Automated Smoothie Maker

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Abstract:
Automation is a common subject in the twenty-first century, and it has become increasingly important in our everyday lives. The key benefit of any automated system is that it reduces human labor, effort, time, and errors caused by human error. The food and beverage industry has undergone major transformations in favor of healthier goods, especially smoothies. Customers are expecting fresher, higher-quality goods as a result of these improvements. Convenient stores have ready-to-eat options. The lack of natural options available in convenience stores, on the other hand, is a concern. This revealed a previously untapped market for the creation of a system capable of making ready-to-drink natural fruit smoothies. Throughout this study, a five-step concept creation process was used to address the best arrangement of pieces, as well as details design and recommendations for further analysis. It can be inferred that the smoothie machine built in this project represents a significant business opportunity, as there are virtually no technologies that serve this growing market at convenient stores.Our project has advanced due to changes in the design and process phases. This digital machine would be beneficial to most people who operate on a tight schedule and find it difficult to maintain a healthy diet. The system's performance can be improved even further with advances in Nanotechnology and Material Science.

1. INTRODUCTION

In recent years, consumer tastes have shifted toward healthier goods. Customers, on the other hand, have discovered a wide range of differences and similarities among healthy products in terms of benefits and added functionality. Consider the controversy between organic and natural goods. Despite the high prices, the smoothie has become very popular across the country as a result of the rise in demand for these types of items. One of the reasons for their popularity is that smoothies have drew the interest of consumers searching for fresh and innovative items over time, thanks to the exotic flavor combinations and endless combinations that smoothies offer.Since there is a growing appetite for healthier goods and innovations capable of providing such products in a more efficient manner, this consumer outlook represents a huge business opportunity. As a result, the aim of this research is to construct a smoothie machine design that can satisfy both trends while remaining affordable. Customers are seeking higher-quality, ready-to-eat goods in supermarkets. As shown by Berry [11], the shortage of natural options in these stores has opened up a previously untapped market for ready-to-drink natural fruit smoothies. This will be addressed in the study by the development of a smoothie machine. The goal of this research is to create a product design for an automated smoothie machine by simplifying and optimizing smoothie production processes in convenient stores all over the United States, as well as other countries where healthy products are demanded.

2. PROPOSED SYSTEM

A cup holder is mounted on the conveyor belt in our proposed system. When we put the cup in the cup holder, the infrared sensor senses it and begins to shift towards the X-axis, where milk is added through the solenoid flow control valve, followed by the fruits. The ingredients are mixed after that, and the smoothie is delivered at the end. It can currently make up to one smoothie at a time, but with the help of a small fridge, we can make multiple smoothies at once. It mixes easily and offers a new smoothie. The main benefit of our proposed system is that it does not need to be maintained on a daily basis.

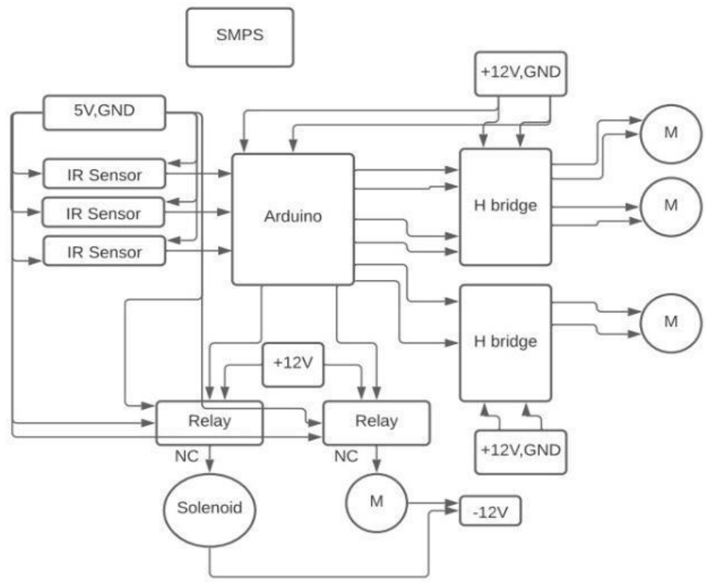

FIGURE 1. BLOCK DIAGRAM OF PROPOSED SYSTEM

3. CIRCUIT DIAGRAM OF THE PROPOSED SYSTEM

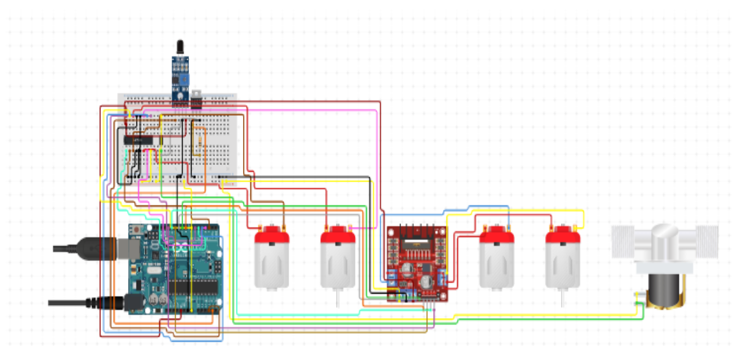

FIGURE 2: CIRCUIT DIAGRAM OF PROPOSED SYSTEM

3.1 HARDWARE USED FOR THE PROPOSED METHODOLOGY

- Arduino UNO
- DC Gear motor
- Solenoid valve
- 12V DC Motor
- Infrared Sensor
- SMPS
- ATmega 328P Microcontroller
- Relay
- H-bridge

3.1.1 ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATMEGA328p. There are 14 digital input/output pins (six of which can be used as PWM outputs), six analogue inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB link, a power jack, an ICSP header, and a reset button on the board. It comes with everything you'll need to get started with the microcontroller. To get started, use a USB cable to connect it to a computer or an AC-to-DC adapter or battery to power it. The Arduino Uno is programmed with the Arduino Software (IDE), a universal Integrated Development Environment that works both online and offline. To track the IR sensor and power the H-bridge and relay, we used Arduino.

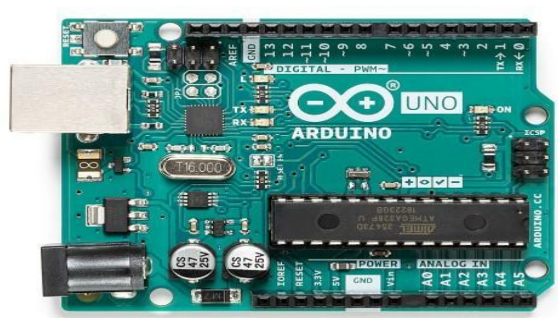

FIGURE 3: ARDUINO UNO BOARD

3.1.2. DC Gear motor

DC Gear motors are also known as DC Geared Motors, Geared Dc Motors, gearhead motors, and gearbox motors. It consists of an electric DC motor and a gearbox or gearhead that reduces the DC motor speed while increasing the DC motor torque. As a result, the gear motor will produce lower speed and higher torque. The gear motors are controlled by an H-bridge. The conveyor belt is moved forward and backward, the blender blade is lifted, and the fruits are dispensed into the cup using a 45 rpm gear motor operating at 12 v.

Specifications

Size: 10x5x5 cm

Weight: 80 g

RPM: 45

Shaft diameter: 6 mm "D"

Operating voltage (VDC): 12

Stall Torque (Kg-Cm): 16

Load Current Max: 300

No-load current (mA): 60

Gearbox Diameter (mm): 37

Motor length: 75 mm

FIGURE 4.DC Gear motor

3.1.3 SOLENOID VALVE

Electricity is used to control a solenoid valve. The valve is operated by a solenoid, which is an electric coil with a movable ferromagnetic core (plunger) at the base. A tiny orifice in the rest place is sealed shut by the plunger. When an electric current is passed through the coil, a magnetic field is generated. The magnetic field forces the plunger upwards, causing the orifice to open. The basic principle that causes solenoid valves to open and shut is this. A solenoid flow control valve regulates the flow of water or milk. The project's solenoid flow control valve has a 12 diameter valve which operates on 12 volts. The solenoid valve is operated by a relay.

FIGURE 5: SOLENOID FLOW CONTROL VALVE

3.1.4 DC MOTOR

As a current-carrying conductor is mounted in a magnetic field, it experiences torque and moves. In other words, when a magnetic field and an electric field interact, a mechanical force is generated. That is how a DC motor, also known as a direct current motor, operates. This is referred to as "motoring motion.

We have used DC motor in this project for the purpose of rotating the blending blades, the switching operation of the DC motor is achieved by interfacing a BC547 transistor with the controller. The power supply to the motor will be either from battery or SMPS.

FIGURE 6: DC MOTOR

3.1.5 INFRARED SENSOR

An infrared sensor is an electronic device that uses infrared light to identify different elements of the environment. An infrared sensor can both sense motion and measure an object's heat. A passive infrared sensor detects rather than emits infrared radiation. By bouncing a beam of infrared light off an object, an IR distance sensor may determine its distance. The distance is determined by triangulating the light beam. An IR LED and a light detector, or PSD, make up the sensor (Position Sensing Device). When a light beam is reflected by an object, the reflected beam enters the light detector, where it forms a "optical spot" on the PSD.

Distance (cm) = 29.988 X POW(Volt , -1.173)

The cup in the cup holder is detected using an infrared sensor. The conveyor belt moves once the cup is identified, beginning of the process.

FIGURE 7: INFRARED SENSOR

3.1.6. SMPS

A switched-mode power supply (SMPS) is an electrical circuit that transfers power using switching devices that turn on and off at high speeds, as well as storage components such as inductors and capacitors that provide power while the switching system is not conducting. Switching power supplies have a high efficiency and are used in a wide range of electronic equipment, including computers and other critical equipment that requires a consistent and reliable power supply.

The DC motor as well as the DC gear motor are both driven by an SMPS. The use of SMPS is effective, lightweight, and ensures low output noise.

FIGURE 8: SMPS

3.1.7 ATMEGA 328P MICROCONTROLLER

The Microchip picoPower 8-bit AVR RISC-based microcontroller has 32 KB ISP Flash memory with read-write capabilityThe system works with a voltage range of 1.8 to 5.5 volts. The system achieves throughputs approaching one MIPS per MHz by executing powerful instructions in a single clock cycle, balancing power consumption and speed.

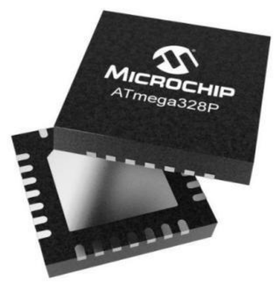

FIGURE 9: ATMEGA 328P MICROCONTROLLER

3.1.8. RELAY

The Single Channel Relay Module is a handy board for controlling high voltage, high current loads like motors, solenoid valves, lamps, and AC loads. It's made to work with microcontrollers including Arduino, PIC, and others. Screw terminals are used to connect the relays' terminals (COM, NO, and NC). It also has an LED that indicates the status of the relay. The relay that is used in this project is Normally Open (NO) and is connected with the blender and solenoid valve.

FIGURE 10: RELAY 5V

3.1.9. H-BRIDGE

An electronic circuit known as an H-Bridge. You can supply current in both directions with such a circuit. The H-Bridge L293D has two potential outputs. That is, you can bind two items to it and regulate the flow of current in each of them.

Technical specifications:

Total number of pins = 16

IC Operating voltage = 5 – 7 v

Input voltage = 4.5 – 36 v

Output voltage = 4.5 – 36 v

FIGURE 11: H-BRIDGE

3.1.10. HOUSING

MDF woods and CPVC pipes are used to build the housing. The whole system is simple to disassemble and reassemble. For transportation, each part of the machine can be easily removed. Blender blades are handcrafted from 7 mm steel plates. The conveyor system used here is designed to be easy in order to minimize costs and improve performance. The Dispenser system is made with normal 8 mm wood and enclosed with steel plates. The support for the pipes has been achieved using Clamps, Elbows and T's.

FIGURE 12: HOUSING

3.1.11. HARDWARE SETUP

If a cup is put on the conveyor belt, the IR sensor senses the cup and pushes the cup towards the dispensing section, which is installed in the housing unit. MDF wood and PVC pipes make up the housing unit. The blender blade is inserted after the dispensing part and the blending operation is completed. After blending for few seconds the blender blade lifts up. Now the smoothie is given on the other end to the user. After the smoothie is taken from the cup holder, the cup holder returns to the initial position.

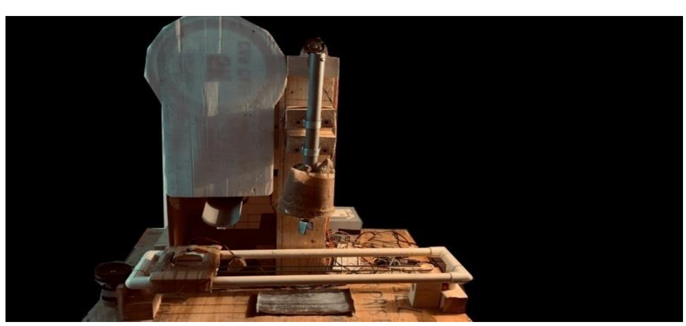

FIGURE 13: HARDWARE SETUP

4. CIRCUIT DIAGRAMS

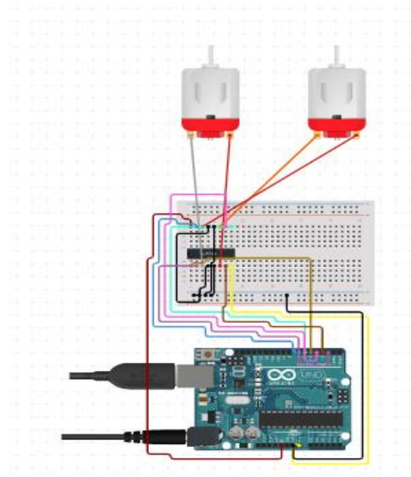

FIGURE 14: CIRCUIT DIAGRAM OF DC GEAR MOTOR CONNECTED WITH MICROCONTROLLER

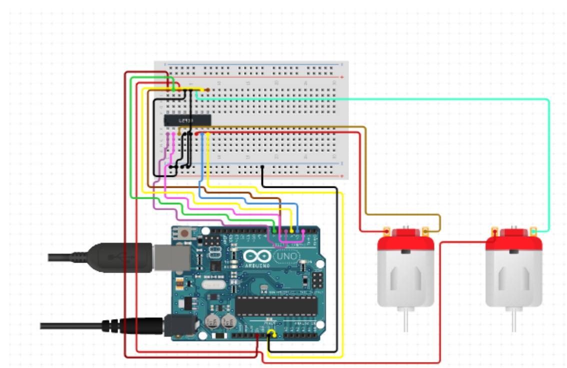

FIGURE 15: CIRCUIT DIAGRAM OF DC MOTOR CONNECTED WITH MICROCONTROLLER

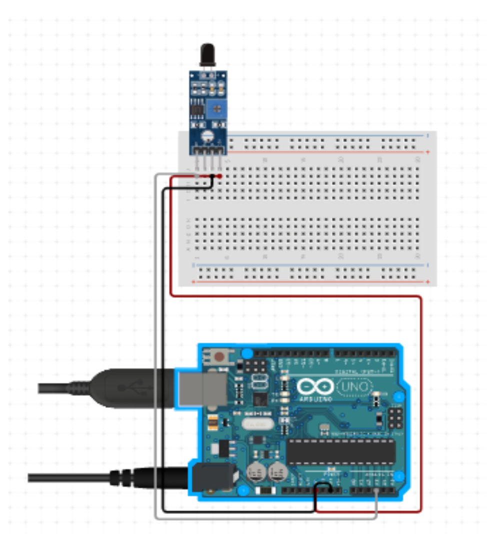

FIGURE 16: CIRCUIT DIAGRAM OF INFRARED SENSOR CONNECTED WITH MICROCONTROLLER

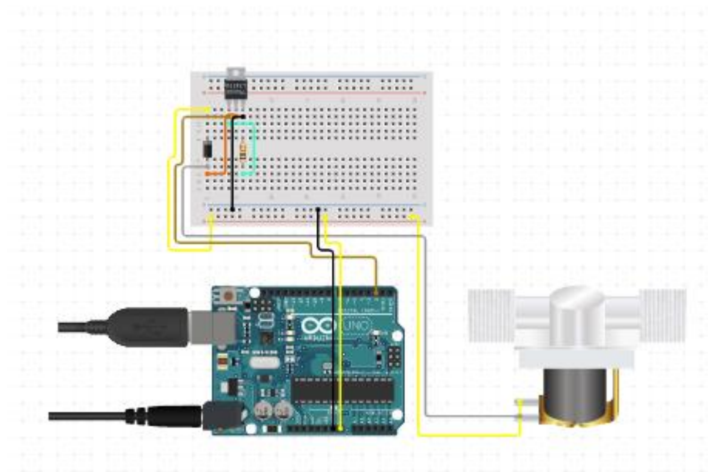

FIGURE 17: CIRCUIT DIAGRAM OF SOLENOID CONTROL VALVE WITH MICROCONTROLLER

5.1 .SOFTWARE

We used the NI LabVIEW Platform to simulate the entire process and got the exact result we wanted. The simulation software is also updated with relation to the I/O interface ports and the interfacing Controller.

Arduino IDE

Arduino UNO is used to control the operation of various motors used in automatic smoothie maker. Arduino IDE is an open source software, which is used to program the arduino UNO thereby controlling different operations. The algorithm used for programming the arduino is simple, the motors are operated for a certain amount of time and then turned off. This takes place when the sensor output matches with the given condition. Once the IR sensor output is high, the process is initiated.

CODE

```
#define ir1 13
#define ir3 12
#define mb1 9
#define mb2 10
#define mi1 7
#define mi2 8
#define p1 5
#define p2 6
#define b1 3
#define s1 4

int b = 0;
int a = 0;
int c = 0;
int ing(int x) {
  digitalWrite(mb1, LOW);
  digitalWrite(mb2, LOW);
  delay(3000);
  Serial.println("ingridents");
  digitalWrite(s1, LOW);
  delay(5000);
  digitalWrite(mi1, LOW);
  digitalWrite(mi2, HIGH);
  delay(6000);
```

```
  digitalWrite(mi1, LOW);
  digitalWrite(mi2, LOW);
  delay(16000);
  digitalWrite(s1, HIGH);
  delay(4400);
  a = 1;
  return a;
}
int blen(int y) {
  Serial.println("blending part");
  digitalWrite(mb1, LOW);
  digitalWrite(mb2, LOW);
  digitalWrite(p1, LOW);
  digitalWrite(p2, HIGH);
  delay(3000);//belt
  digitalWrite(p1, LOW);
  digitalWrite(p2, LOW);
  digitalWrite(b1, LOW);
  delay(6000);//blade spin
  digitalWrite(b1, HIGH);
  digitalWrite(p1, LOW);
  digitalWrite(p2, HIGH);
  delay(2000);//belt
  digitalWrite(p1, LOW);
```

```
  digitalWrite(p2, LOW);
  digitalWrite(b1, LOW);
  delay(12000);//blade spin
  //delay(15000);
  digitalWrite(b1, HIGH);
  delay(3000);
  digitalWrite(p1, HIGH);
  digitalWrite(p2, LOW);
  delay(6000);
  digitalWrite(p1, LOW);
  digitalWrite(p2, LOW);
  delay(3000);
  digitalWrite(mb1, LOW);
  digitalWrite(mb2, HIGH);
  delay(8750);
  digitalWrite(mb1, LOW);
  digitalWrite(mb2, LOW);
  b = 1;
  Serial.println(b);
  Serial.println("b variable");
  return b;

}

void setup() {
```

```
  Serial.begin(9600);
  pinMode(mb1, OUTPUT);
  pinMode(mb2, OUTPUT);
  pinMode(mi1, OUTPUT);
  pinMode(mi2, OUTPUT);
  pinMode(p1, OUTPUT);
  pinMode(p2, OUTPUT);
  pinMode(b1, OUTPUT);
  pinMode(s1, OUTPUT);
```

```
  pinMode(ir1, INPUT);
  pinMode(ir3, INPUT);
  digitalWrite(b1, HIGH);
  digitalWrite(s1, HIGH);
}
void loop() {
  if (digitalRead(ir1) == LOW && a == 0)
  {
    Serial.println(c);
    Serial.println("var in start");
    Serial.println(digitalRead(ir1));
    delay(3000);
    digitalWrite(mb1, LOW);
    digitalWrite(mb2, HIGH);
    delay(2500);
    a = ing(1);
    digitalWrite(mb1, LOW);
```

```
    digitalWrite(mb2, HIGH);
    delay(1500);
    c = 0;
  }
  if (digitalRead(ir3) == LOW && b == 0 && c == 0) {
    Serial.println("blending if condition");
    Serial.println(c);
    Serial.println("c variable in blending part");
    b = blen(1);

  }
  if (a == 1 && b == 1 && digitalRead(ir1) == HIGH) {
    Serial.println("back session");
    Serial.println(c);
    Serial.println("var during back");
    digitalWrite(mb1, HIGH);
    digitalWrite(mb2, LOW);
    delay(15010);
    digitalWrite(mb1, LOW);
    digitalWrite(mb2, LOW);
    a = 0;
    b = 0;
    c = 1;
  }
```

5.2. HARDWARE RESULTS

Figure 17 depicts the automated smoothie maker's final smoothie performance. Without any lag, a fresh smoothie is made in a minute or two. When the user gets the smoothie, the machine returns to its original location. The system's primary flaw is that it lacks an integrated cooling system for storing fruits. The fact that sweeteners like honey or sugar cannot be added to the smoothie is another drawback. This can be overcome by adding an additional compartment to dispensing section.

FIGURE 18: SMOOTHIE

6. CONCLUSIONS

In this project, we ended up with the desired output as we expected. We could even make them more advanced but situations were not favor to us. Automated Smoothie Maker in Markets, Offices, Schools, Universities and gym will help most of the people to follow a proper healthy diet. Improved planning and usage of 3d printed models can somehow help in improved performance and maintenance. Introducing cooling system for the machine can also take this project to the next level.

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