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1 Progress

- [Erdem] Generally, DC motors types (for general robotics applications) are divided into 2, as listed below. Motors such as stepper and servo are omitted, since they are (possibly) not related with driving a vehicle.
  - Brushless DC Motors: Brushless DC motors do not use brushes. The rotor is a permanent magnet and the coils do not rotate, but are instead fixed in place on the stator. One advantage is energy efficient since there are no brushes to cause additional friction in the motor. Another advantage is durability, nothing to be broken inside. Moreover, the noise inside is lowered considerably which results in high torque and precision in controlling. These motors are mostly used in CD drivers and drones.
  - Brushed DC Motors: Brushed DC motors use the brushes to conduct current between the source and the armature. A variation of such motors is geared DC motors. They have a gear assembly attached to the motor. The speed of the motor is reduced with an increase in torque with the help of gear assembly. By usage of the gears, the speed of the DC motor can be reduced with an increase in torque. For controlling geared DC motors, L293D motor driver is normally used in hobby robots.
- [Erdem] Some important points on selecting the right motor are:
  - Electrical Characteristics: Op. voltage, max. current
  - Mechanical Characteristics: Motor type, torque (load, no-load), rpm
  - Battery: Battery should be capable of supplying required current
- [Halil] Image/Video processing can be done using OpenCV, Open Source Computer Vision Library. Written in optimized C/C++, the library can take advantage of multi-core processing. Enabled with OpenCL, it can take advantage of the hardware acceleration of the underlying heterogeneous compute platform.
  - for more info https://github.com/opencv/opencv

  - can be done using Python on Raspberry Pi directly
    - can be slow in high resolutions due to processing power of raspberry.
    - one simple example using Haars Cascade added to repository
  - can be done using Matlab on computer
    - uses C++, native language support.
    - can be slow due to video transmission between robot and device
    - visionSupportPackages should be added to Matlab, there are examples for learning the basics
    - https://www.mathworks.com/help/vision/ug/opencv-interface.html
    - https://www.mathworks.com/discovery/matlab-opencv.html

- [Erdem] Lane detection is mostly done using OpenCV libraries. Some of the applications (using highway roads) first corrects the distortion in the frame. Then a color thresholding is applied since most of the lanes are confined within white or yellow colors. Later, Canny Edge Detection is used to detect the edges. An algorithm is run afterwards to filter the irrelevant detections in the previous step. Lastly, ultimate lines are fitted into the best-line as a result.

- [İlker] In the racing project, TCS230 color sensor can be utilized as an alternative for image processing. The TCS230 basically senses the color with the help of 8x8 array of photodiodes and generates a PWM signal whose frequency is proportional to the light intensity. For example, if the elliptic path is red, we can give the s2 and s3 pins of the sensor low voltage, we activate the red photodiodes and we can use the pulseIn command of Arduino to measure the frequency of the generated PWM signal. When the robots are out of the path, the output frequency of the sensor will significantly decrease, so this information can be used to keep the robots in the path.

- [Sarper] To solve distance measuring problem in cheaper way, instead of laser-based measuring, ultrasonic distance sensors could be an alternative. They are able to measure 2 cm to 4 m with 3 mm precision. One sensor has 15 cm measuring angle and 8 TL cost. To avoid opponent, we can use these sensors for to catch falling balloons and chasing vehicles projects. For mapping projects, they could be used, but eco problem should be handled with the algorithm. In other words, we need to be aware of this problem if we decide to use this technique.

- [Enes] Although stepper and servo motors are not relevant to the racing project, they can be used in other ones to reliably orient the vehicle such as in mapping project or to control the catching arm of the balloon catching project.

  - Some servo motors and their drivers are added to the component list. Selected servos are capable of maintaining 1.3 kg.cm torque which can be sufficient for

arm motion. Also, the servo deriver can be used in other applications since it is basically a PWM generator.

- Stepper motors are usually expensive. However, in case of mapping they can be used for precise measurement of motion to locate the vehicle in the field. A4988 stepper motor driver is added to the component list. It can supply 2A of current to each coil. Some step motors are added to the list as well. Depending on the project and the need they can be considered as solution.
- Use of encoder with DC motors can be another solution for controlled motion. However, a DC motor with encoder is almost as the same price as stepper motor. The resolution of the encoder is an important parameter. Some examples are added to the component list. For the required parameters component search continues.
- For DC motor driver, L298N can be used. It can handle more current, 2A, in case of heavy vehicle.

2 Plans

- [Halil] More research on OpenCV.
- [Halil] Motor derive and basic sensor usage.
- [Erdem] Possible ways to merge lane information and steering of the wheels.
- [Enes] Built simple two motor system and try differential drive.
- [Group] Gather and define objectives for project selection.
- [Group] Gather and make submodule definitions for the selected project.