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ARDUINO – EVOLUTION, ITS ARCHITECTURE AND LEVEL OF IMPLEMENTATION

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Abstract—Arduino has changed the complexity involved in the electronic circuit world. It made the circuit design more flexible and compact. This tiny circuit board is now creating wonders by making the people around the world more productive of their creativity. Arduino lets even novice people to create amazing things. Arduino can connect to all kinds of sensors, light, motor and other devices. All hardware schematics and source code of arduino are easily accessible to anyone because it is available for free under public licences. Another factor that boosts arduino is Google released an arduino based developer board for its android system. Thereby android apps can be build which use the phones camera, motion sensors, touch sensor and internet connectivity to control a display or robot. Arduino was released on 2005 by Maximo Banzi and few others. It was forked from a project named wiring developed by Hernando Bauagen for masters thesis project. The architecture of arduino is it's a micro controller based prototyping kit. The software used is application programming interface. The micro controller used can be programmed using C, C++ or other programming languages. Arduino is a embedded system that is designed to perform uses specified tasks successfully, where it is implemented with or without the interface of the user. Arduino can be succesfull implemented in home automation, public utilty automation and IoT.

***Keywords*—Arduino, Microcontroller, Architcture**

I.INTRODUCTION

Arduino board is dominating the world of electronics circuit board by kicking back all the other circuit boards due to its flexibility like it can be erased, reprogrammed and simple programming features. It is an open source flat form and can be accessed freely by any one. The price of the board is very low and is financially viable for any project.

II. EVOLUTION

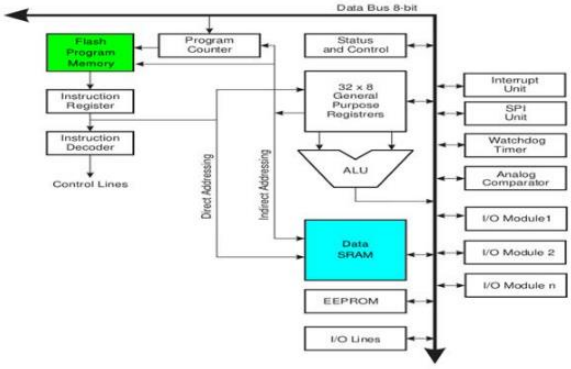
The basic idea behind the arduino board raised on the mind of Hernando Bauagen for his masters thesis project at Interaction Design Institute Ivrea (IDII) in Italy, he named the project as wiring. Later it was reconstructed and further developed by a faculty and his guide Massimo Banzi of Interaction Design Institute Ivrea in 2005. Heather Martin, Yaniv Steiner and Reto Wettach supported him in developing arduino. The name arduino was the name of the pub where Massiomo Benzi used to refresh himself.

At the early stage of arduino it was using an old-style RS-232 serial port version and now it has upgraded to USB version, and now some newer boards are using a Micro HDMI connector. The microcontroller used initially were, ATmega8, Atmega168, Atmega328, Atmega32u4, Atmega1280, ATmega2560. Now it is a 32-bit processor. With further and further improvement in the technology the arduino is also improving itself further and further. The LilyPad series comes with a thinner, compact form factor along with easy-to-use conductive material that can be used while developing wearables products.

The main aim of the developers was to develop an open source platform which can easily accessed by any one and affordable by all common people. The prototyping boards like the Uno, Leonardo, Nano, Mega2560, Primo, and Due are affordable due to their low price, which can be used as modular and adaptable devices. MKR VIDOR 4000, MKR1000, MKRZero, MKRFOX1200, Ethernet, and Primo boards are IoT-centric boards that have good connectivity and communication by consume lower power making them suited for IoT applications. Some other boards are Yun/Yun Mini, Zero, Tian, MO/MO Pro, and the Industrial 101 that are used for industrial needs. Arduino boards can be built for entertainment and educational, like the Esplora which uses Arduino Leonardo.

III.ARDUINO ARCHITECTURE

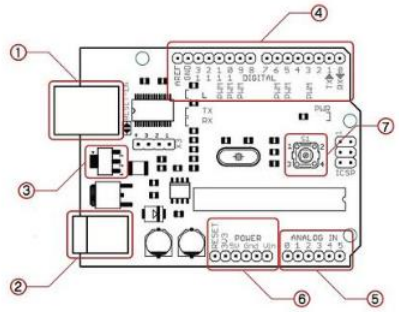
Arduino's processor is based on the Harvard architecture in which program code and program data have separate memory. The code gets stored in the flash program memory and the data is stored in the data memory. The Atmega328 microcontroller has 32 KB of flash memory for storing code (of which 0.5 KB is used for the bootloader), 2 KB of SRAM and 1 KB of EEPROM and operates at a clock speed of 16MHz.



Arduino architecture

The most important components of arduino board are,

1. USB Connector
2. Power Connector
3. Automatic Power Switch
4. Digital pins
5. Analog Pins
6. Power pin
7. Reset switch



Arduino Pin Diagram

IV.PROGRAMMING IN ARDUINO

Programs of arduino are known as sketches. it has three parts as Declaration of Variables, Initialization and control code. Initialization is written in the setup () function. Control code is written in the loop () function. The sketch is saved as .ino extension file. Any operations like verifying, opening a sketch, saving a sketch can be done using the buttons on the toolbar or using the tool menu.

- The sketch is stored in the sketchbook directory.
- Select the required board and the serial port numbers from the tools menu.
- Then upload the code using the upload button in the upload menu. From there the code will be uploaded by the bootloader onto the microcontroller.

Some of the syntax and parameters used while programming in arduino

Parentheses ( )

The parentheses brackets are used to indicate group of arguments, such as method, function, or a code statement. They are also used to group the math equations.

Curly Brackets { }

The statements used are put inside in the curly brackets. Line Comment

Two types of line comments are used as given below:

- Single line comment
- Multi-line comment

4.1 Single line comment

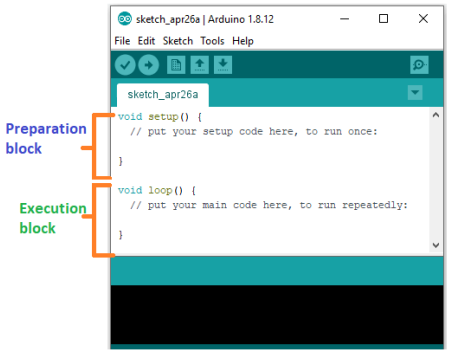
The text that are written along with the two forward slashes are known as a single line comment. The compiler ignores the code written after the two forward slashes. The comments used in single line comment will not be displayed in the output. These text are specified for a better understanding of the code or for the explanation of any code statement. The // (two forward slashes) are also used to ignore some extra lines of code without deleting it.

/ * Multi - line comment */

The Multi-line comment is used to group the information for better understanding. It starts with the single forward slash and an asterisk symbol (**/ ***). It also ends with the **/ ***. It is commonly used to write the larger text. It is also a comment that will be ignored by the compiler.

4.2 Coding Screen

The coding screen is divided into two blocks. The **setup** is considered as the preparation block, while the **loop** is considered as the execution block. It is shown below



The set of statements in the setup and loop blocks are enclosed with the curly brackets. We can write multiple statements depending on the coding requirements for a particular project.

For example:

1. **void** setup ( )
2. {
3. Coding statement 1;
4. Coding statement 2;
5. .
6. .
7. .
8. Coding statement n;
9. }
10. **void** loop ( )
11. {
12. Coding statement 1;
13. Coding statement 2;
14. .
15. .
16. .
17. Coding statement n;
18. }

4.3 Set up of code

It contains an initial part of the code that is to be executed. The pin modes, libraries, variables, etc., are initialized in the setup section. It is executed only once during the uploading of the program and after reset or power up of the Arduino board.

Zero setup () is located at the top of each sketch. As soon as the program starts running, the code inside the curly bracket is executed in the setup and it executes only once.

4.4 Loop

The loop contains statements that are to be executed repeatedly. The section of code inside the curly brackets is repeated depending on the value of variables.

Time in Arduino

The time in Arduino programming is measured in a millisecond.

Where, 1 sec = 1000 milliseconds

We can adjust the timing according to the milliseconds.

For example, for a 5-second delay, the time displayed will be 5000 milliseconds.

Difference between digitalRead () and digitalWrite ()

The digitalRead () function will read the HIGH/LOW value from the digital pin, and the digitalWrite () function is used to set the HIGH/LOW value of the digital pin.

delay ( )

The delay () function is a blocking function to pause a program from doing a task during the specified duration in milliseconds.

For example, - delay (2000)

Where, 1 sec = 1000millisecond

Hence, it will provide a delay of 2 seconds.

Code:

```
1. digitalWrite (13, HIGH);
2. delay (2000);
3. digitalWrite (13, LOW);
4. delay (1000);
```

Some of basic Adruino functions are:

- **digitalRead**(pin): Used for reading the digital value at the given pin.
- **digitalWrite**(pin, value): Used for writing the digital value to the given pin.
- **pinMode**(pin, mode): For setting the pin to input or output mode.
- **analogRead**(pin): Used for reading and returning the value.
- **analogWrite**(pin, value): It writes the value to particular pin.
- **serial.begin**(baud rate): Sets the beginning of serial communication by setting the bit rate.

V.PRACTICAL IMPLEMENTATION OF ARDUINO

5.1 Home Automation

In home automation with the help of Arduino Uno board by using Bluetooth interface for connectivity, using smartphones. Software loaded boards can be connected to the home devices like lamps, A/C, TV, Refrigerator, and Bluetooth software which can be interfaced with the board. The app loaded in the smartphone interact with the processor through Bluetooth connectivity and inputs from the phone are used to control the operation of the devices.

Operations like switch on, switch off, increasing or decreasing the intensity, volume, and other operating of parameters of these devices. Remote monitoring and operation is also enabled. These applications simplify the operation of household gadgets and enables better control.

5.2 Public Utility Automation

Applications to manage public utilities like street lighting, Dynamic traffic management systems are being implemented.

In Street lighting Street lights are fitted with Arduino boards and sensors. The microcontroller is programmed to read the inputs from the signal sent by the sensor on the light and temperature change and dynamically change the voltage supplied to the lights and control the intensity of the light. This system can be used to switch on and switch off the light also.

In Dynamic traffic Management Arduino controller along with infra-red sensors helps in managing the traffic dynamically. Input from the sensor helps the controller to measure the volume of traffic and accordingly control the timing of signals as per the traffic flow and its direction.

5.3 IoT

Poka-yoke is a system suggests the right component be fitted at any stage in the assembly line. This system senses the product that is being assembled and refers ERP system and finds out the component to be fitted at that stage and accordingly illuminates the light of the compartment of that component. The operator picks up that component where the light glows and thus picking the right component is ensured and mistake-proofing is ensured. Arduino board based on the input from the central server send a signal to right bulb in the circuit and illuminates it.

Production counting Sensor placed in the conveyor is activated when the product being assembled moved from one stage to the next stage. Arduino board takes the signal from the sensor and adds to the count and sends the data back to the central server.

VI.CONCLUSION

Arduino is an inexpensive solution as it is an open source on comparing to other development boards.Arduino environment can run on windows, Mac, Linux OS. The future of arduino is very bright and it can be easily use for robotics and automation projects

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