CSEN 701

Project Report

Team_9

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Invaded Systems

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Brief Description

The goal of our project is to make a car with these features: Follow a lane and detect whenever it goes away from it, a rain sensor in the car that will turn the servo on like windshield wipers, a fuel tank that will display its level on a 7 segment display and an FM radio that will be controlled from the touch screen.

Components

First, we have an Arduino mega which is the master board, and an Arduino Uno. The components connected to the Arduino mega are, the rain sensor to detect the water, a servo motor to rotate whenever water is detected, a water depth sensor that measures the depth of the fuel tank, a 7 segment display that has the fuel level on it with the help of the 7 segment decoder, 4 dc motors connected to the H-bridge which is connected to the Arduino Mega to control the motion of the 4 wheels attached to the 4 motors, FM radio connected to a speaker to hear different channels, then we have the Arduino UNO which has the TFT 2.4 screen shield on it and it is connected to the mega board using the I2C to control the FM radio.

Circuit
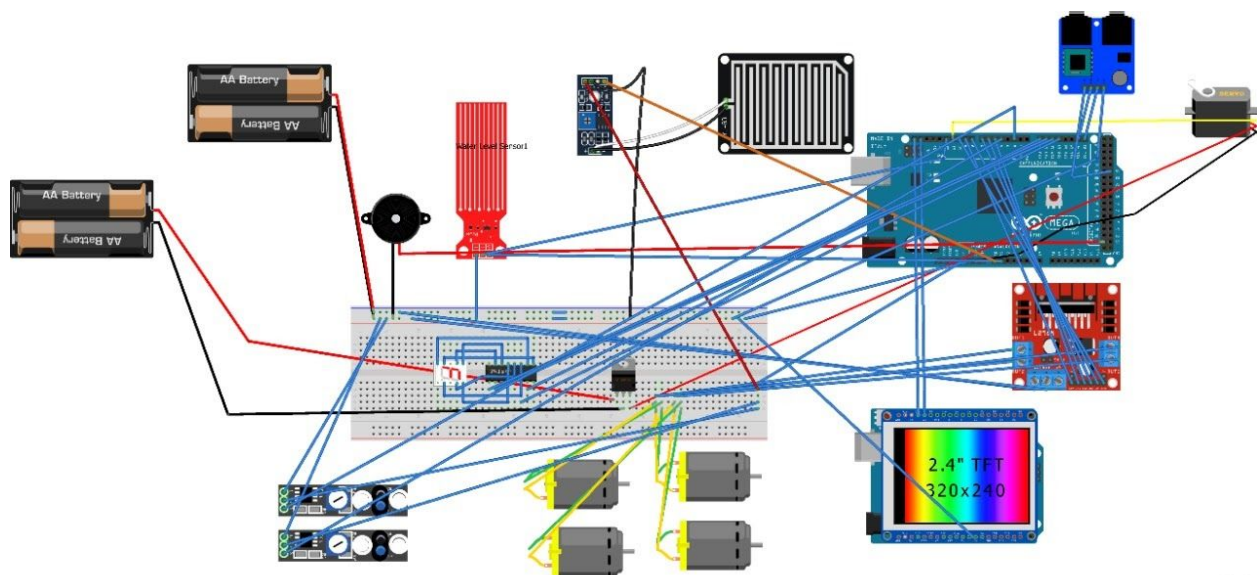
Libraries

Adafruit_GFX

The Adafruit_GFX library for Arduino provides a common syntax and set of graphics functions for all of our LCD and OLED displays. This allows Arduino sketches to be easier to draw.

MCUFRIEND_kbv

MCUFRIEND_kbv inherits all the methods from the Adafruit_GFX class and Print class:

The only "new" methods are hardware related: vertScroll(), readGRAM(), readPixel(), setAddrWindow(), pushColors(), readID(), begin()

So it's just like the Adafruit but with some extra functionalities to help us with the screen.

TouchScreen

This is the 4-wire resistive touch screen firmware for Arduino.

- The above three libraries are all concerned with the touch screen and they are similar but provide us with some methods to make our work with the TFT 2.4 touch screen a little easier.

TEA5767

A simple library that allows us to set the frequency of the TEA5767 FM radio module.

Wire

This library allows us to communicate with I2C / TWI devices. We use it to communicate with the FM Radio and between the two Arduino boards

Arduino_FreeRTOS

This library is used to schedule tasks in the project.

Input Handling

Line Follower sensor has 3 digital outputs connected to our mega pins and we use the values of these outputs with digitalRead to control the car.

Rain sensor has one analog output connected to our mega analog pins which tells how much water is on it and we use the value with analogRead to control (servo).

Water depth sensor has one analog output connected to our mega analog pins which tells how much water is it submerged in and we use this value with analogRead to display the fuel tank capacity

Touch Screen connected to UNO has two buttons displayed on it using the TFT libraries which are the 2 inputs needed to either turn on/off the radio or switch station. These values are fetched using the wire library and the I2C from uno to mega

Output Handling

Servo Motor connected has one analog input which he gets from our mega PWM pins to decide the rotation using pwmWrite.

Fm radio and speaker gets one analog output from our

H-bridge gets one analog output which decides the speed at which the 4 dc motors will rotate using pwmWrite.

7 segment display has 7 digital inputs from the 7 segment decoder and the decoder gets 2 digital inputs from our mega to decide which level will be displayed on the 7 segment display.

Touch Screen connected to the UNO and outputs the current FM radio frequency and state and has two buttons drawn on it to be used as inputs.

RTOS Tasks Division and Priority

We created four tasks in our code:

1. TaskLKA for lane keep assist
2. TaskRainSensor for the rain detection
3. TaskFuelLevel for the fuel level detection
4. TaskRadio for the FM radio modulo

All the four tasks have a priority of 1.

Problems and Limitations

First, we faced a problem when trying to work with the TFT touch screen because we didn't know that it will take all the pins on the Arduino Uno and this was solved by buying the Arduino mega. Moreover, while drawing the circuit diagram on Fritz we couldn't find a model for the line follower that we used so we used two line followers for the circuit diagram but it's the same concept with no differences. Another problem we faced was that

the voltage from our batteries was too high and might burn the components and that was solved by using the voltage regulator and connect it to the low voltage components. The last obstacle we faced was having a common ground between both Arduinos and the screen because the screen took the ground pin so we solved the problem by using male-female jumpers to connect the screen with the Arduino Uno to be able to take a common ground from both of them.

Work Division

The project was mainly divided into 4 big stages:

Stage 1: building the car and calibrating the H-bridge with the dc motors and the mega. Mainly done by Mohamed Fathi and Ashraf.

Stage 2: connecting all the sensors and their configurations.

Mainly done by Bassel and Ahmed Abdo.

Stage 3: connecting all the actuators and their configurations with the sensors if needed.

Mainly done by Bassel and Mahmoud Reda.

Stage 4: connecting both Arduinos and scheduling the tasks.

Mainly by Mahmoud Reda and Ahmed Abdo