SMART WATER LEVEL MONITORING SYSTEM

By

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A Project Proposal Submitted as a Partial Requirement for the Award of a Degree in Bachelor of Science in Telecommunications

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20th July 2021

Declaration

I hereby declare that this project submitted for the award of a degree in Bachelor of Science in Telecommunications is our own original work and has not been submitted to any other institution of higher learning. We further declare that all sources cited or quoted are indicated and acknowledged by means of a comprehensive list of references.

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Abstract

One of the United Development Sustainable Development Goals is to provide clean water to everyone and another one is responsible consumption of resources. Majority of the earth is covered in water but only 5% of it is useful so we need to conserve every drop of water. This project is about the implementation of ultrasonic sensors to measure the water levels in a tank and send the captured data to a website for the users to see, analyze and access from anywhere using their smart devices. The current water reservoir level monitors are only able to monitor when the tank is full and when it is empty, they lack the ability to monitor the level of water in real time. The aim of the project is to enable homeowners to check the level of water in their tanks especially the underground and overhead tanks that are usually unreachable and to conserve clean water. Water needs to be conserved so that we do not end up depleting all the clean water sources.

In this research project we propose the use of ultrasonic sensors to measure the water level in a tank in real time and trigger the pump to either start pumping in water or to stop according to the results obtained. This conserves water by preventing wastage of water if the tank was to overflow and also the fact that people become more conscious about their water consumption after being made aware of it. The results obtained from the sensors are also sent to online servers, through the internet, using the Wi-Fi module. The website then uses an API to communicate with the servers and get the information asked by the user. On the website the information will be displayed in graphs and show the daily, monthly, yearly consumption of every home.

The system will then be tested using different scenarios to see if the data recorded is accurate and if the system is able to work with all the components used to build it.

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CHAPTER 1: INTRODUCTION

1.1 Background

In almost every home there is a water tank that stores water that will be used in the home to do different tasks. In office buldings, car washes, schools e.t.c there is a tank that is used to store water for their daily uses.

A lot more content is missing here. Where do you introduce water meters and smart water meters? or smart pumps?

There are two types of tanks :

- Overhead tanks
- Undeground tanks.

The different types of tanks satisfy the different preferences of their users. For an undeground tank or a tank that has been placed e.g. on top of a tall building, monitoring the water levels in those tanks manually is tiring and somehow impossible. Tanks are essential bceause they are filled up by either borehole water or water from the city council water pipes and stored for future use. The current technology in water level monitoring and flow control in a tank is a float ball valve. The float ball valve is put inside the tank and it allows water to flow until a predetermined level is reached. Once water reaches predetermined level, float will rise with water due to buoyancy and stop the flow of water. As water level drops the ball drops and the valve will open to refill the tank. That prevents the tanks from overflowing and water from being wasted. The more water we preserve and use effeciently the better distribution of the already scarce resource.

The problem about this technology is that it does not automatically switch on the pump whenever the water level in the tank is low. Espcially for the people living in apartments whre the tanks are placed above the building, the water has to be pumped into those tanks because of the high place theyhave been kept, water cannot just flow into those tanks. Also, that technology cannot give real time results of the water level in the tank.

1.2 Problem Statement

Most of us get to use up the water in the tank after a certain amount of hours or days depending on our uses but we fail to know certainly after how long because we do not monitor our water use. Maybe if we constantly monitored the amount of water we use in our entities in a certain amount of time we might become more conservative because we are aware.

What is the clear problem statement?

Those of us who live in apartments or whose tanks are placed at a high place e.g. the roof, water needs to be pumped into the tanks manually by switching on the pump. Most of us usually switch on the pump when we open the taps in the house and no water comes out, which normally means there is no water in the tank. It takes time to pump water into the tank until it is full and by that time there is probably an air lock in the house pipes that also takes time to remove so that the water can flow with sufficient pressure. This can be very inconveniencing to the person especially when you are needed somewhere urgently.

1.3 Aim

Create a system that automatically pumps water once the water level in the tank is low to prevent the house pipes from getting an air lock and that also monitor the water levels in the tank constantly so that the user can tell what use takes up the most water and which takes up the least.

1.4 Specific Objectives

To prevent wastage of water and time by monitoring the levels of water in water storage tanks and automatically switching on the pump whenever the water levels are low.

Install an ultrasonic sensor inside the tank that will monitor the water levels, connect the sensor to a water pump electronically and send the serial data from the sensor to a server.

Create a website that will get data from the server and graphically display the water levels and time the data was recorded.

1.5 Justification

There is a need for a smart water level monitoring system because it makes life simpler and prevents someone from having inconviniences that can be embarrasing when you try to explain them. It also helps people monitor their daily or hourly water use so that they can be more conservative or even just for their knowledge.

1.6 Scope of Study

Set up the IOT based side of the project using arduino, wifi module, pumps, LED lights and wires.

Set up a ThingSpeak server to receive signals from the ultrasonic sensors and use Matlab to display the data in graphs and create a database to store the data.

Create a website that the users will use to see the data collected and pay their bills.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter addresses the existing literature on the current water management situation in Kenyan homes, existing water management systems, the new trends in water management system and the adoption of technology in the new water management systems. It starts by exploring the challenges that exists in the current water management system being used and it ends by depicting the gaps in the existing technologies and how this project may solve them.

2.2 Water Level Monitoring System

Most homes and buildings use reservoirs to store water for a longer period of time so that they can use it for future use and to avoid shortage of water. Monitoring Systems are just used to tell how much water is in a reservoir. This information can be used to switch on the pump to pump in more water into the tank when the water level in the tank is low or it can be used to switch off the pump to stop pumping water into the tank when the water levels are high just like the ones in our toilet reservoirs. The information can also be used to monitor the amount of water being used daily, hourly, monthly so that people are more conscious when they use water. There is a need for proper monitoring of water levels in reservoirs to prevent shortage of water supply due to wastage of it.

2.2.1 Technologies used in water level monitoring in Kenya

Water Level Indicators

These are probe sensors that tell the control panel that corrective action is needed. A combination of high and low sensors is used to tell the control panel when water levels are too high or too low. The control panel will then automatically turn the pump on or off depending on the corrective action needed.

Float Switch

A float switch detects the level of a liquid in a tank or container. It floats on top of the liquid surface and acts as a mechanical switch as the liquid level goes up or down. They control devices like pumps, valves or alarms to notify users. As the liquid level goes up or down, it moves vertically with the liquid level. Depending on the counterweight and pre-set 'trigger', the mechanical switch opens or closes allowing an electrical current through it to the connected device. Typically, this connected device either stops or starts the inflow of the liquid.

Float less Level Switch

Floatless relays are level controllers that detect water levels based on the conductivity of the medium measured by using conductive electrodes. When a relay senses the liquid level measured, the output contacts of the relay are energized and latched. The float less switch uses electrodes to electrically detect the liquid level in a tank. When electrode E1 is not in contact with the conductive liquid which is water in this case, the electric circuit is open and no current flows between the electrodes

2.2.2 Gaps in Existing Systems

Most water level monitoring systems are not connected to the internet or a communication model like GSM, hence the data collected is not stored and cannot be used to come up with predictions or presented in graphical form for the users to analyze their water usage. The user has to be where the physical tank is to be able to read the water levels of the tank, they are unable to access this information remotely like through the internet or via SMS.

Existing Systems only measure water at certain thresholds to either switch on or off the water pump depending on the water levels in the tank. The measurement of the water levels is not for the knowledge of the user but to trigger the water pump.

Existing systems can only measure a number of variables, the levels in the tank with the sensors. They are unable to measure the water levels in a tank in real time.

2.3 Conceptual Model

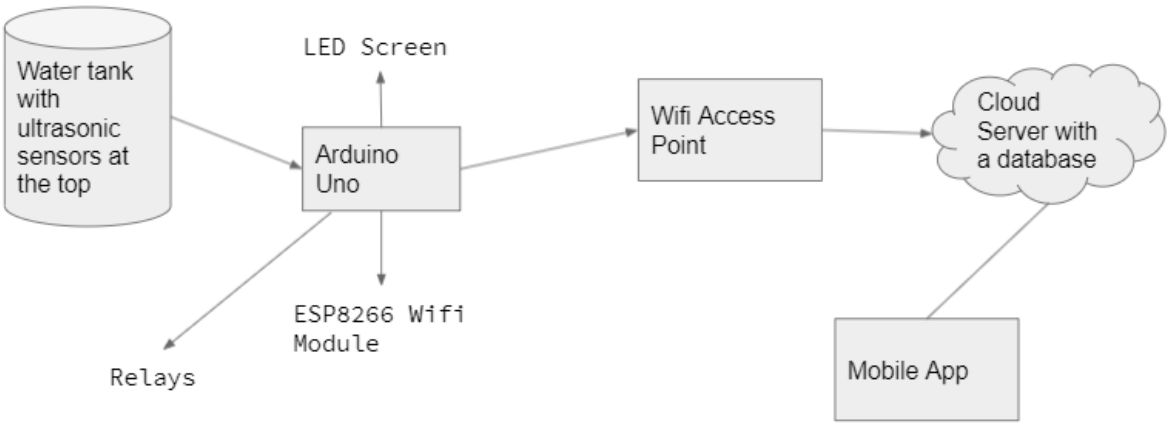

Figure 1: Conceptual Framework of an IOT Water Level Monitoring System

The ultrasonic sensors are places on the lid of the tank and will constantly send waves to measure the level of water in the tank. The signals are then sent to the Arduino uno which has the Wi-Fi module, relays and LED screen connected to it. The LED displays the water level in meters, the Wi-Fi module sends the serial data to an access point which forward the data to a cloud server and database. The relays are used to switch the water pump on or off depending on the water levels in the tank. The cloud server converts the serial data into graphs and analyzed information that the user will view through the mobile app or website using their mobile phone.

You have not looked all the aspects highlighted in your objectives in this section.

CHAPTER 3: METHODOLOGY

3.1 Introduction

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This chapter focuses on the steps that will be taken to implement the project. The first step is project identification, which is the process of looking for project ideas and finally settling on one idea that you decide to pursue. This is done by identifying a problem in the society and coming up with a project that can solve it.

The second step is the Literature survey, where you gather information through extensive reading of books, articles and discussions on similar IOT projects. In this step you get to find out what components and tools you will need to implement the project. You also get to gather information about the communication model you will use e.g., Fiber or ADSL.

In the third step we create the overall design of the project. With the information acquired from the literature review one is able to create a design showing how each component connects to the other and the function of each component.

The fourth step is Coding and Simulation. The micro-controller must be programmed using the Arduino IDE and a website must be created using PHP. Once the design is complete, one can use software simulation applications to test if the prototype will work well and to note the errors and changes that need to be made.

In the last step, which is Testing and Results, the project components, individually, are tested to see if they are in good condition and once the project is assembled then all components are tested together to see if they work well with each other to produce accurate results.

3.2 Analysis

3.2.1 Functional Requirements

Setting up the ultrasonic sensor and connecting it to the microcontroller.

Connecting the relay to the tank using a clear pipe and connecting the relay to the microcontroller.

Connecting the LED screen to the microcontroller.

Programming the microcontroller.

These are not functional requirements.

Setting up an IOT cloud platform.

Creating a website for the users to see a visual presentation their water usage.

Connecting the cloud database with the website.

3.2.2 Non-functional Requirements

Programming the LED screen.

3.3 Design

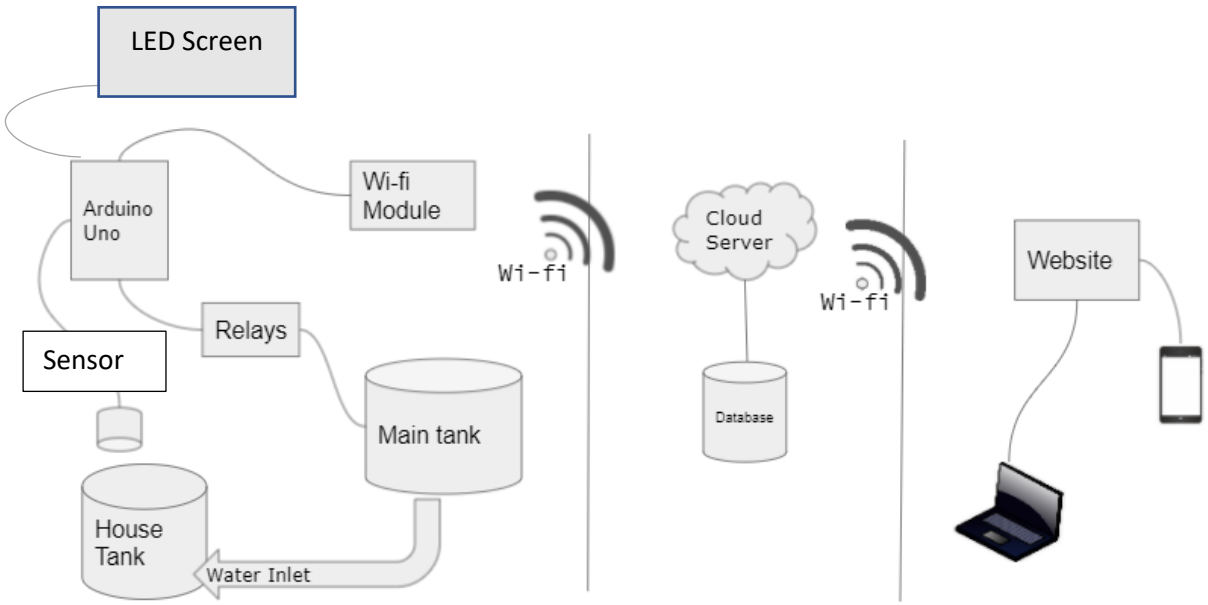

Figure 2: Design Diagram of the Project

The ultrasonic sensors measure the water levels in the home tank by sending waves and calculating the distance. Data collected is then sent to the microcontroller, which is the Arduino Uno, and it is displayed on an LED screen. The microcontroller is also able to trigger the relays to pump water from the main tank into the house tank or to stop pumping water depending on the level of water in the house tank. Serial data from the microcontroller is further sent to a cloud platform using the Wi-Fi module. The Wi-Fi module first sends the data to the home router which sends data to the cloud platform through Fiber to home Internet connection. The cloud platform has a database that the website will connect to in order to display the data collected in a numerical or graphical representation so that the user can easily see and monitor their water consumption from their smart devices anywhere at any time.

3.4 System Development Tools and Techniques

3.4.1 Hardware Requirements

Wires, Microcontroller, Ultrasonic sensors, LED screen, relays, Wi-Fi module, Computer.

3.4.2 Software requirements

YouTube, Notepad++, XAMPP, Arduino, Linux, Cloud Platform.

3.5 Deliverables

The ultrasonic sensors send serial data to the micro-controller which displays the data on an LED screen and also sends the data to a cloud platform using the Wi-fi module as the communication means between the micro-controller and the internet. The end user is then able to access the data in numerical or graphical presentation using their smart phones at any time.

References

Natividad, J. G., & Palaoag, T. D. (2019). IoT based model for monitoring and controlling. *The International Conference on Information Technology and Digital Applications*, (pp. 1-6).

Pfister, C. (2011). *Getting Started with Internet of Things.* O'Relly Media Inc.

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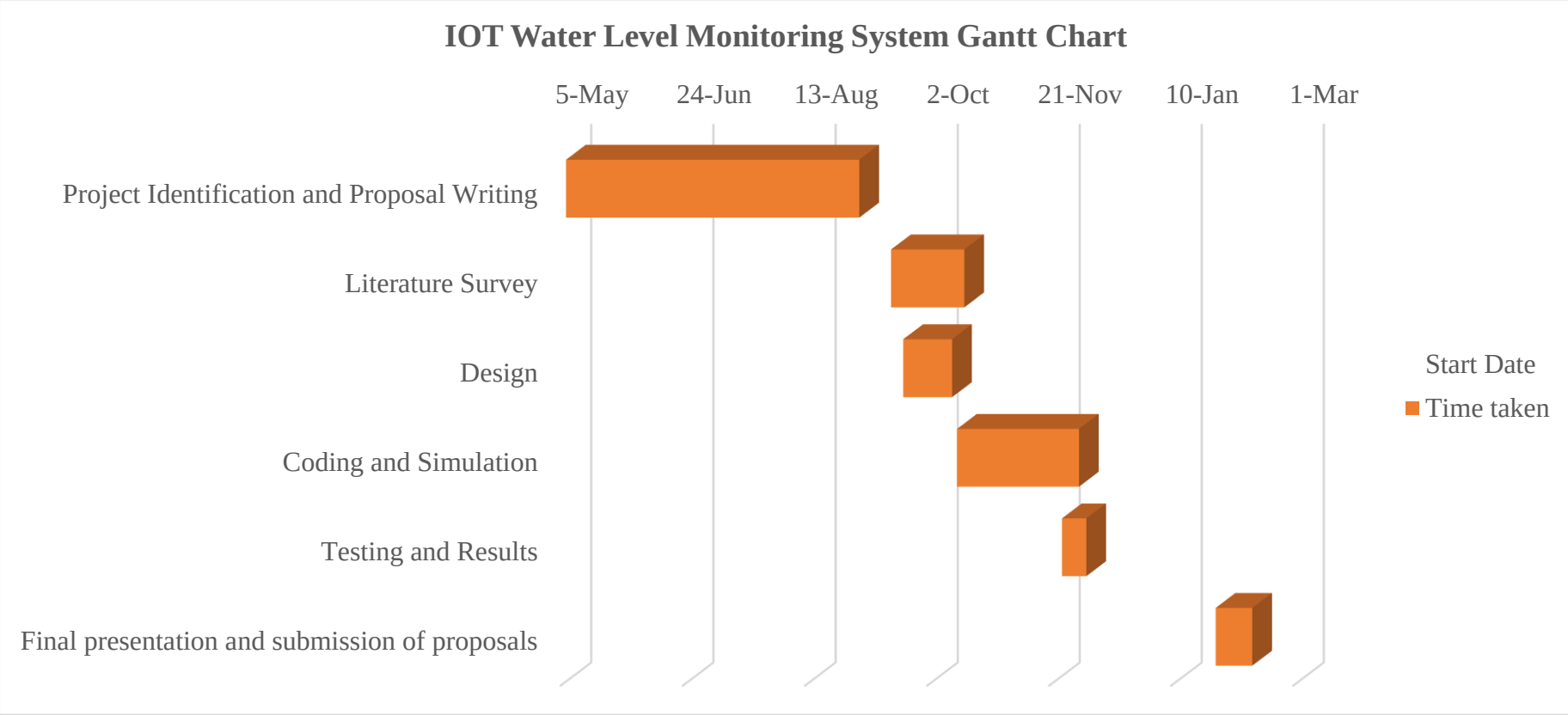
Appendix


IOT Water Level Monitoring System Gantt Chart
5-May
24-Jun
13-Aug
2-Oct
21-Nov
10-Jan
1-Mar
Project Identification and Proposal Writing
Literature Survey
Design
Coding and Simulation
Testing and Results
Final presentation and submission of proposals
Start Date
Time taken