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Text transmission through Laser

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Abstract

In this project, text is being sent to one PC to another PC through laser. Due to its low noise ratio, it is one of the most well suited communication medium. We use Arduino to program laser to send binary bits to solar panel which then gives a character based on what binary numbers has been sent.

Introduction

Laser communications systems are wireless connections through the atmosphere. They work similarly to fiber optic links, except the beam is transmitted through free space. While the transmitter and receiver must require line-of-sight conditions, they have the benefit of eliminating the need for broadcast rights and buried cables. Laser communications systems can be easily deployed since they are inexpensive, small, low power and do not require any radio interference studies. The carrier used for the transmission signal is typically generated by a laser diode.

This paper tells about the microcontroller based communication system using laser light as a device to transmit data. Here the microcontroller is connected with a PC where the PC act as an input to the laser which gives input text to transmit with the help of laser medium. After successfully implementing this project, we found that the data transmission through laser light has achieved great success while comparing with the conventional communication system.

Components

1. **Arduino:** Act as a microcontroller, the central controller for the whole unit of smart cart. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, and a reset button. The board can be programmed with Arduino Software (IDE). The board can operate on an external supply from 6 to 20 volts.
2. **Laser:** The laser module can be directly powered from an Arduino output pin as it only draws 30 mA from the processor that has outputs rated for 40 mA.
3. **Solar panel:** At the receiving end, there is a small solar panel which acts as the receiver. It converts the laser beam energy into a current which flows through the second Arduino.
4. **Computers:** 2 PCs with keyboard and monitor are needed for this project. One is for giving input and other one is for getting output.

Diagram

Following diagram shows the whole system of the project. We give the input in the keyboard of PC1 and get the output from the monitor of PC2.

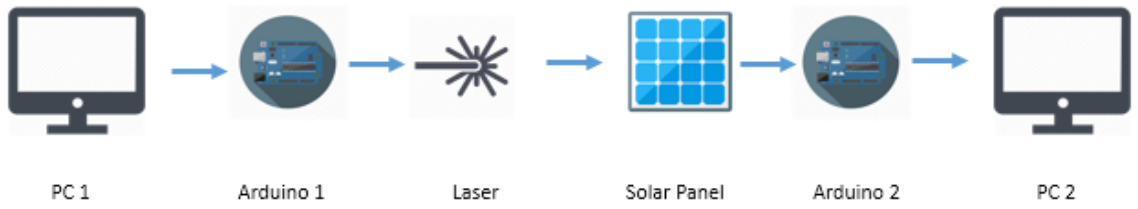


Figure 1 Data transmission

Working Principle

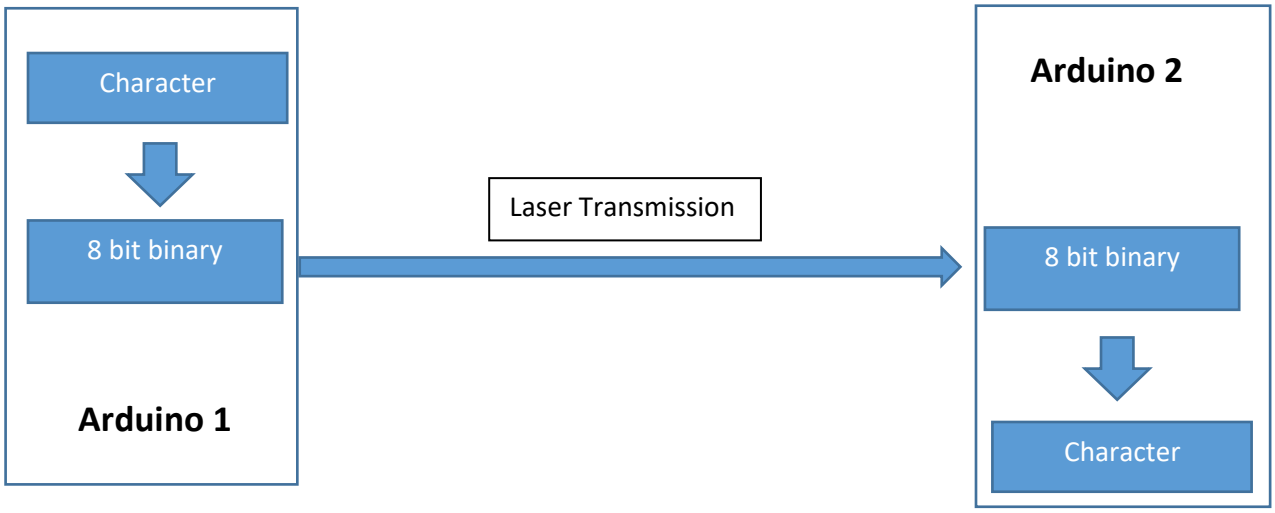
The working principle of the Laser communication system is very similar to fiber optic links, but the difference is that the beam is transmitted through free space. A simple laser communication (LC) system transmits serial data through air from a transmitter to a receiver via a laser beam.

The whole system consists of 3 parts. (1) Transmitter end, (2) Receiver end, (3) Transmission medium.

(1) **Transmitter End:** The transmitter consists of a PC with a keyboard and an Arduino. The input is given through the keyboard (example: AbCdE). The Arduino (1) converts the text into 8 bit binary. On the transmit side, a UART must create the data packet appending sync and parity bits and send that packet out the transmission line with precise timing via a laser beam.

(2) **Transmission medium**: The transmission medium is nothing but air. After transmitting, the information containing laser travels through the air and incident upon the solar panel of the receiver.

(3) **Receiver End:** The receiver contains a small solar panel, an Arduino and a PC with a monitor. When the laser beam is incident on the solar panel, it converts the data containing light signal into a current and this current flow through the Arduino (2). This Arduino converts the bits into corresponding alphanumeric characters and the computer monitor shows them. This is our desired output.



Sending End Arduino Algorithm

At the sending end, Arduino-1 is used to convert the alphanumeric characters into 8 bit ASCII code. For the code, we have to do the followings:

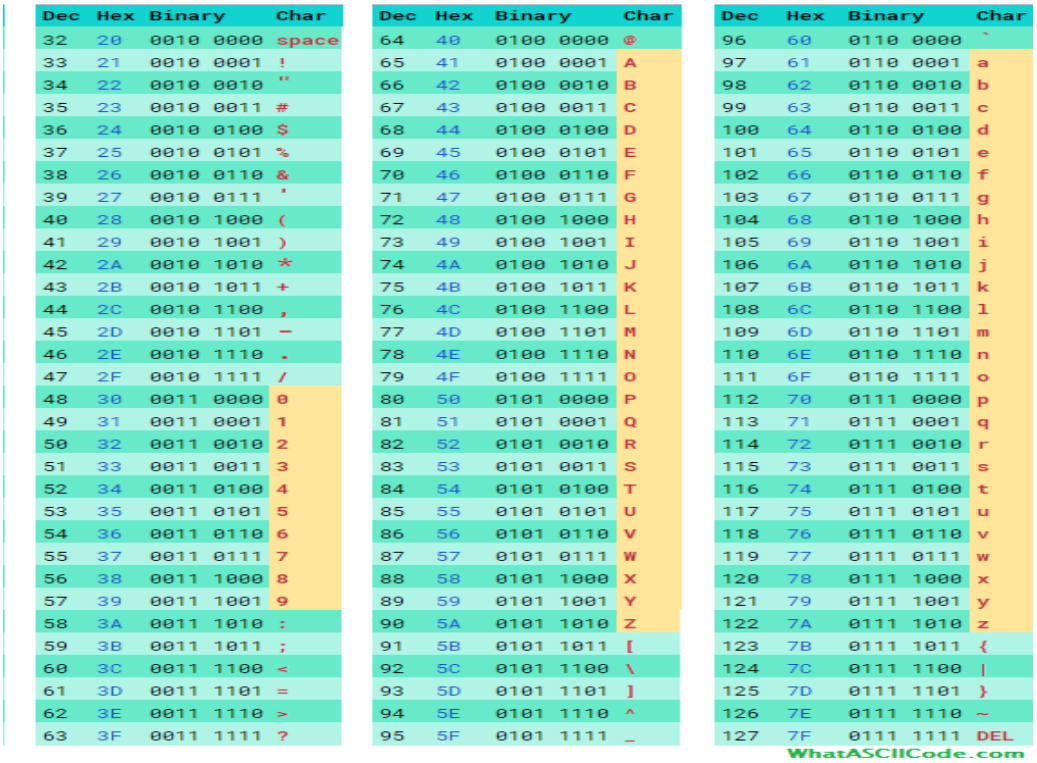
i. Take the characters as input
ii. Convert the characters into ASCII code of which the start bit is 1
iii. The delay is set 10ms between two consecutive bits
iv. Set the delay of 100ms between two consecutive Bytes.
v. Upload the code

Receiving End Arduino Algorithm

Laser light is sent to the solar panel and solar panel now receives the data. The solar panel is connected with the A0 pin and ground. After checking the value of the solar panel using built in "AnalogReadSignal" both when there is no light on the laser, and when there is light on the laser. We then set the THRESHOLD Value for the solar panel by examining the value from "AnalogReadSignal".

In setup, we consider the solarpin A0 as input and fix the Serial.begin to 9600. Then we take the reading from the solar pin. If the Reading from the solarpin is greater than the threshold, then we consider it to be '1', otherwise it is considered as '0'. These binary bits are stored in an array.

We set the delay to '100' to match the delay of the sending side. Anything other than 50, the interpretation will not be right and it can produce false result. The binary bits are converted to ASCII value. Then the ASCII values give us suitable characters.



Dec	Hex	Binary	Char
32	20	0010 0000	space
33	21	0010 0001	!
34	22	0010 0010	"
35	23	0010 0011	#
36	24	0010 0100	$
37	25	0010 0101	%
38	26	0010 0110	&
39	27	0010 0111	'
40	28	0010 1000	(
41	29	0010 1001	)
42	2A	0010 1010	*
43	2B	0010 1011	+
44	2C	0010 1100	,
45	2D	0010 1101	-
46	2E	0010 1110	.
47	2F	0010 1111	/
48	30	0011 0000	0
49	31	0011 0001	1
50	32	0011 0010	2
51	33	0011 0011	3
52	34	0011 0100	4
53	35	0011 0101	5
54	36	0011 0110	6
55	37	0011 0111	7
56	38	0011 1000	8
57	39	0011 1001	9
58	3A	0011 1010	:
59	3B	0011 1011	;
60	3C	0011 1100	<
61	3D	0011 1101	=
62	3E	0011 1110	>
63	3F	0011 1111	?
64	40	0100 0000	@
65	41	0100 0001	A
66	42	0100 0010	B
67	43	0100 0011	C
68	44	0100 0100	D
69	45	0100 0101	E
70	46	0100 0110	F
71	47	0100 0111	G
72	48	0100 1000	H
73	49	0100 1001	I
74	4A	0100 1010	J
75	4B	0100 1011	K
76	4C	0100 1100	L
77	4D	0100 1101	M
78	4E	0100 1110	N
79	4F	0100 1111	O
80	50	0101 0000	P
81	51	0101 0001	Q
82	52	0101 0010	R
83	53	0101 0011	S
84	54	0101 0100	T
85	55	0101 0101	U
86	56	0101 0110	V
87	57	0101 0111	W
88	58	0101 1000	X
89	59	0101 1001	Y
90	5A	0101 1010	Z
91	5B	0101 1011	[
92	5C	0101 1100	\
93	5D	0101 1101	]
94	5E	0101 1110	^
95	5F	0101 1111	_
96	60	0110 0000	`
97	61	0110 0001	a
98	62	0110 0010	b
99	63	0110 0011	c
100	64	0110 0100	d
101	65	0110 0101	e
102	66	0110 0110	f
103	67	0110 0111	g
104	68	0110 1000	h
105	69	0110 1001	i
106	6A	0110 1010	j
107	6B	0110 1011	k
108	6C	0110 1100	l
109	6D	0110 1101	m
110	6E	0110 1110	n
111	6F	0110 1111	o
112	70	0111 0000	p
113	71	0111 0001	q
114	72	0111 0010	r
115	73	0111 0011	s
116	74	0111 0100	t
117	75	0111 0101	u
118	76	0111 0110	v
119	77	0111 0111	w
120	78	0111 1000	x
121	79	0111 1001	y
122	7A	0111 1010	z
123	7B	0111 1011	{
124	7C	0111 1100	|
125	7D	0111 1101	}
126	7E	0111 1110	~
127	7F	0111 1111	DEL

WhatASCIICode.com

Figure 2 Decimal, Hex, Binary, Char chart

Experiment and Result

The experiment has been conducted in different conditions. Delay time determines how fast the data will be sent. If it is low, the data can go quickly.

The final output was satisfactory as we were able to send Sentences through one PC to another PC without any fault. We have used “CoolTerm” software to save the data in a text file.

The system is tested for 2 ft, 5 ft and 10 ft distance and every time the output showed the correct sentences /word that has been sent through laser.

Advantages of Laser Communication

1. The advantage of laser communication is that it allows very fast communication service between two or more devices than other modes of communications.
2. Laser communications systems can be easily deployed since they are inexpensive, small, low power and do not require any radio interference studies. The carrier used for the transmission signal is typically generated by a laser diode.
3. The transmitting and receiving station are smaller and lighter for given range. Less overall power is required for the given distance and data rate. Higher data rate may be achieved for given distance and power output.
4. Signals can be reproduced without distortion, even in long distances. So the system could be used for communication and cable television transmission.

Challenges

1. The noise in photodiodes: The main sources of noise are dark current noise, shot noise and thermal noise in a photodiode. The dark current noise arises due to dark current which flows in the circuit when the solar panel is not in illuminated environment under bias condition.
2. Atmospheric Attenuation: In general, attenuation is the relation between transmitted signal power and received signal power as follow

   Attenuation=10log (Ptransmitted / Preceived)

Conclusion

Lasers are used today in domestic and international network. These optical systems eventually provide the bandwidth that is in such demand. Laser Torch Based Transmission and Reception are cheaper and simpler in construction than RF transmitter and receiver. Infra-Red and Blue-Tooth can also be used for transmission and Reception purpose, but their range is small compared with their price.

On taking the business perspective of the improvements in these area will lead to the better communications at low cost, low loss of the signals, better performance, negligible time delay, better security, less complex systems, will increase the reliability of the communications, more and more application areas (such as medical, lighting and many more).