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ANALYZING AND MONITORING WATERQUALITY AND QUANTITY

T.Satvikreddy[1], CH.Hemanthsai[2], Dr. R. Jebakumar[3]

[1]B.Tech, CSE, SRM Institute of Science and Technology, Kattankulathur Chennai, Tamil Nadu
satviktanuboddi@gmail.com

[2]B.Tech, CSE, SRM Institute of Science and Technology, Kattankulathur Chennai, Tamil Nadu
hemanthchilukuri555@gmail.com

[3]Associate Professor, SRM Institute of Science and Technology, Kattankulathur Chennai, Tamil Nadu
jebakumr@srmist.edu.in

Abstract— With the growing need of population one of the most important requirements has become vegetation. While most produce may be grown in greenhouses which support smart technologies, they are unable to meet the requirements ofthe modern-day need. This is why in our project we would like to create a smart water level dispensing device which is capable of being used in agricultural fields by farmers. Unlike normal dispensing systems which will be responsible for the storage and the suspending of water we will further be equipping our smart device with various different sensors such as DH11 as well as pH sensors which will be able to accurately measure the various aspects of the water. Furthermore, it can intimate the user if thewater or the environment of the planation is in any danger. Through this paper we will explain the various steps in the development of our algorithm as well as why it should be preferred over those currently in the market.

Keywords— Agriculture, Internet of Things, Smart Devices, Water Management System, SOS System, Urban Farming, Water Pollutio

I. Introduction

The modern world has started to develop itself in a rather unique fashion with the forms of technology that we have been able to establish. Unlike previous years in which technology has been built around the infrastructure of the world, it has now started to be used in the development of the world around us from the bottom up. With the introduction to technologies such as the Internet of Things we have been able to overcome the drawbacks of technology and have them communicate with each other and work independently without the need of physical assistance. With all of thispossible for engineers to work with we have been able to develop many new forms of products and technologies which all fall under the categories of Smart products.

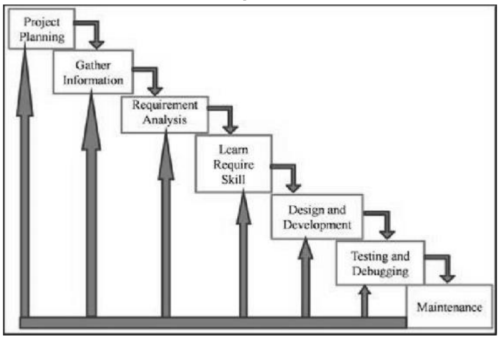
This group of smart products are capable of working independently and on a timely basis when instructed to complete a specific task at hand. For example, instead of having to manually turn on the room heating system at homewe can now control it with respect to time or with an application on our smart phone. With these great leaps in the possibilities of technologies many people have begun to work towards the creation of smart ecosystems [1]. One of the most common instances of a smart ecosystems are smart homes. These homes are rigged with various types of smart instruments which can all be controlled through an application on your phone. Furthermore, these smart homes enable us to increase the security of our living environment, as it is constantly monitored by an online AI assistant. The creation of this smart ecosystem has been possible with the collection of various smart devices and enabling them to communicate with each other under one platform which in this case would be the application for the smart home. In thisproject we will be working towards the creation of a smart ecosystem with respect to the fields of agriculture. With the growing demand for smart products, we have begun to see the rapid growth in the development of these products for our daily needs. However, we believe that may companies have overlooked the requirements of many other domains such as agriculture and only provide them with a few of the functionalities when we can do so much more. Smart Farming systems [2] have been used in various places aroundthe world and with the use of these smart devices we have begun to see the expansion of smart greenhouses which are able to constantly monitor the crops and ensure their proper development and growth throughout their growth period [3]. Although these greenhouses are capable of using these smart technologies in order to obtain produce which is far more superior to conventional methods its drawbacks come at the aspect that these are grown within green houses. While we may just go for the option of opening up more and more greenhouses it would be impossible to monitor thousands of greenhouses at a given time by farmers who often have to work with hundreds of acres of land in order to obtain their produce. This is where we would like to step in to assess this issue by creating a solution which will be able to help these modern-day farmers develop their own agricultural lands in order to catch up with these greenhouse gases which are capable of producing fresh produce.

In our project we would like to focus upon the development of a smart water management prototype [4] which will be capable of constantly monitoring the water and ensuring that the agricultural crops are watered on a timely basis. Unlike greenhouses which are restricted to the area within the green house our prototype will be capable of beingtransported and used wherever installed. We will be able to develop our prototype with the use of various different sensors which will be able to help us grasp an understanding of the environment and act accordingly. The central processing unit of our prototype which will be used to run all of our algorithms and interface our sensor will be an Arduinoboard which can be found anywhere in the market. Due to its high availability and cheap cost we will be able to start with a cheap base to our prototype. Furthermore, we will be usingtwo more sensors which will play a crucial role in the monitoring of the water in our dispensing system. The first important sensor which we will be interfacing with our prototype will be the Ph sensor which will be able to constantly monitor the Ph of the water to ensure that the water is in a healthy condition. The reason for the inclusion of this sensor is due to the importance of fresh water in agriculture. One of the most important factors for the growth of fresh produce is to ensure that the water being provided is full of healthy minerals as well as a stable Ph, however most farmerstend to overlook this basic need and use bore water which is easily accessible to them. While this water may be able to provide the crops with required minerals, they often lack other important minerals which can further enhance the quality of our yield [5]. The second sensor which we will be using is the Ultrasonic sensor. This sensor will be used to constantly monitor water level of our tank and ensure that thewater does not over flow or be wasted. These two are the crucial sensors which we will be using within our prototype in order to monitor the condition of the water. Furthermore, will be using a few other sensors in order gather ore values form the environment into our system to calculate and create the most suitable habitat for our crops. Although all of the sensors in our project will be used in order to collect and analyze the data from our surroundings, we will be further using a GSM sensor which will be only used in order to sendmessages to the respective individual. In the worst-case scenario where our prototype will require human assistance such as the replenishment of minerals in the water or the water itself the individual will be immediately intimated with the issue along with possible solutions.

Now that we have been able to look into the prototype that we have been able to establish we would like to walk you through the solutions which are already present in the modern world. Before the creation of our prototype, we have been able to look upon the various other prototypes developed by engineers throughout the world [6]. Although they often came short in specific domains, we would like to explain how our prototype is superior in comparison with theirs as our supporting argument within the next section of our paper.

I. LITERATURE REVIEW

Through our study on the water dispensing systems which have been developed in the near past we have been able to identify two different prototypes which were focused within the domain of satisfying the need of large planation areas. Other studies focused upon the development or the creation of prototypes which were capable of monitoring single pot sized plants [7]. While they were created with various features capable of helping the plant grow, they were mostly limited to only pot-based plants which are grown within one's house. The two studies which caught our attention were both



based on the creation of prototypes which we able to dispense water to large areas [8].

One of these studies focused upon the creation of water tanker which was capable to storing water in the ideal temperatures as well as environments to ensure that the water being used is full of minerals and Ph. This study only focused upon the properties related to the water being stored within the tank and did not take the environment around it into consideration [9]. While it was able to satisfy the purification of water a farmer would have to manually use this water in order to irrigate the crops in the field. The second study which we were able to assess focused solely upon the irrigation of the crops at a given. This project focused upon the delivery of water from a given source to the field on a timely basis onevery single day. This is a completely automated process and the farmer would no longer be required during the watering of his crops. He can simply program the prototype to water the field at respective times on a daily basis. The downside tothis prototype is its inability to monitor the water being used as its only purpose is dispensing.

As we have observed the modern prototypes which are available in the market either focus upon the dispensing of the water or they focus open the maintenance of the water I order to maintain its minerals and constituency. Taking all ofthese into consideration you can now look into our proposed protypes which is capable of doing both of these tasks at the same time. Furthermore, our system is far more portable andcan be created at a fraction of the cost as well will be using an Arduino instead of the Raspberry Pi [10] boards which were used by many other competitors in the market. Furthermore, our proposed model will come the inclusion of the soil moisture sensor. The advantage to constantly monitoring the soil in the surrounding areas is to ensure that our water output for the fields are adequate

to maintain the required nutrients in the water. As the proper moisture leads to the best living conditions for many forms of fauna it has become a need in farming. In the following section of our paper, we would like to explain the development and the creation of our prototype.

I. PROCEDURE

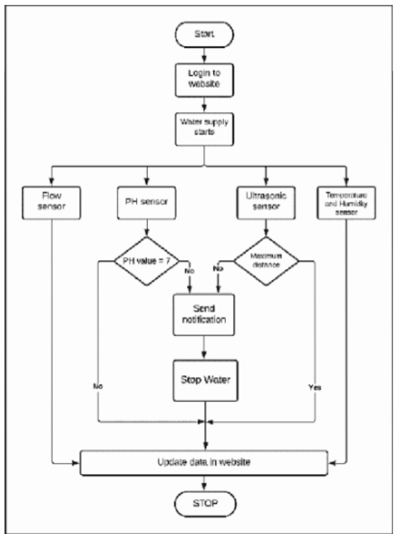
The development of our project has taken place in atotal of four different stages. The initial stage of our project will be focused towards the establishment of all of our project requirements. This will be followed by the creation anddevelopment of our prototype which can be further broken down into two different stages as the prototype as well as thealgorithm which we will need to develop for our Arduino to understand. Finally, we will be able to complete the development of our prototype by testing it in the modern world and ensuring that it is able properly satisfy all the needsand solve the issue. Let us now take a look into this project one stage at a time.

Fig 1. Methodologies used in our Project

The image above depicts all of the methodologies which wehave used within our project along with the iterative cycle First the project planning, gathering information, requirementanalysis, learn required skill, design and development,testing, debugging and maintenance which we will have tofollow to ensure that even in the future of our project we willbe able to constantly have it modified and updated in thefuture. This methodology ensures that there are minimal bugsor errors within our prototype to ensure that all thefunctionalities are perfect.

A. Gathering Project Requirements:

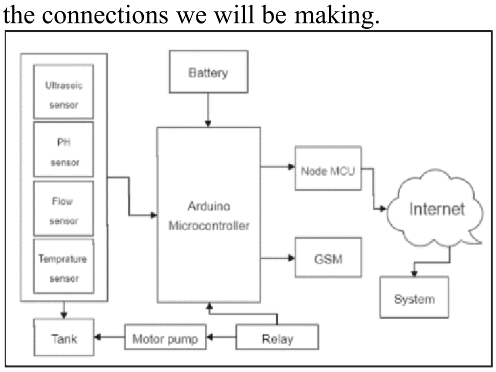
The initial stage of our project will be focused towards the gathering of all of our project requirements. Throughout this project we will need to gather the requirements based upon two different requirements which are hardware as well as software. As we have decided to create the prototype on top of a Node MCU board, we must ensure that the system which we will be using has the proper Arduino IDE software which will be required in order to communicate and establish the algorithm within our board. The Node MCU is one of the latest Arduino boards in the market as it overcomes the need of a ESP8266 module for the Wi-Fi connection in a



regular Arduino board. This board comes installed with the ESP8266 Wi-Fi module to the board so that we will not have to establish any further connections. Once the proper software's have been established in our system, we can now move onto the second requirements of our project which will be acquiring all of the sensors which will fall in the hardware domain. The sensors which we will need to acquire within this project are… DHT11 which will be used for the temperature and humidity analysis, pH sensor which will be used to retrieve the pH of the water, moisture sensor which will be used to measure the moisture in the soil and also the Ultrasonic Sensor for the level of water in our tank. Apart from these we will also require a relay module, flow sensor, and GSM module in order to satisfy the requirements for our project. Once all of these components have been established, we must ensure that they are working properly without any issues and defects.

B. Establishing Circuit For our Prototype:

The second phase of our project will be focused upon the integration of our sensor and ensuring that an efficient circuit is created for our prototype. In order for us to accomplish this we will have to first test all of the sensors andensure that the reading which are procured are accurate to thereal world without any issues or deviations to the real-world values. Once all of the sensors have been integrated and tested with our board, we will now be able to work on establishing an efficient circuit with the minimal number of connections. Now that the circuit to our project has been established, we will now start to move onto the next stage of our project which will focus upon the development of the algorithm in order to make use of all of our sensors. The figure below is the block diagram which will give you a basic idea about the circuit and all the connections we will be making.



Sensor ID	Time	Date	Sensor Data	Level
DIST	15:25	APR 20,2021	8	NF
DIST	15:30	APR 21,2021	9	NF
DIST	15:40	APR 22,2021	5	NF
DIST	18:00	APR 23,2021	10	F
DIST	19:00	APR 23,2021	10	F

Tank Height = 10

F = full NF = Not Full

Fig 2. Block Diagram

C. Development of Algorithm for our Prototype:

In order to develop our algorithm, we must first establisha platform in which we can link all of sensors in order to constantly monitor their values. This is why I our project we have decided to integrate all of sensors onto the cloud, platform on our website. Once we have created an account, we will be given a pair of API keys which we will have to embedinto our algorithm to ensure that all of that data which is beingprocured will eb sent to our cloud platform. Now that we have the API keys which we must use within our algorithm we can now begin to work upon the establishing the code which will be responsible for constantly monitoring the environment as well as the water so that it can intimate the respective

Sensor ID	Time	Date	Sensor Data	Quality
PH	15:25	APR 20,2021	7	G
PH	15:30	APR 21,2021	7	G
PH	15:40	APR 22,2021	8	B
PH	18:00	APR 23,2021	6	B
PH	19:00	APR 23,2021	7	G

G = Good B = Bad

individual in the case of an emergency. Furthermore, all of the data that we will be receiving will be automatically updated on the website for people to manually monitor and observe. I order for you to get a much better idea look into the figure shown below which depicts the Architecture and flowchart indepth.

Fig 3. Flow chat

As we can observe in the diagram depicted above the start of our process will commence with the user logging into our website. Once they are logged in the application will automatically begin the water supply and monitor all of their properties with the various sensors we have talked about. Among these values obtained we will make decisions based upon the pH sensor as well as the level of water inside the tank. With the flag for pH set at 7 points and the maximum distance established by the user these values will trigger the

notifications. This process will automatically stop the flow of water ad update this data into our website automatically before ending the process. Once the algorithm has been successfully created, we can now start to work upon establishing the finalphase of our project.

D. Testing our Prototype:

Now that we have successfully established our prototype it is ow time for us to take it out into the real world and have it tested. In order to ensure that our prototype is flexible we have tested it out by having it installed in three different environments. Once they have been successfully placed in their respective environments, we were able to ensure that they were able to read accurate results as we constantly checked our cloud platform with the values which we were able to obtain manually ourselves.

II. RESULTS

Fig 4. Distance Level in Website

We tested the prototype using ultrasonic sensor, PH sensor, temperature and humidity sensor functions and because we wanted to minimize the cost of experimentation. As a test sample, we used different water storage tanks and ponds, and we have noticed that the different intervals have different level, PH values are almost similar and we can say that there are no regrettable salts that are present in the water which may affect the crop yield so we dealt with adding some training data to accomplish our objective for permitting the system to make decisions dependent on the changing PH and reading temperature. As shown in fig 4,5,6. we collected water level, PH temperature, humidity and moisture in different times from April 20, 2021 until April 23, 2021. The user can make decisions based on the data we got, if they notice that the water has an emergency.

Fig 5. pH Values in Website

Sensor ID	Time	Date	Sensor Data	H or N
TEMP	15:25	APR 20,2021	40°	NF
TEMP	15:30	APR 21,2021	42°	NF
TEMP	15:40	APR 22,2021	30°	NF
TEMP	18:00	APR 23,2021	21°	F
TEMP	19:00	APR 23,2021	18°	F

Temperature Range = 0°C to 50°C

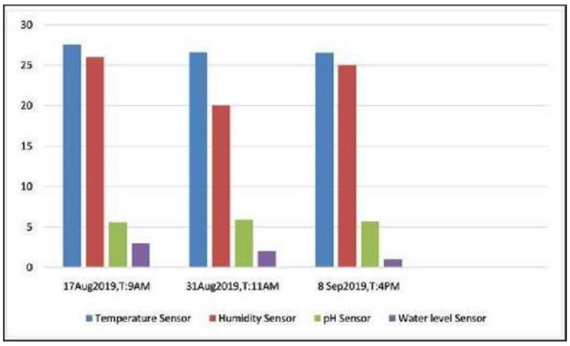
H=High N = Normal

Fig 6. Temperature Values in Website

The values from the sensor are continuously monitored in the IOT webpage. The data from the sensors is stored in the webpage and used for future analysis of the prototype. Using GSM, the alter messages are send directly to the user mobilephone.

Fig 7. Graph of Values

The graph above depicts all of the values that we have been able to obtain from our sensor. They have been neatly arranged in a bar graph so that all of the data can by visually analyzed. As you can observe the various



reading have beencoded and can be seen in various times and dates.

III. Conclusion

Through this project we were able to work with the most recent form of technology which is Internet of Things. While our project may seem small in nature, we were able toovercome many of the problems and defects of modern-day water management and dispensing systems by providing many new features which aren't available in the market. Furthermore, through our rigorous testing we were able to ensure that our prototype is able to work efficiently in the modern world without issues. Apart from these features another major advantage to using our prototype is its ability to perform many new features at merely a fraction of the costdue to many cost-effective ideas throughout our project. While our project may be able to provide the user withvarious features, we believe that I the future we will be able to further work on our project to provide even more features or functionalities which can further automate agriculture in amuch larger level. We look forward to the various studies which will come out within the domains of agriculture and IoT in the future.

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