AUTOMATED CONVEYOR-BASED BOTTLE FILLINGSYSTEM

Introduction

Industrial automation is crucial in modern manufacturing processes to improve efficiency and precision. This project demonstrates an **automated bottle filling system** using an **Arduino, IR sensor, relay, solenoid valve, and a DC motor**. The system detects bottles on a conveyor belt, stops the belt, fills the bottle, and resumes movement.

Objectives

- Automate the bottle filling process using **Arduino**.
- Detect bottle presence using an **IR sensor**.
- Control the **conveyor belt (DC motor) and solenoid valve** for filling.
- Simulate the circuit in **Tinkercad** due to hardware constraints.

Components Used

- **12V DC Motor** – Drives the conveyor belt.
- **IR Sensor** – Detects the presence of a bottle.
- **12V Relay Module** – Controls the solenoid valve.
- **Solenoid Valve** – Releases liquid into the bottle.
- **Arduino Uno** – Controls the operation.
- **12V Battery** – Powers the relay, motor, and solenoid valve.
- **Motor Driver (L298N or MOSFET)** – Controls the motor speed and direction.
- **Diode (1N4007)** – Protects against voltage spikes.
- **Transistor (NPN like BC547)** – Helps control the relay using Arduino's 5V logic.

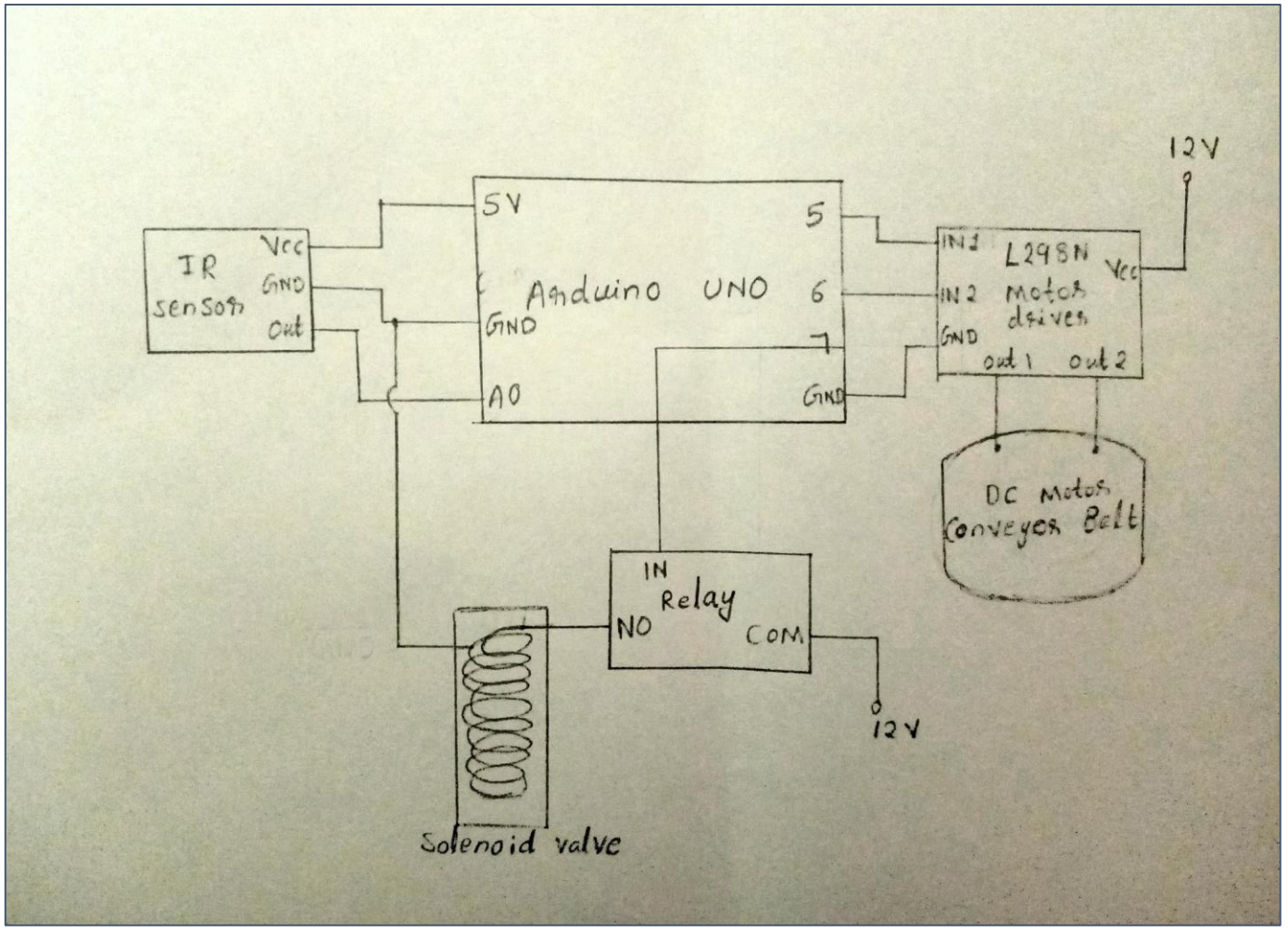
Circuit Connection

1. **IR Sensor** detects a bottle and sends a signal to **Arduino**.
2. **Arduino activates the relay**, which opens the **solenoid valve**.
3. Liquid is dispensed for a fixed time (~3 seconds).
4. **Relay turns off the solenoid valve**, stopping the flow.
5. **Arduino restarts the conveyor motor**, moving the next bottle.
6. **Common ground** is maintained between **Arduino and the 12V system**.

Power Supply Considerations

- **12V Battery** powers the motor, solenoid valve, and relay.
- **Arduino is powered separately** via USB or a 9V adapter.
- A **voltage regulator (LM7812)** can be used for stable voltage if needed.

Circuit diagram



Arduino Code

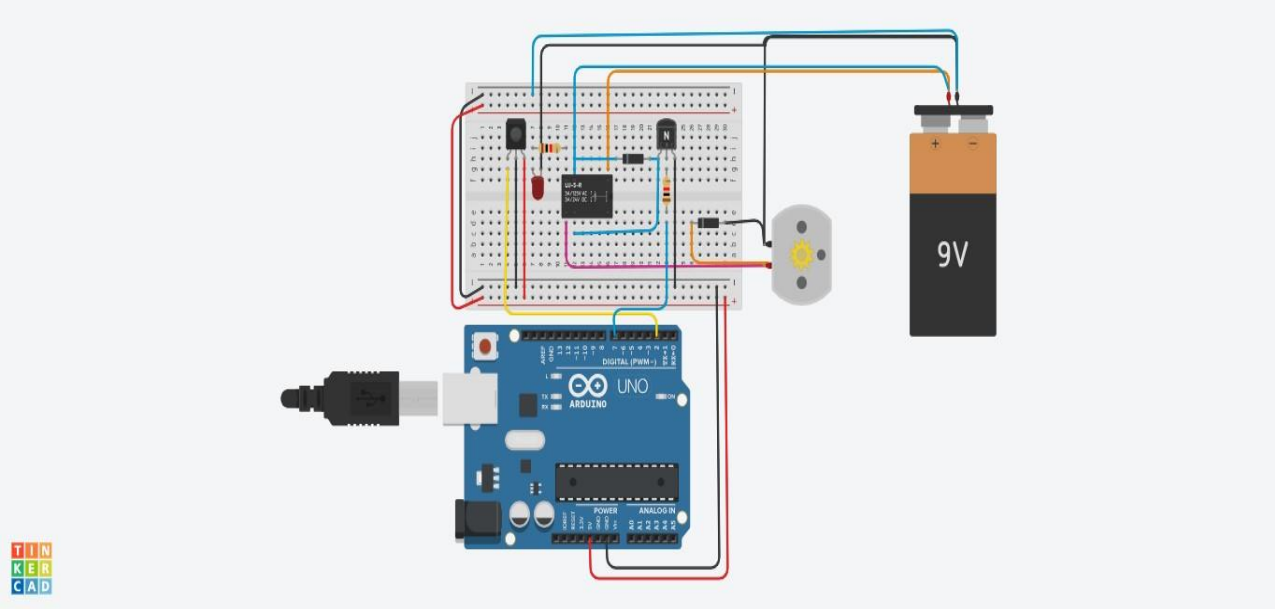
```
const int IR = 2;
const int relayPin = 7; // Controls solenoid valve const
int motorPin = 9; // Controls conveyor motor
 void setup() {
pinMode(relayPin, OUTPUT);
pinMode(motorPin, OUTPUT);
pinMode(IR, INPUT);
Serial.begin(9600);
}  void
loop() {
  if (digitalRead(IR) == LOW) { // Bottle detected
digitalWrite(motorPin,  LOW);  //  Stop  conveyor
digitalWrite(relayPin,  HIGH);  //  Open  solenoid
valve
    delay(3000); // Filling time
    digitalWrite(relayPin, LOW); // Close solenoid valve
    digitalWrite(motorPin, HIGH); // Start conveyor
again   }
}
```

Simulated Setup (Tinkercad)

Component Adjustments for Simulation

Since **Tinkercad does not have a 12V battery**, the following adjustments were made:

- **9V battery used** instead of 12V for relay and motor.
- **Single-channel SPDT relay used** (Tinkercad does not provide all relay types).
- **Transistor used to switch the relay instead of direct control**.
- **Tinkercad's IR sensor module used** (real-world sensors may differ slightly).
- **An LED is used instead of solenoid valve (Tinkercard doesn't have solenoid valve)**



Link to the simulation

https://www.tinkercad.com/things/0XYYqaDD2O0-smashingvihelmo/editel?returnTo=https%3A%2F%2Fwww.tinkercad.com%2Fdashboard%2Fdesigns%2Fcircuits&sharecode=byqWr3ywkjY6UJrsu6JWklxgMy1SgC1CWiA7I5zb6dM

Results

Real-World System

- The **Arduino successfully automates the process**, stopping the conveyor, filling bottles, and restarting it.
- **12V power supply ensures efficient operation** of the motor and solenoid valve.
- **Transistor-driven relay switching works effectively**.

Simulated System (Tinkercad)

- The **9V battery workaround** allows the simulation to function.
- The relay and motor **operate correctly with Arduino commands**.
- A **common ground issue was resolved**, making the circuit work.
- **Tinkercad lacks solenoid valves**, so an LED was used to represent the solenoid's function.

Conclusion

The simulation successfully demonstrates the logic of an **automated bottle filling system**. In a real-world setup, a **12V power source, proper relays, and a motor driver** should be used for efficient and reliable operation.