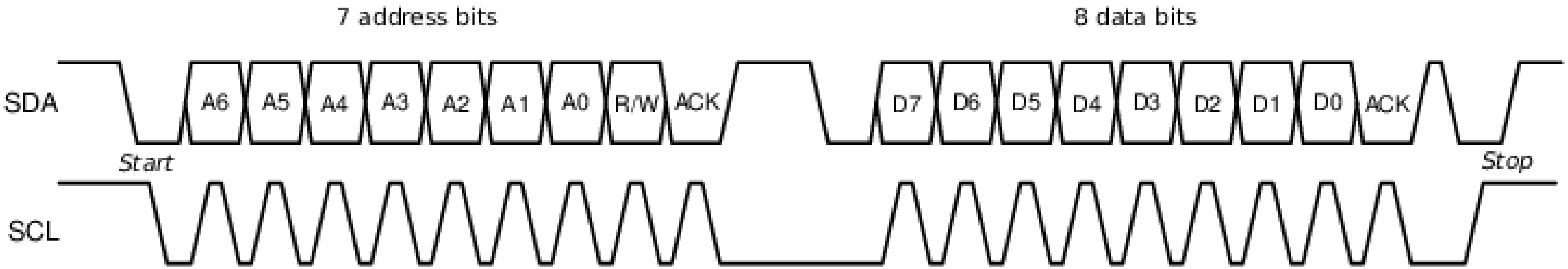
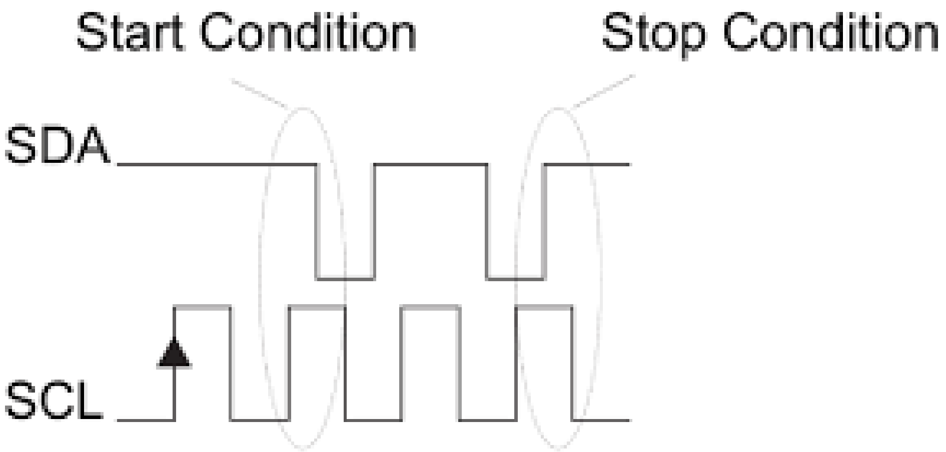
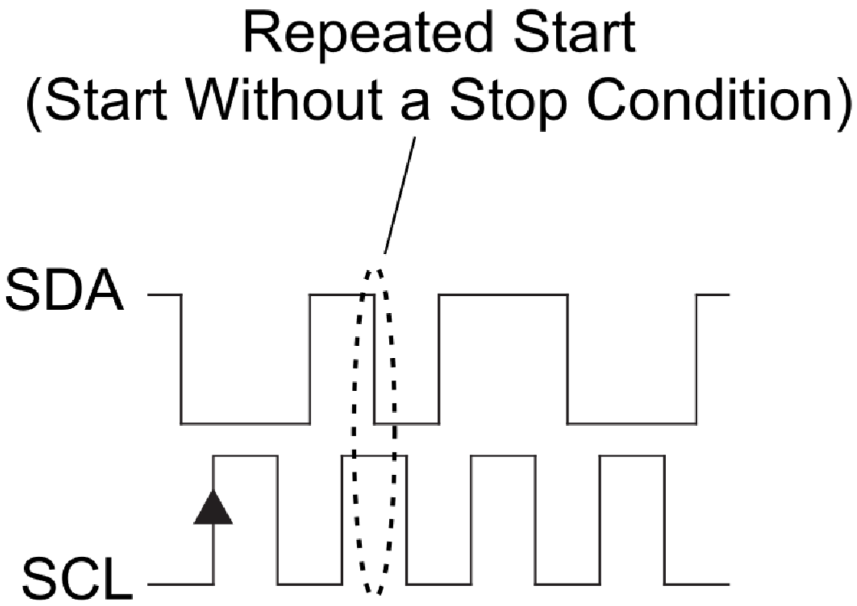
Module I2C
Capstone Project

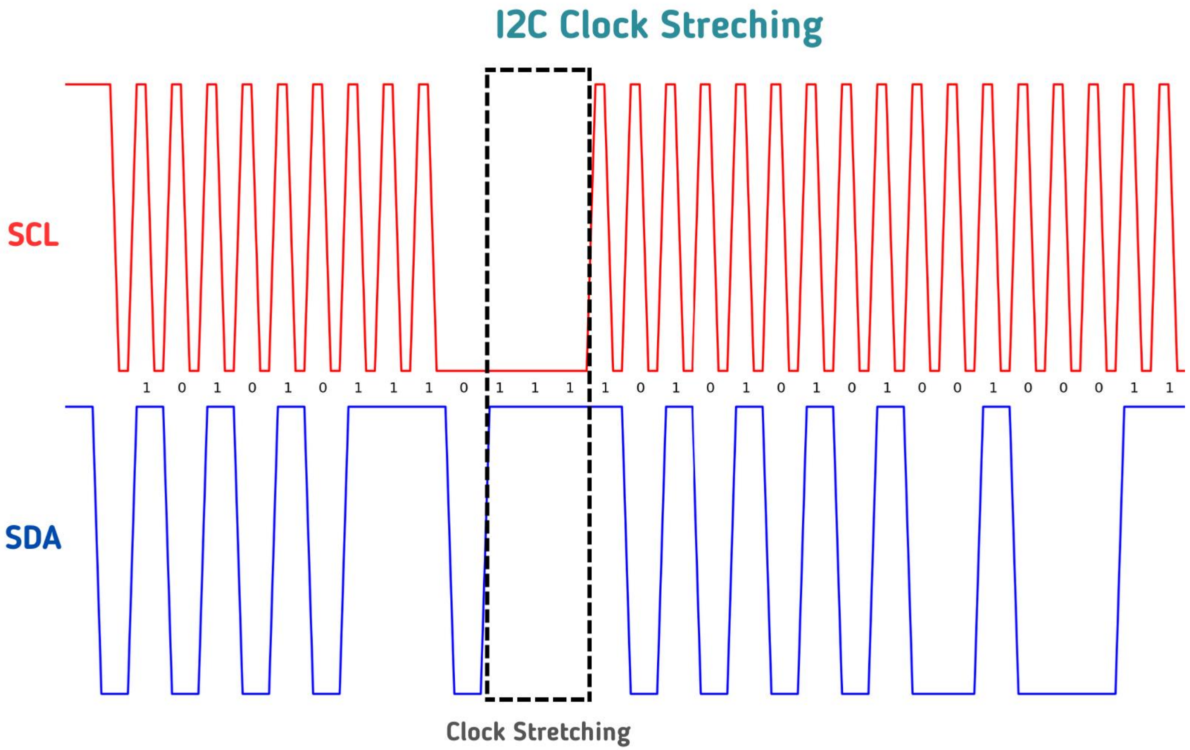
I2C Timing Diagram





I2C Timing Diagram





Register Sequence

- Configure the Clock for – GPIO, I2C
- Configure the GPIO for ALT functionality with open drain and pull up configuration
- Software reset the I2C peripheral - Set and then clear the SWRST bit in I2C_CR1 register
- Configure I2C clock frequency - Set FREQ bits in I2C_CR2 to match APB1 clock frequency in MHz
- Configure I2C clock control register (CCR) For standard mode (100 kHz):
  - Clear FS bit in I2C_CCR
  - Set CCR value = (APB1_FREQ / (2 * I2C_FREQ))
- Configure maximum rise time For standard mode:
  - TRISE = (maximum_rise_time_in_ns / APB1_period_in_ns) + 1
- Set own address (if configuring for slave)
  - Clear ADDMODE bit in I2C_OAR1 for 7-bit mode
  - Set ADD[7:1] bits with the address
  - Set bit 14 in I2C_OAR1 (must be kept at 1 by software)
- Enable I2C peripheral
  - Set PE bit in I2C_CR1 register

Transmitter Sequence

- Wait for the bus to be free (not busy)
- Generate START condition by setting the START bit
- Wait until START condition is successfully generated (check SB flag)
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- Send slave address with Write bit (LSB = 0)
- Wait until address is sent and ACK received (check ADDR flag)
- Clear ADDR flag by reading SR1 and SR2 registers
- Send the data byte by writing to DR register
- Wait until the data byte has been transmitted (check TXE flag)
- If more bytes to send, go to step 7
- Wait until the last byte transfer is complete (check BTF flag)
- Generate STOP condition by setting the STOP bit

Capstone Project – Smart Automation

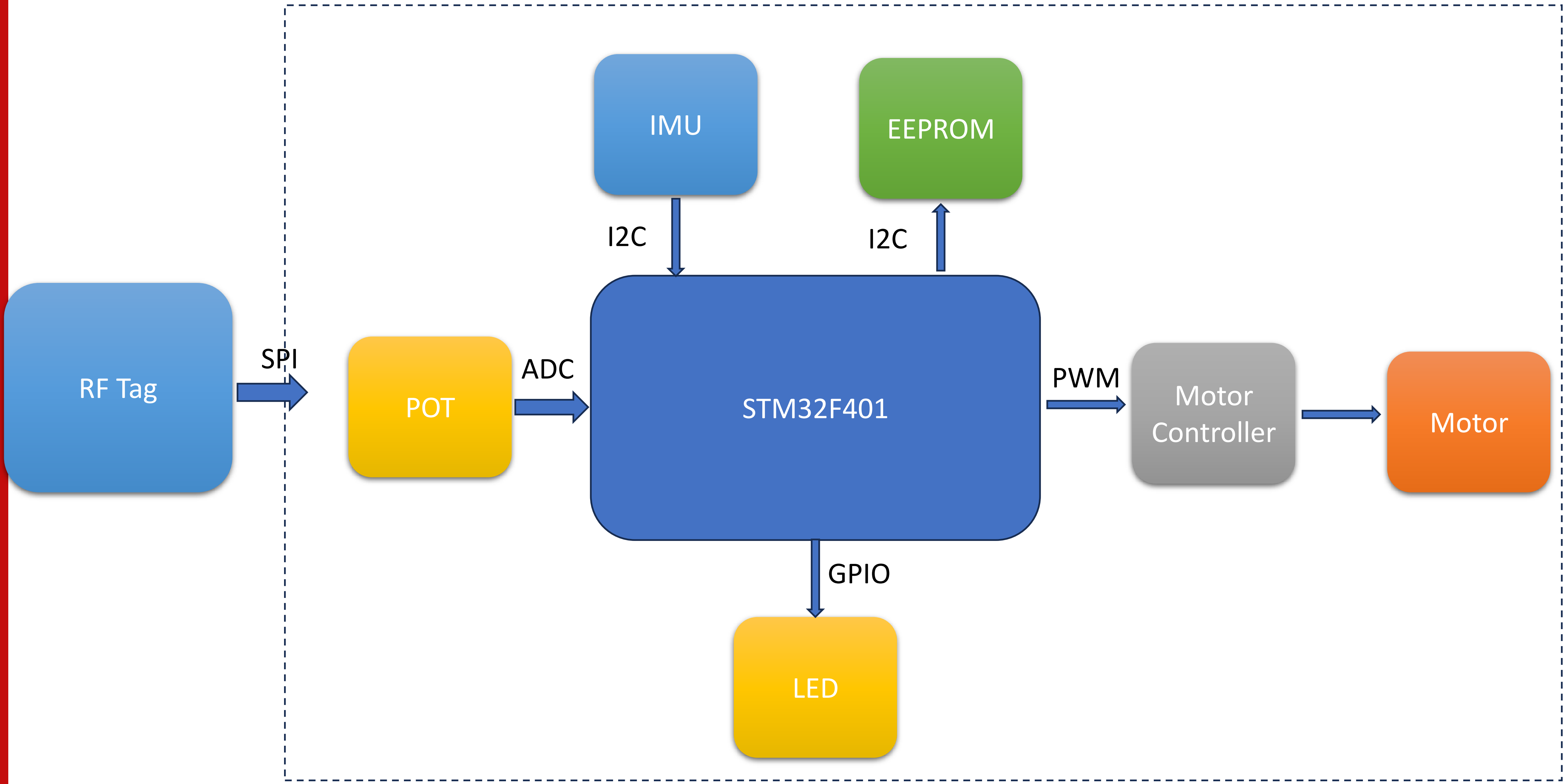
Project Overview

- The system is designed to enable and control peripherals only when a valid RF tag is detected.
- It uses an STM32F401 microcontroller as the central processing unit.
- Communication interfaces include SPI for RF tag authentication, I2C for sensor data acquisition and storage, ADC for speed control, and PWM for motor control.
- The system deactivates all peripherals when the RF tag is removed.

Hardware Components

- **Microcontroller:** STM32F401 (acts as the main controller).
- **RF Tag & Reader:** Used for authentication (connected via SPI).
- **Potentiometer (POT):** Used to control motor speed (connected to ADC).
- **IMU Sensor:** Captures motion data (connected via I2C).
- **EEPROM:** Stores IMU data (connected via I2C).
- **Motor & Motor Controller:** Controls motor speed and direction using PWM.
- **LED Indicator:** Turns on when authentication is successful (controlled via GPIO).

Capstone Project – Smart Automation



Capstone Project – Smart Automation

Functional Requirements

RF Tag Authentication:

- The RF reader communicates with STM32F401 via SPI.
- Only a valid RF tag enables the entire system.
- If authentication fails, all peripherals remain inactive.

LED Control (GPIO):

- If authentication is successful, the LED turns ON.
- If the RF tag is removed, the LED turns OFF.

Motor Speed Control (ADC & PWM):

- A potentiometer provides an analog voltage input to the ADC.
- The microcontroller converts this value into a PWM signal.
- The motor controller receives the PWM signal and adjusts the motor speed accordingly.

IMU Data Acquisition (I2C):

- The IMU sensor collects motion data.
- Data is periodically read via the I2C interface.

Data Logging in EEPROM (I2C):

- IMU data is stored in an EEPROM connected via I2C.
- The system ensures proper data logging while authentication is active.

System Deactivation:

- If the RF tag is removed, all peripherals (LED, motor, IMU logging) are immediately disabled.

Capstone Project – Smart Automation

- **Implement all the given functional requirements**

- **Once implemented, PUSH the code in Github. Kindly attach the short video of the same as well in Github (or link to the video)**

- **The deadline for capstone project is 3rd March 2025**

- **Feel free to approach us for any questions**