UrbanFlow-Smart City

This integrated smart city system uses a **line-following robot**, a **traffic light module**, and an **RFID & ultrasonic sensor setup** for decision-making and movement control. Here's a breakdown of how each module contributes:

1. Smart Car (Line Following + Blynk-Controlled Destination)

- **Line Following**:
    - IR sensors (IR_LEFT, IR_RIGHT) guide movement along black/white lines.
    - Motor control pins (IN1-IN4) and PWM pins (EN_A, EN_B) drive motion.
- **Obstacle Detection**:
    - Ultrasonic sensor (TRIG_PIN, ECHO_PIN) prevents collision by checking object distance.
- **Traffic Control Integration**:
    - Car queries a **traffic light server** (http://192.168.24.174/) to get "RED" or "GREEN".
    - Moves only when status is "GREEN" and no obstacle is detected.
- **Blynk App**:
    - Virtual pin V0 toggles start/stop.
    - Displays real-time status via Serial.

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2. Traffic Light System

- **Wi-Fi Based Server**:
    - Sets up an HTTP server using ESP8266 (ESP8266WebServer).
    - Sends current traffic status (trafficStatus) as "RED" or "GREEN" when queried.
- **Sensor Logic**:
    - Two ultrasonic sensors detect cars at different directions (echo1, echo2).
    - If car is on one side only, priority is given to that direction (green light).
    - Uses timing logic to alternate if both distances are clear (default toggle).
- **Signal Override**:
    - An external digital signal (INPUT_PIN) can manually turn lights green.

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3. RFID Gate Control with Distance Awareness

- **RFID**:
    - Uses MFRC522 module to detect authorized RFID cards (authorizedUID).
    - If match is found, a pin (OUTPUT_PIN) is set HIGH — used as a manual override signal for the traffic light module.
- **Ultrasonic Sensors**:
    - Two sensors determine the distance of obstacles near the gate.
    - LEDs (led1, led2, etc.) indicate presence.

System Integration Flow:

1. Traffic light server waits for signals or distance inputs.
2. Car connects via Wi-Fi, queries server for status.
3. Car starts via Blynk app toggle, follows line, checks ultrasonic sensor and traffic status.
4. If green light and no obstacle → move forward; else stop.
5. RFID system provides override signal (e.g., VIP vehicle or emergency).

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4. Smart Dustbin System

The Smart Dustbin system uses an **ultrasonic sensor** to detect objects and an **IR sensor** to check if a person is nearby. If a person is detected and an object is close (within 10 cm), the system opens the dustbin lid using a **servo motor**. The lid remains closed when there is no person or object detected.

System Integration Flow:

1. **IR Sensor**: Checks if a person is nearby. If detected, the system proceeds to measure distance.
2. **Ultrasonic Sensor**: Measures the distance to an object. If an object is detected within 10 cm, it triggers the servo to open the lid.
3. **Servo Control**: If both a person and an object are detected, the servo opens the lid. If not, the lid stays closed.

The system continuously checks the sensors and controls the servo based on the inputs.