Components

Function	Component	Reason Chosen	Part Number / Link
Microcontroller (MCU)	**ESP32**	Dual-core, PWM, UART, I²C, SPI, built-in Wi-Fi. Handles multi-sensor I/O, low power, ideal for embedded robotics control	ESP32-WROOM-32 Datasheet
Motors for wheels	**A2212 1000KV BLDC Motor (x4)**	High-speed, lightweight brushless DC motor with good torque. Suited for omni-drive when used with compatible ESCs	A2212 1000KV BLDC Motor
Wheel Type	**Omni-wheels (4)**	Enables holonomic drive. Supports simultaneous translation + rotation. Ideal for strafing, turning in place, or cornering smoothly	—----------
Motor Driver (ESC)	**SimonK 30A ESC (x4)**	Controls 3-phase BLDC motors using PWM. Compact, lightweight. Accepts PWM signal from ESP32 and converts to motor commutation	SimonK 30A ESC
Encoder Sensor	**External Optical Encoder (optional)**	Used for odometry. Since BLDC motors don't include built-in encoders, external wheel-mounted encoders are required for precise feedback if needed	LM393 Wheel Encoder Module
IMU (Inertial Unit)	**MPU6050 (6 DOF)**	Provides yaw (heading) angle and orientation. Critical for rotation correction and orientation toward correct goalpost	MPU6050 Datasheet
Color Sensor	**TCS34725 (I²C RGB sensor)**	Detects the tile color under the robot. Used to determine which goalpost to face and to trigger orientation correction	TCS34725 Datasheet
Communication	**UART Protocol between ESP32s**	half-duplex wireless connection. Used to transmit color data, position commands, and synchronization between robots.	ESP32 UART Reference

Speed Control	**PWM Signal from ESP32**	PWM signals (typically 1–2 ms at 50Hz) sent to ESCs to control motor speed. Allows smooth and responsive robot movement	Native PWM support on ESP32
Fallback Indicator	**LED or Buzzer (via GPIO)**	Visual/audio alert when fallback is triggered due to communication loss, timing issue, or robot stuck	Any GPIO-compatible LED or buzzer
Servo (Shooter)	**SG90 PWM-Controlled Servo**	Used to trigger shooting mechanism by rotating a lever or releasing latch. Controlled via PWM from ESP32	SG90 Datasheet
Power Supply	**11.1V (3S) or 14.8V (4S) LiPo + 5V Buck Converter**	ESCs and motors run on LiPo directly. ESP32, sensors, and servo powered via regulated 5V output from buck converter	LM2596 Buck Converter