Build Your Robot 2023

Electronic hardware and embedded software

Your goal is to design a simple microcontroller-based system to control the motion of a rack and pinion mechanism. If you are unfamiliar with the rack and pinion mechanism, you may substitute it with any means of converting rotary motion (from a motor) into linear motion (which we can use to do work). Ideally, your system shall also include a minimal user interface.

Functional specifications:

1. You have no constraints on what type of motor to use. Choosing one type of motor over another, however, requires justification and weighing pros and cons.
2. The velocity of the shaft will be measured and displayed in real time on the user interface.
3. The user shall be able to set a target value to control the position of the system and then confirm it to start the movement. Position settings will be capped to the system's maximum travel, but the hardware should also have some sort of limit switches to prevent accidents.
4. The system's position will be displayed on the user interface at all times.
5. The circuit shall be powered from a +24V supply (or less, depending on the motor specifications). The power supply design is not a requirement for this challenge, but it is a welcome addition.
6. Bonus round: add position feedback to ensure that the system actually reaches your target position.
7. Another bonus round: The system should remember its position even when going through a power cycle.

Please submit the source code and schematics in PDF format. Pictures of an actual, working assembly are also welcome.

Good luck!