Faculty of Engineering and Information Sciences

ECTE250 Deliverable Cover Sheet

Team Name: Team - D

DELIVERABLE NUMBER AND TOPIC: 4 – Smart Parking System

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1. Progress from previous deliverable

Last deliverable's (*deliverable 3*) main aim was to implement a few sets of circuits i.e., sensor, switch debounce etc. on multisim.

For this deliverable it was suggested by the instructor that:

The sensor circuit of the project must be implemented on the breadboard.

The state machine circuit must be implemented on TinkerCAD.

IOT must be implemented through means of blynk app.

The sensor circuit has been successfully implemented on the breadboard and the desired output has been achieved. The state machine was implemented but the desired output could not be observed. Blynk app could not be implemented due to the lack of resources (*an android phone*).

Below sections will explain the three targets that were set and how much of it is completed.

2. Breadboard Circuit

Following up from the sensor circuit presented in the previous deliverable, the goal for the current deliverable was to build a proper working prototype of the Tinker CAD simulation. One of the main goals was to get the circuit for one parking slot, and to implement them. For further progress, the plan is to implement 2 parking slots, with the help of a shift register.

Overall, the constructed circuit is as illustrated:

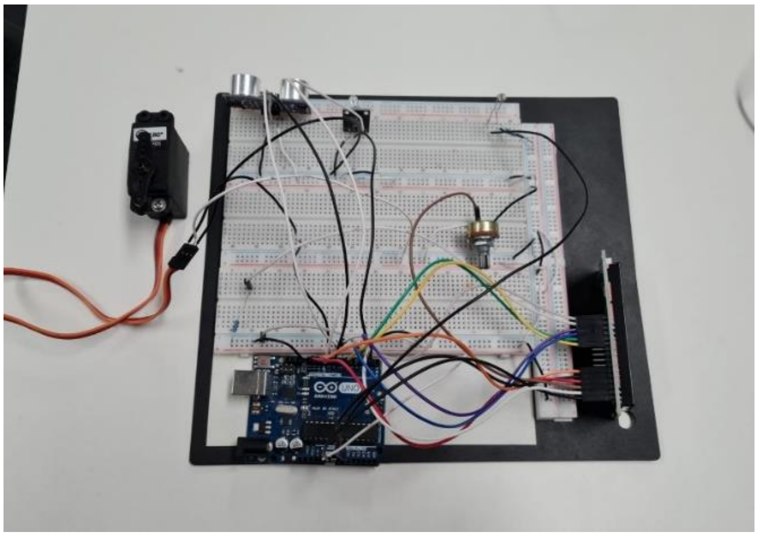

Figure 1: Top view of sensor circuit

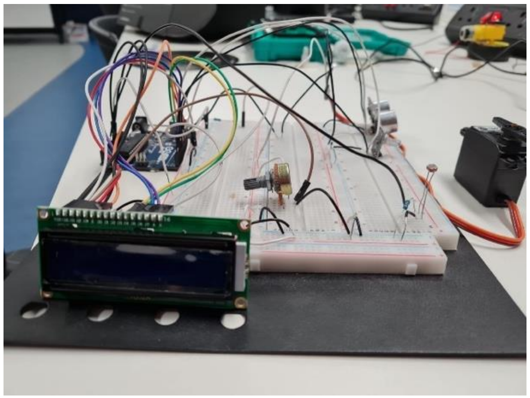

Figure 2: Side view of the sensor circuit

2.1 **Functionality of circuit components**

Arduino UNO

The Arduino UNO is the core of the circuit. It supplies the voltage and ground required to power the rest of the components of the circuit, which is connected via bridging the connections across the breadboard. Additionally, it has a microcontroller, which using some coding can be used to interact with its surroundings in real time. By using the Arduinos 16 digital pins and analogue pins, it takes the readings from the inputs, such as sensors in this case, which is then read by the other components connected to the Arduino to give a particular output, such as the LED's which show a particular color if the (*ultrasonic*) sensor reads a threshold value. (*What is an Arduino? - learn.sparkfun.com, 2022*)

Inputs

Light Dependent Resistor (LDR)

Also known as a photoresistor, this component is used to detect the light intensity, hitting on its surface. Typically, when the light is shone upon the LDR, the resistance decreases in contrast to when the LDR is darkened the resistance increases. (*Light Dependent Resistor (LDR) - Working Principle and Its Applications, 2022*)

In the case, of the sensor circuit, the LDR is used at the entrance of the parking area. As mentioned in the previous deliverables, when a car is brought on top of the LDR, the darkness will be used to indicate the servo to allow the car to enter.

This component is connected to the analogue pin of the Arduino UNO (*pin A0*) from which the brightness levels are read and used to indicate if an object, or a car is on top of the resistor. The pin connected the Arduino port is also attached the ground while the remaining pin is connected to V_{ss}.

Ultrasonic sensors

The sensor consists of 2 transducers, with one being a transmitter and the other being a receiver. The transmitter sends out an ultrasonic sound while the receiver “listens” or detects the transmitted wave. (*2022*)

For the project, the ultrasonic sensor is used for the parking slot, to indicate whether the car has been parked or not. The sensor will be placed directly in the slot, preferably at the back. The sensor will emit an ultrasound which will be approximately 40,000Hz, travelling through air. When an object (*in this case a car*), the transmitted wave is bounced back to the sensor, from where the distance of the car from the sensor will be calculated. (*2022*)

The readings from both the transducers of the sensor will be read/ stored by the Arduino, since both the “Trig Pin” and “Echo Pin” are connected to the “D7” and “D8” pins respectively, while the VCC and GND pins are connected the ground and voltage source ports (*5V*) of the breadboard.

Outputs

Motor Servo

Being an output component of the circuit, the servo motor is a closed loop in which a feedback signal is used to vary the speed and in our case the direction of the motor, where the car can enter the parking area, when the motor is rotated.

To allow the car to enter the parking area, the motor must be rotated to 90 degrees, thus an estimated value of 1.5ms of pulse will be sent to the servo, causing it to rotate, since the amount of time the pulse is held, the angle of rotation of the servo can be set. (*How Servo Motor Works & Interface It With Arduino - Last Minute Engineers, 2022*)

The motor servo has typically 3 terminals, 2 of which are ground (*GND*), 5V (V_{ss}) and control, the first two are connected to the power supply that is provided on the breadboard by the Arduino, while the control is connected to the digital pin 9 (*D9*) of the Arduino.

Figure 3: Servo motor at position 0 degree

RGB Light Emitting Diode (*RGB LEDs*)

As the name suggests, a RGB LED uses red, green and blue to emit a light of a specific color, which can use either all, two or even one of the colors. Each color can have a maximum value of 256. However, since the LED used for the parking slots will only display red and blue, leaving the green port undefined, thus this port of the LED is not connected to the Arduino pins. (*Arduino - RGB LED | Arduino Tutorial, 2022*)

Since the LED has 4 pins, 3 of which are RGB, and the remaining being ground (*GND*), each pin is connected to the respective ports, such as the red pin of the LED connected to D1, the blue pin connected to D10 of the Arduino and the GND pin connected to the ground of the breadboard.

Liquid Crystal Display (*LCD*)

The LCD has a very distinctive display, since it can only output ASCII characters, which are then used to form text. Given that we have a 16 x 2 LCD display, it has 16 pins used to show the appropriate output on the LCD screen. The Ground, V_{cc} and Anode (*A*) and Cathode (*K*) pins are connected to the supply ports of the breadboard.

The reset (*RS*) pin which is used to determine if the commands or data will be sent to the LCD, whereas the enable (*E*) pin enables the registers to be written upon. The data pins used are d4 till d7, allowing some bits of data to be written onto the register. These 6 pins are connected to the digital ports of the Arduino. The pins defined onto the code are D12, D11, D5, D4, D3, D2 respectively.

However, the R/W pin is connected to a 10k potentiometer used to contrast the LCD display by altering the voltage being supplied to it, from 0V to 5V (*Arduino 16x2 LCD Tutorial - Everything You Need to Know, 2022*).

One of the major outputs of the circuit is the LCD, which displays the output of when the slot is occupied or not. As per the reading of the ultrasonic sensors, the LCD reads the command from the code and displays whether the slot is “full” or “empty”.

3. State Machine in TinkerCAD

The state machine of the project was implemented in multisim previously. The task for this deliverable was to implement the same on TinkerCAD. It was implemented very similar to the one in multisim, but due to difference in components the desired output was not achieved.

Connections-wise, the positive side of the function generator was connected to the clock of the 74HC74 dual D-flip flop IC to generate the clock signal in the oscilloscope. The power was taken from Arduino. Input 1 of the flip flop was connected to one end of the switch as per multisim.

The other input and the output 1 were connected to the LED. LED was grounded and had a 5V supply from the Arduino. The output 2 is received in the oscilloscope (*since the unavailability of logic analyzer in TinkerCAD*) and the negative end of it is grounded. The output 1 is also connected to another oscilloscope for the output. The other LED is connected to the output 2 of the IC.

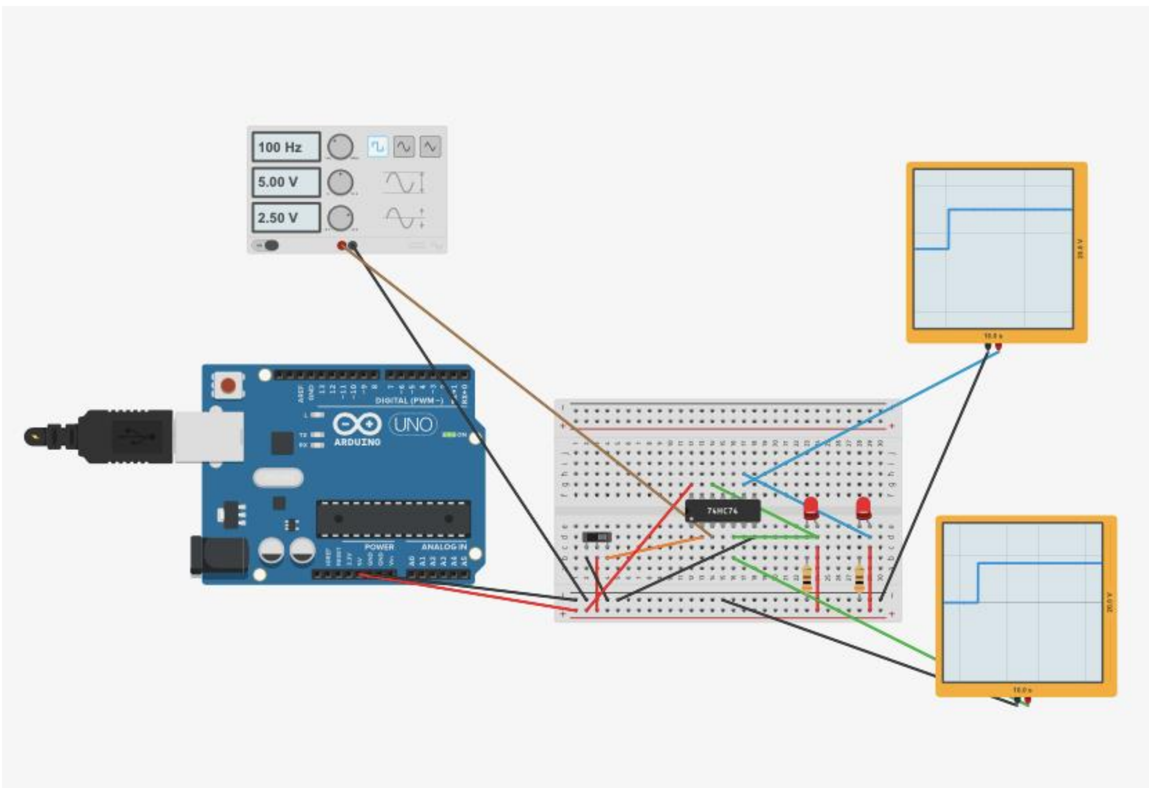

Figure 4: State machine circuit in TinkerCAD

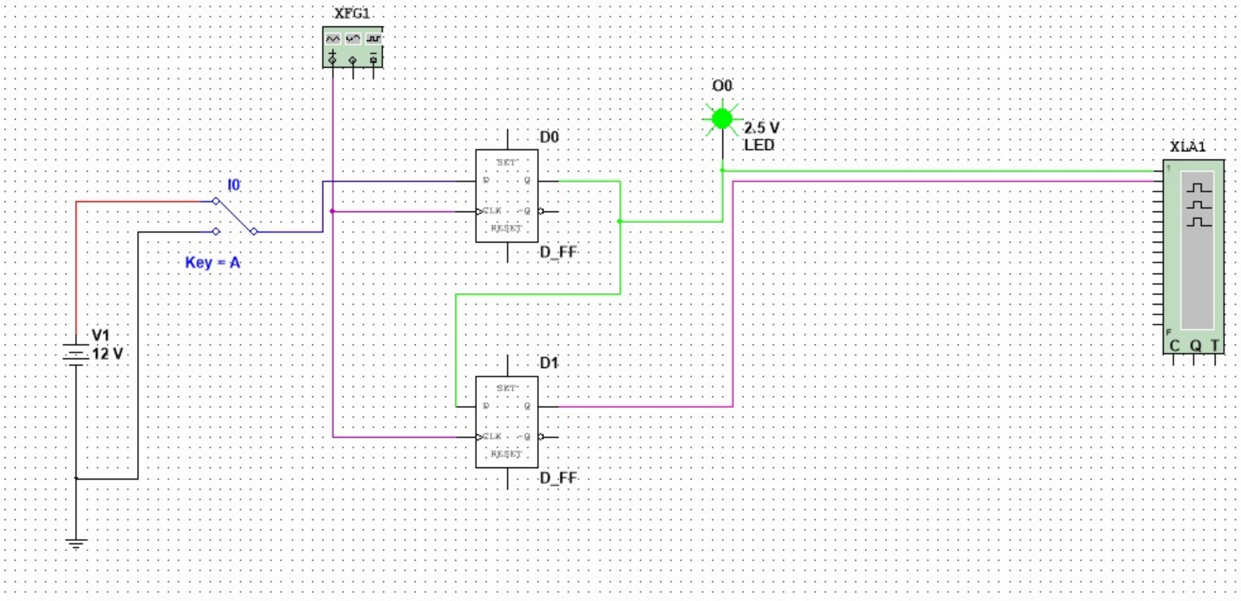

Figure 5: State Machine in Multisim (for ref.)

Issues Faced:

The working of the switch in TinkerCAD is much different from the one in multisim and hence, the working of switch is tough to understand.

The input of the IC is not properly read by the switch.

The LEDs connections seem to be not working as they are switched on all the time even after changing the position of the switch.

4. IoT (*blynk app*)

The concept of IoT (*Internet of Things*) was to be implemented in the project. One of the best ways to implement is by using the blynk app to control some aspect in the project.

The first idea was to implement blynk app to control the servo motor of the system. Since it was later changed to being controlled by the LDR, it was felt that the use of blynk app was not necessary.

But, since it was compulsory to implement it, the instructor had suggested that the blynk app can be used for displaying the same thing that is being displayed on the LCD. It was not implemented as the group members did not have an android phone (*fyi: blynk app only works on android phones*).

The idea of this implementation was already discussed and hence when the resources are received, the implementation will be done.

5. References

- How To Mechatronics. 2022. *Arduino 16x2 LCD Tutorial - Everything You Need to Know*. [online] Available at: <https://howtomechatronics.com/tutorials/arduino/lcd-tutorial/> [Accessed 11 May 2022].

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- Learn.sparkfun.com. 2022. *What is an Arduino? - learn.sparkfun.com*. [online] Available at: <https://learn.sparkfun.com/tutorials/what-is-an-arduino/all> [Accessed 11 May 2022].

6. Appendix

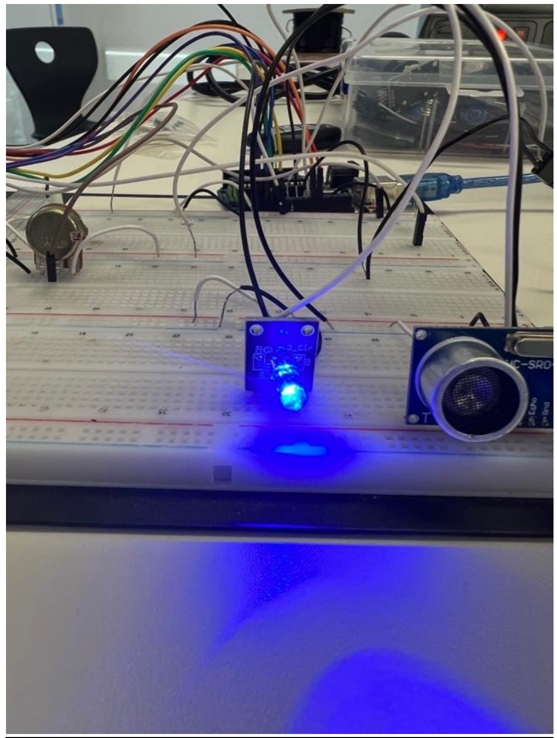
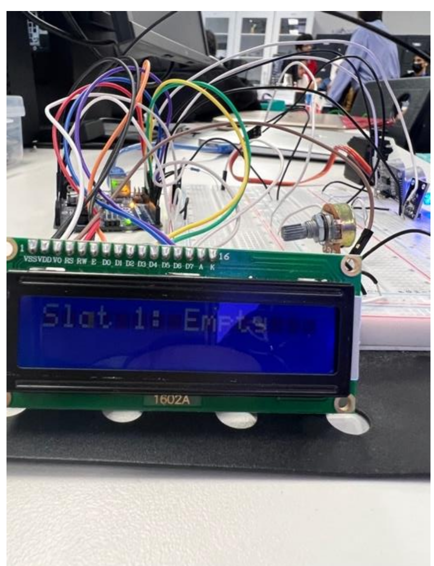


Figure 6: Blue LED when no car is in front



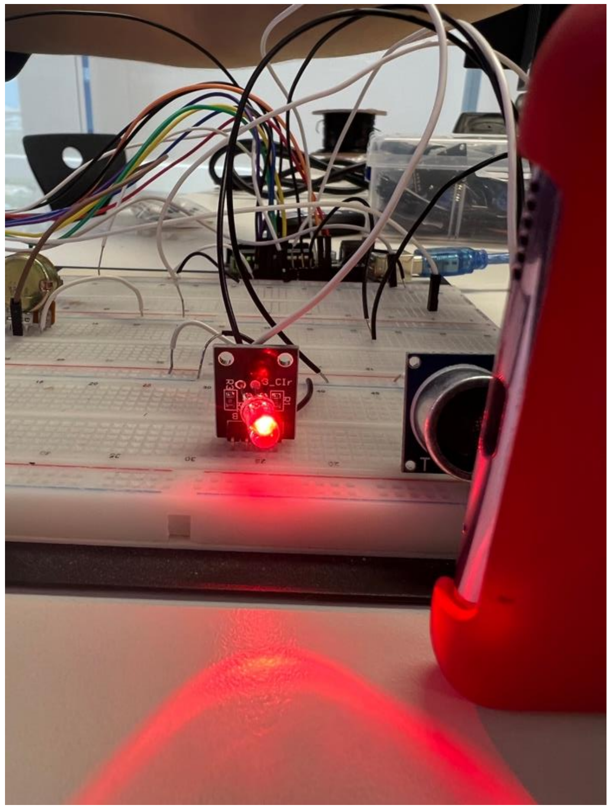


Figure 6: Red LED when car is in front

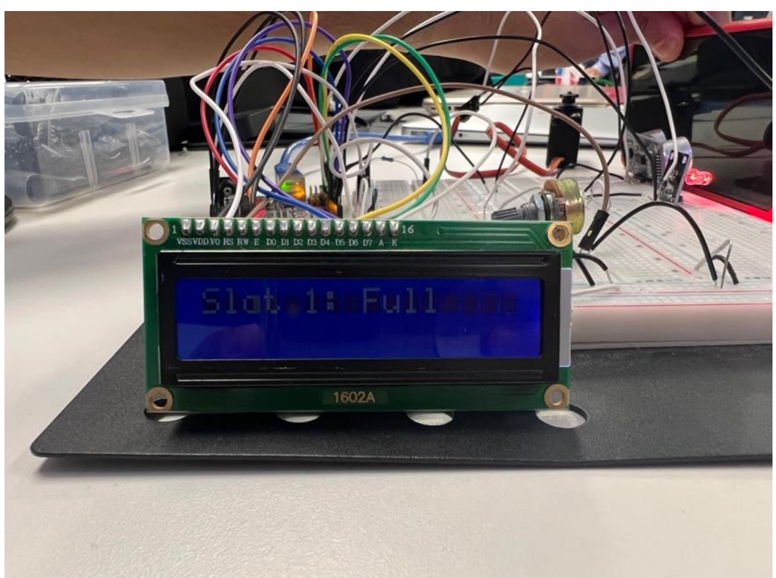


Figure 8: Servo Motor for gate