DESIGN AND DEVELOPMENT OF SMART PUMP CONTROLLER USING ARDUINO BASEDSENSOR FOR HOME APPLICATION

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Abstract—Water is one of the most valuable resources on our planet Earth. We use water for a wide range of purposes. For example: Washing Clothes, Drinking, Bathing, Industry Purposes, ETC....But the water waste problem is a really big issue all around the world. One of the most common reason being Human Errors. A lot of times we switch on the water pump at our house and forget to turn it off. Due to this 100s of Liters of water is wasted daily. To prevent this excess water wastage, we can use an automated system like this. This system is developed to save water, electricity and time in our day-to-day life. This Smart Pump Controller not only controls the water pump automatically but it also shows the live water level, Pump Status on an LCD Display for user's convenience. As for sensing the water level, An Ultrasonic Sound Sensor (HC-SR04) has been used. The reading of the HC-SR04 gets converted to percentage & gets displayed of the LCD.

Index Terms—smart pump control, smart irrigation, digital water level indicator, design of pump control system, save water, household pump automatic operator, digital pump cotroller.

1 INTRODUCTION

Water wastage has become pretty common nowadays. Thus, to solve this issue this device has been made. This device controls the water pump based on the reading of the sensor inside the water tank. The sensor measures distance of the water from the top of the tank. Then it converts the readings to percentage and displays it to the user. The readings have to go through a filter code and thus the readings are stable and do not fluctuate. Thus, even if there is turbulence in the water tank the user will get the exact value in percentage. The values in the device can be changed as per user's convenience and needs via Bluetooth. For example: Tank Height, Maximum Percentage, and Minimum Percentage. The device has a night mode feature in which the water pump is kept off during 11.PM to 7.AM. This feature is necessary to prevent any water wastage during this time period due to any sensor failures.

2 SENSORS AND CONTROLLER:

ARDUINO NANO

HC-SR04

HC-05 BLUETOOTH MODULE

DS3231 RTC MODULE

2.1 ULTRASONIC SOUND SENSOR (HC-SR04):

This Sensor provides microcontroller the water level data in every 1.25 seconds. By default it can provide data in every 50ms but we have written some code to filter out random/error values from the sensor to make sure the water level is displayed smoothly on the LCD. This sensor basically reads the distance of the water from the top of the tank and sends those values to Microcontroller.

2.2 ARDUINO NANO:

Arduino is an open-source electronics prototyping platform. Arduino Nano is one of the most common and famous Boards. This board has enough I/O Pins to connect all the necessary

sensors and displays. C++ is used in order to program this board. This board is basically the brain of the system.

2.3 RTC MODULE (DS3231):

DS3231 is a Real Time Clock (RTC) Module use in this project. The main function being Night Mode safety feature. This module provides us with time data (Hours, Minutes & Seconds) in real time. With that data we can keep the pump off from 11 P.M to 7 A.M & thus prevent any water wastage due to any sensor failure.

2.4 BLUETOOTH MODULE (HC-05):

HC-05 is a Low-cost Bluetooth module which can connect with our smartphones and thus we can use our smartphone to setup/configure the device. We can set Minimum Percentage, Maximum Percentage, The RTC Clock Time, etc. We can use any free app to send commands from smartphone to the device using this module.

3. CALCULATIONS:

Head available can be calculated as velow

Pump HP = 1HP

Pump Efficiency = 90%

Hydraulic Power = 1 x 0.9 = 0.9hp= 61.13watt

Hydraulic power can also be given as,

Hydraulic power = ρ x g x H x Q

671.4 = 1000 x 9.81 x H x 6.65 x 10-4

H = 671.4 / 1000 x 9.81 x 6.65 x 10-4

H = 102.91m

Manometric head available is

Hm= 38m

So frictional and other loss will be

hf = 102.91 - 32 = 70.91m

The variation of this head with respect to flow rate is obtained as

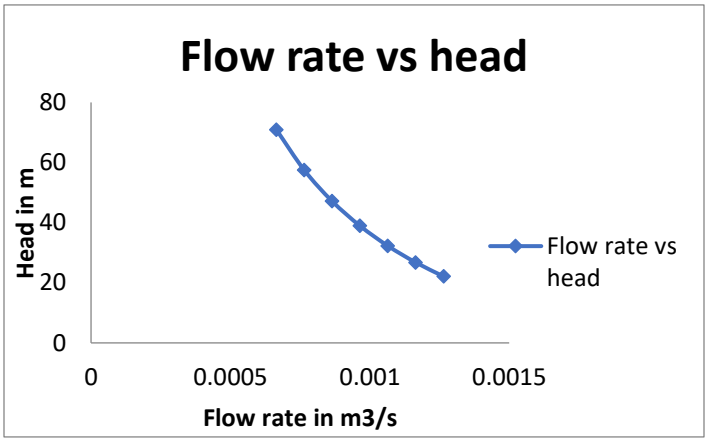
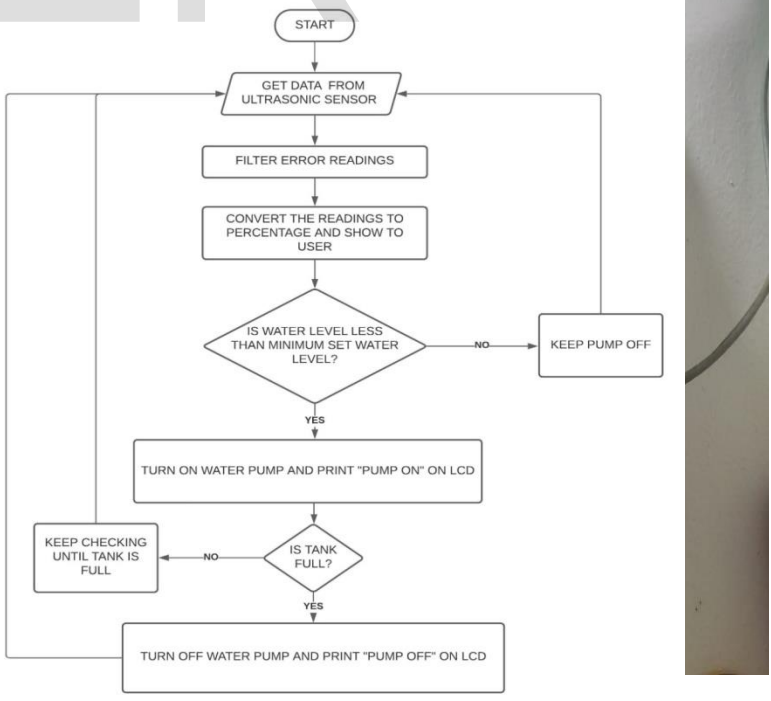


Fig 5: loss of head withrespect to flow rate

The graph shows that it is beneficial to run the pump at high flow rate. In majority ofhome applications users use to keep the flow rate low so that immediate overflow will not be there. So if we use digital controller to regulate the discharge, we can run the pump at maximum flow rate and save the energy as well as water.

4 PROCESS FLOW CHART OF DIGITAL CONTROLLER



First the readings from the ultrasonic sensor are taken by the microcontroller. after this a piece ofcode inside the controller filtrers the error/random values which arise due to moving water inside the tank. after this step we convert the values the

sensor to usable percenatge values. we use these percentage values in order to control the pump as well as showing the current water level to the user on an lcd screen. after this step the percentage values are checked to control the pump. if the current water level is less than the minimum water level set by the user, the pump will be turned on using relays. once the pump is turned on, we print "pump on" on the lcd to show the status of the pump to the user. we keep the pump on till the current water level reaches the maximum percentabe set by the user. once this condition is satisfied the pump is turned off using relays and we print "pump off" on the lcd to show to the user. this whole process is repeated all over again.

5. SETUP OF SYSTEM AND WORKING

The working of the device is simple. we use 2 relays in order to switch on/off the water pump using the provided control box itself. the relays are connected in series and parallel to the switches inside the control box itself. 4 wires are needed in order to do so. by doing this we can not only control the pump using this device but also as per users needs, they can use it manually without having to turn off this device in case they need to switch on the pump for any reason. the switches inside the control box connect a solenoid connector which then controls the pump, so we can use relays to control the solenoid and thus control the pump automatically.

CONCLUSION

After investigating past literature our setup has following benefits:

1. More accuracy because of error filter code
2. Support for submersible pump unlike Jet Pumps so can be used more widely
3. Night Mode safety feature
4. Can be setup using Android Smartphone and Bluetooth CLI so is more convenient
5. Fully customisable Maximum and minimum percentage levels as per users needs

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