PROJECT ALTAIR

Week 1

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Contents

1 Theoretical Part

1.1 Task 01

Task 1. Architecture for a self-driving delivery robot

While a SBC is a full computer with a RAM that can run a complete OS and run all other tasks similar to a computer, the micro-controller can only run specific commands as instructed.

For autonomous driving of a robot, the SBC is a rather safer choice as it can do multiple things at a time, but the micro-controller is a much more efficient choice when it comes to a smaller scale project.

For this scenario, The robot has gear motors and PWM-controlled motor drivers for wheels, servo motors for steering, a rotary encoder, GPS, IMU, and a Stereo Camera. All of these can be brought together with a simple micro-controller, for example - **Arduino UNO**.

So here, the brain will be an Arduino, which can communicate with all the other components. The GPS will start by getting the current location and the target location to set a track for the car. The Motors will be controlled by the PWM motor drivers. These drivers will send the motors to be turned on or off based on the current track obstacle. If there is no obstacle the motors will run on full speed. And to determine the obstacles, we can use the stereo camera. It can sense the obstacles to it's right sensor or left sensor.

- If there is an obstacle to it's right - near, it can slow down, reverse to right and move to left.
- If there is an obstacle to it's left - near, it can slow down, reverse to left and move to right.
- If there's an obstacle to the right - far, it can start to move left.
- If there's an obstacle to the left - far, it can start to move right.
- If there are obstacles to both side - far slow down and stop when they are near.

A rotatory encoder can take care of the turning left and right with inputs from the sensor data and then the IMU can keep the car from losing it's balance while turning or reversing from the data by slowing down the motors or speeding them up.

The reason to pick an Micro-controller over the SBC is for more efficient alogorithms and less complexity. For a bigger scale project the SBC would be safer choice.

References

1. SBC vs Micro-Controllers
2. Functional Architecture for Autonomous Driving
3. Realization of Self Driving Vehicle with Microcontroller

1.2 Task 02

Task 2. Protocol to establish communication between Arduino Mega and Nano

Asynchronous Transmission: Data is sent in form of byte or character. It depends of the amount of time needed to be specified for per byte, which is generally specified as 9600bauds/sec. This transmission is the half-duplex type transmission. In this transmission start bits and stop bits are added with data. It does not require synchronization. Such as UART Communication.

Synchronous Transmission: Data is sent in form of blocks or frames. This transmission is the full-duplex type. Between sender and receiver, synchronization is compulsory. Such as I2C and SPI Communications.

Synchronous communication is more efficient and more reliable than asynchronous transmission to transfer a large amount of data. It is also slower than Synchronous communication. Even though, the UART communication is very much simpler to connect both NANO and MEGA on a PCB, it still falls far behind synchronous communications when it comes to transferring large ammounts of data over limited time.

Between the two types of Synchronous communication methods, the I2C and the SPI, The SPI being a Full-Duplex connection, it can handle data travelling from both the master and the slave at the same time. It is doesn't require a slave id like the I2C, which also makes it so much more faster and can transfer more data. The SPI can work with multiple devices at the same time with the same clock, MISO, MOSI connections. Even though the SPI is only capable of keeping a strong connection within the range of 20cm, whereas the I2C can maintain even at a 1 meters distance, this is where the PCB comes in handy.

Connecting the Arduino NANO and MEGA onto a PCB with a SPI communication is viable as it does not require much distance between the two micro-controllers. As both NANO and MEGA have support for SPI, and has the SPI library to simplify the use, it is a very viable option to use SPI connection for connecting the two devices.

References

1. Synchronous vs Asynchronous Communication
2. Arduino UNO vs NANO vs MEGA
3. Arduino UART Communication
4. Arduino SPI Communication