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An Economic Approach to Build Controller Based Generic Purpose Development Board

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***Abstract:** Controller based development board is deliberated to be exposed vulnerable platform and is a printed circuit board, which contains the insignificant provision rationality essential for engineers to enhance acquainted with the IC that assist to study programs. Assists handlers of the µp as a scheme to prototype applications in commodities. Depending on the creators taste, specifications are added to the controller and placed in customary platform. There are abundant boards like Arduino, Nanode, raspberry pi, Pingunio etc. All these are high priced for trainees who are interested in embedded projects. Many constituents in these sheets remain depleted for specific target due to power loss as well as expense. There has been magnificent expansion in the domain of integrated circuit technology and directed to the elaboration and insight of hardware apparatuses and its employment which consequences in less price tactic for the manipulators. This project mainly put a light on building a controller based generic purpose developmental board for most customary circumstances by an embedded consumers*

I. INTRODUCTION

Embedded System is one that has PC equipment with programming inserted in it as one of its most important Software is used to provide features and flexibility.

Performance is provided by the hardware execution. To carry out specific task, microcontroller or microprocessor is used by the embedded systems. Embedded system is used as unique framework where the computer is totally encapsulated by the device which it controls. It is a dedicated PC-based system for an applications or product items. Printer is an illustration of the embedded system since processor inside it performs one particular task that is getting the information and printing it. Decreasing the space, cost and power consumption is the basic need of embedded system and can be accomplished by integrating more functions into single chip. Embedded system software is referred to as firmware. Wide utilization of the controller boards as part of microcontroller programing is because of its easy to understand and user friendly operations. Controller boards have been with us for a couple of decades however their impact on our lives is significant. There is wide assortment of controller boards. They are as per the following: Using Arduino

- Creators can begin with gadget like Arduino an cheap, less eminent control board
- Easy to program
- Can connect wide variety of hardware equipment which is high quality microcontrollers

II. PROBLEM STATEMENT

The use of microcontroller chip for controlling the embedded system functions are increasing exponentially in everyday technology, design activities in colleges, and technological research institutes. Manufactured board of Arduino Uno costs about 930-/- and further the cost increases for building wide variety of applications whereas cost of prototyping Arduino Uno controller board is 250-/- much lower cost than available in the market which can be developed with components available in the local store. Project aims to provide cost effective controller based generic purpose development boards in embedded system design using microcontroller chip ATmega328P-PU by demonstration of hands-on experiments

III. MOTIVATION

"An economic approach to build a controller based generic purpose development board"

The objective of building own controller board is to provide an easy way for embedded users to create devices that interact with environment in wide variety of applications at much lower cost available in the market.

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IV. LITERATURE SURVEY

There are wide varieties of controller boards that are available. Table 1.1 below distinguishes the differences with respect to all the features in the controller boards.From the comparative study of controller boards with various parameters such as cost, memory of RAM, frequency used, different types of ICs and software related to the controller boards quoted in the table 1.1 we can conclude that Arduino Uno is having the low cost when compared with other controller boards listed in the table. Controller boards such as Nanode, Pingunio pic 32, STM 32 discovery, Teensy are not available in the Indian market. Arduino Uno is having open source platform with software ARDUINO Integrated development environment. Hardware specifications of Arduino Uno are openly available. With all above consideration Arduino Uno is considered to be the best. Throughout the project Arduino Uno is used as reference board with the aim of Economic approach to build a controller based generic purpose development board.

Controller board	Cost	RAM	Crystal	IC	software	Power supply
Arduino	570/-	32kb	16Mhz	ATmega328	Arduino IDE	3.3-5V
Nanode	3812/-	32kb	16Mhz	ATmega328	Arduino IDE	3.3V
MSP430	1300/-	512bytes	16Mhz	MSP430	IAR workbench	5V
Pingunio pic 32	951/-	32kb	20Mhz	PI18F2550	Pingunio IDE	9-30V
STM 32Discovey	4829/-	8kb	24Mhz	STM32ARM	MDK-ARM	5V
Teensy	1090/-	2kb	16Mhz	Atmel32U4-MU		5V

Table 4.1 Five alternatives of controller board

V. METHODOLOGY

By integrating all the blocks such as brawn energy, ceramic resonator, bootstrap, controller board, AVR pocket programmer, boot loader, LED indicator, output ports make an Arduino Uno board.

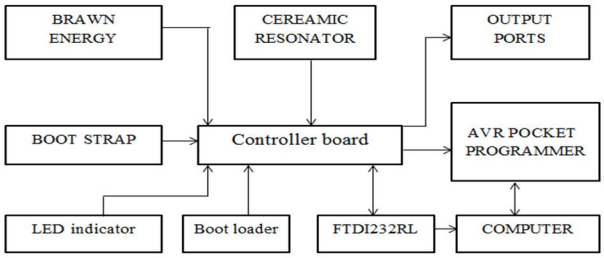


Fig 5.1 Block diagram of Arduino Uno

1) *Brawn Vitality:* Brawn energy is an electronic device that supplies electrical vitality to electrical load. Brawn energy have enhanced in reliability but since they need to handle significantly high voltages and streams than any or the majority of hardware they supply, they are frequently most vulnerable to failure of any piece of electronic systems. In Arduino Uno strength of 5v is utilized.
2) *Boot Strap:* Boot strap is buttons that can reset a device. Pressing a boot strap would be desirable to the power button, which could leave a device in the amidst of some operation and subject to defect. Boot strap would regularly commence delicate boot teaching PC to experience the procedure of closing down, which would clear memory and reset gadgets to their introduced state. It restarts the game, losing the saver unnamed progress. On PCs the reset button clears the memory and reboots the machine.
3) *Ceramic Resonator:* Clay resonator is oscillators where the essential recurrence deciding component is a quartz gem. Ceramic resonator is oscillators where the essential frequency deciding component is a quartz crystal. On account of inherent attributes of the quartz crystal the Crystal oscillators may held to compelling precision of frequency stability. Crystal oscillators are normally settled and frequency oscillators where stability and precision are the primary considerations. Sample incorporates, it is difficult to plan a stable and exact LC oscillator for the upper HF and higher frequencies without restoring to some kind of crystal control. Thus the explanation behind crystal oscillator

4) *FTDI 232RI:* FTDI 232 RI was intended to institutionalize the association of PC peripherals to PCs both to impart and supply electric power. Dissimilar to the information links, USB uses alternate connectors; a type[A or type]B. consideration includes avoiding electrical over-burdens and harm gear's as just sort A gives the force. FTDI 232 RI has replaced wide diversity of parallel/serial portings and in addition to orders with versatile gadgets.connections come in five information exchange modes.
5) *LED:* LED is transmitting diode which radiates light when actuated, when a reasonable voltage is associated to leads, electrons can recombine with electron openings, discharging vitality as photon
6) *Controller:* Main part of the block diagram, it contains everything anticipated that would support the microcontroller

A. Need of Boot Loader

We need to install the boot loader If we are building own Arduino, or need to replace the IC.

- Quickest and easiest method of for reinstalling the boot loader is possible when serial ports in the boards have been turned off.
- Install the boot loader for new boards of Arduino Selection of programmer

It is vital to choose the developer which is required to transfer boot loader to the Arduino Uno controller board. Two diverse sorts of programmers can use to install or reinstall boot loaders Alternative 1: Dedicated Programmers: For a speedy easy programmer it is prescribed to look into AVR Pocket Programmer (Windows only)

Alternative 2: Using the Arduino as a Programmer : The other choice is snatching an Arduino Uno (or Duemilanove). If we go into the Arduino IDE we will see a sample sketch called 'Arduino as ISP.' If we transfer this code to Arduino, it will basically work as AVR programmer. ¬ Also as of this writing the code only works on ATmega328 boards We are having the two options of selecting the programmer. We prefer of choosing option 2 (I.e. Arduino Uno) since AVR pocket programmer is not available in SPARKFUN website, and also it is of high cost when compared to that of Arduino Uno controller board. Main reason of Arduino Uno itself is that “Arduino as ISP” program in Arduino Uno basically acts as AVR programmer.

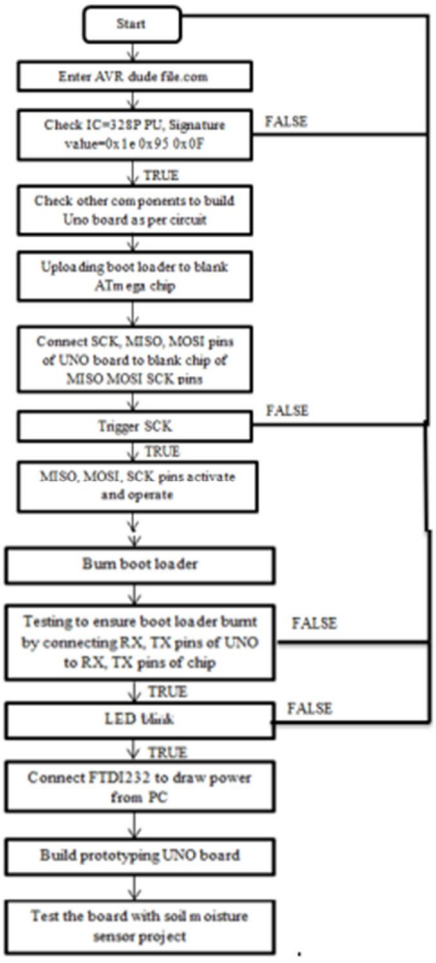


Fig 5.2: Flow chart for Prototyping Arduino Uno board

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VI. IMPLEMENTATION AND RESULTS

The Prototyping Arduino Uno board is implemented as follows:

1) *STEP 1:* Orchestrate the segments on the breadboard Arrange the components on the breadboard. There are couple of components required to make custom Arduino board as in Fig below.Voltage regulator to supply 5V to Arduino. It's supporting hardware to channel the voltage; then 16MHz crystal alongside its parallel associated 22pF capacitors that go about as the clock to the Arduino and Led is associated with the pin no 19 of the ATmega328, for testing reason according to data sheet of Arduino, 19 pin connects to the output

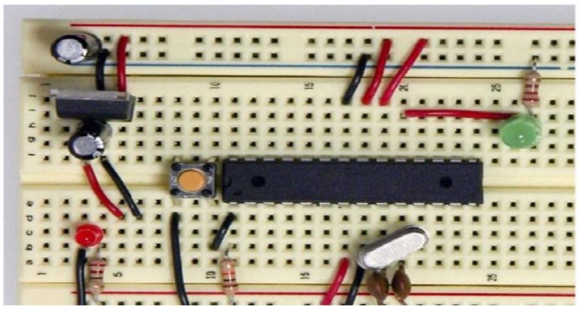


Fig 6.1 Breadboard with the components

Result Blinking LED was observed with the circuit connection which is not expected output because chips in the breadboard and readily available chip slightly differs in the signature value. A small change in signature value AT mega 328p and AT mega 328PU does not produce the output. Most important part of the board deals with selection of IC. From the step 1 I can conclude that a small change in the signature value may not allow the circuit to operate. Signature values play a very important role.

Integrated circuits (IC)	Signature values
AT mega 168	1E9406
AT mega 328	1E9514
AT mega 328 P	1E9504
AT mega 328 P-PU	1E95OF

Table 6.1: Intregrated IC with signature value

2) STEP 2: Uploading the boot loader to the blank ATmega chip

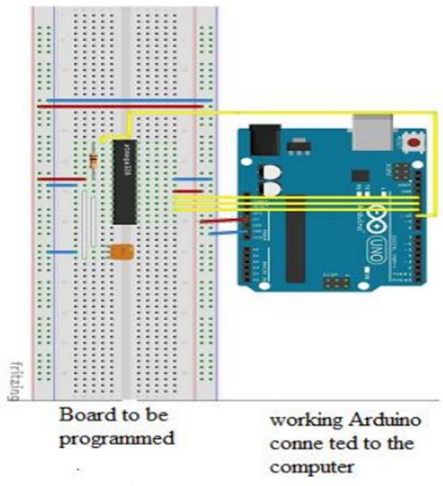


Fig 6.2: Uploading bootloader to blank ATMEGA chip

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Result Transfer the boot loader from master and slave. The essential pins are MISO, MOSI, SCK, and RESET. Then in Arduino software GO to tools and select Arduino Uno board , and select Arduino ISP, verify the code and upload, status bar indicates “Done compiling” .Go to tools and “Burn boot loader” and status bar “Boot loader burnt” indicates the code has been copied to the blank ATmega chip. The snapshots below shows each step carried in burning the boot loader

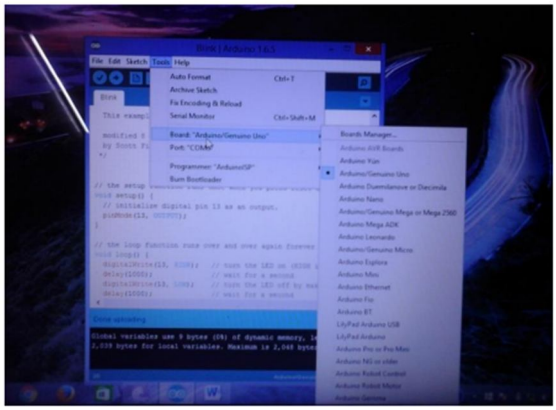


Fig 6.3 Snapshot of selecting the board in Arduino software

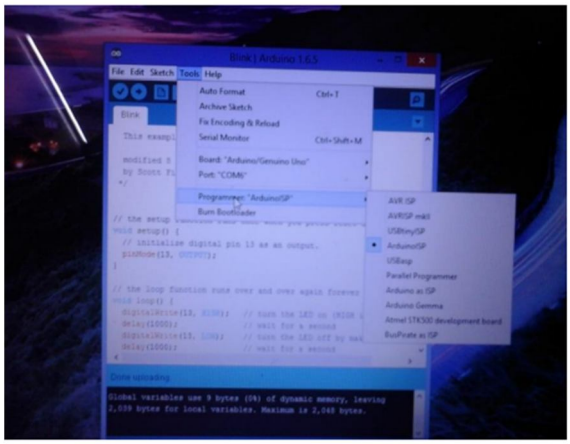


Fig 6.4 Snapshot of selecting the Arduino ISP in Arduino software

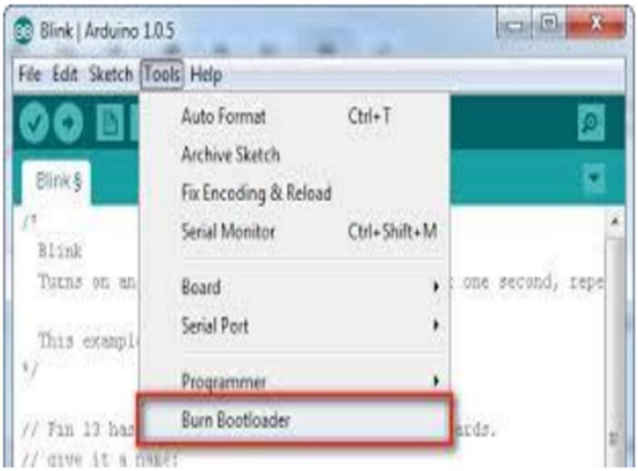


Fig 6.5 Snapshot of burning boot loader

3) STEP3: Testing of ATMEGA chip to ensure boot loader is burnt

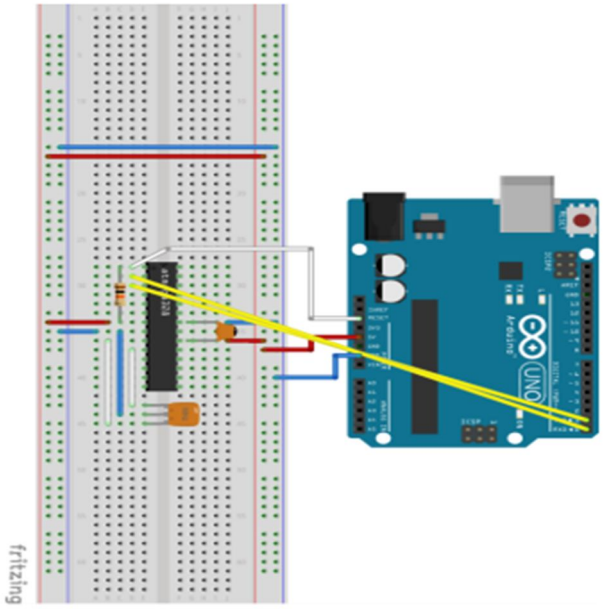


Fig 6.6 Circuit diagram to ensure boot loader burnt to ATmega chip

In this point it is important to check whether the boot loader burnt is transferred to the reasonable chip of ATmega, this method is checked by making the relationship as showed up in the above Fig 5.3.6. Once ATmega328 p has an Arduino boot loader present, that can exchange the activities using Universal0Serial=bus on Uno. Outline demonstrates association of rx/tx connecting outlines fr0m UNO to panel. This is least complex strategy for testing of existing Arduino with successful working Uno board and removes the relationship with IICSP pins. Connect the LED to pin 19 according to the information provided by datasheet to guarantee that boot loader has been burnt.

Result:Testing is done by removing the ATMEGA chip in the master board and also the connections of MISO, MOSI AND SCK and only connecting to TX and RX pins of master board to slave board and uploading Blink LED program to the board to make sure that boot loader has been transferred to blankchip.

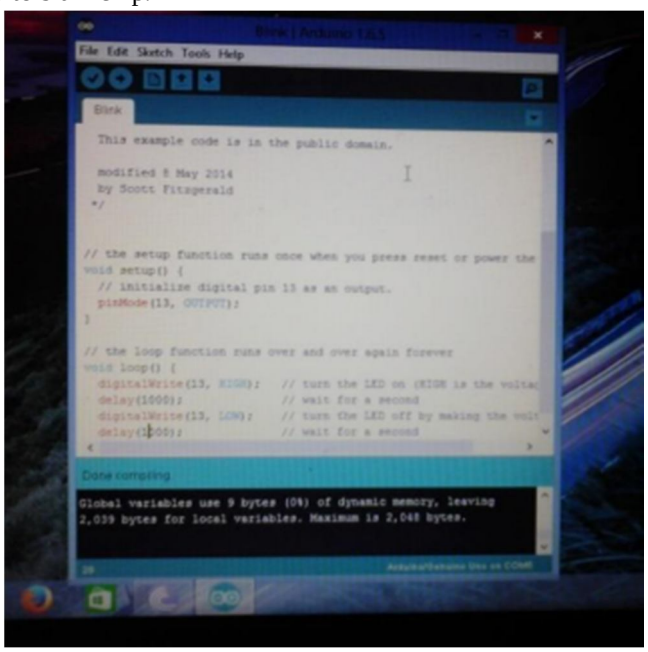


Fig 6.7 Snapshot of Blink LED program verified and complied

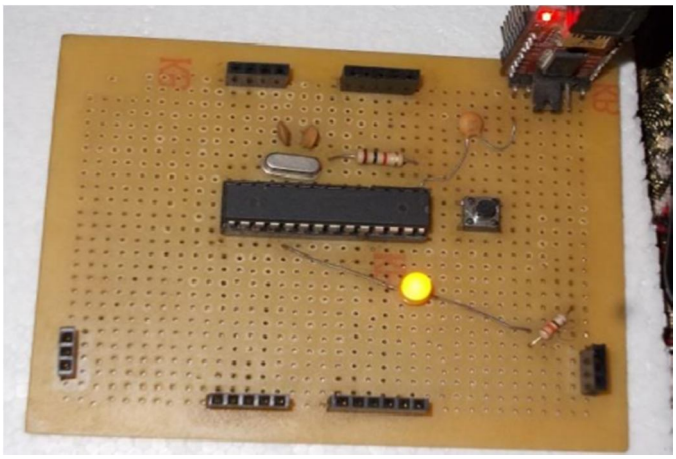


Fig 6.9 Prototyping own Arduino Uno controller board with LED blinking

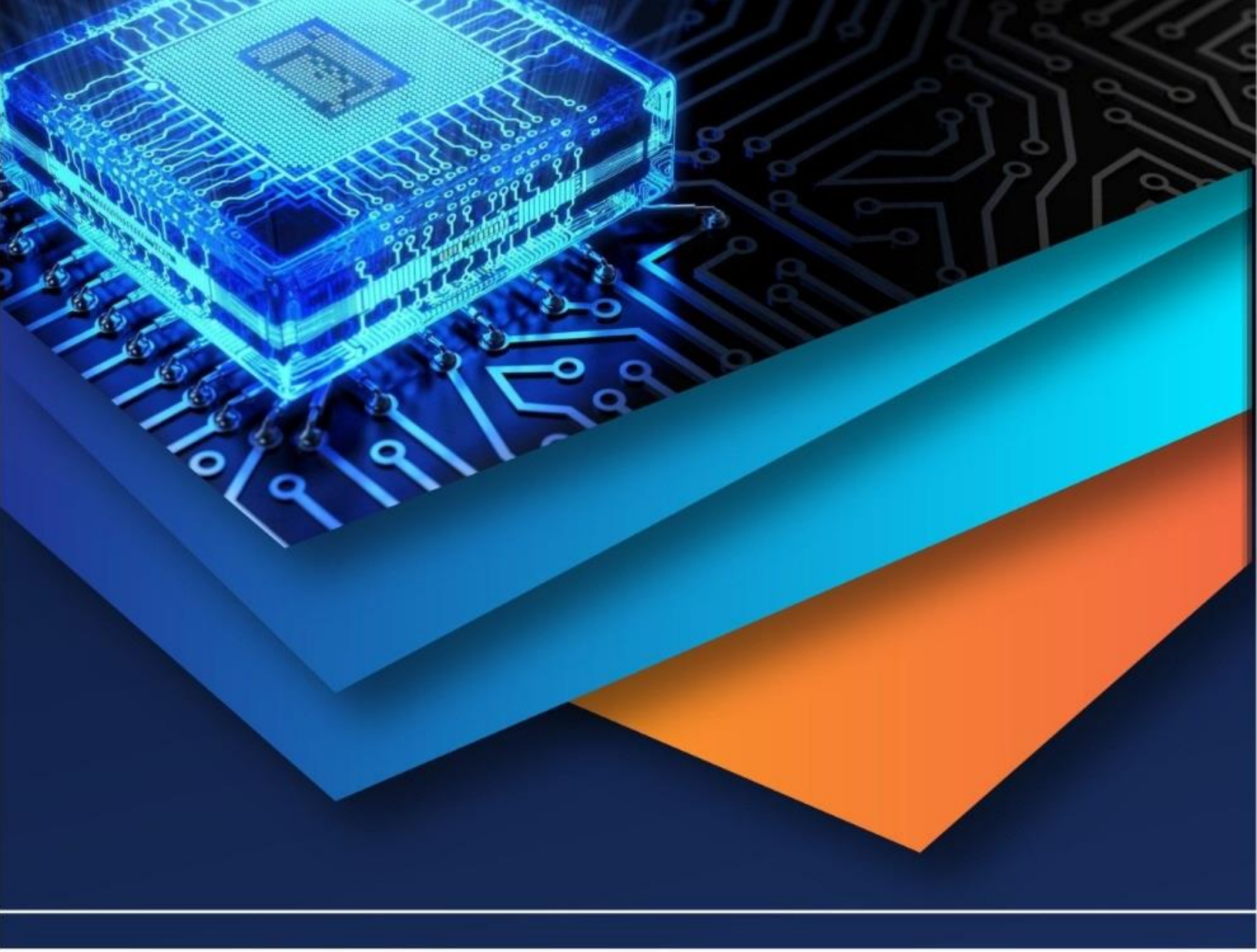
VII. CONCLUSION AND FUTURE WORK

Arduino Uno is open source mainly preferred for beginners. This prototyping has provided easier way of trouble shooting in developed Uno boards. It has aimed for different layouts on Printed circuit boards. In depth knowledge of entire Uno board makes all the designs to be implemented successfully. In the prototyping Arduino Uno board, Ethernet can be built which can be used for computer access and can also implement the wireless communication between transmitter and receiver.

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