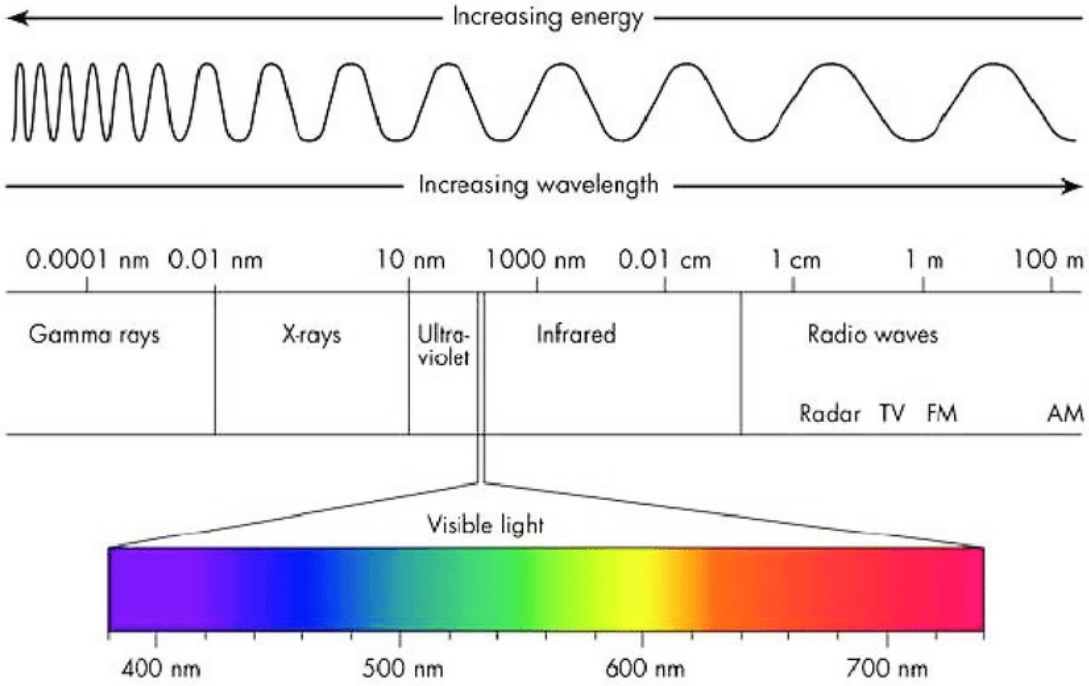
Embedded Systems Interfacing

Lecture one

Digital Input Output Part 1

Infra-Red Communication

Infrared (IR) radiation is simply light that we cannot see, which makes it great for communication. It is electromagnetic radiation (EMR) with wavelengths longer than those of visible light which means that it is undetectable to the human eye.



IR sources are all around us; the sun, light bulbs, or any anything with heat is very bright in the IR spectrum.

Concept Of Operation

IR communication is a common, inexpensive, and easy to use wireless communication technology. For example, when you use your TV remote, an IR LED is used to transmit information to your TV.

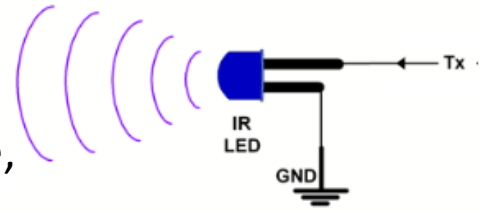
It has many advantages such as:

1. **Safety:** Infrared radiation is not harmful to human beings. Hence infrared communication can be used at any place.

2. **High Speed:** All of electromagnetic radiations travel at the **speed of** 300,000,000 **meters per second**.

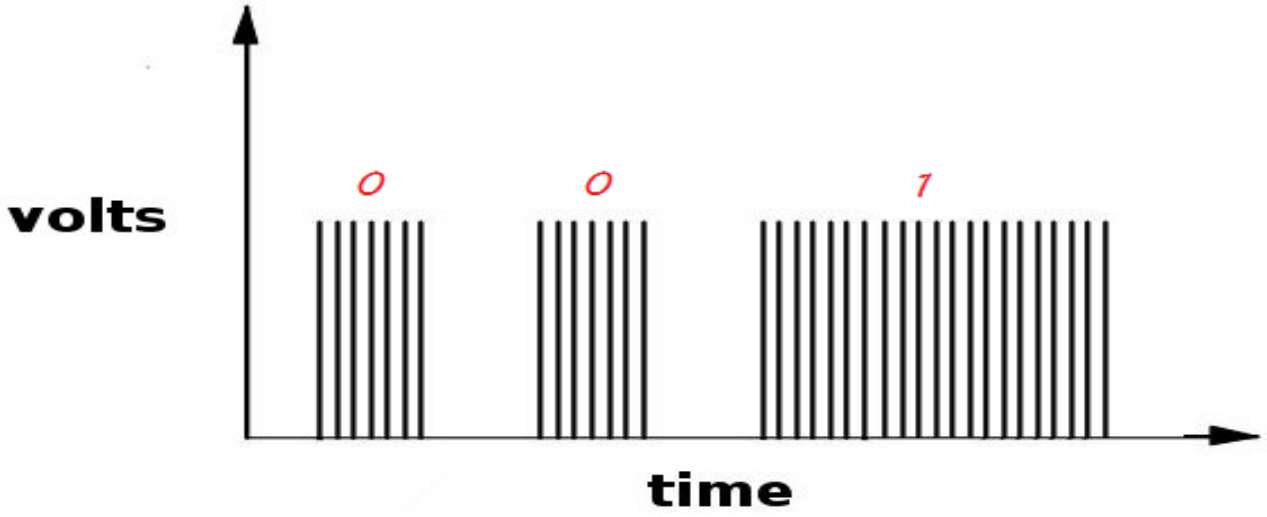
3. **Relatively Long Distance:** Distance between transmitter and receiver in IR communication system is depending on the hardware and most probably ranges in meters. Most of IR systems supports data transfer on a distance up to 10 meters.

IR Transmitter



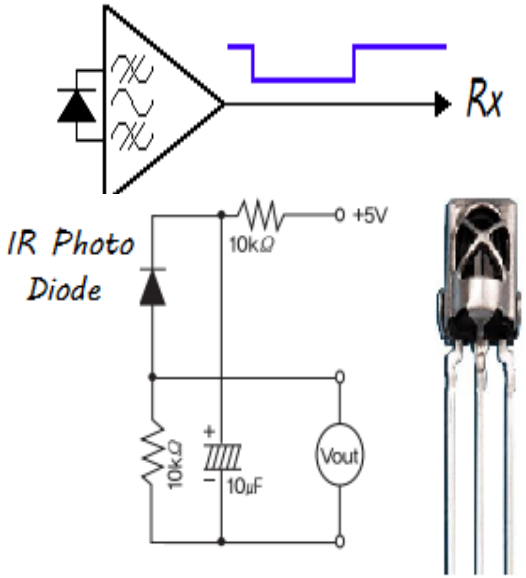
The IR transmitter is a transmitting IR LED that blinks very quickly for a fraction of time. Depending on that fraction of time, the data will be encoded either 1 or 0.

For example, let's say that digital 0 is represented by a fraction of time 0.5 ms and digital 1 is represented by a fraction of time of 2 ms. Assuming the modulation is done on 38KHz frequency; then to send 0 we will blink the LED with frequency 38KHz for 0.5ms. To send 1 we will blink the LED with frequncy 38KHz for 2ms



IR Receiver

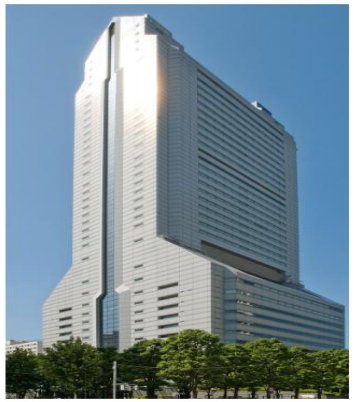
Infrared receivers are also called as infrared sensors as they detect the radiation from an IR transmitter. Normally they come in a form of photodiodes or modules based on photodiodes. Different types of IR receivers exist based on the wavelength, voltage, receiving frequency and packaging. One of the most popular modules are based on 38KHz frequency, they have a digital output that become 0 when an IR radiation of 38KHz is received and become 1 otherwise



IR communication has many protocols identified. These protocols are different mainly in the ecnoding and deconding scheme.

One of the most popular protocol is **NEC** code. Other protocols are exist such as Toshiba Micom Format, Sharp Code, RC5 Code, RC6 Code, R–2000 Code, Sony Format. In our refernce we will focus on NEC protocol.

NEC Protocol

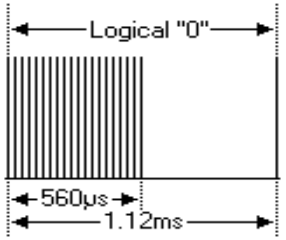


NEC has developed an IR communication protocol which is considered as the most common used one due to its reliability and simplicity.

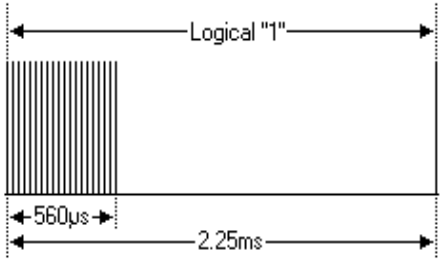
The NEC IR transmission protocol uses pulse distance encoding of the message bits. Each pulse burst is **562.5µs** in length, at a carrier frequency of **38kHz** (26.3µs).

Logical bits are transmitted as follows:

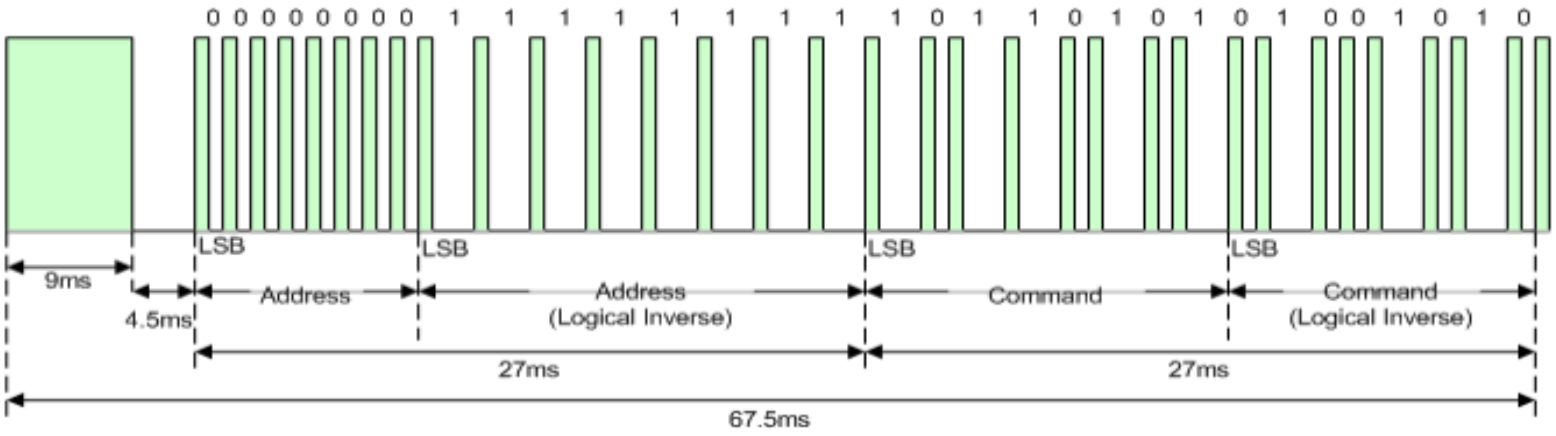
- **Logical 0** – a 562.5µs pulse burst followed by a 562.5µs space, with a total transmit time of 1.125ms



- **Logical 1** – a 562.5µs pulse burst followed by a 1.6875ms space, with a total transmit time of 2.25ms



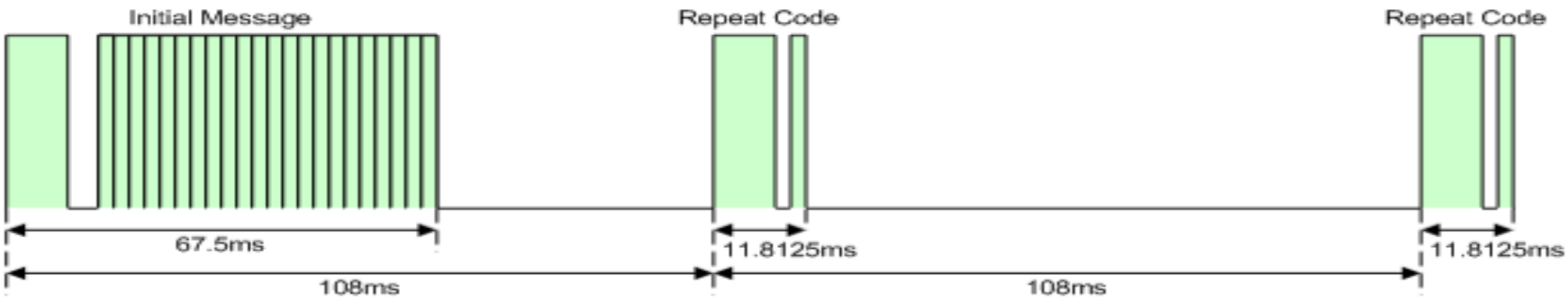
Protocol Frame



When a key is pressed on the remote controller, the message transmitted consists of the following, **in order:**

9ms leading pulse burst
4.5ms space
8-bit address for the receiving device
8-bit logical inverse of the address
8-bit command
8-bit logical inverse of the command
562.5µs pulse burst to signify the end of message transmission.

Repeat Code



If the key on the remote controller is kept pressed, a repeat code will be issued, typically around 40ms after the pulse burst that signified the end of the message.

A repeat code will continue to be sent out at **108ms** intervals, until the key is finally released. **The repeat code consists of the following, in order:**

9ms leading pulse burst
2.25ms space
562.5µs pulse burst to mark the end of the space

Important Note
At the receiver side, the burst is received as 0 and the space is received as 1.

The End …

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