

# Designing of a 4 bit transmission system using lasers



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Title: Laser Communication SystemAbstract:

Communication is a common need. But there are places where wired and frequency wave communication is not possible. Laser as a new form of communication can communicate over those barriers.

This paper deals with designing of a 4 bit transmission system using Laser. This is faster and cheaper communication medium. Laser light has higher intensity, efficiency, as well as better visibility and performance quality. It provides a much simpler communication system and reducing the complex wiring.

Introduction:

Communication is an inseparable part of our life. Search for new mediums of communication is an eternal search that is seen in human history. Newer forms of communication solve the constraints of traditional forms of communication. Today, communication demands more bandwidth allocation, power requirement, accuracy and security in everywhere in everyplace. World needs sufficient mediums to communicate solving the hurdles.

As a communication medium wired communication, optical fiber communication, wireless communication over radio frequency has been established so far. A new form of communication medium like laser communication can bring a new era of communication technology where these communication mediums have limitations. Laser communication system do not need wire like wired and optical also do not need licensed

frequency channel like RF. This communication is reliable, economic, and speedy can replace wireless, fiber optic communication. Laser communication is interesting and important as it can be used in general as well as for confidential data transmission even for inters building communication like in office or in a conference room. Laser is attractive in a sense that it has features like worldwide availability, unlicensed bandwidth, non-interference with radio bands.

Introducing laser communication is not that easy. In the past data were converted into analog waves but the new communication form will have different way of sending data likewise laser communication converts data into laser light.

Many researches have been conducted over this topic. Most of the laser communication research was done on earth station and outer space satellites. Other researches done on laser based communication are either costly or inefficient. So there remains scope and need for further research.

This paper shows a system that can send data over laser beam using a simpler and cheap circuit. Numerical data from 0-9 mapped into 4 bit binary and send over laser beam which taking as a base can send all computer data over laser. This paper did not conducted research on the laser directionality. No solution is given on the correct positioning of the laser beam.

In the next section, related works and then Laser communication system providing components, transmitter and receiver design, constraints and future work can be found. Finally, Section 4 summarizes contributions.

## 2. Laser Communication System:

A laser communication system requires a Transmitter and a Receiver. For better performance 4 laser torch is used so the system can give send and receive 4 parallel bit. These increases speeds by 4X. For demonstration purpose two transmitter and receiver circuit is given. The first transmitter and receiver coded numeric number 0-9 manually and in second transmitter and receiver used encoder and decoder.

### 2.1 Components:

**Laser Torch:** A process of optical amplification is used in laser to emit light based on the stimulated of photons. It is highly directed beam/intense light and power efficient.

**Resistors:** It restricts the flow of current. It is used to restrict excessive power from destroying the laser torch.

**Voltage Source:** It provides voltage difference. Power source of the circuit.

**Buttons:** Enables and restrict power flow. It is used to represent number 0-9.

**LED bulb:** Glows when power is supplied. Used to show output.

**Encoder:** Converts decimal to binary.

**Decoder:** Converts binary to decimal.

**Photodiode:** This device provides current flow if gets hit by a light beam. Used to detect laser beam.

2. 2 Transmitter Design:

The first transmitter circuit requires a 1 voltage source, buttons 0 - 9, 4 resistor, 5 4input OR gate, 1 2input OR gate and 4 lasers. Button 0-9 represents numeric 0-9. The input 0-9 mapped as the figure below.

To construct circuit for the mapped input the equation user is:

$$\text{Laser 1} = 1 \text{ (OR) } 5 \text{ (OR) } 8 \text{ (OR) } 0 = 1 + 5 + 8 + 0$$

$$\text{Laser 2} = 2 \text{ (OR) } 6 \text{ (OR) } 9 \text{ (OR) } 0 = 2 + 6 + 9 + 0$$

$$\text{Laser 3} = 3 \text{ (OR) } 7 \text{ (OR) } 8 \text{ (OR) } 9 \text{ (OR) } 0 = 3 + 7 + 8 + 9 + 0$$

$$\text{Laser 4} = 4 \text{ (OR) } 5 \text{ (OR) } 6 \text{ (OR) } 7 \text{ (OR) } 8 \text{ (OR) } 9 \text{ (OR) } 0 = 4 + 5 + 6 + 7 + 8 + 9 + 0$$

The constructed circuit is given below.

T1

The input can also be through by using an encoder. The second transmitter circuit requires 1 voltage source, 4 Resistor, 4bit encoder, buttons 0-9 and 4 lasers. The constructed circuit is given below.

T2

2. 3 Receiver Design:

The first receiver for the first transmitter requires 1 voltage source, 4 photodiode, 4 NOT gate, 4 resistor, 3 2input AND gate, 7 4input AND gate

and 10 led. The input of 4 photodiode mapped into 0-9 led representing numerical 0-9 like below.

To construct circuit for the mapped input the equation user is:

$$\text{Led 1} = \text{Laser 1 (AND) Laser 4}' = 1 * 4'$$

$$\text{Led 2} = \text{Laser 2 (AND) Laser 4}' = 2 * 4'$$

$$\text{Led 3} = \text{Laser 3 (AND) Laser 4}' = 3 * 4'$$

$$\text{Led 4} = \text{Laser 1}'(\text{AND) Laser 2}'(\text{AND) Laser 3}'(\text{AND) Laser 4} = 1' * 2' * 3' * 4$$

$$\text{Led 5} = \text{Laser 1 (AND) Laser 2}'(\text{AND) Laser 3}'(\text{AND) Laser 4} = 1 * 2' * 3' * 4$$

$$\text{Led 6} = \text{Laser 1}'(\text{AND) Laser 2 (AND) Laser 3}'(\text{AND) Laser 4} = 1' * 2 * 3' * 4$$

$$\text{Led 7} = \text{Laser 1}'(\text{AND) Laser 2}'(\text{AND) Laser 3 (AND) Laser 4} = 1' * 2' * 3 * 4$$

$$\text{Led 8} = \text{Laser 1 (AND) Laser 2}'(\text{AND) Laser 3 (AND) Laser 4} = 1 * 2' * 3 * 4$$

$$\text{Led 9} = \text{Laser 1}'(\text{AND) Laser 2 (AND) Laser 3 (AND) Laser 4} = 1' * 2 * 3 * 4$$

$$\text{Led 0} = \text{Laser 1 (AND) Laser 2 (AND) Laser 3 (AND) Laser 4} = 1 * 2 * 3 * 4$$

The constructed circuit is given below.

R1

The second receiver 2nd transmitter circuit requires 1 voltage source, 4 photodiode, 10bit decoder, 10 resistor and 10 led.

The constructed circuit is given below.

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R2

#### 2. 4 Constraints:

The factors such as beam dispersion, background light, shadowing, rain, fog, snow, pollution, smog causes an attenuated received signal and lead to higher bit error rates. For longer distance communication high power laser is required which is costly. The laser and photodiode position have to be correct which gets difficult with longer distance.

#### 2. 5 Future work:

To provided data computer or any smart device is a remarkable source. Microcontroller will make it more sophisticated. 4 bit data transfer through 4 lasers with TDM (Time Division Multiplexing) can give a super speed and reliability. Improved design of this system can be used to transmit confidential data over long distance with more powered lasers.

#### 3. Related work:

#### 4. Conclusion:

We explored the use of light based carriers for transfer of information. This paper emphasis on the study of laser as a communication medium. Upon study a newer form of communication medium like wireless, optical fiber etc can be established.

Laser Torch Based Transmission and Reception are cheaper and simpler in construction. Blue-Tooth can also be used for transmission and Reception purpose, but its range is small compared with their price.

5. References: