



Working and Usage of Arduino as a Tool for Study and Research

Abhishek Yadav

Department of B.Sc. Information and Technology, B.K Birla College of Arts, Science and Commerce, Kalyan, India

DOI: <https://doi.org/10.55248/gengpi.2022.3.10.20>

ABSTRACT:

This paper explores the working precept and functions of an Arduino board. This additionally explores on how it can be used as a device for learn about and lookup works. Arduino board can furnish a speedy device in development of VLSI check bench particularly of sensors. Main benefits are quickly processing and effortless interface. Today, with the growing range of human beings and the usage of open supply software programs and hardware units' day after day, technological know-how is forming a new dimension by way of making difficult matters appear less difficult and interesting. These open sources supply free or certainly low costs, dependable and inexpensive technology. This paper provides a glimpse of kind of Arduino boards, working principles, software program implementation and their applications.

KEYWORD: Arduino, Microcontroller, Hardware, Software, Open-source platform, VLSI, Sensors

I. INTRODUCTION

Arduino is an open force microcontroller which can be without difficulty programmed, canceled and reprogrammed at any immediate of time. Introduced in 2005 the Arduino platform was formerly designed to give an less precious and handy way for potterers, council scholars and exponents to produce units that have commerce with their surroundings the use of detectors and selectors. Grounded on easy microcontroller boards, it's an open force calculating platform that's used for developing and programming electronic bias. It's also successful of appearing as a mini pc simply like other microcontrollers by taking inputs and controlling the labors for a range of electronics bias. It's also successful of entering and transferring records over the web with the help of a number Arduino securities, which are mentioned in this paper. Arduino makes use of a tackle regarded as the Arduino development board and software program for creating the law recognized as the Arduino IDE (Integrated Development Environment). erected up with the 8- bit Atmel AVR microcontroller's that are manufactured through Atmel or a 32- bit Atmel ARM, these microcontrollers can be programmed without problems using the C or C language in the Arduino IDE. Unlike the different microcontroller boards in India, the Arduino boards entered the digital request only a couple of times agone, and had been restrained to small scale tasks only. People related with electronics are now step by step coming up and accepting the position of Arduino for their systems. This enhancement board can also be used to burn(upload) a new law to the board through in reality the use of a USB string to upload. The Arduino IDE presents a simplified erected- in platform which can run on normal non-public computer systems and approves guests to write operations for Arduino the operation of C or C++. With so numerous Arduino boards accessible in the request, deciding on a precise enhancement board needs a range of check executed with appreciate to their specs and capabilities, which can be used for the assignment prosecution in agreement to its specific operations.

II. NEED FOR ARDUINO

Why is there a want to use Arduino in specific? or What makes it specific from others?

Massimo Banzi, a Co-founder of Arduino mentions some very vital motives for this question.

- 1) **Active User Community:** A crew of humans the use of a comparable product can preserve posted message conversations and share their experiences or resolve the issues of the different customers in the communities with their personal experiences [1]. "If you begin charging for everything, the entirety dies very quickly." says Banzi, Arduino Co-founder.
- 2) **Growth of Arduino:** Arduino was once developed with intent to furnish a budget friendly and trouble-free way for hobbyists, college students and experts to construct units that interact with their scenario the usage of sensors and actuators. This makes it best for freshmen to get began quickly [1].
- 3) **Inexpensive Hardware:** Since Arduino is an open supply platform the software program is now not purchased and solely the fee of shopping for the board or its components is incurred, for this reason making it very cheap. The hardware designs are additionally on hand on line for free from its authentic internet site [1].

4) **Arduino Board as a Programmer:** To make Arduino board characteristic handy and additionally making it accessible in all places these boards come with a USB cable for electricity necessities as properly as functioning as a programmer [1].

5) **Multi-platform Environment:** The Arduino IDE is successful in walking on a wide variety of platforms consisting of Microsoft, Linux and Mac OS X making the consumer neighborhood even large [1].

III. TYPES OF ARDUINO BOARDS

Arduino boards are handy with many one-of-a-kind sorts of built-in modules in it. Boards such as Arduino BT come with a built-in Bluetooth module, for wi-fi communication. These built-in modules can additionally be on hand one at a time which can then be interfaced (mounted) to it. These modules are regarded as Shield. Some of the most usually used Shields are:

- **Arduino Ethernet shield:** It that lets in an Arduino board to join to the net using the Ethernet library and to examine and write an SD card the usage of the SD library [2].
- **Arduino Wireless shield:** It lets in your Arduino board to speak wirelessly using Zigbee [2].
- **Arduino Motor Driver Shield:** It lets in your Arduino boards to interface with driver of a motor etc. [2].

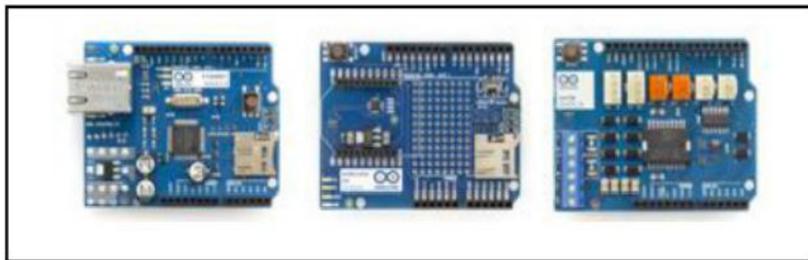


Fig. 1. Arduino Shields – Ethernet, Wireless and Motor Driver.

Here is a listing of the unique kinds of Arduino Boards accessible alongside with its microcontroller type, crystal frequency and availabilities of auto reset facility:

Table 1. Heading and text fonts

<i>Arduino Type</i>	<i>Microcontroller</i>	<i>Clock Speed</i>
Arduino Uno	ATmega328	16 MHz with auto-reset
Arduino Duemilanove / ATmega328	ATmega328	16 MHz with auto-reset
Arduino Nano	ATmega328	16 MHz with auto-reset
Arduino Mega 2560 or Mega ADK	ATmega2560	16 MHz with auto-reset
Arduino Leonardo	ATmega32u4	16 MHz with auto-reset
Arduino Mini w/ ATmega328	ATmega328	16 MHz with auto-reset
Arduino Ethernet	Equivalent to Arduino UNO with an Ethernet shield	
Arduino Fio.	ATmega328	8 MHz with auto-reset
Arduino BT w/ ATmega328	ATmega328	16 MHz with auto-reset
LilyPad Arduino w/ ATmega328	ATmega328	8 MHz (3.3V) with auto-reset
Arduino Pro or Pro Mini	ATmega328	16 MHz with auto-reset
Arduino NG	ATmega8	16 MHz with auto-reset

IV. ELEMENTS OF ARDUINO BOARDS

Elements of an Arduino Board can be achieved into two categories:

- Hardware
- Software

4.1. Hardware

The Arduino Development Board consists of many factors that collectively makes it work. Here are some of these essential factor blocks that assist in its functioning:

- **Microcontroller:** This is the coronary heart of the improvement board, which works as a mini laptop and can get hold of as properly as ship

data or command to the peripheral gadgets linked to it. The microcontroller used differs from board to board; it additionally has its personal a variety of specifications.

- **USB plug:** This plug is a very necessary port in this board. It is used to add (burn) a program to the microcontroller the use of a USB cable. It additionally has a regulated electricity of 5V which also powers the Arduino board in instances when the External Power Supply is absent.
- **Internal Programmer:** The developed software program code can be uploaded to the microcontroller via USB port, except an exterior programmer.
- **Reset button:** This button is existing on the board and can be used to resets the Arduino microcontroller.
- **Analog Pins:** There are some analog enter pins ranging from A0 – A7 (typical). These pins are used for the analog enter / output. The no. of analog pins additionally varies from board to board.
- **Digital I/O Pins:** There are some digital enter pins additionally ranging from two to sixteen (typical). These pins are used for the digital enter / output. The no. of these digital pins additionally varies from board to board.
- **Power and GND Pins:** There are pins on the improvement board that grant 3.3, 5 volts and ground thru them

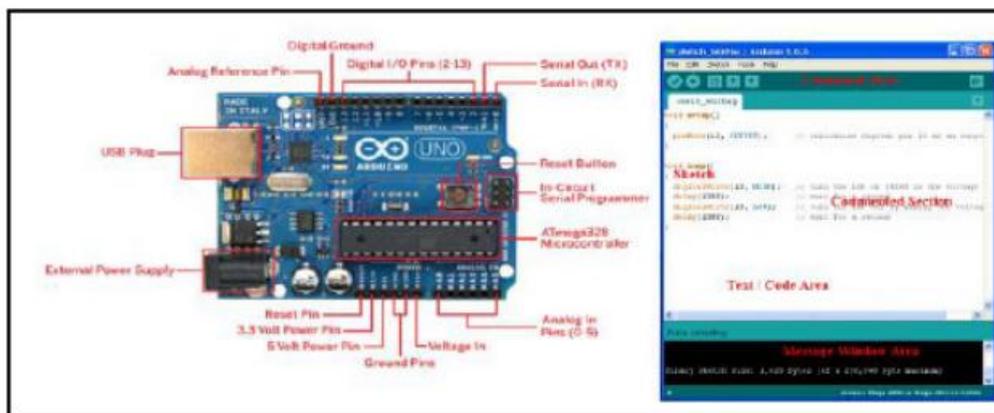


Fig. 2. A labeled diagram of an Arduino Board and an IDE.

4.2. Software

The software code written for Arduino is recognized as a sketch. The software program used for growing such sketches for an Arduino is oftentimes regarded as the Arduino IDE. This IDE incorporates the following parts in it:

- **Text editor:** This is the place the simplified code can be written the usage of a simplified model of C++ programming language.
- **Message area:** It shows error and additionally offers a comment on saving and exporting the code.
- **Text:** The console shows textual content output by using the Arduino surroundings consisting of whole error messages and different statistics
- **Console Toolbar:** This toolbar consists of more than a few buttons like Verify, Upload, New, Open, Save and Serial Monitor. On the backside proper hand nook of the window there shows the Development Board and the Serial Port in use.

4.3. Features of Arduino IDE

- The mission file or the sketches for a challenge are saved with the file extension .ino
- Features such as reduce / reproduction / paste are supported in this IDE.
- There additionally is a facility for discovering a unique phrase and changing it with some other via urgent the Ctrl + F buttons on the keyboard
- The most fundamental section or the skeleton of all Arduino code will have two features.

V. PROGRAMMING BASICS

Now we'll talk about the programming strategies of Arduino design in the Arduino IDE. There are two important parts each layout will usually have, they are:

- void setup ()
- void loop ()

1) void setup ():

This is the first movements that starts off evolved when the Arduino begins functioning. This characteristic is done only as soon as in the course of the complete application functioning. The setup feature carries the initialization of each and every pin we intend use in our mission for enter or output. Here is an instance of how it has to be written:

```
void setup()
{
  pinMode(pin, INPUT);
  pinMode(pin, OUTPUT);
}
```

Here the pin is the no. of the pin that is to be defined. INPUT / OUPUT correspond to the mode in which the pin is to be used.

```
void setup()
{
  Serial.begin(9600);
}
```

It additionally carries the initialization of the Serial Monitor. A serial display is used to recognize the statistics that are being dispatched serially to any peripheral device. Before the usage of any variables for programming it is fundamental to outline them above the feature “void setup ()”

2) void loop ():

This characteristic is the subsequent vital characteristic in the Sketch. It consists of that phase of the code that needs to be constantly accomplished not like the phase of the code written in the setup function. An instance of a void loop is as follows:

```
void loop()
{
  digitalWrite(pin, HIGH);
}
```

Here digital Write is a characteristic that writes an excessive or a low cost to a digital pin. If the pin has been configured as an OUTPUT with pin Mode (), its voltage will be set to the corresponding value: 5V for HIGH, 0V (ground) for LOW. Similarly, if there is a want for prolongation in the layout then there is some other feature that creates a lengthening in the execution of the code

```
delay(1000); //delay for a second
```

This creates a prolong in the execution of the software for the time length targeted (in milliseconds). Using the above two feature lets create a layout for blinking a led.

```
// this loop function executes only once
void setup()
{
  pinMode(13, OUTPUT); // initialize digital pin 13 as an output.
}

// this loop function executes forever
void loop()
{
  digitalWrite(13, HIGH); // turn the LED on (HIGH is the voltage level)
  delay(1000); // wait for a second
  digitalWrite(13, LOW); // turn the LED off by making the voltage LOW
  delay(1000); // wait for a second
}
```

Fig. 3. Arduino Shields – Ethernet, Wireless and Motor Driver.

VI. APPLICATION

Arduino has innumerable functions as it has been used drastically for developing enterprise by way of layman, amateurs and expert in a number fields of engineering. Then there are some of these high- quality enterprises that have been developed on an Arduino platform

1. Arduino Satellite(ArduSat)

ArduSat is an open force satellite television for pc absolutely primarily grounded on Arduino to produce a stage for area discoveries. erected by means of Becket before recognized as NanoSatisfi, ArduSat collects quite a number feathers of information's from the area terrain, with the help of several detectors that consists of temperature detectors, strain detectors, cameras, GPS, spectrometer, and magnetometer and so forth with its programmable Arduino processors (4). This platform also lets in frequent public to test their tasks in space. ArduSat can be used for film land from space, making a spectrograph of the sun, detecting inordinate power radiation, collecting temperature readings and gaping at meteorsetc.(5)(6).

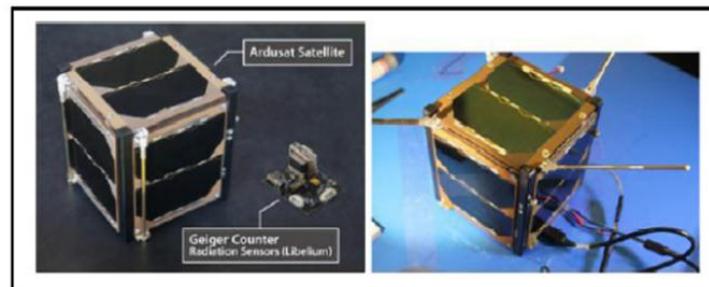


Fig. 4. Actual model of an ArduSat

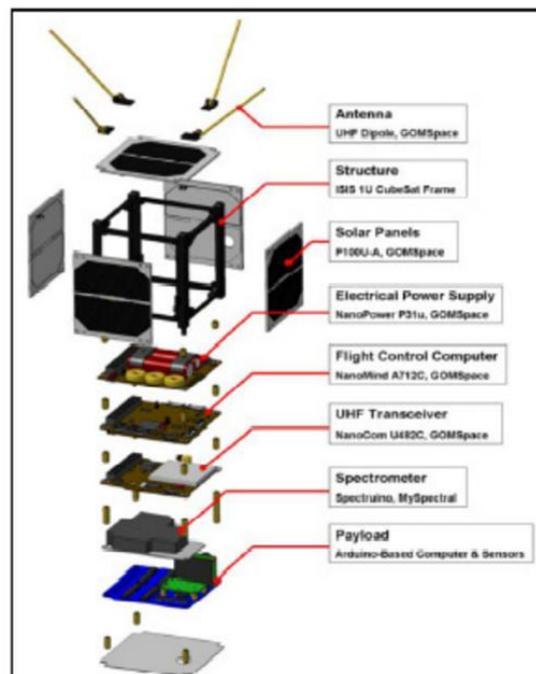


Fig. 5. ArduSat and its major components.[7]

2) ArduPilot (ArduPilotMega - APM)

ArduPilot is an unmanned aerial automobile (UAV) based totally on the open supply platform and constructed the use of Arduino Mega which is capable to manage impartial multicopters, fixed-wing aircraft, common helicopters and floor rovers. [3] It was once created through the DIY Drones neighborhood in 2007 and used to be additionally an award prevailing platform of 2012 [3].

3) Lilypad Arduino

Just like Google wearable's, Lilypad Arduino is a wearable model of Arduino developed and designed by means of Leah Beachley and Spark Fun Electronics with the intention of constructing interactive electronic textiles or e-textiles [10].

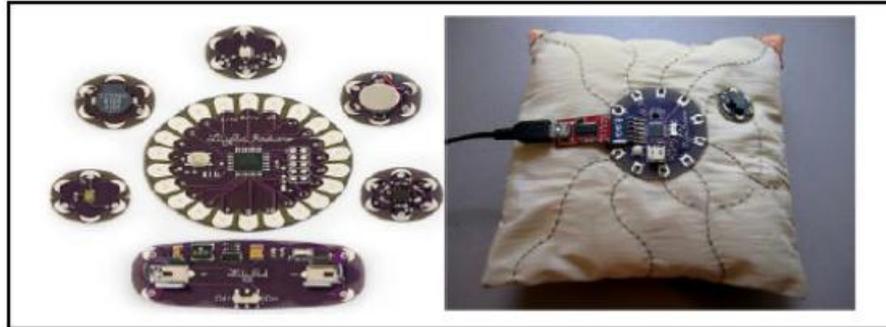


Fig. 6. Lilypad Arduino and so add-on components that can be sewn together and a Lilypad Arduino pillow.

These designs contain use of a range of modules sewn on the fabric with conductive thread to give it the required electrical connections. [10] The microcontroller can be programmed simply like the everyday Arduino boards the use of the USB-to-serial connection. This is an ideal illustration of a user neighborhood decided assignment with the commercial enterprise model of the package designed by way of Leah and Spark Fun Electronics. This is an instance of such designs, right here is a jacket with flip indicators that will let human beings be aware of where you are going when on a bike.



Fig. 7. Examples of jackets with turn signals powered by Lilypad Arduino sewn onto them

CONCLUSION

In this paper, we have studied the working precept of Arduino, its hardware / software program aspects and its purposes as to where it is presently being used and the place all it can be used. We have also learnt how to write sketches for Arduino in its personal IDE (software). Developing new thoughts with Arduino is endless, with the assist of this paper we have learnt to construct new units of our personal to create and enforce modern things. From wearable trend to house research, the probabilities of the use of an Arduino to analyze and boost new thoughts is infinite. Though it does have its personal limitations, it is a remarkable device that can be used in learning.

Reference

- [1]. ARDUINO.CC, "Arduino – Introduction", 2015 [Online] Available: <http://arduino.cc/en/Guide/Introduction>. [Accessed: 25- Feb - 2015].
- [2]. Arduino.cc, 'Arduino - Products', 2015. [Online]. Available: <http://arduino.cc/en/Main/Products>. [Accessed: 25- Feb- 2015].
- [3]. ArduPilot Mega, 'ArduPilot Mega', 2015. [Online]. Available: <http://www.ardupilot.co.uk/>. [Accessed: 23- Nov- 2015].
- [4]. Wikipedia, 'ArduSat', 2015. [Online]. Available: <http://en.wikipedia.org/wiki/ArduSat>. [Accessed: 23- FEB- 2015].
- [5]. Kickstarter, 'ArduSat - Your Arduino Experiment in Space', 2015. [Online]. Available: <https://www.kickstarter.com/projects/575960623/ardusat-your-arduino-experiment-in-space>. [Accessed: 23- Feb- 2015].
- [6]. DIY Space Exploration, 'ArduSat - Your Personal Satellite Built on Arduino', 2013. [Online]. Available: <http://www.diyspaceexploration.com/ardusat-your-personal-satellite>. [Accessed: 13- Sep2015].

-
- [7]. J. Brodtkin, '11 Arduino projects that require major hacking skills—or a bit of insanity', *Ars Technica*, 2013. [Online]. Available: <http://arstechnica.com/information-technology/2013/05/11-arduino-projects-that-require-major-hacking-skills-or-a-bit-of-insanity/2/>. [Accessed: 25- Nov- 2015].
- [8]. Galadima, A.A., "Arduino as a learning tool," in *Electronics, Computer and Computation (ICECCO)*, 2014 11th International Conference on, vol., no., pp.1-4, Sept. 29 2014-Oct. 1 2014 Doi: 10.1109/ICECCO.2014.6997577.
- [9]. Badamasi, Y.A., "The working principle of an Arduino," in *Electronics, Computer and Computation (ICECCO)*, 2014 11th International Conference on, vol., no., pp.1-4, Sept. 29 2014-Oct. 1 2014 Doi: 10.1109/ICECCO.2014.6997578.
- [10]. Lilypad Arduino, 'Lilypad Arduino', 2015. [Online]. Available: <http://lilypadarduino.org/>. [Accessed: 13- Sep- 2015].