MIDDLE EAST TECHNICAL UNIVERSITY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

EE 493-DESIGN STUDIO 1

WEEKLY REPORT VI

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1. SUMMARY OF THIS WEEK'S PROGRESS

In this week, we have concentrated more on the LiFi communication part of the project. As the result of our research, we decided to use On-Off Keying modulation at least for the beginning. We also determined our LED driver and photodiode driver circuit that we are going to use in order to send data by the LEDs and receive it with the photodiodes. As a next step, we will immediately start implementing and testing these circuits. We also made the assembly of our 4wd Arduino car kit so that we can also work on the data transportation part of the project in parallel.

2. ON-OFF KEYING

Although there are different modulation schemes for VLC, mainly, on-off keying (OOK), variable pulse-position modulation (VPPM), color shift keying (CSK) and orthogonal frequency division multiplexing (OFDM), OOK is the most popular and the easiest one to implement which makes it a good choice for us at least as a starting point. In this method, basically the LED intensity is changed between two distinguishable levels corresponding to the data bits (1 or 0). This switching action have a high frequency in order to minimize the transmission time which also means that human eye will not be able identify that the LEDs are turning on and off. This enables that the transmission can be done while lightening an area in the meantime.

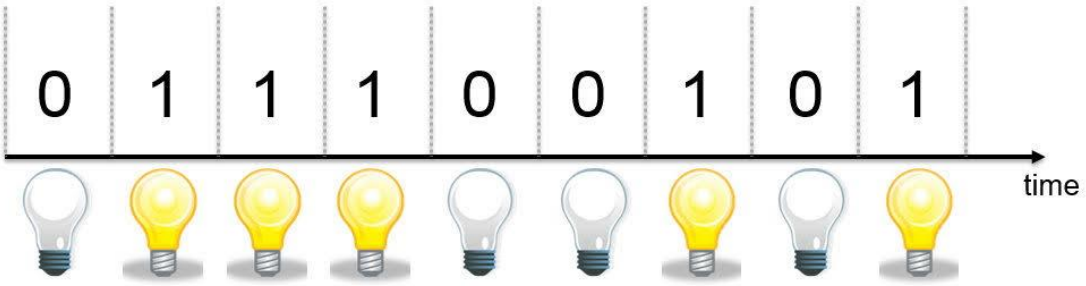

Figure 1. Visualization ON-OFF Keying with bulbs

3. DRIVING THE LEDS

In order to transmit our data by using On-Off Keying, we need to use a driver circuit in order to turn the LEDs on and off. As LEDs are controlled by the current flowing through them, we need such a circuit that will take the high or low voltage output from the RaspberryPi and convert those voltages into current. This is basically a transconductance amplifier which can be implemented by using a single gate and a current limiting resistor as shown in Figure 2.

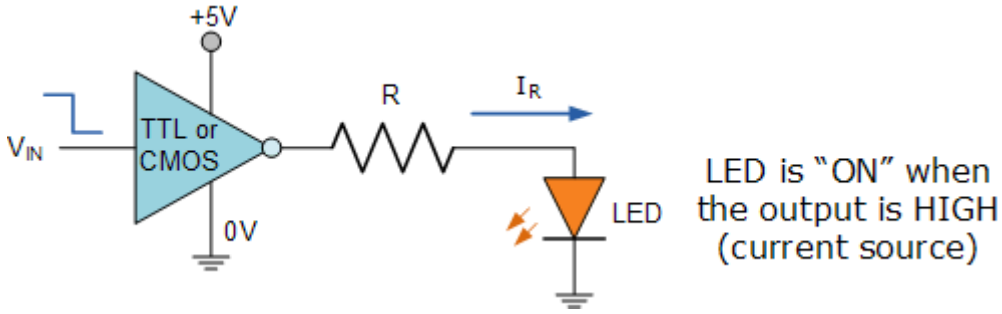

Figure 2. LED driver with IC

4. RECEIVING DATA BY PHOTODIODES

As opposed to the LED driver case, this time we need to turn the current flowing through the photodiodes into either a HIGH or LOW voltage to feed it to our RaspberryPi. This means that we require a transresistance amplifier this time, in order to convert the current flowing through our photodiode into voltage. As the current value is converted into a voltage value, now we need to use comparator to set voltage to the exact HIGH or LOW voltage as we are working in binary domain. In order to do both we decided on sing the circuitry presented in Figure 3 which consists of just two opamps and a few resistors.

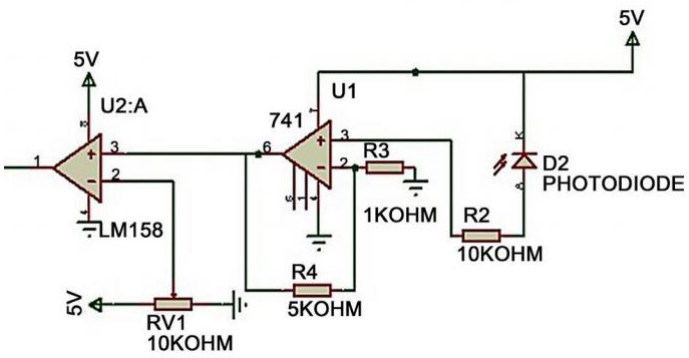

Figure 3. Receiver circuitry

5. ASSEMBLY OF THE CAR MODULE

While working mostly on the communication part of the project, we also spent some time to make the assembly of the 4wd Arduino car that we have purchased last week. We just did the physical assembly yet so that we can also play around with the transportation part of the project while we are concentrated on the LiFi communication part. The assembled car is presented in the photo below.

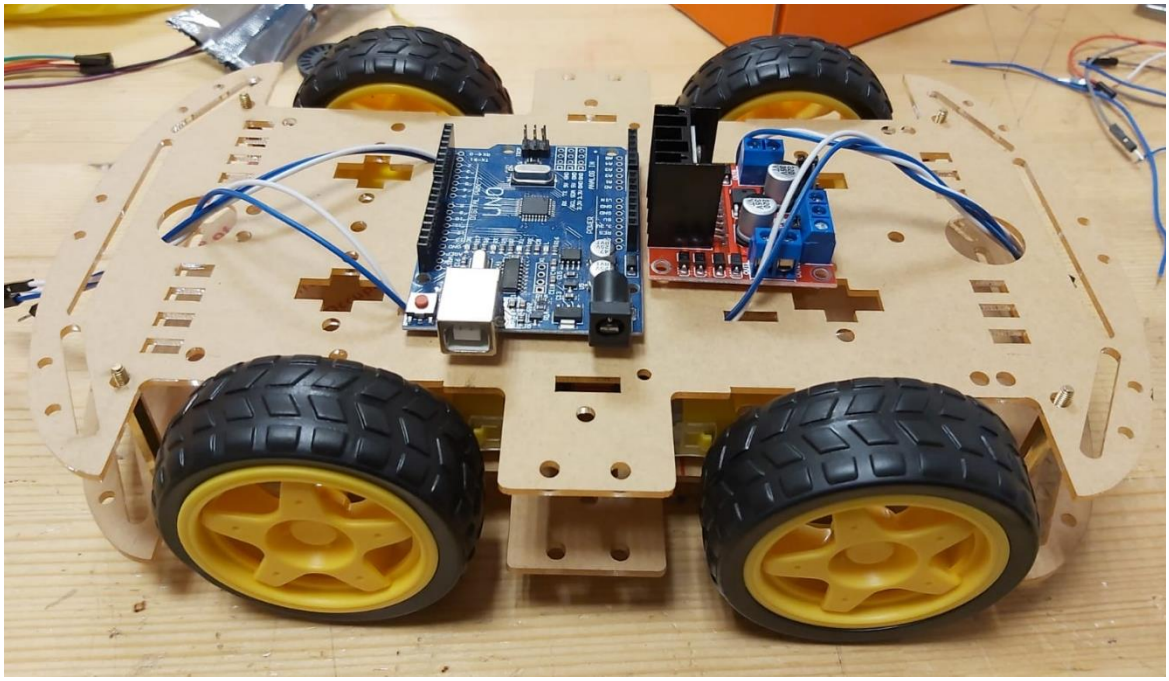

Figure 4. A photo of our car after the assembly

6. REFERENCES

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2. "Light Sensor including Photocell and LDR Sensor," *Basic Electronics Tutorials*, 15-Feb-2018. [Online]. Available: https://www.electronics-tutorials.ws/io/io_4.html. [Accessed: 19-Nov-2019].