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TASK 2: "DESIGN OF AN AUTOMATIC PARKING SYSTEM FOR A SMART CAR"

-V life cycle-

Requirement:

-The system must be able to measure different distances necessary for the automatic parking of the vehicle.
- The flow of information coming from different sensors must offer results more readable and easy to process
- Detection of the dimensions of the parking space
- Design a system of measurements of the distances necessary for the automatic parking based on the CAN bus.
- Design the necessary algorithms for parking automatic vehicle.
- Development of the automatic parking application of the vehicle on an embedded platform.
- The data must be displayed in an HMI interface of Dashboard.

System Requirements:

PAR_001: The system shall be able to measure different distances necessary for the automatic parking of the vehicle.
PAR_002: The distance sensors shall offer results between cars and obstacles in Cm.
PAR_003: The distance sensors shall indicate the localization of the obstacle vis-a-vis the car.
PAR_004: detecting an empty parking space.
PAR_005: Measuring the length of the empty parking space.
PAR_006: Measuring the width of the empty parking space.
PAR_007: The data collected by the distance sensors shall be sent to the HMI node through the CAN bus.
PAR_008: The data collected by the camera shall be sent to the HMI node through the CAN bus.
PAR_009: The data shall be displayed in an HMI interface of Dashboard.
PAR_010: The system shall be able to work in two types of parking parallel and perpendicular.

Architecture Design

Hardware

Component	Requirements	Final choice
Microcontroller		Raspberry pi 3 b+
Chassis	~20 to 30 cm car 4 wheeled, with steerable front wheels and brakes moved by servomotor and DC motor	
Distance Sensor	weather-resistant, capable of measuring distance with a range, and it has to work also in daylight and night time,~1Hz read rate	
Buzzer		
IHM		
Battery		
Rear Camera		

Software

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Module Design:

First unit: System start unit

1. The user shall have access to the IHM interface where he can launch the parking mode.
2. The user shall have access to the IHM interface where he can choose which type of parking to follow parallel or perpendicular.
3. The user can abort the system using the IHM interface if needed.

Second unit: Empty spot detection unit

1. According to the user's choice, the system starts shearing for an appropriate spot to park.
2. The car shall keep moving forward until it finds an empty spot or an obstacle in front of it.
3. If the car doesn't find an empty spot then the user can decide to stop the parking process using the IHM interface.
4. The spot shall be empty and wide enough for the car to fit in.
5. The size of the spot is measured using ultrasonic sensors.
6. The collected data of the distances are displayed on the IHM interface.
7. The size of the parking spot depends on the type of parking and the size of the car.
8. The user can abort this unit using the IHM interface if needed.

Third unit: Parking process unit

1. The parking process shall start only if an empty spot is found by the system and the user agreed to start parking on the IHM interface.
2. The movement of the car wheels depends on the type of parking and the rear camera view.
3. A buzzer sound is lanched whenever an obstacle is too close and its frequency increases with the decrease of the distance between the obstacle and the car.
4. The user can abort this unit using the IHM interface if needed.

Fourth unit: Emergency brake unit

1. The car shall stop immediately when the emergency brake the system and the car.
2. The system is aborted after the emergency brake is launched.
3. The user can launch the emergency brake through the IHM interface.
4. The emergency brake can be automatically launched when an obstacle is detected during the parking process.
5. Once launched the emergency brake can not be aborted.

Unit tests:

Unit	**Input**	**Output**
System start unit	• User start command on the IHM. • User parking choice.	• Parking type
Empty spot detection unit	• Parking type. • Ultrasound data.	• Empty spot detected • Ultrasound data
Parking process unit	• User command • Empty spot • Parking type	• Wheels movement. • Buzzer sound.
Emergency brake unit	• User command • Obstacle detected	• Wheels stop

Integration tests:

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