Embedded Systems Project

The Vesla Car

Team Details:-

Team Number: 12

Team Name: Runtime Terror 1

Team Members:

- Mohamed Amr Aboushnief 40-1465
- Abdelrahman Adel 40-515
- Ali Ibrahim Elsebaie 40-2574

A- Brief Description:

In our project the Vesla Car we implemented a miniature version of an electric car with functionalities that are implemented in real life electric vehicles. Our car has an ADAS functionality and two BCM functionality which will be discussed in the following sections. Our car is also controlled over Bluetooth in which commands are sent from a mobile application on a smartphone over Bluetooth so that the user can accelerate and steer that vehicle. This uses 4 DC motors to move it and pulse width modulation(PWM) to control the speed of the car.

B- Poject components:

I. ADAS Functionality:

For the ADAS (Automatic Driving Assistance Systems) functionality we chose the Automatic Emergency Braking system (AEB) because it is the first line of defense for protecting the passengers in the and pedestrians outside the car. To implement the AEB system we used an ultrasonic sensor to measure the distance of obstacles in

the car path, we used a buzzer and red LED to warn the driver that there is danger ahead, the car will stop automatically when the ultrasonic sensor measures a specific threshold distance that is guaranteed that the car can stop before colliding. The ultrasonic works by sending sound waves to the environment and waits for the echo of the sound waves to return back and using the speed of sound it calculates the distance of obstacles that are in front of the car.

II. BCM Functionality- 1:

For the BCM (Body Control Module) function we made a General-Purpose Display and Automatic Headlights.
We displayed crucial info that the driver needs in order to drive safely which are the current gear, date and time and temperature, all of these information are displayed in real time for the driver. We also have automatic headlights that senses the light intensity and if it detects that the environment is dark that the driver will not be able to see properly it will activate the headlights immediately without the driver intervention so that he can focus on driving only. We used a TFT colored LCD as the dashboard, we used a temperature and humidity sensor, an RTC clock module so that we can display their readings to the driver on the dashboard, We also used a joystick to mimic the gear selector functionality in

automatic transmission vehicles. For the automatic headlights we used a light sensor that senses the light intensity and when the light intensity reaches a specific threshold the LED headlights will be activated automatically.

III. BCM Functionality- 2:

The second BCM functionality was a Luxury functionality, we implemented a keyless entry system so that the user can enter his vehicle without using a mechanical key and without any effort, It also guarantees the car safety from any theft because it only allows the key with the driver to lock and unlock the vehicle because that key has a unique ID that no other key has. After the unlocking of the vehicle the user have to press the engine start button to start the vehicle in order to move it around, also the status of the lock of the vehicle is displayed on the dashboard. We used a button to mimic the engine start button we also used a Radio Frequency Identification (RFID) module which is the module that identifies the ID of the keys.

C- Libraries Used:

-#include <Arduino_FreeRTOS.h>

This library is the library used for including the FreeRTOS in the Arduino environment so that we can use it's functionalities.

-#include <dht.h>

This Library is used for interfacing with the temperature and humidity sensor

-#include <Adafruit_GFX.h>
-#include <MCUFRIEND_kbv.h>

Those two libraries are used together for interfacing with the TFT LCD so that we can use their functions to write texts and specify fonts and colours and othe cool features.

-#include "RTClib.h"

This library is used for interfacing with RTC module that is responsible for the date and time.

D- Input/Output Configurations:

Inputs :-

- joystick : analogRead
- light sensor: analogRead
- powerButton: digitalRead

Outputs:-

- Headlights: digitalWrite
- Motors : digitalWrite and analogWrite for speed(pwm)
- Ultrasonic sensor: digitalWrite
- Brake lights: digitalWrite
- Unlock lights: digitalWrite

There are other components that their libraries handle everything and we just connect the pins. Some of them are digital and some are analog

E- FreeRTOS :

We divided our features in 4 tasks

xTaskCreate(startEng,"startEngine",600,NULL,1,NULL);

We made a separate task with the least priority for the RFID because reading the key is not that important after unlocking the car and also the RFID module doesn't need a fast executing task because we tested it as the least priority and it works well.

xTaskCreate(control,"Drive",500,NULL,4,NULL);

We gave the control task the highest priority because it is the most crucial task as it has the automatic braking system too which needs to be engaged as fast as possible to ensure safety and also the control if the vehicle needs to be executed as fast as possible for the safety.

xTaskCreate(headLights,"headLights",100,NULL,3,NULL);

xTaskCreate(dashboard,"dashboard",300,NULL,3,NULL);

We decided to give those two tasks the same priority because after trial and error we found that this setting gave the best results and the fastest executing of those two tasks and the user would not experience any delays.

F- Challenges:

We faced a big challenge in interfacing the LCD and choosing the best suitable delay for it's task as our LCD was more complicated then the one that other teams used but we wanted our project to look good so we decided to take the challenge. We also faced a problem in implementing semaphores for locking and unlocking the car but it went well and worked at the end luckily.

G- Teamwork:

As a team we wanted to enjoy every part of this project and embrace it, We wanted to get the maximum experience from that project so we all worked with each other on every part of the project without any hesitation.