

Design and Construct Water Levitation Module with Arduino Uno

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ABSTRACT

Sound is exotic thing that ready to be researched and explored. Although many researches were done on this theme, there are still many things that can be obtained when researching about sound. For example, levitate things with ultrasonic frequency. It is amazing that sound, which is like a vibe, can levitate things. From that idea, the writer fascinated to construct the water levitation circuit. In this project, with Arduino and a strobe light, the writer creates a design that makes it possible to see the water levitation phenomenon with using audible frequency. The device provides an optical illusion, so the blink of LED that hit droplets from tube, pumped by water pump, looks like levitate with human eyes. This method can show the variations of water levitation phenomena with correct time setting of the blinking LED and frequency setting of the speaker. The synchronization frequency of LED and speaker will make the water stay. But, frequency of the LED higher than the speaker, then it will make droplets ascend and vice versa, if frequency of LED lower than the speaker, it will make droplets descend as normally it does.

Keywords: strobe light, sound, droplets, levitation, optical illusion, LED.

ABSTRAK

Suara adalah sesuatu yang eksotis untuk diteliti dan dieksplorasi. Meski hal ini sudah banyak penelitian yang dilakukan, masih banyak hal penelitian yang dapat dilakukan tentang suara. Misalnya, tentang levitasi air dengan menggunakan frekuensi ultrasonik. Sungguh menakjubkan suara itu, yang seperti getaran, bisa mengapungkan suatu benda. Dari gagasan itu, penulis tertarik untuk membangun rangkaian levitasi air. Dalam proyek ini, dengan menggunakan Arduino dan lampu strobo, penulis membuat perancangan yang memungkinkan untuk melihat fenomena levitasi air dengan menggunakan frekuensi yang dapat didengar. Perangkat ini menyediakan ilusi optik, sehingga sekejap LED yang menabrak tetesan air dari tabung, yang dipompa oleh pompa air, terlihat seperti melayang bila dilihat dengan mata manusia. Metode ini dapat menunjukkan variasi fenomena levitasi air dengan melakukan pengaturan waktu yang benar dari pengaturan LED dan frekuensi yang berkedip. Frekuensi sinkronisasi LED dan speaker akan membuat air berhenti. Melalui pengaturan frekuensi LED lebih tinggi dari speaker, maka akan membuat tetesan air naik dan sebaliknya, jika frekuensi LED lebih rendah dari speaker, maka akan membuat tetesan air turun seperti biasanya.

Kata kunci: lampu strobo, suara, tetesan, mengambang, ilusi optik, LED.

I. INTRODUCTION

Sound is unique. When several medium emit different sounds at the same time, it does not mix. When the right circumstances, it can set and change the state of a matter. Recently, researchers have successfully used the frequency of the sound to levitate small material in the air [6]. Also the experiment to separate two materials using the sound, that can be further involve in filtering the water [7]. With that experiment, there are many kinds of simplify experiment, one example is water levitate illusion [1]. This experiment using sound to the water, so the water looks like levitate in several distance and neat in time. Levitate the water with only using the sound does not make the water look levitate. In fact, we need a camera that have same frequency as sound, example: when the frequency state 60 Hz, the camera must with 60 fps

($T = 1/60$ s). With that situation, it will be hard if we do not have the camera that equal to the frequency. Instead using camera, the author using blinking technique to get the water levitation phenomena, with Arduino as the controller of the LED light.

II. DESIGN REQUIREMENT AND SPECIFICATIONS

A. The Purposed Circuit of Water Levitation

The purposed of this thesis as mention before, the circuit is designed to research about water levitation and as reference for further research about water levitation. Author hopes that from this design, the water levitation can be on the display, seen by many people.

With addition of strobe light circuit, it will help to realize the water levitation phenomena, instead of using a specific camera.

B. The requirement material

For this water levitation device, the author use:

- 1 Arduino uno R3 for controller.
- 1 Speaker with subwoofer system.
- 100 LED (about 1000 lumens) for strobe light.
- 1 Relay for strobe light’s switch.
- 1 ADC adapter (for 12V).
- 1 Aquarium water pump.

The subwoofer in this device use IC LM 386. The subwoofer system can be seen in Figure 1.

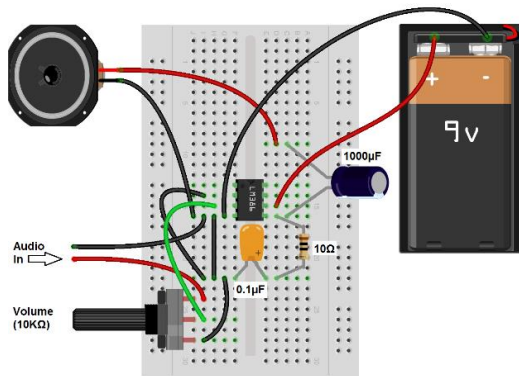


Figure 1. The subwoofer system.

III. DESIGN CoNSTRUCTION AND IMPLEMENTATION

This water levitation design purpose is to make a different way to look over the science. The author think that everybody can make something, different, and useful in some way. This design from the author is to take people to enjoy the greatness of science.

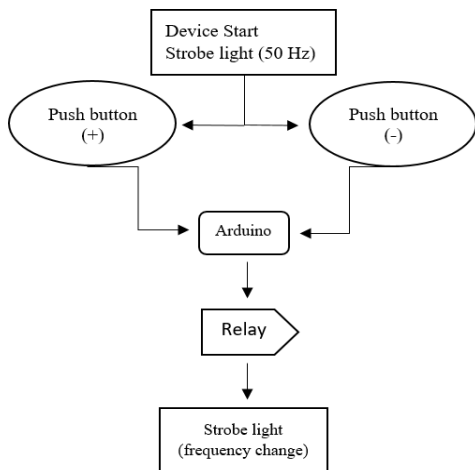


Figure 2. Block diagram of the device.

From Figure 1, device run with strobe light and sound generator at 50 Hz. When one of the push button is on, the Arduino receive the signal from the push button, and send signal to the strobe light with relay. If the push button (+) on, the frequency will add to the strobe light, the blink become faster than before. If the push button (-) on, the frequency will decrease in the strobe light, the blink become slower than before.

A. Cover Design

The cover of device is made of Acrylic. It has shape like water dispenser. From the Figure 2, the device has 1 aquarium motor (cube), 15 cm of water tube, 2 power outlets and 1 speaker that attached to the water tube. The speaker is designed outside of the case, so the water that goes down to the motor, so it does not drench everywhere. The LEDs putted at left side of the wall of the case as the strobe light for the circuit.

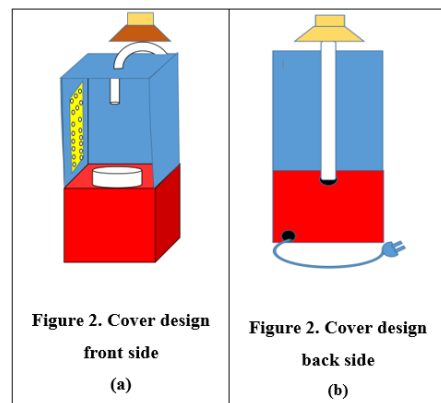


Figure 2. Cover design front side (a)

Figure 2. Cover design back side (b)

B. Circuit Design

Arduino UNO R3 is the main unit of the water levitation circuit. The microcontroller processes the input detected by the push button controls the relay to do the strobe light. The power to the Arduino UNO is provided by ADC adaptor. It has an output 12 V.

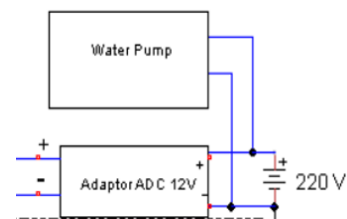


Figure 3. Power supply in circuit.

From Figure 3, there are two type of circuits, subwoofer circuit (Fig. 4) and strobe light circuit (Fig. 5). This two circuits connected with adaptor ADC 12V. Then, the adaptor and water pump motor connected to power supply 220V. In Subwoofer circuit, the main part is IC LM 386. Pin six (pin 6) connect to adaptor (pin +). Pin five (pin 5) connect to capacitor 1000 µF and resistor 10 Ω. The capacitor connect to speaker (pin +) and the resistor connect to capacitor 0.1 µF

and this capacitor have another pin connect to ground of LM386 (pin 4). Pin three (pin 3) connect to potentiometer of 10 kΩ. Pin two (pin 2) connect to ground (pin 4). For Strobe light circuit, the Arduino get power from adaptor with pin 7-12 VDC (pin Vin + and Vin -). The push buttons connect with Arduino from pin A0-A4. For pin A5, it is connected with relay (pin IN) with purpose to control the strobe light.

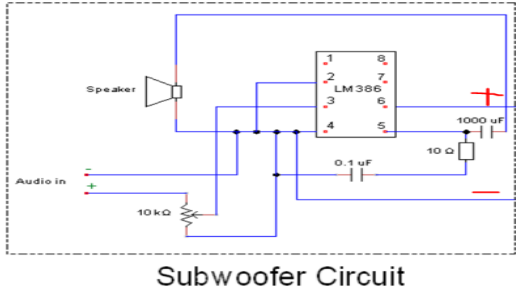


Figure 4. Subwoofer circuit of the device.

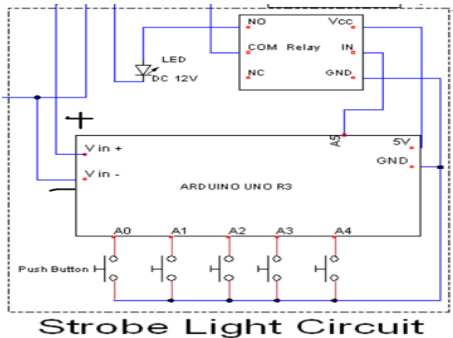


Figure 5. Strobe light circuit of the device.

C. Software Implementation

To implement the program to the microcontroller, the author used Arduino IDE 1.6.14 hourly build. There are three main functions command which can be affixed in the Arduino IDE programming. The first function is library and int (first state), which state the condition of the program and first state of the pin of Arduino. Second, setup(), which runs only once at the beginning. Third, the function is loop(), this command will run continuously in a loop until the power to the Arduino is off.

This are some code that author use in th device with the first state interval is 20

/* CODE FOR ACCELERATE THE BLINKING OF THE LED*/

case btnRIGHT:

```
{
interval = 17;
digitalWrite(ledPin, HIGH);
delay(interval);
digitalWrite(ledPin, LOW);
delay(interval);
// set up the LCD's number of columns and rows:
```

```
lcd.begin(16, 2);
// Print a message to the LCD.
lcd.print("Frequency");
// set the cursor to column 0, line 1
// (note: line 1 is the second row, since counting begins with 0):
lcd.setCursor(9,1);
// print the number of seconds since reset:
lcd.print(interval);
lcd.setCursor(11,1);
// print the number of seconds since reset:
lcd.print("ms");
lcd.setCursor(0,1);
lcd.print("RIGHT ");
break;
}
```

/* CODE FOR SLOW DOWN THE BLINKING OF THE LED*/
case btnLEFT:

```
{
interval = 25;
digitalWrite(ledPin, HIGH);
delay(interval);
digitalWrite(ledPin, LOW);
delay(interval);
// set up the LCD's number of columns and rows:
lcd.begin(16, 2);
// Print a message to the LCD.
lcd.print("Frequency");
// set the cursor to column 0, line 1
// (note: line 1 is the second row, since counting begins
with 0):
lcd.setCursor(9,1);
// print the number of seconds since reset:
lcd.print(interval);
lcd.setCursor(11,1);
// print the number of seconds since reset:
lcd.print("ms");
lcd.setCursor(0,1);
lcd.print("LEFT ");
break;
}
```

IV. RESULTS AND CONCLUSIONS

A. Results

The project device is designed to get control of water flow from aquarium pump by noise generator and strobe light. The speaker and Arduino is outside. The Device works fine in the room with the size of 3 x 6 meters square. The strobe light that make it hard to look for long time, but it does help to reach the levitation phenomena. This result is based of three times of testing the device with take the two of same results. Below here is the picture of the water levitation device (Figure 6).



Figure 6. Water levitation device

When the device start, the aquarium motor pumps water from outside through the funnel. The water should be poured in piecemeal. It aims to get the water phenomena clearly, beside using the strobe light and the subwoofer.

Table 1. Result of Best Two of Three of Testing Device

Frequency of lamp(Hz) [In Delay time]	Frequency of Water (Hz)			
	40	50	60	70
40[25ms]	S	U	U	U
45[22ms]	U	U	U	U
50[20ms]	D	D	D	D
55[18ms]	D	D	D	D
60[17ms]	S	D	D	D

Note:

S= Stay U= Go Up D= Go Down

From the Table 1, result from best two of three device test, with the base of frequency in the lamp, the water levitation frequently going up happens after the frequency of the water is higher than the lamp. The expectations for this project are if the frequency of LED is bigger than frequency of the water, the droplets will go up and vice versa, like shown in Table 2. Also, if the frequency of LED same as frequency of water, the droplets looks like stay at some point. But sometimes, such as at a frequency of 55 Hz, the water is frequently going down. This is happened might be due to fluidity in the water pump and human error when watching the device when it works. Aside from that, the device works according to the author's intention.

Table 2. Expectation Result of Water Levitation Device

Frequency of lamp(Hz) [In Delay time]	Frequency of Water (Hz)			
	40	50	60	70
40[25ms]	S	D	D	D
45[22ms]	U	S	D	D
50[20ms]	U	S	D	D
55[18ms]	U	U	D	D
60[17ms]	U	U	S	D

Note:

S= Stay U= Go Up D= Go Down

B. Conclusions

Based on the design and construct of the “Water levitation device”, there are two conclusions that can be presented:

1. The device run with droplets that pumped from water pump and blink of light from LED.
2. Cause of optical illusion from LED blink, with Arduino as the controller of delay time of strobe light, the device provide various water levitation phenomenon, go up, stay and go down.

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