DESIGN OF AN EASY APPLIANCE CONTROL SYSTEM ON VIRTUAL REALITY

A PROJECT REPORT

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BONAFIDE CERTIFICATE

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ABSTRACT

Technologies these days have made the process of design and implementation of embedded based systems for controlling home-appliances (Home Automation) more advanced and reliable. Virtual Reality has seen a growing demand for smart home automation systems. In appliance control, there is an issue of "delay time" which can be unpredictable. Thus, direct teleportation architecture is proposed. Through this specific architecture, the trajectory error of the appliance control which is controlled via the internet is minimized. An important aspect of virtual reality is that it is not only used conventionally for simulating the behavior of a system but also used in parallel with the real system to improve quality control. In our project, we intend to present a low-cost but yet flexible, feasible, and secure virtual reality-based home automation system. Through this proposed system we will aim to control tube lights, motor, and

other home appliances by giving a 230v power supply. We have used image processing techniques for image acquisition, pre-processing, image segmentation and feature extraction. The virtual sensing unit along with the camera helps in detecting the touch made by the user, depending upon the touch the data is sent to the micro controller. As the micro controller is already programmed the hardcoded data is sent via transmitting Zigbee to the receiving Zigbee. The device is switched on or switched off based upon the data received by the relay unit. The response time of the proposed system is observed to be 160ms. As Automation is becoming the trend nowadays, automating the home appliances using remote controls has limitations with respect to distance. Home automation using virtual reality helps in accessing the devices from anywhere around.

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LIST OF ABBREVIATIONS

1. **ADC**: Analog to Digital Converter
2. **ALE**: Address Latch Enable
3. **CMOS:** Complementary Metal Oxide Semiconductor
4. **EA:** External Access Enable
5. **EOCR:** Electric Over Current Relay
6. **GND:** Ground
7. **IIL:** Integrated Injection Logic
8. **ISP:** Insystem Programmable
9. **LCD:** Liquid Crystal Display
10. **LED:** Light Emitting Diode
11. **MCS:** Multipoint Control Services
12. **MEMS:** Micro-electromechanical Systems

13. **PCM:** Pulse Code Modulation

14. **PDIP:** Dual in-line Package

15. **PSEN:** Program Store Enable

16. **RAM:** Random Access Memory

17. **SFR:** Set Factory Reset

18. **UART:** Universal Asynchronous Receiver-Transmitter

19. **USB**: Universal Serial Bus

20. **VCC:** Voltage Common Collector

21. **VDC:** Voltage Direct Current

22. **VR:** Virtual Reality

23. **Wi-Fi:** Wireless Fidelity

CHAPTER 1

INTRODUCTION

Virtual Reality is the term used when computer technology is used to create a simulated environment. Instead of viewing a screen/surface in 2-Dimensions as always, users are immersed in an entire new world of viewing and interacting with the 3-Dimensional worlds. An important aspect of virtual reality is that it is not only used conventionally for simulating the behavior of a system but also used in parallel with the real system to improve quality control. Virtual Reality has its importance and uses in a variety of fields like Military, Education, and Medicine. This technology enables humans to get immersed in a highly visual world which they explore by means of their senses. To be very specific virtual reality can aid the process of effective training of individuals virtually and this is very important in these times of pandemic. In the field of education VR bridges the gap between instructors and learners and enhance the learning process by teleporting themselves into the VR world. This is just an example of why VR can be/will be the future.

CHAPTER 2

LITERATURE SURVEY

Chih-Hung Wu et al.,[1] designed a Wireless Arm Based Automatic Meter Reading and Control System. This technique was used to calculate electricity using digital meter. The main advantage of this project is that it reduced the error rate. By this an error free reading was calculated. The disadvantage of this project is that it is not intimate to the user.

Bo Chen et al [2]., proposed a Zigbee technology for the application on wireless meter reading system. Here, Zigbee technology is used for getting meter reading on wireless mode. Zigbee is only used for short communication distance and it works only for peer-to-peer communication. There will be no database created in this project. And also, user will not be able to get the bill cycle at the middle of the process.

Later, in 2009, **Li Xiaoguang Hu** et [3]., implemented an Arm- Based Power Meter Having Wi-Fi Communication Module. The technology used here is Wi-Fi. Wi-Fi technology is limited within a building. And also, we cannot fetch the data from the board. Nowadays, a variety of techniques are used to hack the Wi-Fi password, thus it’s not safe to access the database. Several other home automation systems are developed in order to make our life better and easier [4]-[10].

Neng has presented and architecture for home automation where the system was based on a dedicated network. This system only shows how to solve home automation problems at software level and no hardware aspects were considered.

Yavuz and Hasan presented a telephone and PIC based remote control system where pin-check algorithm has also been introduced. Also, to remote control of home appliances such as oven, air conditioner and computer by telephones which offer easy usage has been investigated by Communication takes place via a dedicated telephone line not via a Bluetooth technology.

Al-Ali and AL-Rousan introduced a low-cost Java- Based Home Automation System, without highlighting the low-level details of the type of peripherals that can be attached.

CHAPTER 3

DESIGN OF AN EASY APPLIANCE CONTROL SYSTEM BASED ON VIRTUAL REALITY

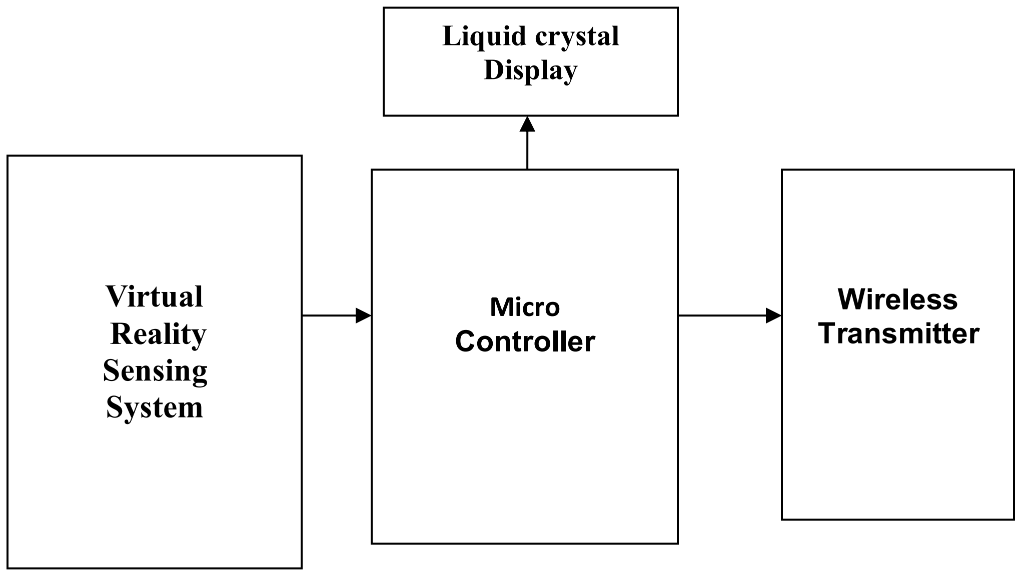
The proposed system consists of a Virtual Reality Sensing Device with 2D 328 specifications, which senses the movement of the user's hand made against a surface. This virtual Reality sensing device consists of a camera, a monitor and a CPU. This is then connected to a PC and projects the details from the PC on to a wall/surface. Since this project involves operating home appliances like Fan, TV more conveniently and without moving from one place to another, the details on the PC will be built-in options like ON or OFF OR it could be anything else required to operate a device. The camera in the Virtual Reality Sensing Device will sense the hand movements on the wall. Now if the user hand moves towards the ON sign, then the camera will capture this hand movement and displays it on the PC. The PC is connected to a Zigbee Transmitter (2-Channel 5V Relay Module Version 3) through which this information is passed on to the receiver. On the Zigbee Receiver side there is a microcontroller board connected. Since the microcontroller (Arduino Uno R3) cannot supply 230V completely to the load or home appliances, there is a relay unit in the between in order to facilitate the power reaching the load through which the device is controlled. The information received by the Zigbee Receiver is processed by the software named Visual basic. Here, Proteus 8.6 is used to execute the code. Further, the Embedded C code is dumped into the Atmega controller using Arduino IDE.

ADVANTAGES:

1. Virtual reality sensing and control system, for easy access.
2. It would be so useful for aged people and handicaps to access home appliances.
3. These appliances can be used from anywhere and can prevent the usage of these appliances when not in need.
4. It sets a huge scope in training and development business by setting up a virtual environment and also provides 100% efficiency.

3.1. BLOCK DIAGRAM

Transmitter



Receiver

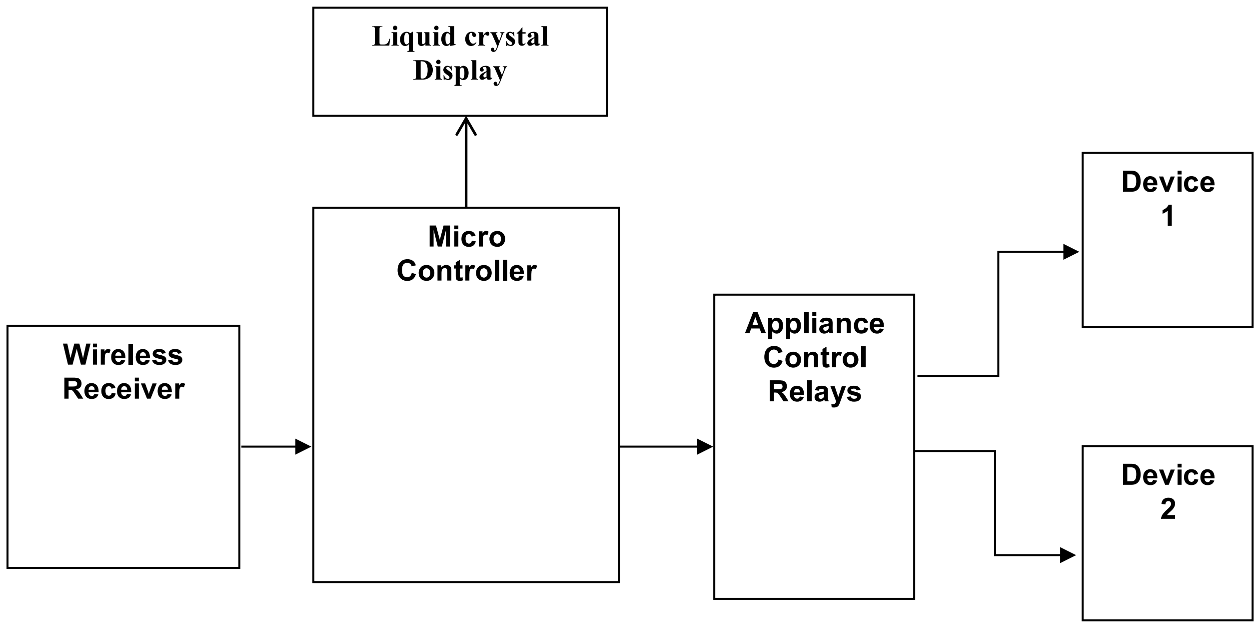


Fig 3.1.1 Block diagram of transmitter and receiver

3.1.1 MODULES

1. Virtual Reality Sensing System
2. Microcontroller
3. Liquid Crystal Display
4. Wireless Transmitter
5. Wireless Receiver
6. Application control relays
7. Device 1
8. Device 2

3.1.2 DESCRIPTION

The transmitter section of the virtual reality appliance control system is shown in Fig.3.1.1. A Virtual Reality Sensing System is the major component in the transmission section. The Virtual Reality Sensing System consists of a camera which displays the image of the ON or OFF device option on a plain wall. The appliances can be controlled by moving the hand in front of the required device option. The Virtual Reality Sensing System captures the movement of the hand and this information is given to the PC via the Zigbee Transmitter. The information obtained is processed by the software named Visual Basic .

The receiver section of the virtual reality appliance control system is shown in Fig.3.1.1. A wireless Zigbee receiver plays a major role on the receiver section. The Zigbee receiver is directly connected to a Microcontroller. The control signals are given to all appliances by the microcontroller board via a relay unit. Since a direct supply of 230V to the load is not possible, there is relay unit to compensate the transfer of power, in order to switch ON or OFF the particular devices .

SOFTWARE REQUIREMENTS

1. Visual basic.

2. Arduino ide

3. Proteus 8.6

Language: Embedded c

3.2 HARDWARE DESCRIPTION

ATMEGA 328P MICROCONTROLLER

Features

- Compatible with MCS®-51 Products
- 8K Bytes of In-System Programmable (ISP) Flash Memory – Endurance: 1000 Write/Erase Cycles
- 4.0V to 5.5V Operating Range
- Fully Static Operation: 0 Hz to 33 MHz
- Three-level Program Memory Lock
- 256 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-bit Timer/Counters

- Eight Interrupt Sources
- Full Duplex UART Serial Channel
- Low-power Idle and Power-down Modes

Description

The ATMEGA 328P is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the Indus-try-standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory pro-grammar. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

The ATMEGA 328P provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM con-tents but freezes the oscillator, disabling all other chip functions until the next interrupt or hardware reset.

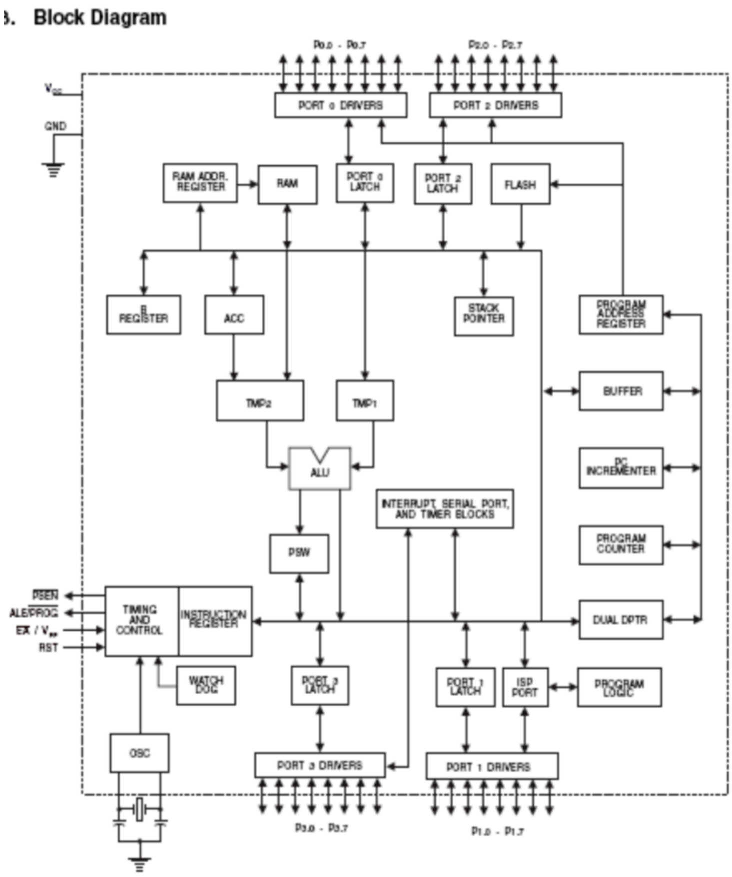


Fig 3.1.2 Block Diagram of Microcontroller

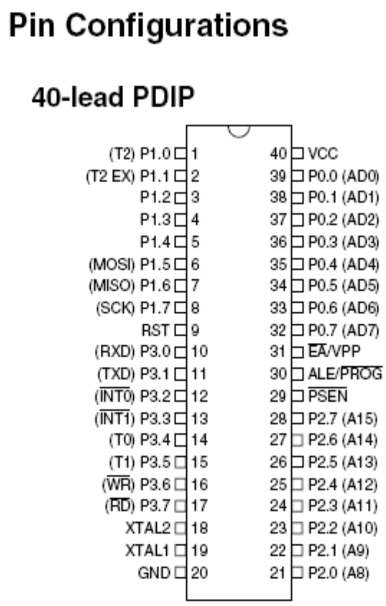


Fig 3.1.3 Pin diagram of Atmega 328P

Pin Description

VCC

Supply voltage.

GND

Ground.

Port 0

Port 0 is an 8-bit open drain bidirectional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high-impedance inputs. Port 0 can also be configured to be the multiplexed low-order address/data bus during accesses to external program and data memory. In this mode, P0 has internal pull-ups. Port 0 also receives the code bytes during Flash programming and outputs the code bytes during program verification. External pull-ups are required during program verification.

Port 1

Port 1 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins, they are pulled high by the inter-nal pull-ups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. In addition, P1.0 and P1.1 can be configured to be the timer/counter 2 external count input (P1.0/T2) and the timer/counter 2 trigger input (P1.1/T2EX), respectively, as shown in the following table. Port 1 also receives the low-order address bytes during Flash programming and verification.

Port Pin	Alternate Functions
P1.0	T2 (external count input to Timer/Counter 2), clock-out
P1.1	T2EX (Timer/Counter 2 capture/reload trigger and direction control)
P1.5	MOSI (used for In-System Programming)
P1.6	MISO (used for In-System Programming)
P1.7	SCK (used for In-System Programming)

Table 3.1.1 Port Functions

Port 2

Port 2 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that uses 16-bit addresses (MOVX @ DPTR). In this application, Port 2 uses strong internal pull-ups when emitting 1s. During accesses to external data memory that uses 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register. Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

Port Pin Alternate Functions

P1.0 T2 (external count input to Timer/Counter 2), clock-out P1.1 T2EX (Timer/Counter 2 capture/reload trigger and direction control) P1.5 MOSI (used for In-System Programming) P1.6 MISO (used for In-System Programming) P1.7 SCK (used for In-System Programming)

Port 3

Port 3 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pull-ups. Port 3 receives some control signals for Flash programming and verification. Port 3 also serves the functions of various special features of the AT89S52, as shown in the following table.

Port Pin	Alternate Functions
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	$\overline{\text{INT0}}$ (external interrupt 0)
P3.3	$\overline{\text{INT1}}$ (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	$\overline{\text{WR}}$ (external data memory write strobe)
P3.7	$\overline{\text{RD}}$ (external data memory read strobe)

Table 3.1.2 Alternate Port functions of 89s52

RST

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device. This pin drives high for 98 oscillator periods after the Watchdog times out.

ALE/PROG

Address Latch Enable (ALE) is an output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming. In normal operation, ALE is emitted at a constant rate of 1/6 the oscillator frequency and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external data memory. If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the microcontroller is in external execution mode.

PSEN

Program Store Enable (PSEN) is the read strobe to external program memory. When the AT89S52 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

EA/VPP

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset. EA should be strapped to VCC for internal program executions. This pin also receives the 12-volt programming enable voltage (VPP) during Flash programming.

XTAL1

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL2

Output from the inverting oscillator amplifier.

Memory Organization

MCS-51 devices have a separate address space for Program and Data Memory. Up to 64K bytes each of external Program and Data Memory can be addressed.

Program Memory

If the EA pin is connected to GND, all program fetches are directed to external memory. On the AT89S52, if EA is connected to VCC, program fetches to addresses 0000H through 1FFFH are directed to internal memory and fetches to addresses 2000H through FFFFH are to external memory.

Data Memory

The AT89S52 implements 256 bytes of on-chip RAM. The upper 128 bytes occupy a parallel address space to the Special Function Registers. This means that the upper 128 bytes have the same addresses as the SFR space but are physically separate from SFR space. When an instruction accesses an internal location above address 7FH, the address mode used in the instruction specifies whether the CPU accesses the upper 128 bytes of RAM or the SFR space.

POWER SUPPLY:

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

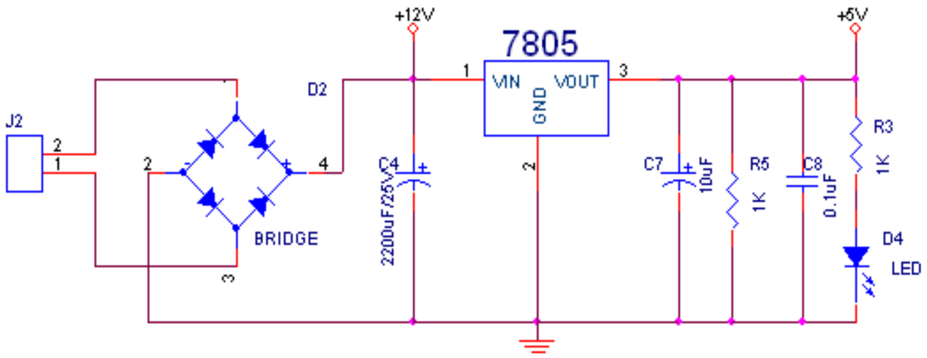


Fig 3.1.4 Power supply

A 230v, 50Hz Single phase AC power supply is given to a step down transformer to get 12v supply. This voltage is converted to DC voltage using a Bridge Rectifier. The converted pulsating DC voltage is filtered by a 2200uf capacitor and then given to 7805 voltage regulator to obtain constant 5v supply. This 5v supply is given to all the components in the circuit. A RC time constant circuit is added to discharge all the capacitors quickly. To ensure the power supply a LED is connected for indication purpose.

BRIDGE RECTIFIER

A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full-wave rectification. This is a widely used configuration, both with individual diodes wired as shown and with single component bridges where the diode bridge is wired internally.

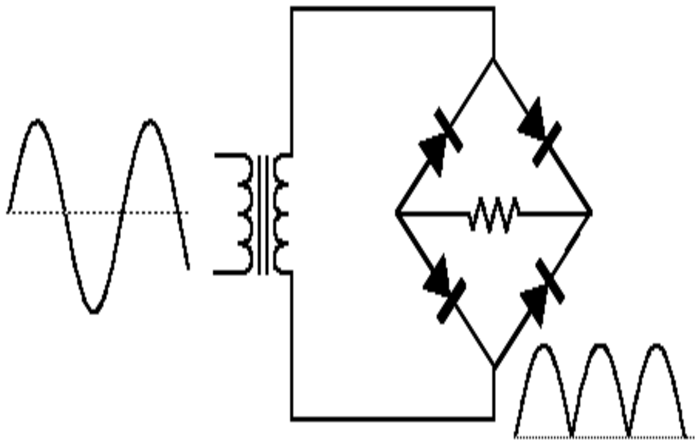


Fig 3.1.5 Circuit of bridge rectifier

VOLTAGE REGULATOR:

LM7805: 3-Terminal 1A Positive Voltage Regulator

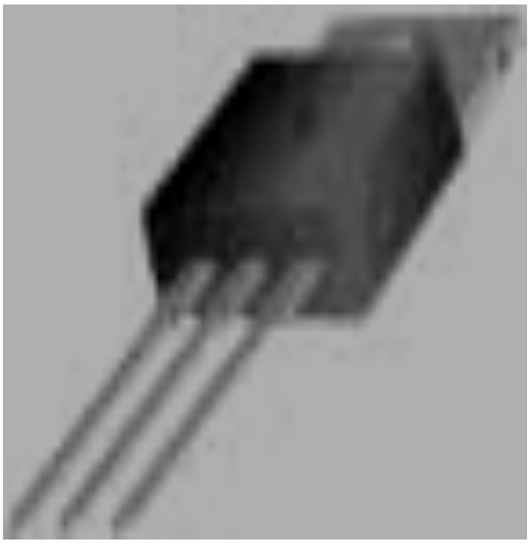


Fig 3.1.6 Diagram of voltage regulator

Features:

• Output Current up to 1A

• Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V

• Thermal Overload Protection

• Short Circuit Protection

• Output Transistor Safe Operating Area Protection

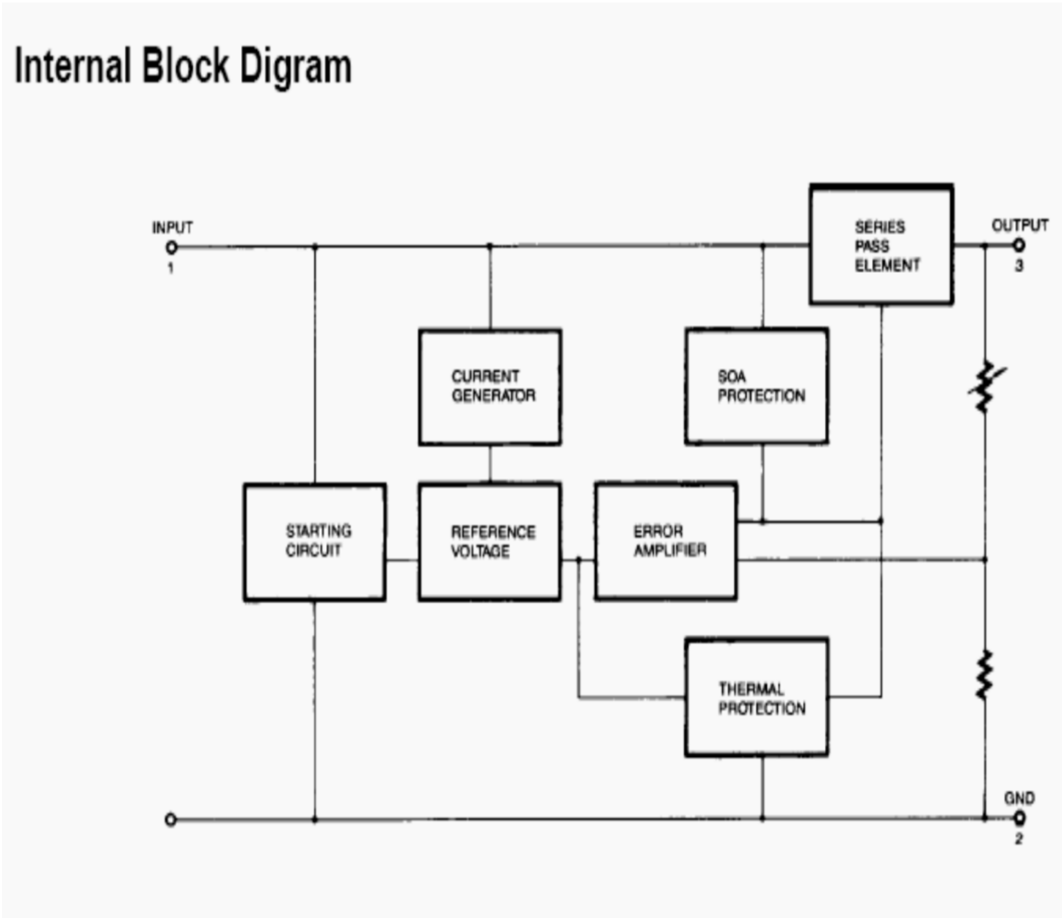


Fig 3.1.7 Block diagram of voltage regulator

Description:

The KA78XX/KA78XXA series of three-terminal positive regulator are available in the TO-220/D-PAK package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

ADC 0808/0809

The ADC0809 data acquisition component is a monolithic CMOS device with an 8-bit analog-to-digital converter, 8-channel multiplexer and microprocessor compatible control logic. The 8-bit A/D converter uses successive approximation as the conversion technique.

The converter features a high impedance chopper stabilized comparator, a 256R voltage divider with analog switch tree and a successive approximation register. The 8-channel multiplexer can directly access any of 8-single-ended analog signals.

The device eliminates the need for external zero and full-scale adjustments. Easy interfacing to microprocessors is provided by the latched and decoded multiplexer address inputs and latched TTL TRI-STATE® outputs.

The design of the ADC0808, ADC0809 has been optimized by incorporating the most desirable aspects of several A/D conversion techniques. The ADC0808, ADC0809 offers high speed, high accuracy, minimal temperature dependence, excellent long-term accuracy and repeatability, and consumes minimal power.

Features

- Easy interface to all microprocessors
- Operates ratio metrically or with 5 VDC or analog span
- No zero or full-scale adjust required
- 8-channel multiplexer with address logic
- 0V to 5V input range with single 5V power supply

Key Specifications

- Resolution 8 Bits
- Total Unadjusted Error ±1⁄2 LSB and ±1 LSB
- Single Supply 5 VDC
- Low Power 15 mW
- Conversion Time 100 µs
-

Block Diagram

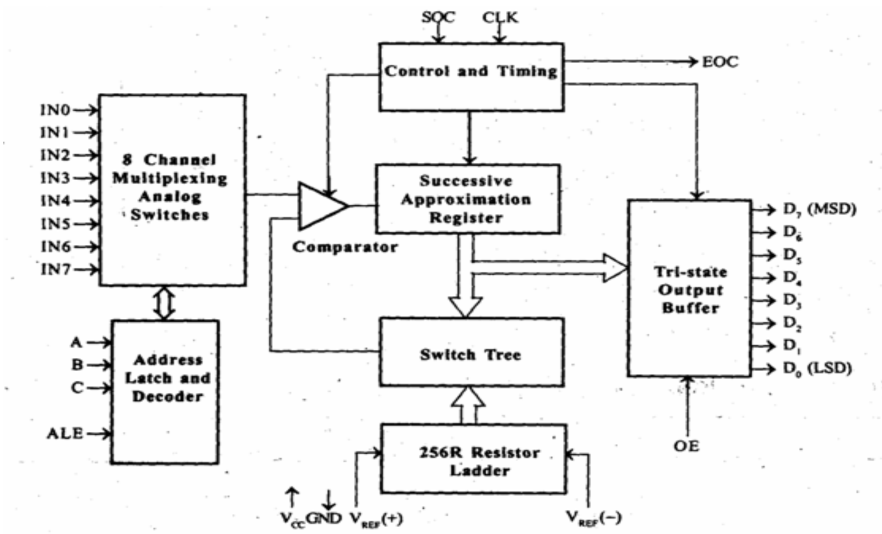


Fig 3.1.8 Block Diagram of ADC 0809

Pin Diagram

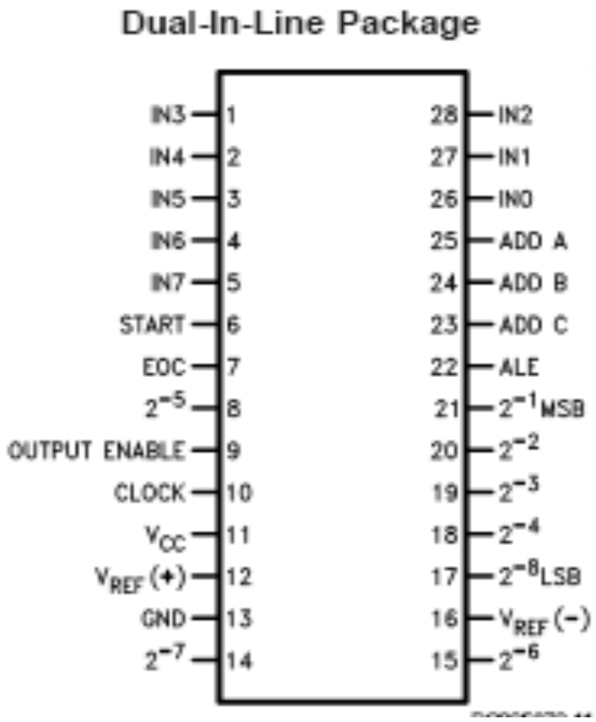


Fig 3.1.9 Pin Diagram of ADC 0809

The ADC0808, ADC0809 data acquisition component is a monolithic CMOS device with an 8-bit analog-to-digital converter, 8-channel multiplexer and microprocessor compatible control logic.

Functional Description

Multiplexer

The device contains an 8-channel single-ended analog signal multiplexer. A particular input channel is selected by using the address decoder. Table 1 shows the input states for the address lines to select any channel. The address is latched into the decoder on the low-to-high transition of the address latch enable signal.

SELECTED ANALOG CHANNEL	ADDRESS LINE		
	C	B	A
IN0	L	L	L
IN1	L	L	H
IN2	L	H	L
IN3	L	H	H
IN4	H	L	L
IN5	H	L	H
IN6	H	H	L
IN7	H	H	H

Table 3.1.3 Address line of ADC

The successive approximation register (SAR) performs eight iterations to determine the digital code for input value. The SAR is reset on the positive edge of START pulse and start the conversion process on the falling edge of START pulse. A conversion process will be interrupted on receipt of new START pulse. The End-Of-Conversion (EOC) will go low between 0 and 8 clock pulses after the positive edge of START pulse. The ADC can be used in continuous conversion mode by tying the EOC output to START input. In this mode an external START pulse should be applied whenever power is switched ON.

The comparator in ADC0809/ADC0808 is a chopper- stabilized comparator. It converts the DC input signal into an AC signal, and amplifies the AC sign using high gain AC amplifier. Then it converts AC signal to DC signal. This technique limits the drift component of the amplifier, because the drift is a DC component and it is not amplified/passed by the AC amp1ifier. This makes the ADC extremely insensitive to temperature, long term drift and input offset errors.

In ADC conversion process the input analog value is quantized and each quantized analog value will have a unique binary equivalent.

Application

- ADCs are integral to current music reproduction technology. Since much music production is done on computers, when an analog recording is used, an ADC is needed to create the PCM data stream that goes onto a compact disc or digital music file.

- High bandwidth headroom allows the use of cheaper or faster anti-aliasing filters of less severe filtering slopes.

- Considerable literature exists on these matters, but commercial considerations often play a significant role. Most high-profile recording studios record in 24-bit/192-176.4 kHz PCM or in DSD formats, and then down sample or decimate the signal for Red-Book CD production (44.1 kHz or at 48 kHz for commonly used for radio/TV broadcast applications).

- **Digital Signal Processing:** AD converters are used virtually everywhere where an analog signal has to be processed, stored, or transported in digital form. Fast video ADCs are used, for example, in TV tuner cards. Slow on-chip 8, 10, 12, or 16 bit ADCs are common in microcontrollers. Very fast ADCs are needed in digital oscilloscopes

UART

A **universal asynchronous receiver/transmitter** is a type of "asynchronous receiver/transmitter", a piece of computer hardware that translates data between parallel and serial forms. UARTs are commonly used in conjunction with other communication standards such as EIA RS-232.

A UART is usually an individual (or part of an) integrated circuit used for serial communications over a computer or peripheral device serial port. UARTs are now commonly included in microcontrollers. A dual UART or **DUART** combines two UARTs into a single chip. Many modern ICs now come with a UART that can also communicate synchronously; these devices are called **USARTs**.

The Universal Asynchronous Receiver/Transmitter (UART) controller is the key component of the serial communications subsystem of a computer. The UART takes bytes of data and transmits the individual bits in a sequential fashion. At the destination, a second UART re-assembles the bits into complete bytes. Serial transmission of digital information (bits) through a single wire or other medium is much more cost effective than parallel transmission through multiple wires. A UART is used to convert the transmitted information between its sequential and parallel form at each end of the link. Each UART contains a shift register which is the fundamental method of conversion between serial and parallel forms.

MAX232:

The **MAX232** is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case.The receivers reduce RS-232 inputs (which may be as high as ± 25 V), to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis of 0.5 V.The later MAX232A is backwards compatible with the original MAX232 but may operate at higher baud rates and can use smaller external capacitors – 0.1 μF in place of the 1.0 μF capacitors used with the original device.

Pin Diagram:

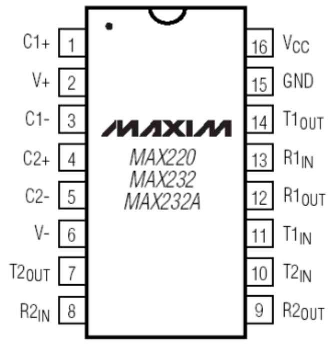


Fig 3.1.10 MAX232

Servo meter:

Features:

- extremely high-power density and overload
- high standstill torque (e.g., for holding vertical position)
- Dynamic response due to low inertia
- Super High Dynamic for **1FK6 HD**
- compact build due to frameless design (flange and shaft compatible to 1FT6)
- integrated feedback system
- robust, essentially maintenance free build
- high level of protection (IP64)
- motor temperature monitoring with KTY 84
- Rated power of 0.7 to 7 HP for rated speeds of 3000 4500(HD) and 6000 r.p.m.

- extremely high-power density and overload
- high standstill torque (e.g., for holding vertical position)
- high dynamic response due to low inertia
- very high efficiency and a very smooth running (low torque ripple)
- integrated feedback system
- robust, essentially maintenance free
- high level of protection (IP64)
- motor temperature monitoring with KTY 84
- Rated power of 0.35 to 46 HP for rated speeds of 1500 to 6000 r.p.m.

ZIGBEE

ZigBee is a specification for a suite of high-level communication protocols using small, low-power digital radios based on the IEEE 802.15.4-2003 standard for wireless personal area networks (WPANs), such as wireless headphones connecting with cell phones via short-range radio. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. ZigBee is targeted at radiofrequency (RF) applications that require a low data rate, long battery life, and secure networking.

Features of ZigBee MRF24J40MA:

- IEEE Std. 802.15.4™ Compliant RF Transceiver
- Supports ZigBee®, MiWi™, MiWi™ P2P and
- Proprietary Wireless Networking Protocols
- Small Size: 0.7” x 1.1” (17.8 mm x 27.9 mm),
- Surface Mountable
- Integrated Crystal, Internal Voltage Regulator,
- Matching Circuitry and PCB Antenna
- Easy Integration into Final Product – Minimize
- Product Development, Quicker Time to Market
- Radio Regulation Certification for United States
- (FCC), Canada (IC) and Europe (ETSI)
- Compatible with Microchip Microcontroller
- Families (PIC16F, PIC18F, PIC24F/H, dsPIC33
- and PIC32)
- Up to 400 ft. Range

Pin Diagram:

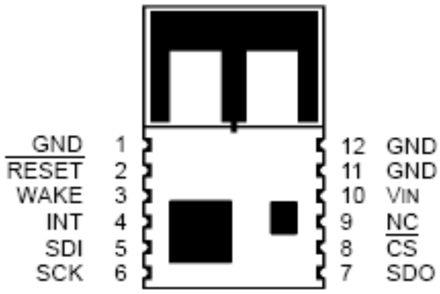


Fig 3.1.11 ZigBee MRF24J40MA

Pin Description:

Pin	Symbol	Type	Description
1	GND	Power	Ground
2	$\overline{\text{RESET}}$	DI	Global hardware Reset pin
3	WAKE	DI	External wake-up trigger
4	INT	DO	Interrupt pin to microcontroller
5	SDI	DI	Serial interface data input
6	SCK	DI	Serial interface clock
7	SDO	DO	Serial interface data output from MRF24J40
8	$\overline{\text{CS}}$	DI	Serial interface enable
9	NC	—	No connection (allow pin to float; do not connect signal)
10	VIN	Power	Power supply
11	GND	Ground	Ground
12	GND	Ground	Ground

Table 3.1.4 Pin description

Device Overview:

The MRF24J40MA is a 2.4 GHz IEEE Std. 802.15.4™ compliant, surface mount module with integrated crystal, internal voltage regulator, matching circuitry and PCB antenna. The MRF24J40MA module operates in the non-licensed 2.4 GHz frequency band and is FCC, IC and ETSI compliant. The integrated module design frees the integrator from extensive RF and antenna design, and regulatory compliance testing, allowing quicker time to market. The MRF24J40MA module is compatible with Microchip's ZigBee®, MiWi™ and MiWi P2P software stacks. Each software stack is available as a free download, including source code, from the Microchip web site http://www.microchip.com/wireless.The MRF24J40MA module has received regulatory approvals for modular devices in the United States (FCC), Canada (IC) and Europe (ETSI). Modular approval removes the need for expensive RF and antenna design and allows the end user to place the MRF24J40MA module inside a finished product and not require regulatory testing for an intentional radiator (RF transmitter). See **Section 3.0 "Regulatory Approval"** for specific requirements to be followed by the integrator.

MEMS:

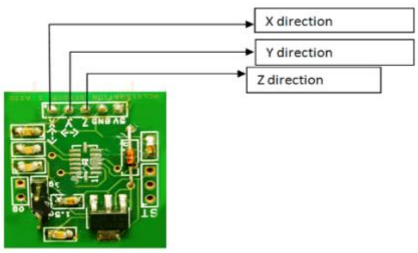


Fig 3.1.12 MEMS IC

Micro-Electro-Mechanical Systems, or MEMS, is atechnology that in its most general form can be definedas miniaturized mechanical and electro-mechanicalelements that are made using the techniques of microfabrication.MEMS is an electrostatic transducer usedfor harvesting and converting the energy of vibrationsinto electrical energy.

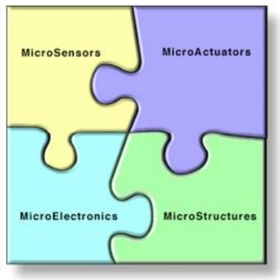


Fig 3.1.13 Components of MEMS

While the functional elements of MEMS are miniaturized structures, sensors, actuators, and microelectronics, the most notable and perhaps the most interesting elements are the microsensors and micro actuators. Microsensors and micro actuators are appropriately categorized as ‘transducers’, which are defined as devices that convert energy from one form to another. In the case of microsensors, the device typically converts a measured mechanical signal into an electrical signal.

Advantages:

- MEMS are extremely diverse technologies that could significantly affect every category of commercial and military product.
- MEMS blurs the distinction between complex mechanical systems and integrated circuit electronics.

- MEMS allows complex electromechanical systems tube manufactured using batch fabrication techniques, decreasing the cost and increasing the reliability of the sensors and actuators to equal those of integrated circuits.

Applications:

- Automotive crash sensors
- Ink jet printer nozzles
- Catheter tip pressure sensors
- Telecommunication
- Biomedical industries
- Aerospace technologies

LCD

DESCRIPTION

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven_segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom_characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

Relay

GENERAL DESCRIPTION

Relays are simple switches which are operated both electrically and mechanically. Relays consist of a n electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet. The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. They were used to switch the signal coming from one source to another destination. The high end applications of relays require high power to be driven by electric motors and so on. Such relays are called contactors.

PRODUCT DESCRIPTION

A relay is an electromechanical switch which is activated by an electric current. A single relay board arrangement contains driver circuit, power supply circuit and isolation circuit. A relay is assembled with that circuit. The driver circuit contains transistors for switching operations. The transistor is use for switching the relay. An isolation circuit prevents reverse voltage from the relay which protects the controller and transistor from damage. The input pulse for switching the transistor is given from the microcontroller unit. It is used for switching of a single device.

FEATURES

- Input voltage: 12VDC
- Driver unit: ULN2003A

- Isolation unit: In4007
- Fast switching

APPLICATIONS

- Ac load Switching applications
- Dc load Switching applications
- Motor switching applications

3.3 SOFTWARE DESCRIPTION

ARDUINO SOFTWARE (IDE)

Get the latest version from the download page. You can choose between the Installer (.exe) and the Zip packages. We suggest you use the first one that directly installs everything you need to use the Arduino Software (IDE), including the drivers. With the Zip package you need to install the drivers manually. The Zip file is also useful if you want to create a portable installation. When the download finishes, proceed with the installation, and please allow the driver installation process when you get a warning from the operating system.

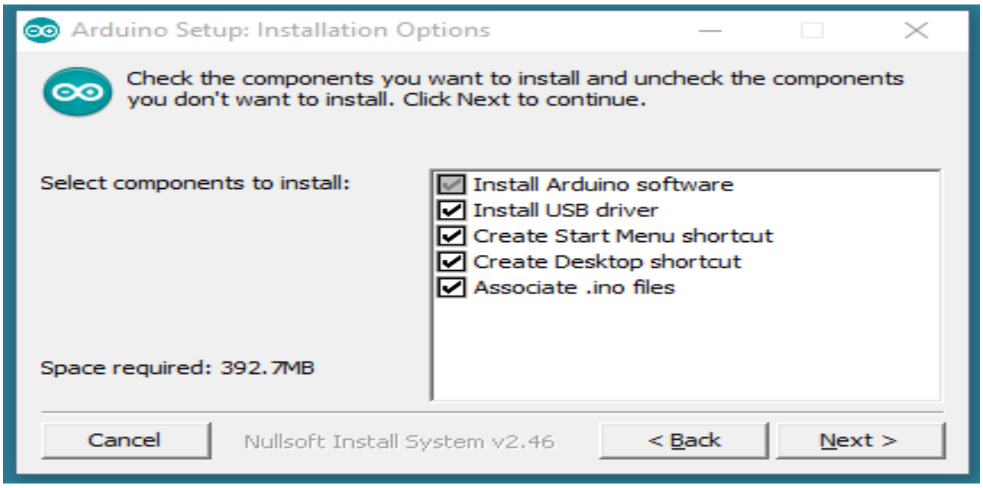


Fig 3.2.1 Components Installation

Choose the components to install

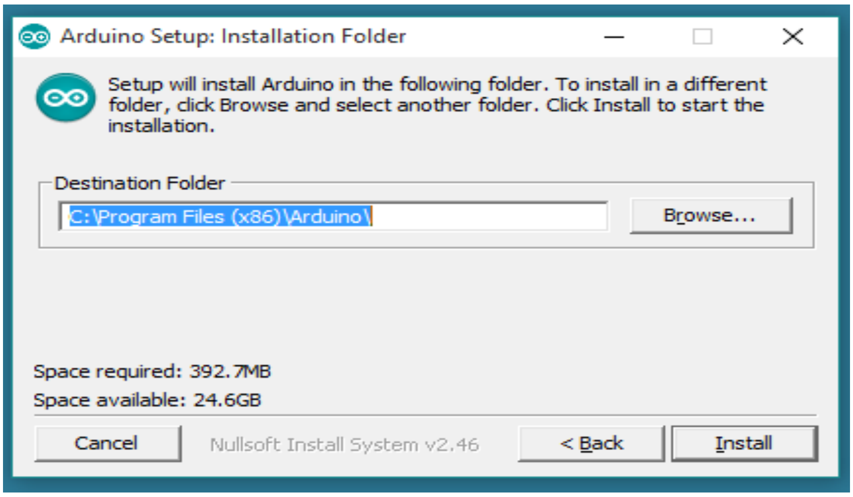


Fig 3.2.2 Installation Directory

Choose the installation directory (we suggest keeping the default one)

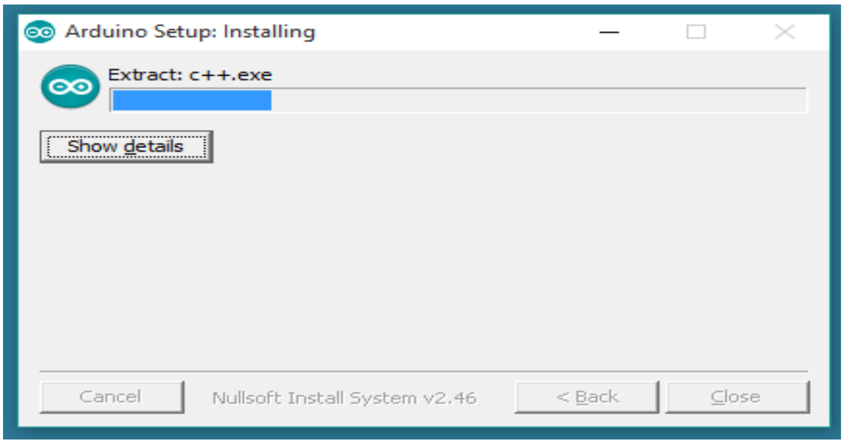


Fig 3.2.3 Installation

The process will extract and install all the required files to execute properly the Arduino Software (IDE)

ARDUINO SETUP

- Download the Arduino Open Source Software
- Power up your Arduino UNO (either via USB or external power)
- Plugin your Arduino UNO board to your computer (make sure you have any required drivers installed)
- Launch the Arduino Open Source Software

Fig 3.2.4 Arduino Software Page

- Change your settings in the Arduino Software to look for an Arduino UNO
- Type the code in the Arduino IDE window and click on the verify option in order to compile the code.
- Once the code is compiled click on the upload option to dump the code into the Arduino Uno board.

Fig 3.2.5 Code Compilation

SUMMARY

• Microcontroller	Arduino UNO
• Operating Voltage	5V Input Voltage (recommended)
• Input Voltage (limits)	6-20V
• Digital I/O Pins	54 (of which 14 provide PWM output)
• Analog Input Pins	16
• DC Current per I/O Pin	40mA

- DC Current for3.3VPin 50mA
- Flash Memory 256 KB of which 8 KB used by the boot loader
- SRAM 8KB
- EEPROM 4KB
- Lock Speed 16MHz

The Arduino UNO can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and V_{in} pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts. They differ from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the programmed as a USB- to-serial converter. **The power pins are as follows:**

- **VIN.** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V.** The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via a non-board regulator, or be supplied by USB or another regulated 5V supply.

- **3 V3**A 3.3-volt supply generated by the on-board regulator. The maximum current draw is 50mA.

- **GND.** Ground pins.

The ATMEGA has 256 KB of flash memory for storing code (of which 8 KB is used for the boot loader), 8 KB of SRAM, and 4 KB of EEPROM (which can be read and written with the EEPROM library). Each of the 54 digital pins on the Mega can be used as an input or output, using pin Mode (), digital Write () , and digital Read() 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 20-50k Ohms. Besides, some pins have specialized functions:

- **Serial: 0 (RX) and 1 (TX); Serial 1: 19 (RX) and 18 (TX); Serial 2: 17 (RX) and 16 (TX); Serial 3: 15 (RX) and 14 (TX).** Used to receive (RX) and transmit (TX) TTL serial data. Pins 0 and 1 are also connected to the corresponding pins of the ATMEGA USB-to-TTL Serial chip.
- **External Interrupts: 2 (interrupt 0), 3 (interrupt 1), 18 (interrupt 5), 19 (interrupt 4), 20 (interrupt 3), and 21 (interrupt 2).** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a changing value. See the attach Interrupt () function for details.
- **PWM: 0to13.** Provide 8-bit PWM output with the analog Write () function.
- **SPI: 50 (MISO), 51 (MOSI), 52 (SCK), 53 (SS).** These pins support SPI communication, which, although provided by the underlying

hardware, is not currently included in the Arduino language. The SPI pins are also broken out on the ICSP header.

- **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.
- **I^2C: 20 (SDA) and 21 (SCL).** Support I^2C (TWI) communication using the Wire library (documentation on the Wiring website). Note that these pins are not in the same location as the I^2C pins on the Arduino.

The Arduino UNO has 16 analogue inputs, each of which provides 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 analogue reference () function.

CHAPTER 4

RESULTS AND DISCUSSION

The proposed system consists of both hardware and software modules. The main hardware components used are virtual reality sensing device: 2D 328P, Arduino uno R3, 2-channel 5V relay module and Zigbee transceiver. The software used for the system are Visual basic, Arduino ide and Proteus 8.6. All codes required for the simulation is written in Embedded C language. The experimental results of the proposed virtual reality appliance control system are shown below.

Fig 4.1.1 Arduino UNO board, Zigbee Transmitter, Relay Board, LCD, Load

Fig 4.1.2 Virtual Reality Sensing Device

4.1 INPUT

The input to switch ON or OFF a particular device is sensed by the Virtual Reality Sensing Device according to the hand movement against the image projected on the wall is shown in Fig 4.1.3

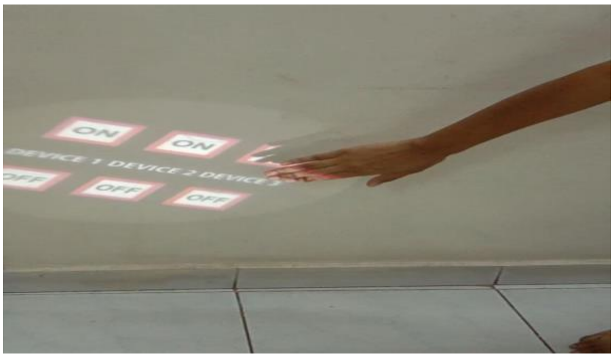


Fig 4.1.3 Projected image

4.2 SOFTWARE PROCESSING

The information to Switch ON or OFF a device is received through the Zigbee Receiver and is further processed on the PC by using the Visual Basic Software. A screen shot of the software processing is shown in Fig 4.1.4

Fig 4.1.4 Visual Basic Software Processing

4.3 OUTPUT

Based on the command received from the transmitter section, the receiver section processed the received command, and the required device is switched ON or OFF. A demonstration of the proposed virtual reality appliance control system is shown in Fig.4.1.5

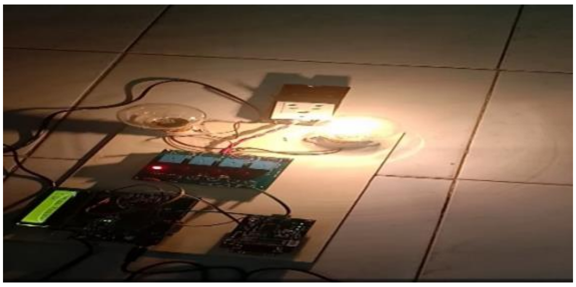


Fig 4.1.5 Output

CHAPTER 5

CONCLUSION

A virtual reality-based appliance control system is developed for controlling the home appliances using hand gestures. Thus, the experimental setup has enabled the operation of home appliances by capturing hand movements using the Virtual Reality Sensing Device. The proposed system can be used to control light, motor and other home appliances by giving 230v power supply.

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