PROPOSED SOLUTION

To enhance the performance, driver comfort, and safety of our Formula vehicle in the SAE competition, we proposed the integration of advanced electronic systems. Our primary focus was on developing an Electro-Pneumatic Gear Shifter, an Electronic Clutch System, a Driver Interaction System, and supporting data acquisition and piggyback ECU systems. Here's a detailed overview of our proposed solution:
Electro-Pneumatic Gear Shifter

1. **Objective**: Improve gear shifting speed and accuracy, reduce driver strain, and enhance overall vehicle performance.
2. **System Choice:**
    - Pneumatic Actuation: Selected due to its lower power consumption and faster actuation compared to electronic linear solenoids and hydraulic systems.
3. **Components**:
    - Printed Circuit Board (PCB): Industrially manufactured for reliability and durability, featuring:
        - Arduino Nano: Chosen for ease of use, community support, and meeting basic requirements.

- Motor Driver L293D: Provides fast switching in a closed-loop system, replacing slower relays.
- Priority Encoder 74148: Reduces the number of wires needed for gear sensing.
- Buck Converter LM2596: Steps down 12V to 5V to power the system, protecting against voltage ripples.

- Solenoid Valve Actuator: 3/2 solenoids for unidirectional control, requiring minimal current for actuation.

- Magnetic Double-Acting Pneumatic Cylinder: Includes a reed switch for precise actuation, reducing energy loss and shift time.

- Paintball CO2 Cylinder (20oz): Lightweight alternative to the previously used large argon cylinder.

- Interstate WR-CO2 Regulator: Compact and lightweight, further contributing to weight reduction.

- Metal Pushbuttons: Durable against high-frequency vibrations.

- Wire Connectors: DB9 connectors and wire couplers for robust, failsafe connections.

Electronic Clutch System

1. **Objective**: Further reduce gear shift time and simplify driving, enhancing vehicle acceleration.
2. **System Choice:**
   - Pneumatic Actuation: Preferred over high-torque motors due to lower power requirements and ability to generate necessary torque using an adjustable lever.
3. **Components**:
   - Printed Circuit Board (PCB): Shared with the gear shifter system.
   - Solenoid Valve Actuator: 3/2 solenoids with silencers for noise reduction and controlled exhaust.
   - Double-Acting Pneumatic Cylinder: Used for clutch operation, incorporating non-return valves for spring action and increased disengagement speed.
   - Paintball CO2 Cylinder (20oz): Lightweight and compact, same as used in the gear shifter system.

- Interstate WR-CO2 Regulator: Same as used in the gear shifter system.

- Metal Switch: Mounted on the steering wheel for manual clutch control, designed to withstand high-frequency vibrations.

- Silencer-Cum Flow Control Valve: Limits exhaust flow, providing controlled speed for clutch engagement.

- OR Valve: Ensures correct pressure flow, preventing malfunctioning of solenoids.

Driver Interaction System

1. Objective: Enable the driver to give commands and receive real-time vehicle information.
2. Components:
   - Metal Pushbuttons: Mounted on the steering wheel for gear shifting commands.

   - OLED Display (0.96 inch): Displays current gear, connected to Arduino Nano using I2C communication.

   - Connections: Ensures updated gear values are displayed using serial communication between Arduinos.

Summary

By incorporating these advanced electronic systems, our solution aims to significantly enhance the performance, reliability, and safety of our Formula vehicle, ensuring competitive advantage in the SAE competition.