



# *Florida Institute of Technology*

## VOICE CONTROLLED ROBOT WITH OBSTACLE AVOIDANCE & ACTIVE FEEDBACK

ECE 5526 – SPEECH RECOGNITION

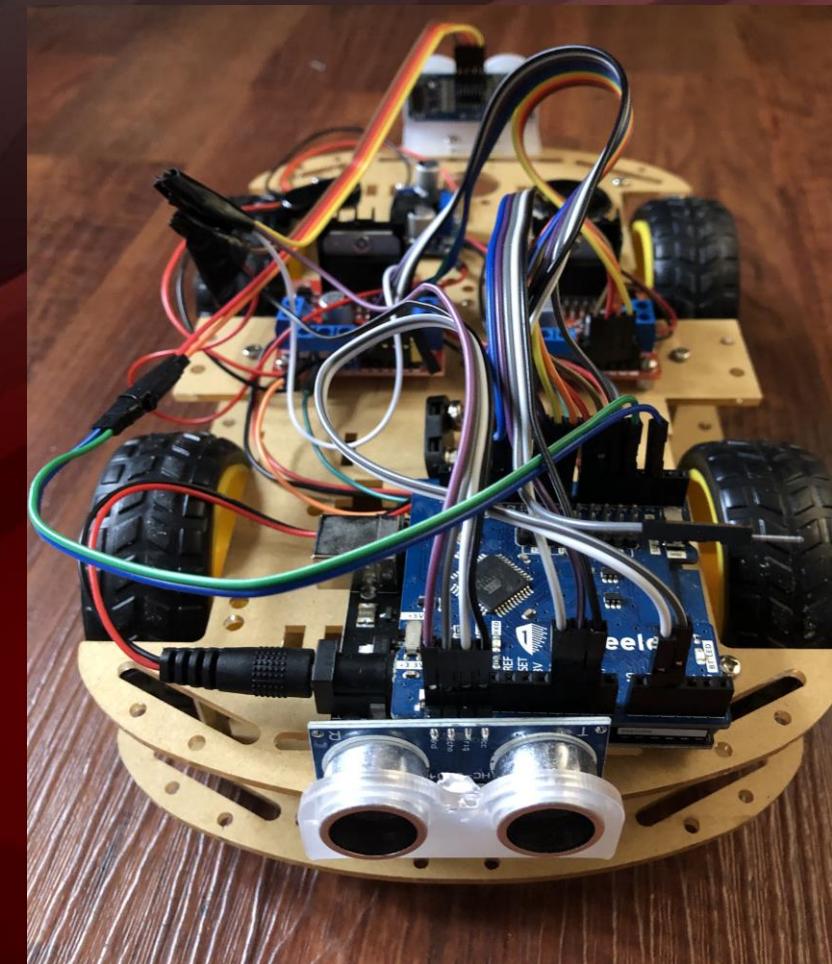
ADOLF A D'COSTA- 903538404





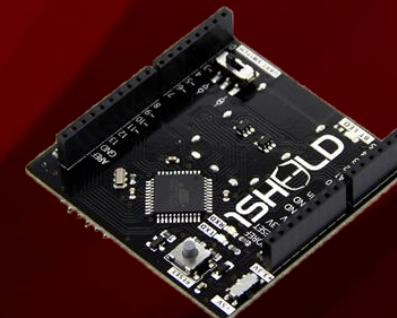
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# VOICE CONTROLLED ROBOT WITH OBSTACLE AVOIDANCE & ACTIVE FEEDBACK



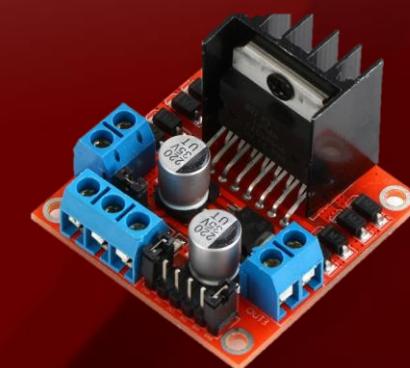
# COMPONENTS USED

- ARDUINO UNO ----
- ROBOT FRAME ----
- 1SHEELD ----
- DC MOTOR (4 PIECES) ----

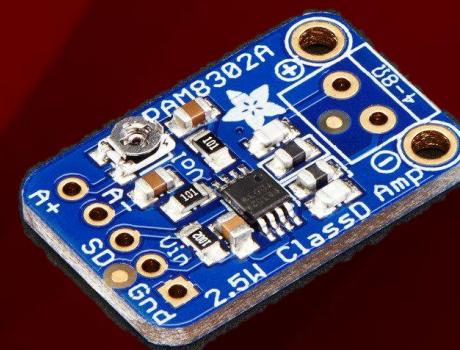
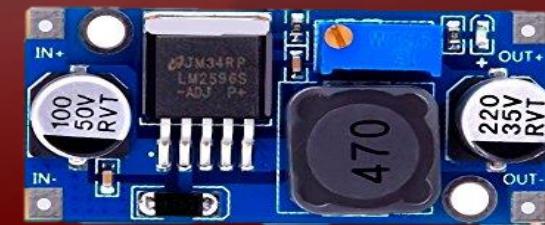


# COMPONENTS USED

- MOBILE (SMART PHONE) ----
- L298N (2 PIECES) ----
- 9V BATTERY (3 PIECES) ----
- WIRES (RIBBON CABLE) ----

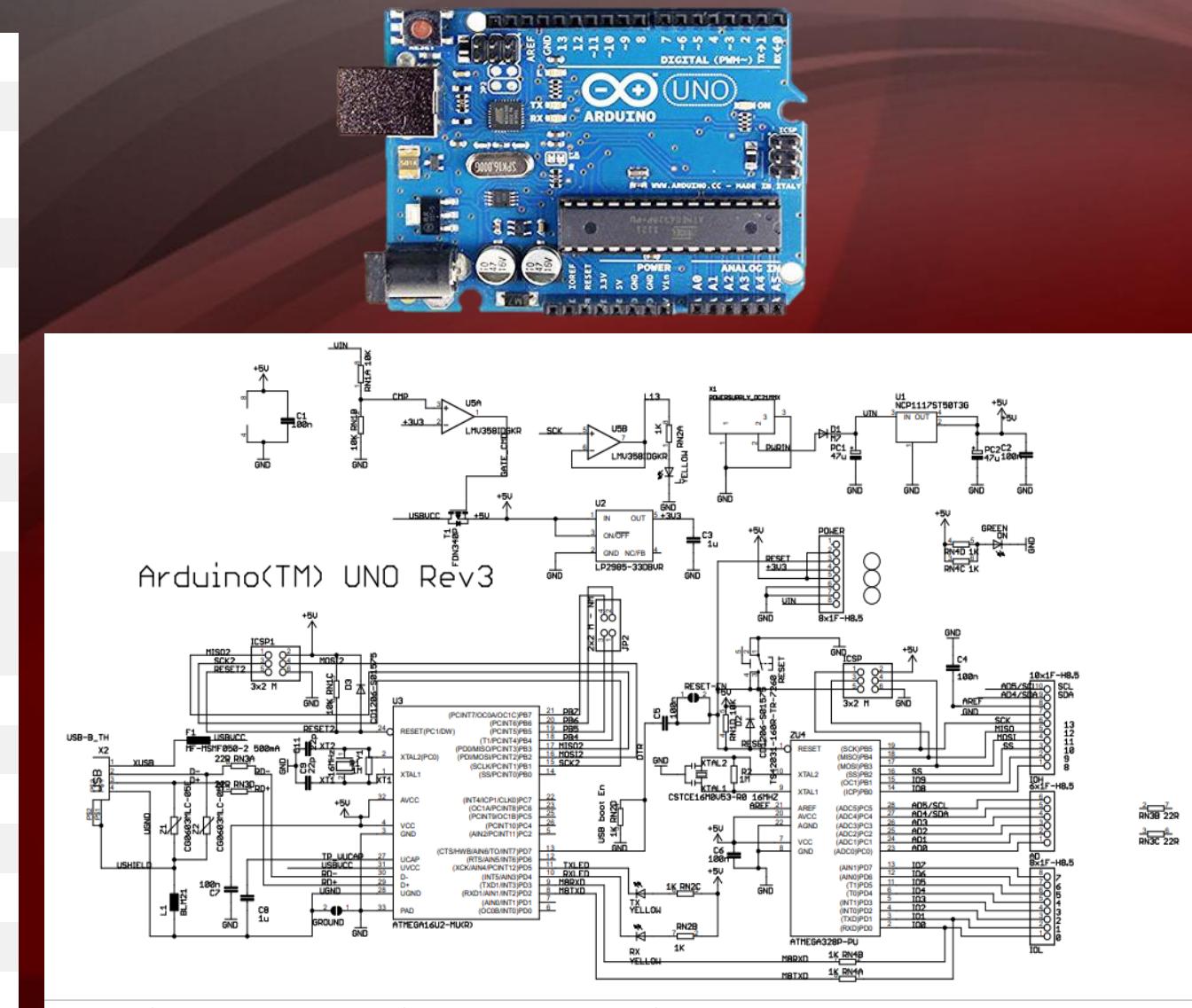


- Ultra Sonic Sensor (4Hz)----
- Step Down DC Power Supply (9V to 5V)----
- PAM8302A(Class D mono Audio Amp)----
- Speaker (8 Ohms, 1Watt)----



# ARDUINO UNO

Microcontroller	<u>ATmega328P</u>
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g



# ROBOT FRAME

- MATERIAL: ABS
- PACKAGE INCLUDED
- 2 x CAR CHASSIS
- 4 x GEAR MOTOR (1: 48)
- 4 x SPEED ENCODER
- 8 x FASTENERS

ONLY THE ABOVE PACKAGE CONTENT, OTHER PRODUCTS ARE NOT INCLUDED.

NOTE: LIGHT SHOOTING AND DIFFERENT DISPLAYS MAY CAUSE THE COLOR OF THE ITEM IN THE PICTURE A LITTLE DIFFERENT FROM THE REAL THING. THE MEASUREMENT ALLOWED ERROR IS +/- 1-3CM.



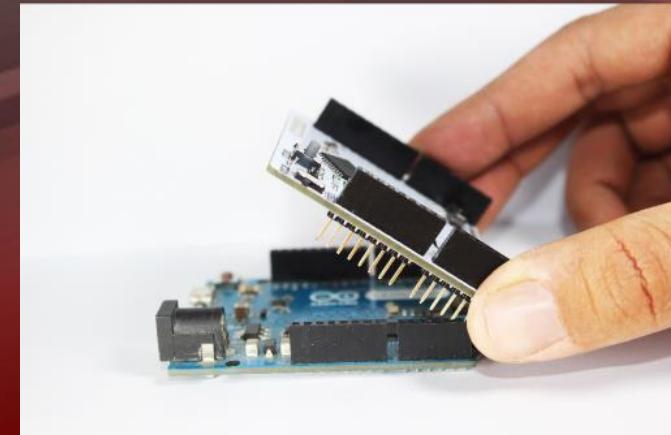
# 1SHEELD

- 1SHEELD IS AN ARDUINO SHEELD WHICH IS USED CONNECT THE SMART PHONE TO THE ARDUINO THROUGH BLUETOOTH 4.0. ALL THE PERIPHERALS ON THE PHONE CAN BE USED AND INTERFACED WITH THE ARDUINO.

EXAMPLES – ACCELEROMETER, LIGHT SENSOR, MIC, SPEAKER, DISPLAY, ETC.

SUPPORTED ARDUINO BOARDS - (UNO , MEGAADK,  
MEGA2560, LEONARDO)

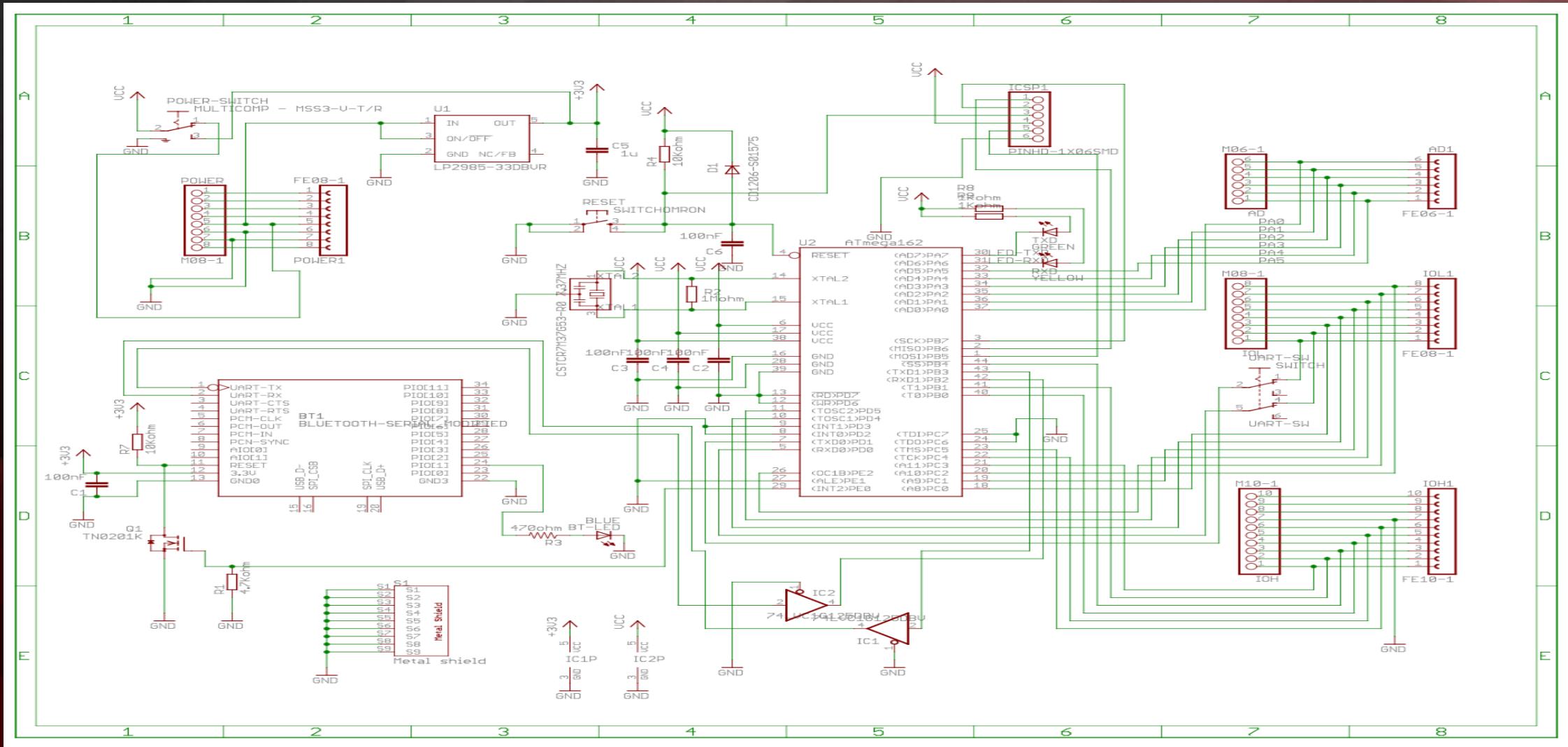
- NOTE - 1SHEELD+ BASED ON A BLE “BLUETOOTH LOW ENERGY” TECHNOLOGY WHICH IS SUPPORTED ONLY BY DEVICES THAT HAS BLUETOOTH 4





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# 1SHEELD SCHEMATIC





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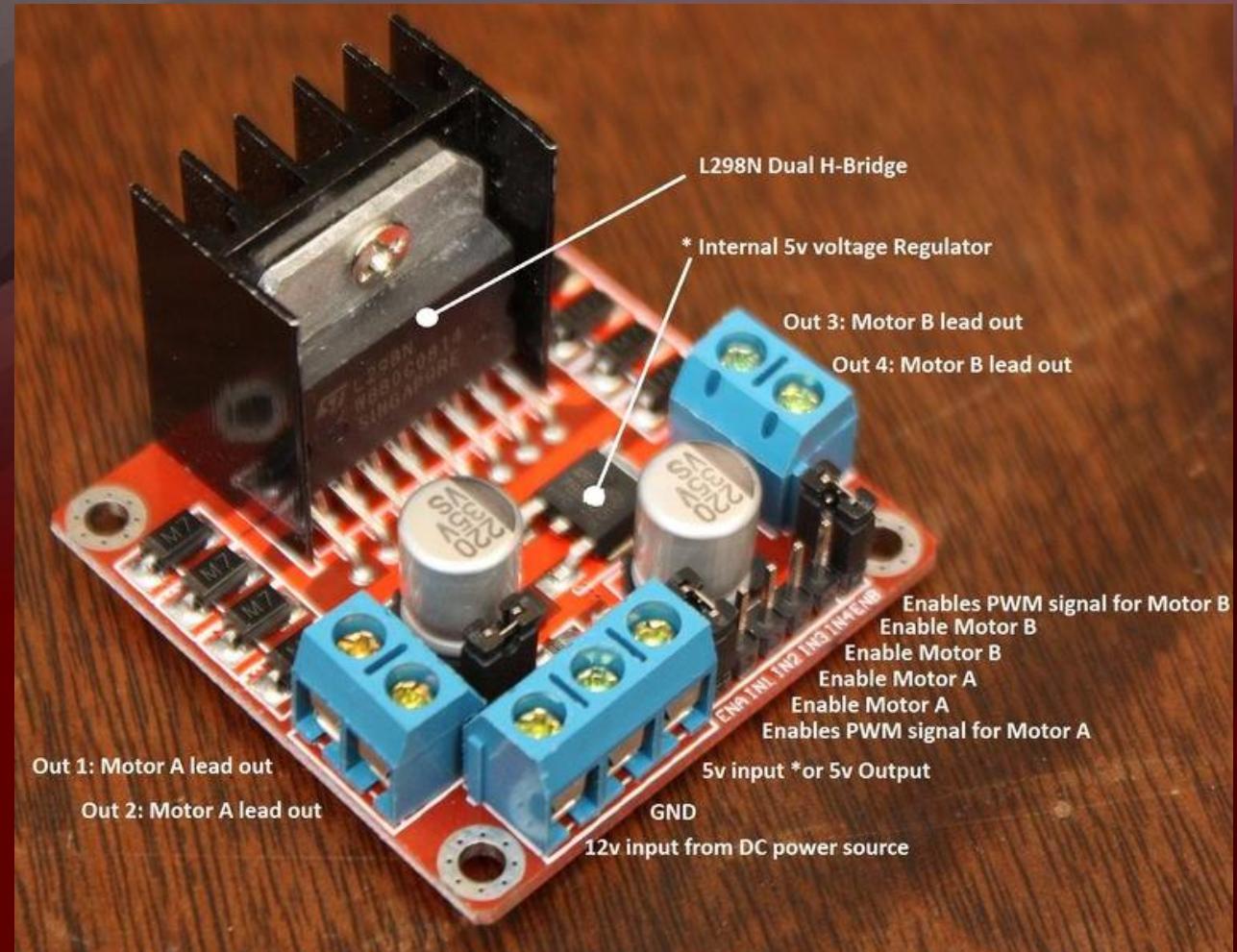
# DC MOTOR

- 2400 RPM
- 360 DEGREE REVOLUTION
- 3VOLT TO 9VOLT OPERATION VOLTAGE
- STALL TORQUE 36 G.CM WITHOUT GEAR SYSTEM
- 115mA CURRENT DRAW

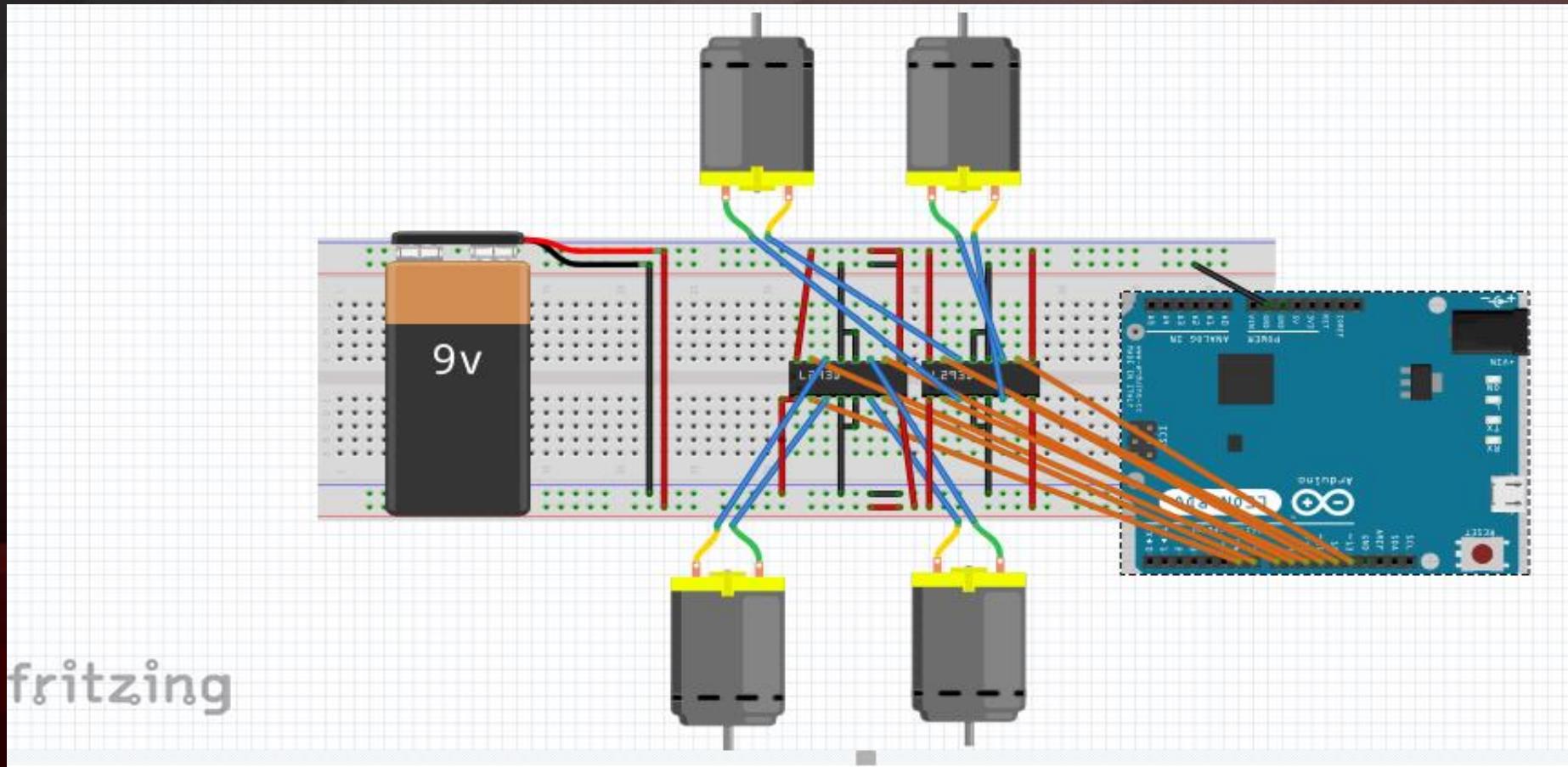


# L298N MOTOR DRIVER

- DOUBLE H BRIDGE DRIVE  
CHIP: *L298N*
- LOGICAL VOLTAGE: 5V *DRIVE*  
VOLTAGE: 5V-35V
- LOGICAL CURRENT: 0-36mA *DRIVE*  
CURRENT: 2A (MAX SINGLE  
BRIDGE)
- MAX POWER: 25W
- DIMENSIONS: 43 x 43 x 26MM
- WEIGHT: 26G



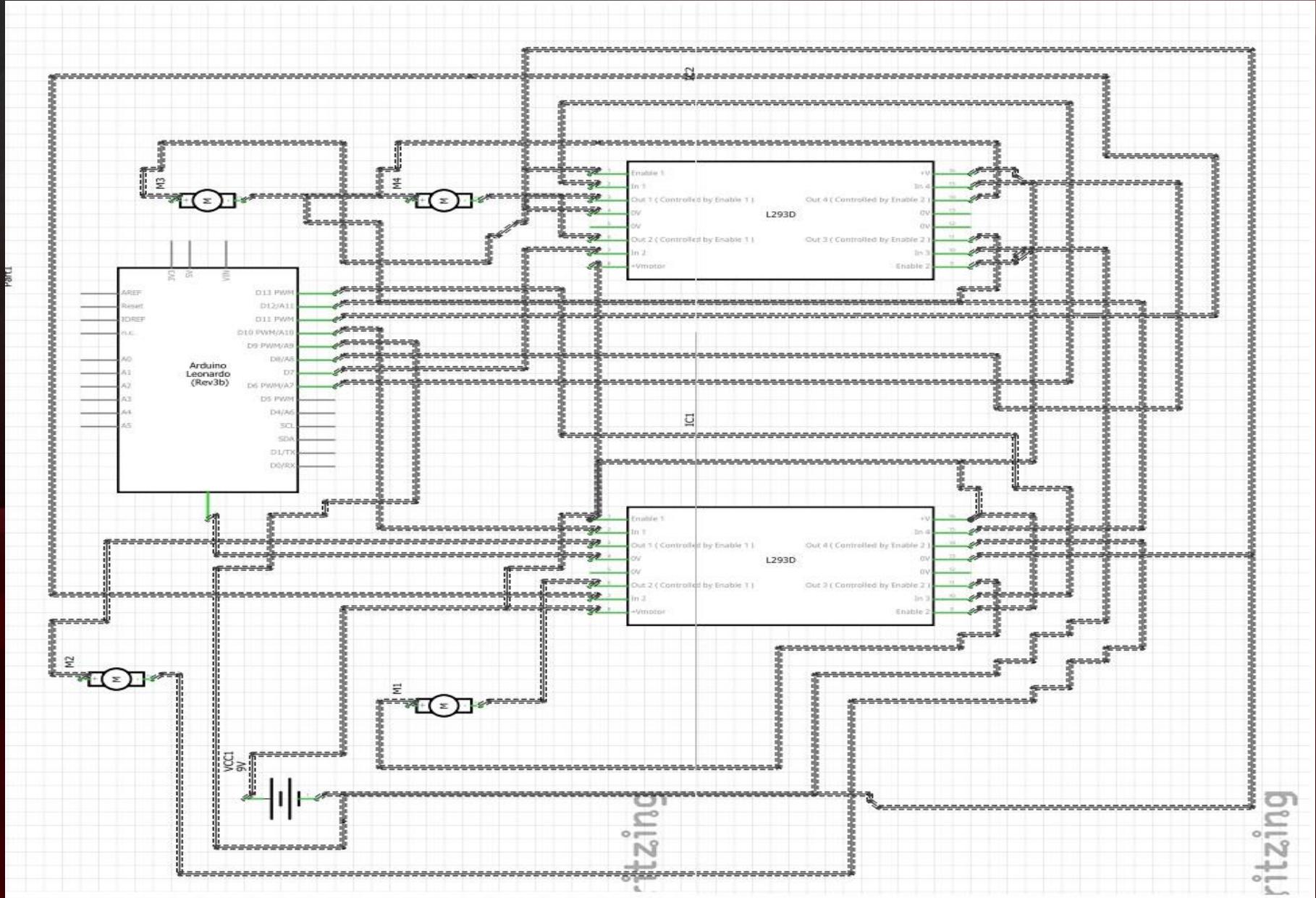
## CIRCUIT DIAGRAM



- NOTE THAT THE (1SHEELD) SHEELD HAS TO BE PLACED ABOVE THE ARDUINO FOR THE INTERFACE WITH THE SMART PHONE.



# SCHEMATIC DIAGRAM

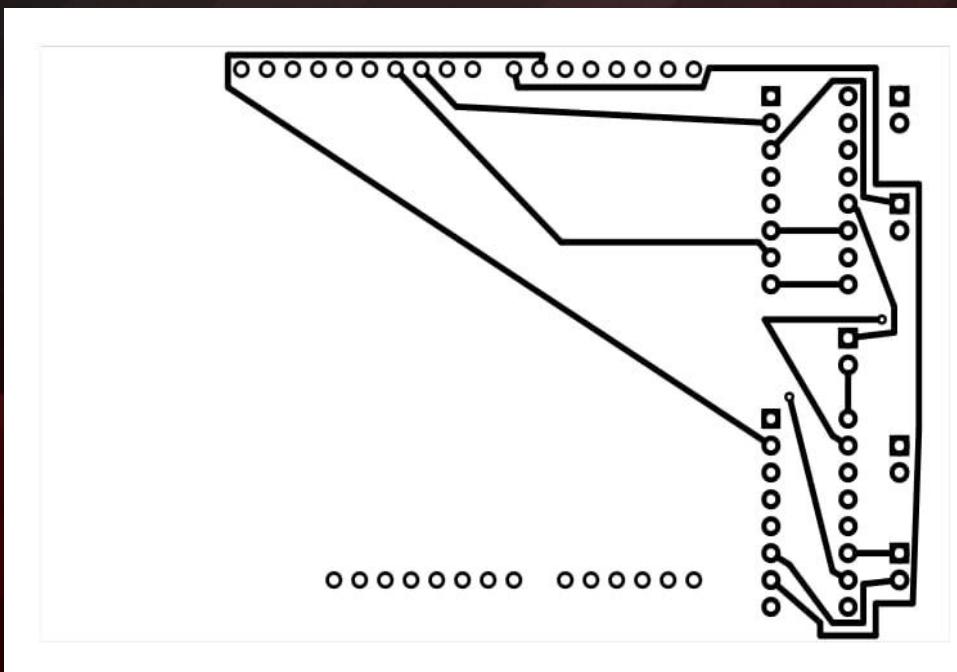




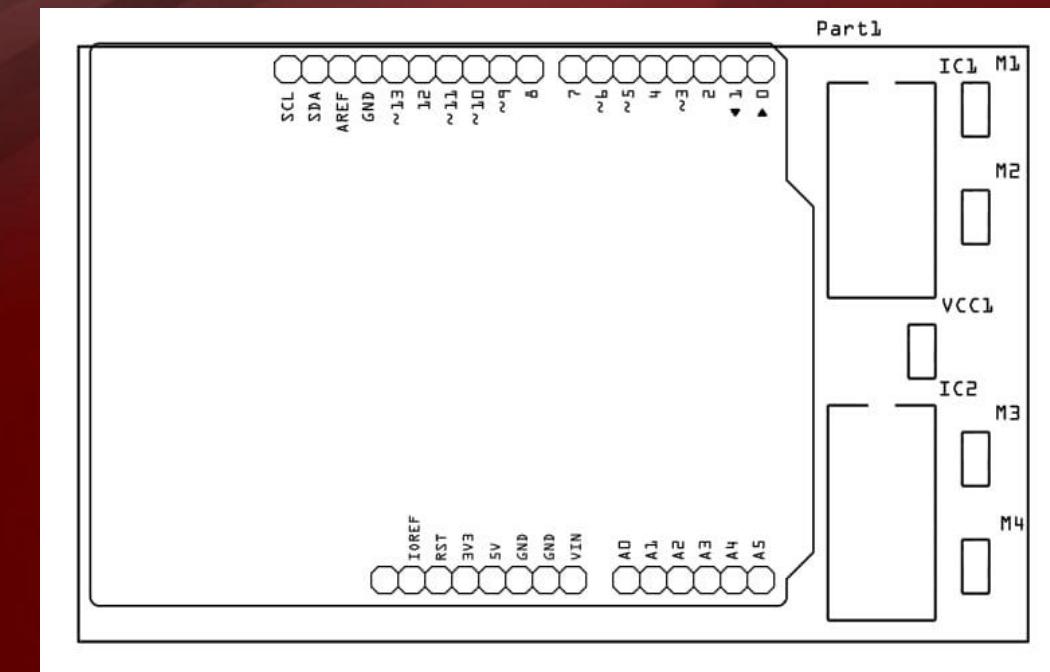
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# PCB SKETCH

BACK



FRONT

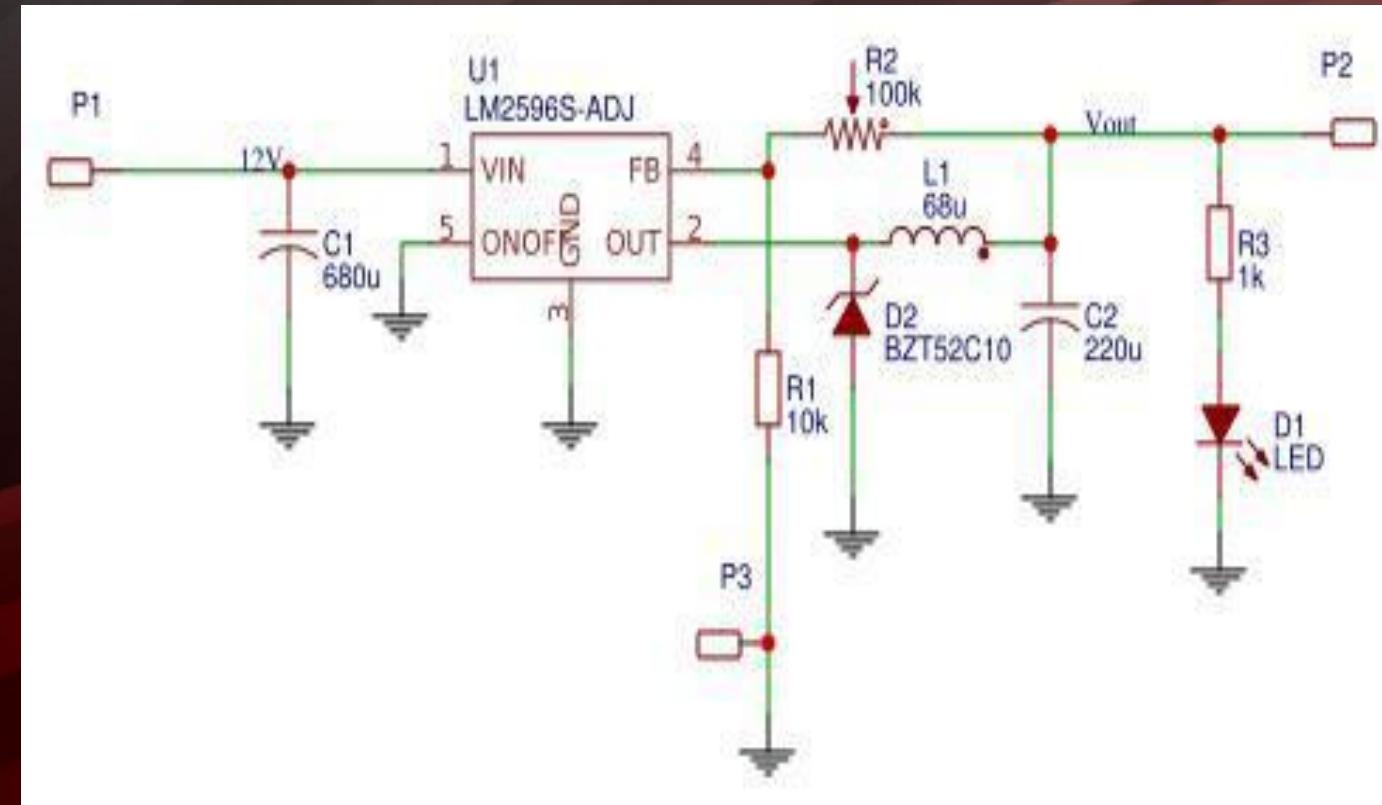


# DC – DC VOLTAGE REGULATOR (LM2596)

- ADJUSTABLE OUTPUT VOLTAGE RANGE 1.23 V – 37 V
- WIDE INPUT VOLTAGE RANGE UP TO 1V - 40 V
- EFFICIENCY- UP TO 93%
- SWITCHING FREQUENCY OF 150 kHz
- 4% TOLERANCE
- 150-kHz FIXED-FREQUENCY INTERNAL OSCILLATOR
- THERMAL SHUTDOWN AND CURRENT-LIMIT PROTECTION
- 3AMP OUTPUT LOAD CURRENT



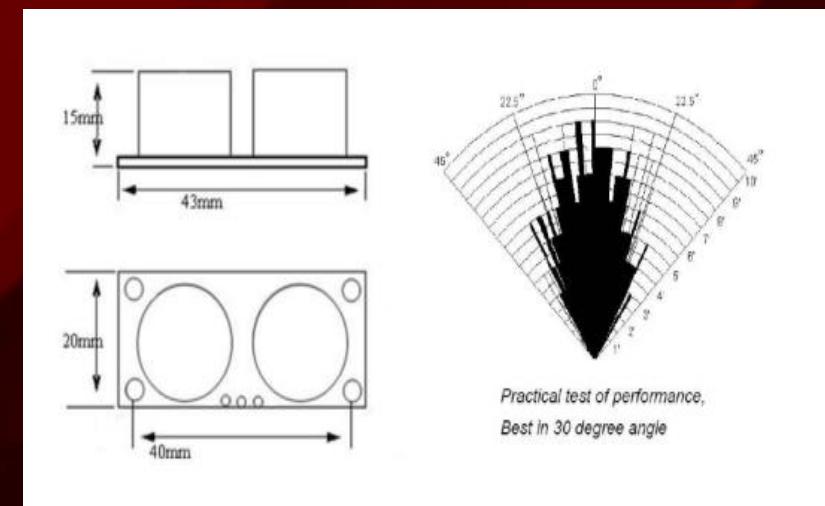
# LM2596 CIRCUIT DIAGRAM



[Link to data Sheet](#)

# HC-SR04

- HC-SR04 ULTRASONIC SENSOR USES SONAR TO DETERMINE DISTANCE TO AN OBJECT
- POWER SUPPLY :+5V DC
- QUIESCENT CURRENT : <2mA
- WORKING CURRENT: 15mA
- DIMENSION: 45MM X 20MM X 15MM
- WORKING FREQUENCY: 40Hz
- RANGE : 2 CM – 4 METERS
- MEASURING ANGLE – 15 DEGREE'S



# WORKING OF HC-SR04

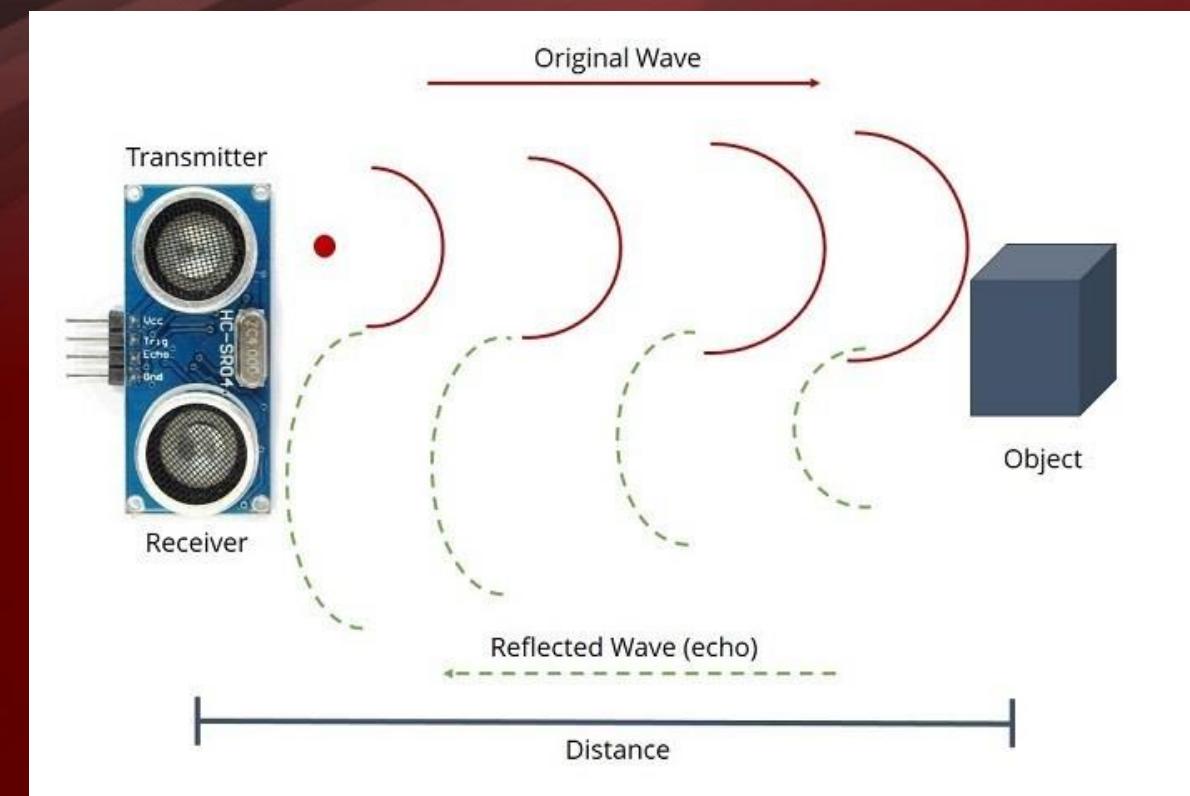
STEP 1: THE TRANSMITTER (TRIG PIN) SENDS A SOUND SIGNAL OF 40Hz

STEP 2: WHEN THE SIGNAL COLLIDES WITH AN OBJECT, IT IS REFLECTED TO THE RECEIVER.

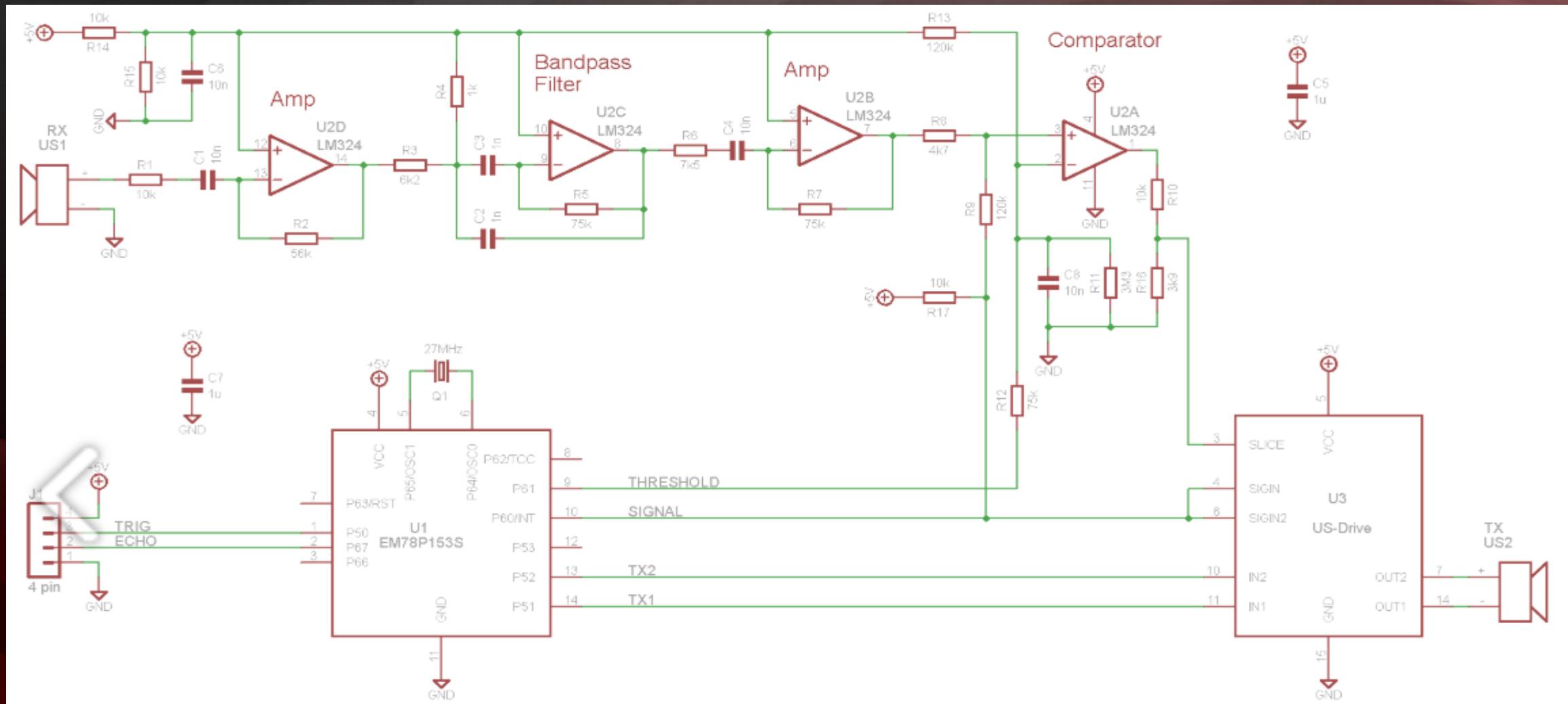
STEP 3: THE RECEIVER (ECHO PIN) RECEIVES IT.

"THE TIME BETWEEN THE TRANSMISSION AND RECEPTION OF THE SIGNAL ALLOWS US TO CALCULATE THE DISTANCE TO AN OBJECT"

THIS SYSTEM IS DESIGNED TO TRIGGER IF THE OBSTACLE DISTANCE IS LESS THAN 12CMS



# HC-SR04 CIRCUIT DIAGRAM



[Link to data Sheet](#)



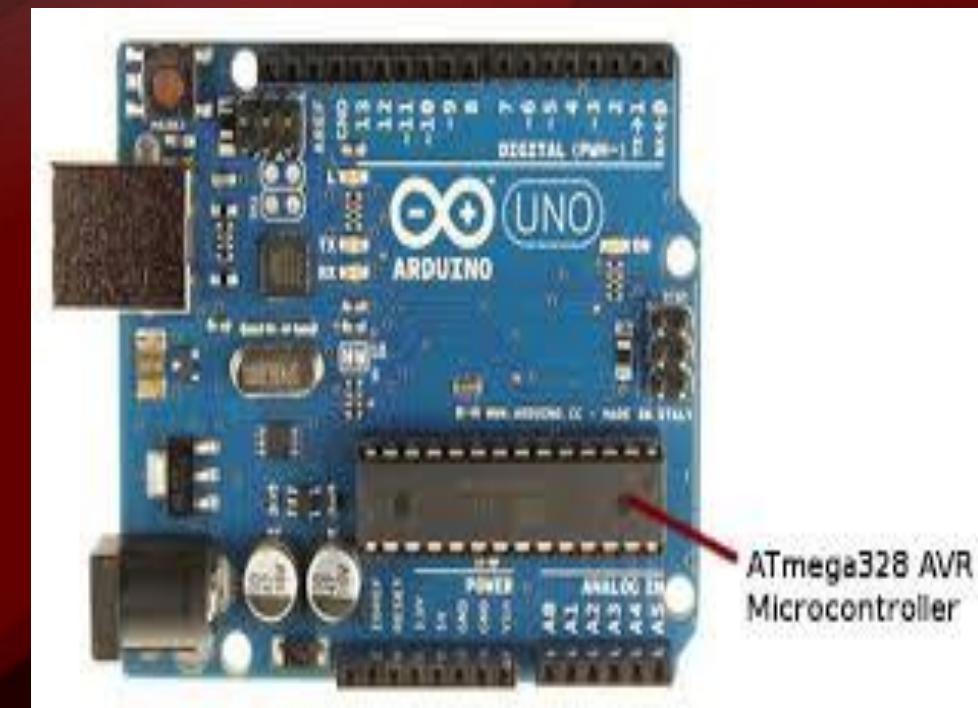
## ARDUINO PCM TO AUDIO

- THE AUDIO PLAYBACK USES TWO OF THE ARDUINO BOARD'S TIMERS, HARDWARE FUNCTIONALITY OF THE AVR (ATMEGA328) MICROCONTROLLER THAT'S NORMALLY USED TO GENERATE PWM OUTPUT WITH THE ANALOGWRITE() FUNCTION.
- ONE OF THE TIMER IS USED TO GENERATE A HIGH-FREQUENCY SQUARE WAVE WHOSE DUTY CYCLE CORRESPONDS TO A PARTICULAR VALUE (AMPLITUDE) IN THE AUDIO SAMPLE AND THE OTHER IS USED TO UPDATE THIS DUTY CYCLE AT 8 KHz, SAMPLE RATE OF THE AUDIO.
- AS A RESULT OF USING THESE TIMERS, PWM OUTPUT (ANALOGWRITE()) WON'T WORK ON PINS 3, 9, 10, OR 11. YOU SHOULD STILL BE ABLE TO USE PINS 3, 9, AND 10 FOR DIGITAL INPUT AND OUTPUT. THE AUDIO SIGNAL WILL BE GENERATED ON PIN 11
- TO USE THESE AUDIO SAMPLES IN ARDUINO THEY SHOULD BE ENCODED WITH A FREQUENCY OF 8KHZ OF 8-BIT MONO SOUND
- AS THE STORAGE OF THE ARDUINO IS SMALL IT CAN STORE AUDIO OF APPROXIMATELY 4 SECONDS ON IT.



# AVR (ATMEGA328)

- THE **ATMEGA328** IS A SINGLE CHIP MICROCONTROLLER CREATED BY ATTEL IN THE MEGA AVR FAMILY
- OPERATING VOLTAGE(V)-- +1.8 V TO +5.5V
- SPEED-- 1MIPS FOR 1MHz
- CPU—8-BIT AVR



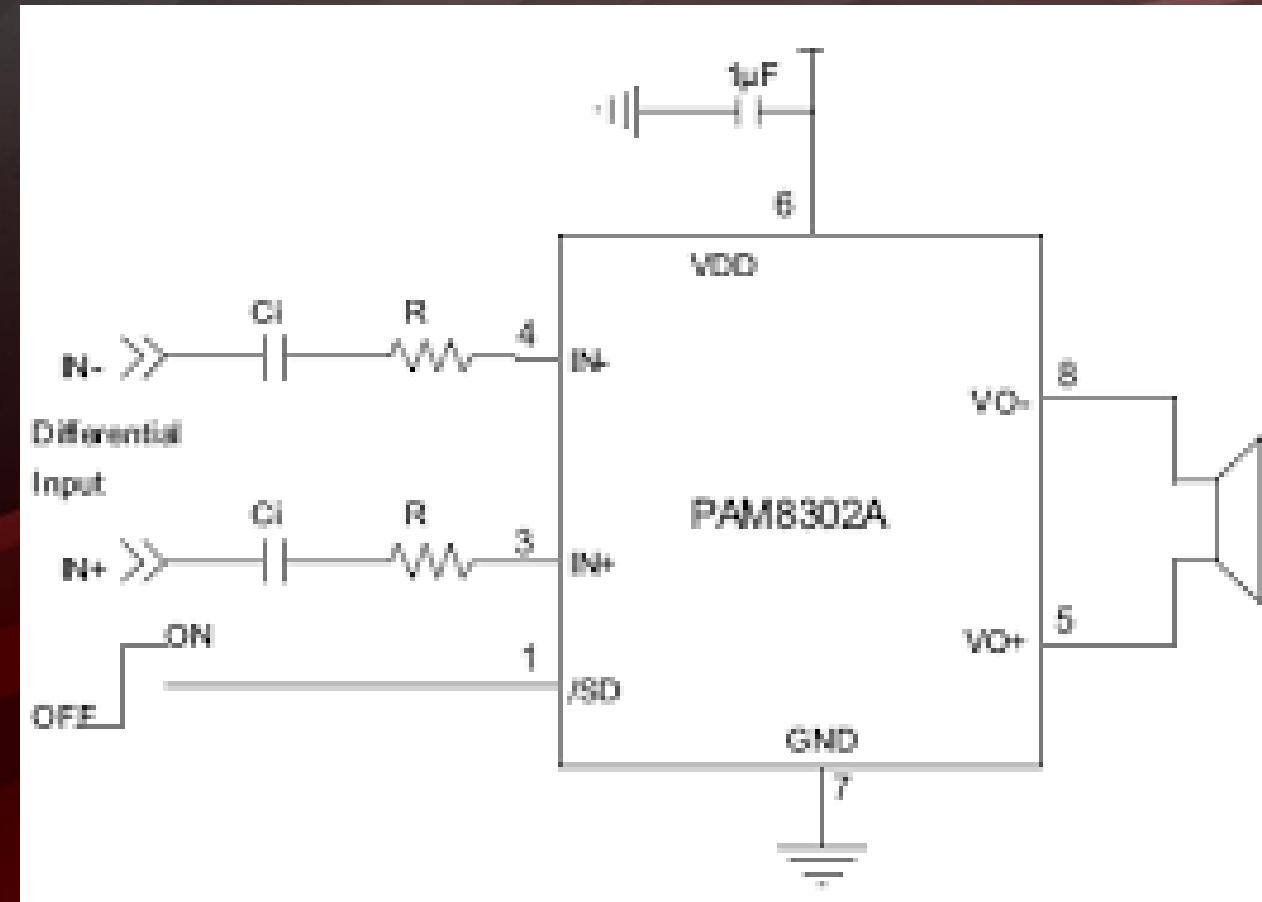


# PAM8302A CLASS D SOUND AMPLIFIER

- IT IS A FILTER LESS ARCHITECTURE WHICH ALLOWS THE DEVICE TO DRIVE SPEAKERS DIRECTLY INSTEAD OF USING LOW-PASS OUTPUT FILTERS, THEREFORE IT SAVES COST AND PCB AREA
- VOLTAGE -- 2V ~ 5.5V
- EFFICIENCY-- UP TO 88%
- SUPERIOR LOW NOISE
- SHORT CIRCUIT PROTECTION



# PAM8302A CIRCUIT DIAGRAM



[Link to data Sheet](#)



# UXCELL OHM MAGNET MINI SPEAKER

- POWER -- 2W
- RESISTANCE -- 8 OHMS
- DIAMETER -- 28MM





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# COMMANDS ACCEPTED BY THE SYSTEM

- STOP –  
STOPS THE VEHICLE
- LEFT –  
MOVES THE VEHICLE LEFT FOR 1.5 SEC
- RIGHT –  
MOVES THE VEHICLE RIGHT FOR 1.5 SEC
- FRONT –  
MOVES THE VEHICLE FRONT UNTIL IT ENCOUNTERS AN OBSTACLE
- BACK –
- MOVES THE VEHICLE BACK UNTIL IT ENCOUNTERS AN OBSTACLE





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# PROGRAMMING CODE

## PRE-REQUISITES FOR CODING

- ARDUINO IDE ([HTTPS://WWW.ARDUINO.CC/EN/MAIN/SOFTWARE](https://www.arduino.cc/en/Main/Software))
- 1SHEELD APP ON (IOS/ANDROID) ([HTTPS://1SHEELD.COM/DOWNLOADS/](https://1sheeld.com/downloads/))
- ARDUINO USB WIRE AND DRIVER





# CODE

```
#include <VoiceRecognitionShield.h>

#define CUSTOM_SETTINGS
#define INCLUDE_VOICE_RECOGNIZER_SHIELD

#include <OneSheeld.h>

/* Voice commands set by the user. */

const char stopCommand[] = "stop";
const char leftCommand[] = "left";
const char rightCommand[] = "right";
const char frontCommand[] = "front";
const char backCommand[] = "back";
```

```
/* Initialization of the pins */
int Pin0M1 = 6;
int Pin1M1 = 7;
int Pin2M2 = 8;
int Pin3M2 = 9;
int Pin4M3 = 10;
int Pin5M3 = 11;
int Pin6M4 = 12;
int Pin7M4 = 13;
```

```
void setup()
{
    /* Defining the State of the pins Output or Input */
    OneSheeld.begin();

    pinMode(Pin0M1,OUTPUT);
    pinMode(Pin1M1,OUTPUT);
    pinMode(Pin2M2,OUTPUT);
    pinMode(Pin3M2,OUTPUT);
    pinMode(Pin4M3,OUTPUT);
    pinMode(Pin5M3,OUTPUT);
    pinMode(Pin6M4,OUTPUT);
    pinMode(Pin7M4,OUTPUT);
}
```

```
/* Compares the command if it is front with the one received
if (!strcmp(frontCommand,VoiceRecognition.getLastCommand()))
{
    digitalWrite(Pin0M1,HIGH);
    digitalWrite(Pin1M1,LOW);
    digitalWrite(Pin2M2,HIGH);
    digitalWrite(Pin3M2,LOW);
    digitalWrite(Pin4M3,HIGH);
    digitalWrite(Pin5M3,LOW);
    digitalWrite(Pin6M4,HIGH);
    digitalWrite(Pin7M4,LOW);
    delay(2000); /* Sets a delay of 2 seconds */
    digitalWrite(Pin0M1,LOW);
    digitalWrite(Pin1M1,LOW);
    digitalWrite(Pin2M2,LOW);
    digitalWrite(Pin3M2,LOW);
    digitalWrite(Pin4M3,LOW);
    digitalWrite(Pin5M3,LOW);
    digitalWrite(Pin6M4,LOW);
    digitalWrite(Pin7M4,LOW);
}
```



## COST

- ROBOT FRAME = 15\$
- 1 SHEELD = 30\$
- ARDUINO BOARD WITH SENSORS = 30\$
- MOTOR DRIVER L298N = 8\$
- ULTRA SONIC MODULE (HC-SR04)= 8\$
- DC TO DC STEP DOWN REGULATOR (LM2596) = 6\$
- AUDIO AMPLIFIER (PAM8302)=6\$
- SPEAKER 8OHM 1 WATT = 6\$

TOTAL PROJECT COST = 110\$





# APPLICATION

- MINE DETECTION ---

PREVENT PUTTING HUMANS IN THE LINE OF FIRE WHERE THERE COULD BE EXPLOSION.

- HAZARDOUS LOCATION ---

PREVENT PUTTING HUMANS IN THE LINE OF FIRE DUE TO TOXIC FUMES OR CHEMICALS

- FIRE FIGHTING ---

EASY TO DEPLOY AND HAS A RANGE OF 70 – 100 METERS.

- SEARCH AND RESCUE ---

GIVES ACCESS IN CONFINED SPACES FOR SEARCH AND RESCUE.



# REFERENCE FOR RESOURCES

- [HTTPS://1SHEELD.COM/DOWNLOADS/](https://1sheeld.com/downloads/) (FOR 1SHEELD APP)
- [HTTPS://1SHEELD.COM/DOWNLOADS/](https://1sheeld.com/downloads/) (FOR LIBRARY)
- [HTTPS://WWW.ARDUINO.CC/EN/MAIN/SOFTWARE](https://www.arduino.cc/en/Main/Software) (FOR ARDUINO IDE AND USB DRIVER)
- [HTTPS://CDN.SPARKFUN.COM/DATASHEETS/SENSORS/PROXIMITY/HCSR04.PDF](https://cdn.sparkfun.com/datasheets/Sensors/Proximity/HCSR04.PDF) (ULTRA SONIC SENSOR)
- [HTTP://WWW.TI.COM/LIT/DS/SYMLINK/LM2596.PDF](http://www.ti.com/lit/ds/symlink/lm2596.pdf) (STEP DOWN VOLTAGE CONVERTER DATA SHEET)
- [HTTPS://WWW.DIODES.COM/ASSETS/DATASHEETS/PAM8302A.PDF](https://www.diodes.com/assets/datasheets/PAM8302A.PDF) (MONO AUDIO AMPLIFIER )

