Project Title:

Closed-Loop Stepper Motor Control Using PIC18F452 and Stepper Motor & Drive

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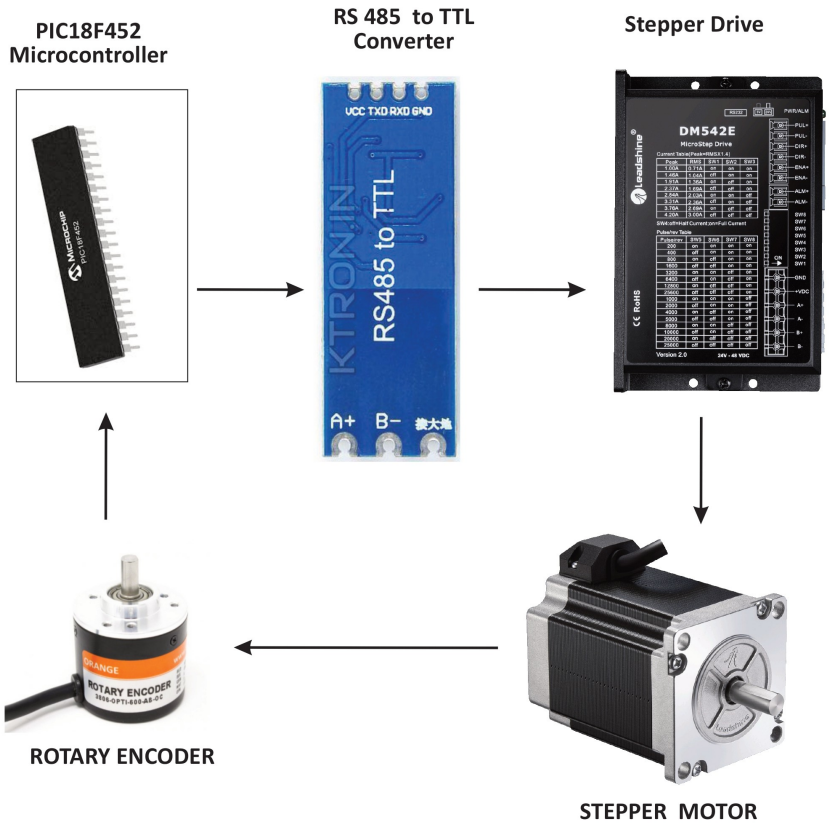
Abstract:

This academic project presents the design and development of a **closed-loop stepper motor control system** using a **PIC18F452 microcontroller** and a **stepper motor and driver**. The goal is to precisely control the motion and position of a stepper motor using **PWM signals** from the microcontroller, while continuously monitoring the motor's performance using **encoder feedback**.

The **PIC18F452** microcontroller will generate the required **step and direction signals** for **Stepper driver**, which in turn drives a **stepper motor**. Unlike open-loop stepper systems, this project implements **closed-loop control** by integrating an **incremental rotary encoder** on the motor shaft. The encoder provides real-time feedback in the form of pulses, which are processed by the microcontroller to calculate the actual motor position or speed.

The PIC18F452 compares the encoder feedback with the desired reference and corrects any deviation by adjusting the pulse frequency or direction. This feedback mechanism ensures high accuracy and reliability, especially in applications requiring precision motion such as CNC machines, 3D printers, and robotics.

Block Diagram:



Applications & Pros of the Project:

1. **Low-Cost Control Solution:**
   Microcontroller-based stepper control is significantly more affordable than PLC-based setups.
2. **Precise Motion Control:**
   Closed-loop feedback enables accurate speed and position tracking, preventing step loss or missed movements.
3. **Real-World Industrial Components:**
   Uses actual industrial hardware such as the **Lead Shine DM542E driver** and **stepper motor**, preparing students for real-world automation tasks.
4. **Flexible and Programmable:**
   Easily adaptable to different motion profiles, speeds, and directions using firmware.

5. **Microcontroller Flexibility:**
   Easy to reprogram or upgrade for advanced features such as acceleration profiles, fault monitoring, or PID control.
6. **Compact, Scalable Design and low-cost Design:**
   Unlike bulky PLC panels, this setup is compact and ideal for small automation systems or as a development prototype.
7. **Educational Impact:**
   Combines concepts from embedded systems, PWM generation, encoder signal processing, and closed-loop control ideal for student learning.
8. **Open Design:**
   The entire system is customizable, which encourages experimentation, learning, and adaptation to future enhancements (like IoT integration).