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Design and Fabrication of a Radio Frequency Based Transceiver for Pc to Pc Communication

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Abstract

This research paper deals with the radio frequency (RF) transceiver, an imperative component of the RF communication system, with which communication can be made between two computers. In a wireless network, the device, named transceiver, is connected to the wired network. The transceiver transmits and receives data between wireless network and the wired network infrastructure. The RF-based low power transceivers consume hundreds of milli-watts of power. The output power of the device has been measured. The effect of temperature and surroundings has also been noted. The research is helpful in improvement and development of circuitry in the field of RF communication.

Key words: Wireless Communication, transceiver, RF technology

Introduction

Wireless communication is one of the wonderful successes of electronics. Wireless systems operate by transmission of date through space rather than through wired connection. The primary advantage of wireless communication over wired communication is that communication can take place without laying a wire between transmitter and receiver. This means that users can communicate while moving or while temporarily stationed in some location not attached to the wired net work.

Wireless LANs are designed for much higher data rates. These are designed to connect PC's, shared peripheral devices, large computers etc, within an office building or similar local environment. The use of infrared, RF and ultrasonic technologies have been proposed for wireless communication (Moustafa *et al.* 2003).

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RADAR uses wireless LAN based RF methods to determine the location of the user, wireless LANs have grown in popularity for providing cost effective location based services indoors (Paramvir and Venkata, 2000).

Radio waves are used to transmit radio and television signals. Radio waves have wavelengths that range from less than a centimeter to tens or even hundreds of meters.

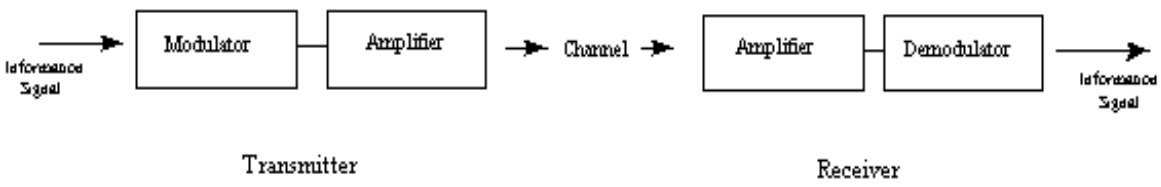
Radio waves can also be used to create images. Radio waves with wavelengths of a few centimeters can be transmitted from a satellite or airplane antenna. The reflected waves can be used to form an image of the ground in complete darkness or through clouds.

The RF energy from wireless LANs does not affect the function of the health of living things. The RF energy is extremely low because these systems operate at very low power (1 watt), less energy than is used for most cellular telephones.

RF communication works by creating electromagnetic waves at a source and being able to pick up these electromagnetic waves at a particular destination. These electromagnetic waves travel through the air at near the speed of light. The wavelength of an electromagnetic signal is inversely proportional to the frequency; the higher the frequency, the shorter the wavelength. RF transmitters are electronic devices that create continuously varying electric current, encode sine waves, and broadcast radio waves. RF transmitters use oscillators to create sine waves, the simplest and smoothest form of continuously varying waves, which contain information such as audio and video.

In academia, there are several projects that involve wireless network on various topics. One of the leading researches in this area is the *AMPS* (Micro Adaptive Multi-domain Power-aware Sensors) project that focuses on developing a complete and flexible power-aware system for wireless sensor networks (Chandrakasan *et al.* 2000).

The basic communication system is shown with the help of the following diagram.



RF transmitters use oscillators to create sine waves, the simplest and smoothest form of continuously varying waves, which contain information such as audio and video. Modulators encode these sign wives and antennas broadcast them as radio signals. There are several ways to encode or modulate this information, including amplitude modulation (AM) and frequency modulation (FM).

The process of separating the original information or signal from the modulated carrier is called demodulation. In the case of amplitude or frequency modulation it involves a device, called a demodulator or detector, which produces a signal corresponding to the instantaneous changes in amplitude or frequency, respectively. This signal corresponds to the original modulating signal. In radio transmission this process is a major function of a receiver, in order to retrieve the desired signal.

In a wireless network, the device, named transceiver, is connected to the wired network. The transceiver transmits and receives data between wireless network and the wired network infrastructure. The RF-based low power transceivers consume hundreds of milli-watts of power with many of chip components (Ajjikuttira et al. 2001). As RF-based wireless technology is not restricted by line of sight, network components do not need to be located in the same room to communicate.

Materials and Methods

The essential parts of the circuit are MAX232, micro-controller AT89C51, the decoder PT2272, voltage regulators L7805 and L7812, the bridge rectifier DB107 and RF transmitter and receiver module. The MAX232 was used in order to convert and invert the level of the logic input and output signal. The microcontroller was used for switching purpose. The decoder PT2272 was used to decode the received signal from the receiver module.

The transmitting unit sends the data through serial port cable from serial port to the MAX232. This guides the received signal to the microcontroller. The microcontroller after verification sends signal to the RF module from which it is transmitted in the form of radio frequency wave.

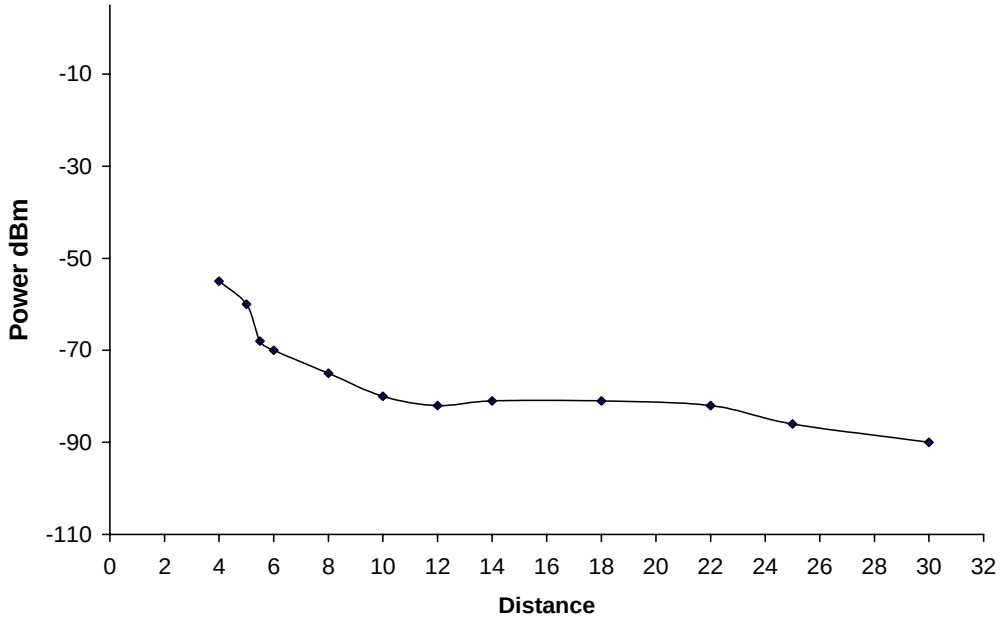
After traveling through free space, when the RF signal reaches the receiver then antenna receives it. The receiving antenna guided this signal towards the decoder IC, named PT 2272. The encoded waveform received is serially fed to PT 2272 at the Data Input Pin (DIN). PT 2272 decodes the received waveform. The waveform is decoded into code word that contains the address, data and. The decoded address bits are compared with the address set at the address input pins. Now if both address matches for two consecutive code words, PT 2272 sends the signal to microcontroller from which it is sent to MAX232. MAX232 sends the received information to the serial port via serial port cable.

Results and Discussion

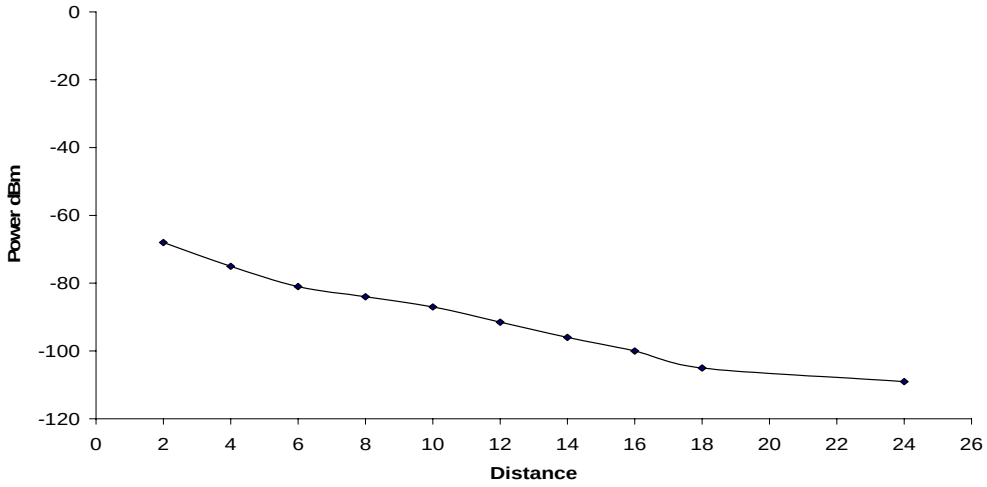
Reliable communication is crucial for successful deployment of wireless networks. Therefore, it is important to understand the impact of environmental conditions on the performance of wireless communication system. Wireless communication is affected by many environmental factors (D. Ganesan, 2002).

To validate the performance of RF communication system, the performance of the system was checked in free space and in the fields where bushes and trees were present. In this, the distance between transmitter and receiver was varied. The signal was given by function generator. The output power was noted with the help of power meter an different distances from the transmitter. The variation of power with distance (in both cases) is shown in the graphs.

Graph # 1: Graph of Power Variation Versus Distance in Free Space



Graph # 2:Graph of Power Variation Versus Distance Cultivated Field

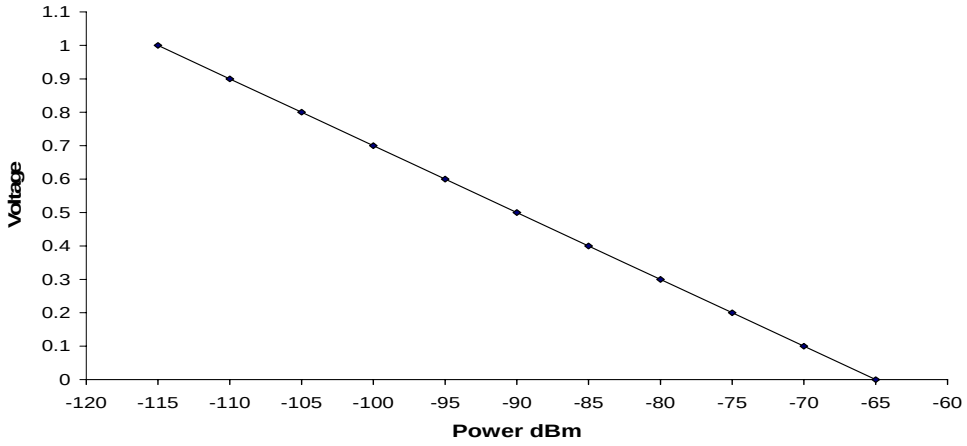


Graph # (1,2) shows how received signal strength drops when the distance between transmitter and receiver increases. The signal strength curves decrease logarithmically with distance.

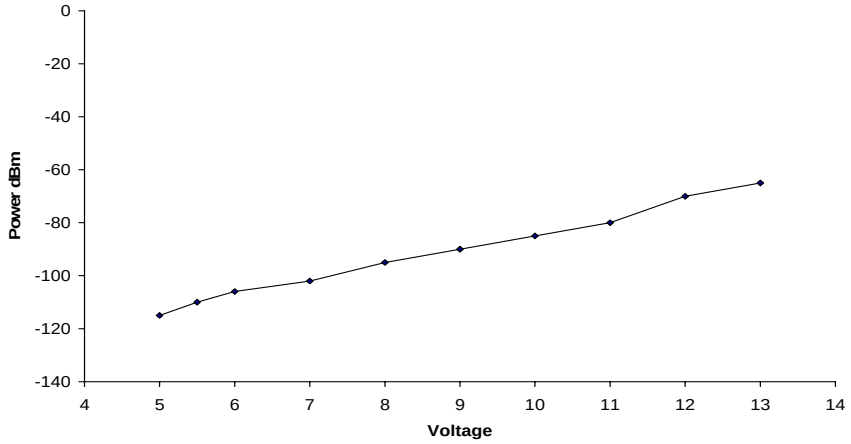
At 12 feet distance, we can notice that there is less power received in the field where bushes and trees were grown. This fact can be seen by comparing graphs at point indicating distance of 12 feet.

The variation in the transmitted and received power of the RF signal with varying voltage was also checked. The studied variation is given in tabular and graphical form as follows.

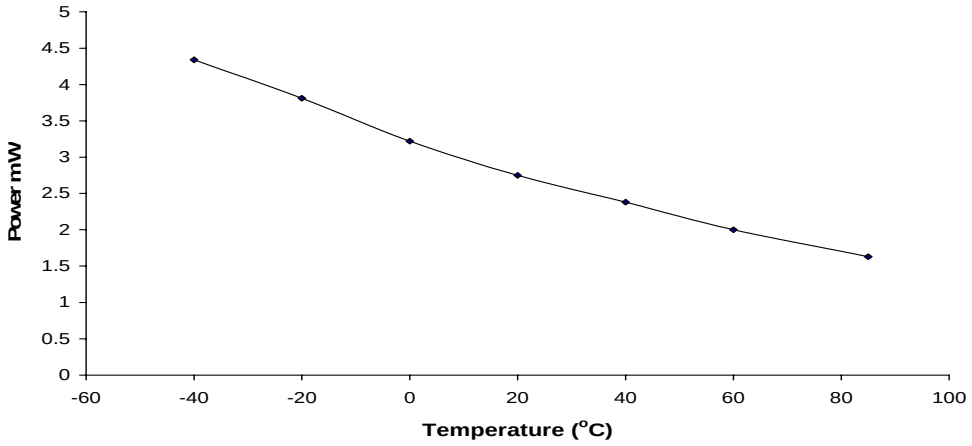
Graph #4: Graph of Receiver Module Power Variation Versus Voltage



Graph #3: Graph of Transmitter Power Variation Versus Voltage



Graph #5: Graph of Power Variation Versus Temperature



The analysis of this graph shows that received signal strength indicator provides an analogue output voltage that is inversely proportional to the RF energy present within the pass band of the receiver.

As the temperature does not remain the same throughout the year and as also it varies from place to place, therefore, it was also essential to determine the behaviour of RF communication system at different temperature. Keeping in view this thing, the performance of the system was tested from low temperature to high temperature.

This experimental work was done in Centre of Advanced Studies In Physics (CASP), Lahore.

For the hardware, the plane earth propagation model predicts a communication range of 30 feet. In practice, however, we observed that a careful indication for reliable communication (-90dBm receive power threshold) in grown field would be 10 feet and 23 feet when there is free space. In our setup, radio waves propagate better with high humidity (i.e., at night and during rain). The transmission range of the RF communication systems decreases significantly in the presence of rain. We attribute the impact of humidity on transmission range to changes in the reflection.

Following conclusions can be made on the basis of experimental study given above.

- RF communication system works better in free space.
- The power of the RF communication system can be varied by varying voltage.
- The transmitted power of the system varies with the variation in temperature.
- RF system works well in conditions with a high humidity (i.e., at night and during rain).

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