Learning

I. INTRODUCTION

The number of contaminated water resources is increasing day by day. Water pollution has become a major environmental threat for all of us. The reason for water pollution are industrialization, urbanization and also due to the unhygienic habits of the human beings. The major increase in population also plays an important role in water contamination. When quality of water decreases, it not only affects us but also our ecosystem as well. The health of a person depends on the things that consumed by that person. An unavoidable thing in human life is water. Knowingly or unknowingly we are destroying the major source, which plays a key role in our health habit. It has become a crucial factor to monitor the water sources. In early days monitoring was done manually, but using today's technology, man labor can be reduced. Speaking of early system, monitoring was done by taking samples from the water resources and analyzing the samples at the laboratory. The quality of water can be determined by the elements in water. It can be chemical, physical or biological factors. The physical properties of water quality include temperature and turbidity, where the chemical characteristics involve pH and dissolved oxygen. The biological indicators of water quality are algae and phytoplankton. The value of pH gives us the amount of hydrogen ion present in the water. It has a neutral value of 7. pH value can indicate the alkalinity or the acidic property of water. Main feature of water is its cleanliness and clarity. The turbidity indicates the unsolvable particles present in water. When turbidity increases, the light penetration into the water will be decreased. Temperature of water increases as turbidity is increased. Temperature effects adversely on water quality.

II. LITERATURE SURVEY

IoT is simply the network of interconnected things or devices which are embedded with sensors, software, network connectivity and necessary electronics that enables then to collect and exchange data making them responsive. In this paper[1], the paper describes about a system to automate the traditional water analysis method in which samples from the water sources were taken and investigated thoroughly in the laboratories. For automation, water quality monitoring sensors, arduino IDE, Zigbee module and data concentrator modules are used. The above mentioned components are physically placed in each and every water source in the locality. The quality parameters gathered by the sensors are forwarded to arduino IDE to convert it from binary to digital. Digital datas from arduino IDE is forwarded to data concentrator module through zigbee module for remote transfer of data to the lab. The datas from each data concentrator module located at different locations are sent to the cloud configured server which is located at the testing laboratory. The employees at the lab thoroughly investigate those datas and the datas will be provided to the requested users securely. RSA algorithm is used as the cryptographic technique for security. This system ensures accurate and continuous monitoring and provides awareness about local water bodies.

A real time water quality monitoring system is described in this paper[2], using wireless sensor network. Water quality parameters such as pH level, turbidity, and temperature are measured using various sensors and gathered data will be

sent to the base station or monitoring room. pH sensor that senses the acidity or alkalinity of water, temperature sensor that senses the temperature of water and turbidity sensor that sense the turbidity or purity based on phototransistors, are immersed in water for real time monitoring. Sensed information are converted into electrical signal and passed to microcontroller or microprocessor for processing. Zigbee is used to transmit the processed information to the monitoring room. Received data will be displayed using the built GUI on the base monitoring station. GUI platform is developed using MATLAB software which can be used to interact with hardware at base station. Push buttons are provided to read data from sensors. Plotted values are saved in Ms Excel database, which can be accessed by using the push buttons and average data values can be calculated. System is of low cost, easy ad hoc installation, easy handling and maintenance. GUI platform using MATLAB is cost effective and it allows easy customization.

A real time application to monitor the quality of water over different sites with a base station and distributed sensor nodes are suggested in this paper[3]. Nodes and base station are connected by a WSN technology like Zigbee. Various datas collected through pH sensor, turbidity and oxygen level are sent to the base station. Collected datas are displayed and are analyzed using certain simulation tools. This system was designed to measure the quality of drinking water as well as water used for agriculture and industrial process. Simulation software is used at the base station to analyze the quality parameters and certain control measures can be taken to improve the water qualities. Solar energy is used to supply power to sensor nodes. Synchronization of the data communication between source and sink nodes are done using time division. VB and MATLAB are used to simulate and analyze quality parameters for quality control. The recorded information will be published over web for public information and for further assessment. The abnormal moments in sea can be guessed using the recorded information. Low power consumption, no carbon emission and the flexibility of deployment at remote sites are the advantages of this system.

The health of a human body depends on what we consume. Elements are the basic constituents that make up the human body. Drinking water is the main source of everything in our body. Here in this paper[4] use support vector machine, this comes under supervised learning. In the proposed method SVM is used to select the elements with most discrepancy. SVM is a pattern recognition technique for small sample size classification problem. In this proposed system, SVM is applied to analyze the difference of element quantities in drinking water from different water bodies. SVM uses specific indices for classifying regions or subjects with different phenomenon. Support vector machine has a good theoretical basis in solving classification regression and density function problems. SVM is a linear pattern recognition technique. It does the mapping from the original sample space to high-dimensional linear space by using a non-linear transformation. The technique SVM has some advantages when compared with traditional methods such as high generalization ability, kernel trick, unique solution etc. It is a successful method for classifying two data sets with the test samples to verify the model, the misclassification rates are zero. High drinking water quality is the major need for the human being.

Water pollution is rapidly increasing in today's world. Monitoring water resources has become an important aspect in human life. This paper[5] discusses bio-monitoring and multiclass support vector machine. Bio-monitoring is a computer vision technology. It is an effective way for the assessment of water quality by monitoring the various health state, physical change and behavioral response. In the proposed method we are analyzing the behavioral response of group of fishes in a tank. The behavioral response is noted and an early warning system is given in this study. In this paper, real time monitoring is done and the quantified data is stored in a database. For classification, SVM is used. The classification is done according to the behavioral changes of the fishes in the toxic environment. The behavioral parameters of group of fishes are extracted using bio-monitoring technique. Compared to the traditional ways for water quality assessment, the bio-monitoring and multiclass SVM has more advantages. The SVM discussed here use specific indices for classifying the great theoretical in solving classification regression and density function estimation problem. From the results obtained different alarm signals can be sent out and required emergency measures can be taken to control pollution.

Due to the phenomenon of absorption and scattering of light in aquatic environment, the images taken under water are of low contrast and non-uniform colour cast. We may require the images taken under water for many applications. So we need to have images with high contrast so that we require a reliable pre-processing stage. In this paper[6], unsupervised colour correction method is described, which consist of two colour models that are RGB model and HIS model. By using the proposed method image enhancement is done. The method starts with the RGB model in which the colour value is equalized, and then the contrast correction method is applied. From that point the red colour value is increased by maximizing the red histogram and blue colour value is reduced by stretching the histogram towards the minimum. After finishing this, the HIS model is considered in which the saturation and intensity values are taken into account. By using saturation, true colour of the image is enhanced and through intensity value the illumination problem is addressed. The method have the advantage of addressing the illumination problem and to take the effective measures to reduce the high bluish colour cast and the presence of low red colour value. The proposed method is one of the best ways to improve the quality of images taken in aquatic environment.

Images captured in aquatic environment are usually of low quality, due to different phenomenon happening for light in aquatic environment. The images do not have high quality and it can't be used for the purpose of display and analysis. In this paper[7] there are two types of algorithm that are useful to overcome the ongoing situations in the aquatic environment. The first algorithm is underwater image dehazing algorithm which has the purpose to restore the visibility, colour and natural appearance of the underwater images. Second one is mainly useful for increasing the contrast since it is a contrast enhancement algorithm based on histogram distribution prior. Both of the algorithms differ from the existing algorithms mainly because it is based on the minimum information loss principle. The presence of two types of algorithms gives two types of enhanced output. One of which will have genuine colour and natural appearance, it is mostly used for display. For the need of extracting information from the images the second enhanced output is used. It is mainly because it contains high contrast and brightness. The proposed method achieves a better visual quality in terms of other traditional methods because of the presence of minimum information loss principle and the two types of algorithms. It has more accurate colour restoration than several state of the art methods. The paper introduces fewer artifacts and noises and the outputs have different applications.

In today's world the quality of water is decreasing day by day due to increased urbanization and industrialization. There are many systems developed nowadays that are able to monitor water quality in real time. Quality of water can be determined by using different parameters that can be physical, chemical or biological. The most cost effective system for monitoring water is the wireless systems which will reduce the overall cost and also man labor is reduced. In this paper[8], wireless sensor network is developed containing a high power transmission Zigbee based technology which is combined with the IEEE 802.15.4 compatible transceiver. Since it is a wireless sensor network, it allows easy customization as well as cost effective. The implemented system mainly monitors the parameters such as pH, turbidity and temperature. The proposed method is mainly advantageous activities in large areas. The proposed system is able to display the parameters in real time, using the development of Graphical User Interface. The GUI is made available at the base monitoring station which constitute as the main component of the implemented system. GUI is developed using Borland C++ builder programming which is a rapid application development environment. By using the proposed method, flexibility is achieved along with low power consumption. The usage of Zigbee is because of the fact that it is a well-known communication standard for wireless sensor network. The proposed method is most reliable when compared to the traditional methods.

The use of wireless sensor network nowadays is more than ever. It is mainly due to its features such as flexibility and cost effectiveness. From these features one can achieve more reliable network. The system proposed in this paper[9] is based on the wireless sensor network. It consists of a base station and sensor nodes. Speaking of the sensor module, it includes a temperature sensor and a pH sensor. The use of wireless network comes in use when the collection of data from remote sources is required. The implemented system follows a master slave method in which there is a single master with several slaves. The transmission standard followed is IEEE 802.15.4 and the routing of data is done on the basis of well known communication standard Zigbee. This paper shows the practical application of the network for monitoring a fish farm with sensor module and wireless sensor network. The data from the sensor module is transmitted to the wireless network with the help of a wired connection. Compared to the wired applications, wireless sensor network can work in wide range of environments along with providing advantages like low power consumption, reduced size, and distributed intelligence. The main components that make up the wireless sensor network are radio frequency transceivers, sensors, microcontrollers and power source. An effective monitoring of fish farm is achieved with the help of sensor module and wireless sensor network.

In existing method, water quality is monitored by taking water samples from remote water sources and analyzing them at laboratories. But nowadays technologies have developed a lot in which requirement of man labor is not needed any more. In today's world, the market is expanding for novel, miniaturized, intelligent monitoring systems for pure water catchments, transitional and coastal waters. The paper[10] describes a smart coast multi sensor system for the monitoring of water quality. The main goal of proposed system is to provide a platform that is able to meet the requirements of the water frame work directive. The parameters that are used for monitoring the quality of water include temperature, phosphate, dissolved oxygen, conductivity, pH, turbidity and water level. The main module of the proposed system is the wireless sensor network platform developed at Tyndall. By using this module an easy integration of sensors are done because of the plug and play capability of the wireless sensor network. The phosphate sensor used here uses yellow method for phosphate detection. It also has a linear dynamic range which comes in between 0 and 20mg per litre. The communication standard used here is Zigbee. The proposed method shows that it is possible to make wireless sensor network are viable.

The quality of an image can be degraded due to many factors; bad weather is one of that. Bad weather corresponds to factors like fog and haze that can reduce the visibility to an extent. It is mainly due to the presence of particles that absorb and scatter the light. In traditional methods, we require multiple input images of a scene to analyze the quality. These images usually have different degree of polarization or different atmospheric conditions. This requirement in the

traditional methods is its main drawback. The proposed method solves the drawback of the traditional method. In this paper[11] the only requirement is a single input image. The whole system is based on two basic observations. The first observation is that, images taken in bad weather has less contrast compared to images taken in clear day. The other one corresponds to the fact that air light variation is mainly based on the length between object and the viewer and it tends to be smooth. From these observations the implemented system develops a cost function in the framework of Markov random fields. Various optimization techniques are there to increase the efficiency of the proposed method. The proposed paper has many applications since it does not need the geometrical observation of the input image and the method can be applied to colour and grey image.

In this system[12] the water quality sensors collect data from industrial and municipal water bodies. At the substation these collected data get processed. Then processed data send to the main station through Ethernet network. Differentiated data from the main station is given to environment and public department using internet. Advantages of this system are data accuracy, reliability and efficiency. The drawback of this system is that it cannot provide real time monitoring of water parameters. Water is essential for agriculture, industry and for existence of human, animals; so water quality monitoring is essential to control physical, chemical, biological characteristics of water information collected can be used to give alert to users so they can take various actions against water pollution, WSN help to monitor the quality of water with the help of information sensed by sensors. Feature of WSN is combined with zigbee based technology. Various advantages include are low cost, minimum power usage, simplicity in implementation reliability and scalability. Various sensors used are ph sensor, turbidity sensors, conductivity sensor, and temperature sensor. When values from sensors exceeds a threshold value it give alert to users so they can take various actions according to that also can prevent water pollution in their locality. The use of GUI for the monitoring purpose at the base monitoring station is another component discussed in this paper.

In this system[13] data collected from water body using water quality monitoring sensors is given to data processing unit through GSM modem. In data processing unit the data from different sensors are differentiated and continuously compared with the threshold value. If the water didn't meet the quality parameters then alert signal go to user that is connected to the buzzer. Advantage is that it eliminates cost consuming jobs of manual monitoring. Drawback is that this system not reliable for long distance can only apply to single source of water. The pollution of water resource becomes a common human problem. Traditional method of water quality monitor contains the manual collection of water sample from different locations. Then sample is bought to laboratory and tests .such methods are time consuming and is no efficient current methodology using IOT technique to monitor water quality using wireless sensors, various sensors using are ph sensor, turbidity, conductivity, and temperature sensor. Today there is large need for continuous monitoring of water quality parameters in real time. Output from sensors are processed by microcontroller and sent to core controller remotely using zigbee.IOT module is used to access processed data from core controller to cloud. These data can be monitor on a web browser also user can take necessary action against pollution.

In this system[14] data collected through water quality smart sensors send wirelessly to the device which collect data from the all the nodes. This data is send to remote server through GPRS network and user can see data remotely. User can done analysis according to the threshold value. Advantages of this system are highly scalable faster and also user friendly. Drawback is that it is costly because of using smart sensors; also, the size of sensors is not reliable for water tap.Water pollution increases due to chemical and biological wastes. This causes huge amount of diseases to human beings and animals.so there is need for avoiding pollution and also need to take necessary action.in this system we monitoring different parameters including ph, oxidation and reduction potential, conductivity and temperature using a RS technology.IOT technology is used to real time monitoring is possible. User can continuously monitor various parameters and can get alert message if values exceeds threshold value. So by this, water pollution can be detected early values monitored are stored in a database also it is programmed by comparing threshold value. If it is exceeding alert message send to user.

This system[15] is based on wireless sensor network. That consists of wireless water quality monitoring network and remote data centre. The wireless sensor network is built on zigbee network protocol. Sampling of water done by WSN and send data to internet with help of GPRS DTU, having built in –TCP\IP protocol used for data transmission. Data is collected at a remote data centre with help of internet and this data can be analyzed and can be used for further processing. Advantages of this system are it is long term, stable. Drawback is it is costly. Water quality is an important thing that is essential for human beings and also animals. Due to water pollution various diseases are caused that lead to even death that effects the socio economic growth. This system uses wired sensors for water quality monitoring. So it is effective to a small distance. Also an alarm system is connected. When monitored values from a water source using wired sensors are compared with threshold value if it is exceeds that value then an alarm system become active that give alert to users. So they can take necessary action against water pollution and also can escape from diseases. This system is cost effective because wired sensors are using but it is applicable to small distance.

This paper[16] introduces a new approach IOT based water quality monitoring system. This system monitors the quality of water in real time. This system includes some sensors which measure the water quality parameter such as pH, conductivity, temperature, dissolved oxygen. The collected values from sensors are processed by micro controller and these processed values are transmitted remotely to the core controller that is raspberry pi using zigbee protocol. Sensors data can see on internet browser application using cloud computing. Advantages are more user friendly, efficient. Drawback is high cost for smart sensors. In this system uses wireless sensors for monitoring quality of water parameters monitored are ph, turbidity, conductivity, temperature. A micro controller has the task of signal digitalizing, data transmission, network management. All the devices are worked under a single battery source. Base station is located at the centre of area and sensor node is placed at certain interval of distance at different angle, covering 0 to 360 .This system offering low power consumption with high reliability. Another advantage of the system is easy installation. Where the base station can be placed at local residence close to target area and monitoring task can be done by any person with minimum training at the beginning of system installation.

The system[17] is mainly used to monitor the water quality in river, lake that need on online water monitoring system. In this, we measure parameters such as ph, temperature, turbidity, conductivity, salinity. In this system, we continue data sampling. This system is working by associated with Wi-Fi. Then measurement can do in real time. Also old data measured can be analysed using historical view feature. The advantages of the system are can eliminate use of mouse and keyword. So it is portable. Quality of water is essential for human, agriculture also animals ecosystem, but pollution of water increases day by day. There are many 3 sources for water become pollutant. They are sewage, industrial and agricultural waste. IoT of infectious diseases are effecting to human beings and also animals. So it is very important to measure water quality .they are ph, turbidity, temperature, dissolved oxygen by the enhanced technology, today can easily verify the quality of water. For wireless monitoring we use Zigbee communication protocol. In this paper a measurement device based on WSN is used. It can view or check water quality online continuously in high speed. It is also portable using low voltage with rechargeable batteries. Wi-Fi network is used for implementing all these features. pms device is also used to do some calculation. Wi-Fi communication is used have its own table on the database.

Today water quality monitoring in real time is difficult because of growing population .So it is essential to develop techniques for monitor quality of water in real time .In IOT based water quality monitoring system ,real time monitoring is possible, here[18] uses some sensors that can measure water quality parameter such as ph, turbidity, conductivity, dissolved oxygen, temperature. These measured values are processed by microcontroller and given to core controller using Zigbee protocol. Finally data captured by sensors can see on internet using cloud computing. There are 2 parts includes, first one is hardware and second one is software. The hardware part contains sensors which collect data in real time and other is Arduino Atmega328 that used to convert analogue to digital values.LCD shows the display output from sensors. Wi-Fi module is used to give connection between hardware and software. By using WIFI we can monitor the value in real time and people can take necessary actions when exceeds a threshold value. This paper presents a development of a low cost system for real time water quality monitoring using IOT. In order to measure physical and chemical parameters ,various sensors are using ph, temperature, turbidity are the basic parameters monitoring, measured values can be processed by the core controller. Arduino model can use as a core controller. At lost, sensor data can be viewed on internet by using Wi-Fi system. Advantage is that, real time monitoring of water quality is possible.

In this system[19] a simpler power efficient solution for in-pipe water quality monitoring based on IoT technology is presented .This model is used for testing water samples using various sensors. The basic parameters monitoring are ph, turbidity, conductivity, temperature etc based on monitored value, this system gives an alert to users if monitored value exceed a threshold value. Users can see the measured values on internet. Advantage is that, this system is power efficient because low power Wi-Fi devices and real time monitoring of water quality parameters are also possible. Disadvantage is that sensors are costly. Water quality is affected by various matters such as discharge from industries, run-off from agricultural fields and urban wastes. Other sources are floods, droughts and lack of awareness and education among people. Also less quality of water spreads disease, even cause death and it affect socio-economic progress. In this paper presenting a low cost, less complex smart water quality monitoring system using a controller having inbuilt Wi-Fi module in order to monitor various water quality parameters such as ph, turbidity and conductivity. The system also provide an alert facility to users if there is any parameter value exceeds threshold value there are various system used. There are data management subsystems, data transmission subsystem, Data collection subsystem. Controller used in this system improves speed of operation by reducing complexity. Also low power WIFI device is used that reduces energy consumption.

The smart water quality monitoring system measure various parameters for analysis that is potential hydrogen, oxidation and reduction potential, conductivity, temperature using a RS technology. User will get and alert if there is any pollutant in water with the help of IoT technology. The system[20] contains sensors and analogue to digital

converter, microcontroller and GSM module. Data collected is stored on the SD card. Reading collected at 1 hour intervals for total of 12 hours. GSM technology is used successfully to send alarm based on collected parameter to the user for taking immediate action to hold water quality. Also parameters referred from different water sources used to build classifiers which are used to perform automated water analysis in the form of neural network analysis. The result obtained is not matched with threshold value then an alert signal went to users through GSM technology. In order to collect data, today lot of new techniques are using like IoT, remote sensing. Water quality is so much affected by high use of fertilizers, industrialization. Water is an essential thing for human existence. Water pollution increases by day. Because of this lot of diseases are effected to humans, animals. Also unavailability of good quality water is caused to better growth of plants by using IoT we can monitor the quality of water in real time. So people can take necessary actions when any parameter value exceeds threshold value.

Today wireless communication technologies are used increasing amount of monitoring water quality. This help human to reduce their intervention. Advantages of using WSN are low cost for maintenance and installing also has long operation time. Remote sensor network is commonly used for different needs such as environmental monitoring, research in agriculture, disaster management. WSN contains sensors for sensing. This system[21] maintains interaction between persons or computers and also with surrounding environment. WSN system allows users to view and control the connected devices from the base station through various wireless communication standards such as Wi-Fi, GPRS, Zigbee. Advantages of WSN are low power usage, remote monitoring, and fast establishment of network. Various sensors are using in the system .They are turbidity sensor, temperature sensor, carbon dioxide sensors, ph sensor. FPGA board is used to control the entire system of the proposed smart WQM system. With the development of IOT and WSN water quality monitoring at real time is very easy and effective. In this paper a reconfigurable. Smart sensor interface device is used for water quality monitoring system in an IOT environment. In this use field programmable gate array design board is the main component of this system. 5 parameters are monitoring ph, water level, turbidity, carbon dioxide. When these parameters cross the threshold value people get can alert message.

III. CONCLUSION

This paper is all about discussing many of the proposed systems to automate the traditional water quality monitoring. One of the major issues faced by the world is water scarcity. Another one is water contamination. Reasons for these two can be increased population, growth of urbanization to its peak and tremendous increase of industrialization. The proposed system can be implemented by including basic parameters checking and can be expanded by incorporating various features associated with water quality. These kinds of quality monitoring systems will help the society to achieve more secured future as water pollution can be controlled to a great extent through continuous monitoring. With minimal features implementation will be much easier.

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REFERENCES

[1]. Pandian D R, Dr. Mala K, “Smart Device to monitor water quality to avoid pollution in IoT environment” - International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE) ISSN: 0976-1353 Volume 12 Issue 2 –JANUARY 2015.
[2]. Shruti Sridharan, "Water Quality Monitoring System Using Wireless Sensor Network" - International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) Volume 3, Issue 4, April 2014
[3]. R.Karthik Kumar, M.Chandra Mohan, S.Vengateshapandiyan, M.Mathan Kumar, R.Eswaran, " Solar based advanced water quality monitoring system using wireless sensor network " - International Journal of Science, Engineering and Technology Research (IJSETR), Volume 3, Issue 3, March 2014 ISSN: 2278 – 7798.
[4]. Jinmei Lu, Fuqing Yuan, Fengying Zhang, “Use of SVM Technique for Comparison of Water Quality: A Case Study from China” – International Journal of Performability Engineering, Vol. 11, No. 5, September 2015, pp.473-480.
[5]. Yue Liao, Jianyu Xu, Wenjing Wang, “A Method of Water Quality Assessment Based on Biomonitoring and Multiclass Support Vector Machine” – 2011 3rd International Conference on Environmental Science and Information Application Technology (ESIAT 2011)
[6]. Kashif Iqbal, Michael Odetayo, Anne James, “Enhancing The Low Quality Image Using Unsupervised Colour Correction Method”
[7]. Chong- Yi Li, Run-Min Cong, Yan-Wei Pang, Bo Wang, “Underwater Image Enhancement by Dehazing With Minimum Information Loss and HistogramDistribution Prior” – IEEE Transaction on Image Processing, Vol. 25, No.12, December 2016.
[8]. Zulhani Rasin and Mohd Rizal Abdullah, "Water Quality Monitoring System Using Zigbee Based Wireless Sensor Network "- International Journal of Engineering & Technology IJET -IJENS Vol:09 No:10.
[9]. Kirankumar G.Sutar , Prof.Ramesh T.Patil ," Wireless Sensor Network System to Monitor The Fish Farm" - Int. Journal of Engineering Research and Applications Vol. 3, Issue 5, Sep-Oct 2013, pp.194-197.
[10]. O’Flynn,B,Martinez-Catala, " A wireless sensor Network for water quality moniotoring"; 32 nd IEEE Conference on Local computer Networks,2007,LCN 2007.
[11]. Robby T. Tan, “Visibility in Bad Weather from a Single Image” – Imperial College London

[12]. An Ning, An Yu(2015),Monitoring System For Water Quality.
[13]. Dong He,Li-Xin Zhang(2017),The Water Quality Monitoring System Based On WSN
[14]. Flona Regan,Audrey Mc Carthy(2010),Smart Water Quality Monitoring System.
[15]. Izzatdin Abdul Aziz,Mazlina(2011),Water Quality Monitoring Systrm Using Wired Sensors.
[16]. Jayti Bhatia,Jignesh(2008),Real Time Water Quality Monitoring System.
[17]. Taufik Ibnu Salim,Hilman S.Alam and Rian P.Pratama(2018),Portable And Online Water Quality Monitoring System Using Wirless Sensor Network,435-440.
[18]. Vaishnavi V. Daigavane and Dr. M.A Gaikwad(2017), Water Quality Monitoring System Based On IOT ,10.
[19]. S. Geetha and S. Gouthami (2017), Internet Of Things Enable Realtime Water Quality Monitoring System
[20]. A.N.Prasad, K. A. Mamun, F. R. Islam, H. Haqva,(2015), Smart Water Quality Monitoring System.
[21]. Cho Zin Myint, Lenin Gopal, and Yan Lin Aung(2017), Reconfigurable Smart Water Quality Monitoring System in IoT Environment.

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