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Universal Remote Control For Home Appliances Using Aduino

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ABSTRACT:

With the new inventions and advancements in technology in the field of electronics, the desire to live a better life is increasing day-by-day. The new technologies have emerged in almost every sector/field like medical field, industries, aeronautics and telecommunication and now it has also entered in domestic's, which is also known as home automation. Apart from their busy and hectic schedule, human beings want their day to day tasks to be done on a click of button. The new technologies and unique methodologies have tried to fulfill this wish of human beings to some extent by means of smart home or home automation.

The main object of home automation is to provide a wireless communication link of the home appliances to the remote user and provide convenience and ease of work. There are several ways to automate home. The design and implementation of home appliance controlling using IR sensors, LCD, TRIAC and Arduino UNO single board microcontroller. Here, the IR data is transferred between IR remote and Arduino board.TSOP1738 IR-sensor is used to communicate between remote and Arduino. And Arduino UNO serves as the controlling and monitoring unit. It accepts and decodes the signal received from TSOP 1738 IR sensor and then the switching application (turn on/off) is performed through TRIAC. LCD is used to display the messages and status of the loads. In software process the program for this project is written in C language and uploaded into the memory of the microcontroller on Arduino board by Arduino IDE window software. The operations of the whole circuit are controlled by software.

Keywords: Arduino UNO board, IR-sensor, Arduino IDE window software.

INTRODUCTION:

The objective of proposed research work is to implement such a system that can reduce efforts, energy losses, provides a comfortable life, enhance living standards and can help the elderly, handicapped, disables as well as the normal beings to control the home appliances remotely. A home automation system may be defined as the technological solution that enables automating the bulk of electronic, electrical& technology- based tasks within a home. It uses a combination of hardware and software technologies that enable control and management over appliances and devices within a home.

A home with an automation system is also known as a smart home. Since, man's life and work are increasingly tight day- by- day with the rapid growth in communication and information technology. So there is an urgent need of such a system that can ease the day today task and allows access to the home appliances to the remote user. In the

proposed research work, we are propagating the use of wireless communication technology by using IR sensor and single microcontroller board to allow control over the electrical home appliances to the remote user. The proposed system is based on embedded system i.e. it is a combination of both hardware and software.

The system consists of two units: one is the Transmitter section and other is the Receiver section. Transmitter section consists of a TV remote and the Receiver section is consists of a PCB board over which- an IR Receiver module, dc power supply, Arduino UNO single board microcontroller(controlling unit) ,zero crossing detector, ac source and Triac+ optocoupler followed by ac loads is mounted. The user will send the commands with the help of remote control and those signals will be sensed by the receiver IR module which further sends it to the arduino board. Arduino decodes the signals and performs the switch ON/OFF of home appliance via Triac.

RELATED WORK / LITERATURE REVIEW

A smart home covers a variety of theoretical and practical approaches that deals with living today and in the future. There are several ways or methodologies to automate home through wireless communication technology.

Some of them are as follows:-

(a) SharonPanth&Jivani Mahesh proposed a methodology to automate home by using android for mobile phone. Here author discusses the use of android mobile phone's inbuilt facility i.e. Bluetooth to automate home along with the use of an ATMEL 89C51, 8 bit microcontroller.

(b) PawanSharma &JoshiDeepika has proposed a methodology about controlling home appliances through remote operated master switch via infrared technology. They has introduced a unique remote control circuit to permit the automatic control of switches and switchboards from a remote location that does not require any internet network as well as mobile network or battery. It was a completely hardware based system and does not require any software to control and monitor the system.

(c) Samiran Maiti & Pabitra Kumar Nandi proposed a solution of home appliance controlling by the use of IR remote control signal decoder. Author discusses about the use of NEC555 timer IC, decade counter, Triac along with IR sensor to automate home. It is also a hardware based project.

(d) Monika Rana & Ramandeep Singh shows an another way to automate home through a PC Internet-Uno microcontroller based home automation system. The proposed system has two operational modes. The first one is manually-automated mode and the second one is self automated mode. The system consists of two main hardware components: the PC home server and the arduino-uno microcontroller board.

(e) Naresh P Jawarkar & Vasif Ahmed has demonstrated that home appliance controlling can also be done by microcontroller based remote monitoring using mobile through spoken commands.

(f) Satish Palaniappan & Naveen Hariharan has shown the ways to provide remote accessing of home appliances to the user by using GSM technology and Zigbee technology.

INTRODUCTION TO EMBEDDED SYSTEMS:

Application Areas:

Nearly 99 per cent of the processors manufactured end up in embedded systems. The embedded system market is one of the highest growth areas as these systems are used in very market segment- consumer electronics, office automation, industrial automation, biomedical engineering, wireless communication, data

communication, telecommunications, transportation, military and so on.

Consumer appliances:

At home we use a number of embedded systems which include digital camera, digital diary, DVD player, electronic toys, microwave oven, remote controls for TV and air-conditioner, VCO player, video game consoles, video recorders etc. Today's high-tech car has about 20 embedded systems for transmission control, engine spark control, air-conditioning, navigation etc. Even wristwatches are now becoming embedded systems. The palmtops are powerful embedded systems using which we can carry out many general-purpose tasks such as playing games and word processing.

Office automation:

The office automation products using embedded systems are copying machine, fax machine, key telephone, modem, printer, scanner etc.

Industrial automation:

Today a lot of industries use embedded systems for process control. These include pharmaceutical, cement, sugar, oil exploration, nuclear energy, electricity generation and transmission. The embedded systems for industrial use are designed to carry out specific tasks such as monitoring the temperature, pressure, humidity, voltage, current etc., and then take appropriate action based on the monitored levels to control other devices or to send information to a centralized monitoring station. In hazardous industrial environment, where human presence has to be avoided, robots are used, which are programmed to do specific jobs. The robots are now becoming very powerful and carry out many interesting and complicated tasks such as hardware assembly.

Medical electronics:

Almost every medical equipment in the hospital is an embedded system. These equipments include diagnostic aids such as ECG, EEG, blood pressure measuring devices, X-ray scanners; equipment used in blood analysis, radiation, colonoscopy, endoscopy etc. Developments in medical electronics have paved way for more accurate diagnosis of diseases.

Computer networking:

Computer networking products such as bridges, routers, Integrated Services Digital Networks (ISDN), Asynchronous Transfer Mode (ATM), X.25 and frame relay switches are embedded systems which implement the necessary data communication protocols. For example, a router interconnects two networks. The two networks may be running different protocol stacks. The router's function is to obtain the data packets from incoming pores, analyze the packets and send them towards the destination after doing necessary protocol conversion. Most networking equipments, other than the end systems (desktop computers) we use to access the networks, are embedded systems

Telecommunications:

In the field of telecommunications, the embedded systems can be categorized as subscriber terminals and network equipment. The subscriber terminals such as key telephones, ISDN phones, terminal adapters, web cameras are embedded systems. The network equipment includes multiplexers, multiple access systems, Packet Assemblers Dissemblers (PADs), satel1ite modems etc. IP phone, IP gateway, IP gatekeeper etc. are the latest embedded systems that provide very low-cost voice communication over the Internet.

Wireless technologies:

Advances in mobile communications are paving way for many interesting applications using embedded systems. The mobile phone is one of the marvels of the

last decade of the 20th century. It is a very powerful embedded system that provides voice communication while we are on the move. The Personal Digital Assistants and the palmtops can now be used to access multimedia services over the Internet. Mobile communication infrastructure such as base station controllers, mobile switching centers are also powerful embedded systems.

Insemination:

Testing and measurement are the fundamental requirements in all scientific and engineering activities. The measuring equipment we use in laboratories to measure parameters such as weight, temperature, pressure, humidity, voltage, current etc. are all embedded systems. Test equipment such as oscilloscope, spectrum analyzer, logic analyzer, protocol analyzer, radio communication test set etc. are embedded systems built around powerful processors. Thank to miniaturization, the test and measuring equipment are now becoming portable facilitating easy testing and measurement in the field by field-personnel.

Security:

Security of persons and information has always been a major issue. We need to protect our homes and offices; and also the information we transmit and store. Developing embedded systems for security applications is one of the most lucrative businesses nowadays. Security devices at homes, offices, airports etc. for authentication and verification are embedded systems. Encryption devices are nearly 99 per cent of the processors that are manufactured end up in~ embedded systems. Embedded systems find applications in. every industrial segment-consumer electronics, transportation, avionics, biomedical engineering, manufacturing, process control and industrial automation, data communication, telecommunication, defense, security etc. Biometric systems using fingerprint and face recognition are now being extensively used for user authentication in banking applications as well as for access control in high security buildings.

Finance:

Financial dealing through cash and cheques are now slowly paving way for transactions using smart cards and ATM (Automatic Teller Machine, also expanded as Any Time Money) machines. Smart card, of the size of a credit card, has a small micro-controller and memory; and it interacts with the smart card reader! ATM machine and acts as an electronic wallet. Smart card technology has the capability of ushering in a cashless society. Well, the list goes on. It is no exaggeration to say that eyes wherever we go, we can see, or at least feel, the work of an embedded system.

HARDWARE IMPLEMENTATION OF THE PROJECT

This chapter briefly explains about the Hardware Implementation of the project. It discusses the design and working of the design with the help of block diagram and circuit diagram and explanation of circuit diagram in detail. It explains the features, timer programming, serial communication, interrupts of atmega328 microcontroller. It also explains the various modules used in this project.

Project Design :

The implementation of the project design can be divided in two parts.

- Hardware implementation
- Firmware implementation

Hardware implementation deals in drawing the schematic on the plane paper according to the application, testing the schematic design over the breadboard using the various IC's to find if the design meets the objective, carrying out the PCB layout of the schematic tested on breadboard, finally preparing the board and testing the designed hardware.

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The project design and principle are explained in this chapter using the block diagram and circuit diagram. The block diagram discusses about the required components of the design and working condition is explained using circuit diagram and system wiring diagram.

INTRODUCTION TO MICROCONTROLLER:

Based on the Processor side Embedded Systems is mainly divided into 3 types

1. Micro Processor: - are for general purpose eg: our personal computer

2. Micro Controller:- are for specific applications, because of cheaper cost we will go for these

3. DSP (Digital Signal Processor):- are for high and sensitive application purpose

MICROCONTROLLER VERSUS MICROPROCESSOR:

A system designer using a general-purpose microprocessor such as the Pentium or the 68040 must add RAM, ROM, I/O ports, and timers externally to make them functional. Although the addition of external RAM, ROM, and I/O ports makes these systems bulkier and much more expensive, they have the advantage of versatility such that the designer can decide on the amount of RAM, ROM and I/O ports needed to fit the task at hand.

In other words, the processor, the RAM, ROM, I/O ports and the timer are all embedded together on one chip; therefore, the designer cannot add any external memory, I/O ports, or timer to it. The fixed amount of on-chip ROM, RAM, and number of I/O ports in Microcontrollers makes them ideal for many applications in which cost and space are critical.

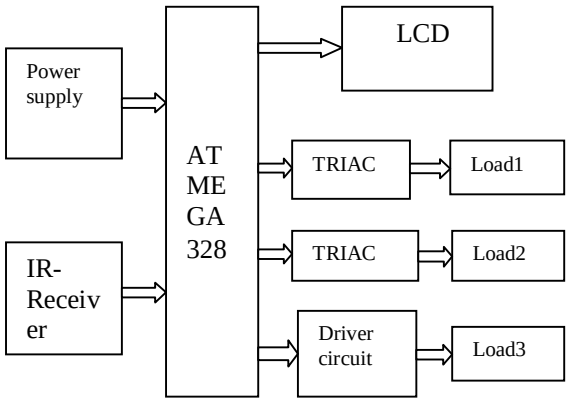
Microprocessor vs. Microcontroller	
Microprocessor	**Microcontroller**
CPU is stand alone RAM, RAM, I/O, timer are separate	CPU,RAM,ROM,I/O and timer are all on a single chip
Designer can decide on the amount of ROM, RAM and I/O ports.	Fix amount of on chip ROM,RAM, I/O Ports.
Expansive, Versatility	For applications in which cost, power and space are critical
General purpose	Single purpose

Table: Microprocessor versus Microcontroller

Block Diagram of the Project

The block diagram of the design is as shown in the figure below. The brief description about block diagram is given below.

Block diagram of proposed system:



Power Supply:

The input to the circuit is applied from the regulated power supply. The a.c. input i.e., 230V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating d.c voltage. So in order to get a pure d.c voltage, the output voltage from the rectifier is fed to a filter to remove any a.c components present even after rectification. Now, this voltage is given to a voltage regulator to obtain a pure constant dc voltage.

Voltage regulator:

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As the name itself implies, it regulates the input applied to it. A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. In this project, power supply of 5V and 12V are required. In order to obtain these voltage levels, 7805 and 7812 voltage regulators are to be used. The first number 78 represents positive supply and the numbers 05, 12 represent the required output voltage levels.

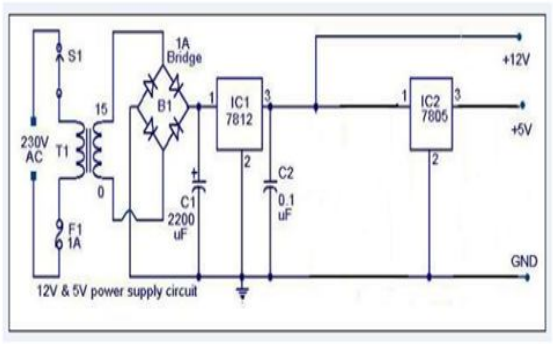

Fig: Power supply circuit diagram

ARDUINO UNO :

Arduino is used for building different types of electronic circuits easily using of both a physical programmable circuit board usually microcontroller and piece of code running on computer with USB connection between the computer and Arduino. Programming language used in Arduino is just a simplified version of C++ that can easily replace thousands of wires with words.

FIG: ARDUINO UNO

ARDUINO UNO-R3 PHYSICAL COMPONENTS :

ATMEGA328P-PU microcontroller :

The most important element in Arduino Uno R3 is ATMEGA328P-PU is an 8-bit Microcontroller with flash memory reach to 32k bytes.

Features

1. High Performance, Low Power Atmel®AVR® 8-Bit Microcontroller Family

• Advanced RISC Architecture
– 131 Powerful Instructions
– Most Single Clock Cycle Execution
– 32 x 8 General Purpose Working Registers
– Fully Static Operation
– Up to 20 MIPS Throughput at 20MHz
– On-chip 2-cycle Multiplier
• High Endurance Non-volatile Memory Segments
– 32KBytes of In-System Self-Programmable Flash program

2. Memory

– 1KBytes EEPROM
– 2KBytes Internal SRAM
– Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
– Data Retention: 20 years at 85°C/100 years at 25°C(1)
– Optional Boot Code Section with Independent Lock Bits

- In-System Programming by On-chip Boot Program
- True Read-While-Write Operation
– Programming Lock for Software Security
- Atmel® QTouch® Library Support
– Capacitive Touch Buttons, Sliders and Wheels
– QTouch and QMatrix® Acquisition
– Up to 64 sense channels

3. Atmel-42735B-ATmega328/P_Datasheet_Complete-11/2016

- Peripheral Features
– Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
– One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
– Real Time Counter with Separate Oscillator
– Six PWM Channels
– 8-channel 10-bit ADC in TQFP and QFN/MLF package
- Temperature Measurement
– 6-channel 10-bit ADC in PDIP Package
- Temperature Measurement
– Two Master/Slave SPI Serial Interface
– One Programmable Serial USART
– One Byte-oriented 2-wire Serial Interface (Philips I2C compatible)
– Programmable Watchdog Timer with Separate On-chip Oscillator
– One On-chip Analog Comparator
– Interrupt and Wake-up on Pin Change
- Special Microcontroller Features
– Power-on Reset and Programmable Brown-out Detection
– Internal Calibrated Oscillator
– External and Internal Interrupt Sources
– Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and

4. Extended Standby

- I/O and Packages
– 23 Programmable I/O Lines
– 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF
- Operating Voltage:
– 1.8 - 5.5V
- Temperature Range:
– -40°C to 105°C
- Speed Grade:
– 0 - 4MHz @ 1.8 - 5.5V
– 0 - 10MHz @ 2.7 - 5.5V
– 0 - 20MHz @ 4.5 - 5.5V
- Power Consumption at 1MHz, 1.8V, 25°C
– Active Mode: 0.2mA
– Power-down Mode: 0.1µA
– Power-save Mode: 0.75µA (Including 32 kHz RTC)

OTHER ARDUINO UNO R3 PARTS:

Input and Output :

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode (), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 k Ohms.

In addition, some pins have specialized functions:

- **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 ATmega8U2 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.
- **PWM: 3, 5, 6, 9, 10, and 11.**
Provide 8-bit PWM output with the analogWrite() function.
- **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. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off. The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e.1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function.

Additionally, some pins have specialized functionality:

- **TWI: A4 or SDA pin and A5 or SCL pin.** Support TWI communication using the Wire library. There are a couple of other pins on the board:
- **AREF:**
  Reference voltage for the analog inputs. Used with analogReference().
- **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.

Memory:
The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Communication:
The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A SoftwareSerial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a
Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

Programming:
The Arduino Uno can be programmed with the Arduino software (download). Select "Arduino Uno from the Tools > Board menu (according to the microcontroller on your board). For details, see the reference and tutorials.

The ATmega328 on the Arduino Uno comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files).

You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header; see these instructions for details.

The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available. The
ATmega16 U2/8U2 is loaded with a DFU bootloader, which can be activated by:

On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2.
On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode. You can then use Atmel's FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load a new firmware. Or you can use the ISP header with an external programmer (overwriting the DFU bootloader).

Description:
The Atmel AVR® core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in a single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.
Atmel offers the QTouch® library for embedding capacitive touch buttons, sliders and wheels functionality into AVR microcontrollers. The patented charge-transfer signal acquisition offers robust sensing and includes fully debounced reporting of touch keys and includes Adjacent Key Suppression® (AKS™) technology for unambiguous detection of key events. The easy-to-use QTouch Suite toolchain allows you to explore, develop and debug your own touch applications.
The device is manufactured using Atmel's high density non-volatile memory technology.

The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core.

The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega328/P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications. The ATmega328/P is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, Program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits.

Configuration Summary:

Features	ATmega328/P
Pin Count	28/32
Flash (Bytes)	32K
SRAM (Bytes)	2K
EEPROM (Bytes)	1K
General Purpose I/O Lines	23
SPI	2
TWI (I^2C)	1
USART	1
ADC	10-bit 15kSPS
ADC Channels	8
8-bit Timer/Counters	2
16-bit Timer/Counters	1

Table: Arduino Configurations

Block Diagram:

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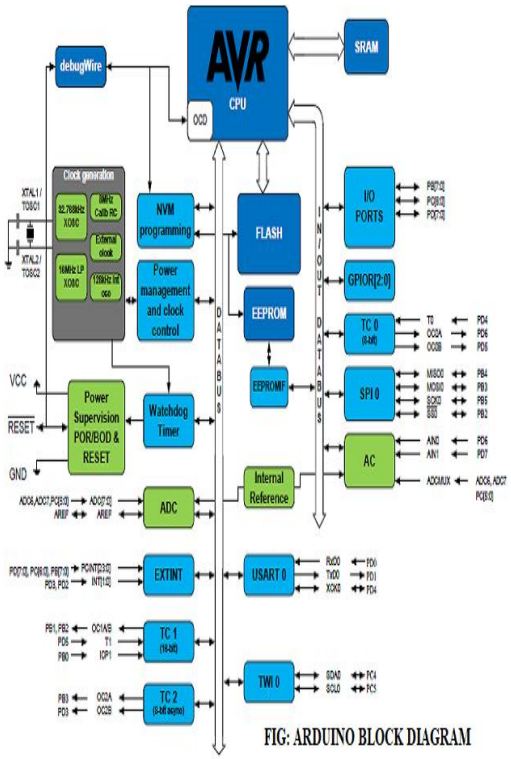

FIG: ARDUINO BLOCK DIAGRAM

Pin Configurations:

Pin-out

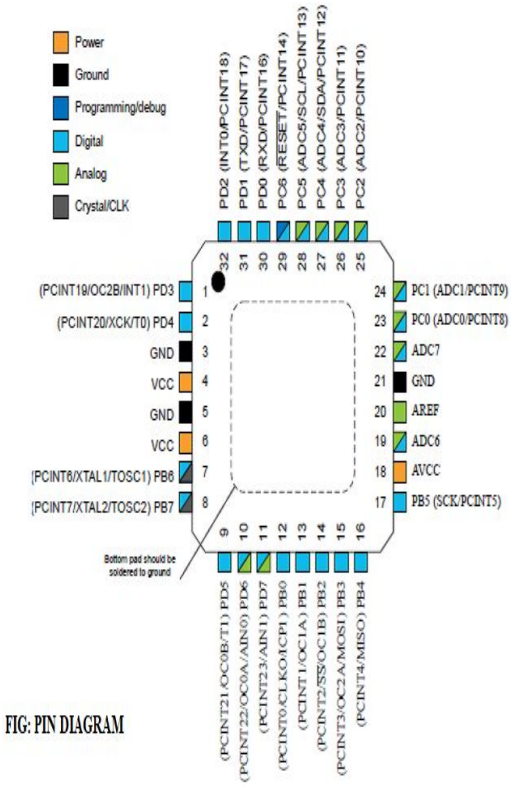

FIG: PIN DIAGRAM

Pin Descriptions:

VCC - Digital supply voltage

GND – Ground

Port B (PB[7:0]) XTAL1/XTAL2/TOSC1/TOSC2:

Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit Depending on the clock selection fuse settings, PB7 can be used as output from the inverting Oscillator amplifier. If the Internal Calibrated RC Oscillator is used as chip clock source, PB[7:6] is used as TOSC[2:1] input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set.

Port C (PC[5:0]):

Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The PC[5:0] output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.

PC6/RESET|:

If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical characteristics of PC6 differ from those of the other pins of Port C. If the RSTDISBL Fuse is unprogrammed, PC6 is used as a Reset input. A low level on this pin for

longer than the minimum pulse length will generate a Reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a Reset. The various special features of Port C are elaborated in the Alternate Functions of Port C section.

Port D (PD[7:0]):
Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

AVCC:
AVCC is the supply voltage pin for the A/D Converter, PC[3:0], and PE[3:2]. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter. Note that PC[6:4] use digital supply voltage, VCC.

AREF:
AREF is the analog reference pin for the A/D Converter.

ADC[7:6] (TQFP and VFQFN Package Only):
In the TQFP and VFQFN package, ADC[7:6] serve as analog inputs to the A/D converter. These pins are powered from the analog supply and serve as 10-bit ADC channels.

I/O Multiplexing:
Each pin is by default controlled by the PORT as a general purpose I/O and alternatively it can be assigned to one of the peripheral functions. The following table describes the peripheral signals multiplexed to the PORT I/O pins.

TTYPES OF ARDUINO BOARDS:-

- Arduino UNO.
- Arduino MEGA.
- Arduino MINI.
- Arduino NANO
- Arduino DUE.
- Arduino YUN.
- Arduino Lily pad.
- Arduino Duemilanova.

Apart from this there are many more boards that can be used. As it's open source instead of Arduino you can also find, Freeduino, Arduino etc. available in the market. Selection of Board should be done according to the application.

Choosing the right controller:
The table below compares the Arduino Uno, Leonardo, and our A-Star 32U4 Prime controllers. The A-Star Primes are based on the same ATmega32U4 AVR microcontroller as the Leonardo and ship with Arduino-compatible bootloaders. The Primes also offer many advantages, including superior power management that enables efficient operation from 2.7 V to 11.8 V (LVversion) or 5 V to 36 V

(SVversion).

		Arduino Uno R3	Arduino Leonardo	A-Star 32U4 Prime LV	A-Star 32U4 Prime SV
Microcontroller:		ATmega328P	ATmega32U4	ATmega32U4	
Clock:		16 MHz resonator	16 MHz crystal	16 MHz crystal	
User I/O lines:		20	23	26	
PWM outputs:		6	7	7	
Analog inputs:		6	12	12	
Ground access points:		4	4	43	
User LEDs:		3	3	3	
User pushbuttons:		—	—	3	
Reset button:					
Power switch:					
Buzzer option:					
microSD option:					
LCD option:					
Arduino-compatible bootloader:					
USB connector:		B	Micro-B	Micro-B	
USB/regulator power selection:		partial	partial	TPS2113A	
High-performance reverse-voltage protection:					
Recommended input voltage:		7 V to 12 V	7 V to 12 V	2 V to 16 V	5 V to 36 V
Regulator type (5 V):		linear	linear	switching step-up/step-down	switching step-down
Available 5 V output current:	at 3 V in	—	—	0.75 A	—
	at 5 V in	—	—	1.5 A	0.2 A
	at 7 V in	1.0 A	1.0 A	1.9 A[1]	1.0 A
	at 9 V in	0.5 A	0.5 A	1.9 A[1]	1.0 A
	at 11 V in	0.35 A	0.35 A	1.8 A	1.0 A
	at 24 V in	—	—	—	1.0 A
	via USB connector	0.5 A[2]	0.5 A[2]	1.9 A[3]	1.9 A[3]
Weight:		28 g	20 g	13 g to 33 g	

1 There is more available 5 V output current via VREG, see maximum regulator output current graph for details.
2 With sufficient USB power supply.
3 Nominal current available through power MUX with sufficient USB power supply.

LIQUID CRYSTAL DISPLAY:

LCD stands for Liquid Crystal Display. LCD is finding wide spread use replacing LEDs (seven segment LEDs or other multi segment LEDs) because of the following reasons:

1. The declining prices of LCDs.
2. The ability to display numbers, characters and graphics. This is in contrast to LEDs, which are limited to numbers and a few characters.
3. Incorporation of a refreshing controller into the LCD, thereby relieving the CPU of the task of refreshing the LCD. In contrast, the LED must be refreshed by the CPU to keep displaying the data.
4. Ease of programming for characters and graphics.

These components are “specialized” for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD.

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (*Hitachi*) and can display messages in two lines with 16 characters each. It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right), appearance of the pointer, backlight etc. are considered as useful characteristics.

Pins Functions :

There are pins along one side of the small printed board used for connection to the microcontroller. There are total of 14 pins marked with numbers (16 in case the background light is built in). Their function is described in the table below:

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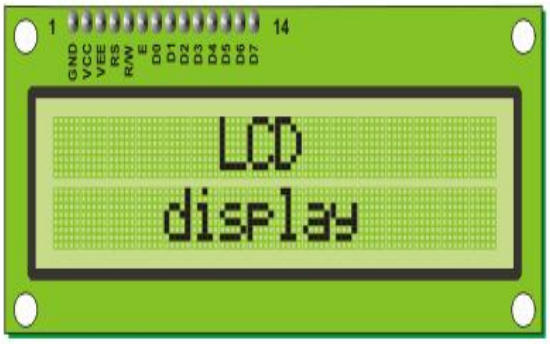
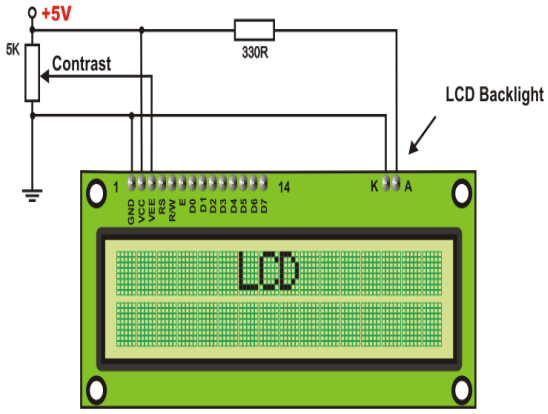
on the power supply voltage and whether messages are displayed in one or two lines. For that reason, variable voltage 0-Vdd is applied on pin marked as Vee. Trimmer potentiometer is usually used for that purpose. Some versions of displays have built in backlight (blue or green diodes). When used during operating, a resistor for current limitation should be used (like with any LE diode).





Function	Pin Number	Name		Description
Ground	1	Vss	-	0V
Power supply	2	Vdd	-	+5V
Contrast	3	Vee	-	0 - Vdd
Control operating of	4	RS	0 1	D0 – D7 are interpreted as commands D0 – D7 are interpreted as data
	5	R/W	0 1	Write data (from controller to LCD) Read data (from LCD to controller)
	6	E	0 1 From 1 to 0	Access to LCD disabled operating Data/commands are transferred to LCD
Data / commands	7	D0	0/1	Bit 0 LSB
	8	D1	0/1	Bit 1
	9	D2	0/1	Bit 2
	10	D3	0/1	Bit 3
	11	D4	0/1	Bit 4
	12	D5	0/1	Bit 5
	13	D6	0/1	Bit 6
	14	D7	0/1	Bit 7 MSB

LCD screen:

LCD screen consists of two lines with 16 characters each. Each character consists of 5x7 dot matrix. Contrast on display depends

LCD Basic Commands :

All data transferred to LCD through outputs D0-D7 will be interpreted as commands or as data, which depends on logic state on pin RS:

RS = 1 - Bits D0 - D7 are addresses of characters that should be displayed. Built in processor addresses built in “map of characters” and displays corresponding symbols. Displaying position is determined by DDRAM address. This address is either previously defined or the address of previously transferred character is automatically incremented.

RS = 0 - Bits D0 - D7 are commands which determine display mode. List of commands which LCD recognizes are given in the table below:

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Command	RS	RW	D7	D6	D5	D4	D3	D2	D1	D0	Execution Time
Clear display	0	0	0	0	0	0	0	0	0	1	1.64mS
Cursor home	0	0	0	0	0	0	0	0	1	x	1.64mS
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	40uS
Display on/off control	0	0	0	0	0	0	1	D	U	B	40uS
Cursor/Display Shift	0	0	0	0	0	1	D/C	R/L	x	x	40uS
Function set	0	0	0	0	1	DL	N	F	x	x	40uS
Set CGRAM address	0	0	0	1	CGRAM address						40uS
Set DDRAM address	0	0	1	DDRAM address							40uS
Read "BUSY" flag (BF)	0	1	BF	DDRAM address							-
Write to CGRAM or DDRAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	40uS
Read from CGRAM or DDRAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	40uS

I/D 1 = Increment (by 1)
0 = Decrement (by 1)
S 1 = Display shift on
0 = Display shift off
DL 1 = 8-bit interface
0 = 4-bit interface
D 1 = Display on
0 = Display off
U 1 = Cursor on
0 = Cursor off
B 1 = Cursor blink on
0 = Cursor blink off
R/L 1 = Shift right
0 = Shift left
N 1 = Display in two lines
0 = Display in one line
F 1 = Character format 5x10 dots
0 = Character format 5x7 dots
D/C 1 = Display shift
0 = Cursor shift

LCD Initialization:

Once the power supply is turned on, LCD is automatically cleared. This process lasts for approximately 15mS. After that, display is ready to operate. The mode of operating is set by default. This means that:

1. Display is cleared
2. Mode

DL = 1 Communication through 8-bit interface

N = 0 Messages are displayed in one line

F = 0 Character font 5 x 8 dots

3. Display/Cursor on/off

D = 0 Display off

U = 0 Cursor off

B = 0 Cursor blink off

4. Character entry

ID = 1 Addresses on display are automatically incremented by 1

S = 0 Display shift off

Automatic reset is mainly performed without any problems. Mainly but not always! If for any reason power supply voltage does not reach full value in the course of 10mS, display will start perform completely unpredictably. If voltage supply unit cannot meet this condition or if it is needed to provide completely safe operating, the process of initialization by which a new reset enabling display to operate normally must be applied.

Algorithm according to the initialization is being performed depends on whether connection to the microcontroller is through 4- or 8-bit interface. All left over to be done after that is to give basic commands and of course- to display messages.

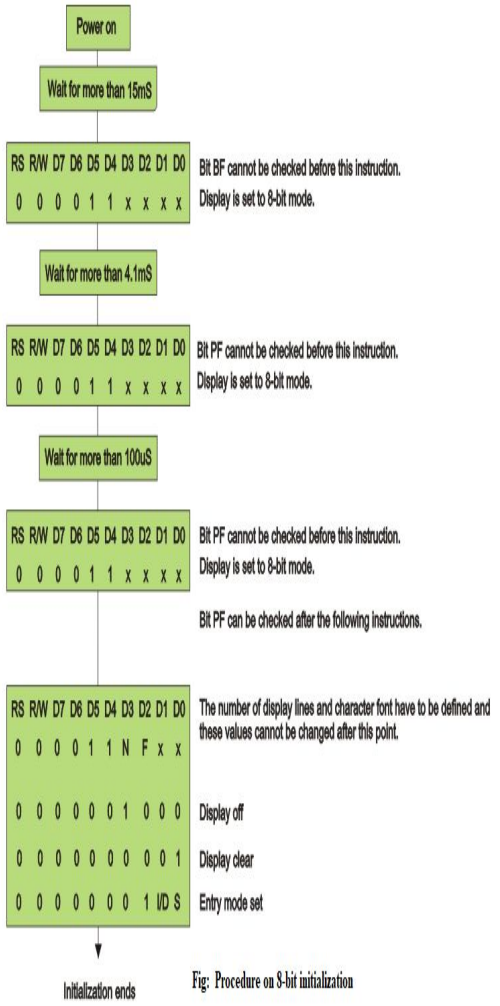

Fig: Procedure on 8-bit initialization

IR Section:

IR Tx:

TSAL6200 is a high efficiency infrared emitting diode in GaAlAs on GaAs technology, molded in clear, blue grey tinted plastic packages. In comparison with the standard GaAs on GaAs technology these emitters achieve more than 100 % radiant power improvement at a similar wavelength. The forward voltages at low current and at high pulse current roughly correspond to the low values of the standard technology. Therefore these emitters are ideally suitable as high performance replacements of standard emitters.

Features:

- Extra high radiant power and radiant intensity
- High reliability
- Low forward voltage
- Suitable for high pulse current operation
- Standard T-1¾ (□ 5 mm) package
- Angle of half intensity $\phi = \pm 17°$
- Peak wavelength $\lambda p = 940$ nm
- Good spectral matching to Si photodetectors

Applications:

- Infrared remote control units with high power requirements
- Free air transmission systems
- Infrared source for optical counters and card readers
- IR source for smoke detectors

IR Rx:

Description:

The TSOP17.. – Series are miniaturized receivers for infrared remote control systems. PIN diode and preamplifier are assembled on lead frame, the epoxy package is designed as IR filter. The demodulated output signal can directly be decoded by a microprocessor. TSOP1738 is the standard IR remote control receiver series, supporting all major transmission codes.

Features:

- Photo detector and preamplifier in one package
- Internal filter for PCM frequency
- Improved shielding against electrical field disturbance
- TTL and CMOS compatibility
- Output active low
- Low power consumption
- High immunity against ambient light
- Continuous data transmission possible (up to 2400 bps)

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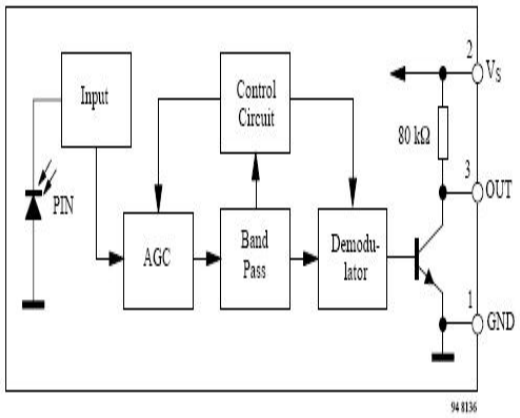
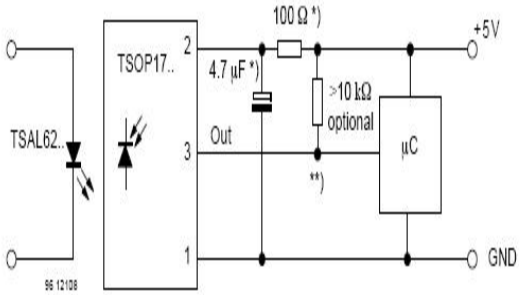
- Suitable burst length .10 cycles/burst.

Block Diagram:



Application Circuit:



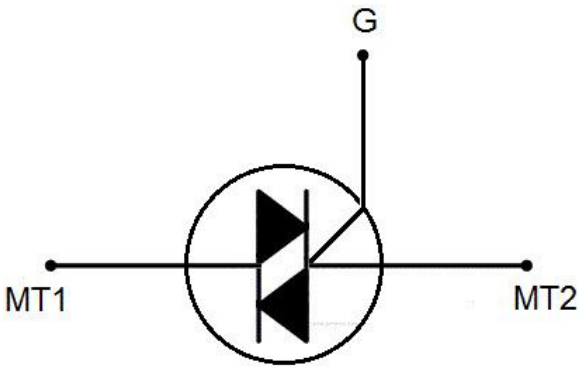
The circuit of the TSOP1738 is designed in that way that unexpected output pulses due to noise or disturbance signals are avoided. A band pass filter, an integrator stage and an automatic gain control are used to suppress such disturbances. The distinguishing mark between data signal and disturbance signal are carrier frequency, burst length and duty cycle. The data signal should fulfil the following condition:

- Carrier frequency should be close to center frequency of the band pass (e.g. 38kHz).
- Burst length should be 10 cycles/burst or longer.
- After each burst which is between 10 cycles and 70 cycles a gap time of at least 14 cycles is necessary.
- For each burst which is longer than 1.8ms a corresponding gap time is necessary at some time in the data stream. This gap time should have at least same length as the burst.
- Up to 1400 short bursts per second can be received continuously.

When a disturbance signal is applied to the TSOP1738 it can still receive the data signal. However the sensitivity is reduced to that level that no unexpected pulses will occur.

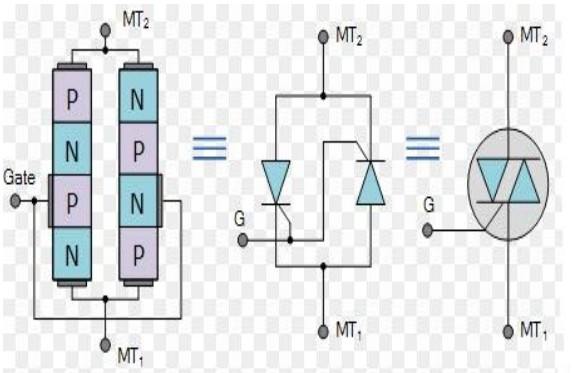
TRIAC:

The TRIAC is an ideal device used for the AC switching applications. This can control the flow of current over both halves of an alternating cycle. The Thyristor can control only over the one-half of a cycle. The other remaining half no conduction occurs and accordingly only half the waveform can be utilized.



1.1.1. Construction of TRIAC:

The TRIAC consist of four layers like PNPN is in the positive direction and the negative direction consists of NPNP as we can see in the figure. The three-terminal bidirectional device blocks the current in the OFF state and it will act as an open circuit switch.



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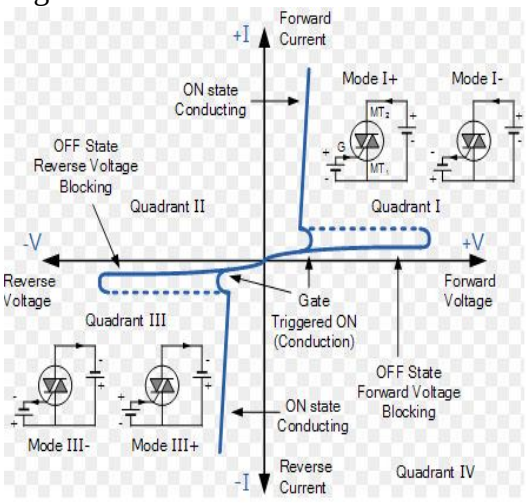
The four triggering modes of operations can operate by using the I-V characteristics of TRIAC.
Quadrant I operation: VMT2, positive; VG1 positive
Quadrant II operation: VMT21 positive; VGl negative
Quadrant III operation: VMT21 negative; VGl negative
Quadrant IV operation: VMT21 negative; VG1 positive
where VMT21 and VGl are the voltages of the terminal of MT2 and gate with respect to terminal MT1.

I-V Characteristics:

The following figure shows the typical TRIAC characteristics. The Triode For Alternating Current consists of ON and OFF state characteristics which are similar to the SCR. Now the characteristics are applicable to both the voltages of positive and negative.



I-V Characteristics of TRIAC

Advantages of TRIAC:

- In the TRIACs, there will be single gate control conduction in both the directions.
- If the voltage is decreased to zero the TRIAC turns OFF
- Basically, it is bidirectional device and in the both the directions it will conduct.
- High voltage rating are available

Disadvantages:

- It doesn't fire symmetrically on both sides of the waveforms
- It doesn't appropriate for the DC power
- It has very high switching delay.

Applications:

The TRIACs are using many electrical switching applications like

- The electric fan speed control
- Smaller motor controls
- Domestic light dimmer
- Control of small AC powered domestic appliances

BT136 Description:

Glass passivated triacs in a plastic envelope, intended for use in applications requiring high bidirectional transient and blocking voltage capability and high thermal cycling performance. Typical applications include motor control, industrial and domestic lighting, heating and static switching.

PIN	DESCRIPTION
1	main terminal 1
2	main terminal 2
3	gate
tab	main terminal 2

Pin description

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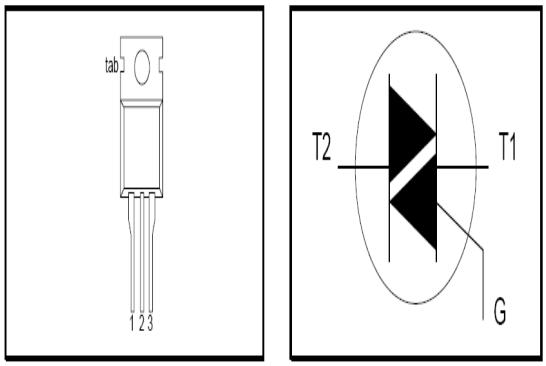
PIN CONFIGURATION SYMBOL



FIRMWARE IMPLEMENTATION OF THE PROJECT DESIGN

FIRMWARE IMPLEMENTATION:

This chapter briefly explains about the firmware implementation of the project. The required software tools are discussed in the following sections.

Software Tool Required:

Arduino 1.0.6 software tools used to program microcontroller. The working of software tool is explained below in detail.

PROGRAMMING MICROCONTROLLER:

A compiler for a high level language helps to reduce production time. To program the Arduino UNO microcontroller the Arduino is used. The programming is done strictly in the embedded C language. Arduino is a suite of executable, open source software development tools for the microcontrollers hosted on the Windows platform.

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

One of the difficulties of programming microcontrollers is the limited amount of resources the programmer has to deal with. In personal computers resources such as RAM and processing speed are basically limitless when compared to microcontrollers. In contrast, the code on microcontrollers should be as low on resources as possible

ABOUT ARDUINO COMPILER:

GET AN ARDUINO BOARD AND USB CABLE:

You also need a standard USB cable (A plug to B plug): the kind you would connect to a USB printer, for example. (For the Arduino Nano, you'll need an A to Mini-B cable instead.)

CONNECT THE BOARD:

The Arduino Uno, Mega, Duemilanove and Arduino Nano automatically draw power from either the USB connection to the computer or an external power supply. If you're using an Arduino Diecimila, you'll need to make sure that the board is configured to draw power from the USB connection. The power source is selected with a jumper, a small piece of plastic that fits onto two of the three pins between the USB and power jacks. Check that it's on the two pins closest to the USB port. Connect the Arduino board to your computer using the USB cable. The green power LED (labelled PWR) should go on.

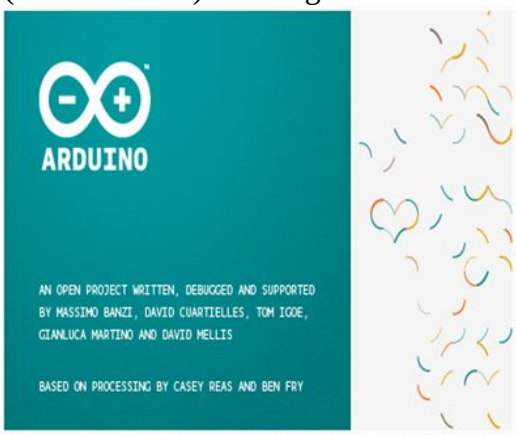


FIG: OPENING THE ARDUINO WINDOW

Open the blink example:

Open the LED blink example sketch: File > Examples > 1.Basics > Blink.

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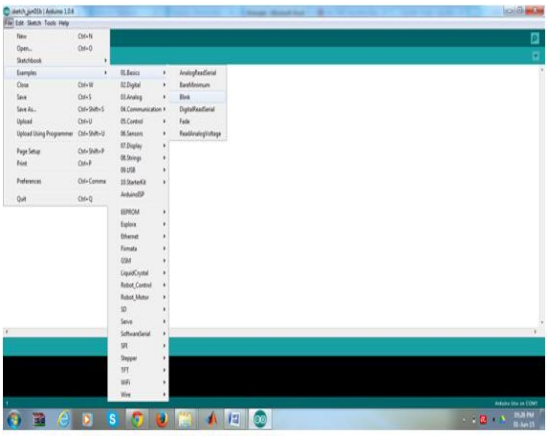

FIG: OPENING BLINK EXAMPLE

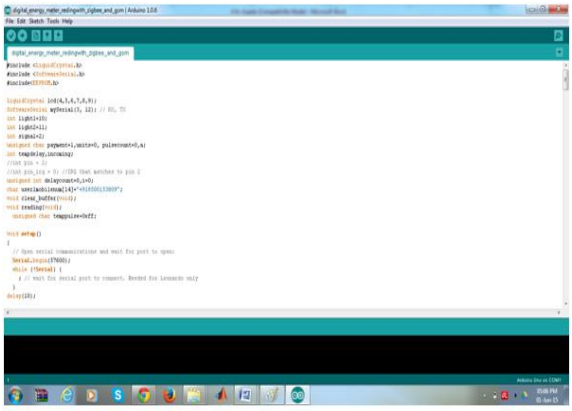

FIG: SOURCE CODE WRITTEN IN ARDUINO COMPILER

Select your board:

You'll need to select the entry in the Tools > Board menu that corresponds to your Arduino.

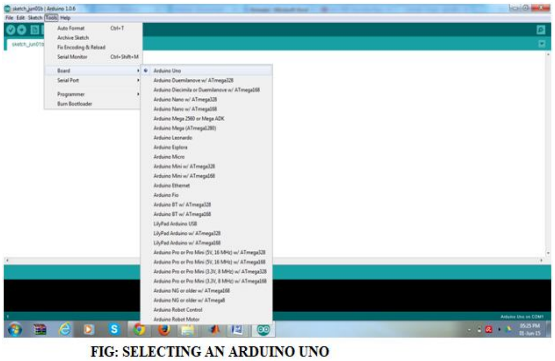

FIG: SELECTING AN ARDUINO UNO

WRITING SKETCHES:

Software written using Arduino are called sketches. These sketches are written in the text editor. Sketches are saved with the file extension .ino. It has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino environment including complete error messages and other information. The bottom righthand corner of the window displays the current board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches and open the serial monitor.

NB: Versions of the IDE prior to 1.0 saved sketches with the extension .pde. It is possible to open these files with version 1.0, you will be prompted to save the sketch with the .ino extension on save.

Verify	Checks your code for errors.
Upload	Compiles your code and uploads it to the Arduino I/O board. See uploading below for details. Note: If you are using an external programmer, you can hold down the "shift" key on your computer when using this icon. The text will change to "Upload using Programmer"
New	Creates a new sketch.
Open	Presents a menu of all the sketches in your sketchbook. Clicking one will open it within the current window. Note: due to a bug in Java, this menu doesn't scroll; if you need to open a sketch late in the list, use the File | Sketch book menu instead.
Save	Saves your sketch.
SerialMonitor	Opens the serial monitor.

Additional commands are found within the five menus: File, Edit, Sketch, Tools, Help. The menus are context sensitive which means only those items relevant to the work currently being carried out are available.

1.1.2. SELECT YOUR SERIAL PORT:

Select the serial device of the Arduino board from the Tools | Serial Port menu. This is likely to be COM3 or higher (COM1and COM2 are usually reserved for hardware serial ports). To find out, you can disconnect your Arduino board and re-open the menu; the entry that disappears should be the Arduino board. Reconnect the board and select that serial port.

UPLOAD THE PROGRAM:

Before uploading your sketch, you need to select the correct items from the Tools > Board and Tools > Serial Port menus.

The boards are described below. On the Mac, the serial port is probably something like /dev/tty.usbmodem241 On Windows, it's probably COM1 or COM2 (for a serial board) or COM4, COM5, COM7, or higher (for a USB board) - to find out, you look for USB serial device in the ports section of the Windows Device Manager. On Linux, it should be /dev/ttyUSB0,/dev/ttyUSB1 or similar.

Once you've selected the correct serial port and board, press the upload button in the toolbar or select the Upload item from the File menu. Current Arduino boards will reset automatically and begin the upload. With older boards (pre-Diecimila) that lack auto-reset, you'll need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino environment will display a message when the upload is complete, or show an error.

When you upload a sketch, you're using the Arduino bootloader, a small program that has been loaded on to the microcontroller on your board. It allows you to upload code without using any additional hardware. The bootloader is active for a few seconds when the board resets; then it starts whichever sketch was most recently uploaded to the microcontroller. The bootloader will blink the on-board (pin 13) LED when it starts (i.e. when the board resets).

Now, simply click the "Upload" button in the environment. Wait a few seconds - you should see the RX and TX leds on the board flashing. If the upload is successful, the message "Done uploading." will appear in the status bar. (*Note:* If you have an Arduino Mini, NG, or other board, you'll need to physically present the reset button on the board immediately before pressing the upload button.)

FIG: COMPILATION UNDER PROCESS

A few seconds after the upload finishes, you should see the pin 13 (L) LED on the board start to blink (in orange). If it does, congratulations! You've gotten Arduino up-and-running.

RESULTS AND DISCUSSIONS

WORKING PROCEDURE:

In this project, IR based wireless communication technology is implemented along with Arduino UNO single board microcontroller. The designed circuit has four units as- a dc power source, controlling unit (Arduino), Receiver IR module and switching section which is further connected to home loads. Arduino is the heart and brain of this system. It is used to control and monitor the whole system. Arduino UNO is a popular open-source single board microcontroller. Arduino has an 8 bit, 32 pin ATmega328 processor IC. The flash memory of ATmega328 is 32KB of which 2KB is utilized by bootloader. This board has 14 digital I/O ports of which 6 of them provide PWM outputs. The operating voltage of Arduino is 5V. It has 2 ground pins, 2 reset pins and 1 supply voltage pin. Arduino is a pre-burned microcontroller using arduino IDE software, in which codes are designed and written is usually dumped into it via computer.

Here, the IR sensor is in-built in remote which sends the coded infrared signal (as chosen by the user) to the IR module at the receiving section. The IR Receiver module is connected to the Arduino board. The IR

Receiver module passes the RC5coded data to the board. Arduino then compares the received RC5code with the codes stored in it and then decode it. On the basis of decoded data/signal, it produces the relevant outputs i.e. switch ON/OFF of the desired appliances via BT136 Triac. Two loads are controlled by TRIAC. The other load is driven by the transistor. LCD is used to display the relevant messages.

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