📅 Date:	Topic: **Series Servo Controller Communication Protocol**	**Time Required: 90 minutes**

🎯 **Learning Target/Objectives:**
- **I can** identify the components of a serial data packet, including the header, data length, and command values.

- **I can** explain how a servo controller uses visual and audible feedback to signal the success or failure of data transmission .

- **I can** calculate the appropriate data length for a command packet based on the number of parameters being transmitted .

📜 **Vocabulary:**

- **Serial Communication**

- **Baud Rate**

- **Hexadecimal (0x)**

- **Command Packet**

- **Lower/Higher 8 Bits**.

- **Proactive Transmission**

❓ **Guiding Questions:**

- Why does the controller require a specific "Header" (0x55 0x55) before it will start processing a data packet?

- How does the buzzer "beep beep" serve as a troubleshooting tool for an engineer?

- In a multi-servo move command, how does the system distinguish between a "time value" and an "angle position value" ?

📚 **Lesson Design Details:**
- **Activity 1: The Packet Architect**
  - **Focus:** Students are given a robotic task (e.g., "Move Servo 1 to position 500"). They must use the command table to manually write out the hexadecimal string for the packet.

- **Activity 2: LED & Buzzer Logic Lab**
  - **Focus:** Students observe the controller's Blue LED2 and buzzer. They must create a "Logic Chart" showing what happens when correct data is sent versus incorrect data.

- **Activity 3: The Battery Monitor Challenge**

  - **Focus:** Students send the "Get Battery Voltage" command and interpret the returned packet to determine if the robot has enough power to continue.

Key Points (Vocabulary):

- **Serial Communication:** A method of sending data one bit at a time over a communication channel.

- **Baud Rate:** The speed at which information is transferred in a communication channel, set here to 9600.

- **Hexadecimal (0x):** A base-16 numbering system used in computing to represent byte values (e.g., 0x55).

- **Command Packet:** A formatted block of data sent to the controller to execute a specific task.

- **Lower/Higher 8 Bits:** A method of splitting large numbers (like 1000ms) into two smaller bytes for transmission .

- **Proactive Transmission:** When the controller sends data to the user automatically to signal a change in state .

Key Points of Instruction

- **Data Structure Precision:** Students must understand that computers are rigid. If the "Data Length" byte is incorrect, the controller will trigger a buzzer error because the packet size does not match the parameters.

- **Physical Connectivity:** Instruction must emphasize that the transmit (TX) pin of the user's device must connect to the receive (RX) pin of the servo controller, and both must share a common Ground (GND) .

- **Active vs. Proactive Communication:** Teach the difference between the user "actively" sending a command and the controller "proactively" reporting that a task is finished .

- **Byte Splitting:** Explain that large values (like an angle position of 2000) are too big for a single byte, so they must be broken into "Higher" and "Lower" 8-bit components.

- **Pro-Tip for Educators:** If students are struggling with hexadecimal, remind them that "0x" is just a prefix that tells the computer "the next two characters are in base-16." This is essential for distinguishing the command "0x03" from the number 3.

Teacher's Cheat Sheet	
Parameter	**Technical Data Point**
Baud Rate	9600 baud
Packet Header	0x55 0x55 (Indicates start of packet)
Length Formula	N (parameters)

Success Indicator	Blue LED 2 flashes once
Error Indicator	Buzzer beeps twice
Servo Move Cmd	Value: 11 (0x0F)
Action Group Cmd	Value: 6 (Run) / 7 (Stop)

Category	Standard Organization	Standard/Benchmark Code and Description
Computer Science	NCSOS	**HS-CS-03:** Illustrate the ways computing systems implement logic, input, and output through hardware components [1].
Computer Science	NCSOS	**HS-NI-02:** Explain the protocols used to move data across a network (serial communication) [2].
Technology	ITEEA	**STEL-2P:** Select and use appropriate tools and skills to help do work and achieve a desired outcome [3].
Engineering	ITEEA	**STEL-2V:** Analyze the stability of a technological system and how it is influenced by components in the feedback loop [44].
Digital Literacy	ISTE	**1.5.d:** Students understand how automation works and use algorithmic thinking to develop a sequence of steps [5].