Embedded Project

Car Project

Anas ElNemr
Ahmed Ibrahim
Ahmed Farouk
Abdelrahman Hafez

December 2021

German University in Cairo

Project Description

The Project was Arduino based. Our goal was to build a car that can keep it's lane , light in the darkness, and play music. Our approach was first to research what components were needed, and then how to read/input data from them. Moreover, read the datasheet and understand how the connections will be made.

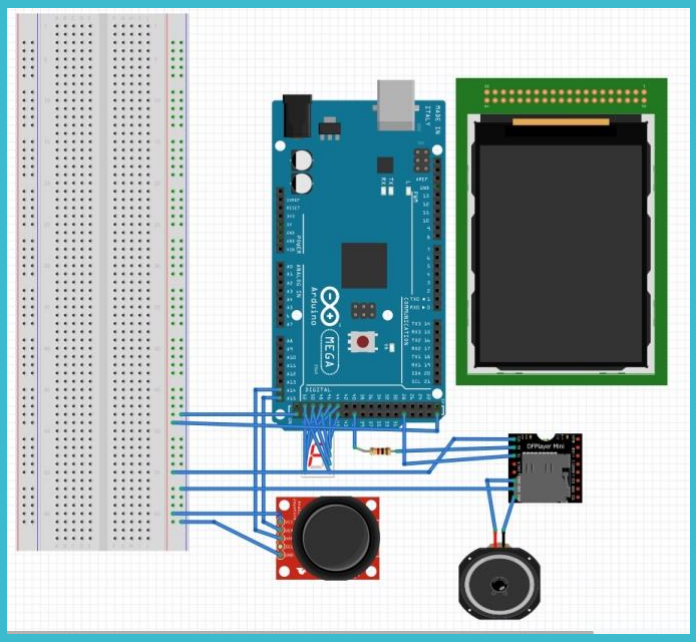
Components

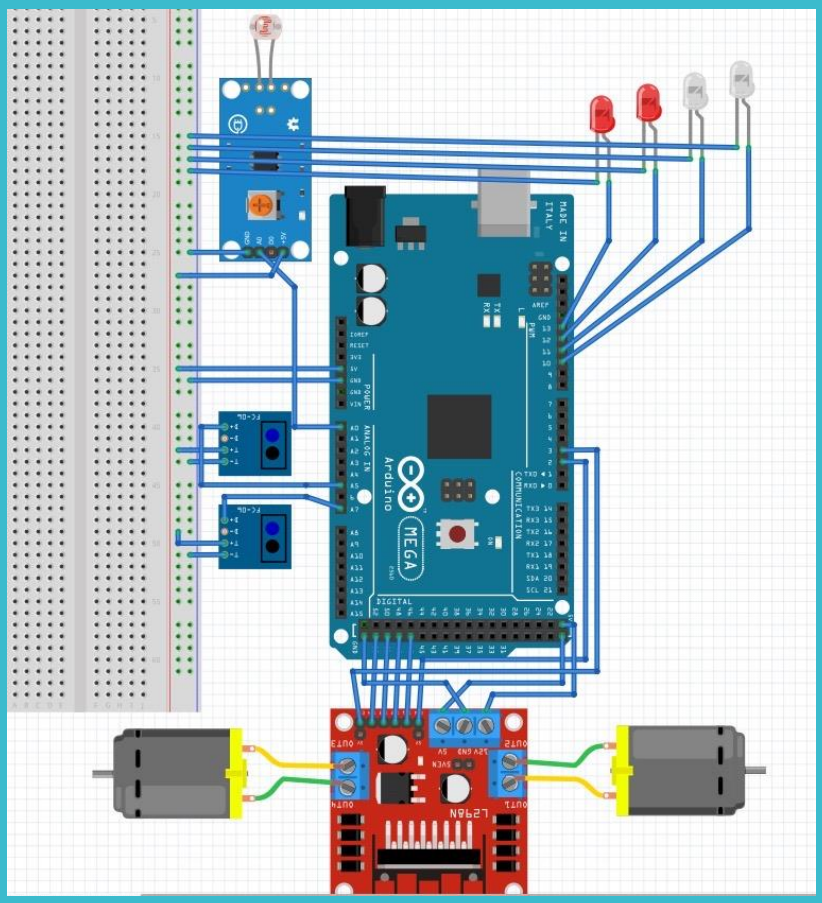
1. 4 LEDs
2. 1 SD Card
3. 2 Wheel Car kit
4. 2 Line follower (TCRT5000)
5. Light ambient Sensor
6. MP3 Driver
7. 7 Segment
8. Joystick
9. Speaker
10. Dual H-bridge motor driver using L298N
11. 2.4" Colour TFT LCD display
12.

Libraries

- #include <Arduino_FreeRTOS.h> (To handle Scheduling)
- #include <semphr.h> (Semaphore library)
- #include <AFMotor.h> (Adafruit Motor shield firmware)
- #include <Adafruit_TFTLCD.h> (Adafruit library for 8-bit TFT LCDs)
- #include "Arduino.h"
- #include "SoftwareSerial.h" (Allow serial communication)
- #include "DFRobotDFPlayerMini.h" (Library for LCD to play Music)
- #include <Adafruit_GFX.h> (Fonts Library)
- #include <TouchScreen.h>(4-wire resistive touch screen firmware for Arduino)
- #include <SPI.h>(Allows connections with SPI advices)
- #include <MCUFRIEND_kbv.h>(inherits from Adafruit_GFX)

Project circuit (Fritzing)





Handling Inputs

There are 4 main inputs to the Arduino :-

1. Light Sensor
2. Joystick
3. Line Follower
4. Touch Screen

Each Input is assigned an Input Pin and then based on it's use affects something.

- If the Light Sensor reads a value above 500 the LEDS open
- Depending on the joystick position the Car's gear changes.
- If the Line Follower reads a 1 then the Car moves left or right, depending on which Line Follower read the 1.
- Depending on where the touch occurred on the touch screen, the coordinates are sent to the Arduino and matched with the specified task that should be preformed.

Handling Outputs

There are 4 main actuators/output devices that responds to the inputs read by the Arduino:-

1. Head Lights
2. 7 Segment display (Gear Display)
3. Motors (Car Movement)
4. Speaker & Mp3 module

Each Output is assigned an Output Pin and then based on it's use affects something.

- The Head Light response according to the inputs read by the light sensor
- The 7-segment display show the gear position of the joystick currently
- The Left and Right motors moves forward or backward according to the inputs that was read by the line follower sensor, so that the car can turn left or right by reversing the direction of the right wheel to move right and reversing the direction of the left wheel to if the sensor detected that it should move left to stay on the lane.
- The Mp3 module read the file (song) that was chosen on the touch screen from the SD card and send the audio signals to the speaker accordingly.

Features prioritizing and task scheduling

There are 4 main task divided on 2 different Arduinos:-

- The bottom Arduino consist of 2 main tasks. Task#1 (motor - line followers - blinker warning) which is responsible for the car movement thus given the highest priority to keep the car moving. Task#2 (light senor - headlights) which is responsible to detect when it start diming and lights the road up, and as it's not as critical as the movement/speed/direction so it's given a lower priority. Both tasks are scheduled with a minimal delay between each other to allow the other task to run, with Task#1 having a delay of 20ms and Task#2 having a delay of 100ms to allow more time for Task#1 to keep running as it's of a higher priority.
- The Top Arduino consist of 2 main tasks as well. Task#1 being the (LCD - MP3) which is responsible for the sound/entertainment system thus given a lower priority. Task#2 (7segs - joystick) which is the gear setup thus given the highest priority on this Arduino board as the gear chosen should be set and displayed right away to determine the motion of the car. Both tasks are scheduled with minimal delays as well, with Task#1 having a delay of 100ms and Task#2 having a delay of 20ms, so it can runs 5 times before Task#1 gets it's turn again.

Problems and Limitations Faced

One of the main issues we Faced was choosing and adjusting the positions of the 2 line follower sensors, as they weren't detecting the Black Line drawn. Therefore we had to reposition them a couple of times until we managed to get them as close to the ground as possible and finally start reading some accurate results. Then the decision of whether to place it at the very edges of the car or at the middle followed, after a couple of trials and errors we found out it was the best to have it in the middle so the car won't deviate a lot before it start to counter steer and recorrecting it's direction back on the Lane.

Another issue was the touch screen as it kept choosing just a white screen no matter what design or code we write to it. Until we found out after a bit of research that the issue was on a library latest version that was needed for the lcd screen to run, and we had to install an older version of the library instead. It took us quite a long time to figure that out but once we did that everything worked perfectly!

How did we divide the work among us

We had the team split up on 2 main tasks, 2 of us (Anas ElNemr & Ahmed Farouk) were responsible for the top level which consisted of the Entertainment/Sound system (Dealing with the Touch Screen and it's issues, finding a suitable design and writing up the code needed to control the mp3/speaker from the touch screen and displaying the needed info on it (ex. song name/number) as well as being able to control the sound level/Equalizer/moving back and forth between songs and having the total number of songs displayed on the screen, Dealing with the mp3 module and writing up it's code to have it working successfully and connected with the speaker). The other task was to connect the joystick and the 7-seg display to the Arduino and writing it's code as well to output the movement of the joystick on the 7-segment display.

The other 2 (Ahmed Ibrahim & Abdelrahman Hafez) worked on the bottom level that was responsible for the car movement and had tasks that consisted of (Wiring up the motors to the H-bridge, adjusting and positioning the line follower sensors and dealing with the issues that came along with it, connecting both of them to the Arduino and wiring the warning lights (blinkers) at the back of the car to the Arduino as well, writing code that would be responsible for lane departure detection and the change in motors speed and direction needed in response to the input read by the sensors to adjust the direction and having a warning light on the left or the right side before it start following the lines again. The other task was to connect the light sensor and the Headlights to the Arduino and writing it's code as well to reflect the inputs of the light sensor in the form of head lights being turned on or off accordingly.

We also had common tasks in between that we all meet and had it done together such as building up the car as a whole and connecting the 2 levels (bottom/top) levels together, wiring up the 2 Arduino's together and setting up the i2c connection, And finally deciding for what tasks would be together and scheduling the 4 tasks we had on the 2 Arduinos.