MIDDLE EAST TECHNICAL UNIVERSITY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

EE 493-DESIGN STUDIO 1

WEEKLY REPORT VIII

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1. SUMMARY OF THIS WEEK'S PROGRESS

In this week, we have mainly worked on the implementation and testing of the visible light communication system design that we have obtained up to now. For the LED driver circuit we have implemented the circuit in Figure 1 and as it worked in the first go we have sticked to it through the rest of our work.

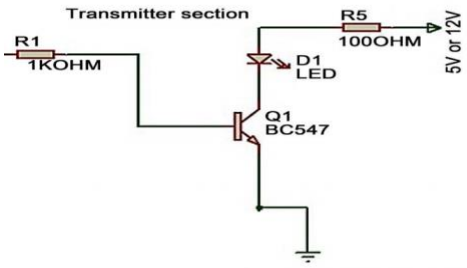

Figure 1. LED driver circuit

For the receiver side, we have implemented a basic transresistance amplifier using a single LM741 op-amp. The output we obtained from the op-amp in the lab was about 2V when the LED is OFF and about 5.5V when the LED is ON. As the digitalRead command of the Arduino takes voltages below 1.5V as LOW and above 3V as HIGH we decided on simply putting 3 regular diodes at the output of the op-amp in order the pull down the output voltages to the desired range. With this final circuitry, we can successfully transmit PWMs up to 20kHz and turn it into binary info by using the digitalRead command of the Arduino UNO board. In Figure 2 and Figure 3 the applied and obtained waveforms for a 1kHz and10kHZ PWM can be seen.

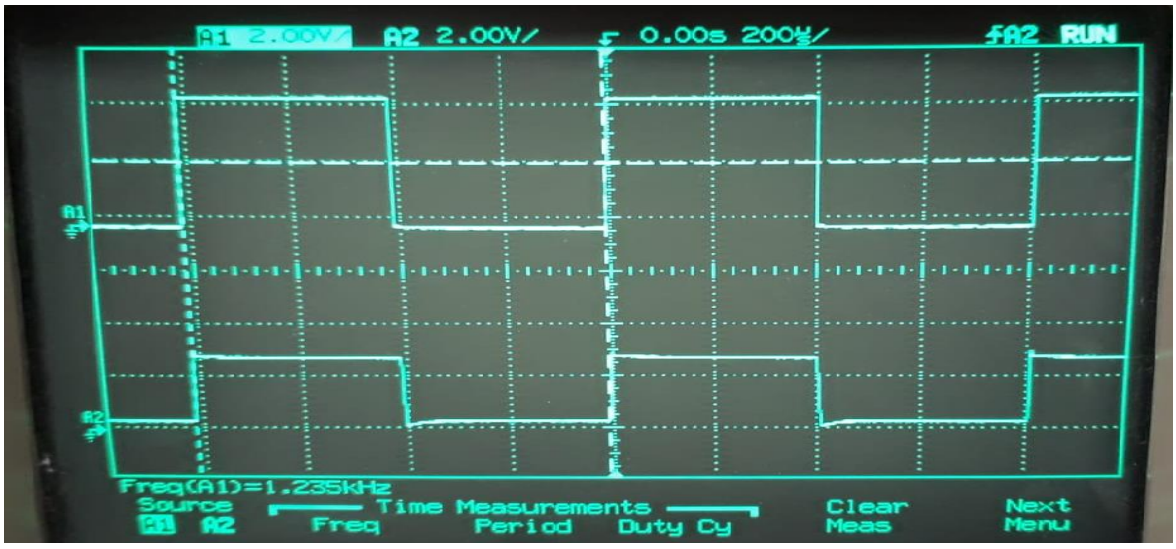

Figure 1:. Applied (on top) and obtained waveforms at 1kHz

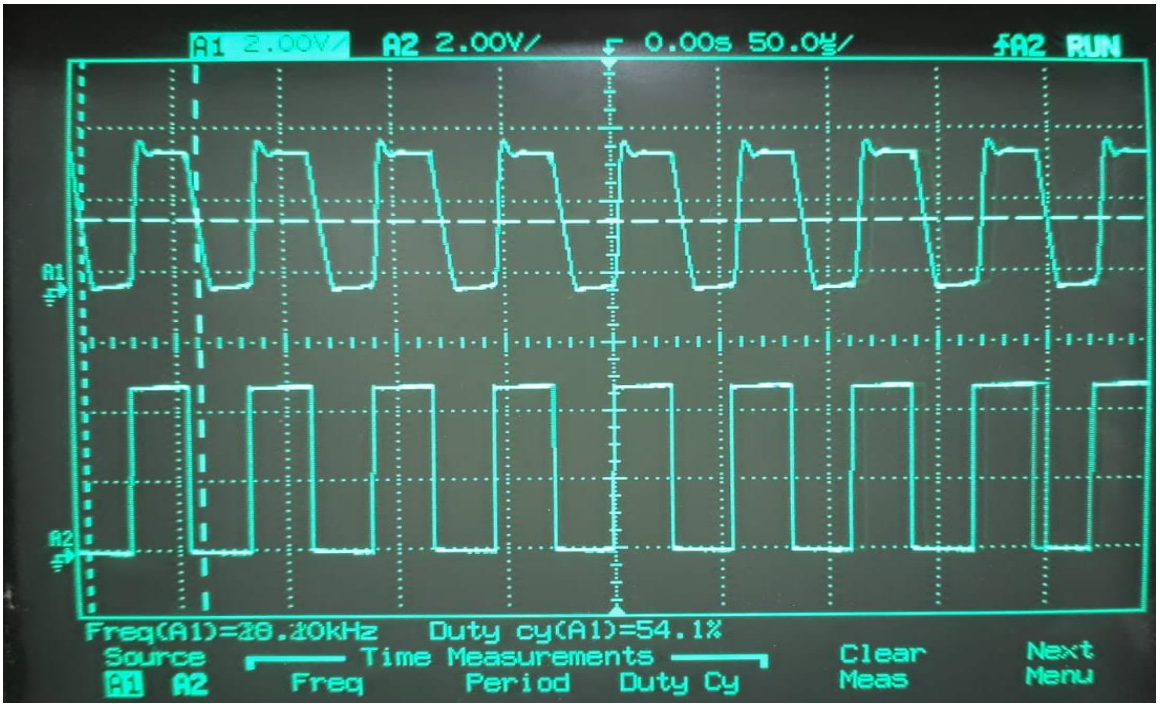

Figure 2. Applied (on top) and obtained waveforms at 20kHz

Although we believe that there are some missing parts in the designed circuit, at this stage, it is sufficient for our purposes.

2. OTHER DESIGN APPROACHES

Before deciding to use the circuit outlined in the first section, we have considered some other design alternatives which, unfortunately didn't work well. The problems we have encountered were mainly about the receiver structure of the circuitry.

Our first design consisted of a transresistance amplifier followed by a voltage comparator. The amplifier gain was arranged such that it produced 8V for HIGH and 4V for LOW. After this, we set up a comparator which compares the output of the amplifier with 6V and produces 8V or 1V as the output. After that, we have reduced the voltage span roughly to 0V-5V and given it to the Arduino board. However, as we increased the bit rate, we realized the the shape of the square wave at the output started to diminish. That was because the slew rate of the op amps were too slow. For that purpose, we bought two different op amp models with high slew rate, but for some reason which we couldn't understand, we failed to set up the transresistance amplifier.

Being stuck against this problem, instead of finding a better op amp, we decided to reduce the gain and change the circuitry altogether. In our next setup,

there was a high pass filter after the transresistance amplifier and the gain of the amplifier was much lower, its voltage swing was between 2V and 5V. After the high pass filter output, we have obtained a swing between 1.5V and -1.5V. However, instead of converting this to 0V-5V, we decided to skip the high pass filter and utilize the output of the photodiode driver instead.