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Arduino Uno

Overview

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R3) programmed as a USB-to-serial converter.

Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DTR mode.

Revision 3 of the board has the following new features:

- 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that use the AVR, which operate with 5V and with the Arduino Due that operate with 3.3V. The second one is a not connected pin, that is reserved for future purposes.
- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

Summary

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<tr>
<th>Microcontroller</th>
<th>ATmega328</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Voltage</td>
<td>5V</td>
</tr>
<tr>
<td>Input Voltage (recommended)</td>
<td>7-12V</td>
</tr>
</tbody>
</table>
Input Voltage (limits) 6-20V
Digital I/O Pins 14 (of which 6 provide PWM output)
Analog Input Pins 6
DC Current per I/O Pin 40 mA
DC Current for 3.3V Pin 50 mA
Flash Memory 32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM 2 KB (ATmega328)
EEPROM 1 KB (ATmega328)
Clock Speed 16 MHz

Schematic & Reference Design

EAGLE files: arduino uno-Rev3-reference-design.zip (NOTE: works with Eagle 6.0 and newer)
Schematic: arduino uno-Rev3-schematic.pdf
Note: The Arduino reference design can use an Atmega8, 168, or 328. Current models use an ATmega328, but an Atmega8 is shown in the schematic for reference. The pin configuration is identical on all three processors.

Power

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.
External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board’s power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.
The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than 5 volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.
The power pins are as follows:

- **VIN.** The input voltage to the Arduino board when it’s using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V.** This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7-12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don’t advise it.
- **3V3.** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND.** Ground pins.

Memory

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20–50 kOhms. In addition, some pins have specialized functions:

- **Serial: 0 (RX) and 1 (TX).** Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- **External Interrupts: 2 and 3.** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- **PWM: 3, 5, 6, 9, 10, and 11.** Provide 8-bit PWM output with the analogWrite() function.
- **SPI**: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the **SPI library**.
- **LED**: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e., 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the `analogReference()` function. Additionally, some pins have specialized functionality:

- **TWI**: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the **Wire library**.

There are a couple of other pins on the board:

- **AREF**: Reference voltage for the analog inputs. Used with `analogReference()`.
- **Reset**: Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

See also the mapping between Arduino pins and ATmega328 ports. The mapping for the Atmega8, 168, and 328 is identical.

**Communication**

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (3V) serial communication, which is available on digital pins 0 (RX) and 1 (TX), and ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A **SoftwareSerial library** allows for serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a **Wire library** to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the **SPI library**.

**Programming**

The Arduino Uno can be programmed with the Arduino software (download). Select "Arduino Uno from the **Tools > Board** menu (according to the microcontroller on your board). For details, see the reference and tutorials.

The ATmega328 on the Arduino Uno comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, `stk500weis`).

You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header; see these instructions for details.

The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available at the Atmega16U2/8U2 is loaded with a DFU bootloader, which can be activated by:

- On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2.
- On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode.

You can then use Atmel's FLIP software (Windows) or the DFU program (Mac OS X and Linux) to load a new firmware. Or you can use the ISP header with an external programmer (overwritting the DFU bootloader). See this user-contributed tutorial for more information.

**Automatic (Software) Reset**
Rather than requiring a physical press of the reset button before an upload, the Arduino Uno is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload. This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

The Uno contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line; see this forum thread for details.

**USB Overcurrent Protection**

The Arduino Uno has a resettable polyfuse that protects your computer's USB ports from shorts and overcurrent. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.

**Physical Characteristics**

The maximum length and width of the Uno PCB are 2.7 and 2.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Four screw holes allow the board to be attached to a surface or case. Note that the distance between digital pins 7 and 8 is 160 mil (0.16"), not an even multiple of the 100 mil spacing of the other pins.
MQ-3  Semiconductor Sensor for Alcohol

Sensitive material of MQ-3 gas sensor is SnO₂, which with lower conductivity in clean air. When the target alcohol gas exist, The sensor’s conductivity is more higher along with the gas concentration rising. Please use simple electrocircuit, Convert change of conductivity to correspond output signal of gas concentration.

MQ-3 gas sensor has high sensitivity to Alcohol, and has good resistance to disturb of gasoline, smoke and vapor. The sensor could be used to detect alcohol with different concentration, it is with low cost and suitable for different application.

Character
* Good sensitivity to alcohol gas
* Long life and low cost
* Simple drive circuit

Application
* Vehical alcohol detector
* Portable alcohol detector

Technical Data
Basic test loop

<table>
<thead>
<tr>
<th>Character</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater Resistance</td>
<td>Rₕ = 3kΩ±5Ω (Room Temp.)</td>
</tr>
<tr>
<td>Sensing Resistance</td>
<td>Rₛ = 2kΩ-20kΩ(in 0.4mg/l alcohol)</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>S = Rs(in air) / Rs(0.4mg/L Alcohol)</td>
</tr>
<tr>
<td>Slope</td>
<td>α = 0.6(Rₛ/RL)²</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tem. Humidity</td>
<td>20°C±2°C, 65%±5%RH</td>
</tr>
<tr>
<td>Standard test circuit</td>
<td>Vₛ = 5.0V±0.1V, Vₛ = 5.0V±0.1V</td>
</tr>
<tr>
<td>Preheat time</td>
<td>Over 48 hours</td>
</tr>
</tbody>
</table>

Pₛ=Vₛ²×Rs(Rₛ+RL)²

The above is basic test circuit of the sensor. The sensor should be put 2 voltage, heater voltage (Vₕ) and test-voltage (Vₛ). VH used to supply certified working temperature to the sensor, while VC used to detect voltage (Vₛ) on load resistance (RL) whom is in series with sensor. The sensor has light polarity, VC need DC power, VC and VH could use same power circuit with precondition to assure performance of sensor. In order to make the sensor with better performance, suitable RL value is needed.

Power of Sensitivity body(Pₛ):
Resistance of sensor (Rs): \( R_s = (V_0 + V_{RL} - 1) \times R_L \)

**Sensitivity Characteristics**

![Sensitivity Characteristics Graph](image)

Fig. 1 shows the typical sensitivity characteristics of the MQ-3 sensor. The ordinate indicates resistance ratio of the sensor (Rs/Ro), the abscissa represents concentration of gases. Rs means resistance in different gases, Ro means resistance of sensor in 0.4 mg/l alcohol. All test are under standard test conditions.

P.S.: Sensitivity to smoke is 10pcs cigarettes in 8m³ room, and the output equals to 0.1mg/l alcohol.

**Influence of Temperature/Humidity**

![Influence of Temperature/Humidity Graph](image)

Fig. 2 shows the typical temperature and humidity characteristics. Ordinate means resistance ratio of the sensor (Rs/Ro), Rs means resistance of sensor in 0.4 mg/l alcohol under different temp. and humidity. Ro means resistance of the sensor in environment of 0.4 mg/l alcohol, 20% 65% RH.

**Structure and Configuration**

![Structure Diagram](image)

Structure and configuration of MQ-3 gas sensor is shown as Fig. 3. sensor composed by micro Al2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-4 have 6 pin, 4 of them are used to fetch signals, and other 2 are used for providing heating current.
Notification

1 Following conditions must be prohibited

1.1 Exposed to organic silicon steam
   Organic silicon steam cause sensors invalid, sensors must be avoid exposing to silicon bond, fixture, silicon latex, putty or plastic contain silicon environment

1.2 High Corrosive gas
   If the sensors exposed to high concentration corrosive gas (such as H₂S, SO₃, Cl₂, HCl etc.), it will not only result in corrosion of sensors structure, also it cause sincere sensitivity attenuation.

1.3 Alkali, Alkali metals salt, halogen pollution
   The sensors performance will be changed badly if sensors be sprayed polluted by alkali metals salt especially brine, or be exposed to halogen such as fluorin.

1.4 Touch water
   Sensitivity of the sensors will be reduced when sattered or dipped in water.

1.5 Freezing
   Do avoid icing on sensor's surface, otherwise sensor would lose sensitivity.

1.6 Applied voltage higher
   Applied voltage on sensor should not be higher than stipulated value, otherwise it cause down-line or heater damaged, and bring on sensors' sensitivity characteristic changed badly.

1.7 Voltage on wrong pins
   For 6 pins sensor, if apply voltage on 1, 3 pins or 4, 6 pins, it will make lead broken, and without signal when apply on 2, 4 pins.

2 Following conditions must be avoided

2.1 Water Condensation
   Indoor conditions, slight water condensation will effect sensors performance lightly. However, if water condensation on sensors surface and keep a certain period, sensors sensitivity will be decreased.

2.2 Used in high gas concentration
   No matter the sensor is electrified or not, if long time placed in high gas concentration, if will affect sensors characteristic.

2.3 Long time storage
   The sensors resistance produce reversible drift if it's stored for long time without electrify, this drift is related with storage conditions. Sensors should be stored in airproof without silicon gel bag with clean air. For the sensors with long time storage but no electrify, they need long aging time for stability before using.

2.4 Long time exposed to adverse environment
   No matter the sensors electrified or not, if exposed to adverse environment for long time, such as high humidity, high temperature, or high pollution etc, it will effect the sensors performance badly.

2.5 Vibration
   Continual vibration will result in sensors down-lead response then rupture. In transportation or assembling line, pneumatic screwdriver/ultrasonic welding machine can lead this vibration.

2.6 Concussion
   If sensors meet strong concussion, it may lead its lead wire disconnected.

2.7 Usage
   For sensor, handmade welding is optimal way. If use wave crest welding should meet the following conditions:

   2.7.1 Soldering flux: Rosin soldering flux contains least chlorine
   2.7.2 Speed: 1-2 Meter/ Minute
   2.7.3 Warm-up temperature: 100±20℃
   2.7.4 Welding temperature: 250±10℃

   If disobey the above using terms, sensors sensitivity will be reduced.
Structure and configuration of MQ-3 gas sensor is shown as Fig. 1 (Configuration A or B), sensor composed by micro Al₂O₃ ceramic tube, Tin Dioxide (SnO₂) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-3 have 6 pin, 4 of them are used to fetch signals, and other 2 are used for providing heating current.

Electric parameter measurement circuit is shown as Fig. 2

E. Sensitivity characteristic curve

Fig. 3 is shows the typical sensitivity characteristics of the MQ-3 for several gases.
- in their Temp. 20°C
- Humidity: 65%
- O₂ concentration 21%
- Rₐ=200kΩ
- Rₒ: sensor resistance at 0.4mg/L of Alcohol in the clean air.
- Rₒ: sensor resistance at various concentrations of gases.

Fig. 2 sensitivity characteristics of the MQ-3

Fig. 4 is shows the typical dependence of the MQ-3 on temperature and humidity.
- Rₒ: sensor resistance at 0.4mg/L of Alcohol in air at 33%RH and 20°C
- Rₒ: sensor resistance at 0.4mg/L of Alcohol at different temperatures and humidities.

SENSITIVITY ADJUSTMENT

Resistance value of MQ-3 is difference to various kinds and various concentration gases. So, When using this components, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 0.4mg/L (approximately 200ppm) of Alcohol concentration in air and use value of Load resistance(Rₒ) about 200 KΩ (100KΩ to 400 KΩ).

When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence.
# Listing Program

```c
#include <LiquidCrystal.h>

LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

int pinAout = A0;

int a;

int kalibrasiGasSensor;

void setup() {
    int i;
    lcd.begin(16, 2);
    lcd.setCursor(18, 0);
    lcd.print("Alat Pendeteksi");
    lcd.setCursor(16, 1);
    lcd.print("Kadar Alkohol");
    for (i = 0; i < 40; i++)
    {
        lcd.scrollDisplayLeft();
        delay(500);
    }
    lcd.clear();
}

void loop() {
    a = analogRead(pinAout);
    kalibrasiGasSensor = map(a, 0, 1023, 0, 255);
    kalibrasiGasSensor = constrain(kalibrasiGasSensor, 0, 100);
    lcd.setCursor(0, 0);
    lcd.print("Kadar Alkohol:");
    lcd.setCursor(1, 8);
    lcd.print(kalibrasiGasSensor % "");
    lcd.print("\%");  
}
```
Skema Rangkaian
<table>
<thead>
<tr>
<th>NO</th>
<th>Nama Komponen</th>
<th>/pcs</th>
<th>Harga</th>
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</thead>
<tbody>
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<td>1.</td>
<td>Arduino Uno</td>
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<td>Rp. 85.000</td>
</tr>
<tr>
<td>2.</td>
<td>Sensor MQ-3</td>
<td>1</td>
<td>Rp. 57.000</td>
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<tr>
<td>3.</td>
<td>LCD 16X2</td>
<td>1</td>
<td>Rp. 35.000</td>
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<tr>
<td>4.</td>
<td>Push Button</td>
<td>1</td>
<td>Rp. 3.000</td>
</tr>
<tr>
<td>5.</td>
<td>Potensiometer</td>
<td>1</td>
<td>Rp. 2.000</td>
</tr>
<tr>
<td>6.</td>
<td>Kabel Jumper</td>
<td>3 lembar</td>
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<tr>
<td>7.</td>
<td>Batrai</td>
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<tr>
<td>8.</td>
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<tr>
<td></td>
<td><strong>TOTAL</strong></td>
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Foto Alat