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Controlling of Home Appliances using Arduino UNO Board with Infrared (IR) and Radio Frequency (RF) Technologies

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ABSTRACT

Two/Three decades before the interfacing with computer was done using serial port and parallel port but now new hardware boards are designed with lots of functionalities, using these hardware boards variety of projects could be designed for military applications, environmental applications, health applications, automotive applications, home & office applications and many other commercial applications. In this paper, we are presenting a project, which controls home appliances of 220 voltage electronic current through Infrared (IR) and Radio Frequency (RF) technologies using Arduino UNO hardware board interfacing with Infrared (IR) sensors and Radio Frequency (RF) sensors.

Key words: Arduino, Infrared (IR), Radio Frequency (RF)
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1. INTRODUCTION

Sensors are smaller, cheaper and smarter, equipped with wireless interfaces that allow them to communicate and transform physical to the digital world that can be processed and store. Sensor is used for sensing from physical world, source to source energy is converted from sensors because of having functionality of transducer [6]. Sensors use developments in technologies such as very large scale integration (VLSI) and micro electro mechanical systems (MEMS).
In wireless sensor networks, base stations like access point, phone, mobile phone, personal digital assistant, personal handheld devices and many other devices receive data from radios, these radios are introduced because of having limited memory in sensors it could not possible to store huge amount of sensed information. Battery is embedded in sensors as primary source of power, sensors are also designed which may have capability to harvests energy from other the atmosphere such as solar panel can be applied to the node depending on the suitability of the area where the sensor is to be used. Wireless based applications are giving facility to control home appliances remotely. A chip having input, output, memory, processing capability is called micro-controller [3].

The first Arduino was introduced in 2005. A company namely Arduino genuino is a platform for manufacturing and designing computers' both open source software and hardware and microcontroller based kits for supporting and building digital devices as well as interactive objects for sensing and controlling physical devices.

1.1 Infrared and Radio Frequency Technologies

The infrared radiation (Line of sight) technology was introduced by astronomer Sir William Herschel in 1800 [8].

Table 1: Frequency of Infrared

Name of Technology	Frequency Range
Infrared	700 nm – 1 mm
	430 THz – 300 GHz
	1.24 meV – 1.7 Ev

Radio frequency (RF) is any of the electromagnetic wave frequencies that lie in the range extending from around 3 kHz to 300 GHz [8]. Transmissions, noise, and interfering signals. Ground waves, tropospheric spread out and skywaves can all achieve greater ranges than line-of-sight propagation. The radio propagation allows estimates of useful range to be made.

Table 2: Frequency of Radio

Name of Technology	Frequency Range
Radio	1 mm – 100,000 km
	300 GHz – 3 Hz
	12.4feV – 1.24 meV

1.2 Types of Arduino Boards

- Arduino Mega 1280 / 2560
- Arduino YUN,
- Arduino Mini / Mini Lite,
- Arduino Pro Mini 3.3v / Mini Pro Mini 5v,
- Arduino Fio,

- Arduino LilyPad / Simple LilyPad,
- Arduino Leonardo,
- Arduino Pro.
- Arduino UNO

Above Arduino boards are designed for distinct functions amongst this each have different operating voltage, digital and analog pins. The most popular of the Arduino boards is Arduino UNO, It is a low cost microcontroller with Open Source hardware, it has Microcontroller ATmega1328, Operating Voltage 5V, Digital I/O Pins 14 (of which 6 provide PWM output), and Analog Input Pins 6) as shown in figure# 1.

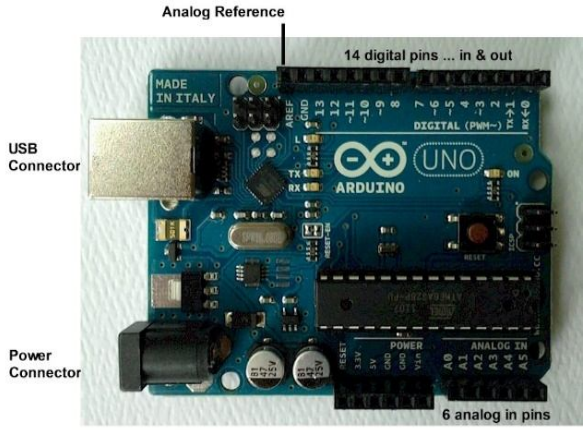

Figure 1: Arduino UNO

Figure 2: 5 V Relay Module 2 Channel

1.3 Use of VirtualWire

Low cost RF transmitters and receivers are being used for communicating with Arduino using VirtualWire communication Library, this library gives features for sending short messages exclusive of addressing, retransmitting and acknowledgment. User Data Protocol (UDP) is being used for faster communication and data transmission over wireless channel applying ASK (Amplitude Shift Keying).

1.4 Use of Relay

Relay as shown in figure# 2 is an electronic component used for controlling AC voltage to DC voltage conversion. This electronic socket is containing three connections (C-Common Connection, NC Normally Closed Connection and NO Normally Open Connection). The NO Normally open connection giving End Connection be controlled through Arduino 5v).

2. STUDY AREA

Controlling of home appliances using computing devices is not easier task it requires lots of expertise over electrical engineering and computing devices. Various methods are proposed to control home appliances (AC, TV, Fridge, Washing Machine, Tube Light Bulb, Saver, Fan etc) using serial ports and parallel ports or even other hardware interfaces applying Wifi, GSM, Line of Sight, Bluetooth with locally or remotely network/internet connections. One speech recognition based home appliance was controlled that could handle one home appliance with sound only [1, 4]. A wheel chair was controlled for disable peoples using HM2007 chip [2]. Many number of car manufacturing companies have been using Arduino boards for providing various functionalities [6, 7]. To the best our knowledge using Arduino UNO and Infrared and Radio Technologies no such work is done in past which is controlling home appliances. We proposed an efficient and cost effective system that controls appliances of home.

3. DESIGNED MODEL AND ITS WORKING MECHANISM

3.1 IR and RF Designed Model

As shown in figure#3, in this model we have connected IR Receiver and RF 433MHz Receiver with Arduino board for

receiving transmitted signal from IR Remote Control (Transmitter) and RF (Transmitter) for encoding signals. After receiving encoded signals, decoding is being performed using IR Remote.h library and RF Remote.h library. Decoding and comparing is done depends upon the defined value. Related function such as switching on/off comes in action using relay by using digital input or output when matching occurs. Here AC load is used for demonstration using three home appliances. Zero watt bulbs, 100 watt bulb and TV/LCD. In addition to these a small LCD display is connected with Arduino board for displaying the status of performed action whether there is use of IR Technology or RF Technology.

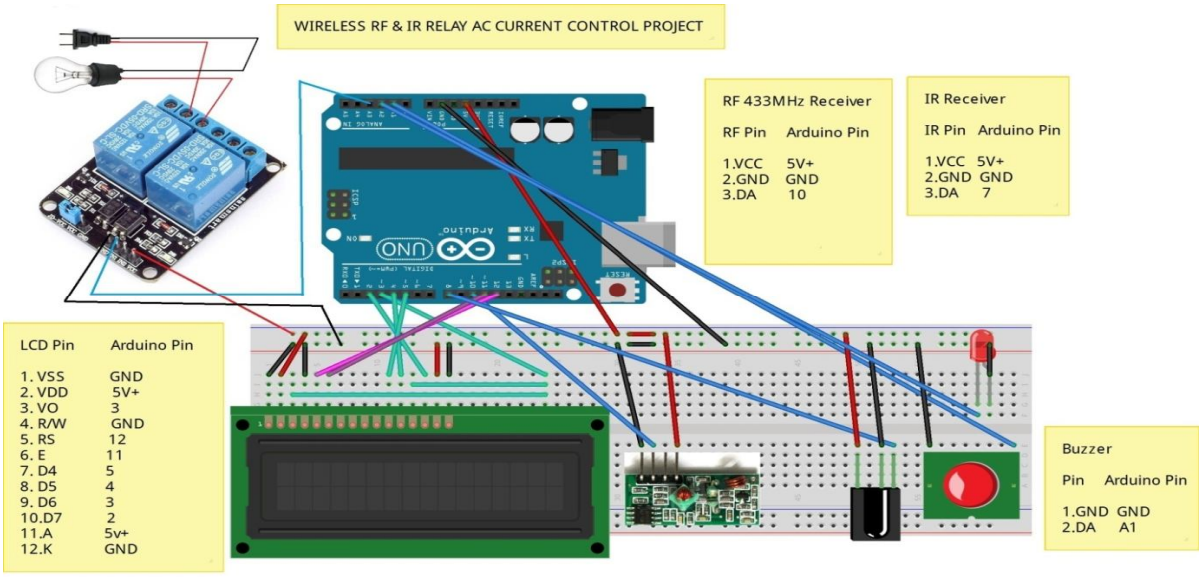

Figure 3: IR and RF Design Model

3.2 RF Transmitter Designed Model

Figure#4 shows the RF Transmitter Model, functionality is added in Arduino board for sketching program using Arduino IDE Technology that may control input/output digital ports like one/zero, on/off, high/low for switching purpose. The range for analog values exists from 0 to 255. Three push buttons are used in this model that control on and off of relay also change RF to IR Mode. RF 433 MHz transmitter is used to transmit signal to RF 433 MHz receiver using DA,VCC and GND with 10, 5V+ GND ports of Arduino. Program/Script is loaded into ROM of Arduino for controlling microcontrollers. With the use of solderless breadboard it has been very easy to built prototype as fast as possible.

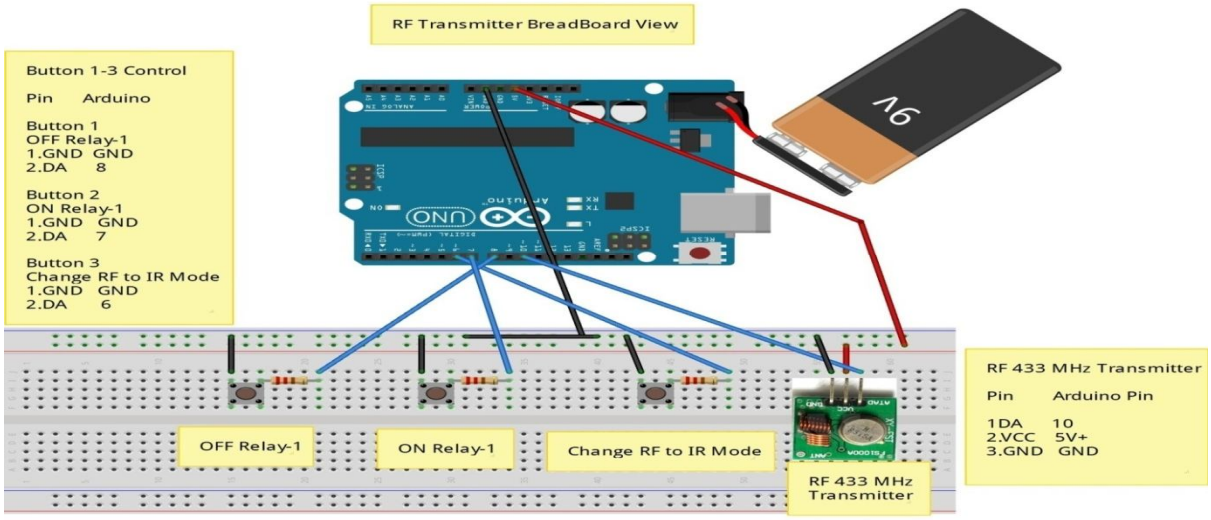

Figure 4 RF Transmitter Design Model

1. HARDWARE AND SOFTWARE REQUIREMENT

4.1 Hardware Specifications

1. Arduino UNO
2. IR Transmitter (Remote Control) and Receiver
3. Relay Module
4. 220 Watts Bulb and Buzzer
5. LCD 12x2
6. RF Module (433 Mhz) - Transmitter and Receiver
7. 220 WattsBulb and Buzzer
8. Button

4.2 Software Specification

1. Arduino-1.6.0-Windows
2. Virtual Wire External Library
3. IR Remote External Library
4. Fritzing

5. CONCLUSION

Controlling home appliance through inexpensive sensor result confirm that using higher power devices like lights bulbs, motors, Television TV, Air Condition AC, Washing Machine etc. It is not easy to work with high powered electronic devices which may be controlled using AC or DC current because of direction of flow of electrons, zero of high frequency, power factor, impedance, resistance etc. As we have designed an efficient circuit using Arduino UNO board for controlling home appliances, the working prototype of proposed IR and RF designed model using inexpensive Arduino Board and Relay to Control 220 Watts electric appliance (High Voltage current from AC light through Arduino 5 V).

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