Mini-Project: Automated Thruster-Assisted Braking ECE 5780

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Demo: https://youtu.be/HEGGMaDjZek

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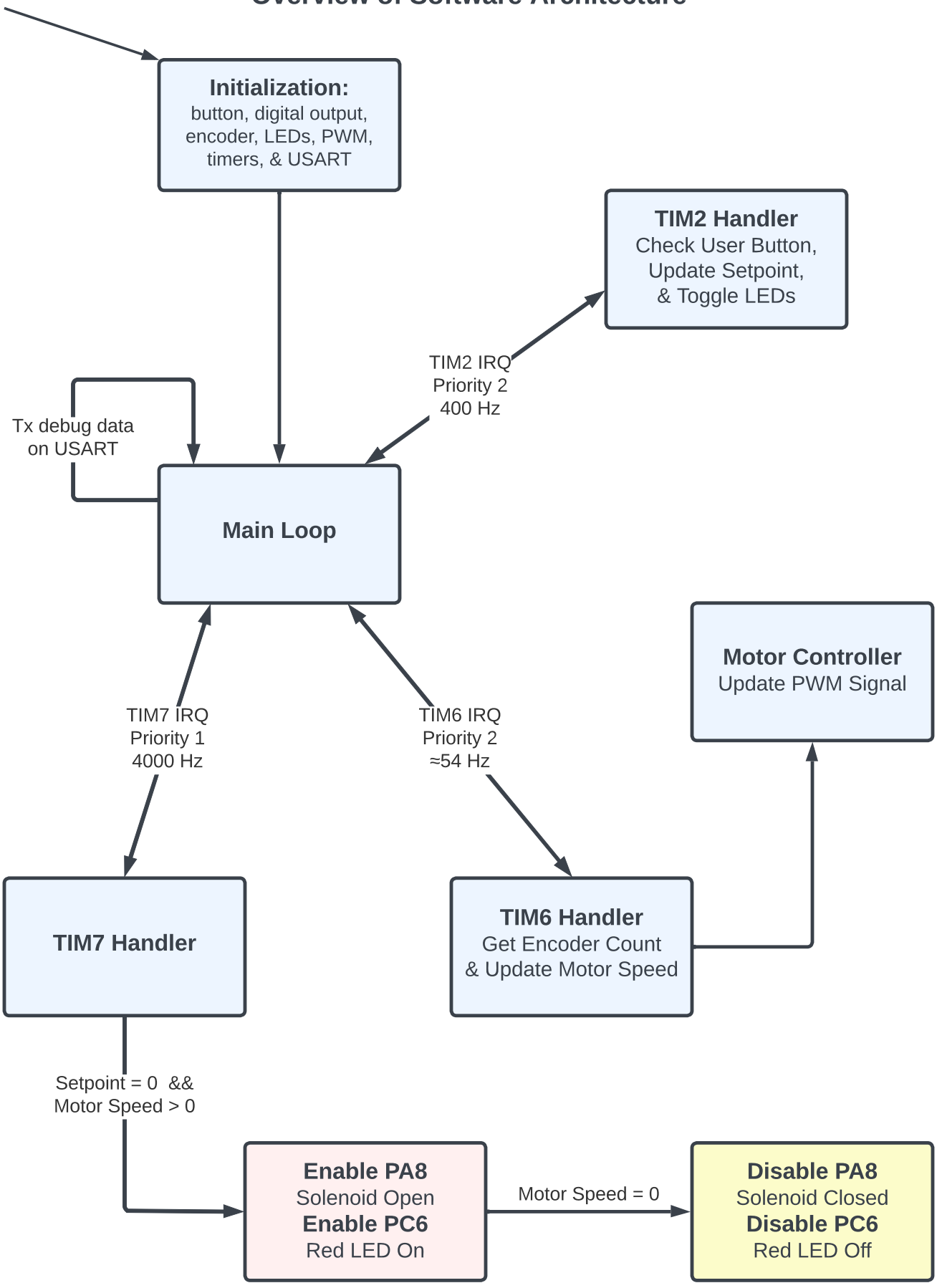
This concept project demonstrates how interrupts, motor encoders, and transistors could be utilized to create a small, low-powered embedded system that would control a brake-assist feature in a next-gen vehicle. Sensors such as electric motor encoders, inertial measurement units (IMU), etc. can be used to detect tire slippage and loss of control. Thrusters powered by compressed gas do not depend on friction between the vehicle and the ground which make them a great candidate for improving performance and safety.

My model uses an STM32 Discovery board, H-bridge motor driver, 12V DC electric motor, an electro-pneumatic solenoid valve, four small NPN transistors, and a 14.8V LiPo battery. A push button stands in for the throttle commanding the motor to slowly work up to speed. When the throttle is released the motor is de-energized, but continues to coast on its momentum. This event is considered equivalent to tire slippage in an actual vehicle which activates the transistors and powers the solenoid allowing compressed gas to escape (and help decelerate the vehicle). For debugging and visual aid, the four onboard LEDs indicate the current motor setpoint and messages are sent over USART to a terminal. One timer-based interrupt checks for user button input and updates the setpoint. It also calls a rudimentary motor control algorithm that commands the PWM signal to match target RPMs. A second timer-based interrupt watches for the critical event when target speed is much lower than actual motor speed. When triggered a digital output enables the transistors and the solenoid is energized so that gas can flow.

Overview of Software Architecture



CIRCUIT DIAGRAM OF SOLENOID SWITCH