Introduction

In today's world, we are more connected than ever before. Because of the internet and smartphones, we have essentially shrunk the Earth, a phenomenal known as time-space compression. We can communicate with others on the other side of the planet almost instantly. This same technology can be used with our devices to communicate with each other which often referred to as the Internet of Things. This level of communication is most commonly found in sensors that are battery operated. This means these sensors are only good for while the battery lasts and are limited by that. [1] However if you could turn off a part of the sensor or put it to sleep while not using the sensor and only have it active when recording data, you would extend the life of the sensor.

Approach

The sensor in our situation was a pressure sensor that used a cell radio to send that collected data back. The Arduino which is hooked up to all the sensors uses most of the power and the circuit was only going to be used to measure every fifteen minutes. This means that the Arduino will spend most of its energy idling. On previous tests the battery which powered the circuit died in less than a day which was too short to be of use. A solution like this could be normally powered by using Wi-Fi however the Arduino uses 3.5V to 5V and Wi-Fi for the moment is limited to using only 1V [2]. This means we would have to figure out a way to reduce power by shutting of the Arduino when It was not being used. Here we first used a MOSPHET but then quickly moved on to a timer.

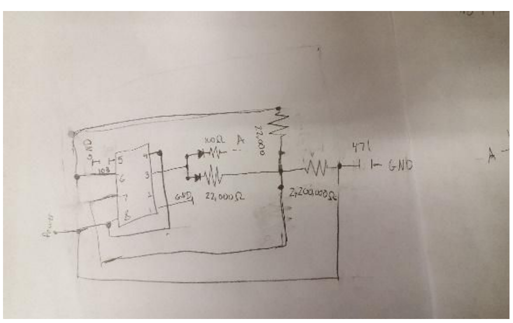

Figure 1. The first schematic for the timer circuit.

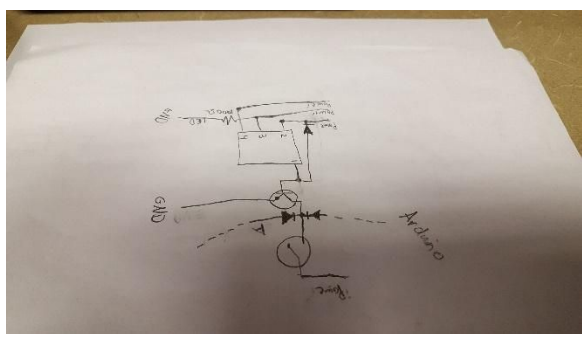

Figure 2. The first schematic for the relay circuit.

Experiment

The first task was to set up the 555C timer chip which would control when the Arduino turns on by sending power to it. Next the Arduino had to be set up in a way to wake up when the timer triggered it and then turn off (low power mode) after the time had expired. A primary solution dealt with using a transistor and a relay to turn the Arduino off. However, it turned out that the relay by itself was more than enough to accomplish this goal. The relay in question was a double coiled double pole double throw latching relay. To have the relay be work we set the ground end of the Arduino on the normally open side and an output pin on one of the coils so when the Arduino sent out a signal it flipped the relay to the normally open side breaking the circuit and turning the Arduino off. The timer chip was hooked up to the other side of the relay in a mirror fashion. When the timer went off the it triggered the relay to return to its normal state turning the Arduino on again.

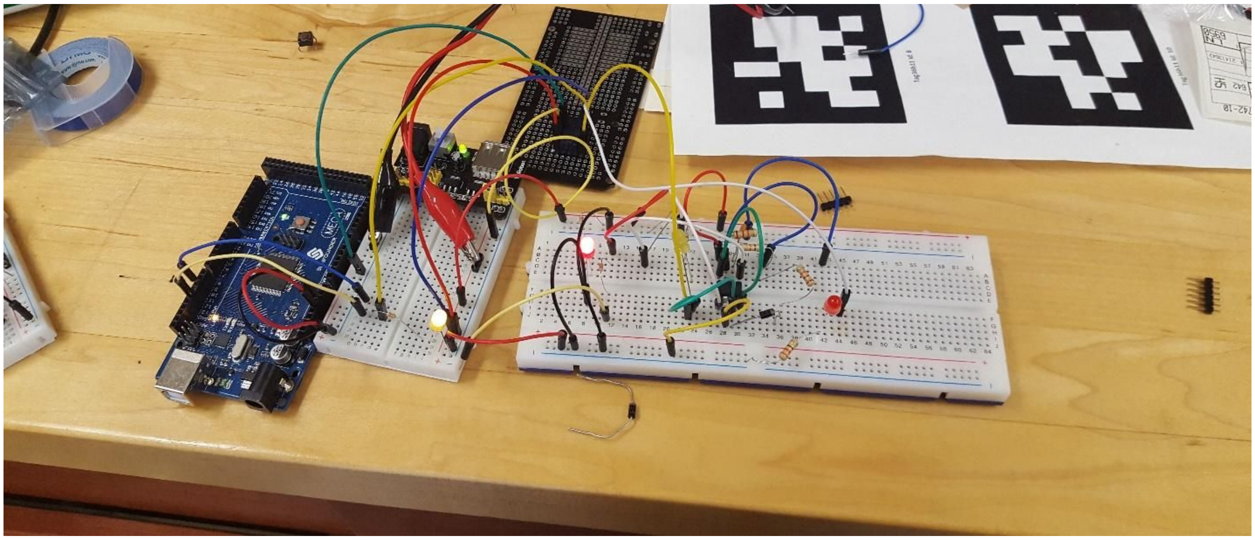

Figure 3 The final circuit with the Arduino side turned on (yellow LED) and the timer off(RED LED that is unlit). The lit red LED means that there is power in the circuit.

Analysis and Conclusion

A problem that arose from this was the that if the Arduino side was on then the timer could do nothing to turn it off and vice versa. This meant that one had to switch off before the relay could switch sides which was not useful for solving the task because if the two sides went out of sync the battery would die quicker or the data would not be collected for some cycles. Another problem was dealing with the duty cycle of the timer. The duty cycle kept the timer on for half the programs time which meant that unless this duty cycle was lowered for 7.5 minutes the circuit would still be using power. While this is a 50% improvement it is still 435 seconds of wasted energy while the two remain somewhat in sync A proposed solution was to wire the left coils together and then separately connect the right coils together. This should make the relay more like a switch where the last side which sends a pulse controls the direction of the relay.

Citations

[1] Sai V. and Mickle M, "Exploring Energy Efficient Architectures in Passive Wireless Nodes for IoT Applications" in IEEE circuits and systems magazine (Second Quarter 2014).

[2] Talla V, Kellogg B, Ransford B, Naderiparizi S, Smith J, and Gollakota S, "Powering the Next Billion Devices with Wi-Fi" in Communications of the ACM Vol. 60 | NO. 3 | (March 2017).