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Research Article

AUTOMATED OVERHEAD WATER TANK LEVEL CONTROL SYSTEM USING WIRELESS COMMUNICATION

[1,*]Jai Sreedhar Ganeshsubramoniam, [2]Venkata Prasad Vellore, and [3]Jainam Sachin Mardia

[1,3]Department of Electrical and Electronics Engineering, Rajalakshmi Engineering College, Chennai, Tamilnadu, India
[2]Department of Electronics and communication Engineering, Rajalakshmi Engineering College, Chennai, Tamilnadu, India

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Abstract

Water supply is the most vital aspect of daily household life, particularly for washing, cleaning, and bathing. Most of the water is supplied using ground water sources which is done by Pumping ground water to fill a water tank in the community. However, the usage of a non-automated switch to turn on and off a pumping machine might result in either overflow of water or excessive power consumption. so in order to overcome these issues the automation of this this process is the only solution, so this automation is done using the proposed system which has two parts where one part is placed near the pumping machine such that enables the pump when the water level is empty or level ONE, and it switches off pump when the water level reaches maximum-level and remains steady until the water level is empty. Another part is placed near the water tank to find the water level in the tank and the two parts of the system will be communicating using a radio frequency Transceiver.

Keywords: Water, Wireless transmission, Float sensor, Transreceiver, Power.

INTRODUCTION

Water is essential for life, and we know that the earth is topped with 70% of water. That leads to the obvious conclusion that it will always be plentiful. However, just 3% of total water is freshwater suitable for human consumption. The remaining water is either in glacier form or can be used for daily functions. As a result, freshwater is a tremendously precious resource. People who live in cities with an unrestricted supply of water are often unaware of the severity of the water shortage. A day without water seems inconceivable to them. According to the Ministry of Housing and Urban Affairs, the benchmark for urban water delivery in India is 135 liters per capita per day (lpcd).Water spilling and wasting is a typical occurrence for people with an uninterrupted water supply. On the other hand, there are 1.1 billion people worldwide who do not have access to fresh water and 2.7 billion people have limited access to water for at least one month of the year. Freshwater resources such as rivers, lakes, aquifers, and groundwater are either dehydrated or contaminated, which makes them unfit for drinking use. Almost half of the world's wetlands have vanished. Climate change has also caused drought in certain regions and flooding in others. India accounts for 17.7% of the total global population and acquires 4% of the global water resources. According to UN forecasts, India's urban population would reach 50% of the total present population by 2050. As a result, domestic demand in India will rise from 25 billion cubic meters to 52 billion cubic meters during the next twenty years. The facts described above draw our attention to the urgent necessity of adopting preventative measures to preserve water. Water conservation and usage management are essential for the country's long-term prosperity. Most of the water used in the urban areas is mostly from groundwater sources. And most of the urban jungles are dominated by apartment buildings, which require a tremendous amount of water for everyday usage where they usually prefer the head storage system.

Corresponding Author:** ***Jai Sreedhar, G.
Department of Electrical and Electronics Engineering, Rajalakshmi Engineering College, Chennai, Tamilnadu, India

This system, in which the groundwater is pumped to an overhead tank present above the building, ensures uninterrupted water supply, and is commonly adopted in all the places where there is a requirement for uninterrupted water supply, which includes individual houses, small industries. So, to ensure the proper usage of water without wasting the water source and the power that is used to pump the water to the storage area. Individually, this may be accomplished by installing devices that ensure that water flow is switched off after the tank is entirely filled. and turned on when the minimum level of water is reached, such that the system does not wait until the overhead tank is drained, which may cause many severe problems in day-to-day life [1, 2].

The market-available systems or previously proposed systems for this specific issue are those that were only made to alert the user that the overhead tank has reached the top level or is about to overflow, and some others use wired communication between the motor and actuator present in the overhead tank to turn off the motor when the overhead tank is about to fill, requiring separate wiring and pipelines and wiring setup [3, 4, 5, 6]. And because this wire is located on the exterior of the building, it is subject to accidents, which reduces the lifetime of the wire, and there may be a leakage current in this system due to its damage held in the wiring, which is a highly notable issue [7, 8]. This method is not preferred for use in multi-story structures since it is prohibitively expensive to implement. There must be certain physical factors in everyday life that must be regulated in order for them to fulfill their expected actions. As a result, an automated system is described as a device that controls, commands, directs, or regulates the behavior of other devices or systems. As a result, automatic systems are being employed in a variety of industries [9,10]. Which is also implied in this system which is coupled with wireless transmission fig.1, to perform the task with ease, which makes the system work independently on the pre-set parameters, which avoids human faults and carelessness [21, 22].

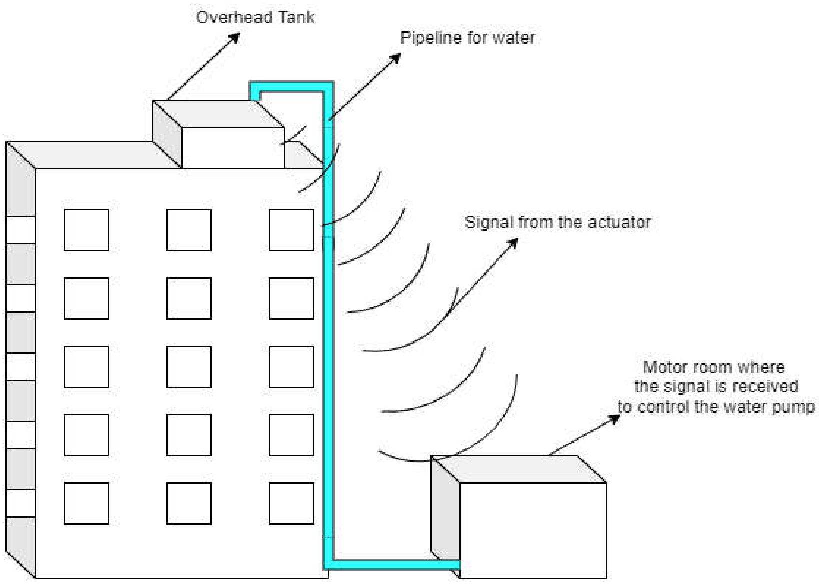

Fig. 1. Illustration of the proposed system

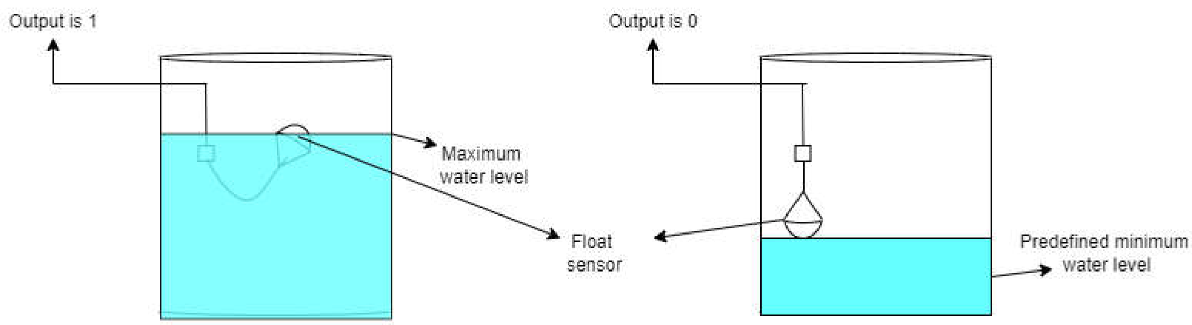

Fig. 2. Working of float sensor

METHODOLOGY

The old method required the user to physically turn off the switch by either verifying the volume of water pushed to the overhead tank or estimating the time required to fill the overhead tank. However, the proposed method first checks the water level in the overhead tank using the water float switch sensor, which will float when the water level in the overhead tank is almost full and give the output as 1, and will give the output as 0, when the water level in the overhead tank decreases to the designated pre-fixed level, so the output of the sensors will be obtained by the arduino-nano microcontroller to process the data fig.2 [11, 12]. When the data is received by the microcontroller and processed, the data is transmitted to the receiving end, which is the water-pump control [13, 14, 16, 20]. This transmission is carried out with the help of a nRF24L01+ PA LAN transceiver, which is connected to the microcontroller, which receives data from the float sensor, which is located within the tank. It transmits a 2.4GHz + LNA SMA wireless radio signal up to 1 kilometre using the selected frequency [17, 19, 23, 24]. Once the data is transmitted, it is received by another nRF24L01+ PA LAN transceiver that is also coupled with the arduino-nano microcontroller, and the microcontroller is coupled with an Ac relay that is triggered by a 5v dc source, so that once the data is received at the receiving end of the system by the radio frequency transceiver, it is sent to the microcontroller that is coupled with the Ac relay, and the data is processed, which decides to turn OFF or to turn ON the water-pump [15,18].

Hardware

One of thenRF24L01+ PA LAN transceiver modules is linked to an Arduino to operate the water pump by using the interface of the AC relay contact as a switch. The microprocessor is located on the Arduino-NANO board which is a ATMEGA328P which is a 8 bit processor, which is powered using a 7–12V source. It features 22 digital I/O pins, including six DIO pins that may be used as pwm output. There are eight analogue input pins (A0 to A7), each having a 0 to +5v analogue voltage range. It comes with a 10-bit A/D converter. A hardware RESET switch may be used to manually RESET the microcontroller. Circuit serial programming is supported by the board. It has 2KB SRAM, 32KB flash memory, 1KB EEPROM, and a 16MHz clock. There are additional software controls available. Many further technical characteristics are accessible from the Arduino official website's technical handbook. In the given arduino-nano board the transceiver is connected accordingly the vcc pin of the transceiver is given to 3.3v output pin of the microcontroller and ground pin to ground,CE(chip enable) to digital pin 9, CNS(chip not select) to digital pin 8, serial clock to digital pin 13, MOSI(master out slave in) to digital pin 11,MISO(master in slave out) to digital pin 12 which has been illustrated in fig.3. And the water float sensor is connected to digiatl pin 2 and the ground of the microcontroller, the the trigger of relay is connected to digital pin 3 and ground is connected to the relay from the microcontroller. And the water-pump (motor) terminals are connected on the high voltage side of the Ac relay.

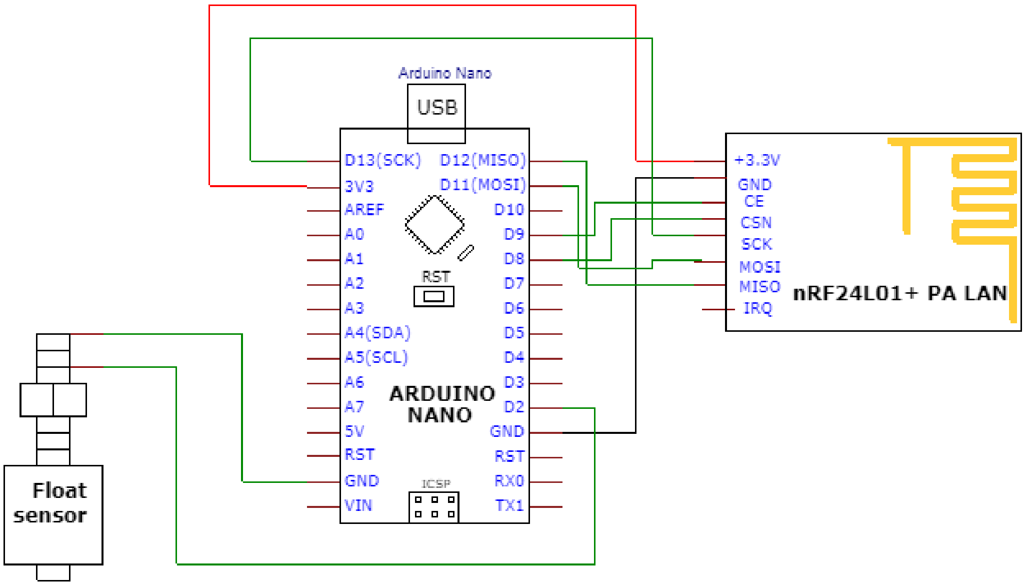

Fig. 3. Transmitting end

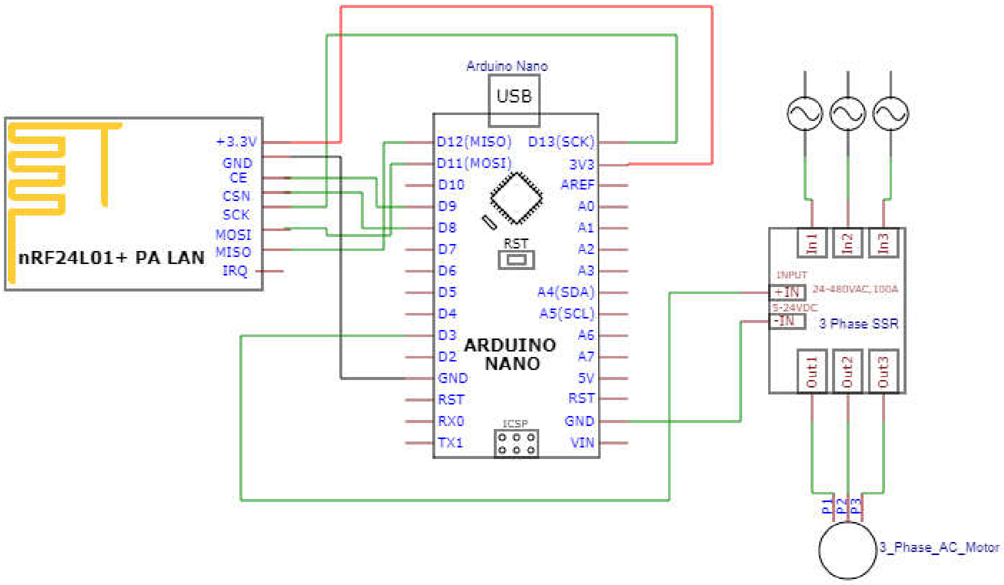

Fig. 4. Receiving or controlling END

Software

The arduino-nano is loaded with the micro c sketch and it is coded using the arduino IDE, and an algorithm is developed for intend design.

Algorithm 1 (Transmitting end):

1. Set the address for the communication of the system
2. Set the communication device as a transmitter
3. Check the value received from the float sensor
4. if the value from the float sensor is “1” send text to receiver as “OFF”
5. If the value from the float sensor is “0” send text to receiver as “ON”

Algorithm 2 (Receving end):

1. Set the address for the communication of the system
2. Set the communication device as a receiver
3. Read the data available in the buffer
4. If the received data is “ON” turn on the Ac relay by making the digital pin high
5. If the received data is “OFF” turn on the Ac relay by making the digital pin low

RESULTS AND DISCUSSION

The proposed system's prototype was created and tested in small apartment which has a 5HP water pump, yielding positive results and demonstrating that the system saves energy when compared to the traditional method since this proposed system will turn on only when there is a requirement, that is, when the water level reaches the preset minimum level, and does not waste water due to the absence of humans in the system. And the water supply was provided uninterruptedly. The float level sensor employed in this proposed system operates on the boyance fource principle, which states that when the water fills up, the lighter part of the sensor rises to the surface of the water while the heavier component of the sensor remains in the same place. As a result, when the water level reaches its maximum, the sensor generates an output. Not only does the suggested method automate the water level, but it also reduces water waste.

Conclusion

Water monitoring and automation systems based on wires are currently available on the market. However, the main disadvantage of wired networks from overhead tanks and ground tanks to control systems Power losses in the wiring, electromagnetic interference, wire aging, wear and tear, and cost are all factors to consider. If the structure is multistory, the problem becomes even worse. The IOT-based solution, on the other hand, requires internet access. To address these shortcomings, we propose a wireless solution. The advantages of the wireless approach are that the wiring infrastructure is avoided, which lowers the cost of building it, reduces most configuration, and therefore requires nearly no maintenance. We employ an anti-corrosion water level sensor. When the switch was set to 1, it was in the off position, and when it was set to 0, it was in the on position. We chose the nRF24L01+ PA LAN transceiver module because it is a simple and cost-effective way to set up your wireless communication system, which uses radio frequency for communication and does not require any internet facilities. The transceiver transceiver runs in the 2.4GHz band and has an auto-retransmit capability. Throughout, the datasheets for the nRF24L01+ PA LAN transceiver module claim a wireless communication distance of 800-1K meters in the open air.

Declarations

Ethics approval and consent to participate: Not Applicable.

Consent for publication: Not Applicable.

Competing interests: The author declares that there are no competing interests.

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