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|  |  |  | 19-01-2023  Embedded Systems Architecture | |
| Arduino\_FreeRtos  Autonomous embedded system Vehicle | | | | |
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| A-Introduction This is An Electronic unidentified robotic object or E.U.R.O for short designed and implemented to mimic a real time scheduled embedded system using an Arduino uno board and the ATMEGA238-B micro-Controller on board to schedule several individual tasks of different severities and types varying from hard to soft Real time systems assuring that all of them try to meet their respective deadlines while favoring tasks of higher priority if the case arises and two tasks conflict | |
| B-HARDWARE 1.Sensors :  *i-IR-Sensor: An analog /digital Sensor that detects light intensity and returns a Value between 0 (Detecting) and 1024 (not detecting).*  *ii-Light Sensor Module: A digital Sensor Module that detects the existence of light 0(Detecting) and 1(not detecting)in the surrounding environment using the on board photo-resistor .*  *iii-Joy Stick Module : An Analog Sensor That detects motion in both x and Y direction and returns value between 0 and 1024* | 2- Actuators*:*  *i-5V DC Motor and h bridge l298n: used with PWM to simulate motion at different speeds*  *ii-7-Segement 4 digit display Used in displaying data that represents the system state*  *iii-8-Ohm Speaker and SD Card module : a magnetic speaker that and SD card used to play different Sounds and Audio.wav files*  *iv-RGB Led: A red ,Green , blue led module with on board resistor used in indicating different states of the system by different colours of light* |

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| C-Libraries 1. TM1637Display.h:  *The library used to communicate with the 7-segemnt display mentioned above through mapping the value of the desired character to different segments of the specified segment*  2. SdFat.h:  *The library used to communicate with the Sd Card module and reading data from it and sending it through the Arduino board* | 3. TMRpcm.h:  *The library used to communicate with the 8-Ohm speaker and send values read from the SD card to it as a digital audio signal and controlling the pausing ,playing and next actions of said audio files*  3. Arduino\_FreeRTOS.h:  *The library used for creating the various task of the system and assigning them priority according to the developer intention and then scheduling said tasks accordingly* |
| D-Handling Inputs 1. Lane Keeping assist:  *2 IR sensors that read the road. If they detect high (black line), the input is sent to slow a side of the car so that the cat returns into the lane.*  *I.E if the right IR sensor detects black line, the input becomes over 700 which means car is sliding left and leaving the lane so right motor slows down (left stays same) so car moves right.*  2. Control indicators :  *i-The joystick that changes the gears on the seven segment display by inputting X >1000 or X<50 or* | *Y>1000 or Y<50 to the Arduino and Arduino sends output to 7 segment display*  *ii- the light sensor is used to control the RGB led module through the Arduino board when it detects light (1) a signal is send to the Arduino and the microcontroller onboard orders a high signal to the led.*  *3. Sound System:*  *The SD Card module is used to read data from the installed 4GB SD Card and send it to the Arduino board to channel it to the (-ohm speaker .* |
| E-Handling Outputs 1-An RGB Led that uses pins 7(blue) and 9(red) of the Arduino. It turns blue when light sensor does not detect light and lights red when the car drifts out of its lane to warn the driver.  2-Motors connected to a H-Bridge connected to pin 5 and a 9V battery to power on the  motors depending on the result | of 2 IR sensors in front of the car (mentioned how they work in part D)  *3* A 7-segment display that starts by showing name of car and then show current gear that changes to P/R/N/D depending on the coordinate that the joystick moved to.  An SD card reader and a speaker to output music. |
| F-Features 1-Lane Keeping Assistance that keeps car on track  Lane Keeping Assistance had the highest priority (3) because missing its deadline can be fatal for the driver.  2-Light Indicator that turns on light when it is dark. A gear display that displays current gear. Gear Display and | Light Indicator both have same priority (2) as them missing a deadline is not fatal for the driver.  3- Sound system thay plays music. Sound system has lowest priority (1) as if it misses deadline, it will only cause annoyance to the driver |
| G-Problems and limitations faced 1-The tasks were not being scheduled and run due to the limitation of the Arduino’s stack size and memory. H- Division of labor 1- Display of gears was made by Daniel and Samuel  2-SD card reader and speaker was made by All of us (it was annoying yes) and even for another Karim from IET | 2-The calibration of the IR  sensors that detect if the car is leaving the lane.  SD card reader was using too much memory from the Arduino that it was preventing other tasks from running.  3- Light Indicator was made by Mostafa and Abanob  4-Lane Keeping Assistance was made by Karim and Mostafa |
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| Always Check the Data Sheet |