

Electronics: Thermal Sensors and Operational Amplifiers

Final Presentation
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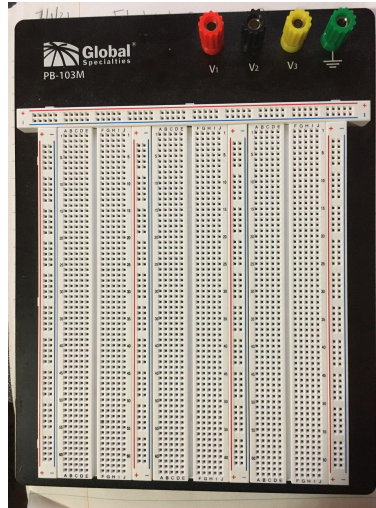
Goals

- Design and build a circuit that will play audio in response to receiving a signal from a laser.*
- Gain a fundamental understanding of the various components that play a role in the overall circuit.
- This project is meant to be an introduction to the field of Electrical Engineering.

* The project was changed to something different. It will be addressed in a later slide.

List of Components

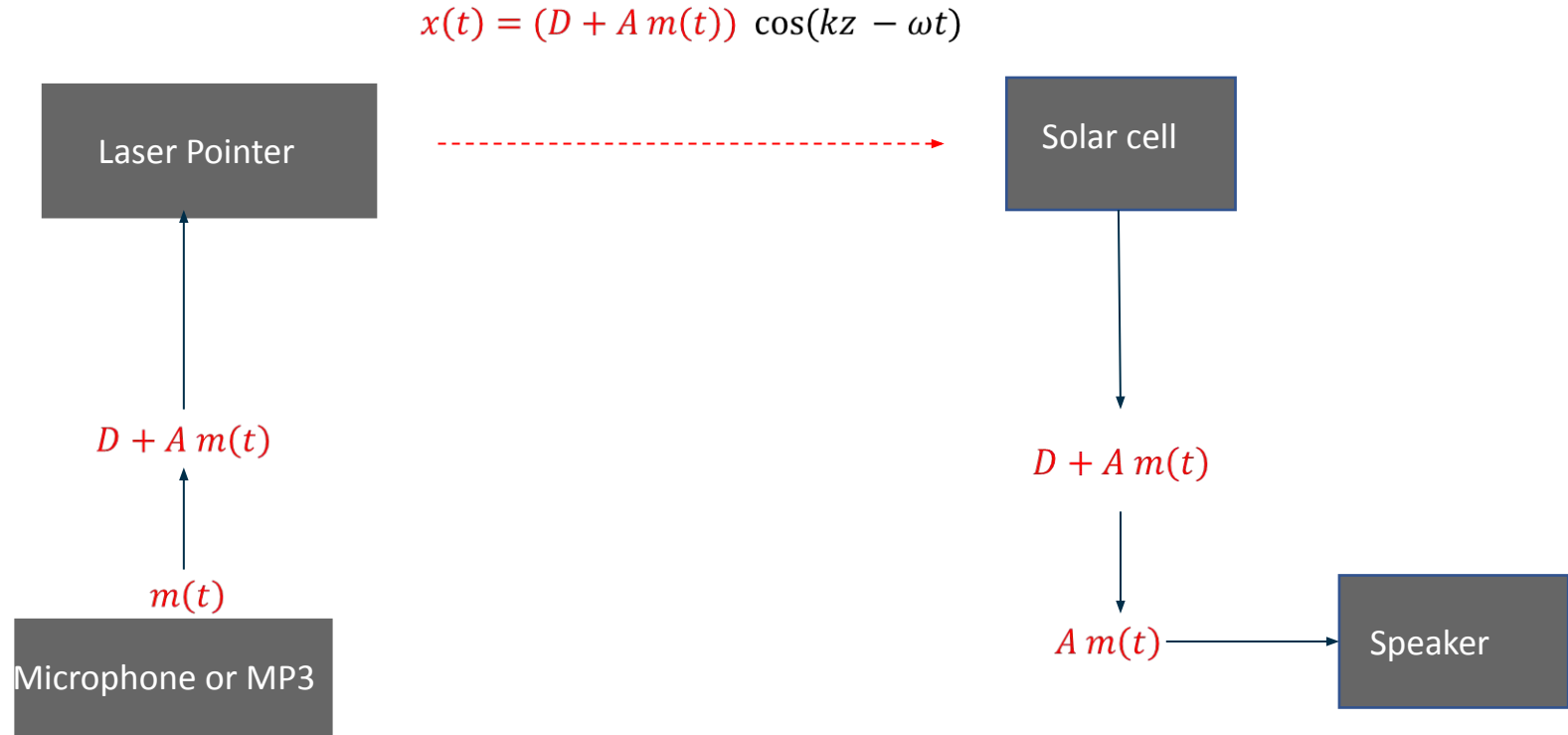
- Solderless Breadboard
- Set of jumper wires (connects different parts of the circuit)
- Photocell (laser input)
- Photodiode (converts light to electrical current)
- 9V batteries
- Various Capacitors
- Various Resistors
- Operational Amplifiers
- Different colored LEDs
- Multimeter
- Speaker (for audio output)
- Solar Cell



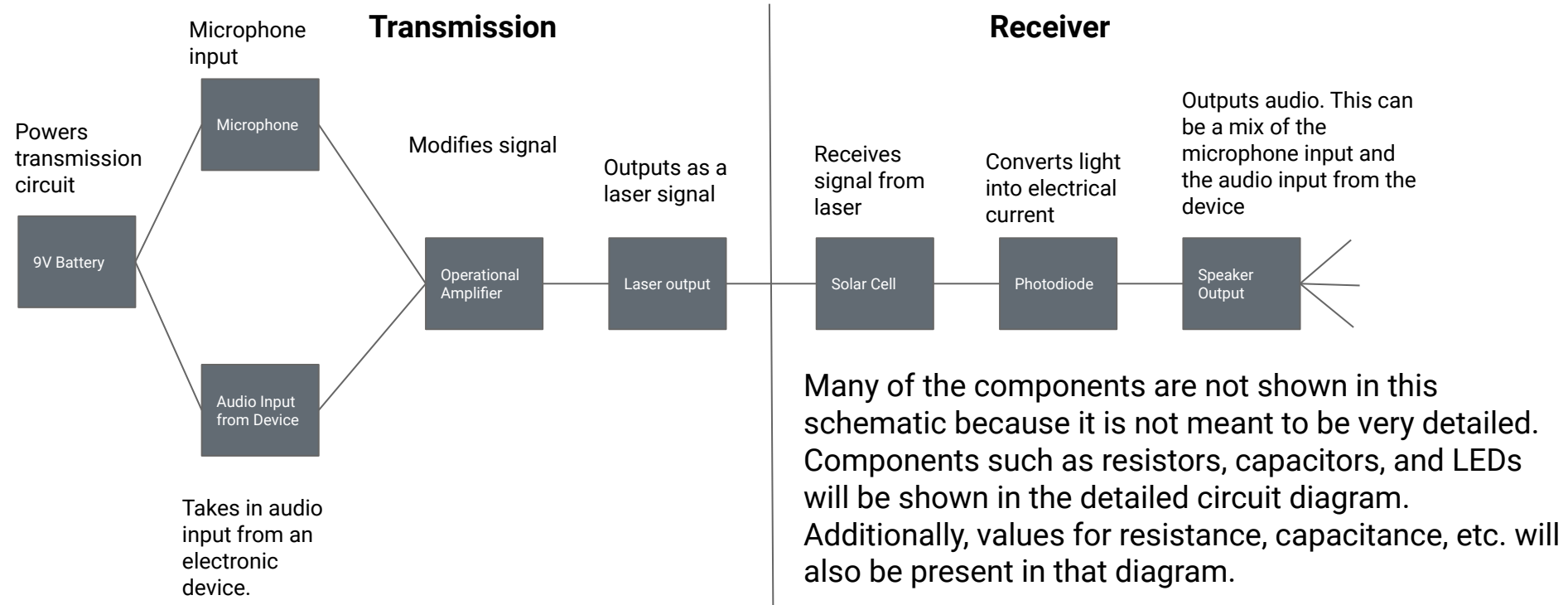
Steps for Project

1. Design Principles (System diagram)
 - Describes flow of signal through circuit.
 - Amplitude Modulation (AM) - Important concept to understand before designing the circuit.
2. Circuit Diagram
 - More detailed than system diagram
 - Includes values/calculations for resistance, current, voltage, etc.
 - Involves the use of LTSpice.
3. Building and testing circuits
 - Use of various tools, such as ADALM200 active learning module and multimeter.

Signal Flow – System Diagram



Circuit Schematic – Describes Basic Functions

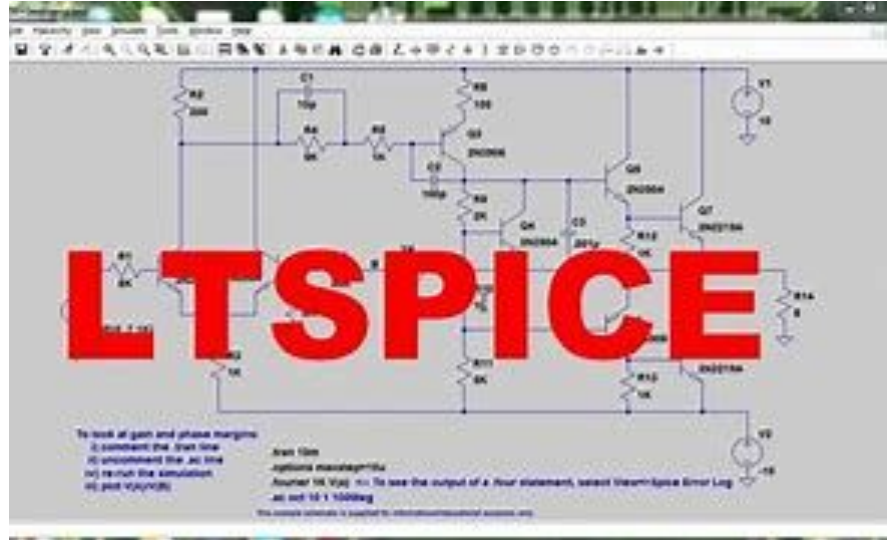


Use of Software in this Project

Scopy



LTSpice



Changes to the Original Project

Original Project (Might be explored in the future):

- Microphone Input + Speaker Output
- Use of an Operational Amplifier to amplify the input signal.
- Heavy emphasis on Amplitude Modulation (AM)
- Use of laser to transmit signal between the Transmitting and Receiving circuits.
- More complex compared to the current Thermistor project.
- Many future applications.

Current Project:

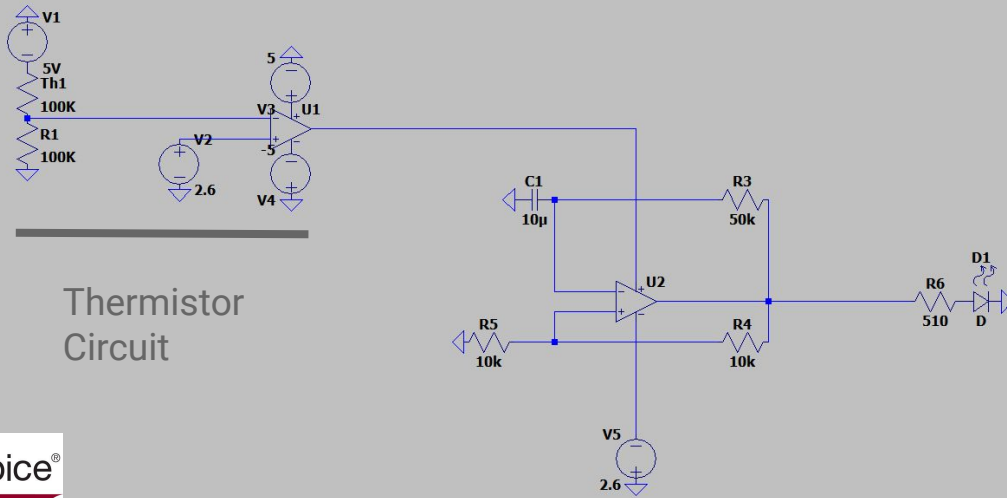
- Usage of Thermistor (temperature dependent resistor)
- Use of Operational Amplifiers
- Developing an Oscillating Circuit
- Signal Processing and Flow is still important in this project.
- Less complex because it does not require the use of a laser.
- Many future applications

What is an Operational Amplifier?



An Operational Amplifier or opamp for short is a device that takes in two inputs and outputs amplified voltage. It is usually in the form of an Integrated Circuit. In my project, two opamps are used and their purpose is to amplify the DC signal.

Diagram for Thermistor + Oscillating Circuit



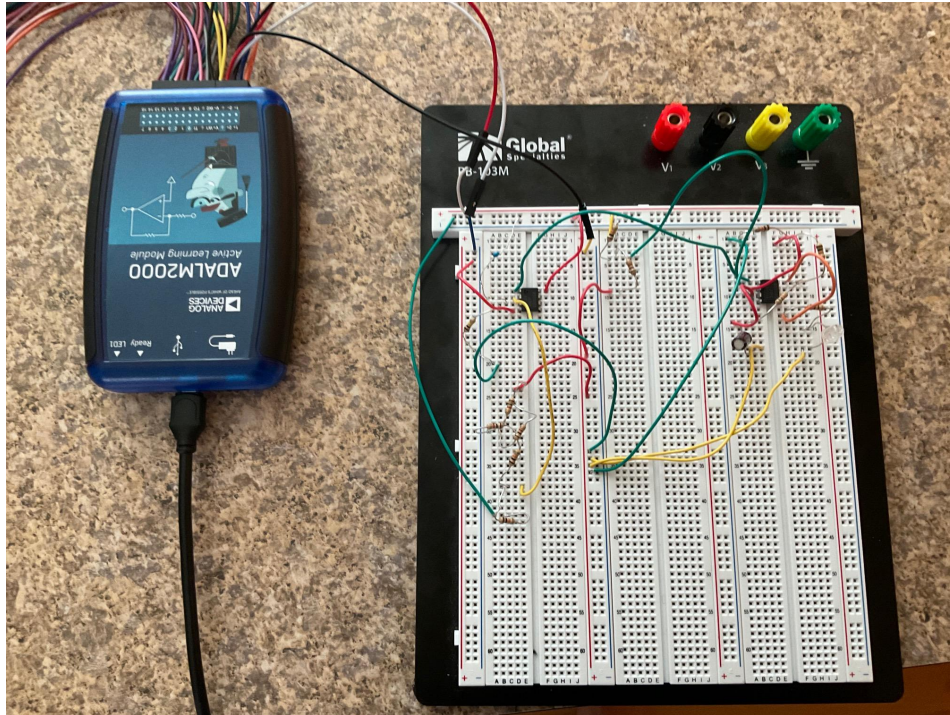
Thermistor
Circuit

Oscillating Circuit



I used the software LTSpice to design these two circuits. It is imperative that you only start building after you have a completed design. This way, there won't be as much trial and error when building and suppose a problem arises, you can always refer to the diagram to help find a solution.

Thermistor + Oscillating Circuit



This is an image of the fully completed circuit. The part on the left is the Thermistor circuit. The output from the Thermistor circuit feeds into the Oscillating Circuit, which results in an LED blinking. The LED should only blink if the thermistor is being touched. The opamp output voltage determines whether the LED will turn on.

https://drive.google.com/file/d/1qk6tYje0_Wzg4cm_uJA3Q-kXmjGwXHI8E/view?usp=sharing

An oscillating circuit allows for two different outputs (two states) represented by the LED either being on or off.

Future Endeavors

Suppose there was more time to work on this project:

- Incorporated laser into the overall circuit.
- Added a speaker output (alarm system)
- Added microphone input

These can all be explored in the future.



Abstract

https://docs.google.com/document/d/17f36Kqa_wo2H7EOGcC_vDt2Q4x4ZtuuojisasOtKBXr8/edit?usp=sharing

Summary of Presentation

1. Goals and Main Ideas
2. List of Components
3. Steps for the Project
4. Examples of System Diagrams
5. Use of Software
 - a. LTSpice
 - b. Scopy
6. Changes to Project
7. Circuit Diagram
8. Final Circuit + Video
9. Future Endeavors
10. Abstract

References and Acknowledgements

References:

- “Op-Amp Multivibrator OR Op-Amp Astable Multivibrator.” *Basic Electronics Tutorials*, Aspencore, 1 Apr. 2020, www.electronics-tutorials.ws/opamp/op-amp-multivibrator.html.
- Team 2102 Final Reports (Fall 2020 + Spring 2021) - UConn

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Q&A