November-December 2019
ISSN: 0193-4120 Page No. 5200 - 5204

Water Tank Monitoring System Using Iot Technology

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Abstract

Water is crucial to our life and needed in daily activities. Sometime we will facing water disruption issue. This research paper proposed a water level monitoring system using LoRa technology that will notify users when the water level in the water tank goes low. The prototype are using Arduino, LoRa shield and water sensor as main components. Once the IOT sensor is been triggered, the signal communication occurs between transmitter and receiver module via LoRa wireless technology. The signal is then process and displayed using LED and serial monitor. The distance covered by the LoRa signal is also tested. The prototype works well within 500 meters' distance range under given circumstances. The system is valuable in measuring and monitoring the water level inside a tank with minimal physical work.

Keywords: *LoRa, Single Point Water Sensor, Water level, Water Tank, IOT sensor.*

I. INTRODUCTION

Water is crucial to our life, as it is needs in our daily activities. We will be facing water disruptions when there is lack of rainfall distribution or water pollution. Population increase is one of the major contribution for inadequate water supply. Nowadays, many newly developed housing areas are built without housing water tank. The residential owners are depending on their house water tank only. If the duration of water disruption occurred for several days, the amount of water in the house water tank is not enough especially with large household members. Hence, the need of water tank lorry is much needed. However, with the increasing population the delay will be much longer.

To ease the water disruption issue faced by the house owners, we proposed the development of water tank monitoring system using LoRa technology. LoRa technology is used as the communication medium in this prototype. LoRa technology is a long-range transmission with low power consumption using wireless Radio Frequency (RF) Technology. This wireless data communication IoT technology with sensor are used to measure and monitor water level remotely. LoRa is also a low-cost technology, which reduce up front infrastructure investments and operating costs, as well as end-node sensor costs. By implementing LoRa technology, the system can monitor and trigger alert to users whenever the water level in the tank hits the critical state. This will prompt them to take necessary action.

The rest of the paper is organized as follows: Section 2 presents the studies done by researchers on water automation and monitoring system; Section 3 discusses the methodology to develop the prototype; Section 4 presents the results; and finally, Section 5 concludes the paper..

November-December 2019
ISSN: 0193-4120 Page No. 5200 - 5204

II. RELATED WORK

Several research works exist, where water automation system are discussed. Mahfida Amjad et.all (2019) studied water automation on controlling, monitoring and billing of water usage based on different purposes using different types of hardware and technologies. The research present Automated Water Management System (WMS) which can monitor water tank by measuring the water flow, water level, water temperature, cut ON/OFF water supply and send notifications to the user through mobile messaging. In future, this system will add billing system for user and water cooling system for better performance [1].

Umirka Sengupta et al. (2018) studied a technology to control water pumps and prevent wastage of water using smartphones. The research present a different way of finding the water level using an ultrasonic module; Arduino (Android Lollipop) which contactless and much easier to install than regular systems. In future, the connection between Arduino and relay is wireless and the exchange of information happens involve the connection of the Internet for updating values [2].

Siti Aisyah Che Kar et al. (2017) studied a system to aid homeowner in monitoring supply and safety of water tap in their home. The research based on ATmega328P microcontroller as the main controller for the whole system while the ultrasonic sensor and pH probe are used as inputs to the system beside the 16 x 2 characters LCD display, buzzer and the LEDs are used as outputs. In future, solar panel can be used as alternative for limited power resources problem beside implemented on the system such as wireless monitoring systems or using remote control system or can also be integrated through internet, thus making it possible to monitor the system anywhere and anytime [3].

Giridhar Urkude et al (2018) studied a system for the overflow and under flow detection of tank following IoT Concepts. The research based on Ultrasonic Distance Sensor that measures the water level of the water tank using Raspberry Pi which alerts when the tank is empty or when water overflow, based on the Threshold value, which is calculated dynamically. In future, the system can easily be upgrade to IoT ecosystem and connected to the Internet [4].

Prasad et .al (2018) studied automated water pump system for home or any user for filling tanks as well as for using water supply. The research present a system consists of water sensor, temperature sensors, float switch, Wi-Fi module and GSM modem, which controlled by PIC also LED light to know the pump condition. In future, the system can be able to control the pump using apps on the smart phone [5].

Above studies shows different to our work on various aspects, such as components, purposes, environment or implementation. Our work used:

a) LoRa shield SX1278 as wireless technology.

b) Single point float sensor as liquid level detector sensor.

III. WATER TANK MONITORING SYSTEM

In this study, a prototype model of water tank monitoring system is been developed to notify consumer if the water level in the tank is insufficient. Single point float sensor is use to detect the water level within the tank while LoRa technology is used as transmission medium between the transmitter and receiver. The development of the prototype is separate into two modules; transmitter and receiver. The prototype is also evaluate based on water level and distance range.

Figure 1 shows the complete water tank monitoring system block diagram. When the water level in the tank detected by the sensor indicated to be low, a signal is triggered and sent to transmitter module. The module will transmit the received signal to the receiver module. The signal is processed and displayed at LED or/and serial monitor.

November-December 2019
ISSN: 0193-4120 Page No. 5200 - 5204

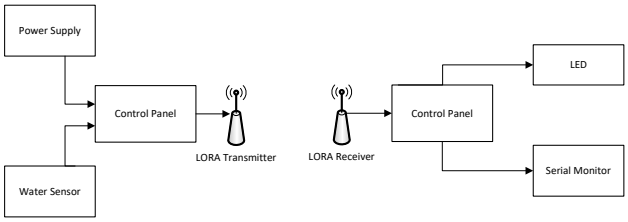

Fig. 1 Water Tank Monitoring System Block Diagram

A. *Transmitter Module*

The transmitter module is developed to detect the water level in the tank. The components used in this module are Arduino UNO, single point float sensor, LoRa shield and power supply. The Arduino UNO will act as main component which controls the system where else 9V of power supply is used. Water level is detected by using single point float sensor. A single point sensor functions by opening and closing the dry contact to reed switches to identify the water level before sending electrical signals. When the sensor is closed which is the water in appropriate amount, it will not send any data. When the water level is high, the float is closed. Once the water level is below the limit, the float opens which indicates low level. This will trigger the sensor and an electrical signal is sent. The LoRa shield type SX1278 is used as the transmission medium. Figure 2 show the complete transmitter module.

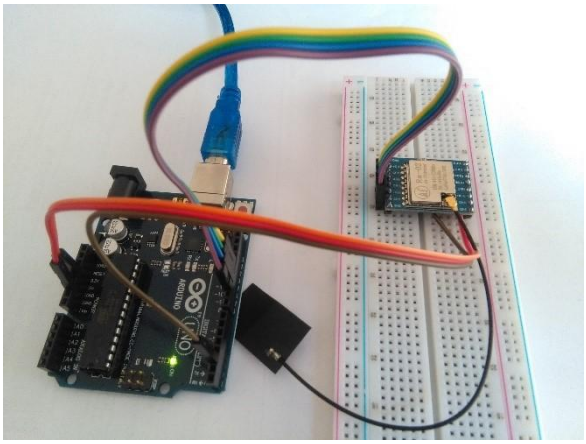

Fig. 2 Water Tank Transmitter Module

B. *Receiver Module*

The receiver module is used to notify consumer where the water in the tank is sufficient or not. This module will receive an incoming signal from transmitter module using LoRa shield type SX1278 and displays the output to consumer. There are two types of output that been embedded which is LED or serial monitor. A light up LED indicates that the amount of water in the tank is insufficient and at the same time, it is been displayed at the serial monitor. In this prototype, the allowed voltage to operate the module is set to a 9V adapter. Figure 3 shows the receiver module with LED light been up while Figure 4 shows output displayed at serial monitor.

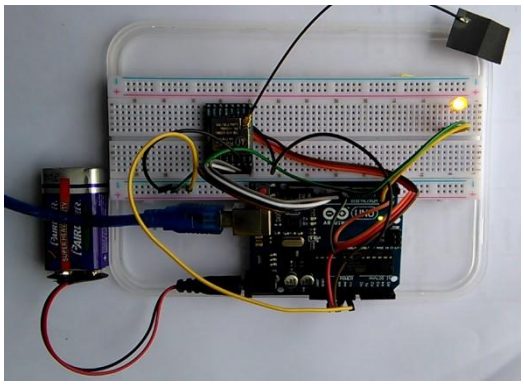

Fig. 3 Water Tank Receiver Module with LED

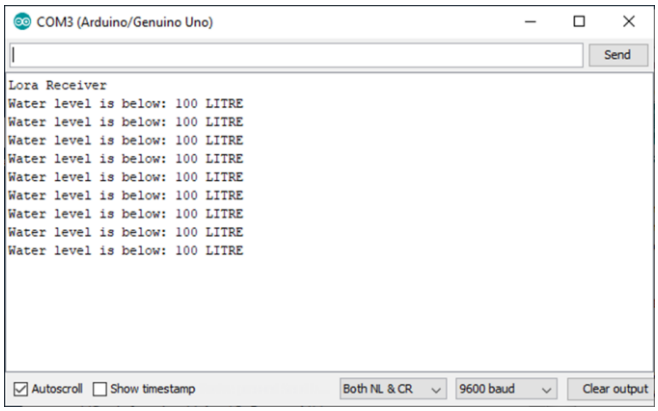

Fig. 4 Serial Monitor Output

IV. RESULT AND DISCUSSION

The objective of this study is to develop a prototype that will notify consumer in case their water level in the tank is low which indicates inadequate amount of water. The signal communication between the transmitter and receiver is tested to identify the distance covered by LoRa signal. This investigation

November-December 2019
ISSN: 0193-4120 Page No. 5200 - 5204

is significant so that the prototype may be used not only by landed property but also by high-rise buildings.

The experiment has been conduct for both indoor and outdoor environment of a condominium. For the indoor experiment, the test categorized into two; similar floor and different floor. The distance range is been identified as 5 meters, 10 meters and 60 meters for the same floor category. Table 1 shows the results of the connectivity between transmitter and receiver within the same floor. The transmitter is been placed at the back of the floor. When we move forward, the signal strength detected by the receiver decreased as shown in Figure 5. At 5 meters, the signal strength is -31 dBm while at 60 meters the signal strength is -252 dBm. For RSSI measurement, when signal close to 0 dBm is the better signal. If the signal is -30 dBm it is considered as amazing signal strength. When the signal is -80 dBm and below, the signal strength is not good because the best signal is closed to 0 dBm. As we move to different floor, the signal strength also decreased and no signal received at 4th floor of the building. Hence, it affects the connectivity of the prototype as shown in Table 2. The loss of signal might be due to multiple obstacles in the pathway of the modules. Figure 6 shows the connectivity between transmitter and receiver at different floor.

Table 1: Connectivity of sender and receiver at similar floor

Distance	5 m	10 m	60 m
Sender	√	√	√
Receiver	√	√	√
RSSI	-31	-55	-252

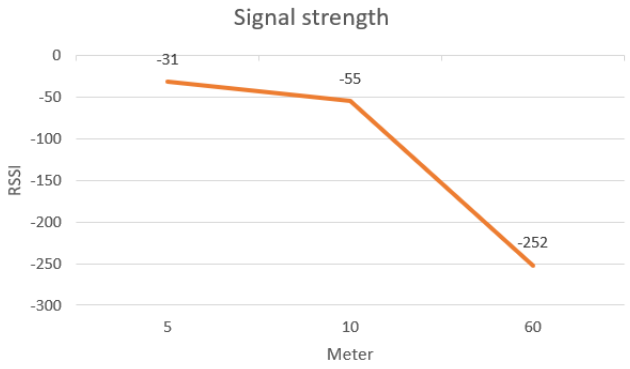

Fig. 5 Graph of signal strength Received in Same Floor

Table 2: Connectivity of sender and receiver at different floor

Floor	1	2	3	4
Sender	√	√	√	√
Receiver	√	√	√	x

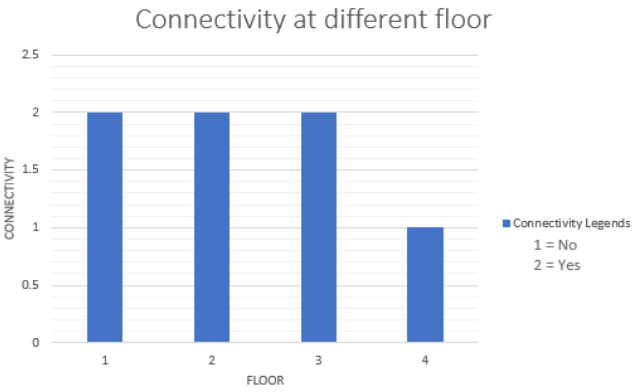

Fig. 6: Graph of connectivity at different level of floor

The second experiment was conduct in outdoor environment. For outdoor experiment, the transmitter and received is placed at various distances from each other and the result gathered is shown in Table 3. The result shows that LoRa signal is not been detected at the distance of 500 meters. This may be due to the obstacles such as trees and building that appear along the selected testing path. Figure 7 shows the connectivity when distance is increased.

November-December 2019
ISSN: 0193-4120 Page No. 5200 - 5204

Table 3: The connectivity of the prototype at different distance range

Distance	150 m	300 m	500 m
Connectivity	√	√	x

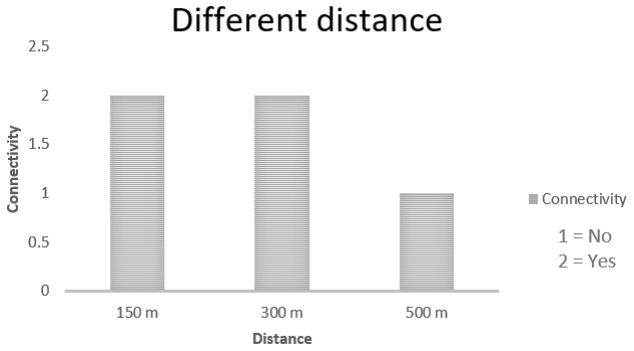

Fig. 7: Graph of connectivity at different distance

V. CONCLUSION

In this paper, the prototype developed is able to alert the user on the tank water level. This is beneficial as it will be very helpful in rationing the water usage during water disruption. Apart from that, it can also be a useful tool in case of any leakage in the tank. This is because the system will trigger alert when the water in the tank is in critically low level. The experiment also shows the capabilities of LoRa technology as communication medium in transmitting the data. The distance covered for signal transmission in this prototype is not more than 500 meters. However, this feature can be improve for further undertakings.

Nonetheless, the research work is preliminary and many issues related to Internet of Thing (IoT) technologies were not discuss. For future work, the prototype enhancement will include the ability to measure the water flow with notification system through LCD and mobile phone.

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