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CS560HO
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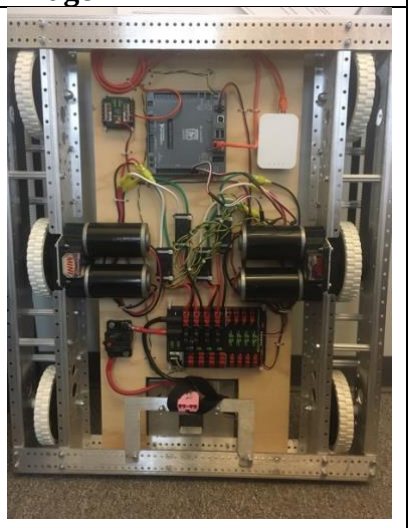
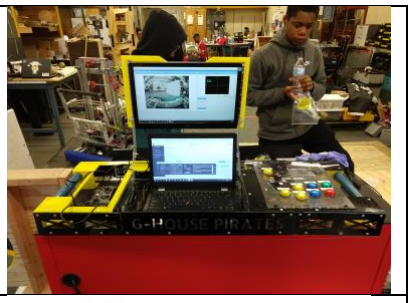
Question 1: FRC Electronics

Item	Definition/Description/Purpose	Image
Electronics System	The collection of electrical/electronic and pneumatic components that make the robot run.	
roboRIO	The robot's main computer.	
Radio	The component that provides wifi communication between a robot and a driver station.	

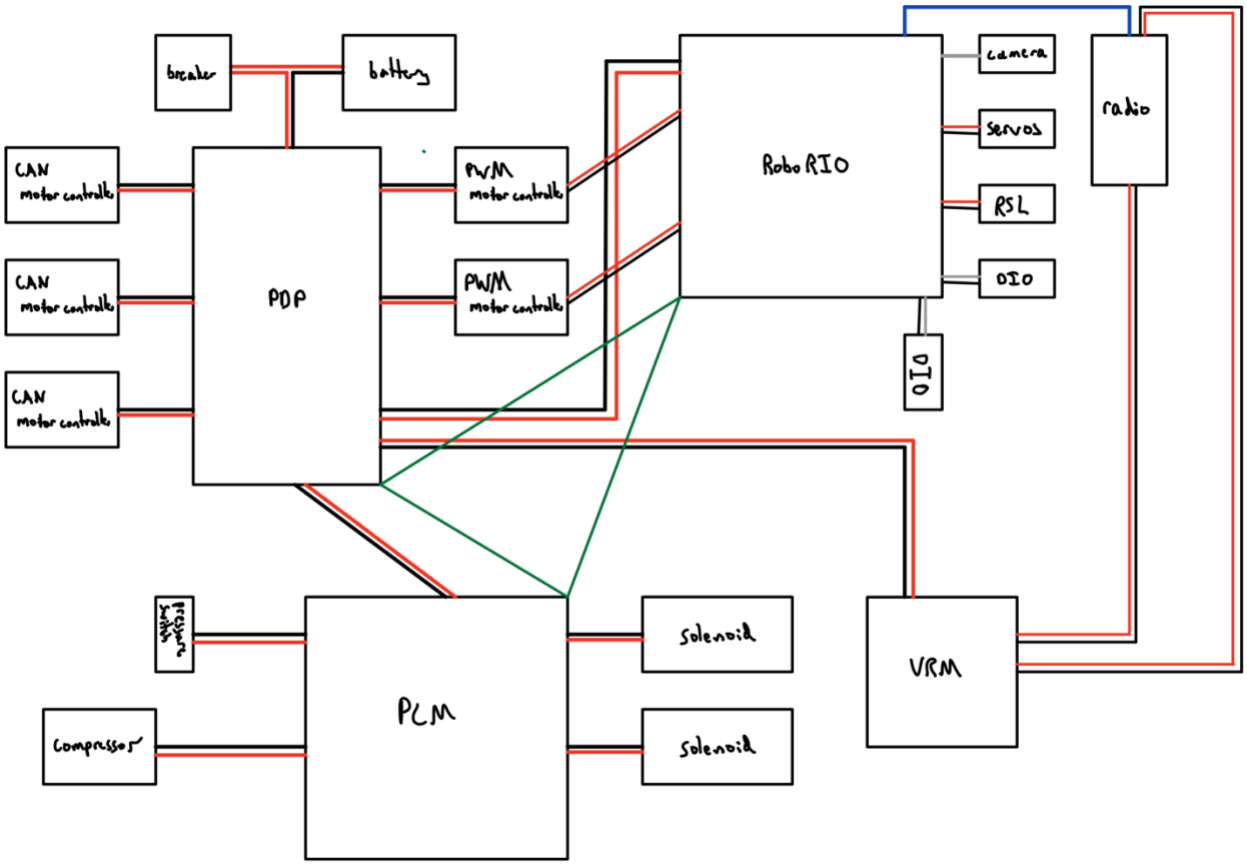
Driver Station	A laptop, switchboard, and hand controllers used to operate a robot.	
Battery	The 12V, lead acid, rechargeable battery that powers the robot.	
Main Breaker	Turns the robot on and off, connects the battery to the PDP.	
Power Distribution Panel (PDP)	Distributes voltage from the battery to the motor controllers and other onboard devices.	
Motor Controllers (speed controllers)	Controls the direction the motor spins and how much voltage it is given.	

Voltage Regulator Module (VRM)	Takes power from the PDP and provides regulated voltage to 12V and 5V devices.	
Pneumatic Control Module (PCM)	Controls the robot's pneumatic compressor and provides on/off commands to the pneumatic solenoids.	
Solenoid	An electrically operated valve that delivers air to extend and retract pneumatic actuators.	
Compressor	Provides compressed air at 120 psi to the pneumatic system.	

Pneumatic Regulator	Intakes high pressure air from the compressor or air storage and delivers low pressure, 60 psi air, to the pneumatic control components.	
Robot Signal Light (RSL)	Is used to communicate the robot's state. If solid: robot disabled. If blinking, robot enabled.	

Question 2: Control System Sketch

Create a sketch of the FRC control system using the Team 3161 diagram.



Question 3: Sensors

What is the difference between digital and analog sensors?

Digital sensors output discrete signals to the roboRIO and are connected to the digital ports. Analog sensors output a range of values and are connected to the analog ports of the roboRIO.

Question 4: Common FRC Sensors

Sensor	**Definition**
Rotary Encoder	Digital or analog sensors that measure rotations in both analog and digital inputs but only outputs as analog.
Magnetic (Mag) Encoder	Digital sensor that neasures rotations of a shaft by sensing the magnetism of the shaft.
Potentiometer (Pot)	Analog sensor that measures limited rotations.
Limit Switch	Digital sensor used to detect when something has reached its limit.
Ultrasonic Sensor	Analog sensor used to measure distance using ultrasonic sound waves.
Accelerometer	Analog sensor used to measure acceleration.

Gyroscope	Analog sensor used to measure the change in rotational angle per unit of time, generally for the entire robot.
Beam Break Sensor	Digital sensor used to detect when an object crosses a beam.

Question 5: Cameras in FRC

What are the purposes of cameras in FRC?

Cameras are used in FRC as sensors, such as in computer vision tracking or a game object identification system. They are also useful for providing video feedback to the driver's station.

Question 6: Compare FRC Vision Systems

Compare and contrast the LimeLight, PixyCam, Gloworm and Jevois vision systems.

LimeLight is a plug and play camera developed by FRC Team 987. PixyCam is a camera designed to interface with a Raspberry Pi or an Arduino. It is not as plug and play as the LimeLight. The Gloworm is an open-source hardware solution built around allowing FRC teams to develop their custom computer vision software.

Question 7: PWM & CAN

What is PWM? What is CAN?

PWM (Pulse Width Modulation) is a communication method using electrical signals sent in pulses. CAN (Control Area Network) is a communication network originally developed for the automotive industry to simplify wiring harnesses.

Question 8: Motor Controllers

Name	Communication Method	Notes	Photo
Talon SRX	CAN/PWM	Can run internal loops when sensor is plugged in.	
Victor SPX	CAN/PWM	Similar to Talon SRX, but does not have internal features or allow sensor input. It is a lighter, smaller, and cheaper than a Talon.	

Spark	PWM	One of the cheapest FRC motor controllers.	
Spark MAX	CAN/PWM/USB	Only motor controller for the REV NEO brushless motor.	
Nidec Controller	PWM	Motor controller that is integrated into the Nidec brushless motor.	
TalonFX	CAN/PWM	Motor controller that is integrated with the Falcon 500 motor.	

Question 9: Pneumatics

What is a pneumatic system?

A pneumatic system is a system that uses compressed air to power pneumatic devices that control inputs and various other systems.

Question 10: Pneumatic Components

Component Name	**Description/Use/Purpose**
Accumulators (Air Tanks)	Plastic or metal tanks that store pressurized air.
Pneumatic Control Module (PCM)	Controls the robot's pneumatic compressor and provides on/off commands to pneumatic solenoids.
Solenoid	An electrically operated valve that receives a command from the PCM and delivers air to extend and retract the pneumatic cylinders.
Compressor	Provides compressed air at 120 psi for the pneumatic systems. In past seasons, it could be either onboard the robot of offboard.

Pneumatic Regulator	Intakes high pressure air from the compressor, or air storage, and delivers a lower pressure to the pneumatic control components. This is considered a safe "working pressure" for FRC robots.
Working Pressure	The pressure the actuators use, which is lower than the pressure in the accumulators. Historically, the maximum working pressure has been 60 psi, however refer to the current year's FRC rules for the official maximum legal working pressure.
Pressure Relief Valve	A spring-operated valve that releases all air from the pneumatic system. These valves are usually pre-set to 125 psi, the maximum system pressure allowed by FRC.
Pneumatic Tubing	Usually a polyurethane tubing that connects the components of the pneumatic system that use air. Tubing must be certified for 125 psi.
Pneumatic Cylinder	Linear actuator that extends and retracts using pressurized air.
Single-Acting Pneumatic Cylinder	A cylinder that is extended with air, but retracted with a spring (or vice versa). Can be controlled by either a single-acting or double-acting solenoid.
Double-Acting Pneumatic Cylinder	A cylinder that is extended and retracted using air. Can be controlled by either a single-acting or double-acting solenoid.

Question 11: Pneumatic Use Cases

What are common uses of pneumatics in FRC?

They are generally used in mechanisms that just have two positions.

Question 12: Pressure Calculations

Calculate the force exerted by the following pistons:

Piston Diameter	Working Pressure	Calculated Force (psi)
6"	60 psi	360 psi
4"	70 psi	280 psi
¾"	80 psi	60 psi
1.5"	90 psi	135 psi

Question 13: Connectors

How are electrical connectors sized? How are they classified?

They are sized based on the voltage and current passing through them.

Question 14: High Power Connections

Why are high power connections so critical? What are they used for in FRC?

They are the most critical connection because a failure here means a dead robot on the field. They are used for carrying the entire power load of the robot.

Question 15: Medium and Low Power Connections

What are the different types of medium and low powered connections? What are their uses?

The two different types of medium power connections are Anderson Power Poles and XT - 60s. These are used for motors and non-sensor applications. Low power connections include Molex SL, Ferrules, WAGO Lever Nuts, Duponts, and JSTs. These are typically used on signal or low power applications.

Question 16: Insulators

What is heat shrink used for? What about electrical tape?

Heat shrink is used for exposed connections. Electrical tape should only be used in emergencies because it is faster to apply.

Question 17: Energy Chain

What kinds of mechanisms would energy chain be useful for in FRC?

They are used for when the cable path is defined and consistent, perhaps for the drivetrain.