

وزارت علوم، تحقیقات و فناوری



دانشگاه علم و فرهنگ

The Final Project for a Bachelor's Degree: Solar Tracker (Sunflower)

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Contents

- What is Arduino?
- Arduino Uno Specifications
- Arduino Software IDE
- Coding with Arduino
- Arduino vs. AVR
- Solar Tracker Project
- How Sunflower Functions
- Resources

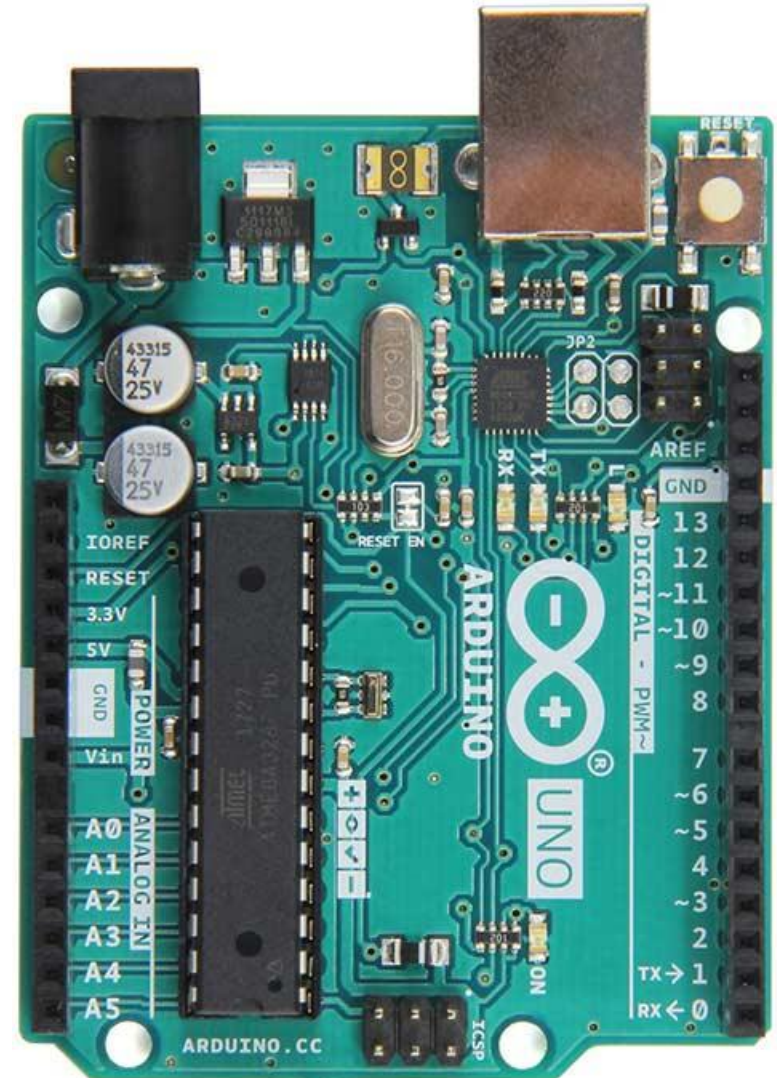
What is Arduino?

- Easy-to-use open-source hardware and software
- Based on Wiring programming framework
- Cross-platform (and/or cloud-based) IDE
- Embedded on-board programmer
- USB as power supply
- Relatively cheap



Arduino Uno Specifications:

- Microcontroller **ATmega328P**
- 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) 0.5 KB used by **bootloader**
- SRAM 2 KB (ATmega328P)
- EEPROM 1 KB (ATmega328P)
- Clock Speed 16 MHz
- Weight 25 g



Arduino Software IDE

- Free, updated and open-source
- Verifies the code and uploads directly to the board
- Supports Windows, macOS, Linux and Cloud
- Pre-installed libraries to work with multiple modules



The screenshot shows the Arduino IDE interface with the following code in the main editor:

```
1 void setup() {  
2   // initialize digital pin LED_BUILTIN as an output.  
3   pinMode(LED_BUILTIN, OUTPUT);  
4 }  
5  
6 // the loop function runs over and over again forever  
7 void loop() {  
8   digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH is the voltage level)  
9   delay(1000); // wait for a second  
10  digitalWrite(LED_BUILTIN, LOW); // turn the LED off by making the voltage LOW  
11  delay(1000); // wait for a second  
12 }
```

The IDE title bar reads "Blink | Arduino 1.8.5". The status bar at the bottom right indicates "Arduino/Genuino Uno on COM5".

Coding with Arduino

- `setup()`: in order to setup tasks like setting pin modes or initializing libraries, this function is called once.
- `loop()`: looping consecutively, this function allows the program to change and respond.

A basic example:

```
void setup() {  
  pinMode(LED_BUILTIN, OUTPUT);  
}
```

```
void loop() {  
  digitalWrite(LED_BUILTIN, HIGH);  
  delay(1000);  
  digitalWrite(LED_BUILTIN, LOW);  
  delay(1000);  
}
```

Arduino vs. AVR



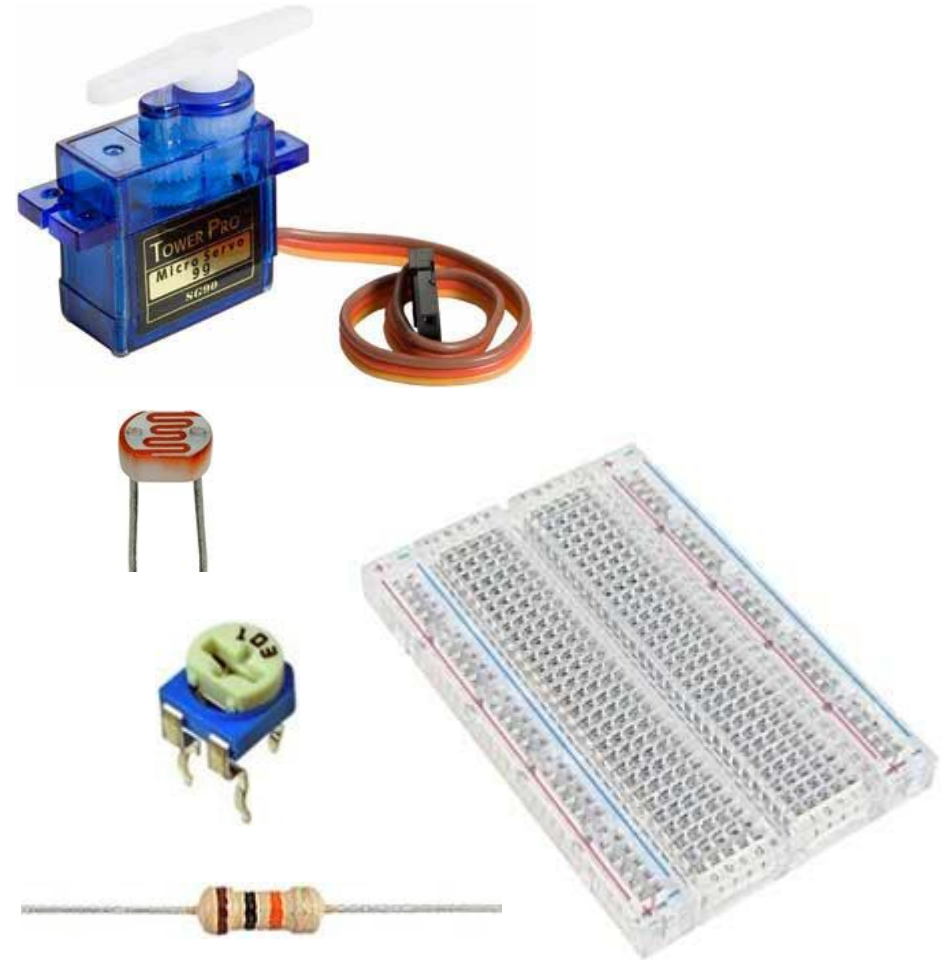
- Code independent of hardware
- Easy to learn
- Suitable for quick projects
- Expensive in comparison with AVR
- Active community with a number of examples and libraries



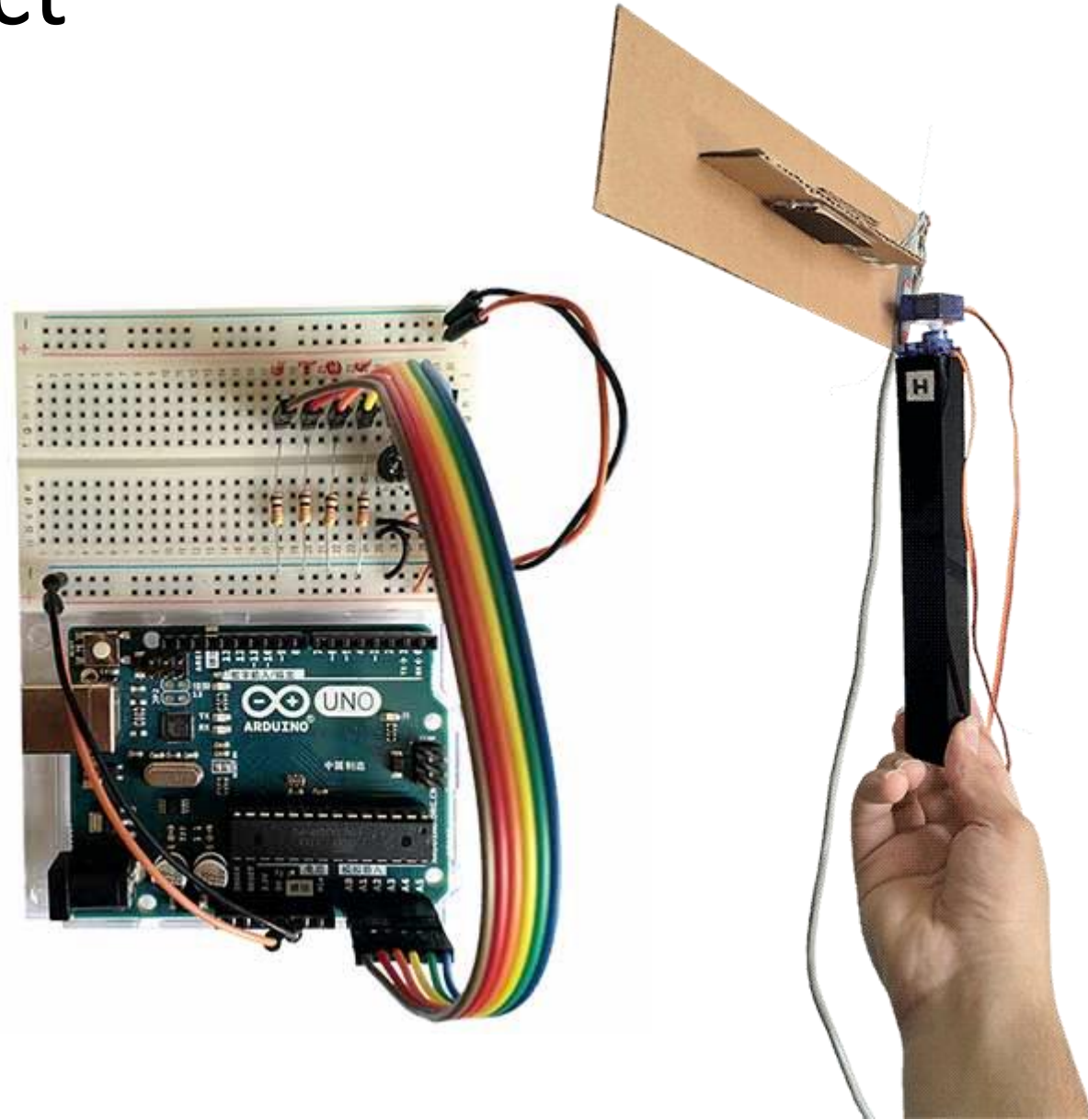
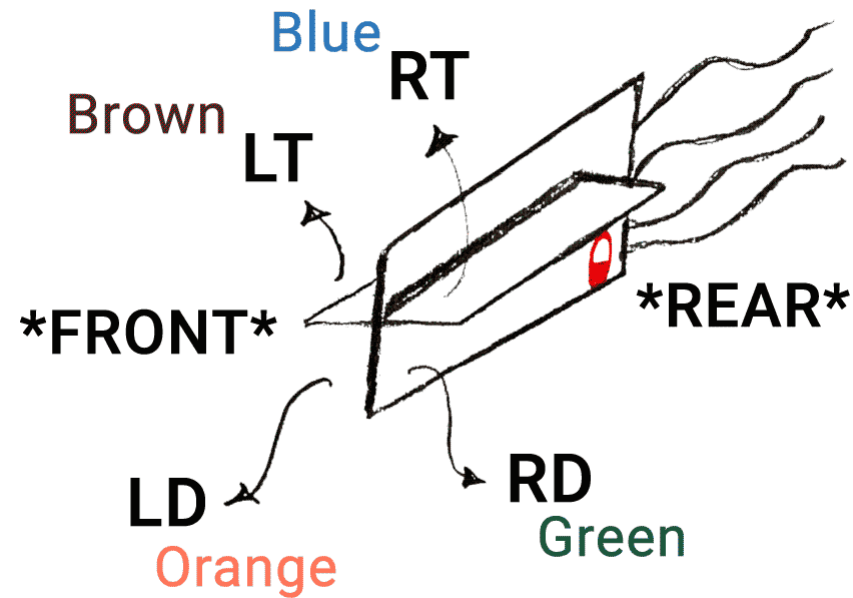
- Requires a working knowledge of microcontrollers, pins and programmers
- Suitable for large-scale production
- Highly customizable for advanced projects

Solar Tracker Project

- Arduino Uno (x1)
- 10 k Ω Resistor (x4)
- 10 k Ω Potentiometer (x2)
- Light-dependent resistor (LDR) (x4)
- Servomotor (x2)
- Breadboard (x1)
- Stand (x1)
- Pre-crimped wire
- Cardboard



Solar Tracker Project



How Sunflower functions

- LDRs function as photodetector
- Voltage division happens, which is the result of distributing the input voltage between the resistors and LDRs. Four separate voltages are sent to analog inputs
- Potentiometers act as fine-tune volumes for speed control
- Average of up/down/left/right is calculated
- Distance from “up/down” average and “left/right” average is calculated
- Error range is processed and decision is made
- Command is sent to the servomotors
- Interruption

Resources

- <http://www.instructables.com>
- <http://arduino.ir>
- <http://arduino.cc>
- <http://www.the-diy-life.com>