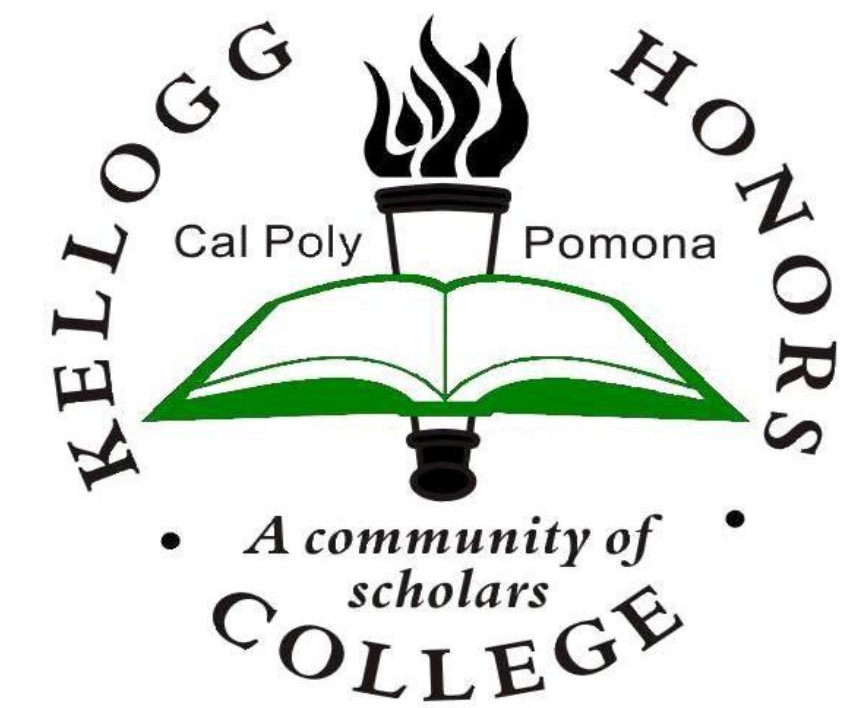# Remote Controlled Laptop

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Kellogg Honors College Capstone Project

Background

Wireless communication has been a point of interest and focus in electrical engineering since AM modulation was first developed in 1893, prompting further communication developments in the form of FM modulation, Cellular Communication, WIFI, Bluetooth, and the controversial 5G. Currently, Bluetooth communication is the standard for in-home laptop/smartphone device connection. However, Bluetooth communication has two setbacks: wavelength, and security. Firstly, $\lambda = c/f$, where λ is the wavelength, and f is the wave frequency. For Bluetooth, the operating frequency is 2.4GHz, while FM operates in the range 85MHZ- 500MHz. Noting the formula for wavelength, as frequency increases the wavelength decreases. Smaller wavelengths allow for more data to be transmitted in one period, but the overall distance the data can travel is significantly reduced. Bluetooth signals can only travel 30 feet. While FM can travel hundreds of yards since it has a smaller frequency and thus larger wavelength. Factories that implement wireless data feedback would benefit from FM communication since it can travel farther, without the need for a booster. The second setback of Bluetooth is the inherent vulnerability to hackers. This vulnerability is intrinsic to Bluetooth communication by design because Bluetooth is intended to be easily accessible by many devices in the nearby area. FM, on the other hand, can be easily encrypted. For these reasons, the Project utilizes FM communication, because of FM's adaptability for data encryption and travel length.

Design

Objectives:

Develop a remote capable of wireless RF communication, which speaks and can control a laptop. Furthermore the data transfer must support a future method of encrypting the data sent between the laptop and receiver to limit access points for potential hackers.

Procedure:

The Design was split into four phases in order to meet the specified objectives. First, the wireless communication portion, where a 433 MHz RF modulator/ demodulator and an HT12 encoder/decoder were used in the remote to transmit data. Second, a PIC 16F628A microcontroller was used to process the data and create the serial communication interface. Third, an RS-232 protocol chip was connected to the microcontroller's serial data pin to processes the serial data and allow for it be sent to the Laptop's serial terminal via Serial-USB converter cable. Lastly, the software aspect, where the laptop's serial terminal was used to store the incoming data to a dump file, which was then accessed and manipulated via batch code. The batch code runs among laptop startup and continuously searches the specified dump folder for strings of data. When the batch code finds a string match is empties the dump folder and turns the laptop off.

The most efficient way to ensure data security was to create a closed wireless circuit where information is only understood between the transmitter and receiver. Currently, the remote and receiver do not encrypt data, however, the closed circuit configuration will allow for an easy way to secure the data transfer. This is because a closed circuit transmission means that the receiver could only processes information after the correct Transmitter ID was first sent. Furthermore, an encryption key could be placed within the receiver so the data being transmitted is useless until the receiver processes and translates the data. For these reasons, a closed circuit communication was implemented.

The PIC 16F268A microcontroller was selected for two reasons: firstly because it has the potential for data encryption, secondly it can establish a serial interface. The microcontroller could be programmed to read data sequences from the decoder and if the decoder data did not match the specific id number associated with the encoder nothing would happen. Then even if the proper source ID was transmitted, algorithms could be embedded into the microcontroller's data processing pin which would serve as an encryption key. This would allow for data protection in the system if so desired. The microcontroller also has a UART Function which allows for data to be transmitted serially out of the microcontroller's serial pin. Which can then be processed by the RS-232 Serial protocol chip.

Schematics and Final Product

RECIEVER CIRCUIT

Transmiter Circuit

Final Product
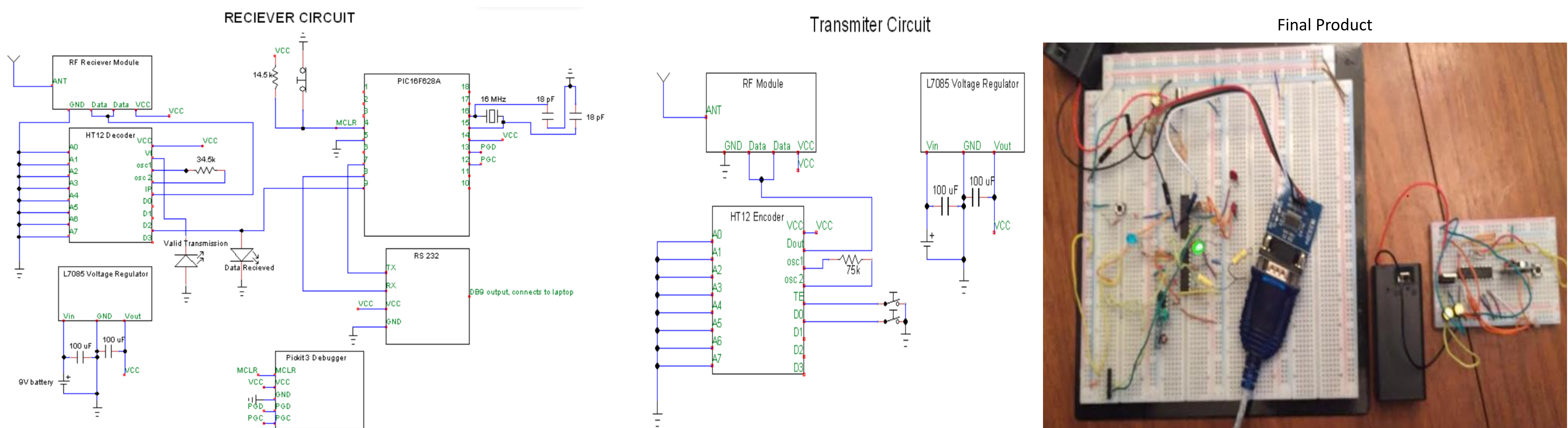
Results and Improvements

A 9-volt battery supply was passed through an L7805 voltage regulator to provide a steady 5 volt supply to both the microcontroller and the modulators. This power consumption provided a transmission range of about 10 feet. Which makes sense because Bluetooth consumes less power than FM modulation. However, if instead the 9 volts was applied to the modulators and demodulators the signal range would increase beyond the 10 feet with the 5 volts supply. The 5 volt supply was the minimum amount of voltage the modulators could operate with. For an even greater range, a series of transistors could be used to increase current and voltage to the demodulators/modulators. Secondly, if an RF modulator with a lower carrier frequency was used then the wavelength would be even larger than the 433MHz wavelength, naturally improving signal coverage.

The RS-232 chip converts the serial logic from the pic16F into a usable DB9 port, which is then converted to USB logic connectable to any computer. This feature is desirable since most systems speak serially, but serial logic connectors are obsolete. The last advantage of the serial communication protocol is that a dump file with all data values is created. This would allow a user built code to sift through the dump file and make a factory alert to any changes in specific parameters. For the purpose of the project, a batch script searches the dump file for a specific string, placed there when the button on the remote is pressed. When that string is read by the batch script the laptop is shut down.

As mentioned before the circuit does not encrypt, luckily an additional microcontroller can be added to the transmitter which would allow for data encryption. This second microcontroller could be a future additional improvement for the circuit. With the addition of the second microcontroller, the data would be encrypted rather easily, because of the preexisting closed circuit communication. Another improvement that could be made is the addition of a second RF modulator to the receiver circuit, and demodulator the transmitter circuit, establishing two-way communication between the laptop and the transmitter. This would be beneficial again in a control system since by allowing data to flow into the remote, and actions prompted by the data into the laptop.

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