Senior Project ~ Electrical Engineering ~ 2020

Smart Tennis Net Using RF Wireless Power

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Advisor ~ Professor Hedrick

INTRODUCTION:

- Radio frequency (RF) energy harvesting is when collected electromagnetic energy is turned in a continuous voltage
- The use of energy harvesting to power low powered sensors would eliminate the need for electrical wiring as well as be energy efficient
- RF harvesting is extremely difficult at long distances because it is limited to how much ambient energy is in the surrounding atmosphere
- Using wireless power transmission can help assist energy harvesting by providing an additional source of power
- With the ability to harvest enough RF energy to power a motion sensor, I would be able to build a system that can track how many times a tennis player hits a ball over a net in a rally
- If a player can simultaneously keep track of how consistent they are in a point while performing at their best, they would be able to record and improve their tennis ability

DESIGN REQUIREMENTS:

- Minimum of 3 volts out to power a PIR motion sensor
- Frequency around 145 MHz
- Only can use available electromagnetic waves
- System must not get in the way of the people playing tennis when in use
- Weather resistant

CURRENT DESIGN:

- A picture of my current transmitter and receiver is shown below on the left
- A picture of the circuit on the receiver is shown below on the right

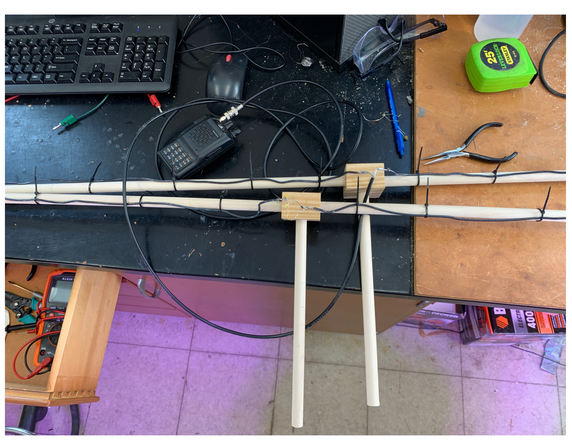

Figure 3. Transmitter and Receiver

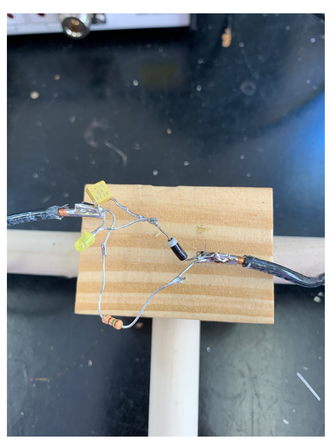

Figure 4. Receiving Circuit

- Figure 4 doesn't have the doubler or storage component yet
- A LED is being used as the load until the PIR motion sensor comes in

DESIGN:

- The design to power the PIR motion sensor is shown below

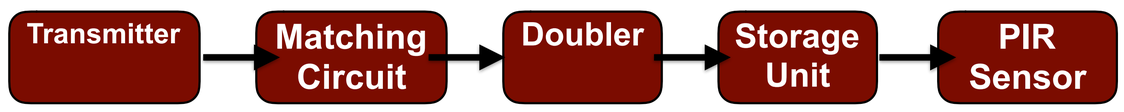

Figure 1. Block Diagram of RF Harvester

- The transmitter uses a VHF FM transceiver that is powered at 5V
- The matching circuit consists of one 68 ohm resistor
- The doubler consists of two 1N21C diodes in parallel with two 1nF capacitors
- The storage unit consists of a 1F super capacitor
- The transmitter and receiving circuit uses a half-wave length antenna to communicate
- The antenna is 3.2 feet on both the transmitting and receiving side

- A proposed schematic for the doubler and storage unit using a low pass filter is shown below

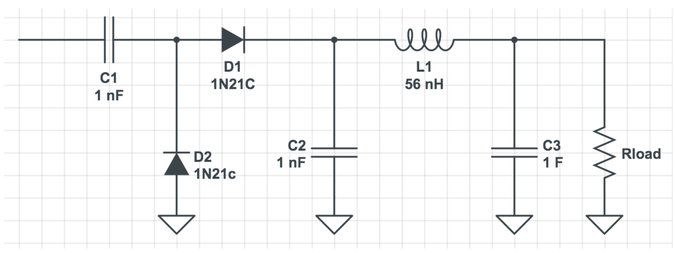

Figure 2. Proposed Doubler and Storage Unit

- The sensor would be attached to the net of the the tennis post

CURRENT RESULTS:

- The last few weeks were spent debugging the circuit because the LED was not receiving enough current
- This was fixed by shortening the antenna length
- The current circuit is getting over 2.7 volts at a distance of 2 feet from the transmitter

FUTURE WORK:

- Add in the doubler to get more voltage to the load at a further distance away
- Add a storage unit and low pass filter
- Replace the LED with a PIR motion sensor
- Display results of the system on a computer

ACKNOWLEDGEMENTS:

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