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Sea Water Monitoring Using IOT

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ABSTRACT: IoT sensors for the measurement of various marine water parameters are discussed here, targeted at an educational sense, leading to a deeper understanding of the use of aquatic ecosystems as natural resources and the adoption of environmentally sustainable behaviors. Due to practical difficulties in deployment, sewage sensing via IoT has not been extensively explored, and the same applies to the creation of acceptable scenarios for understanding aquatic parameters in STEM education. In this paper is mentioned a short hands-on IoT sensing study, which was performed at various locations on the Aegean Sea. This work aimed at gaining insight into actual data sets on which observations can be based for the creation of practical aquatic parameter educational scenarios. The findings of this experiment are intended to further direct research by shedding light on the issues of IoT sensing which are involved in a scientific sense of education. The aim is to conduct broader IoT water sensing research towards their further use in STEM education.

KEYWORDS*:*Crowd Sensing, IoT, Science Technology Engineering and Mathematics Education, Water Sensors.

I. INTRODUCTION

There are rising threats to the ocean ecosystems and marine resources on which society relies, and there is the need for a well-trained ocean science workforce. The contribution of the ocean economy as a percentage of the EU's gross domestic product is 4.0%, and estimates are projected to double by 2030 in the aquaculture, offshore wind, fish processing, and shipbuilding and repair sectors. Scientists and educators need to consider incorporating scientific knowledge of aquatic resources into educational practices in order to satisfy the need for a scientifically qualified workforce in this field. Starting at schools where students can be inspired to take an interest in this field and provide them with technology-rich experiences that improve their knowledge and skills.
Yet the use of water sensor data in STEM education is a field that has not received much attention yet. IoT water sensing scenarios and activities in an effort to respond to this challenge, engaging children through scientific exploration and game ful learning. Various deployments and tests against this target were carried out in Rome, Italy, and Greece, on the Cyclades Islands in 2018. The Rome experiment is mentioned, aimed at facilitating the participation of children in the process of measuring and understanding aquatic parameters; a game was developed, implemented and tested in an initial deployment with a simple IoT sensor system to measure water parameters based on suitable educational scenarios. School children then embarked on an initial search to calculate a range of sweet-water source parameters in Rome[1]

Although this work is still ongoing, parallel directions of a step-by-step approach have led to another hands-on experiment: with an alternative set-up of IoT water sensing, test measurements were taken in seawater, in the Cycladic Islands, to collect real data with the goal of exploring data correlations and creating potential and practical educational scenarios. Students should use the actual data to describe anomalies related to the parameters being measured. This was important for an educated understanding of what is a very complex aquatic environment, as well as for coping with issues related to equipment earlier, realizing what the problems will be, and planning and designing effective educational activities. Hence, this paper documents the observations of the researcher from plunging sensors into salty seawater.

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II. LITERATURE REVIEW

To ensure secure drinking water supply the quality must be tracked in real time. This paper presents a concept and implementation of a low cost device within IOT (internet of things) for real-time monitoring of the water quality. The device consists of multiple sensors which are used to determine water's physical and chemical parameters. It is possible to measure parameters such as temperature, PH, turbidity, conductivity, water dissolved oxygen. The Core Controller can process the measured values from the sensors. You can use the raspberry PI B+ model as the core controller. Finally, data from the sensor can be viewed through cloud storage on the internet[2]. For the collection of sensor data from industrial wireless sensor networks (WSN) in IoT environments a sensor interface system is important. However, the system typically limits the current link number, sampling rate, and signal types of sensors. Meanwhile, each sensor connected to the computer is required to write complicated and cumbersome software code for data collection in the Internet of Things (IoT) environment. In this paper, a new approach for designing a reconfigurable smart sensor interface for industrial WSN in IoT setting is proposed to solve these problems, in which complex programmable logic device (CPLD) is adopted as the core controller[3]. This paper established an IoT-based Smart City using Big Data analytics while collecting data from the city in real time author used the deployment of sensors like sensors for real-time data collection at the smart house, smart parking, vehicle networking, security, weather and water monitoring system, etc. The complete framework is represented using Hadoop ecosystem in a real world, using its proposed architecture and implementation prototype. In addition, the Smart Digital City services are expanded by creating the intelligent Smart Transportation Network to encourage people while delivering real-time traffic information and warnings via big graph processing. The proposed system consists of a number of stages including the generation and storage of data, aggregation, filtration, sorting, preprocessing, computation, and decision taking[4]. The paper suggested and developed an IoT-based smart city network using Big Data Analytics and used the installation of sensors like smart home sensors, car networking, weather and water sensors, smart parking sensors, tracking items etc. This proposes the complete design and implementation model which is applied in a real environment using Hadoop ecosystem. The implementation of the method consists of various steps starting from the generation of data and the selection, aggregation, filtration, sorting, preprocessing, computation and finishing of decisions. The Big Data processing efficiency is achieved with spark over Hadoop[5]. This paper shows that measurement of chlorophyll concentration is gaining more and more significance in determining marine ecosystem status. The program is intended to be an effective tool for water quality assessment and a legitimate help to strategic decisions on crucial environmental issues. The proposed program aims at recording potential catastrophic events and gathering data over long-term periods[6]. Internet of Things (IoT) is a network of sensors and networking allowing maximum irrigation for applications such as agriculture. WSN and WMSN are an integral part of IoT. This paper clarified and proved the feedback control method's effectiveness in greenhouse crop irrigation. A study to see the similarity of these two approaches was performed. The methods are irrigation by plan or by irrigation based on feedback. Scheduled irrigation is for the plant to be supplied with water at different time periods. Feedback dependent irrigation is intended to irrigate plants when the moisture or media wetness level has exceeded predefined value. The test shows a mean savings of 1,500 ml per day per branch[7]. The proposed device collects water quality data such as water pH, water level, turbidity, carbon dioxide (CO_2) in parallel and in real-time at the water surface and water temperature with high speed from five different sensor nodes. Computer simulation and laboratory tests are used to check the performance of the proposed reconfigurable WSN program[8]. This paper introduces a smart sensor interface system which can be reconfigured to monitor water quality in an IoT environment. The smart WQM device consists of design board FPGA, sensors, wireless communication module based on ZigBee, and personal computer (PC). The FPGA board is the central component of the proposed framework, and is programmed using Quartus II software and Qsys tool in the programming language of VHDL and C. The proposed WQM device gathers in parallel and in real time the five parameters of water data such as water pH, water density, turbidity, carbon dioxide (CO_2) on the water surface and water temperature with high speed from several different sensor nodes[9]. This project uses ARM microcontroller (LPC 1768) with multiple sensors attached to the platform; temperature and humidity sensor, carbon monoxide sensor (MQ-7), Global Positioning System (GPS) sensor, pH sensor, and water level sensor that serve as data. Both the data from the sensors are processed in a data logger and sent to the Internet clouds. To get accurate data, the data were collected three times a day using a time-based sampling process. In addition, the data can also be tracked in real time by the users on their cell phone or directly via the Internet cloud[10].

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III. METHOD

The sensor device used in our experiments is based on the Arduino platform which is open source. The Arduino platform has been selected as it is a well-established prototyping platform for electronics and offers multiple variations which provide us with the correct core components for lowest cost and effort building sensing devices. The use of the Arduino platform to provide measuring devices in education has been studied with extremely positive results in the past and is completely in line with the Arduino group principles. Arduino was designed by instructors and artists who wanted to quickly create and teach electronics and interactive design, without the need for deep expertise in electronics and hardware design.

Our goal was to develop a lightweight, relatively inexpensive, portable system that can be easily deployed and packaged after collection of the measurements. Because of our test area, the open sea and island beaches and wanted a simple way to gather measurements without the need for a communications network that was deployed. Hence, use was made of an Arduino system fitted with an SD card reader module. Using an Arduino Ethernet module. While the Ethernet module is not relevant to our project, as it is installed on the board, it provides the easiest way to communicate with the SD card reader. Use the SD card allows us to store locally the measurements obtained at each session. The SD card can be removed from the Arduino after data collection, and the measurements can be conveniently transferred to a smartphone or a laptop. It could become a more automated method in a future version of our system, by transmitting the data to a mobile application using Bluetooth or WiFi, including geolocation and local time.

The Arduino software takes an incredibly simplistic approach to measurement selection. If the computer is enabled, a file is generated to add new data in the SD card. Each sensor is sequentially polled and, once data is retrieved for all sensors, the data collected is appended to the file along with a relative timestamp. This timestamp displays the time after the system's on-time power (because the computer has no real-time clock or battery to hold a constant reference time). Therefore, after each sampling session, it is important to store the measurements, and tag them manually for position and time. The final code for the program is available on GitHub.

At this point it should be noted that each sensor used as a measuring tool is distinguished by its size, sensitivity, accuracy and range. Based on these characteristics, the instruments used in any experiment have a major effect on the results and these must be considered particularly when using low cost sensors to make the sensing infrastructure accessible to students.

Precision: How close a quantity measured or estimated to its real (true) value is.

Repeatability: (or reproducibility) is closely related to precision but has a distinct definition. A measuring system is repeatable if, under similar conditions, several measurements of the same parameter give the same result.

Sensitivity: is the minimum size change that the measuring system can find in the "parameter to be measured" Of example, if you have a digital thermometer and the smallest detectable change corresponds to a temperature shift of 0.1 μC, the temperature measurement device would have a "sensitivity of 0.1 μC."

Range: The unit of the sensors varies with the range of measured values and precision.

IV. DISCUSSION

Two major challenges emerged from the experiences recorded using the Arduino sensor IoT kit in water: sensor failure after several (some) uses and sensor measurement calibration. The robustness of the sensors in these systems presents major challenges for the students to distribute and use these systems more widely. The turbidity sensor actually failed due to the rust caused by the salty sea water and the salt deposition inside. There are two ways to tackle this challenge: Sensor replacement, which the students would inevitably need to do while using these kits in the educational sense. Alternatively, omitting sensors for turbidity, because they have a short life span.

Calibration problems observed, in particular in the pH sensor, in the related experiment mentioned earlier in spring 2018, with water pH in Rome's tap water being calculated as alkaline due to the difference in the calibration of the sensors. When using low cost sensors for simpler and wider distribution purposes, what gives is the manufacturing efficiency of the sensor, its robustness and the efficacy of the measurement.

To convert this fascinating task into an opportunity, educational scenarios can be designed to teach scientifically and accurately the basics of sampling. To set up / calibrate the sensors until they are used in tests, a learning exercise can be

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devised. Many equipment tests can be implemented as interim sensing activities in which students gain experience in scientific methods of measuring, and quality testing to ensure accuracy and repeatability of the data generated.

V. CONCLUSION

Immersion of students into realistic learning environments has proved to be a very successful approach to learning. The ultimate aim of the research recorded here is to pave the way for educational design activities that lead students to acquire experience by engaging in coastal field exercises and gathering data using IoT technologies. The aim is to engage interactions that relate to their interests in an active learning framework that moves to engagement with teachers, peers and the world beyond strict delivery and memorization of classrooms. The way students research the water-monitoring method is to design a study that supports their own student thesis. The design process of the study follows the scientific method which aims to address a research question, collect and analyze data, draw conclusions and give recommendations from the analysis. A comprehensive and carefully planned monitoring protocol may recognize issues with the water quality and help address questions that lead to a solution to problems.

The first step is to identify the purpose: for example, if the problem is the danger of pollution coming into a bay from a large hotel unit's sewage pipeline, you may ask the question: Is the sewage pipeline affecting the existence of the aquatic bays? The response to that will decide what to track, where, when, and how. Second step is to determine the parameters of water quality are needed: how can those parameters achieve the function of monitoring? Is there, for example, a relationship between the levels of Dissolved Oxygen and the types of plants, animals or other species that one encountered in the water?

If so, the relation should be defined. The next step is to determine the location; review a map of the area of interest, identify the points selected, note latitude / longitude, local weather conditions during the sampling, water body conditions.

The next issue is the sampling procedure; that means explaining how data will be collected, analyzed and recorded. After that, consideration must be given to the deployment duration and sampling frequency (seasonally, monthly, daily), because conditions of a water body that change gradually or rapidly depending on several factors. And finally, processing, evaluating and recording the data as a last step, which in turn includes the actions of entering and validating the data process, drawing certain conclusions and presenting the findings. Students will eventually respond if the experimental findings support the initial hypothesis and whether significant water quality problems have been discovered affecting the body of water.

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