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Laser Based Wireless Image Transmission System Using Base 64 Algorithm

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ABSTRACT: Our project is basically a LASER (Light Amplification by Stimulated Emission of Radiation) communication system which transmits the signal through a laser beam. They work for clear line-of-sight conditions between transmitter and receiver unit. Laser based communication is a potential technique for its high bandwidth, high data transfer rate, reasonably large range, small size, low power consumption, immunity to interference and jamming and covertness of transmission. Sending and receiving the data using laser to encode and transmit the data is faster than other modes of communication.

KEYWORDS: Laser, signal, interference, transmission, communication.

I. INTRODUCTION

Today, lasers have become one of the world's most important technologies in industries ranging from information technologies to telecommunication, medicine, consumer electronics, law enforcement, military equipment, entertainment and manufacturing. Our project is based on LASER communication system which transmits the signal through a laser beam. In the atmosphere, the Laser communications systems are connected through a wireless connection which is focused on decreasing the noise ratio in optical communication system. Data transmission using laser light is superior in many aspects to the conventional communication system. Throughout the world, it is now being used to transmit audio, image, video and other signals as light waves.

One of the interesting developments in recent years in the field of telecommunication is the use of laser light to carry information over large distances. It has been proved that light wave transmission through laser light is superior to transmission through other lights. Laser communication is much better than radio waves as light wavelength are packed much more tightly than radio and transmit more information per second with a stronger signal. Laser based communication is a potential technique for its high bandwidth, high data transfer rate, reasonably large range, small size, low power consumption, immunity to interference and jamming and covertness of transmission. A remarkable feature of laser is the concentration of its energy to extremely high intensities that's remaining almost constant over long distances because of low divergence. The main advantage of this system is high reliability as it is impossible to track the data on the way of transmission. That is why this design can be used for transmitting confidential data as well as for general conversation. Sending and receiving the data using laser to transmit the data is faster than other modes of communication.

II. LITERATURE SURVEY

In 2020, Mrs.VarshaPatil, RevanPatil, OmkarTingre, KaushalPathak, AniketJadhav, SomeshwarGavhave, VenkateshKapare published a paper on "Image and Audio Transmission through Laser". This paper aims on the realization of transmission-reception system to transfer image via Laser without a guiding medium. It results in faster transmission of data with minimum power consumption.

In 2019, AyadQaysAbdulkareem, Isam Salah Hameed and Ahmed Salah Hameed published "A Novel and Fully Synchronized Laser-based Wireless Communication System". This paper says that data transfer is obligated to the line of sight condition which requires the laser element to be accurately positioned in the path of the receiving element. This work provides an applicable data transmission for remote areas where mobile communication towers is hard to be setup.

In 2019, Tarek A. Eldallal, Heba A. Fayed, Moustafa H. Aly published a paper on "Data transmission prototypes through wireless optical communication link using Arduino microcontroller". Here we see that the data transmission



models are implemented using a programmed microcontroller “Arduino Uno”. The use of Arduino microcontroller offers a more accurate transmission of higher quality.

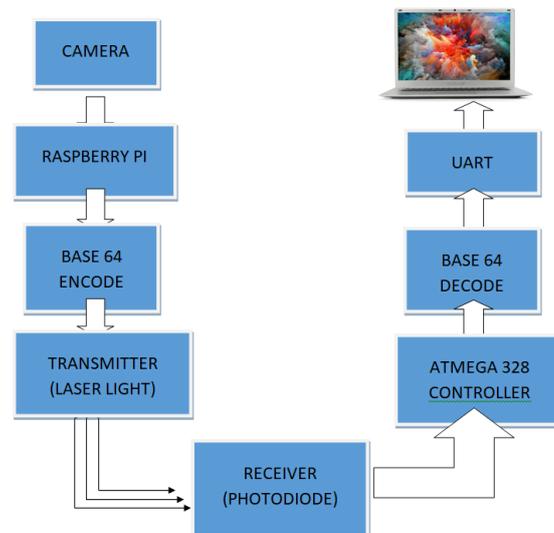
In 2017, VarchasSrinivas, RiteshAgarwal, ShashankShinde, Mr. N. S. Kulkarni developed a paper on “Transmission of Audio, DTMF and Serial Data Using LASER”. This paper provides knowledge about the transmission of high-speed computer network data has been demonstrated using free-space LASER communication. The paper addresses a technology that can be used for wireless line-of-sight communication.

In 2017, the author Abubaker M. SaeedHamed established a paper on “Data transfer by laser beam light using parallel connection method”. In this paper he says that Optical communication is one of the most promising ways to achieve highest receiver sensitivity, excellent spectral efficiency and longest transmission distance.

III. SYSTEM OVERVIEW

The main aim of our project construction is to build a communication system using laser which can be built by the general people quite easily with the available equipment. Generally RF signals are used to communicate between two stations but here we use laser as the communicating medium. With the base64 algorithm, image is transmitted through laser and received by photo diode. In the transmitting side we have camera, raspberry pi, Laser source, external SD card and in the receiving side we have photodiode, Atmega328 controller, UART, PC system. This system involves transmission and reception of a large amount of information in a short period of time. Data transfer is done through serial bit by bit technique.

IV. PROPOSED METHODOLOGY



At first, camera for recording an image of an object on a light-sensitive surface is interfaced to Camera serial interface port of raspberry pi board. Laser module is connected to GPIO pins of raspberry pi. The laser’s light wave’s travel together with their peaks all lined up, or in phase. The laser we used is general purpose 650nm wavelength.

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. Raspberry pi captures the image using the camera and it stores the captured image in its memory. Then it encodes the image using base 64 encode and it sends the data via laser light source. In serial transmission, the various bits of data are transmitted serially one after the other. In receiver, photo diode receives the data in the atmega328 controller and then decodes it. Photodiodes are similar to regular semiconductor diodes except that they may be either exposed or packaged with a window or optical fiber connection to allow light to reach the sensitive part of the device. Controller sends the data to PC system through UART to view the received image.



V. PROPOSED PROJECT

This project consists of both hardware and software components. The transmitter side of the hardware has a Raspberry Pi 3 and a laser. The Raspberry pi 3 has a dedicated camera input port that allows user to record videos and high-resolution photos. A laser light is used as the transmitting source to transfer the data. The receiver side of the hardware has a photodiode, Atmega328P microcontroller, UART and a PC system. The photodiode is a semiconductor p-n junction device that converts light into an electrical current. The current is generated when photons are absorbed in the photodiode.

An Atmega328P microcontroller is an 8-bit microcontroller with AVR Architecture. It is a low power microcontroller which helps to decode the program sent from the transmitter side. A UART is a computer hardware device for asynchronous serial communication which sends data bits one by one, from the least significant to the most significant, framed by start and stop bits so that precise timing is handled by the communication channel. A PC system is used to view the final image after the transmission process. In the software part, the commands are given using the Python language. Here we use Base64 encoding algorithm in the transmitter side and Base64 decoding algorithm in the receiver side.

VI. EXPERIMENTAL RESULT

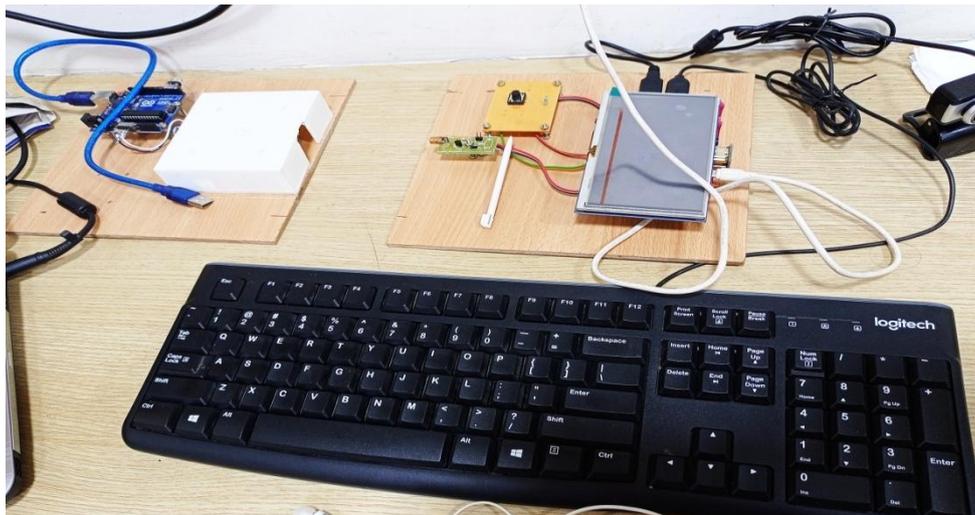


Fig.1 Test setup of project

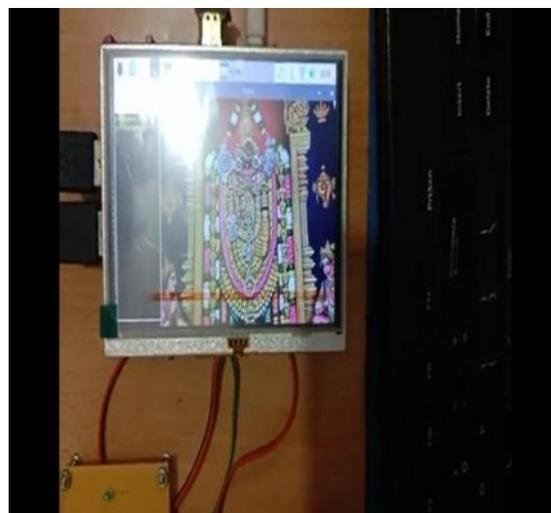


Fig. 2 Transmitter side view



According to our Base64 encoding algorithm, the image is captured with the help of the camera and it is displayed on the raspberry pi screen using written commands in python language and then the image is stored in the external SD card. The image is resized to lower resolution and gets converted to grayscale image. Image that is about to transmit can be seen in following figure.

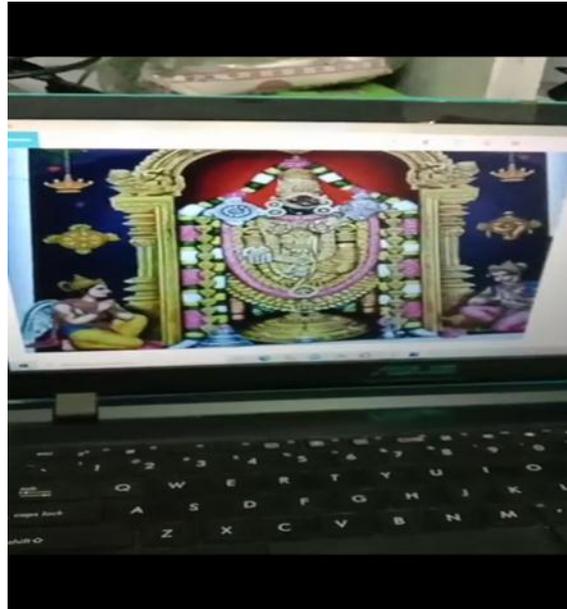


Fig. 3 Receiver side view

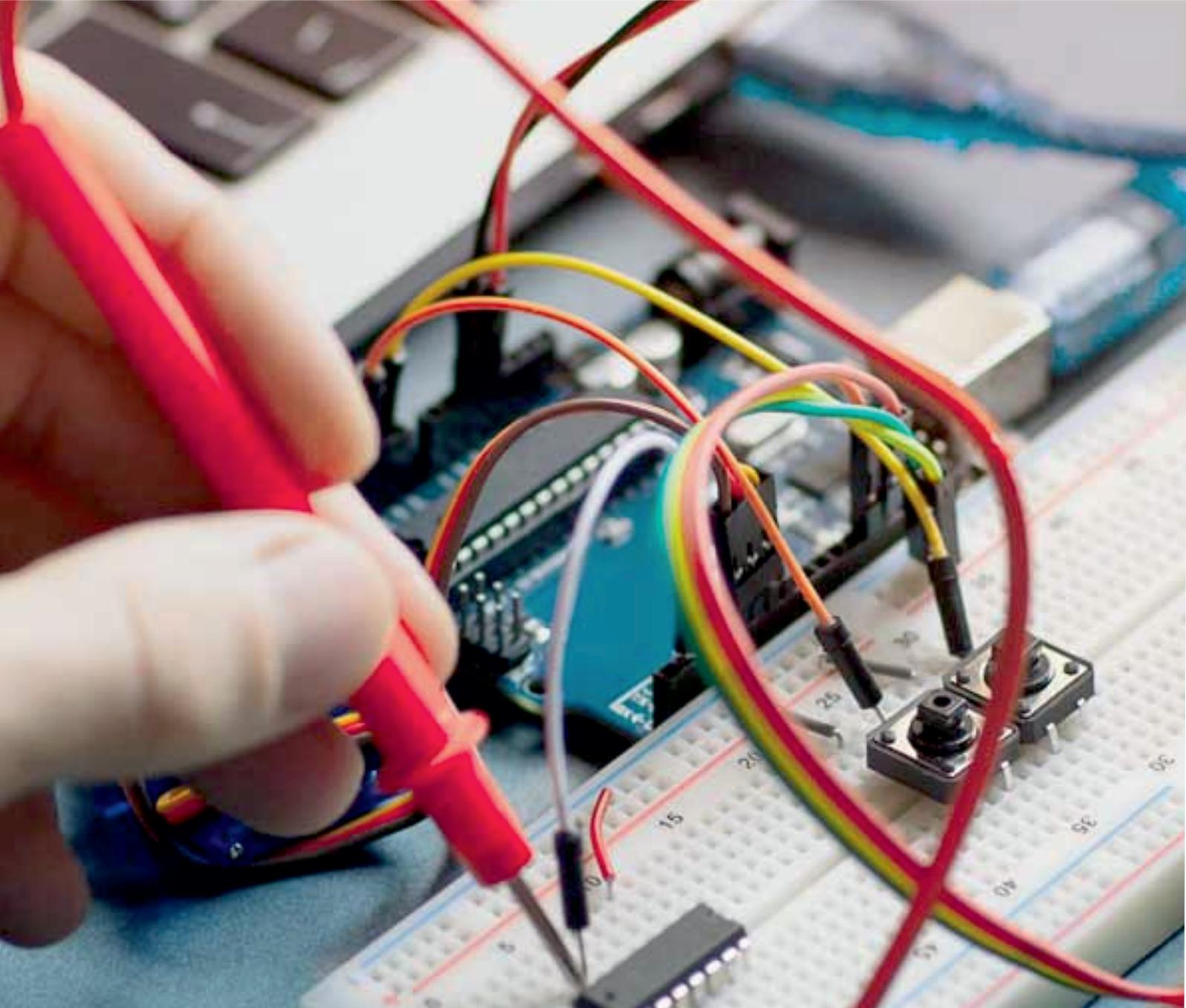
At the receiver side, after receiving the data with photodiode, the com port is given to Arduino Uno board for serial communication. The incoming pixel values are stored in array form after getting the X and Y dimensions using the commands. After system configuration the received image is viewed in the PC system. The received image is shown below.

VII. CONCLUSION

The image captured by the camera is stored and processed. The encoded image is sent through the transmitter via laser light source. It is transmitted with less distortion and noise. Laser-based communications are more secure and it delivers the same amount of signal over large distances. Laser light has higher intensity, efficiency, better visibility, low divergence, performance quality, high transmission security, quick link setup, high bit rate and low bit error rate are main advantages using laser light over other modes of communication.

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