Mini and Cost-Effective Musical Water Fountain

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ABSTRACT
A musical water fountain, also known as a dancing fountain , is a type of animated fountain are used to day to decorate city parks and squares ; to honor individuals or events that creates an aesthetic design. The musical fountain combines moving jets of water, sound detector, colored lights and recorded music, that controlled by a microcontroller or computer, for dramatic effects. In this paper a mini and low cost musical fountain was designed using Arduino board. Arduino was used to control water valves and create interesting effects in the fountain, like pulses of water that are timed to be in synchronization with music. A transistor also used as switch to turn the fountain on and off according to the music and the particular LED will light up synchronously.

Keywords
Arduino UNO, DC, IDE, NPN, TIP120

1. INTRODUCTION
A water fountain or animated fountain is widely used these days to decorate city parks and squares. It can either spray water into the air or create a waterfall effect.

Water fountains mainly need three parts to operate: water source, water pump and delivery channel [1]. All outdoor water fountains have a water source or reservoir from which they draw their water and to which the water returns, creating a closed circuit. The power to move the water is supplied by a pump. The pump is usually submerged in the water reservoir. A spinning impellor in the pump draws water in and is spinning at such a speed that the water is forced out of the pump by centrifugal force. The water forced from the pump is delivered to the delivery channel or fountain head where it is sprayed into the air through a fine nozzle or where it is allowed to flow down the outside of the structure of the fountain, The water that is sprayed into the air will fall back into the fountain and drain back into the reservoir [2][3].

Hero of Alexandria (in the 1st century) was perhaps the first designer of fountains with special effects. The U-shaped served as the main part responsible for creation of special effects in his fountains [4]. Water fountain then become very interesting issue in the 12th, 16th, 17th and 20th centuries. Among all these years there were big developments in the design of fountains [5][6][7].

Nowadays water fountains differ in shape, size and design. They can be very small that decorate houses and gardens [8][9] or it can be very large that decorate squares (such as Dubai fountain [10]). Also fountains' design can be simple that use small number of water jets and lights, or can be very complex that use hundreds of water jets and lights [11][12].

Fountains' style may also differ according to the place and purpose. For example a mercury fountain is a fountain constructed for use with mercury rather than water. It existed in some castles in Islamic Spain [13]. A dry fountain is another example which is usually built in public squares and shopping centers to provide playful water displays in a minimum of space. The dry nozzle fountain is installed underground, while the dry fountain is running; it is allowed children to play with water columns in the fountain (see Figure 1) [14].

Fig. 1: Dry fountain [15]

Another special fountain is digital water curtain (also called waterfall graphic, curtain images, and digital water curtains as shown in Figure 2). It can create any visual, logo, word besides projecting any type of content in high quality with the water itself by using the water writing technique [16].

In this paper, a small and low cost water fountain will be designed and built. This musical water fountain will be controlled by music using Arduino programming system. The basic concept of the project operation depends on taking an input (a sound) from a sound detector sensor, then according to the sound volume (loud or calm), the valves will be turned on\off (by Arduino) such that each different volume of the sound will operate the fountain differently.

Fig.2: Digital water curtain [17]

2. PROJECT COMPONENTS

The block diagram of the mini musical water fountain is shown in Figure 3.

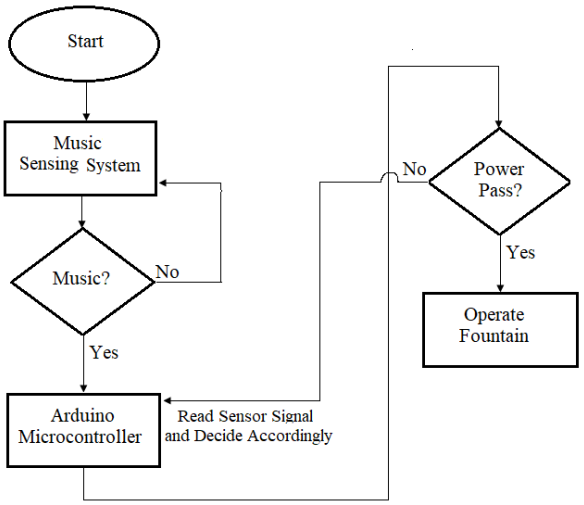

Fig. 3: Fountain's block diagram

2. 1 Arduino UNO

Arduino is an open source platform that is used in many projects [18][19]. It consists of a programmable circuit board (called a microcontroller), as well as a programmable part of an integrated development environment (IDE [20]) that runs on the computer and is used to write and load code (which is a simplified version of C++) from the computer to the Arduino panel[21]. Arduino Uno was used in this project (see Figure 4) which contains 14 digital ports (input / output) and 6 analog inputs [22].

Fig.4: Arduino UNO

2.2 Sound detector sensor

Sound detector sensor is a small board that combines a microphone and some processing circuit; it has the ability to detect different sounds (Note that this sound sensor is used to detect whether there's sound surround or not, it cannot recognize the frequency or volume). Its pins and diagram is shown in Figure 5 [23].

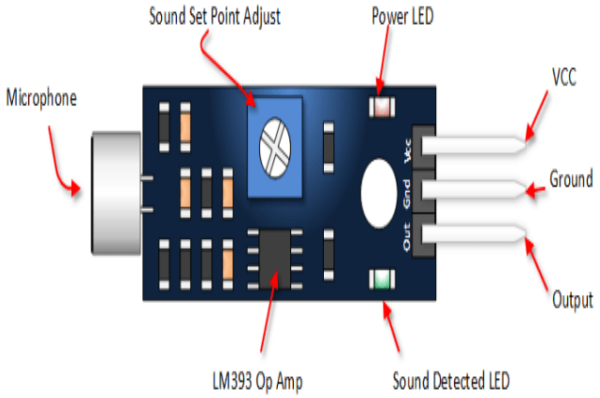

Fig. 5: Sound detector sensor

2.3 TIP120 transistor and 1n4148 diode

TIP120 transistor is an NPN transistor; it can be used with Arduino as a fast switch and because the valves and water pump operate at 12 volt so the required voltage is higher than that Arduino can provide. TIP120 will go in between the power supply and Arduino. The use of diode is to protect TIP120 from damaging because of the high voltage. TIP120 pins and diode are shown in Figure 6 [24].

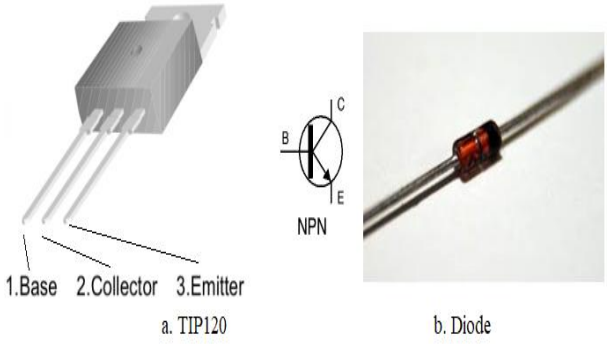

Fig. 6: TIP120 transistor and 1n4148 diode

TIP120 transistor is connected with the water valves as a switch because of its speed than other switches (like Relays). The circuit of this connection is shown in Figure 7.

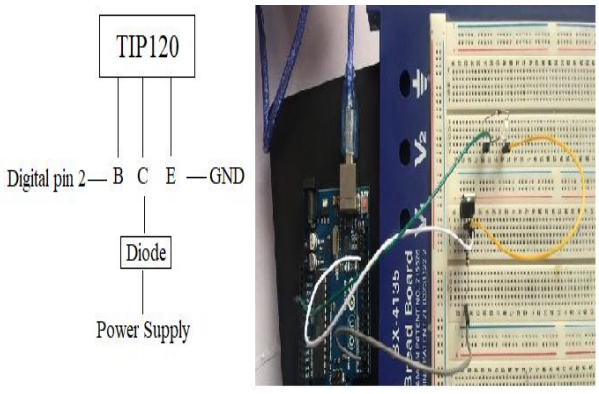

Fig. 7: TIP120 transistor as switch

2.4 Water Pump

Water pump or DC (direct current) powered pumps use direct current from motor, battery, or solar power to move fluid in a variety of ways. Motorized pumps typically operate on 6, 12, 24, or 32 volts of DC power (12 volt was used as shown in Figure 8). The main advantage of DC pumps is that they can

operate directly from a battery, making them more convenient and portable. They are easier to operate and control [25].

Fig. 8: water pump

2.5 Solenoid valve

A solenoid valve (see Figure 9) is an electromechanical device in which the solenoid uses an electric current to generate a magnetic field and thereby operate a mechanism which regulates the opening of fluid flow in a valve. The valve can use a two-port design to regulate a flow or use a three or more port design to switch flows between ports. Multiple solenoid valves can be placed together on a manifold [26].

Fig. 9: Solenoid valve

2.6 Other assisted components

These components are shown in Figure 10 and include a breadboard, jumper wires, (12v) power supply and resistors (560Ω) and LEDs.

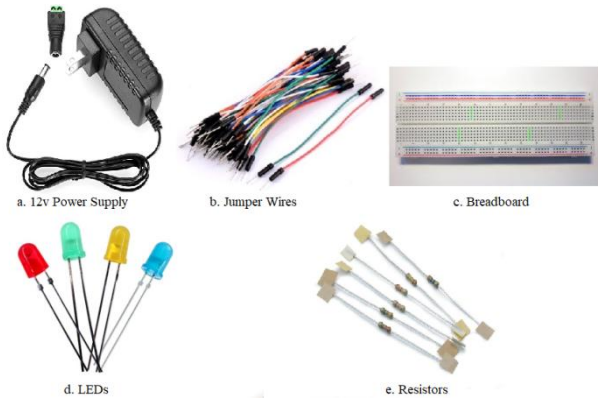

Fig.10: Assisted components

3. CIRCUIT CONNECTION

In this project, the sound sensor is connected as below:

- Vcc pin of sound sensor with 5v pin on Arduino
- GND pin of sound sensor with the GND pin on Arduino
- Output pin of sound sensor with analogy pin on Arduino (A0)

5 TIP120 transistors were used as switches (with 5 diodes) and they connected as below:

- Base pin of each transistor is connected with the digital pins (0-4) of Arduino through a (390 ohm) resistor.
- Emitter pin of each transistor is connected to GND pin of Arduino and in the same time with the (–ve) terminal of the power supply and (–ve) terminal of the water pump.
- Collector pin of each transistor is connected with 1n4148 diode and in the same time with the (–ve) terminal of each solenoid valve.

5 solenoid valves were connected in the project. The (+ve) terminal of the power supply, the (+ve) of each solenoid valve and the (+ve) terminal of the water pump are all connected with the other terminal of 1n4148 diode. Figure 11 and 12 show the complete connection of the project.

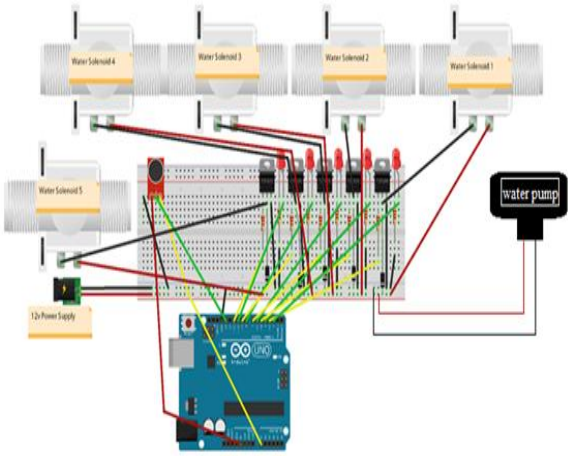

Fig.11: Circuit connection

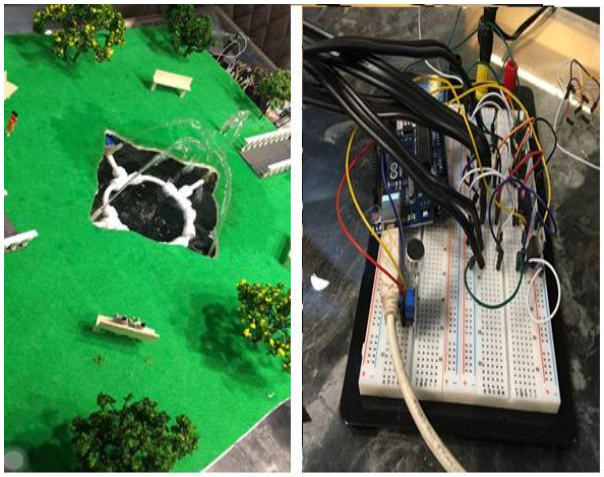

Fig. 12: Final completed project

4. CONCLUSION

In this project, a mini and cost effective musical water fountain had designed. Simple components with Arduino were used to build the design. It gave an accurate result such that it worked with any type of music and LEDs gave the project more beautiful effects. The use of the transistor as a switch has made fastest response and the control of valves was very effective. This project can be used to decorate houses and offices or it can be built with larger numbers of valves with the same principles so that it can be used in shopping centers.

5. ACKNOWLEDGEMENTS

The authors gratefully acknowledge Alfarabi University of the pacific for their fountain project. The following individuals have assisted the authors in gathering information and photos for his research on fountains. With thanks, they are Riham Khalil, Zahraa Mohammad and Masam A.Salih.

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