Zigbee based Home Automation using Arduino

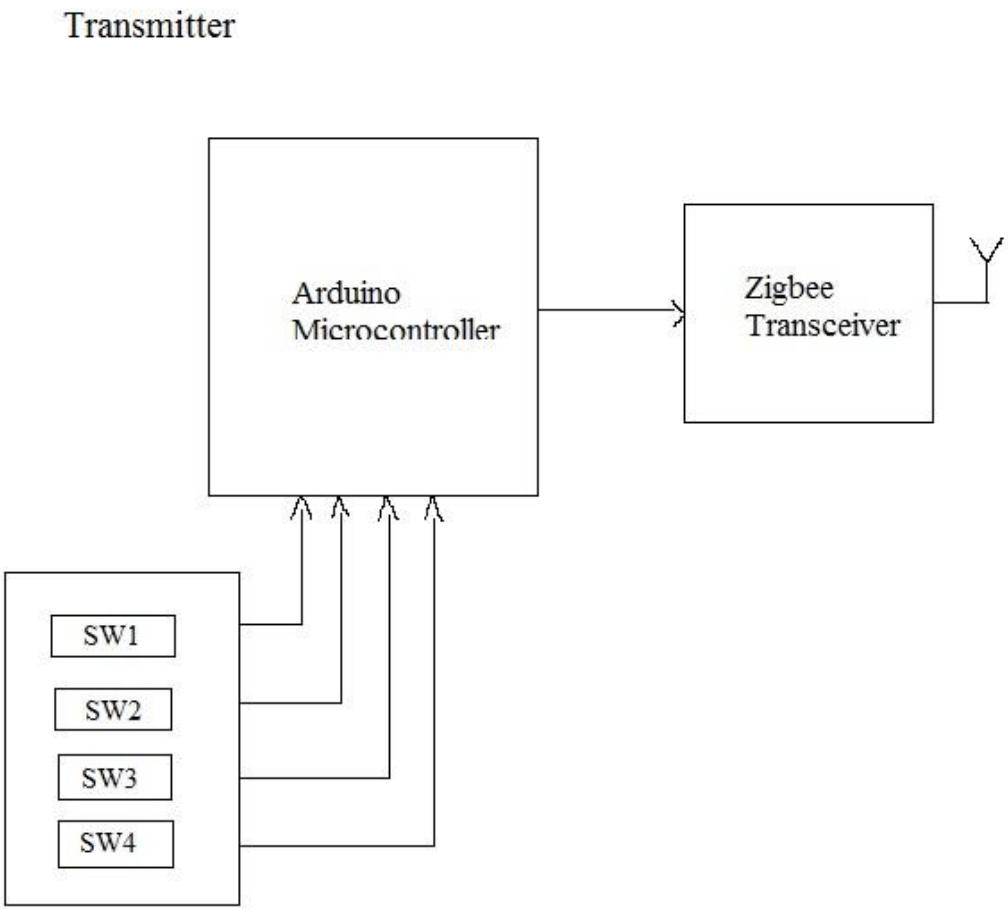
Overview

- Introduction
- Block Diagram
- Hardware requirements
- Software requirements
- Advantages and Disadvantages
- Future Work
- References

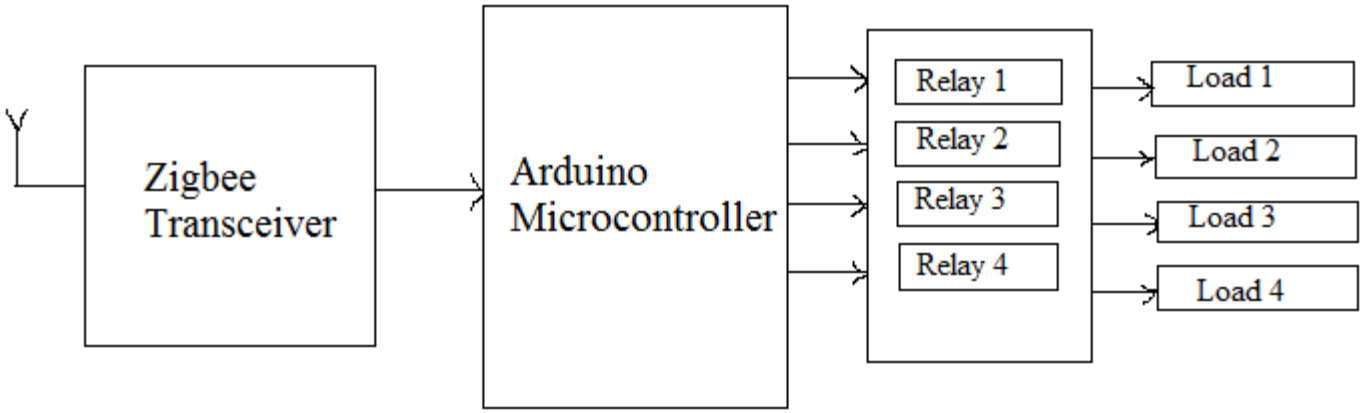
Introduction

- Home automation – The use and control of home appliances, doors, gates remotely
- Designs low power RF Zigbee based control system for home automation using Arduino
- A keypad array acts as input interface

Block Diagram



Receiver


Zigbee
Transceiver
Arduino
Microcontroller
Relay 1
Relay 2
Relay 3
Relay 4
Load 1
Load 2
Load 3
Load 4

Zigbee Protocol

- Technological Standard Created for Control and Sensor Networks
- Based on the IEEE 802.15.4 Standard
- Operates at ISM 2.4GHz frequency
- Low data rate
- Low power consumption
- Small packet devices

Hardware Requirements

- Microcontroller board – Arduino Uno
- Atmega 328
- Zigbee Module - XBee
- 12V relay
- 12V relay driver – ULN2003
- Power supply

Arduino Uno Features

- ATmega328P microcontroller
- Input voltage - 7-12V
- 14 Digital I/O Pins (6 PWM outputs)
- 6 Analog Inputs
- 32k Flash Memory
- 16Mhz Clock Speed

ATMEGA 328P

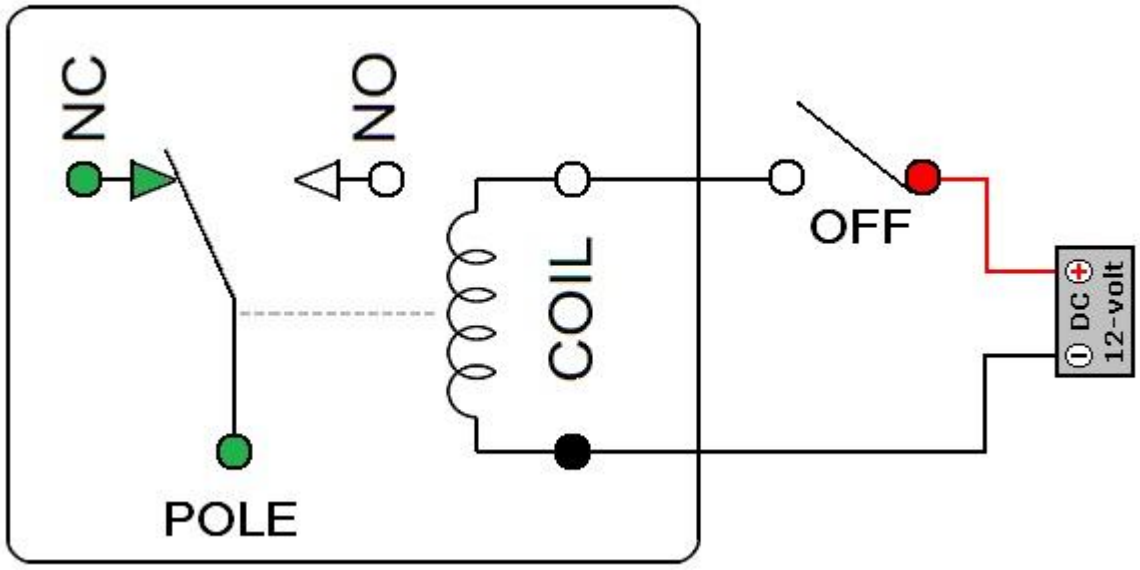
- 32K bytes of In-System Programmable Flash
- 1K bytes EEPROM
- 2K bytes SRAM
- 23 general purpose I/O lines
- 32 general purpose working registers
- three flexible Timer/Counters with compare modes, internal and external interrupts
- a serial programmable USART
- a byte-oriented 2-wire Serial Interface, an SPI serial port
- a 6-channel 10-bit ADC
- a programmable Watchdog Timer with internal Oscillator
- five software selectable power saving modes.

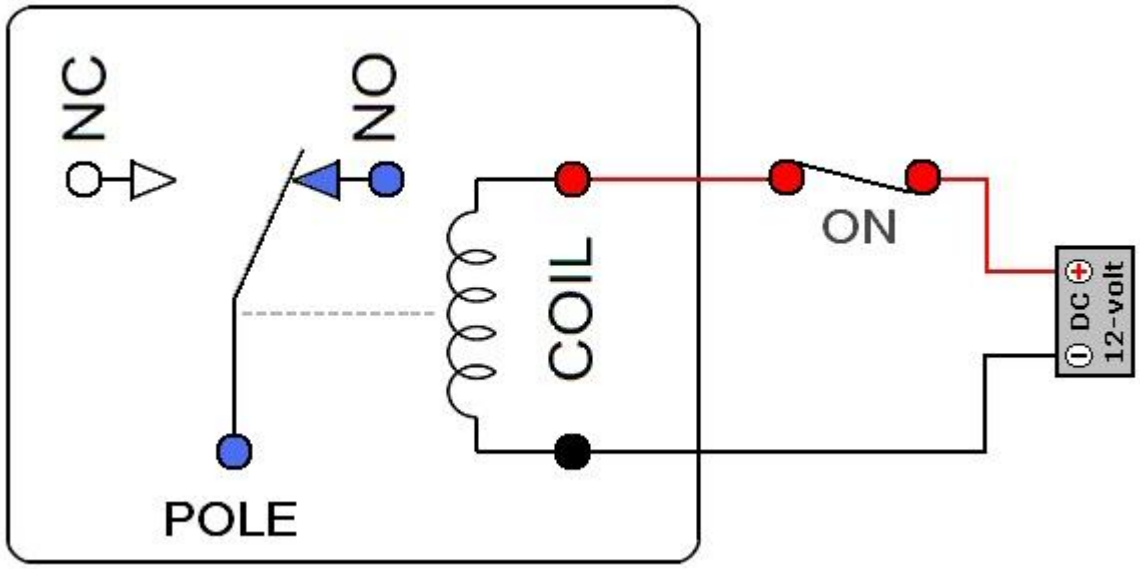
XBee

- operate with Zigbee protocol
- operate within the ISM 2.4 GHz frequency band
- used in low cost low power wireless sensor networks

Specification	XBee	XBee-PRO
Performance		
Indoor/Urban Range	Up to 100 ft (30 m)	Up to 300 ft. (90 m), up to 200 ft (60 m) International variant
Outdoor RF line-of-sight Range	Up to 300 ft (90 m)	Up to 1 mile (1600 m), up to 2500 ft (750 m) international variant
Transmit Power Output (software selectable)	1mW (0 dBm)	63mW (18dBm)* 10mW (10 dBm) for International variant
RF Data Rate	250,000 bps	250,000 bps
Serial Interface Data Rate (software selectable)	1200 bps - 250 kbps (non-standard baud rates also supported)	1200 bps - 250 kbps (non-standard baud rates also supported)
Receiver Sensitivity	-92 dBm (1% packet error rate)	-100 dBm (1% packet error rate)
Power Requirements		
Supply Voltage	2.8 – 3.4 V	2.8 – 3.4 V
Transmit Current (typical)	45mA (@ 3.3 V)	250mA (@3.3 V) (150mA for international variant) RPSMA module only: 340mA (@3.3 V) (180mA for international variant)
Idle / Receive Current (typical)	50mA (@ 3.3 V)	55mA (@ 3.3 V)
Power-down Current	< 10 µA	< 10 µA
General		
Operating Frequency	ISM 2.4 GHz	ISM 2.4 GHz
Dimensions	0.960" x 1.087" (2.438cm x 2.761cm)	0.960" x 1.297" (2.438cm x 3.294cm)
Operating Temperature	-40 to 85º C (industrial)	-40 to 85º C (industrial)
Antenna Options	Integrated Whip, Chip or U.FL Connector, RPSMA Connector	Integrated Whip, Chip or U.FL Connector, RPSMA Connector
Networking & Security		
Supported Network Topologies	Point-to-point, Point-to-multipoint & Peer-to-peer	

12 V Relay

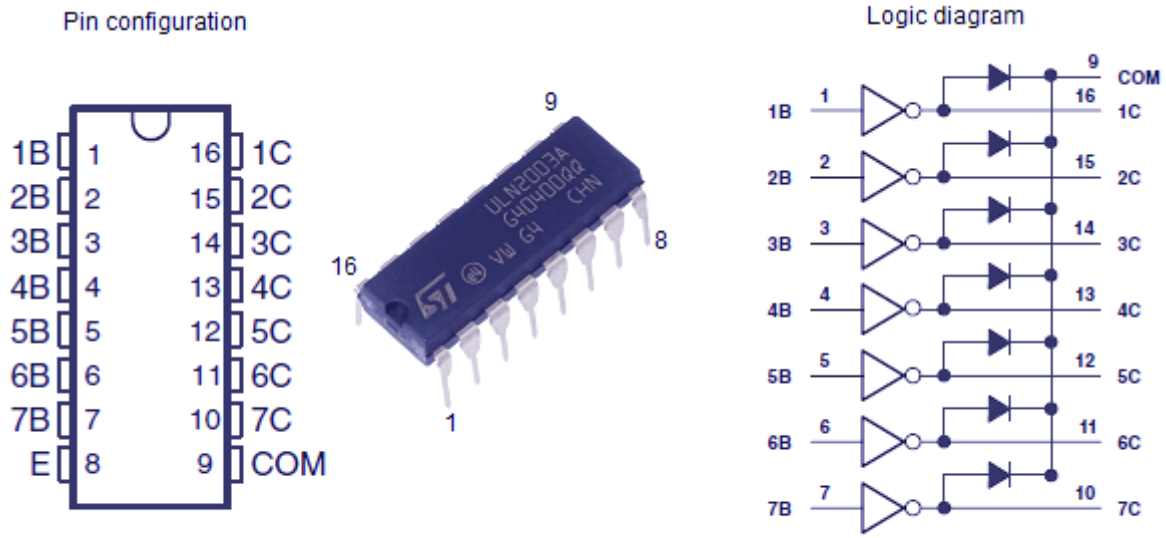



NC
NO
COIL
ON
POLE
DC
12-volt

Contd..

- Relay board module is used for controlling higher current loads from the microcontroller development board
- 4 onboard relays which can switch up to 7 Amp

12 V relay driver – ULN2003



ULN2003A driver IC pin configuration and internal logic diagram

www.circuitstoday.com

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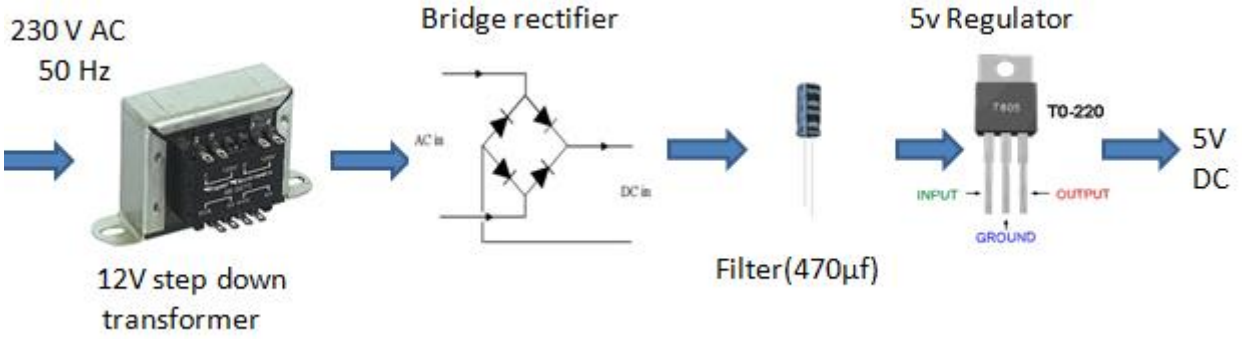
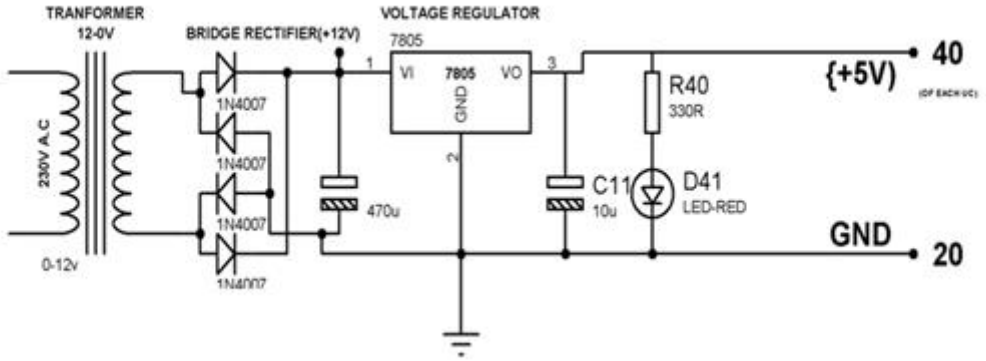
- Relay safely driven by ULN2003 IC
- Protect microcontroller from relay kick back using integrated clamping diodes
- Has 7 high current Darlington arrays each containing 7 open collector Darlington pairs with common emitters

Power supply





Software requirements

- Tool

  Arduino IDE

- Programming Languages

  Embedded C/C++

Advantages and Disadvantages

Advantages

- Code compatibility and expandability across different Arduino boards
- Cost is less as Arduino is open source
- The schematic of Arduino is open source. So for future enhancement of the project, the board can be extended to add more features
- Low Power consumption
- Has 255 subchannels . Allows simultaneous connectivity to multiple hardware devices

Disadvantages

- Appliance status get reset during power failure

Future Work

- Memory can be used to remove the drawback of appliance status getting reset during power failure Memory can be used to store the appliance status during power failure.
- Appliance scheduler/timer can be implemented using RTC (Real Time Clock)
- It can be changed to an IoT device using WiFi connectivity

References

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