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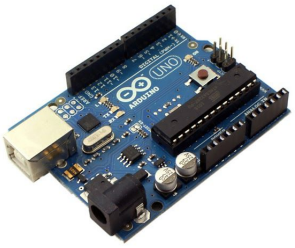
B-Project Description :

In the First section , We made 1.1 Lane Keeping Assist (LKA) .The car is programmed to move on a black line and turn left or right according to the line(the lane) , Our black line is a symbol for our lane .
In the Second section ,the first requirement in this section : We made 2.1 Control Indicator(CI) . The seven segment shows P,D,N and R according to the joystick position it will show on the 7 segment one of the letters (D,N,P or R) . The second requirement : there is a LED that its light intensity is adjusted according to the light in the room . if the room is dark the intensity will light up with full power and vice versa.
In the Third section ,We made the Sound System (SS) which consists of two parts the mp3 player and the lcd. The mp3 is controlled through the touch screen which has play, pause, previous and next buttons. When the play button is pressed the mp3 plays the first song, if you press previous or next the song will change, if pause is pressed the mp3 player will be paused and no song will be played if next or previous were pressed. The song number will be displayed on the screen and will be changed according to the buttons “incremented when next is pressed, decremented when the previous is pressed”. Song number appears once the play button is pressed.

C- Used Components :



Arduino Uno (R3)

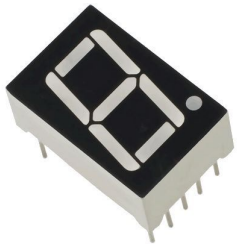
Arduino Mega 2560

LCD TFT 2.4 Touch screen

DFPlayer Mini MP3 Player

Speaker 8 ohm

Resistor 1k (for MP3)



7-segment display

Joystick 2 Axis (Analog)

Resistor 330K (for 7-segment)

Photoresistor (LDR) 12 mm

Resistor 10k (for LDR)

2 Line Follower Sensor

H-Bridge l298 n

Car (4 dc motors)

4 Breadboards

LED (RGB) 5mm

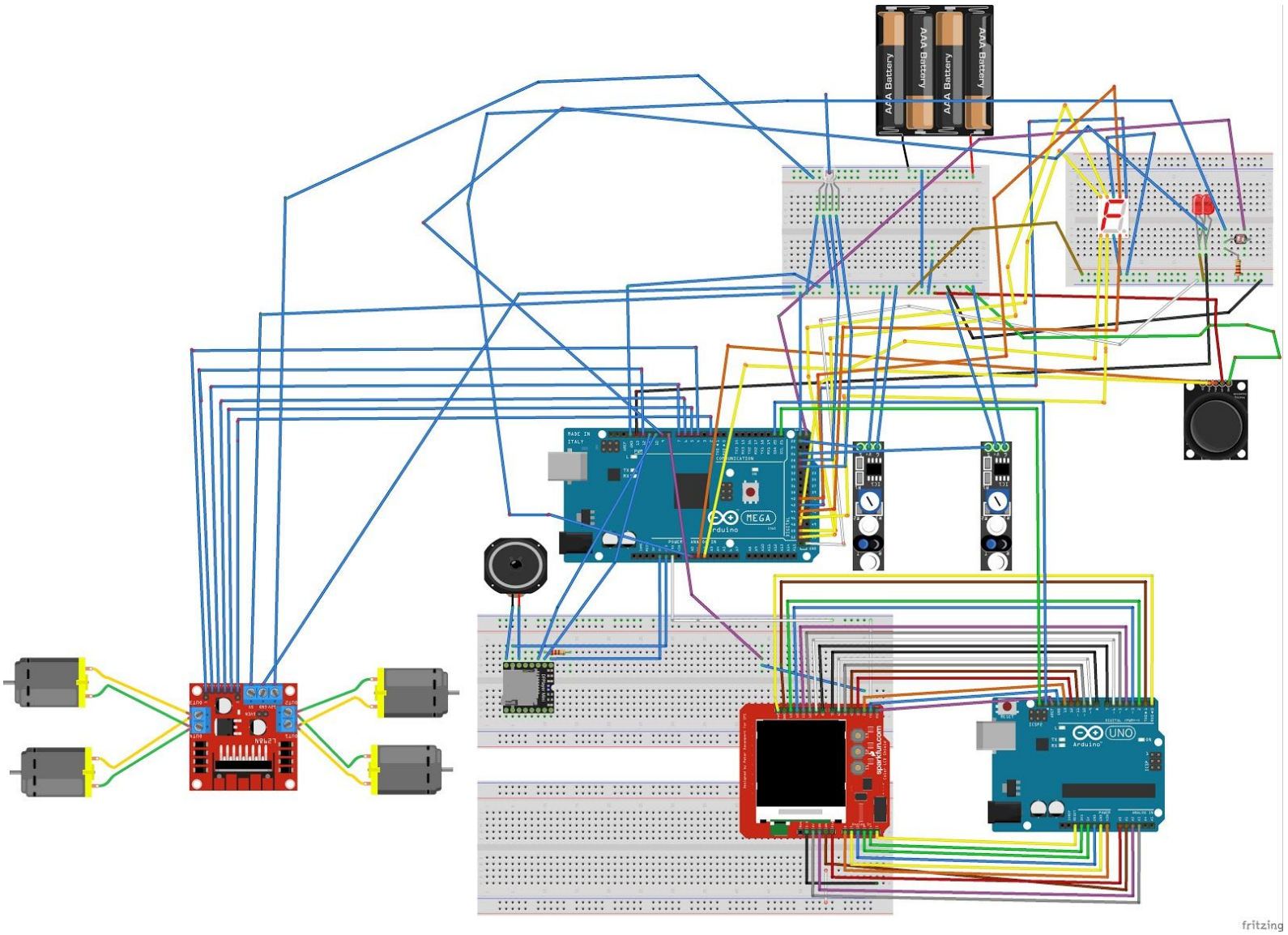
D - Project full circuit :

The resistor connected to the MP3 should be 1k, however, 1k was not available.
For the LCD, the LCD which was used in the project is 2.4 tft LCD which was not available on fritzing so an arduino color LCD shield was used instead. Pin names are different so I assumed that pin names are as the 2.4 tft one as follows:

Reset → -
3.3 → LCD_RST
5V → LCD_CS
GND → LCD_RS
GND → LCD_WR
Vin → LCD_RD
A0 → -
A1 → GND
A2 → -
A3 → 5V
A4 → 3V3
A5 → -

ref → -
GND → -
13 → LCD_02
12 → LCD_03
11 → LCD_04
10 → LCD_05
9 → LCD_06
8 → LCD_07
7 → LCD_D0
6 → LCD_D1
5 → SD_SS
4 → SD_D1
3 → SD_D0
2 → SD_SCK
TX → -
RX → -

The resistor connected to the photoresistor (LDR) should be 10k , however , it was not available on fritzing while drawing the circuit diagram, so, I used 220 instead while drawing the diagram.


AAA Battery
AAA Battery
AA Battery
AA Battery
MEGA
UNO
L298N
sparkfun.com
fritzing

E - Libraries and their Functionalities :

1. ***Arduino Mega:***
    - **Wire.h:** For the communication between the arduino uno “slave” and arduino mega ”master” (I2C).
    - **DFRobotDFPlayerMini.h:** For the MP3 player
    - **SoftwareSerial.h:** Enables serial communication between with a digital pin.
    - **Arduino_FreeRTOS.h:** For scheduling and dividing the code into tasks.
    - **Semphr.h**

2. ***Arduino Uno:***
    - **SPFD5408_TouchScreen.h:** For the touchscreen calibration and to specify the sensitivity of the screen.
    - **SPFD5408_Adafruit_TFTLCD.h:** Was used to start the communication with the screen, drawing the buttons on the screen, printing the song number on the screen and everything related to what is displayed on the screen.
    - **SPFD5408_Adafruit_GFX.h:** Adds core graphics library for displays
    - **Wire.h:** For the communication between the arduino uno “slave” and arduino mega ”master” (I2C).

F- Handling the inputs :

1. ***Arduino Mega:***

Part 1.1 :

Pins Used: 22 , 24 ,26

Type : Digital Pins.

For : the line Follower sensor .

For the left , right and center sensor that gives the arduino the input that according to this signal the car will move .

Photoresistor (LDR) and led :

The analog input received from the LDR is in pin A0 in the arduino Mega which is an analog pin in the arduino, taking the light intensity of the surrounding to display the output accordingly.

7 Segment and joy stick:

The input is received from the A1 and A2 in the arduino taking the position of X and Y from the joystick to display the output accordingly.

Sound System:

The arduino mega receives the data sent by the slave of address 8 from pin 8 which is an analog pin (PWM).

The input is received through serial communication in pin 10 which is an analog pin (PWM) and is handled by the library: *DFRobotDFPlayerMini.h.*

2. ***Arduino Uno:***

Pins 8 and 9 which are digital pins, pins A0, A1 and A4 which are analog pins

G- Handling the Outputs :

1. ***Arduino Mega:***

Part 1.1 :

Pins Used: 2,4,5,7,8 and 28, 30 .

Type : 28 ,30 are digital pins while 2,4,5,7,12 are analog pins (PWM pins).

For : H Bridge connected that is connected to the car motors .

For the 2 enables and 4 input signals for the H Bridge that will control the motion of the cars which wheel to slow down and which to move fast on detecting the input from the line follower sensor.

Photoresistor (LDR) and led :

The output is transmitted through pin 9 and pin 13 from the arduino giving voltage to the 2 LEDs to light up .

7 Segment and joy stick:

The output is transmitted through pins 40,42,44,46,48,50,52 from the arduino to the 7 segment lighting the corresponding leds in the 7 segment to display the corresponding letter (D,N,P,R).

Sound System:

The output is transmitted through serial communication in pin 11 which is an analog pin (PWM) and is handled by the library: *DFRobotDFPlayerMini.h.*

2. ***Arduino Uno:***

The output is transmitted to the arduino mega through pin 13 which is a digital pin.

H- FreeRTOS :

Two tasks were created, the first one contains the car movement “Lane Follower” and the second one contains all other components. The first task has the highest priority (2) and the second one has a priority of 1. A delay was added in each task to avoid starvation of the task with the least priority.

I- Problems or limitations faced during the implementation:

Sound System:

When connecting the LCD with the MP3 player using I2C, the LCD_RST pin uses pin A4 (SDA) of the arduino which is being used by the I2C. So the screen enters an infinite reset loop. However, it was working alone when it was not connected to the arduino mega as the SDA was not used to send data between the two boards. Also, the ground pin of the arduino was taken by the screen so we could not take common ground between the boards. This problem was solved by placing the screen on a breadboard to be able to take common ground as well as pins A4 and A5 of the arduino uno were left empty and the LCD_RST pin was connected to a common node on the breadboard which is connected to the reset pin of the arduino uno.

J- Work distribution among team members:

1. Lane follower part was divided into software and hardware, Farah took the hardware part and Kareem took the software part.
2. The 7-segment and joystick was done by Mohamed.
3. LDR and freeRTOS was done by Passant.
4. Sound system (MP3 and LCD) was done by Nour.