Wireless Infrared Receiver Design

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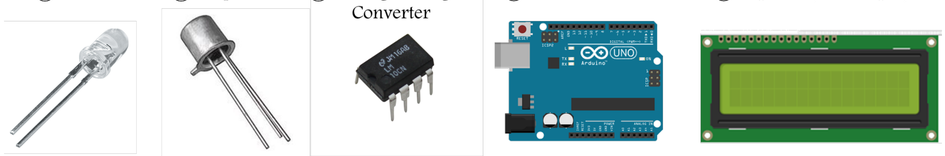
ABSTRACT: At the University of California Berkeley, there has been a recent decline in student's interest in majoring in Electrical Engineering as opposed to Computer Science, whereas 20 years ago this was the exact opposite. On Berkeley's campus, the Electrical Engineering and Computer Science departments start off running parallel to one another, leading professors to believe the introductory courses to be at fault for this shift in interest. Therefore, they proposed integrating a new project into the curriculum in hopes of regaining attention and overall student interest thus, making Electrical Engineering more attracting to Berkeley's students.

INTRODUCTION:

In this project, only the infrared (IR) portion of the electromagnetic wave spectrum was explored. The objective is to design a 'Wireless Infrared Receiver' that is able to produce a successful transmission from a pre-designed IR Transmitter. The receiver must be able to detect, amplify, and digitize the transmitted binary signal in order to display the message being sent. The design should be robust enough to be able to detect the signal at varying infrared light levels regardless of the level of ones and zeros being sent. The detected bits will then be sent into a microcontroller and the displayed on a liquid crystal display (LCD) or seen on the oscilloscope.

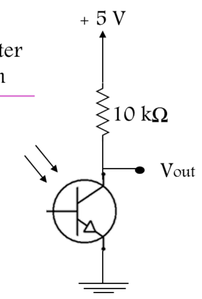
① Detection ② Amplifier ③ Analog-to-Digital Converter ④ Microcontroller ⑤ Liquid Crystal Display

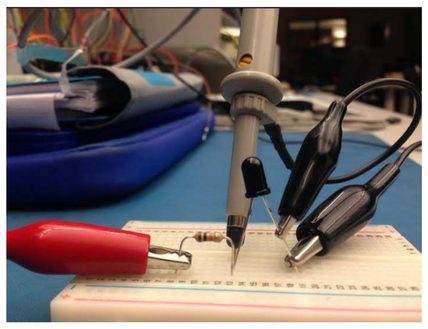


METHODOLOY:

Detecting the Signal: Phototransistor Circuit

Common-emitter configuration

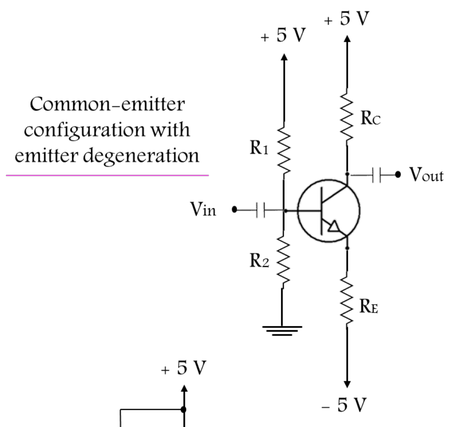


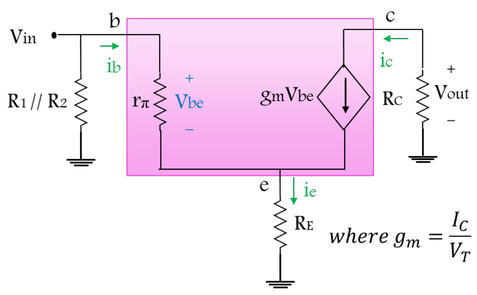


Phototransistor Circuit

Amplifying the Signal: Bipolar Junction Transistor

Common-emitter configuration with emitter degeneration

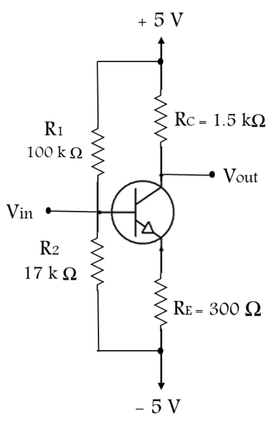




$where\ g_m = \frac{I_C}{V_T}$

$$Av = \frac{V_{out}}{V_{in}} = \frac{-g_m R_C}{g_m R_E + 1} \approx \frac{-R_C}{R_E}$$

$as\ long\ as\ g_m R_E \gg 1$



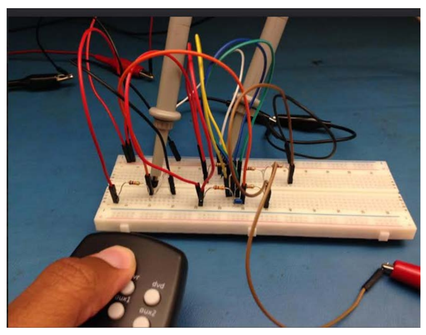
$A_v = 5$

$g_m = 0.1 \frac{A}{V}$

$I_C = 2.6\ mA$

$V_{in} = -3.52\ V$

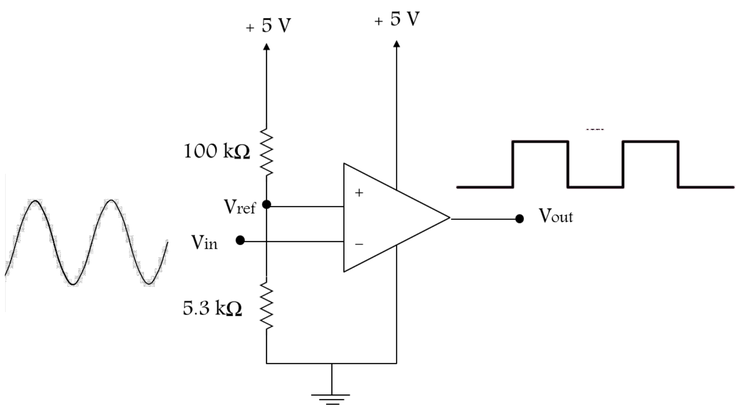
$V_{out} = 1.1\ V$

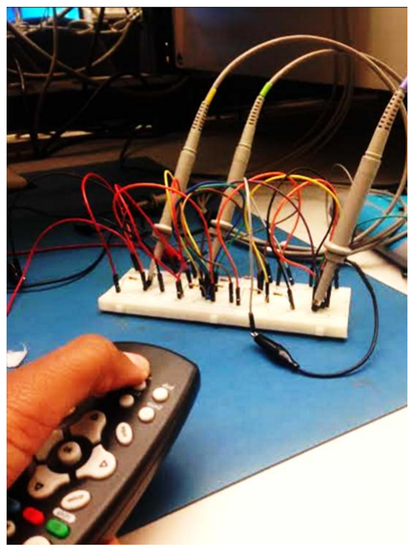


BJT Circuit

Digitizing the Signal

Inverting Voltage Comparator Circuit





Voltage Comparator

RESULTS:

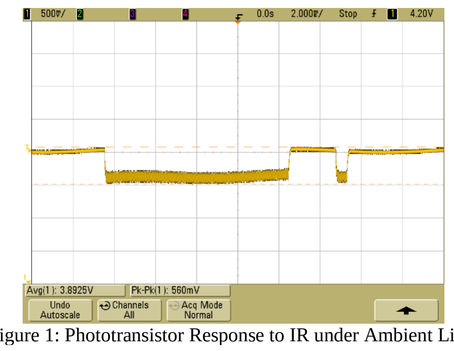


Figure 1: Phototransistor Response to IR under Ambient Light

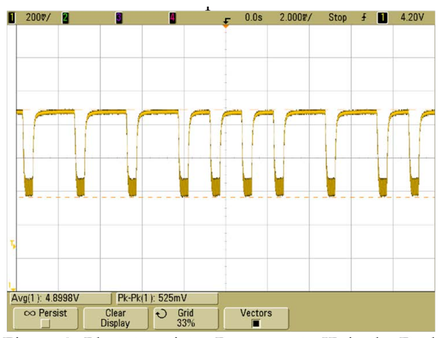


Figure 2: Phototransistor Response to IR in the Dark

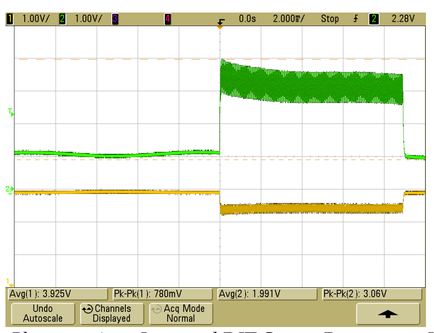


Figure 3: Phototransistor Input and BJT Output Response to IR under Ambient Light

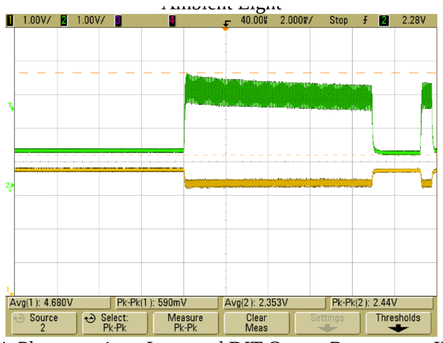


Figure 4: Phototransistor Input and BJT Output Response to IR in the Dark

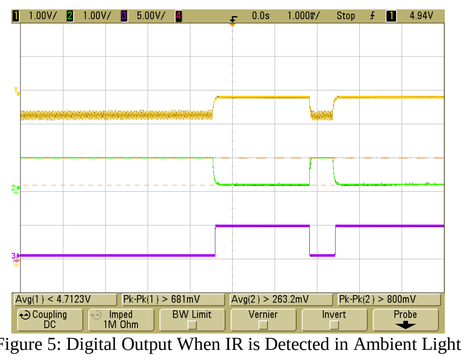


Figure 5: Digital Output When IR is Detected in Ambient Light

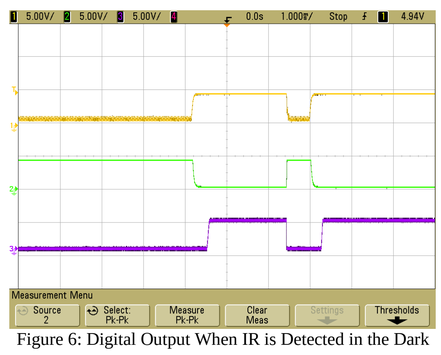
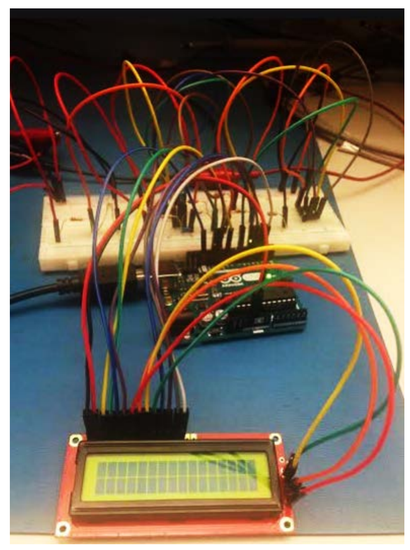


Figure 6: Digital Output When IR is Detected in the Dark

Finished Circuit:



CONCLUSIONS/ FUTURE STEPS:

My receiver works really well., with the universal remote, for close distances but, not too well for further distances. In the future, I would like to be able to test my circuit with the actual transmitter, in order to be able to test the robustness of my design.

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