Liquid Level Monitoring System

Sandesh Sharma

ssharm53@binghamton.edu

Binghamton University

ABSTRACT

It is a very difficult and tedious task to manually monitor the level of liquid in a container. Sometimes, there might be some harmful chemicals in the container which may cause various health hazards. Also, the container might be sometime in a remote location, so a person must visit the location every time to monitor the level of liquid in a container. This paper proposes a solution called a liquid level monitoring system which can constantly monitor the level of liquid in a container and send data to the remote android device. Ultrasonic sensor connected to the raspberry pi constantly monitors the level of liquid in a container. Android app is also developed to get the data from the raspberry pi and display it to the user. Hence, the user can see the level of liquid from the remote location.

1. INTRODUCTION

Liquid level must be monitored everywhere from home to various industries. In various countries, the water container is placed at the top of the house to supply water to the whole house. Hence, a person has to go to the top of the house (where the container is placed) and manually monitor the water level to refill the container with the water. Sometimes, the container is placed in the dangerous location, so various accidents might occur during the monitoring process. Also in industries, liquid levels must be monitored constantly. There might be harmful chemicals in the container which may cause serious health hazards. The container, sometimes, is placed in a location far away so a person must drive to the location to monitor the level of liquid which can be very time consuming.

Hence, a liquid level monitoring system solves all the problems that are mentioned above. If a person's job is to refill the container if the liquid level drops below a certain level, then he/she does not have to go to the spot and do it manually. An individual can just request the level of liquid to the remote server from his/her android device and only go to the spot if the liquid level drops below a certain level to refill the container. Finally, sometimes there might be some valuable chemicals in the container which might get stolen. So, this system also prevents the theft of liquid in the container by providing the level of liquid in the container to the end user.

2. SOFTWARE AND HARDWARE REQUIREMENTS

For the hardware requirement, following hardware components were used.

i) **HC-SR04 Ultrasonic Sensor.**

ii) **Raspberry Pi Model 3B**
iii) **Jumper Wires.**

For the software requirement, there are two components

i) **Back End Component (raspberry pi python server)**
ii) **Front End Component (Android Application)**

The Back End component of this project was coded in python. Thonny Python Editor was used as an IDE to write the python code.

Similarly, the FrontEnd component of this project constitutes an Android application. Android Studio was used as an IDE to write the Android application. Java was used as a programming language to develop the application.

3. SOFTWARE DESIGN AND ARCHITECTURE

As it is mentioned already, this project has two components front end and back end communicating with one another. Besides that, there is also an ultrasonic sensor, that is connected to raspberry pi. Figure below depicts the architecture of the system.
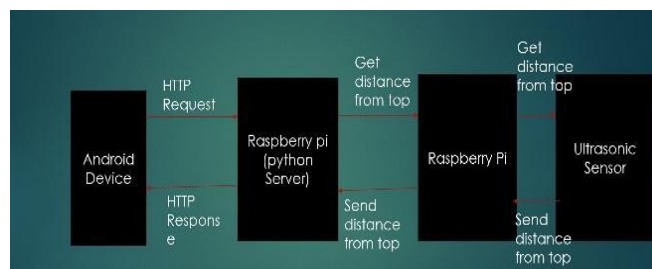

Figure 1: Architecture of Liquid Level Monitoring System.

The Android device which is the front end for this project sends the HTTP request to the raspberry pi (python server). The Raspberry pi python server, constantly listening for any incoming request, receives the request from the android device. Now, the raspberry pi python server sends the request to raspberry pi for the distance of liquid from the top of the container. The raspberry pi uses an ultrasonic sensor to get the distance of the liquid from the top of the container and sends back the data to the raspberry pi python server. The raspberry pi python server sends the response back to the Android device. Now, the Android device converts the distance to the percentage using the formula below.

Total Percentage of liquid filled = ((total depth – distance of liquid from top)/total depth) * 100

Finally, the android application displays the result back to the user.

4. IMPLEMENTATION

When the android application is started, at first the Main Activity is launched as shown in the   figure below.
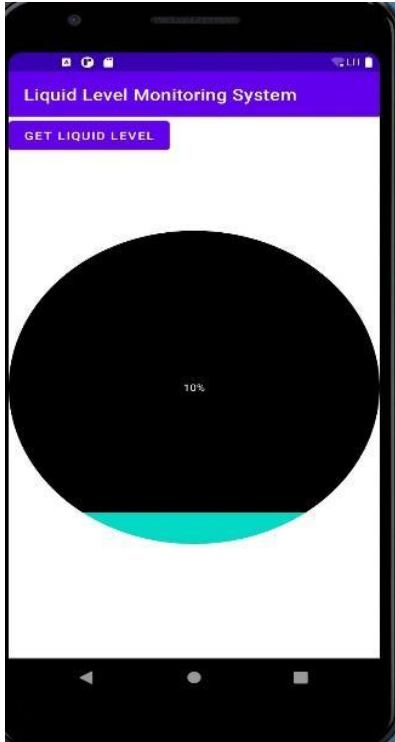

Figure 2: User interface For Android Application.

When the user presses the button GET LIQUID LEVEL a new method is executed in the background so that it does not block the main activity. That method sends the HTTP request to the Raspberry Pi python Server and when it gets the data back, a call back method which is in main activity will be called. So, inside that call back method the GUI for liquid level display is changed and it shows the correct liquid level.

Now comes the backend part, the raspberry pi python server. A python server is started in a raspberry pi using the ip address and port number for the android device to connect. When the raspberry pi receives the connection from the android device, it measures the distance of the liquid from the top of the container using the ultrasonic sensor.

Below is the logic to measure the distance from the ultrasonic sensor.

```
while GPIO.input(ECHO)==0:
    start_time = time.time()

while GPIO.input(ECHO)==1:
    end_time = time.time()

total_time = end_time - start_time

distance = total_time * 17150
```
Fig 3: Logic to measure distance from ultrasonic Sensor.

So, at first, the total time taken for the ultrasonic wave to reach the liquid level and come back is calculated. The total distance is measured by multiplying the total time with the speed of the ultrasonic wave. Since the speed of ultrasonic waves is 34300 cm/s it is divided by 2 which is 17150, since ultrasonic waves must reach the liquid level and come back.

5. EVALUATION

The ultrasonic sensor has an error rate of +- 4 cm. The evaluation can be seen in the demo video. Initially the level of liquid is 46% which was manually tested and was 100% correct. Then some water is poured into the container and then the level of liquid was measured to be 61%. Finally, some more water was poured and then the liquid was almost full and was measured to be 84%. An alert message was displayed since the water level was more than 80%. Because of the error rate of ultrasonic sensors, sometimes the percentage of liquid filled is slightly more or less than the actual percentage.

6. CONCLUSION

Monitoring the liquid level can be very difficult at times because of various reasons. It might cause a dangerous accident or a serious health hazard depending upon where the container is placed and the type of liquid in the container. The liquid in the container might also be stolen because of not tracking the level of liquid in the container. This project solves all the above problems with the help of "Liquid Level Monitoring System". The Liquid level monitoring system consists of an android application which displays the level of liquid in the container which is placed in the remote location. It can also prevent theft because the user knows from the remote location if there is significant deduction in the level of liquid. Hence, this project can come handy to people who must monitor the level of liquid constantly.

ACKNOWLEDGEMENT

REFERENCES
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