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Industrial Technology 251
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A Water Level Meter

Inspiration

The water tank for Peggy Minclier's residence is on the fifth floor of the water tower. The level of the tank is determined by either climbing the ladders to the fifth floor and knocking on the tank or waiting for the sound of overflow trickling down the side of the house.

Design

To improve the tank level measurement techniques at Peggy's, I decided to build an electronic water level meter. I found designs online at the website of Nathan Hurst, a graduate student at Monash University in Australia. The design uses a capacitance probe technique commonly used to determine levels of tanks containing hazardous materials.

The general layout of the circuit is visible in Figure 1. The Oscillator drives the Timer. The Timer measures the length of time required to charge the probe. The signal from the Timer is passed through a Low–pass filter to get rid of any noise. The Low–pass Filter is more useful in high speed situations where the meter is measuring waves. For the water tank, the slowest possible measurement is fast enough. The signals from the Timer and the Oscillator are buffered and passed through the Comparator which outputs voltage proportional to the similarity of the wave forms.

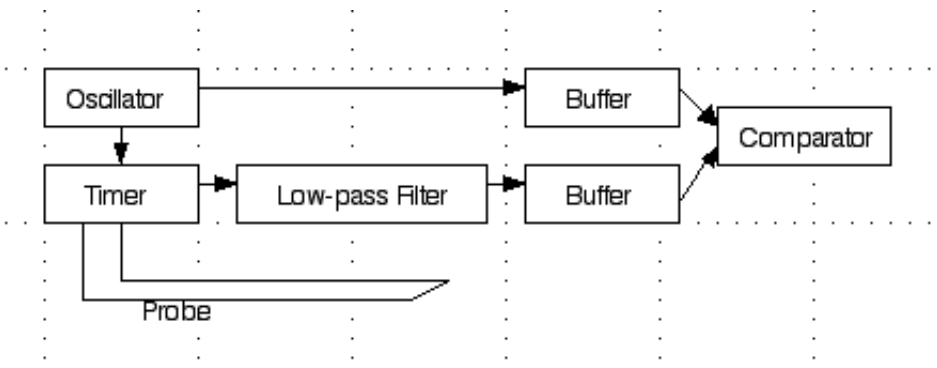

Figure 1: A block diagram of the Water Level Meter.

The schematic for the circuit was provided but required some calibration before use as shown in Figure 2. The resistor, R12, must be set so that the pulse width of the timer at the maximum water level (maximum capacitance) is slightly less than the period of the oscillator. The schematic also indicates that Vcc be +9V, +12V, or +15V but since I used some lower power ICs, I was able to use only +5V.

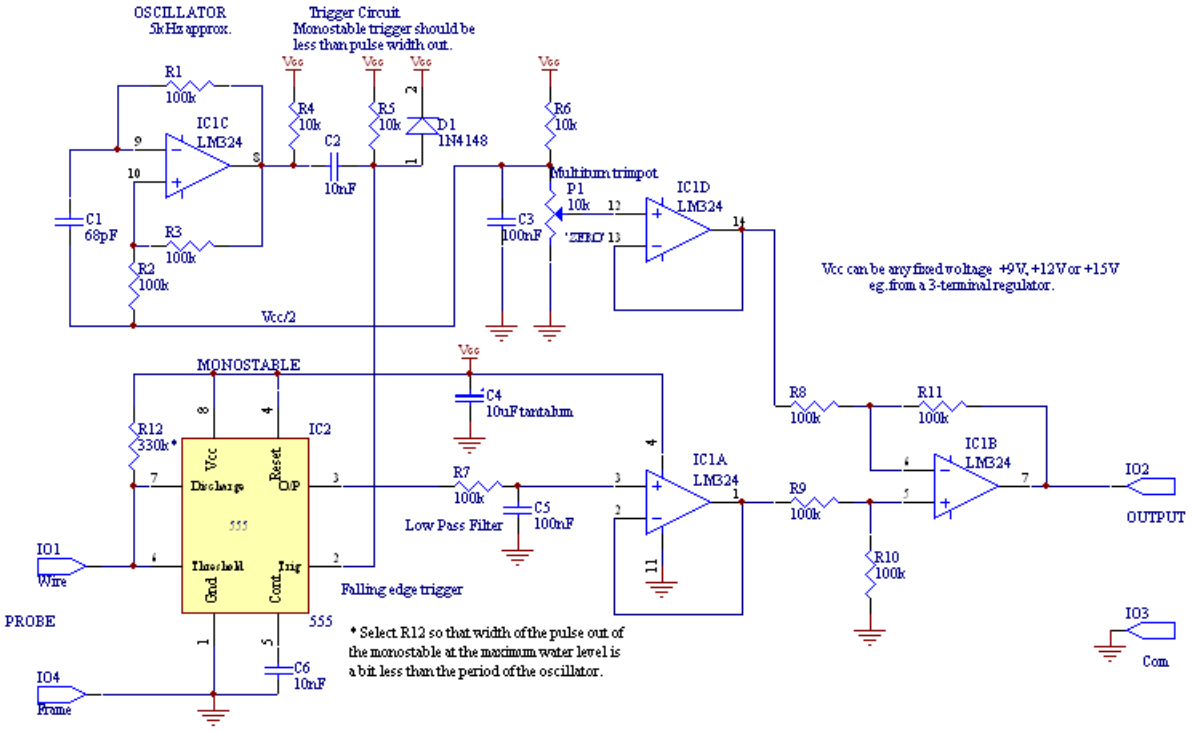

Figure 2: The schematic of the circuit. The oscillator, two buffers, and comparator all use op–amps on the same chip, a quad LM324CN.

Circuit Construction

I simulated the circuit using Multisim and calibrated the resistor, R12, for the timer. The circuit simulated perfectly. I assembled most of the circuit in one day; a big mistake which lead me through a long string of messy situations. In fact, I have yet to get my circuit working at all.

The prescribed oscillator is a "quick and dirty" oscillator built using capacitors, resistors, and an op–amp. After a lot of work, I got the oscillator working on a breadboard but have yet to get it working on my wired circuit board. I also got the timer working on a breadboard while using two pieces of copper–plate as the 0 to 100 pF capacitor and a frequency generator for the trigger. However, I could not get the oscillator to drive the timer. For this reason, I have decided to build a more accurate oscillator using an additional 555 chip.

Conclusions and Reflections

I burnt out this term. I am aware that this report is of very poor quality and am equally aware that my project, in it's unfinished state, may not be passing material. I will accept the grade given for this project. I will finish the circuit on my own time as I have with other circuits. I enjoyed the laid–back nature of this class. I found the material valuable but was too burnt to get out of it what others may have.

Improvements

I will be finishing this project over the summer. It is the second in a slough of projects I am doing at Peggy's house to (1) improve her and my Dad's quality of life and (2) to get practice for all the improvements I will someday be doing to my own house.

PTFE Wire

A wire is run the depth of the tank and connected to a timer. The wire is treated as a capacitor where the conductor is one plate of a capacitor, the insulation is the dielectric, and the water in the tank is the other conductor. The capacitance of the wire is proportional to the height of the water. While the probe would not work for pure water, it is practical for Peggy's water tank which holds groundwater pure enough to drink but impure enough to work for capacitance. My search for PTFE wire has taken me to Britain where I found it in 50 USD spools.

LED Display

The output of the system will be wired to a small 10 LED array. The water tank is approximately eight feet deep so one LED will remain on when the tank is empty, one LED will not be used, and the other eight will indicate how full the tank is.

Solar Powered

In the interest of keeping the system autonomous, my Dad wants to install a small solar panel to keep a small battery charged. This will be very easy to do once the rest of the system is functional.