Automatic Water Level Controller with Short Messaging Service (SMS) Notification

Sanam Pudasaini[*], Anuj Pathak[*], Sukirti Dhakal[**], Milan Paudel[*]

[*]Department of Mechanical Engineering, Kathmandu University, Nepal
[**]Department of Electrical and Electronics Engineering, Kathmandu University, Nepal

***Abstract*-** Having the hydropower potential of 42000 MW and other immense source of electrical energy, Nepal still faces the problem of load shedding. And this problem has catastrophic consequences as electricity rules the routine of our busy lives from micro to macro level; say to charge a cell phone (essence of today's lives) or to fill tank by water for numerous purposes. However, the situation, when the daily busy schedule and the problem of load shedding intersect, can be addressed.

The paper presents a system of an automatic water level controller with SMS notification. The project was carried out to assist user in load shedding based country like Nepal. SMS notification was added to automatic controller system so that water can be managed by user during load shedding. Two systems work synergistically; automatic level controller system and SMS system. The program was developed in Arduino program developing environment and uploaded to the Microcontroller. Water level in the system is controlled automatically. The controller operates on a battery power. Whenever the system encounters empty level and the status of load shedding, the SMS notification is sent to the user.

***Index Terms*-** Load shedding, Short Messaging Service (SMS), Arduino Uno

I. INTRODUCTION

Automation of smart system is the essence of today's world. The 'Automatic Water Level Controller with SMS Notification' can be the appropriate example for smart system. It, not only avoids the empty tank condition, but also continuously updates the level of water with SMS. This project efficiently reflects the principles of Control Engineering.

The system will automate the process by placing a single sensor unit in the tank that will periodically take measurements of the water level and will control the motor automatically. This system eliminates the efforts of people for daily filling of the tank and checks for overflow. The problem like overflow of water in the tank of interest, empty tank condition and motor overheating due to continuous usage is avoided. Despite its smartness, this project does not explain the update water level of source tank. Moreover, during no lighting condition, SMS notification is sent to user. This assists user to manage the water demand with municipal water supply system. Simply, the reservoir tank and tank of interest holds no any communication.

II. DISCUSSION

Overall system runs on battery power and comprises of four sub circuits working synchronously; sensor circuit, controller circuit, SMS circuit and relay driver circuit. Sensor senses the level of the water in tank which is continuously fed to controller system. As the system encounters the empty level (A_0) condition, status of load shedding is checked. Relay coil is energized and the pump operates when there is no load shedding. SMS is only delivered if status of load shedding is encountered by the controller. Pump stop when the tank is full (A_1). Figure 1 shows the flowchart of the system.

A. Sensor circuit

Water being good conductor of electricity, conductive sensor was found to be appropriate choice for the system. Two levels are checked; A_0 and A_1. This system is powered by 12 V battery. Voltage divider in the circuits delivers voltage of 6 V as an output to the Arduino. Figure 2 shows sensor circuit.

B. Controller circuit

Arduino Uno, an open-source electronics, was used as controller of the system [1]. The program was developed in Arduino development environment and was burned to the microcontroller. Digital pins 2 and 3 were used for serial communication with the cell phone (Motorola c261), pin 8 and pin 9 for connection with sensor output A_0 and A_1 respectively and pin 7 for indicating status of pump.

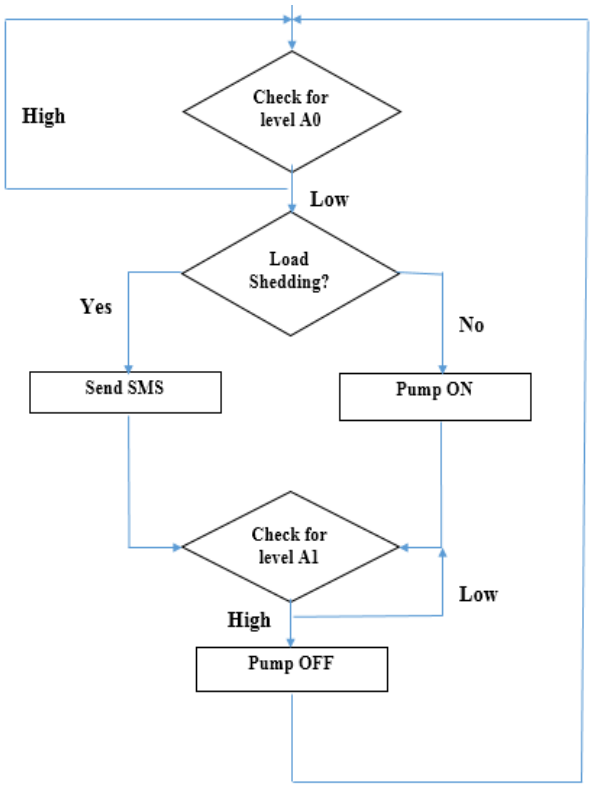

Figure 1: Flowchart of the system

C. SMS circuit

Unlike many cell phones, Motorola c261 model supports serial communication with headset plug i.e. with 3/32 mini stereo jack [2]. Moreover it supports AT commands which can be used for Global System for Mobile **(**GSM) control system. The pin layout with their functions and code representation for Arduino is shown in Table 1. AT commands used in the system is shown in Table 2 [3].

D. Relay driver circuit

Figure 4 shows relay driver circuit using the NPN transistor BC548 with forward current gain (H_{fe}) of 110 [4]. The 12V relay (JQC-3FC/T73 model) was connected between the collector and positive rail of the transistor. The relay can handle the pump with rating of 220 V ac with maximum current of 7 A. 470 uF electrolytic capacitor was added at the base of transistor to avoid clicking of relay. Moreover clean switching of the relay was obtained. Another 470uF capacitor is added parallel to the relay coil. Steady current was maintained through the relay coil to avoid relay clicking during momentarily variation of signal.

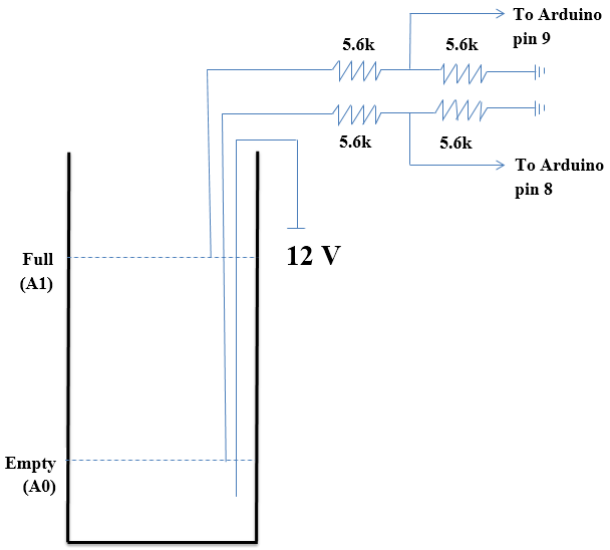

Figure 2: Sensor circuit

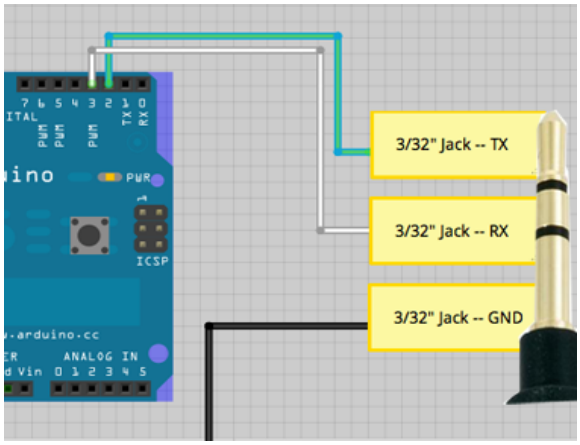

Figure 3: 3/32 mini stereo jack connected

IN4007 diode protects the transistor by eliminating back e.m.f when the relay switches off [5]. LED indicates status of the relay. Value of resistor R_1 was calculated to 13.5 kΩ for base voltage (V_b) of 5 V, supply voltage (V) of 12 V, 0.7 V of transistor biasing and relay resistance(R) of 350 Ω. But R1 was set to 1 kΩ to pull collector to ground as transistor goes in saturation and to achieve effective switching. Figure 4 shows relay driving circuit.

$$\text{Relay current (I)} = \frac{V}{R} \qquad \text{Equation 1}$$

$$R_1 = \frac{(V_b - 0.7) \times H_{fe}}{I} \qquad \text{Equation 2}$$

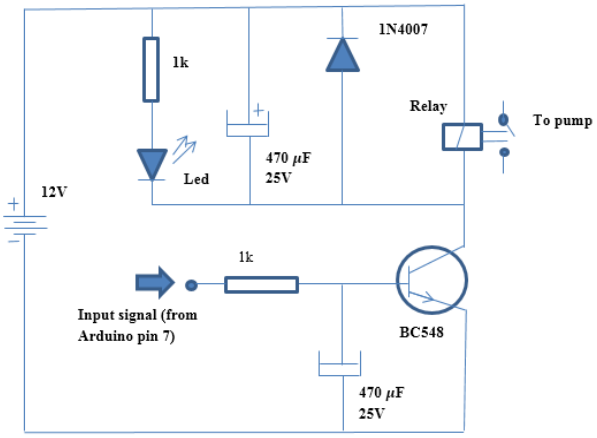

Figure 4: Relay driver circuit

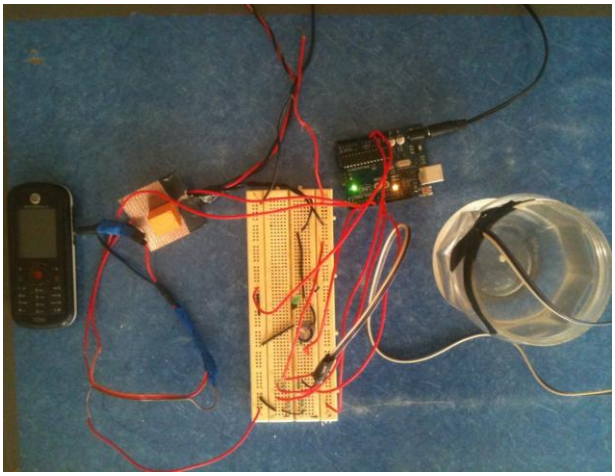

Figure 5: Working system

Table 1: Pin layout, function and code representation for 3/32 mini stereo jack

Plug	Function	Represented in code
Sleeve	Ground	NA
Ring	Phone TX/Arduino RX	SSerial2Mobile(<Arduino pin>,X)
Tip	Phone RX/Arduino TX	SSerial2Mobile(X,<Arduino Pin>)

Table 2: AT commands used in Arduino

S.N	Code	Function
1	mySerial.println("AT");	Wake up cell phone
2	mySerial.println("AT+CMGF=1");	Put phone into SMS mode
3	mySerial.println("AT+CMGW=\"+977984162**99\"");	Creates new message to user number
4	mySerial.print("tank is empty");	Message contents
5	mySerial.write(byte(26));	Signals end of message
6	mySerial.println("AT+CMSS=1");	Sends message at SIM index of 1

III. CONCLUSION

The automatic water level controller is Smart system as all processes occur automatically with continuous updates by controller, to the user, via GSM technique i.e. SMS Notification. This system is deprived of any sort of noise and has effective switching action. To widen the application to this project work, security home alarm system can be matching application. The automatic water level controller system can be used in home, office sectors, swimming pool and even in industrial areas. As mentioned earlier there is no link between reservoir tank and tank of interest; henceforth, communication between the two can take this project to another level. Furthermore, extra care needs to be given as water is used as conducting media. Moreover, GSM module can be replacement to cell phone. The system also can be modified to two tank system with wireless communication between tank of interest and reservoir tank. All in all , despite being the smart system there are many rooms for improvement, which when considered, this system can be more smart ultimately user being smarter.

ACKNOWLEDGEMENT

In the process of inquisition on this very topic, we have dependent on countless acts of support, generosity and guidance. But perhaps more importantly, the challenges, this research demands. We take this as an opportunity to thank all the intellects, teachers and friends who one way or the other has contributed for this project. We are thankful to Dr. Bim Prasad Sherstha for supervising this project. We owe huge debt of gratitude to the department of Mechanical Engineering, Kathmandu University. We would also like to acknowledge Shweta Dahal, Anil Tiwari, Bhoj Bahadur Chaudhary, Sumitra Rayamajhi and Nukesh Jung Tiwari for their support in carrying out the project.

REFERENCES

[1] "Arduino Uno," Arduino, [Online]. Available: arduino.cc/en/Main/arduinoBoardUno. [Accessed 22 12 2013].

[2] Motorola, "Motomanual, C261 GSM," [Online]. Available: https://motorola-global-portal.custhelp.com/euf/.../Manuals/C261_US.pdf. [Accessed 19 10 2013].

[3] "Developer's guide, Motorola c 18 AT Commands," 2005. [Online]. Available: harvestelectronics.com/harvest/.../c18%20at%20commands%20guide.pdf. [Accessed 21 11 2013].

[4] P. Semiconductor, "Data Sheet, BC546; BC547; BC548 NPN general purpose transistor". Netherlands 04 march 1997.

[5] D. Icorporated, "Rectifier, 1N4001 - 1N4007," [Online]. Available: www.diodes.com. [Accessed 05 01 2014].

AUTHORS

First Author – Sanam Pudasaini, Final Year Undergraduate Student, Department of Mechanical Engineering, Kathmandu University, Nepal, email: Sanam.pudasainee@gmail.com
Second Author – Anuj Pathak, Final Year Undergraduate Student, Department of Mechanical Engineering, Kathmandu University, Nepal, email: Anuj.paathak@gmail.com
Third Author – Sukirti.dhakal, Department of Electrical and Electronics Engineering, Kathmandu University, Nepal, email: Sukirti.dhakal@gmail.com
Fourth Author – Milan Paudel, Final Year Undergraduate Student, Department of Mechanical Engineering, Kathmandu University, Nepal, email: Milan.paudel1992@gmail.com

Corresponding Author – Sanam Pudasaini, Sanam.pudasainee@gmail.com, +977-9841628699