

Components

Function	Component	Reason Chosen	Part Number / Link
Microcontroller (MCU)	ESP32	Dual-core, PWM, UART, I ² C, SPI, built-in Wi-Fi. Handles multi-sensor I/O, low power, ideal for embedded robotics control	ESP32-WRO OM-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 (I ² C 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	Full-duplex wired serial 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