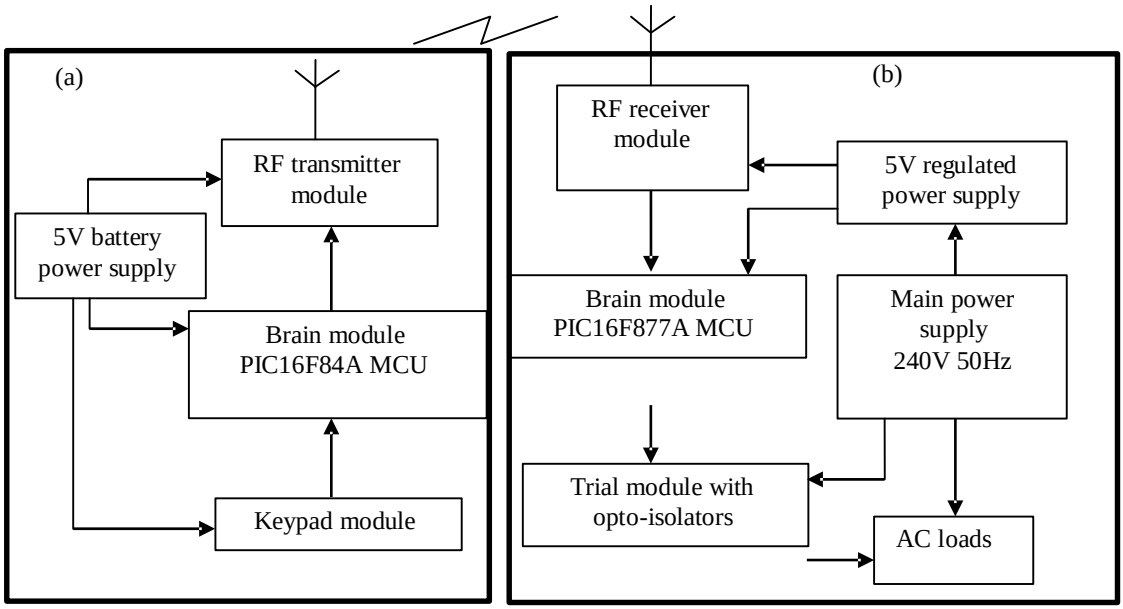
Radio frequency remote controller for domestic AC loads

K.G.H.A. Somasiri* and W.K.I.L. Wanniarachchi
Faculty of Science and Technology, Uva Wellassa University of Srilanka

Introduction

In today's electronic market, there are two primary types of remote control systems available to consumers, they are IR (Infrared) based systems and RF (radio frequency) based systems. The most common type of remote control receiver is the IR based. It works well, but with limitations. With an IR remote control, typically, one must have a very clear line of site from the remote to the device that is trying to control. IR transmitting and receiving systems are inexpensive and are generally reliable. The carrier frequency of such infrared signals is typically in the order of around 38 kHz. In most cases, the IR signals are send only one way, in a low-speed burst for distances of up to 30 feet. Even though IR remotes are the most common due to the low cost and most of the time it used to control a single device, RF remote controls are easier to use because they do not require line of sight and do not have to be aimed at the equipment. The RF remote can also be operated from another room. RF remotes use radio frequencies that travel far and can easily pass through walls and floors and also it can control more than one device with a single remote controller. So it offers a far better range in terms of distance. In this work RF remote controller was developed to control domestic AC appliance like CFL/incandescent bulbs, fans, heaters, single phase motors, pumps, etc…

Methodology



(a) Portable RF remote controller (transmitter)unit

(b) RF receiver/AC load unit

Figure 01: System Overview

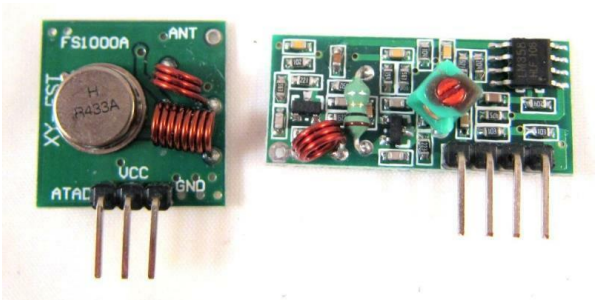


Figure 02: RF receiver and transmitter pair

As shown in above figure the developed system consist with two main units, portable RF transmitter unit and RF receiver/ AC load unit which was fixed in a remote location. The transmitter and the receiver modules use 433MHz radio frequency for data communication. Even though the low power (10mW) transmitter (MX05) was used it covered 20m radius area which is well enough for domestic usage. The used receiver module (MX-FS03) has high sensitivity as -100 dBm which provides better receiving signal/noise ratio for the signal coming through walls.

In both transmitter and receiver ends PIC microcontrollers were used as shown in the figure 01. The built system can control four AC loads remotely. At the transmitter end, four mico-switch keypad inputs were used for selecting particular AC load. The brain module at the transmitter end identifies each input and transmits the data in predefined protocol as shown below.

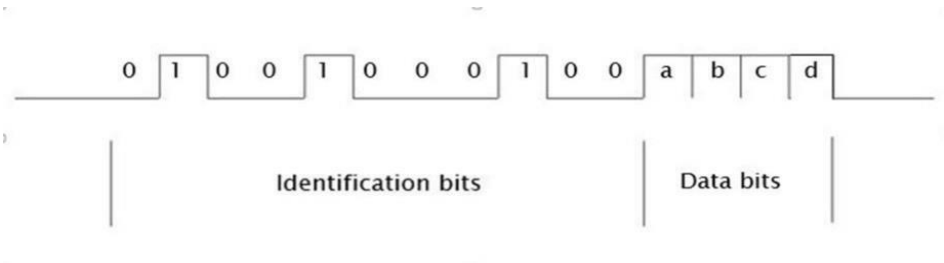


Figure 03: Data transmitting protocol

The first eleven bits were used confirm the data were received by the relevant RF remote unit. The next four bits used to identify the AC load. In this case four AC loads were controlled. This protocol can customize according to the user needs. The received data decode by the brain module at the receiver end and controls (turn on/off) the corresponding opto-isolator (MOC3041). The opto-isolator isolated the circuit that drives DC voltages and AC voltages where it minimize the risk of damages which will happen by short circuiting the AC and DC circuits. The opto-isolator switches the relevant BT139 triac which will leads to control the particular AC load.

Results and Discussion

As shown in figure 02 the built in antenna cannot be used for long distance controlling. To improve the signal strength at the receiver end 18cm wire was attached to the built in antenna. As RF signals are Omni-directional so it doesn't need a specific antenna configuration.

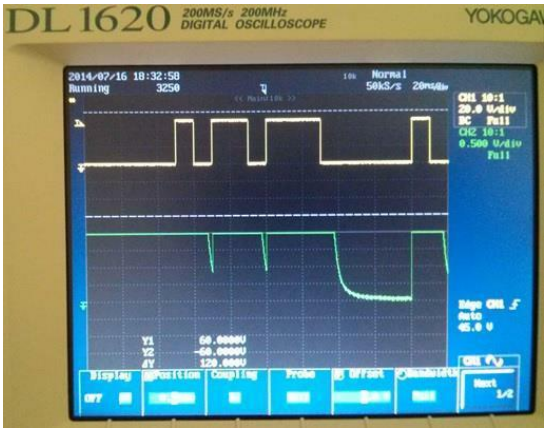


Figure 04: Transmitting signal vs receiving signal

Figure 04 shows the transmitting waveform (white) of the transmitter end and receiving signal pattern at the receiver end after implementing the external antenna to the receiver unit. Accuracy of the remote controller depends on the power supply of the remote. A 9V battery was used in our case. Receiver power supply also needed to rectify smoothly otherwise small voltage changes can reduce the accuracy of the remote.

When comparing IR remotes vs. RF remotes, RF remotes offer great advantages when controlling a device from a longer distance or a device that is tucked away in a cabinet. It allows more flexibility in the install, more reliability, and better ease of use. It is Omni-directional and allows the control of devices in other rooms. So RF system is usually the better choice.

Reference

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