

ARDUINO TECHNOLOGY AND ITS VARIOUS APPLICATIONS

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Abstract

This paper is mainly focuses on Arduino technology, its architecture, various types of arduino boards, working principles, programming basics and their uses in different types of applications. It can be used as a tool for study and research part. Arduino boards have a variety of microprocessors and microcontrollers which can be used for different types of projects. The main advantage of using arduino is that it has fast processing and easy user interface. Today, many people are using open source hardware and software devices which helps to make complicated things look easier and interesting. The devices which uses arduino can be controlled through a web application or via Bluetooth andriod based smart phone app. Due to the open source platform, the projects which uses arduino are of low costs, highly reliable and are of affordable technology.

Keywords - Arduino, Microcontroller, Software, Hardware, Open-source platform, Smart devices

I.INTRODUCTION

Arduino is an open-source electronic platform which is based on easy-to-use hardware and software. It can be easily programmed, erased and reprogrammed at any instant of time. Arduino boards are able to read inputs and turn it to an output like activating a motor, turning on an LED, publishing something online. Arduino was introduced in 2005 the, platform was designed to provide an cost effective and easy way for students and professionals to create smart devices that interact with their environment using sensors and actuators and other devices. It is capable of sending and receiving information over the internet and can be connected with the other devices.

The hardware used in arduino is known as Arduino development board and the software used for writing the code is known as Arduino IDE (Integrated Development Environment). C or C++ programming language is used to program the microcontrollers in the IDE. It is built using 8 bit Amtel or 32 bit Amtel AVR microcontrollers that are manufactured by Amtel. Earlier, Ardiuno was restricted to small scale projects only but now its use is extended in wide range of applications. The best thing about arduino is that it can be reprogrammed easily according to the requirement. The code can be burned or uploaded to arduino by just connecting a USB cable to the Arduino board. Arduino provides a simplified integrated platform that can run on personal computers and laptops.

II. IMPORTANCE OF ARDUINO

Following are the reasons due to which arduino is differeent from others:

1. Inexpensive harsdware: Since it is an open source platform, the cost of software is not involved and only the cost of buying boards and its parts are included.
2. Multi-platform environment: The Arduino IDE can run on a number of platforms including Microsoft, Linux and Mac OS and hence making the user community even larger.
3. These boards come with a USB cable for power requirements as well as functioning as a programmer to make Arduino board function easy and also making it available everywhere.

III. TYPES OF ARDUINO BOARDS

Arduino boards are available in many different types with built-in modules in it. Boards such as Arduino BT comes with a built-in Bluetooth module, for wireless communication purpose. These built-in modules are also available separately which can then be interfaced to it. These modules are called Shield.

Most common types of Shields are:

- Arduino Ethernet shield: It allows an Arduino board to connect to the internet using the Ethernet library and to read or write an SD card by using the SD library.
- Arduino Wireless shield: It allows Arduino board to communicate wirelessly by using Zigbee.
- Arduino Motor Driver Shield: It allows the Arduino boards to interface with driver of a motor etc.

Arduino type	Microcontroller	Speed
Arduino Uno	ATmega328	16 MHz with auto-reset
Arduino Nano	ATmega328	16 MHz with auto-reset
Arduino Duemilanove / ATmega328	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 BT w/ ATmega328	ATmega328	16 MHz with auto-reset
Arduino Fio.	ATmega328	8 MHz with auto-reset
Arduino Pro	ATmega328	16 MHz with auto-reset
Arduino NG	ATmega8	16 MHz with auto-reset

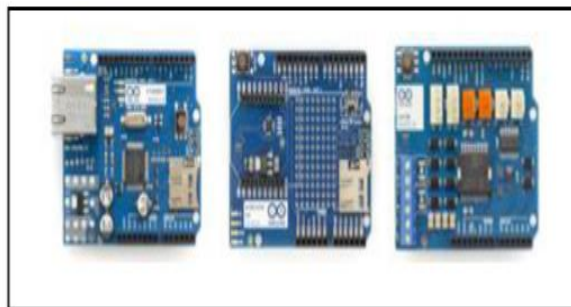


Fig. 1. Arduino Shields – Ethernet, Wireless and Motor Driver.

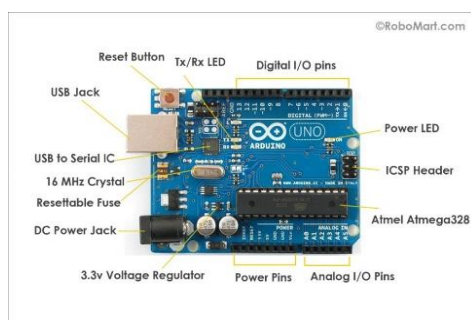


Fig2: Labelled diagram of arduino

IV. HARDWARE AND SOFTWARE DETAILS

4.1 Hardware

The Arduino Development Board composed of many components that together make it work. Here are some of the main component blocks that help in the functioning of arduino.

- **Microcontroller:** It is the heart of the development board that works as a mini computer and it can both receive and send information or command to the peripheral devices connected to it. The microcontroller used differs from board to board; it also has its own different specifications.
- **External Power Supply:** Power supply is used to power the Arduino development board with a regulated voltage ranging from 9 – 12 volts.
- **USB plug:** This plug is important port in this board. It is used to upload (burn) a program to the microcontroller by using a USB cable. It has a regulated power of 5V which powers the Arduino board when the External Power Supply is absent.
- **Internal Programmer:** The developed code can be uploaded to the microcontroller through USB port, without any external programmer.
- **Reset button:** This button is present on the board and can be used to reset the Arduino microcontroller.
- **Analog Pins:** There are some analog input pins ranging from A0 to A7 (typical). The pins are used for analog input / output. The number of analog pins varies from board to board.

- Digital I/O Pins: There are some digital input pins also ranging from 2 - 16 (typical). The pins are used for digital input / output. The number. of these digital pins varies from board to board.
- Power and GND Pins: There are pins on the development board that provide 3.3 volts, 5 volts and ground through them

4.2. Software

The code written for Arduino is called as a sketch. The software used for developing such codes for an Arduino is known as the Arduino IDE. The IDE contains the following parts in it:

- Text editor: This is where the simplified code can be written by using a simplified version of C or C++ programming language.
- Message area: It displays the error and gives a feedback on saving and exporting the code.
- Text: The console displays text output by the Arduino environment which includes complete error messages and other information
- Console Toolbar: This toolbar contains certain buttons such as Verify, Upload, New, Open, Save and Serial Monitor. The bottom right hand corner of the window displays the Development Board and the Serial Port in use.

V. FEATURES OF ARDUINO IDE

- The project file for a project are saved with the file extension .ino
- Features such as cut / copy / paste are supported in this Arduno IDE.
- There is a facility of finding a particular word and replacing it with another by pressing the Ctrl + F buttons on the keyboard
- The most basic part of all Arduino code will have two functions

VI. PROGRAMMING BASICS IN ARDUINO

There are two main parts every sketch will have, these are:

- void setup ()
- void loop ()

1. Void loop(): This is the first routine which begins when the Arduino starts functioning. This function is executed only once during the entire program functioning. The setup function contains the initialization of every pin we intend use in the project for input or output.

Void setup()

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

Here the pin is the number of the pin that is to be defined. INPUT / OUPUT corresponds to the mode in which the pin is to be used.

Void setup()

```
{
    Serial.begin(8600);
}
```

It also consists of the initialization of the Serial Monitor. A serial monitor is used to know the data that are sent serially to any of peripheral device. Before using any variable for programming it is necessary to define it above the function “void setup()” .

2) void loop():

This function is the next important function in the Program. It contains that part of the code which needs to be continuously executed unlike the part of the code written in the setup function. An example of a void loop is shown below:

Void loop()

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

Here digitalWrite() is a function which writes a high or a low value to the digital pin. If the pin has been configured for the OUTPUT with pin Mode(), its voltage will be set to the corresponding value: 5V (or 3.3V on 3.3V boards) for HIGH and 0V (ground) for LOW. Similarly if there is a need to delay in the sketch then there is a function which creates a delay in the execution of the code. The value for delay is given in milliseconds. Example:
 delay(2000); //delay for 2seconds

VII. APPLICATIONS

Arduino has wide range of applications as it has been used extensively for creating projects in various fields of engineering. Some of those amazing projects that have been developed on an Arduino platform are as follows:

7.1 Home Automation System Using Arduino

A low cost and efficient smart home system is presented in the design. The system has two main modules: first is the hardware interface module and second is the software communication module. The heart of this system is the Arduino Mega 2560 microcontroller which is capable of functioning as a micro web server and the interface to all the hardware modules. All communication and controls in this system will pass through the microcontroller.

As we can see in figure 3, the smart home system offers feature such as environmental monitoring by using the temperature, humidity, gas and smoke sensors. It also offers switching functionalities for controlling lighting, fans/air conditioners, and other home appliances that are connected to the relay system. Additional feature of this system is the intrusion detection which it offers by using the motion sensor and all these can be controlled from the Android smart phone app or web application.

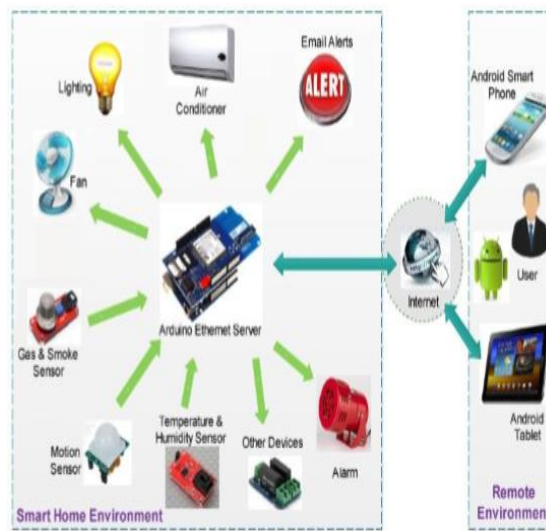


Fig 3: architecture of smart home system

7.2 Underground Cable Fault Detector Using Arduino

The Project detects the location of fault in underground cable lines from the base station in kilometers by using an arduino board. It uses the standard concept of ohms law that is, when a low dc voltage is applied at the feeder end through a series resistor to the cable lines, then current will vary depending on the fault location in the short circuited cable. When there is a short circuit, the voltage across series resistances changes accordingly and fed to an ADC to develop precise digital data which the programmed arduino will display using the lcd in kilometers. The project consists of series of resistors that represents cable length in kilometers and fault creation is made by a set of switches at every known km.

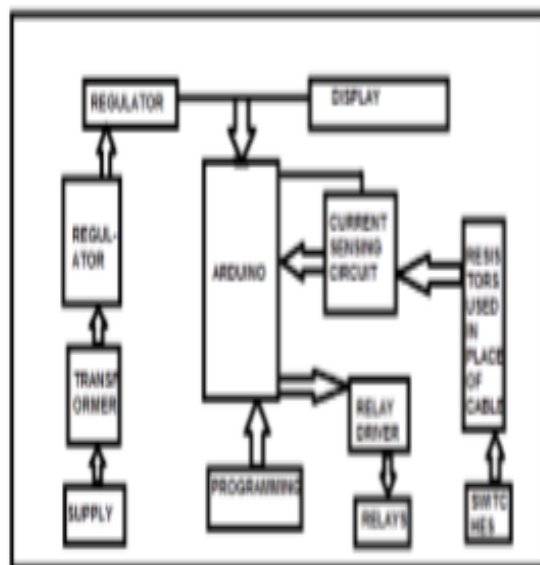


Fig 4: Block diagram for Cable Fault Detector

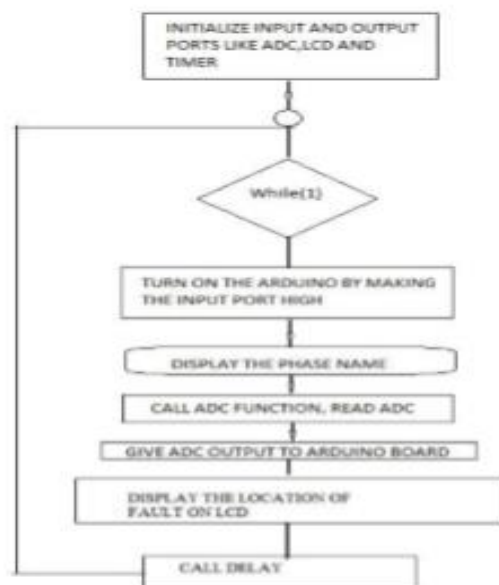


Fig 5. Flowchart of Underground Cable Fault Detector

7.3 GSM Based Fire Sensor Alarm Using Arduino

The system is completely controlled by microcontroller and Microcontroller constantly monitors sensors, Detector and GSM Modem. If the sensor voltage level. If input pin goes to zero then it will send 'AT' CMGS = 'User Mobile Number' in GSM Modem Through the serial port. Reaction with GSM Modem Character '>'. '>' Resume after receiving the microcontroller Security problem SMS + CTRL Z type in GSM modem. Then GSM modem will send the problem to the user.

For example, any moment in the security area was detected Time of microcontroller pin number 39 goes to logical zero Microcontroller felt and immediately sent the problem to GSM modem When GSM modem realized the problem will send to the user.

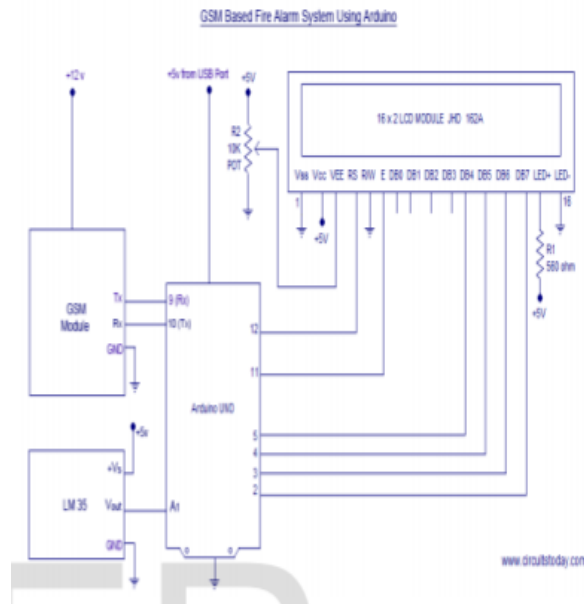


Fig 6: circuit diagram of fire sensor alarm

VIII. CONCLUSION

In this paper, we have studied the working of Arduino, its hardware and software features and its applications as to where it is currently used and where all it can be used. We have also learnt about writing sketches for Arduino in its own IDE (software). Development of new ideas with Arduino is endless, with the help of this paper we have learnt to build new devices of our own to create and implement new things. From wearable fashion to space research, the possibilities of using an Arduino to learn and develop innovative ideas is infinite. Although it does have its own limitations but it is a great tool that can be used in learning.

IX. REFERENCES

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