

Wireless Optical Digital Radio

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Outline



- **Overview of Project**
- **Motivation**
- **Design Approach**
- **Demonstration**
- **Design Analysis**
- **Non-technical Issues**
- **Closing Remarks**

Project Description

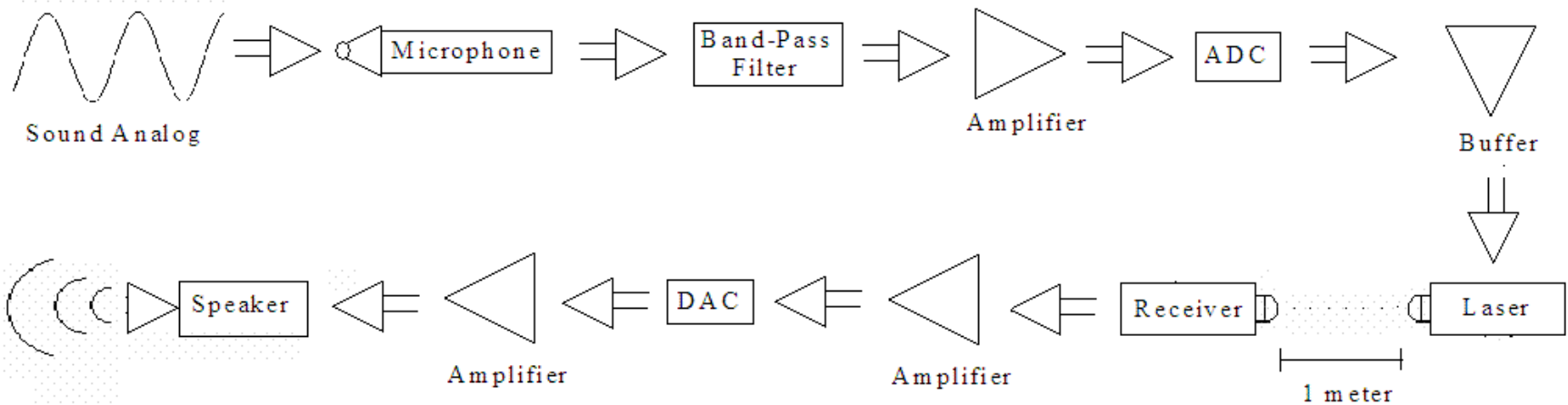
- **Sending sound signal through Analog-to-Digital Converter (ADC).**
- **Sending signal through laser diode and receiving signal through photodiode.**
- **Sending signal through Digital-to-Analog Converter (DAC) to be heard through speakers for audio/radio transmission.**

Motivation

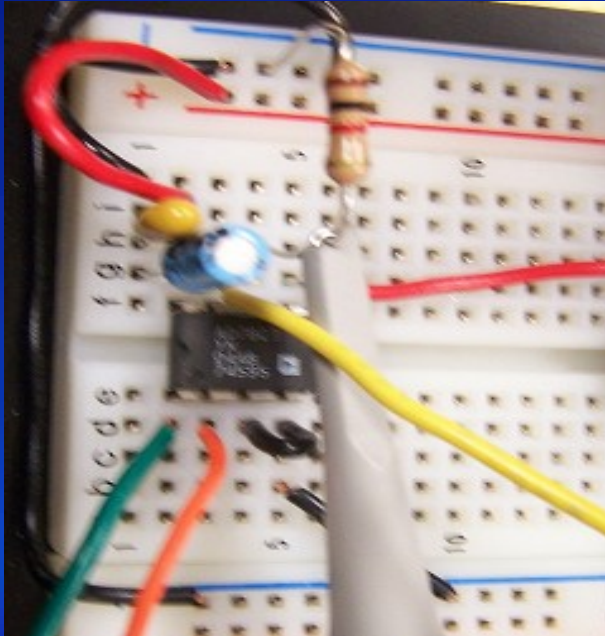
- **To construct a digital radio using wireless optical communication to send a signal over a length of one meter.**
- **By constructing this project, we will have utilized our understanding from our course of study here at the Henry Samueli School of Engineering.**
 - **Laser diodes, photodiodes, inverters, buffers, amplifiers, filters.**

Design Approach

Block Diagram:



Design Approach



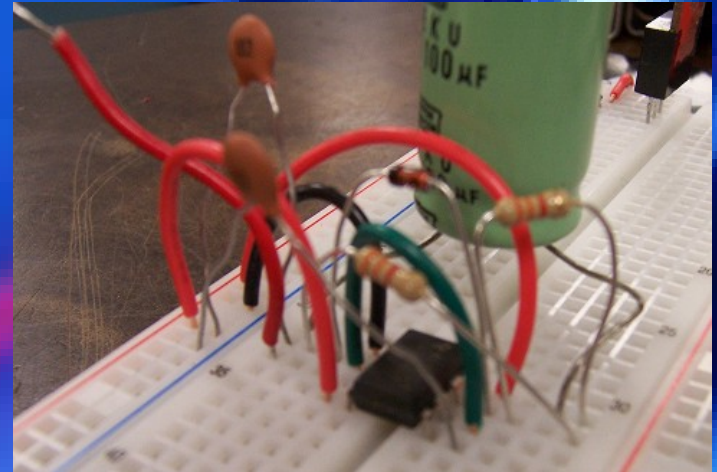
- **Analog-to-Digital Converter (ADC):**
 - 8 bit or 10 bit serial output
 - Converting analog signal into digital signal
 - Sampling analog signal up to 20kHz
 - Sampling frequency up to 40kHz



- **Amplifier:**
 - Amplify or buffer
 - Cascading amplifiers

Design Approach

- **Clock:**
 - 555 Timer or Crystal Oscillator
 - Switching Diode
- **Digital-to-Analog Converter (DAC):**
 - 8 bit or 10 bit serial output
 - Converting digital signal into analog signal
 - Sampling rate of 320 kHz
 - Nyquist frequency of 20 kHz (bandwidth)



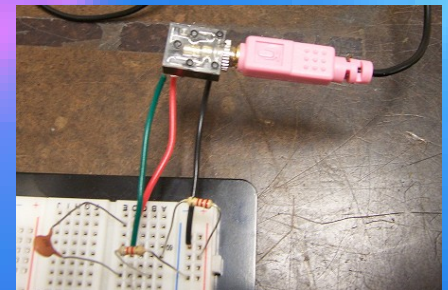
Design Approach



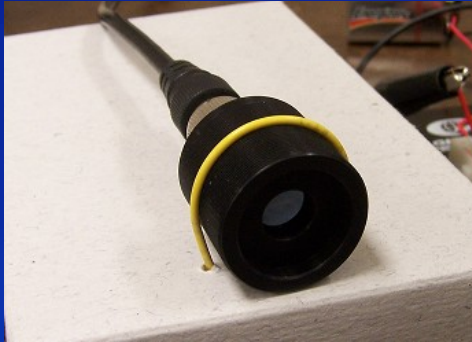
- **Laser Diode:**
 - Laser pen
 - 650 nm wavelength
 - Forward biasing 2.07 V
 - Driving current



- **Microphone:**
 - Band-pass filter noise
 - Amplify analog signal



Design Approach



- **Photodiode:**
 - Photovoltaic mode
 - Photoconductive mode
 - Modulation speed



- **Speaker:**
 - Store bought audio speaker

Demonstration

Please focus your attention at our set-up during this time.



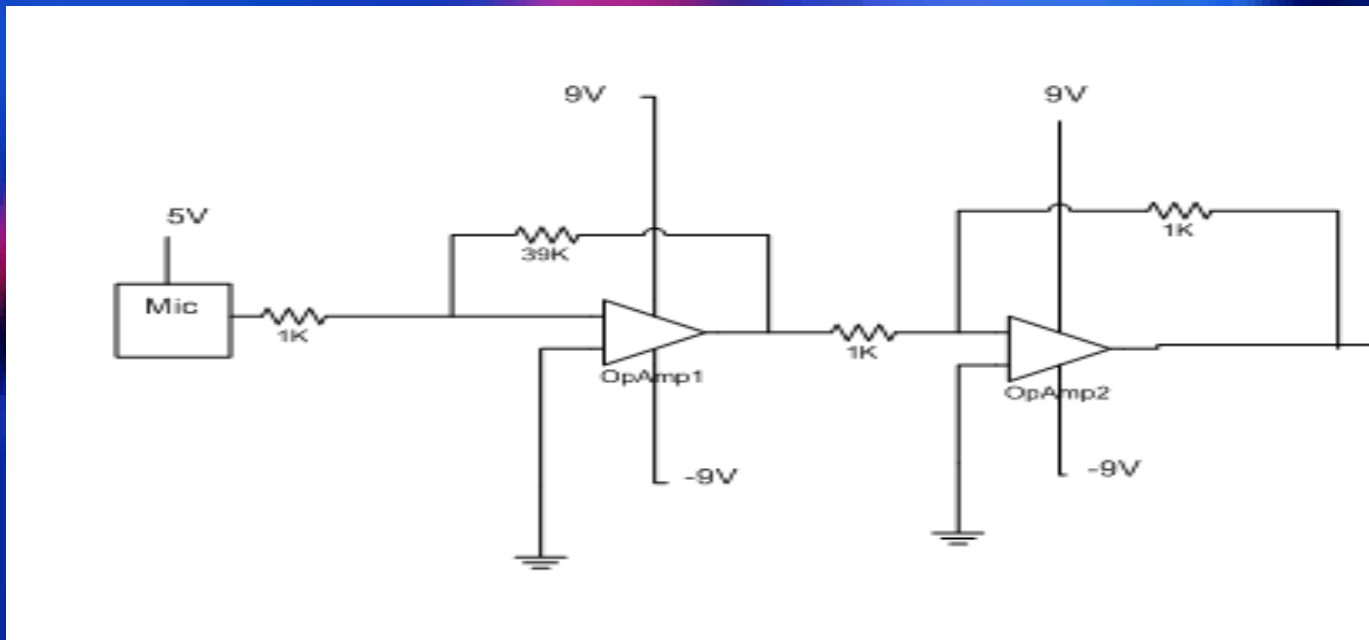
Video: 555 Clock



Design Analysis

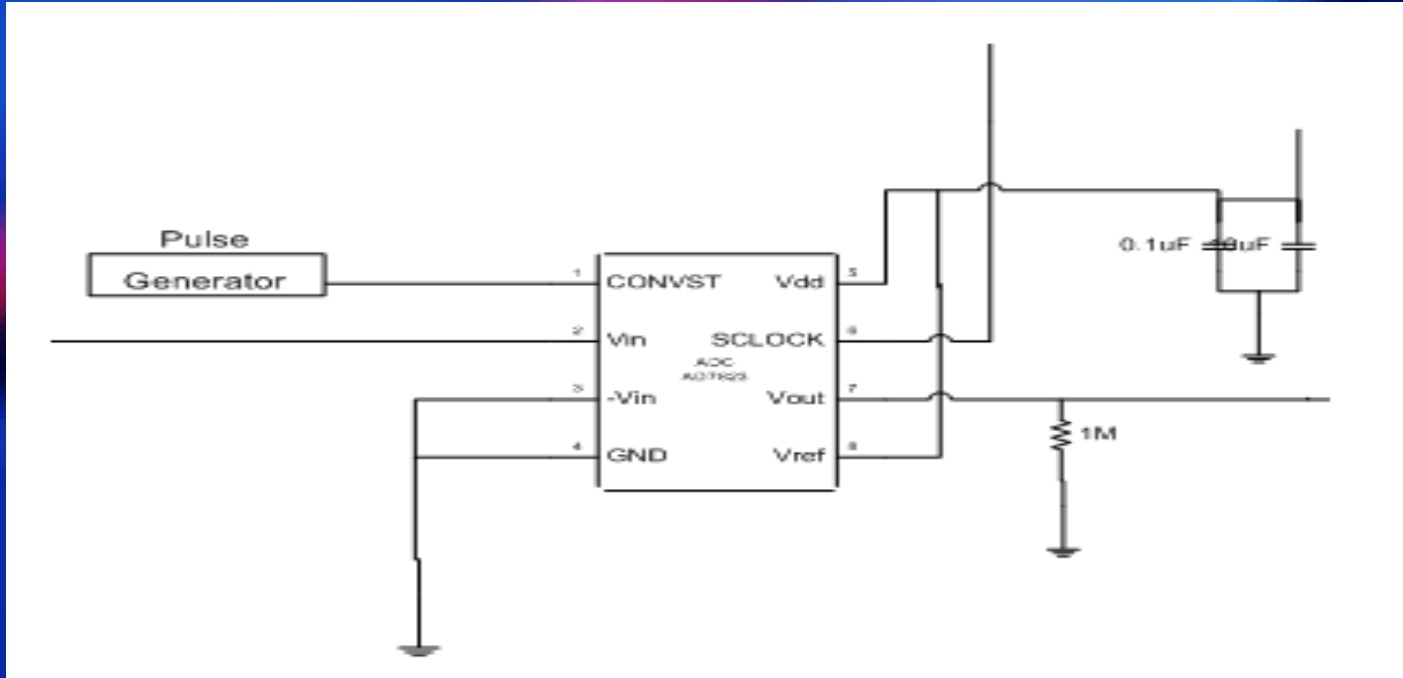
- **Microphone**

- Requires biasing to read out signal
- Requires filters to eliminate noise
- Requires amplification before ADC



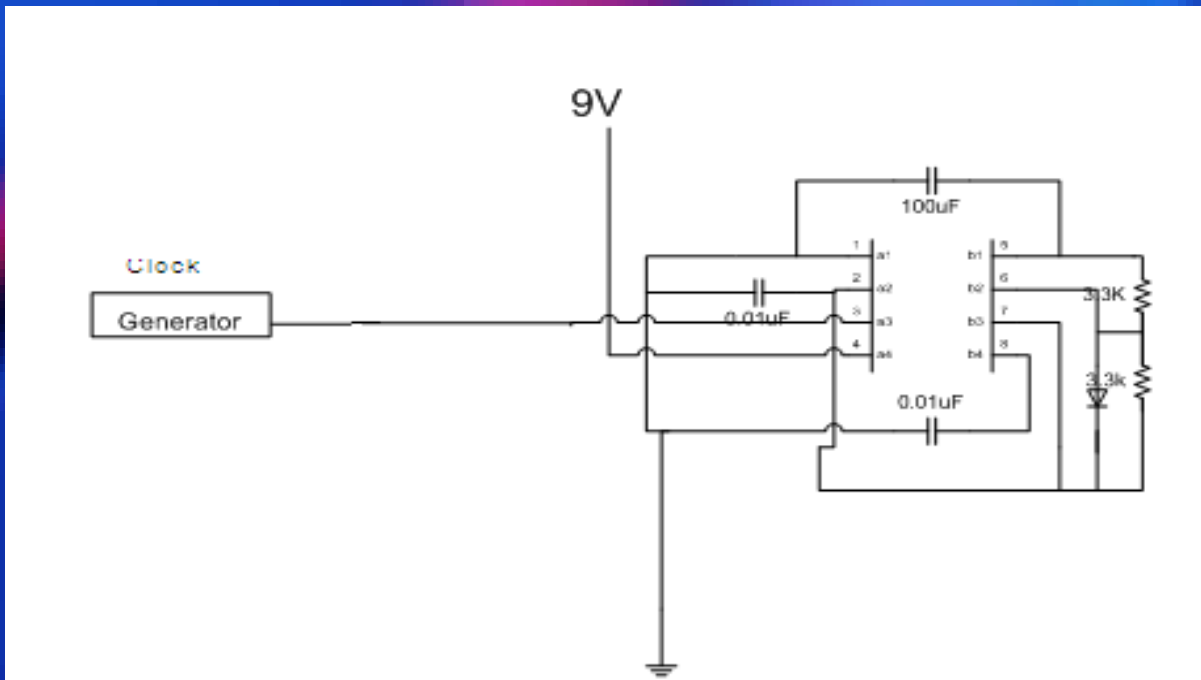
Design Analysis

- ADC
 - Testing method beyond our scope
 - Output current and voltage insufficient for driving laser diode

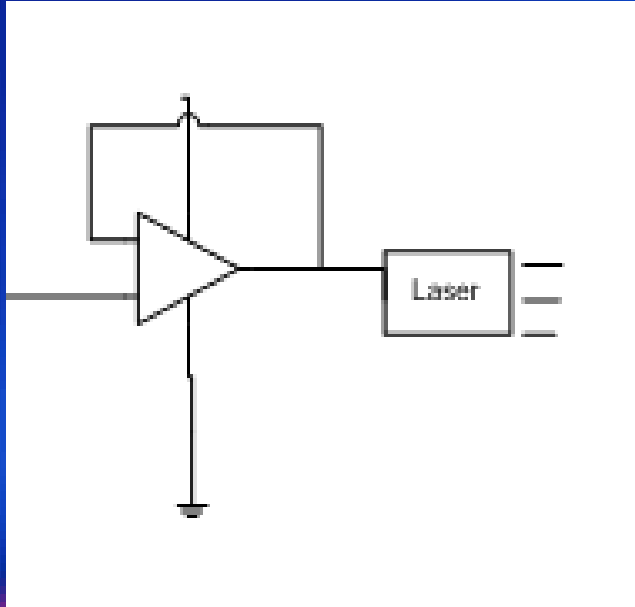


Design Analysis

- **Clock**
 - 555 timer used for on board clock
 - Set capacitor for easy configuration
 - Use diode to achieve 50% duty cycle



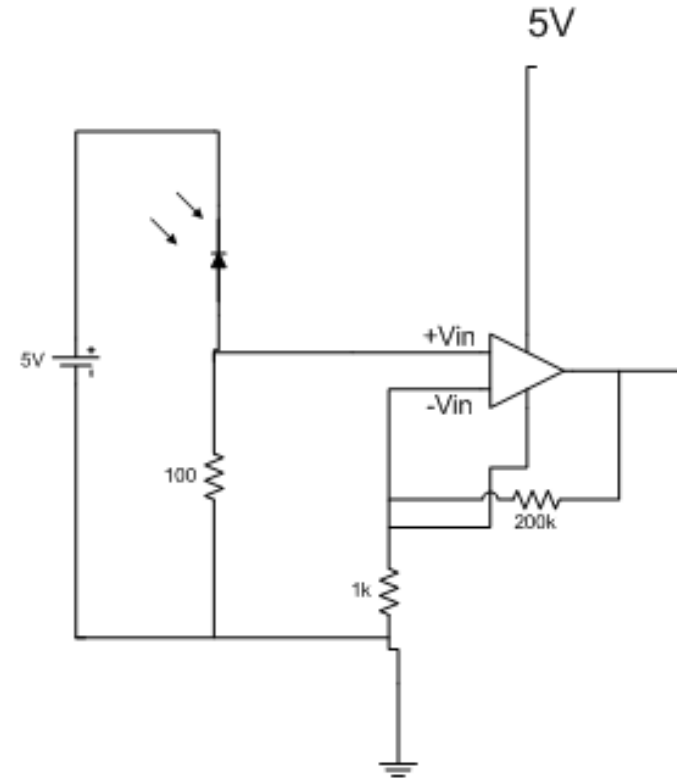
Design Analysis



- **Laser Diode**
 - **Biasing voltage 2.07 V required**
 - **Driving current 15 mA required**

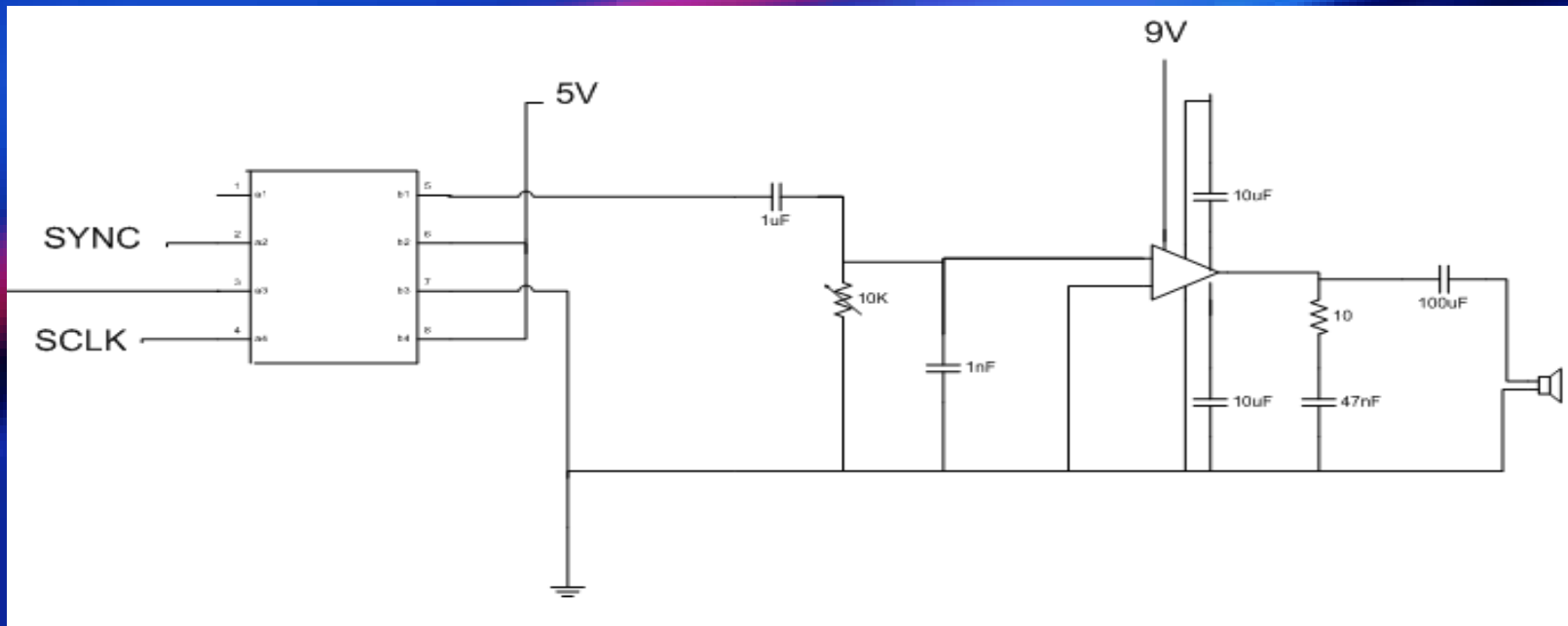
Design Analysis

- **Photodiode**
 - Reverse biasing required
 - Amplification required



Design Analysis

- DAC
 - Microcontroller needed vs. function generator
- Speaker
 - Amplifier needed for speaker



Non-technical Issues

- **Group load:**
 - Merging of groups
- **Contacting Companies:**
 - Difficulty being taken serious as undergrad students with a senior project
- **UROP Funding**
- **Contacting Faculty:**
 - Met frequently with faculty advisor Prof. Boyraz throughout both quarters
 - Received positive feedback from following faculty members: Prof. Green, Prof. CC Lee, Prof. Eltawil
 - Received additional help from following TAs: Rong, Fares, and Gang

Special Thanks to...

Our Faculty Advisor: Prof. Boyraz

Prof Green, Prof CC Lee, Prof Eltawil,
Rong, Fares, and Gang
Also, our joint group partners
Bryan, Ryan , and Philip