Digital Data Transmission Through Free Space Optical LASER

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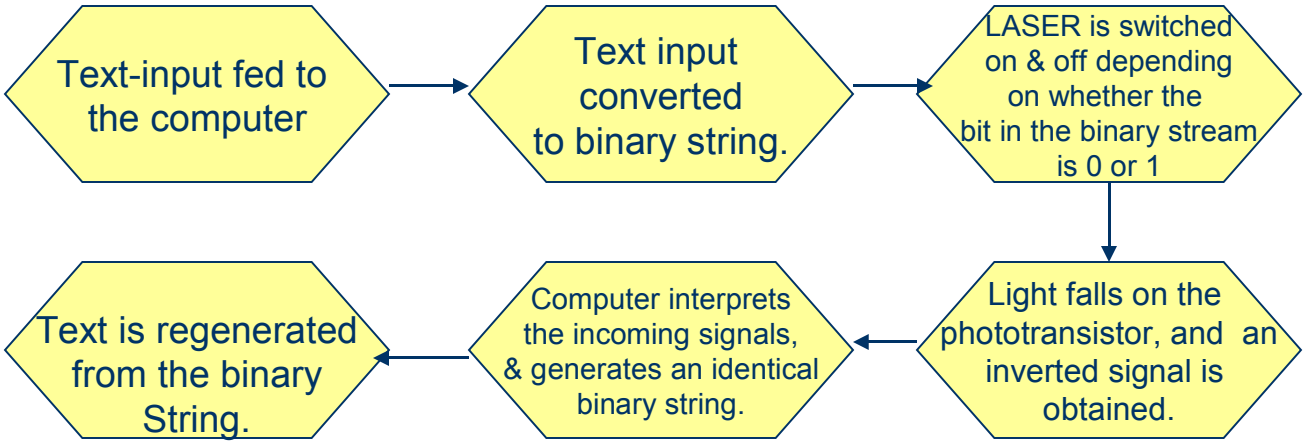
Introduction:

- **Free Space Optics** (FSO) is a telecommunication technology that uses light propagating in free space to transmit data between two points. The optical links usually use infrared laser light, although low-data-rate communication over short distances is possible using LEDs. Distances up to the order of 10 km are possible, but the distance and data rate of connection is highly dependent on atmospheric conditions.

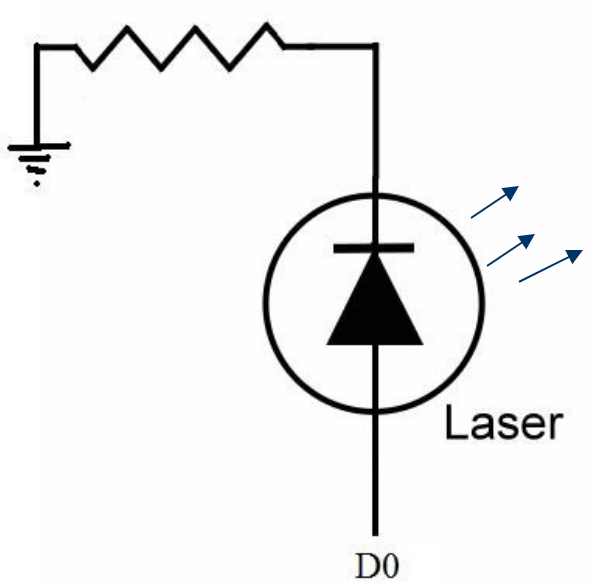
- In this demonstration I have used an ordinarily available semiconductor diode laser to construct the transmitter.
- For the receiver I have used an 2N5777 Phototransistor and a 2N2222 transistor to amplify the signals.

Procedure:

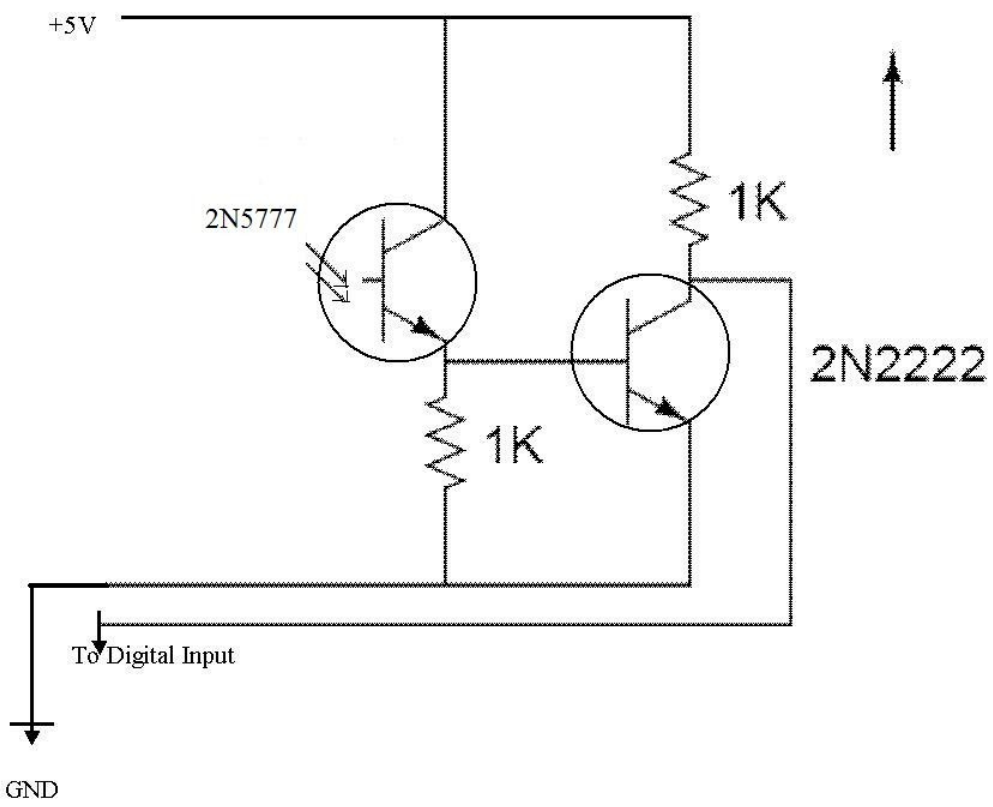

Text-input fed to the computer
Text input converted to binary string.
LASER is switched on & off depending on whether the bit in the binary stream is 0 or 1
Light falls on the phototransistor, and an inverted signal is obtained.
Computer interprets the incoming signals, & generates an identical binary string.
Text is regenerated from the binary String.

Circuit Diagram:

- Transmitter



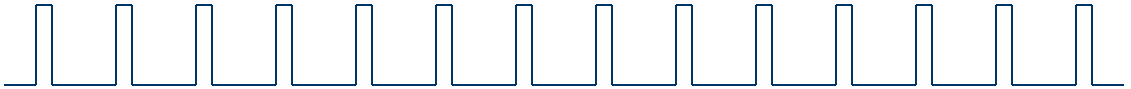
Receiver:



Theory:

Transmitted Signal

Sampling



Received

0 1 0 1 0 1 0 0 0 1 1 1 1 0

Interfacing:

- The interfacing with the PC was done using the “PHOENIX” Interface.
- The LASER was switched on and off using the digital output pin of the “PHOENIX”.
- The incoming signal from the receiver was fed to the digital input pin of the “PHOENIX”.

Applications:

- Though this is just a small scale demonstration, FSO is a very promising point to point communication technology.
- ***Typically scenarios for use are:***
- LAN-to-LAN connections in a city. *example, Metropolitan area network*
- To cross a road or other physical barriers.
- Temporary network installation.
- As an alternative or upgrade addon to existing wireless technologies.
- As a safety addon for important fiber connections (redundancy)
- For communications between spacecraft, including elements of a satellite constellation.
- For interstellar communication.
- The lightbeam can be very narrow, which makes FSO hard to intercept, improving security.

Advantages:

- It’s chief advantages over RF communication and Fiber Optics are:
- Quick link setup.
- No regulatory issues.
- High transmission security.
- High bit rates.
- Low bit error rate.
- No interference.
- Compared to a microwave link, the advantages are that it can support higher bit rates (under good conditions), that its dispersion is lower.
- No need of expensive Optical Fibres.

Limitations:

- For terrestrial applications, the principle limiting factors are:
- Beam dispersion
- Atmospheric absorption
- Rain / fog /snow (attenuation)
- Background light
- Shadowing
- Pointing/alignment stability in wind
- Pollution / smog .
- These factors cause an attenuated receiver signal and lead to higher bit error rates. Atmospheric and fog attenuation, which are exponential in nature, limit practical range of FSO devices to few kilometres.

References:

- Harvard Broadband Communications Laborat
- Wikipedia.

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THANK YOU