Mechatronics Individual Project

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The Eggo-matic

Project Overview

The Eggo-matic is a hands free, fully automated egg mixing machine. To use simply crack an egg into a bowl and place it underneath the mixer. To sense that the bowl is in the correct position for operation, an ultrasonic distance sensor is placed at the base of the machine to sense that the bowl is the correct distance from the back plate. This ensures the bowl will be underneath the whisk when the mixing operation occurs. To alert that user that the bowl is in the correct position, a green LED a top the Eggo-matic will light up. When the LED is lit, the Eggo-matic is ready to begin the mixing cycle. To start the mixing cycle, the button must be pressed. This will send a signal to the Arduino to start the mixing cycle. The mixing cycle begins by turning off the green LED to alert the user the mixing process has begun, and then lowering the whisk into the bowl. This is done by having the motorized whisk attached to a servo with an operating angle and a resting angle. Once the servo has lowered the whisk into the operating position, the whisk will begin to mix for 10 seconds. After the 10 seconds have passed, the whisk will once again raise up and turn on the green LED to alert the user that the mixing process is done. Once done, the user may grab the bowl of mixed eggs and once removed the LED will turn back off. Now the device is ready to mix more eggs or be turned off.

Project Design Considerations

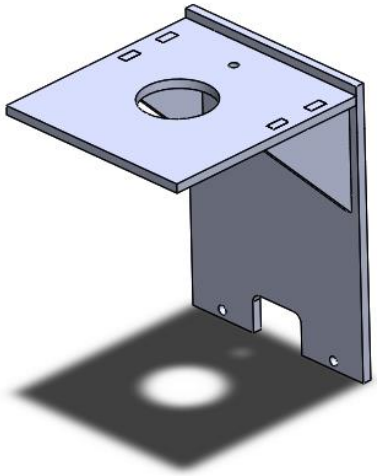
If one were to replicate this project, there are several design considerations that should be made. For one, if I were to redo this project, I would make several different design choices. Mostly these design choices would improve the overall integration and aesthetics of the project and not the actual functionality. Firstly, I would make my base plate a laser cut integrated piece instead of the plywood used. This would look nicer, allow better integration of the Arduino and circuitry behind the back plate, and better fit the sizing of the project. Functionally though this would not affect much apart from allowing the Arduino and breadboard to be better integrated and be less likely to move out of place. This said it would be hard to implement and stay under budget. Secondly, I would design my laser cut pieces such that the pieces that have parts stuck into them have slightly larger holes than the pins that are put into them. I ran into the issue that the parts did not fit as the tolerances between each piece were just too high and I ended up having to manually sand each pin down which took time and made for a less than ideal final fit and finish.

Additionally, if I had more money, I would have liked to better attach the servo motor to the laser cut structure. With more money I could have created a custom 3d printed part that could be screwed into the top part of my structure and securely house the servo. In my iteration as a cost saving measure the servo is taped to the top however this is not an ideal solution. Secondly, I would have liked to buy a higher quality motor. This would give more torque to blend the eggs with and create a better user experience. In the current set up the speed of the whisk slows down significantly when it hits the yolk, and likely can not mix more the 3 or 4 eggs at a time. Furthermore, a motor with a better torque rating could allow this device to be used to mix thicker things such as batter, and this would increase the functionality of the device.

Assembly Instructions

The Eggo-matic is made using laser cut pieces and a wooden base. To assemble first attach the whisk to the motor. To do this put two screws on opposite sides into the side of the whisk and resting up against the output shaft of the motor, then tighten to ensure a secure connection. Next, attach the motorized whisk assembly to the servo. To do this, securely zip-tie the motor to the servo's mounting points on the output of the servo.

Next, assemble the laser cut structure. This is done by inserting each pin into the corresponding hole. The final structure should appear as shown below.



Next, screw in your back plate to the plywood base through the bottom holes in shown in the structure. This should be a strong connection to ensure the structure does not fall. Once the main structure is complete now you may attach the servo/motor unit to the underside top part of the structure. While doing this, ensure that the back end of the motor will be in the top hole when the servo is in the operating position. This will prevent the motor from hitting the top structure piece. Next, place the LED in the small hole on the top plate. Finally, wire the motor, servo, and LED to your breadboard. Holes through the backplate are cut into the sheet to allow for clean wiring.

Now that the structure is complete, place the ultrasonic distance sensor such that it points through the bottom opening and at the location the bowl should be placed.

Operation Instructions

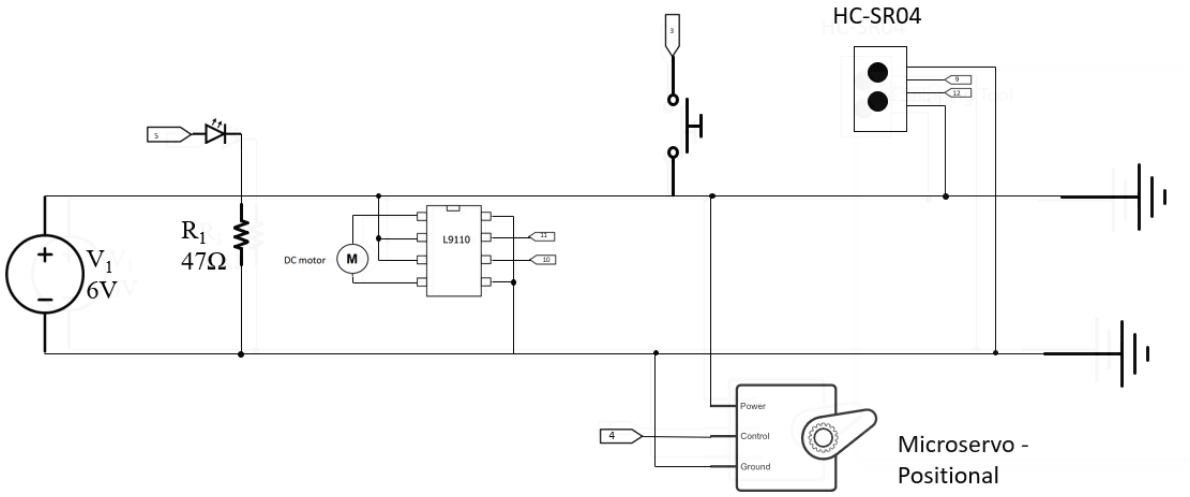
Operation of the Eggo-matic is simple. First take your bowl and crack anywhere from 1-4 eggs into it. Next, place this bowl underneath the whisk. When the bowl is in the correct location the green LED will light up signifying that the bowl is in the correct place and it is ready to begin the mixing cycle. To begin the mixing cycle press the buttom wired into the breadboard to begin. The whisk will now lower into the bowl and begin to turn for 10 seconds. Once time is up, the motor will stop and the whisk will raise out of the bowl allowing you to easily remove your bowl. The LED will light to notify you once mixing is complete. Finally, either run it for another cycle by pressing the button again or remove your bowl and enjoy your eggs. Once the bowl is removed, the LED will shut off and the device is either ready for more mixing or to be shut off.

Appendix A: BOM

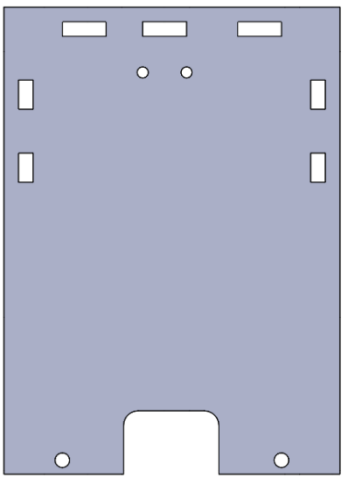
Part Name **Purchased for project in bold**	Part Number	Price	Purchase Link
Motor Driver IC: L9110H	1528-4489-ND	$1.42	Digikey.com
Mini DC motor 1.5-12VDC 1350 rpm	2209094	$1.25	Jameco.com
Mini Breadboard	98AC7296	$1.05	Newark.com
Microservo - Positional	SER0006	$3.30	Dfrobot.com

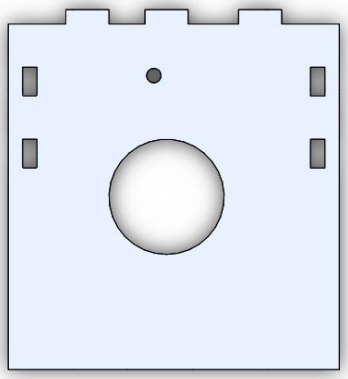
Tactile Switch Push Button	155380	$0.35	Jameco.com
Bread Board	79X3922	$2.71	Newark.com
3-Wire Extension	1568-1930-ND	$1.35	Digikey.com
Wire Kit	B07PQKNQ22	$2.17	Amazon.com
Green LED	334086	$0.08	Jameco.com
Zinc-Plated Alloy Steel Socket Head Screw 10-24 Thread Size, 3/8" Long	**90128A218**	**$1.37**	**https://www.mcmaster.com/90128A121/**
Cdx Grade Plywood Sheet, 3/8" Thick, 12" Long x 12" Wide	**1121T511**	**$4.87**	**https://www.mcmaster.com/1125T511/**
HC-SR04 Ultrasonic sensor	**1528-2711-ND**	**$3.95**	**https://www.digikey.com/en/products/detail/adafruit-industries-llc/3942/9658069**
Tape		$0	
Laser Cut Structure		**$7.60**	**RPL**
22AWG solid-core hookup wire (per foot)	**4 ft**	**$0.40**	**Lab Shop**
Cost of Purchased Components		**$18.19**	**(wood, screws, laser cut structure, wire)**

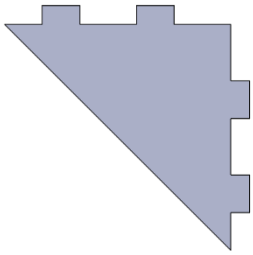
Appendix B: Circuit Diagram

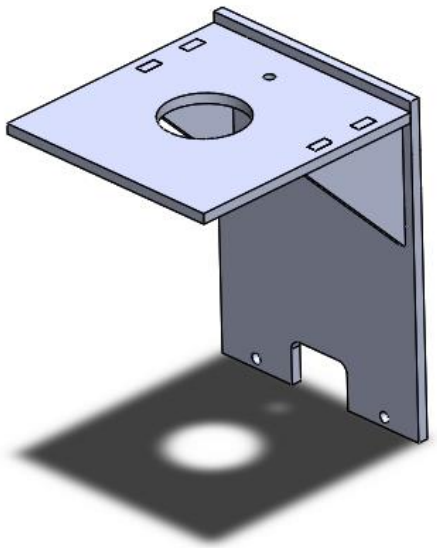


Appendix C: CAD Models

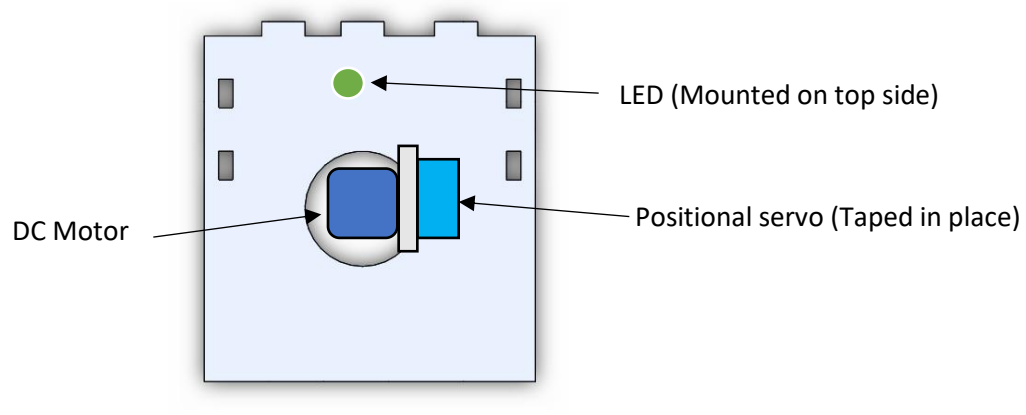








Servo-motor mounting diagram



Appendix D: Commented C Code

```
// C++ code to run eggo-matic. Includes code to run distance sensor. Initiates Mixing sequence
//only if bowl is within range (turning on LED) and then the button is pressed. Mixing cycle runs
//10 seconds at ~75% power, can be changed.
#include <Servo.h> // load servo library
#include <stdio.h>//load standard inputs
Servo myservo;  // create servo object
int angle = 0;  // declare variable for servo angle
int angle1 = 120;//set servo rest position (whisk out of bowl)
int angle2 = 40;//set servo operating angle (whisk in bowl)
int trigPin = 12;//set trigger pin as 12
int echoPin = 9;//set echo pin as 9
//int dt = 10;    // short delay time
void setup(){  // setup code tha only runs
  myservo.attach(3);// set servo pin to 3
  Serial.begin(9600);// serial initializer
  pinMode(11, OUTPUT);//set 11 as output pin for h-bridge
  pinMode(9, OUTPUT);//set 9 as output pin for h bridge
  pinMode(4, OUTPUT);//set 4 as output pin for LED
  pinMode(3, OUTPUT);//set 3 as output pin for servo
  pinMode(2, INPUT);//set 2 as input pin for push button
  myservo.write(angle1);//set servo initial position at rest position
  pinMode(trigPin, OUTPUT);//set triggerpin as an output
  pinMode(echoPin, INPUT);//set echopin as an input

}
```

```
void loop()
{
 long duration, distance;//code for ultrasonic sensor
 digitalWrite(trigPin, LOW);//turn off trigger pin
 delayMicroseconds(2);//wait 2 microseconds
 digitalWrite(trigPin, HIGH);//turn on trigger pin
 delayMicroseconds(10);//wait 10 microseconds
 digitalWrite(trigPin, LOW);//turn off triggerpin
 duration = pulseIn(echoPin, HIGH);//set pulse lenth
 distance = (duration/2) / 29.1;//distance conversion
 Serial.print(distance);//print distance
 Serial.println(" cm");//add units to distance

  {
  if(distance<=11){//if the bowl is the correct distance from the sensor under whisk
   digitalWrite(4,HIGH);//turn on LED
   if(digitalRead(2) == HIGH){//if button is pressed
    digitalWrite(4, LOW);//turn off LED
    myservo.write(angle2);//move servo to operating position
    delay(1000);//wait 1 second
    analogWrite(11, 180);//Turn on motorized whisk forward
    digitalWrite(9, LOW);//Do not turn motor backward
    Serial.print("Button has been pressed");//for code testing purposes
    delay(9000);//wait 9 seconds
    Serial.print("10 Seconds Passed");//for testing
    digitalWrite(11, LOW);//turn off motor
    digitalWrite(9, LOW);//turn off motor
    delay(1000);//wait 1 second
    myservo.write(angle1);//put servo back to inital position;
    digitalWrite(4, HIGH);//turn on LED mixing cycle is over
    }else if(distance>=11){//If bowl is not in correct position
     digitalWrite(4,LOW);//turn off LED
    }
  }
 }
}
```