WATER LEVEL INDICATOR

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Abstract

When researching daily applications of circuits, we searched for a circuit that will be feasible to build within a month time and incorporate many aspects that we learned in class. After researching many circuits, we decided to look closer into a circuit that measures the water level in a container. Using P-Spice we will be able to design a water level indicator that will use transistors, resistors, a rectifier, a transformer, LEDs, and a sound buzzer. The transistors in our circuit will be used as switches. The resistors in our circuit will be used to lower the voltage going into the transistors and LEDs. The rectifier is used to convert the voltage from the transformer from AC to DC voltage. The LEDs are used to indicate the water level in the tank. The sound buzzer will be used to indicate when the tank is full.

Introduction and Background

Science and Inventions are making our daily lives so effortless. Many of the electronics that we use today consist of some type of circuitry, which most of the time, we overlook this and take many of the devices we use for granted. As such, Water level Indicators employ a simple circuit to detect and indicate the water level in a container or a tank. We will be looking further into water level indicators used in overhead water tanks which can be found in many homes today. The idea of this project is to measure the level of water in a tank without any means of manual measurement. In the past, John R. Gomersall invented a way to detect the water level in non-transparent coffee makers. Thus the idea came to be useful way to detect the water level of an overhead tank in homes. There are many different types of water level indicators available on the markets which involve much more complex circuitry and complexity. For instance, automatic water level indicators are an advanced microcontroller based device which can detect not only the level of water, but can also power on and off of the water pump by using a sensing device. In order to stay with our original motivations for this project, we had to avoid the complex water level indicator circuits. Therefore, we were able to finish before the deadline. Many of water level indicators work in a similar fashion as the one we have built.

Problem Formulation

Our main motivation for this project came from the many instances where people have overfilled some sort of tank because they could not see into the tank. We had two main goals for this project; the first was to decrease the amount of water overflow of a tank as well as make it more convenient for someone to fill up their water tank without the need for manually checking. This water level indicator will not only tell you the level of water in the tank, but it will also alarm you when the tank is full. After much research, we were able to come up with a circuit design to accomplish our goals and understand each component that went into our design.

Methodology

First, we had to come up with a power source. Normally, a device like this will be plugged into a wall outlet, but this would require a bridge rectifier converting an alternating current to a direct current. This will also require a filtering capacitor bring the voltage from the wall outlet to down to the desired voltage. This would have been much more complicated for us to complete, so instead, we used a simple nine volt battery as our power supply giving us our desired nine volts as well a direct current. Next, we needed a component which could indicate to us where the water was in our container. The most simple and obvious component for this would be a light emitting diode (LED). We then needed a way to switch the LED back a forth between off and on. In order to do this, we used a transistor allowing current flow to the LED only when the transistor was provided a certain voltage. We then needed a way to provide the transistor with the desired voltage. To do this, we used the conductivity of water. We took one wire from the power source and placed it along the inside of our water tank. We then used several leads and placed them along the inside of our water tank varying the location of the leads which corresponded to the different levels of the container. The final step in our design was to come up with a way to notify the user when the tank was full. To accomplish this, we used a simple buzzer which would turn on only when the final LED would also turn on. The final design of our circuit can be seen in Appendix A.

Components

Our circuit required some components which were easy to understand. This includes a battery, switch, buzzer, and resistors. The battery is simple enough; it provides our circuit with the desired voltage and a direct current. The switch is also simple in that, it will stop or start the voltage and current flow from the battery to our circuit. The buzzer is connected to our last sensor so when it is provided with a voltage and current, it will in turn emit a sound tone. Another simple component in our circuit is the resistor. All this does is, allow us to manage how much voltage is moving from one point to another within our circuit. Our circuit design also required some components which we did not learn about during the lectures or labs and are slightly harder to understand. The first is the light emitting diode, also known as an LED and the other is the transistor.

LEDs can be found everywhere in our daily lives including flashlights, traffic signs, lamps, and many more; but how many people know how an LED works? An LED is a basic semiconductor containing two types of material, which when put together, create a diode. One side of the diode contains positively charged carriers called holes and the other contains negatively charged carriers called electrons. When a current source is connected to both sides of the diode, the holes are forced to move in one direction and the electrons are forced to move in the opposite direction, in turn, forcing them to combine with one another. When these carriers combine, they will emit a photon into the air which we perceive as light. We are able to accomplish this in our circuit, because on leg of our diode is receiving a current from the power source and the other leg is receiving a current from our transistor.

Transistors are another key component in our everyday lives which people tend to overlook. Transistor can be found in almost every electronic device that you use including cell phones, computers, flashlights, and pretty much anything electronic. Transistors come in all different shapes and sizes, but they all function in a similar way. One of the most common transistors is the PNP transistor which contains three prongs, the collector, base, and emitter. The initial state of a transistor is off, where there is no current flowing through it. In order to turn the transistor on, you have to provide a voltage to the base prong. By doing this, it allows current to flow from the base to the emitter. By having a current flow from the base to the emitter, the transistor will in turn, allow an even larger current to flow from the collector to the emitter. This is perfect for our circuit because we will need to provide our LED with a current only when our leads are sending a voltage into our circuit.

Challenges

There were a few challenges we ran into while researching and building our circuit. The first problem we faced was the lack of needed supplies in the supply closet. We were easily able to compromise for the resistors by placing a few resistors in series until we got our desired resistance. As for the other components, we simply went to Radioshack to purchase the missing components. Another challenge we faced was what to use as our leads and how to implement them. Initially we stuck them into the side of the cup, but as you might expect, the wires did not provide a good enough seal, causing the cup to leak. We tried solving this by putting electrical tape over the holes, but the water still found a way to escape from the cup. Our final solution to this was to tape our leads to the inside of the cup. We ran into one final challenge which was the simulation for our circuit. Since PSpice did not have a way to simulate an LED, we had to look for other programs that are able to do such a simulation. Thankfully, we stumbled upon a program that was able to do such a simulation called, EveryCircuit. Using EveryCircuit, we were able to simulate the LED lighting up with a corresponding water level. This simulation can be seen in Appendix B.

Conclusions

A water level indicator is a direct application of what we have learned in circuit analysis and has also strengthened some of the concepts we learned. Not only did this project reinforce what we learned, but it also introduced us to concepts beyond what we have studied.

References

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[4]. "EveryCircuit." *MuseMaze, Inc*. 2015. Web. 28 Nov. 2015. <http://everycircuit.com/>.

Appendix A

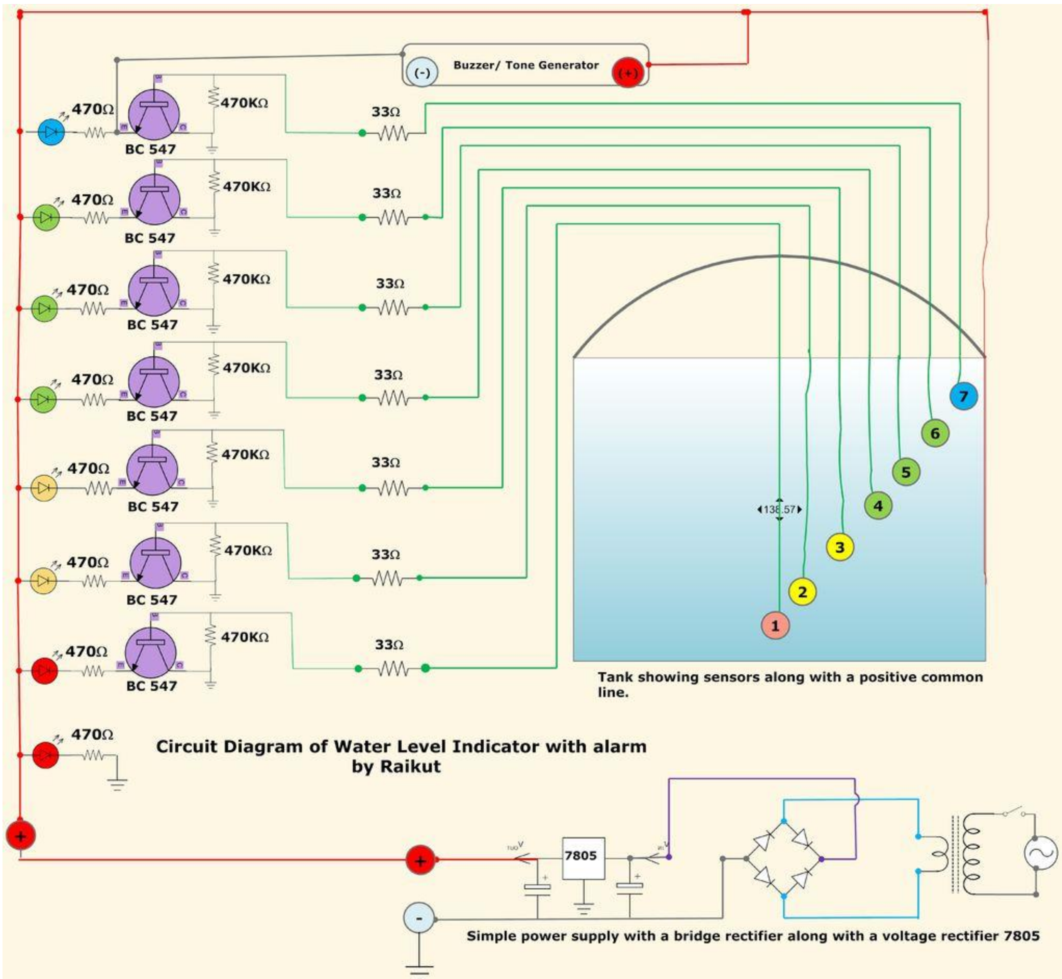

Figure 1: Schematic of Water Level Indicator

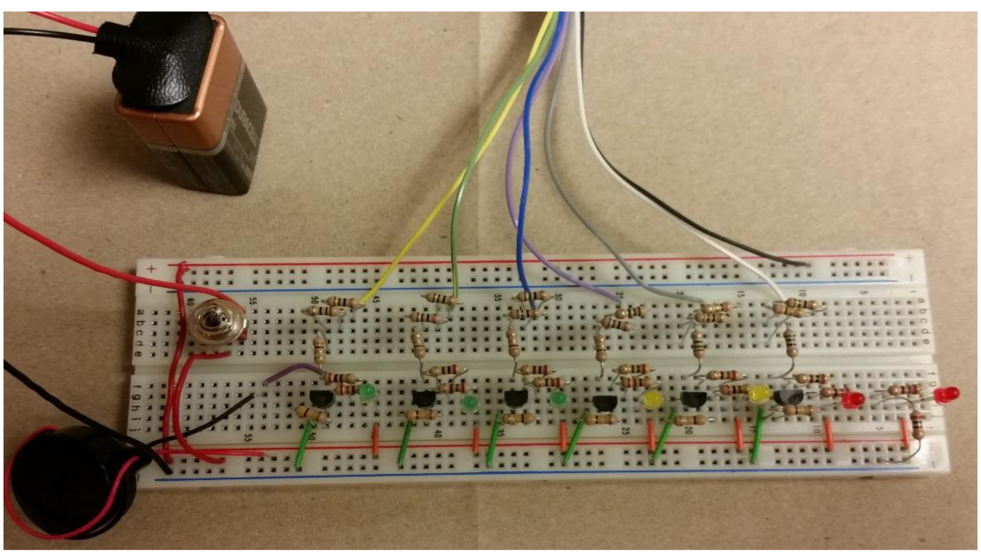

Figure 2: Built circuit of Figure 1

Appendix A cont.

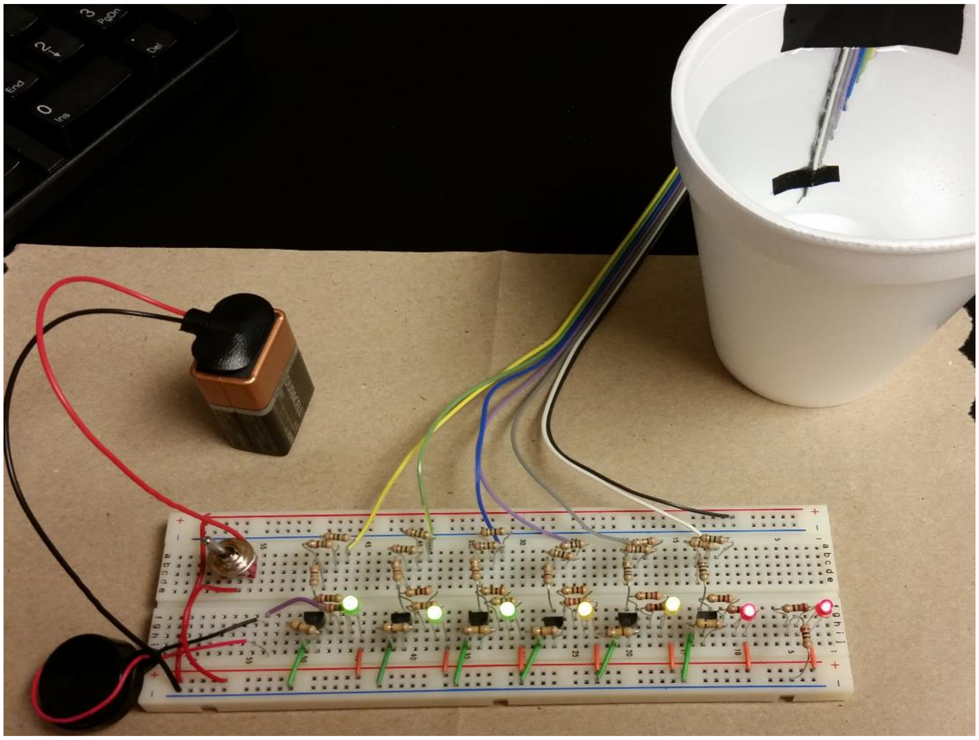

Figure 3: Working circuit of Figure 2

Appendix B

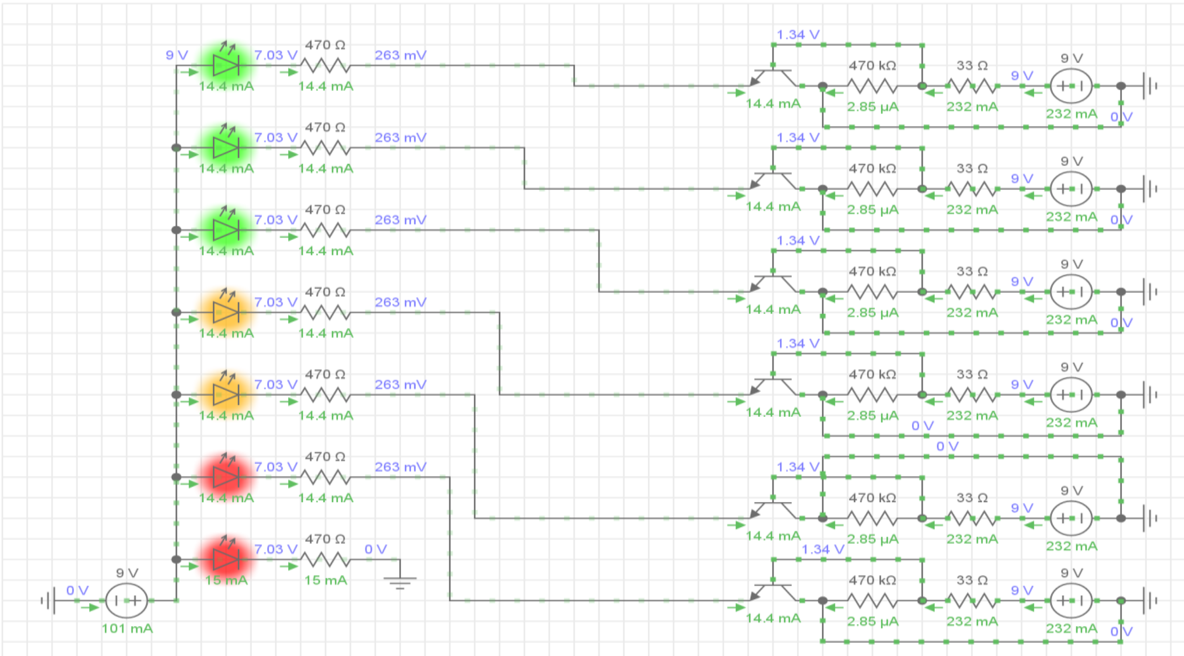

Figure 4: Simulation using EveryCircuit