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Survey of the Systems for Water Level Detection

Mr. Keval Sunil Mehta
Department of Information Technology
Shah & Anchor Kutchhi Engineering College Mumbai, India

Mr. Parv Tushaar Maru
Department of Information Technology
Shah & Anchor Kutchhi Engineering College Mumbai, India

Mr. Nill Paresh Shah
Department of Information Technology
Shah & Anchor Kutchhi Engineering College Mumbai, India

***Abstract*— In recent times, scarcity of water resources in rural areas as well as urban areas has become a major concern. There are very few systems and resources deployed to overcome this problem. Recently the Governments of various countries have taken a few initiatives to prevent scarcity of water, but they have not been able to find an optimal solution. This paper focuses on, IoT device for Measurement of water levels. IoT instruments used to calculate water rates can be designed in such a manner that there is a broad variety of various sensors that can also be combined with it. Using modern analytic techniques the demand of water for specific district or areas can also be calculated. The water demand prediction is the application that is made by collecting quantitative data which are measured from different consumption units, meters from the water distribution network facilitated in each region around the world. Load sharing is one of the methods that are employed by governments around the world to sustain their demand for water across their nation. The load sharing is a method in which a set of demand for water is distributed over a set of resources, which in turn makes the process of supply and demand more efficient.**

Keywords—Water Level; Iot; sensors; Water level measurement; comparative analysis

I. INTRODUCTION

A Depth Measurement device is a device that is used to measure the depth of the water body. The depth of a water body is the distance between the floor of the water body and the upper layer of water. By measuring this distance, we can predict the water level of a water body.

In recent times, scarcity of water has become a major challenge. To fight this many resources and research has taken place in this field. Water is the basic and essential need for the all the living organism in the whole world. So we are notice the importance of the water in the modern era. To measure water levels in today's world there are multiple methods. They can primarily divide into 2 types: Traditional Methods and by using IoT Devices.

IoT is an acronym for Internet of Thing. IoT is not a relatively new concept but has been around for a few years. An IoT device is a piece of hardware with a sensor that transmits data from one place to another over the Internet. Internet of things is advancing day by day because of intermingling of various innovations, constant examination, machine learning, installed systems and product sensors. [1] Any Benefit of using IoT devices to measure water levels is the large array of different types of sensors that can also be integrated with it. Another challenge regarding water in today's world is the distribution of quality water in Urban and rural areas to consumers and general public, since the water have to travel through different areas and prone to get polluted from the environment [2]. The distribution of water and monitoring the quality of water is also done manually. Due to the manual process, huge man power is required and this leads to wastage of water in lots of place. Thus, even if we try to save water in some way or another we waste water.

The recent advancement in the field of machine learning (ML) has made a significant computational analysis of Water Level Networks in multiple regions (WDN) [3]. In order to measure accurate estimation of water level there is a need to have fully dynamic and adaptive self-learning algorithm [4]. Machine Learning algorithms are perfect to solve such a problem. One benefit of ML is that the algorithm can be customized i.e. they can be curetted in such a way that they tend to the desired problem.

II. REVIEW OF LITERATURE

The First paper that surveyed was IoT Based Water Level Meter [1]. In this paper the problem of cracking Dam and leading to floods in many areas has been taken into consideration. Often the dam cracks and the water flow in large amounts over the villages. The earlier system comprises a NETDUINO board which is costly and if implemented on large scale the coding work becomes tedious. To overcome these issues the proposed solution is to make the system cheap. The proposed model uses three water sensors which are located at different places all connected to the Node Mcu board. Each sensor has three LEDs that indicate the water level purple - water is high, orange - water is medium level, green - water is low. If water level is detected high the motors are turned on and Dam doors are opened. [1]

The Second paper was Smart Water Quality Monitoring and Metering Using Lora for Smart Villages [2]. In this paper, the authors are discussing the use of sensors to measure the quality of water. They have discussed the different minerals in water that can be present in different types of water. One of the major talking points in the paper is the use of the brand new LoRa module. Its new module which uses unlicensed broadcasting frequencies of 433MHz and 868MHz, its range is about 15km and the

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authors think of it as further technological advancement towards smart villages. [2]

The third paper was IOT based Water Level Monitoring and Implementation on both Agriculture and Domestic Areas [5]. In this paper the proposed system is an IoT device for water tanks and soil. The authors of this paper plan on doing so by using ultrasonic sensor and moisture sensor, the collected data is then sent to a cloud server from where the user can get an alert. The main focus of the paper is to prevent the wastage of fresh water resources. The paper further discusses the use of a relay to stop the flow of water into the water tank. The same relay can be used to stop the flow of water onto the ground by using the moisture sensor. [5]

The fourth paper was a very detailed paper by the title A Novel ANN Based Adaptive Ultrasonic Measurement System for Accurate Water Level Monitoring [9]. This paper describes the basic UMS's (Ultrasonic measurement systems) perks and cons. The authors of this paper have also described the different types of device which can be used for measuring water levels.

The authors have proposed a system that can be unaffected to external factors such as temperature, humidity, placement of sensors, containers in which water is stored etc. The main focus of this paper is the effect that these external factors have on the ultrasonics sensors effectiveness. The authors proposed a system which consists of multiple UMS connected to a single Arduino board and by doing so decrease the error and standard deviation of the combined UMS system. [9]
The fifth paper reviewed was titled Non-contact Water Level Monitoring System Implemented Using LabVIEW and Arduino [6]. In this paper the authors have proposed a system which will help us in detecting the depth of the water. It uses non-contact water level monitoring system implemented using LABVIEW and Arduino. Ultrasonic sensor is used to measure the depth of the water. Pump is switched on by the Arduino and off if the tank is fully filled. Advantage of this over other existing automatic system is it provides non-contact water level measurement using ultrasonic sensor, but existing automatic system using SS (stainless steel) sensor which is a contact type water level sensor and also these sensors quickly corroded by some chemicals. [6]

The next paper reviewed was Flash Flood Detection in Urban Cities Using Ultrasonic and Infrared Sensors [3]. It is also a transaction paper. In this paper the flash floods are detected by the author with the help of ultrasonic rangefinder sensor and some infrared temperature sensors. Ultrasonic range finder sensor is used for measuring the distance to objects below it and sending these measurements to a microcontroller via a serial port when the environmental conditions are well known. Author has used six infrared temperature sensor which helps in measuring both the ground temperature in their field of view and their actual temperature. As the raw data generated by the ultrasonic rangefinder and infrared temperature sensors have different scale and exhibit inconsistency therefore preprocessing procedure is essential in the accurate sensing of floods based on measurement data produced from sensor nodes. Preprocessing involves fault detection and missing data reconstruction. Artificial neural network (ANN) is used to monitor water level in real time as it has the excellent accuracy, high precision and have a low computational complexity which makes it suitable to low-power embedded platforms. [3]

The following paper describes the quality parameters for water. It is the seventh paper that was reviewed. Its title is Assessment of Surface Water Quality by Using Satellite Images Fusion Based on PCA Method in the Lake Gala, Turkey [3]. In this paper the author has used satellite images for measuring the depth as well as quality of the water. For experimental purposes the gala lake which has a surface area of 5.6 sq/km, which has many rivers connected to it. Principal Component Analysis (PCA) is an unsupervised, non- parametric statistical technique primarily used for dimensionality reduction in machine learning PCA can also
be used to filter noisy datasets, such as image compression. Then the PCA based fused satellite images are used along with various other algorithms, multiple linear Regression (MLR) artificial neural networks (ANN), support Vector Machine (SVM). Same image has been taken from 3 satellites and then by using PCA and machine learning algorithm data mining is done and the quality of water can be determined. MLR is the method to learn the relationship between independent variable and dependent variable. SVM is a learning method with good generalization ability, especially in a limited number of examples. ANN has the ability to learn from examples that express system behavior. The data set for each model was divided into two parts a training set, which included 70% of the data to be used for modeling phase, and 30% of the data for validation of the models. [3]

The eighth paper that was review is Water Demand Prediction Using Support Vector Machine Regression [7] .Water is a critical resource. So there's a need for keeping a track and limit on the usage of water to conserve water. The proposed system proposes a water demand prediction using machine learning algorithms. For experimental purposes the author had used a dataset of dairy work of 90 days of water usage. The data contains the amount of water used in liters. Then a time series of water consumption is plotted. Simultaneously a SVR is plotted. Then the actual usage is compared with the predicted usage graph and the pattern is observed. This pattern is used to make dataset more precise for machine learning algorithm. [7]

The last paper reviewed was A Water Level Detection: IoT Platform Based on Wireless Sensor Network [8]. In the proposed system the WSN (wireless sensor network) has been used. The proposed system works on node Mcu along with HC-SR04 sensor, a distance measurement sensor and

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ESP8266 a wifi module which is used to transmit data to the cloud storage. The data gathered is used in real-time monitoring. The cloud API used is thingers.io gathers the data and shows the graph plotted. The flood prone areas are taken into consideration for real time monitoring of flood and accordingly use preventive measures [8].

In this patent the inventors have invented a water level measurement device and shoreline extraction method. A water level measurement device comprising of a pixel selection unit for selecting a pixel of interest from an image area designated from a captured image captured by a monitoring camera. An identification unit is made for calculating an identification strength indicating a degree to which an area corresponding to each of the plurality of identification images is a water area, on a basis of a result of machine learning related to identification between the water area and a non-water area. A water level calculation unit for calculating a water level within an image capturing range of the monitoring camera on a basis of the shoreline extracted by the shoreline extraction unit [10]

In this patent the inventors have invented a smart water quality monitoring system used to check the quality of water with the help of IOT and embedded systems. The system consists of several sensors which measure the quality by keeping the said parameters into consideration like temperature, pH, Humidity and turbidity. The system consists of several sensors to measure the water parameters and update the water purity level periodically in a public cloud and monitored via Android app. The sensor measures the different parameters value's for every shift/changes in changes in latitude & longitude with the help of GSP module and sensor data can be viewed by the internet using wifi-system and the mobile application available. [11]

III. COMPARATIVE ANALYSIS

Table 1: Comparative Study of system for Water Level Measurement

Sr.No	Ref. No	Title	Author's	Year of publication	Approach	Boards	Sensors	Other's	Cost
1	[1]	IOT based water level meter	Yellamma Pachipala,CN agaraju,Raju Anitha,A Yeshwanth,K Karthik,P Surendra	2018	To detect the water level of the dams	Node mcu	Water sensor	IoT packet transmit data to an online cloud platform used to gather and display data	Low
2	[2]	Smart water quality monitoring and metering using Lora for smart villages	Anto Merline Manoharan,V inailaththan Rathinasabap	2018	To detect the quality of water	M2M LoRa, ICT-LoRa mote	Ph sensor water quality sensor	-	High
3	[5]	IOT based water level monitherring and implementation on both agriculture and domestic areas	Jisha RC,Vignesh G,Deekshit	2019	To estimate the water dimension and to improve the moisture level of the soil	Arduino	Ultrasonic sensor, moisture sensor, GSM module	-	Medium
4	[6]	Non-Contact Water Level Monitoring System Implemented using LabVIEW and Arduino	Shrenika RM,Swati S Chikmat,Dr Ravi KumarAV,Mr s Divyashree YV,Mrs Roopa K Swamy	2017	Non-contact water level monitoring system	Arduino UNO	Ultrasonic sensor	-	Low
5	[7]	Water Demand Prediction Using Support Vector Machine Regression	Amrita Tanwar,Sanu ksha Shukla	2019	Water demand prediction using machine learning algorithm	-	-	Machine learning algorithm along with support Vector Regression	-
6	[8]	A Water Level Detection: IoT Platform Based on Wireless Sensor Network	Anthon prafanto,Edy Budiman	2018	Water detection and transmit data to the cloud storage for further analysis	Node Mcu	HC-SR04(ultrasonic sensor) ESP8266 wifi module	Thingers an online cloud platform used for plotting the gathered data	High
7	[9]	A Novel ANN Based Adaptive Ultrasonic Measurement System for Accurate Water Level Monitoring	Ajit Kumar Sahoo and Sibaram K. Udgata	2019	To use ultrasonic sensor for accurate water measurement and monitoring system	Arduino uno	HC-SR04 ultrasonic sensor, Bluetooth module, temperature and humidity sensor	Machine learning algorithm ANN(artificial neural network)	Medium
8	[3]	Flash Flood Detection in Urban Cities Using Ultrasonic and Infrared Sensors	Mustafa Mousa, Xiangjiang Zhang, and Christian Claudel	2016	In this paper the flash floods are detected by the author with the help of ultrasonic rangefinder sensor and some infrared temperature sensors.	32-bit microcontroller	pir motion sensor, zigbee module,ultrasonic sensor,infrared temperature sensor	-	High
9	[4]	Assesment of Surface Water Quality by Using Satellite Images Fusion Based on PCA Method in the Lake Gala, Turkey	Ercan Batur and Derya Maktav	2019	In this proposed system satellite images are used to detect water quality of lake	-	-	Staellite images from various satellite are used. PCA,MLR,ANN, SVM machine learning algorithm used	-
10	[10]	Water Level Measurement Device And Shoreline Extraction Method	MAEHARA, WANG, HINO, MISHIMA,UEDA,WADA, TABA	2020	water level measurement device and shoreline extraction method	-	-	machine learning for identifying water areas and non-water	-
11	[11]	Smart Water Quality Monitoring System	GANESH PRABHU .S, MAHESWAR .R, UDAIYA KUMAR .R, SUNDARARAJAN .TVP	2019	a smart water quality monitoring system used to check the quality of water	32-bit microcontroller	ESP8266 WI-FI module, GSP module, ph sensor, humidity sensor	-	Low

IV. DISCUSSION

The survey of the measurement devices was performed on the basis of what micro-controller is used; sensor's integrated in the system, if the system had cloud storage integrated for message transmission etc. Upon the survey it was noticed in Table 1 that a majority of literature reviewed had a basic UMS employed. Some of the literature also mentions the use sensors such as pH sensor, water sensor etc. To improve the accuracy of water level it is being noticed that machine learning algorithms are used. The detailed specifications of the proposed systems are stated above in the literature review.

V. CONCLUSION

An IoT device is a piece of hardware with a sensor that transmits data from one place to another over the Internet. IoT devices that are used to measure water levels have a large array of different types of sensors that can also be integrated with it. Using modern software technologies the accuracy of water level prediction in a certain district or area can be increased. The water level prediction is the application that is made by collecting quantitative data which are measured from different consumption units, meters from the water distribution network facilitated in each region around the world. Upon survey of recent paper, it is found out that there are few existing systems with some drawbacks. After reviewing the literature we have identified the following challenges: provide viable data, improve or reconstruct a better IoT packet, provide offline support and create a better method for better prediction. After reviewing some literature we also came to know that there are measurement systems that are protected under patent and copyright. Upon review of literature it is being noticed that ultrasonic sensor and transmission of data into cloud storage is a common practice for these systems.

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