CSEN 701 Embedded Systems

Project Report

Team Number: 16
Team Name: Embeddedteam

Group Members:

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Project: APA+ CI + SS

Project idea and Approach.

The project is based on modern day cars. It is designed to mimic the nowadays vehicles regarding safety measurements, entertainment features. The features that we have chosen to work with are the Active Parking Assist, Control indicators such as Current Gear Display and Adaptive headlights and lastly a Sound System that can be controlled using a touch screen.As for the first feature which is the Active Parking Assist (APA) we used ultrasonic sensors in order to make the parking process more easily by being aware of the distance surrounding the car. When the car finds the perfect spot, it automatically parks the car with only the assistance of the sensors.As for the second part which is the Control Indicator ,it contains two features. To show the current gear display we used a 7 segment display and a Joystick. We used the joystick to move in 4 different directions representing the 4 automatic gears (p, r, d, n), which we display on the 7 segment display as small letters. The second feature is the Adaptive Headlights and to implement this we have used a LED and a Light Intensity Module that detects any change that happens regarding the light. We have made the LED light at different intensities depending on the brightness around the car. So if the car is surrounded by darkness it lights up to its maximum. If the brightness around the car is medium it lights a little bit less. If the brightness is high(example : sunlight) it should light up but at a very low intensity. Coming to our last feature which is the one mainly for entertainment, the sound system.We used an MP3 Module to insert the SIM card filled with the pereferd songs, we used a speaker to output the song chosen and a LCD touch screen to choose the desired song to be played. All these features were later scheduled and added having all the same priority in order to be able to work simultaneously together.

Components Used

- **Arduino uno**
  Functionality: used as the slave. We used it to connect to the LCD touch screen and then send its output to the master(arduino Mega)
- **Arduino mega**
  Functionality: Used as our master where we used it to connect every other component and integrate our code on it
- **MP3 mini player**
  Functionality: the mp3 player plays the music downloaded on an SD card placed inside it
- **SD card**
  Functionality: stores music (our music was in .mp3 format)
- **Speaker**
  Functionality: produce audio output
- **Touch Screen (LCD)**
  Functionality: Used to as an input to control the sound system by touching the required action on it.
- **Ultrasonic Sensor**

Functionality: Used as an input device to get the distance between two objects. We used it in the car to help us park by knowing the distance it can move before it could collide with an object.

- **HBridge**
  Functionality: Used to allow the motors we use in the car to move forwards or backwards.
- **Light Intensity Module (LDR)**
  Functionality: Used as an input to be able to detect the intensity of the light surrounding it.We used it while working with the headlights in the car.
- **LED bulb**
  Functionality: Used to emit light as an output. We used it with different intensities to show the difference in the headlights of the car.
- **7 Segment Display**
  Functionality: Used as an output to display the 4 gear methods(p, d, r, n)
- **JoyStick**
  Functionality: Used to move up , down , right and left and each display a different thing using the 7-segment display.Used as an input for the 7-segment display.

Libraries Used:

#include "SoftwareSerial.h"

- This library allows serial communication while doing other tasks

#include <Wire.h>

- This library allows the communication between IC2 devices(uno and mega) using the bus.

#include "DFRobotDFPlayerMini.h"

- This library allows us to use the mp3 mini player to play music, pause, play next, etc.

Inputs and Outputs:

MP3:

The mp3 mini player has 8 pins. We take the 2nd and 3rd pins (RX,TX) as inputs to the arduino board. We connected them to pins 11 and 10 respectively and declared them as iSoftwareSerial mySoftwareSerial(10, 11); in the code to use them for serial communication.

Master & slave:

The master takes inputs from the slave. We connected the SCL in slave to SCL in master and SDA in slave to SDA in master.

LED:

It is connected to pin 5 in MEGA and it takes an output.

Joystick:
It inputs to MEGA using A0 and A1 as analog inputs.

7 Segment Display:
It uses pins (a-45 , b-42, c-41 , d-39, e-49 , f-44 , g-47, d1-46) which are pins on MEGA. It outputs.

SD card
It is used as an input
Speaker
It is used as an output to the sd module
Touch Screen (LCD)
It is used as an output. It uses all the UNO pins.
Ultrasonic Sensor
It uses trigger as an output and echo as its input
The first sensor has trigger as 37 , echo as 36 and the second sensor has trigger 33 and echo 32.
Light Intensity Module (LDR)
It inputs to MEGA using A2 as an analog input.
Buzzer:
It outputs data using pin 3 on MEGA

h) Explain how the features were prioritized and divided into tasks using freeRTOS

We gave all features the same priority (priority=1). We divided the features into 4 tasks. One task for the parking, one for the headlights, one for the gear, and one for the sound system.

i) The problems or limitations faced during the implementation of your project.

The biggest problem we faced was failure in the hardware components. We were unable to connect to the mp3 player even though we were sure of the code and connections and it turned out one of the jumpers was not working. Later when doing the scheduling, the arduino board itself stopped functioning properly and was giving us incorrect outputs. We used another one and it finally worked.
We had some problems in implementing some libraries.
Some of our team members had the corona virus and this led us at first to fear meeting with each other. And after a while we had to continue meeting as we had a lot of work to be done and the deadline was not going to be changed. We worked with a lesser number of team members than normal and this of course made the work even harder. Working remotely was not the best way to work on a hardware project.

j) How did you divide the work among the team members?

We mainly worked together but each one of us were assigned and responsible for one of the features in this project.

Mariam Emad : Sound System + Connection between UNO & MEGA
Mariam Enany : Current Gear
Sara Walid Saied : LCD Touch Screen
Miral Abdullah : Adaptive Headlights
Hoda Elhemaly : Parallel Parking + Ultrasonic Sensors