DANCING ROBOT USING ARDUINO

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ABSTRACT

This paper attempts to achieve dancing robot by using Arduino UNO, Arduino Nano and Bluetooth as a main processor. In this system used seven major components which are Arduino Uno, Nano Board, HC-05 Bluetooth Module, Servo motor, 8x8 dot matrix, MP3 module and DC Buck Converter. The system is implemented on an embedded platform and is equipped with a Bluetooth module (HC-05) which gives the required input for operation. The main objective of this paper is to dance according to our commands using Bluetooth module via Arduino.

KEYWORDS: Aurdino UNO, Aurdino Nano, HC-05 Bluetooth Module, Servo motor, 8x8 dot matrix and MP3 module.

1. INTRODUCTION

The proposed system is Dancing Robot using Arduino. Internet of Things has emerged as one of the most promising technologies for the future [1]. This field is actively researched, and different solutions have been proposed to address the challenges in this area, such as limited amount of energy and cost-efficiency [2]. One of the most discussed topics in IoT is the Home Automation, developing an inexpensive and safe system for indoor use has been a widely researched area which has brought advances in technology and availability of small, flexible, and smart systems.

This system proposed a low-cost system using Bluetooth which can make our daily life happy and enjoyable by spending our time with this little robot.

2. BACKGROUND THEORY

A brief introduction about Bluetooth and Arduino is presented. These components are the main parts of the proposed system design. Microcontroller can be regarded as a single-chip special-purpose computer dedicated to execute a specific application. As in general purpose computer, microcontroller consists of memory (RAM, ROM, and Flash), I/O peripherals, and processor core. However, in a microcontroller, the processor core is not as fast as in general purpose – computer, the memory size is also smaller.

Microcontroller has been widely used in embedded systems such as, home appliances, vehicles, and toys etc. There are several microcontroller products available in the market, for example, Intel's MCS - 51 (8051 family), Microchip PIC, and Atmel's Advanced RISC Architecture (AVR). Arduino UNO and Bluetooth module are discussed in this section.

This design is based on both hardware and software. For the design to be implemented, we will be using an ATMega328 Microcontroller, interface with some other hardware components.

2.1 Hardware Components

The circuit diagram of the dancing robot is as shown in Fig 1 and hardware components are shown in Table 1.

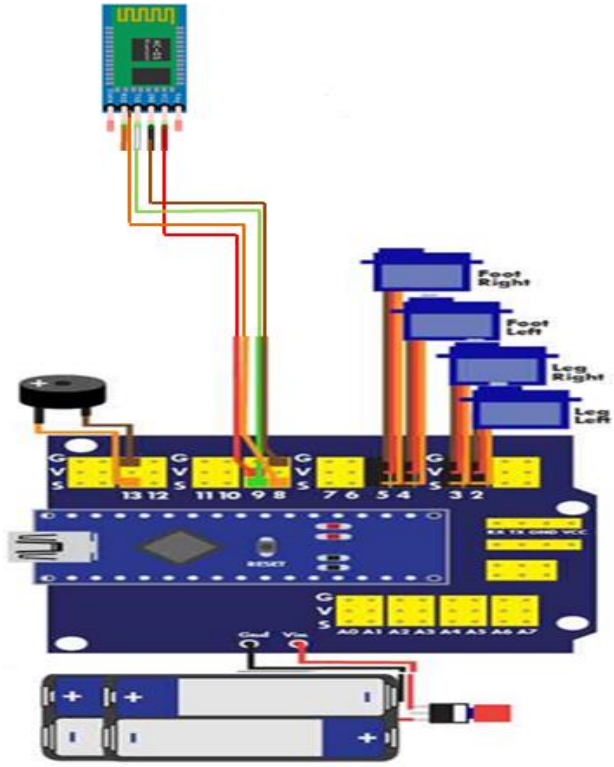


Fig 1. Circuit Diagram of Dancing Robot

Table 1. Hardware Components

No.	Part Name	Specification	Quantity
1.	Arduino	UNO	1
2.	Arduino	Nano	1
3.	Bluetooth module	HC-05	1
4.	8x8 dot matrix (with module)	MAX 7219 CWG	1
5.	MP3 module	JQ8400-FL-10P	1
6.	Servo motor	MG996R	4
7.	Speaker	8 Ω, 0.5 W	1
8.	Battery (Rechargable)	12 V, 3000 mAh	1
9.	Battery	9 V	1
10.	DC Buck Converter	LM2596S	1

2.1.1 Arduino

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board we can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

2.1.1.1 Features of the Arduino UNO Board

Arduino is a USB interface like a serial device. The board directly plug in to the computer so it is easy and comfortable to interface with the computer. It is an open source device and very easy to debug the problem so it is more advantages between the large community peoples. In order fast up for application it has 16 MHz clock.

It has inbuilt in voltage regulation in order to manage power inside and can be directly powered by USB without any external power. This board has 13 digital and 6 analog pins to connect the hardware with the external environment. With the help of these pins we can directly plug in the real-world data. This board has a ICSP connector which is necessary to re bootload our chip and has 32 KB of flash memory for storing our code. An on board LED and reset button is attached in order to make debug process easy.

2.1.1.2 Arduino Nano

The Arduino Nano is a compact board similar to the UNO. The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P (Arduino Nano *3.x*). It has more or less the same functionality of the Arduino Duemilanove, but in a different package.

2.2 Bluetooth Module

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It has the footprint as small as 12.7mmx27mm.

2.3 DC Buck Converter

DC-DC Buck Converter Step Down Module LM2596 Power Supply is a step-down (buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version. The LM2596 series operates at

a switching frequency of 150 kHz, thus allowing smaller sized filter components than what would be required with lower frequency switching regulators [3].

2.4 Interfacing 8x8 LED Matrix with Arduino

LED matrix displays can be used to display almost anything. Most modern LED sign board's uses various types of matrix boards with controllers. 8×8 matrix consists of 64 dots or pixels. There is a LED for each pixel and these LEDs are connected to total of 16 pins. The pin out and circuit diagram of it using the following Fig 2. In Fig 2, C1 to C8 are Column pins and R1 to R8 are Row pins.

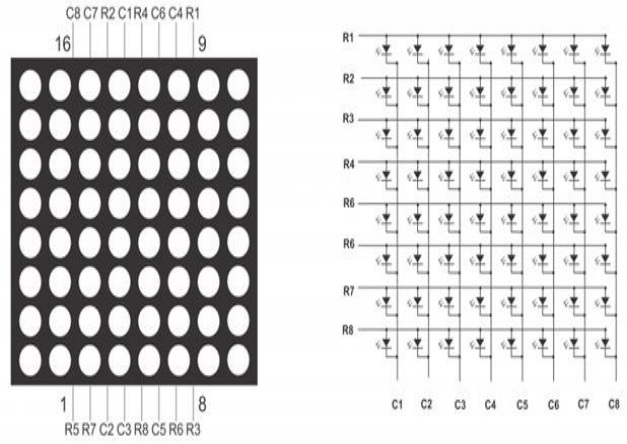


Fig 2. 8x8 Matrix Pin out

We can see all anodes of same row are connected to one pin and all cathodes of same column are connected to another pin. We have 8 row pins and 8 column pins. If a positive voltage is applied to R1 pin and negative to C1, we can see that the first pixel turns on. If we apply negative to C2 then the second pixel turns on. Like this we can turn each pixel by hanging the supply pins. However we have 64 supply combinations, and doing it manually is practically impossible [4]. In this paper, the 8x8 dot matrix demonstrates the face of the dancing robot.

2.5 Servo Motor

A servo motor is a rotary actuator or motor that allows for a precise control in terms of angular position, acceleration and velocity, capabilities that a regular motor does not have. It makes use of a regular motor and pairs it with a sensor for position feedback. The controller is the most sophisticated part of the servo motor, as it is specifically designed for the purpose. Servo Motors are employed for the movement of the robot. Two servos at both the feet help the robot turn [5].

3. PROPOSED SYSTEM

In this paper, dancing robot was designed and implemented using Arduino microcontroller devices which is programmed by open source IDE and uses 4 servos for balancing. The functional block diagram of the design is shown in Fig 3. This design is in seven modules; Bluetooth module (HC-05), servo motor, 8x8 dot matrix, MP3 module, DC Buck Converter, Arduino UNO and Nano modules. While the Arduino UNO forms the main control element, the Bluetooth module is connected with other hardware components. After connecting successfully, according to our commands to dance the robot.

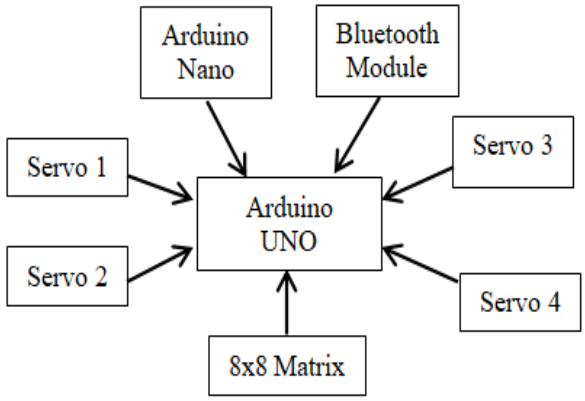


Fig 3. Functional Block Diagram of the Design

4. OPERATION OF THE SYSTEM

The Arduino program controls the movement of the servo motor with music. The robot starts dancing as soon as the music has begun. The MP3 module helps that process. The servo motors control the movement of robot. Moreover, when a speech signal (a string of characters) is given to it, it translates into ROBOT LANGUAGE. Bluetooth is used to give command to the robot. In this paper, the 8x8 dot matrix demonstrates the face of the robot.

Arduino UNO is used to control the 4 servo motors and Nano for sound functions and 8x8 matrix LED display. These 2 microcontroller boards are connected by 3 digital pins; 1 pin for 'Enable' and 2 pins for choosing one out of the four main functions.

4.1 User Interface

In this design, four main functions (string commands) are applied. These functions are 'HELLO', 'music 1', 'music 2' and 'GOODBYE' function. In these function, 3 digital pins (en, s1, s0) are used.

"Hello! I'm Dante. And I am dancing robot. Welcome to my show". This is the sentence come out from the robot when we give the string command 'HELLO'.

```
while (voice! = nextvoice)
 {
  if (voice == "HELLO")
  {
   digital Write (en, 1);
   digital Write (s1, 0);
   digital Write (s0, 0);
   delay (200);
   digital Write (en, 0);
   delay (100);
  }
```

We added 2 parts of songs to the MP3 module. It has a memory chip around 4 MB of data size. It is short music since the music module which supports an SD card utility is not yet available here.

String command 'music1' switch on the song no.1 by Arduino Nano and 'music2' for song no.2.

```
if (voice == "music1")
  {
   digitalWrite (en, 1);
   digitalWrite (s1, 0);
   digitalWrite (s0, 1);
   delay (100);
   digitalWrite (en, 0);
   digitalWrite (s0, 0);
   delay (10);
   Tune1 ();
   normalPOS ();
  }
  if (voice == "music2")
  {
   digitalWrite (en, 1);
   digitalWrite (s1, 1);
   digitalWrite (s0, 0);
   delay (100);
   digitalWrite (en, 0);
   digitalWrite (s1, 0);
   delay (10);
   Tune2 ();
   normalPOS ();
  }
```

It's ending sentence "Thanks for watching my show. Have a nice Day. Good Bye!" will come out when 'GOODBYE' string is sent to Arduino through Bluetooth.

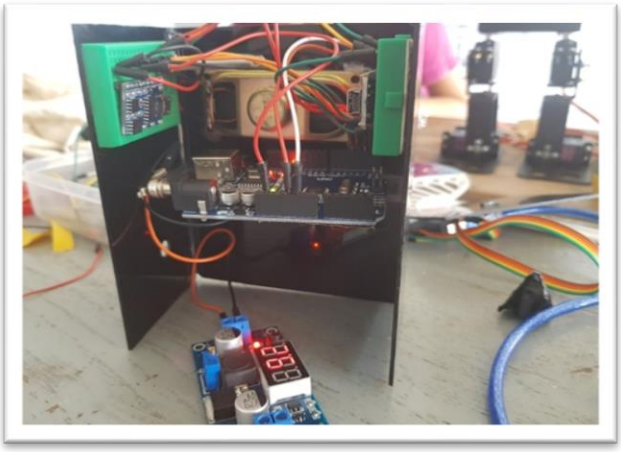
```
if (voice == "GOODBYE")
          {
           digitalWrite (en, 1);
           digitalWrite (s1, 1);
           digitalWrite (s0, 1);
           delay (100);
           digitalWrite (en, 0);
           digitalWrite (s1, 0);
           digitalWrite (s0, 0);
           delay (10);
          }
```

4.2 Software Modules

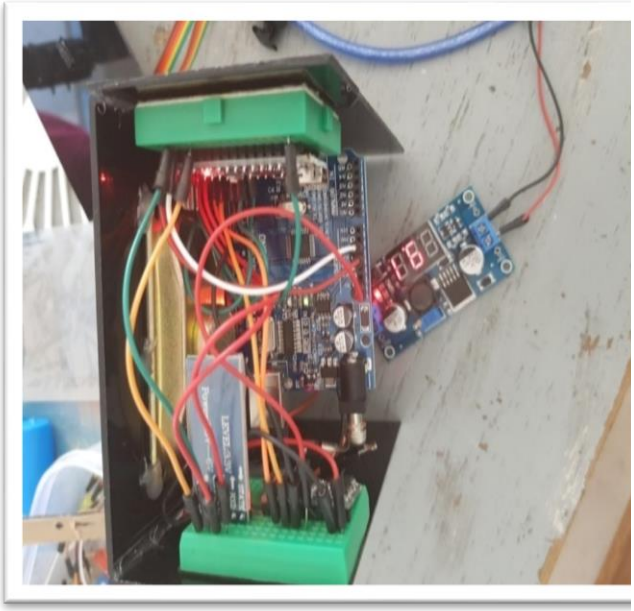
The library files additionally used in our Arduino programs are Servo.h and MaxMatrix.h.

4.3 Step by Step Construction of Robot

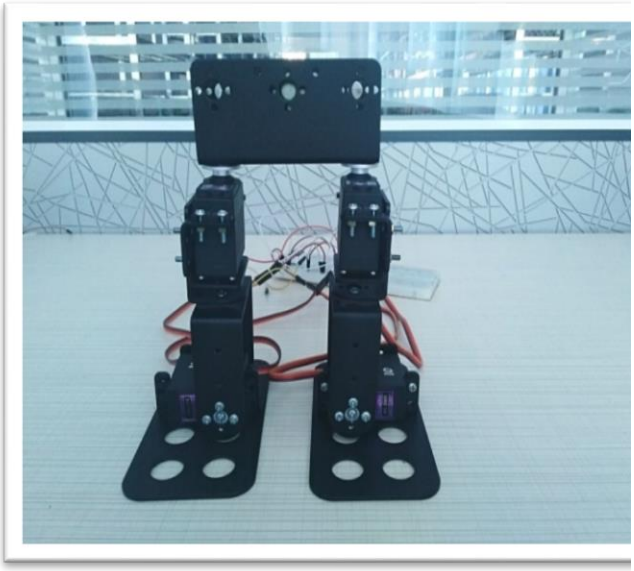
The step by step construction of the dancing robot is shown in Fig 4.



(a)



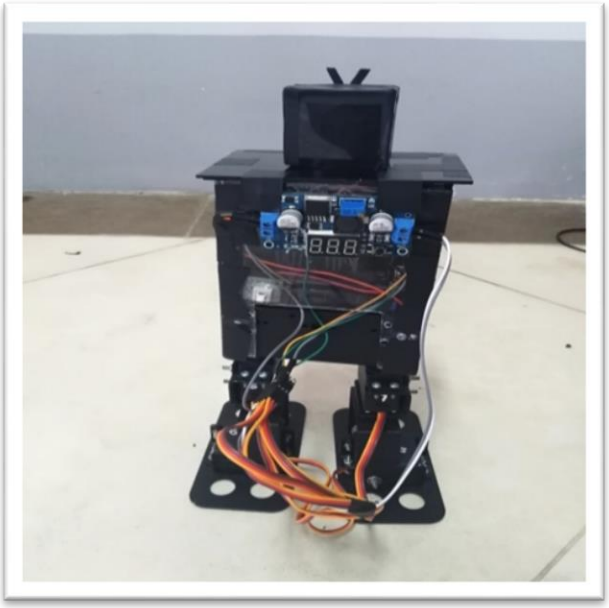
(b)



(c)

Fig 4. Step by Step Construction of Dancing Robot

Front view



Back view

Fig 5. Dancing Robot (Front View and Back view)

After upload the program through the Arduino, demonstrates programming of a simple robot motion. Finally, the robot is placed on a table or on the floor; their program starts are synchronized by a function; and the dancing music is started. While dancing, the robot demonstrates various motions. Fig 5 is a photograph showing the robot dancing on the lab floor (front view and back view).

5. CONCLUSIONS

The purpose of this paper is to learn how to connect simple. This robot has only 2 legs. No more leg needed but 2 hands are necessary to be dancing much more efficiently. Micro-servos with metal gears are okay for them and one more servo at the neck is recommended for the best performance.

Significantly good looking functions can be added if sound encoder for Arduino is available. Suppose the robot can hear a song from beginning to end. Then the robot should be able to sing the vocal of the whole song when we give a specific command to the robot.

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