Rotarix

Precision Tracking for Industrial Automation

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1 Introduction

Rotarix is a real-time motor monitoring system designed to track motor speed and direction and display the data on an LCD via UART communication. The system enhances industrial automation by providing precise tracking for motor-driven applications.

2 Project Objectives

- Monitor motor speed and direction in real-time.
- Transmit motor data via UART to an LCD display.
- Enhance industrial automation with improved motor diagnostics.
- Implement efficient interrupt-based handling.

3 Hardware Components

The system consists of the following key hardware elements:

- **TM4C1294 Microcontroller** – Handles motor control and UART communication.
- **Motor Module** – Features an incremental encoder for speed calculation.
- **Serial LCD Module** – Displays real-time motor speed and direction.
- **Timers and Interrupts** – Ensures precise event handling.

4 System Architecture and Working Principle

The system follows these steps:

1. The **motor module** detects speed and direction using an incremental encoder.
2. The **microcontroller** processes sensor data and calculates speed.
3. **Interrupt Service Routines (ISRs)** trigger updates to the LCD.
4. **UART communication** transmits formatted data to the LCD.
5. The **LCD displays** team name, motor speed (km/h), and direction.

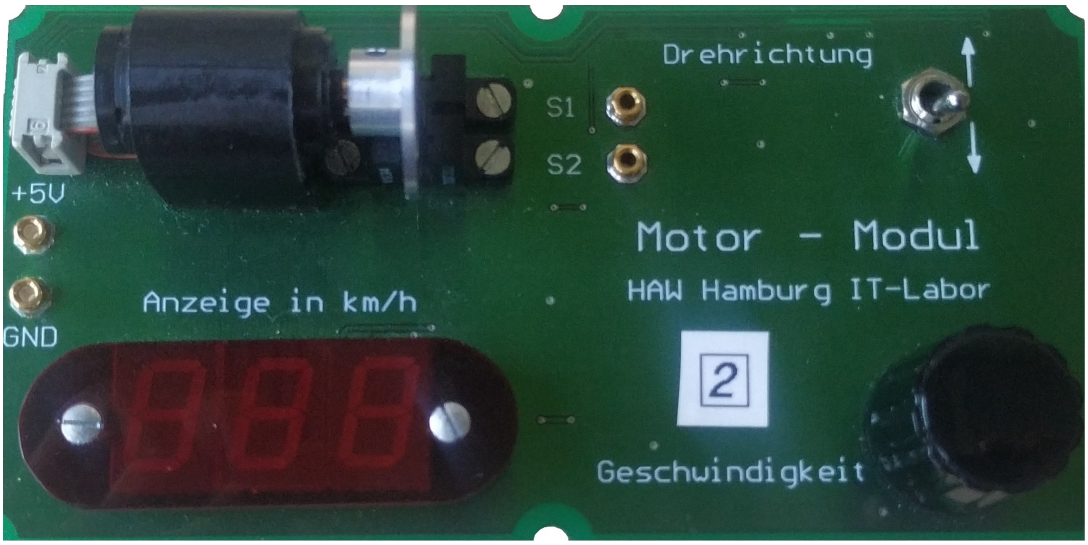

Figure 1: Motor Module Used in Rotarix

4.1 Motor Module Interfaces and Specifications

Interfaces:

- **5V** – Supply voltage.
- **GND** – Ground reference.
- **S1, S2** – Through-beam signals (CMOS level).
- **Toggle switch** – Sets motor rotation direction.
- **Rotary potentiometer** – Adjusts motor speed.
- **7-segment display** – Shows current motor speed (km/h).

Specifications:

- Voltage: 5V
- Encoder Factor: 16
- Motor Radius: 1.2 cm

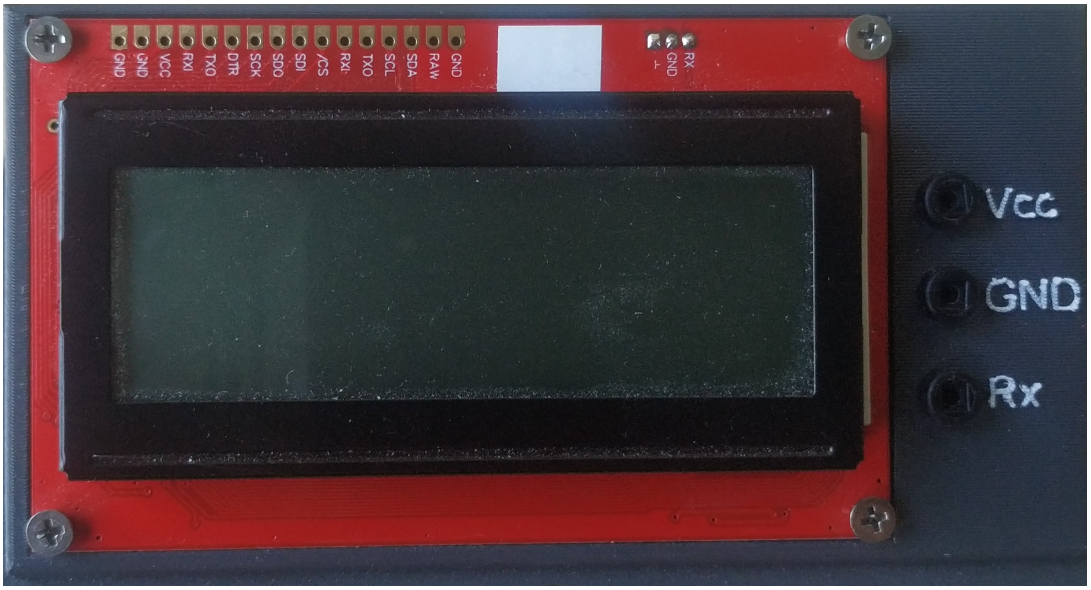

Figure 2: LCD Module Used in Rotarix

4.2 LCD Module Interfaces and Specifications

Interfaces:

- **Vcc** – Supply voltage (3.3V CMOS level).
- **GND** – Ground reference.
- **Rx** – Received data (UART input).

Specifications:

- LCD Size: 4x20 characters
- Baud Rate Control: 9600bps – 115200bps
- Backlight: Adjustable (0-255)

5 Software Implementation

The firmware is written in C and structured into modular components:

5.1 Motor Speed Calculation

```
// Motor speed calculation
void calculateSpeed(float cycleTime)
{
    float r = 0.0101; // Motor radius in meters
    float circ = 2 * M_PI * r; // Motor circumference
    speed = (circ / cycleTime) * 3.6 * ENCODERFACTOR; // Convert to km/
       h
}
```

5.2 Direction Detection

```
// Motor direction detection
void IntPortCHandler()
{
    GPIO_PORTC_AHB_ICR_R = 0x10;
    if((GPIO_PORTC_AHB_DATA_R & 0x10) == 0x10)
    {
        direction = "C.W";   // Clockwise
    }
    else
    {
        direction = "A.C.W";  // Anti-Clockwise
    }
}
```

5.3 LCD Update Routine

```
// Updating LCD with motor data
writeToLCD("Team␣Name:␣Got␣iT!", "␣", (char*) direction, buffer2);
```

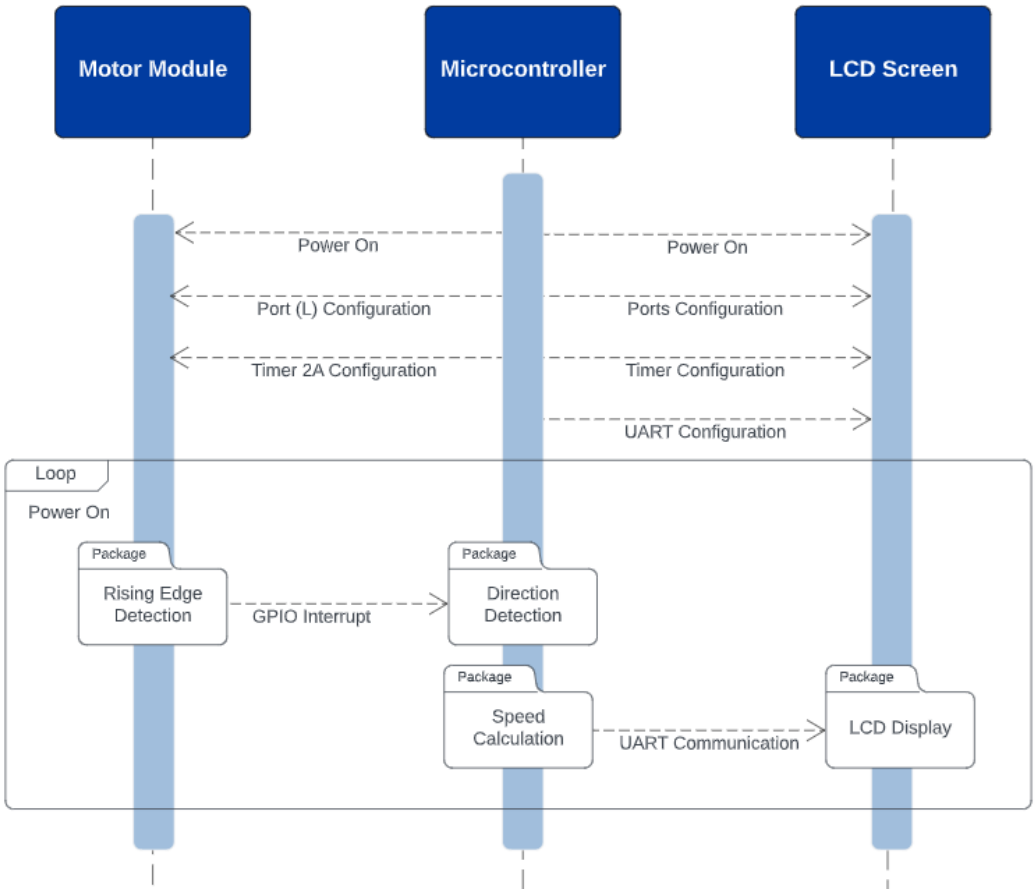

Figure 3: Process Flow of Rotarix

6 Applications and Future Enhancements

6.1 Applications

- Industrial Automation – Real-time monitoring of motor-driven conveyor belts.
- Smart Manufacturing – Data-driven motor efficiency optimization.
- Automated Quality Control – Detecting irregular motor behavior.

6.2 Future Enhancements

- Wireless Communication (Bluetooth/Wi-Fi).
- Cloud-Based Data Logging.
- AI-Based Predictive Maintenance.
- Expanded Sensor Support (Temperature, Vibration).

7 Conclusion

Rotarix is a scalable system that enhances industrial automation by providing real-time motor monitoring. Using interrupt-driven processing, it efficiently calculates motor speed, detects rotation direction, and transmits data for display.