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ARDUINO - A BRIEF REVIEW

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ABSTRACT
Arduino (since 2015 it is known as Genuino outside the United States) is an open source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices. The project is based on a family of microcontroller board designs manufactured primarily by Smart Projects in Italy, using various 8-bit Atmel AVR microcontrollers or 32-bit Atmel ARM processors. These systems provide sets of digital and analog I/O pins for interfacing. The boards feature serial communications interfaces, including USB on some models, for loading sketches from personal computers.

KEYWORDS: *Microcontroller (µC), Shield, Integrated Development Environment (IDE), Zigbee, Xbee, Harvard architecture*

I. INTRODUCTION

Arduino is an open-source electronics platform. Arduino can take the input from many sensors attached to it & can give the output to many lights, motors etc. Arduino platform provides an integrated development environment (IDE) based on the Processing project, which includes support for C, C++ and Java programming languages. Arduino platform mainly contains a Hardware Board called Arduino Board .Other external hardware like Sensor Modules, Motors, lights etc. could be attached with the board. The project is based on a family of microcontroller board designs manufactured primarily by Smart Projects in Italy, and also by several other vendors, using various 8-bit Atmel AVR microcontrollers or 32-bit Atmel ARM processors. These systems provide sets of digital and analog I/O pins that can be interfaced to various expansion boards ("shields") and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits [1].

II. PRINCIPLE

Arduino works on a basic combination of hardware (Arduino board or simply the board), software (IDE) & programming language (generally supports C, C++ & Java). In IDE we wright the sketch in supported languages & burn it to the µC board through which are hardware can work. In general the input & output is in the form of high or low impulses, because the Arduino is generally use to work with digital signals [2], [3].

III. DESIGN

Arduino's processor basically uses the Harvard architecture where the program code and program data have separate memory. The code is stored in the flash program memory, whereas the data is stored in the data memory.

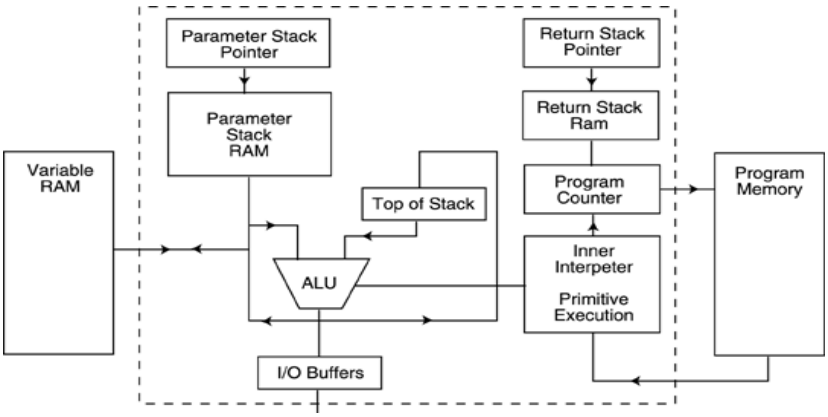

Figure 1: Harvard Architecture

IV. PIN CONFIGURATION

The basic circuit diagram of Arduino is shown below (we take Arduino Uno circuitry for an example, because it is configurations are most general). The connections are according to the µC used. ATmega 328 consist of 28 pins which are described below.

- **VIN-** The input voltage to the Arduino board when it's using an external power source.
- **5V-**This pin outputs a regulated 5V from the regulator on the board.
- **3.3V-** A 3.3 volt supply generated by the on-board regulator.
- **GND-** Ground pins.
- **IOREF-** This pin on the Arduino board provides the voltage reference with which the microcontroller operates.
- **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 µC 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 by use of attach Interrupt() function.
- **PWM: 3, 5, 6, 9, 10, and 11-** Provide 8-bit PWM output with the analog Write() function.

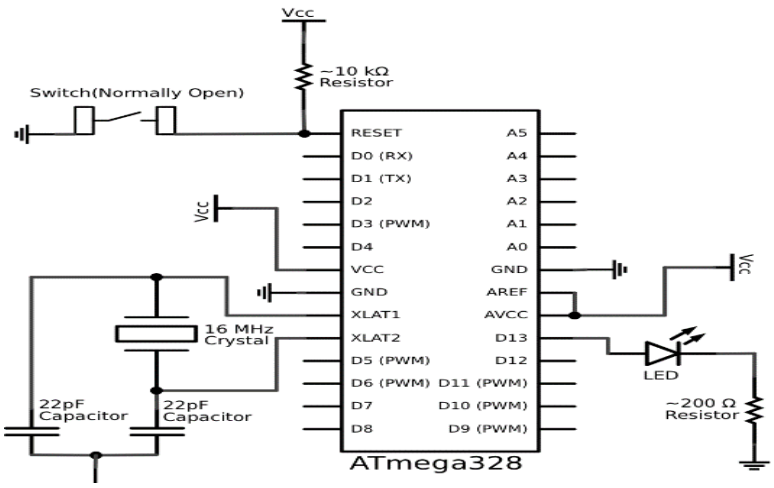

Figure2: Circuit Configuration of Arduino Uno in general

- **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.
- **TWI: A4 or SDA pin and A5 or SCL pin-** Support TWI communication using the Wire library.
- **AREF-** Reference voltage for the analog inputs. Used with analog Reference().
- **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.

V. SKETCH

In Arduino we simply call the programming code the" sketch", because it is based on wiring platform (combination of hardware (connected with the help if wires), software & programming language), in Arduino the hardware is fabricated on printed circuit expansion board (PCB). It is like to draw or we can say, we made sketch of a circuit so 'sketch'. Sketches have mainly two sections:

1. **setup() function:** All of the initial or only a single time initialized information is declared in this function.
2. **loop() function:** All the information which should be used or processed for number of times are writhed in this functions.

VI. METHODOLOGY

Steps to use Arduino

- Download the IDE from the website of Arduino (http.arduino.cc) & install.
- Connect the board (with the connections according to our need).
- Choose the board (or µC in some versions).
- Choose the board in which the board is connected.
- Write the sketch (or open if it is predefine in the IDE) & check for the errors through compiler.
- Burn (upload) it to the board.
- Now we can run the setup according to our need.

VII. FEATURES

In Arduino there are number of features according to the board needs, but some features are general. Some of the general features are as follows:

- **USB-to-serial converter:** It converts hexadecimal codes of computer into binary form with the help of FTDI chips.
- **USB Jack:** Use for burning the sketch directly from PCs (eliminate the need of specific programmer device).
- **ICSP Header:** Gives ability to µC to programed & reprogramed even after fabricated it on board (eliminate the need of preprograming).
- **Power Selection Jumper:** To select the appropriate voltage supply from various supplies connected together (through USB, adopter etc.).
- **Reset button:** Use to take the Arduino to the initial state of burned sketch.

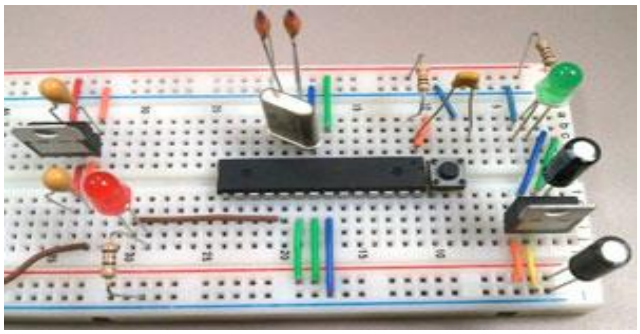

Figure3: Physical Arduino Structure on bread

Some special features according to the specific boards are as follows:

- **LilyPad Arduino:** Flexibility & light weighted (can be stitched in cloths).
- **Arduino Fio:** Design for use best as radio.
- **Arduino Yun:** Whole WiFi system on a single board
- **Arduino 101:** Newest member of Arduino family, it contains Bluetooth, 6-axis accelerometer, gyro-meter.
- **Arduino Leonardo:** Built-in-USB communication (elimination of FTDI Chips) etc.

VIII. APPLICATIONS

Some of the applications of Arduino are as follows:

1. **Smart Traffic Light Control and Congestion Avoidance System During Emergencies Using Arduino and Zigbee**[4]

Wireless Sensor Networks deployed along a road can be utilized to control the traffic load on roads

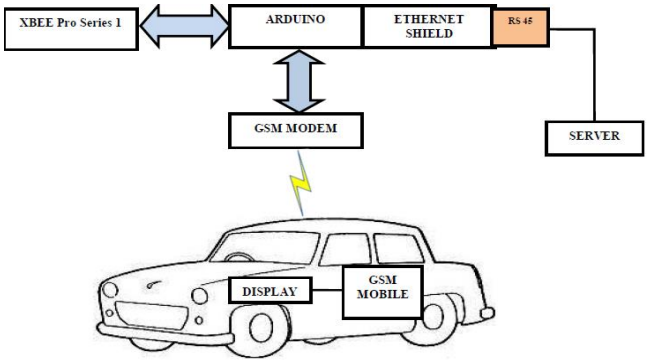

Figure 4: Block Diagram for Smart Traffic Light Control and Congestion

and at traffic intersections. Sensors are deployed on either side of roads at intersection points and in emergency vehicles respectively. Existing traffic light systems have timers that are set at regular intervals. This leads to the wastage of precious time especially in case of rescue vehicles for emergency conditions. In order to control this situation, we have proposed a system consisting of two parts: Smart Traffic Light Control System (STLC) and Smart Congestion Avoidance System (SCA) during emergencies. STLC System controls the change of traffic lights at intersection points giving high priority to emergency vehicles. SCA System is a smart traffic routing system that chooses the shortest routes having the least congestions. Sensors used in this system are mainly of two types: Simple proximity sensor and Modulated IR sensor.

2. **Arduino Based Automatic Plant Watering System** [5]

Irrigation is the artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and re vegetation of disturbed soils in dry areas and during periods of inadequate rainfall.

The vapor pressure deficit is a measure of the difference between the amount of moisture the air

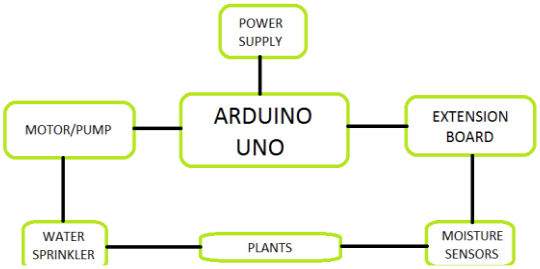

Figure 5: Block diagram of Arduino Based Automatic Plant Watering System

contains at a given moment and the amount of moisture it can hold at that temperature when the air would be saturated. Pressure deficit measurement can tell us how easy it is for plants to transpire:

higher values stimulate transpiration (but too high can cause wilting), and lower values inhibit transpiration and can lead to condensation on leaf and greenhouse surfaces. There are two functional components in this project. They are the moisture sensors and the motor/water pump. Thus the Arduino Board is programmed using the Arduino IDE software. The function of the moisture sensor is to sense the level of moisture in the soil. The motor/water pump supplies water to the plants.

3. Arduino Microcontroller Board as Proxemics [6]

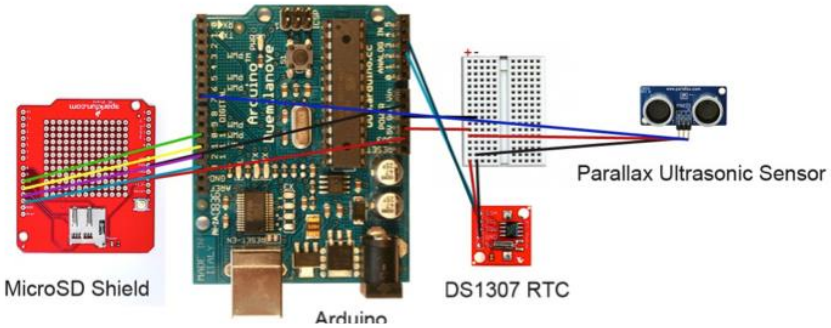

Figure6: Arduino Microcontroller Board as Proxemics

The accurate and anonymous measurement of proxemics in social research can prove to be problematic. Proxemics is defined as a human being's preferred level of spatial separation from other beings and objects. For purposes of this project, the focus is human/object spatial distance. Design considerations include methods used to obtain proximity information using an ultrasonic sensor attached to an Arduino microcontroller board and the electronic configuration needed to record information such as a time/date stamp and duration on a storage device for subsequent analysis.

IX. ADVANTAGES

- **Compatibility:** The Arduino is compatible with Windows, Linux & even Mac.
- **USB connectivity:** We can connect it with USB which make it to be connectable with any device.
- **Less expensive:** The cost is one of the major factors for anything. The Arduino is comparatively less expensive than many other boards.
- **More powerful than a BASIC stamp:** Arduino is more powerful than BASIC Stamp because of its less simple design.
- **Something that could be built by self & easy to fix:** As its design is simple anyone a built it at home & fixes some small damages (connectivity issues).
- **Simple and easy to use by someone without formal electronics training:** No formal knowledge is required because of it easy interface.

X. RESULT & DISCUSSION

The Arduino is easy to use system due to its simple design, easy to use headwear, and availability of documentation. It is the one of the most useful tools in the field of research & development. Variety of boards & shields which are available with some specific functionality & features made it a more suitable tool for our needs.

XI. CONCLUSION

Arduino is a simple system designed for creative people with little or "no prior knowledge of electronics" says Banzi. "It's cheap and open source with lots of documentation written in a not too technical language. Above all, it has a very welcoming attitude towards beginners".

XII. FUTURE SCOPE

Over the years, Arduino has went out to become a huge success and a common name among students. With Google deploying it, people's imagination has went out to much higher level than before. A

developer in the annual GOOGLE I/O conference said "when Arduino and Android coming together, this really proves "INFINITY EXISTS" in the future".

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