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DESIGN AND IMPLEMENTATION OF LASER COMMUNICATION USING ARDUINO

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Abstract - *Communication is a process of interchanging the information between two sources via text, signs, behavior, voice, etc...this project proposed a system that transfers the voice to communicate from one place to another with the help of laser communication technology. laser communication was first introduced in 1960 and since then many advanced alterations have been made to this laser technology. Laser communication is widely used in space and satellite communication with a 5G network. Laser technology has been used in different sectors nowadays such as surgeries, bar-code scanners, laser cutters, etc... Laser communication offers an alternate option for transferring high-bandwidth data when fiber optic cable is neither practical nor feasible. This laser communication system may be completely in space like inter-satellite laser link and ground -to- satellite communication and vice versa.*

The reason for using laser technology in this project is, that it has a high bandwidth when compared to radio waves and it can transmit more data in less time. This paper includes the detailed analysis, design, and implementation of a laser communication system using arduino for voice transmission. It works similarly to fiber-optic communication instead the light beam is transmitted through free air. This system works on the principle of "Amplitude Modulation"

Key Words: **Wireless Communication System, Laser Communication, Arduino, Amplifier LM358, LM356**

1.INTRODUCTION

Since its introduction in 1960, lasers have been investigated for space communications. However, despite the laser's ability to send data at extremely high speeds, it was quickly apparent that some improvements to its performance and system engineering, particularly in the field, where required. -appropriate hardware Over the last three decades, advances in system design, data formatting, and component technology have made laser transmission into space not only efficient but also appealing for satellite link applications.Laser communication provides many times the amount of data and information obtained by radio frequency (RF) devices. Because of the antenna's small size, the car's weight and volume are only slightly increased. Furthermore, this feature significantly reduces the ban on viewing platforms for the most attractive satellite sites. Smaller antennas, less than 30cm in diameter, cause the least amount of interference with sensitive satellite sensors. Because there are fewer satellites than larger and heavier RF systems, fewer materials are required for longer life.The modest poles' separation provides for a smooth and secure operation. In space, laser communication devices allow for wireless communication. They work in the same way as fibre optic connectors, but the beam is transferred over open space. While visual coding criteria should be required by the broadcaster and receiver, they have the advantage of avoiding the need for broadcast rights and encrypted cables. Laser communication systems are simple to install since they are affordable, compact, and require no radio interference courses. A laser diode is frequently utilized to create the conductor for the transmission signal.One beam for transmission and one for reception are required. The plan selected for this project is only one alternative due to budget constraints. This project is a laser communication system based on Arduino for efficient data transport. We used two Arduino in this project, one transmitting data using a laser transmitter and the other receiving data via a laser receiver attached to the receiver module pin, where the transmission and voice signal were received and the output sound came from the speaker.

1.1 Project Overview

The Laser Communication System Project describes novel wireless communication technologies that have been created. In addition to the laser communication systems with major applications, several communication technologies have recently been created.

1.2 Laser Constrains

They necessitate huge and costly optics with enormous source sizes. It has a significant heat issue. Large laser pellets necessitate great driving power. It uses a combination of absorption and retraction to lower light intensity.

1.3 Laser Engineering

The laser beam serves as a carrier in this laser communication system, which is substituted by a signal to be transmitted. The desired signal is isolated from the carrier at the receiver's output. In a line of sight, a wireless laser link (with a laser diode) is used to transport data from one end to the other.

1.4 Optical Fiber Communication

Before getting started with the laser communication system, we need familiarise ourselves with fibre optical communication, or communication via glass fibres, because laser communication is a type of optical communication that can occur both inside and outside the optical fibre and laser. with an LED (light emitting diode) light source for optical communication During the period of Alexander Graham Bell, this optical link thinking using glass fibre was established.However, it took many years for it to be widely accepted as the best quality glass at a reasonable cost. Long after that, electronic devices were created.

The development of virtual communication began in the 1960s with the invention of new computers and threads, which is still ongoing. The 1980s were the most thrilling decade. Over the last decade, social networking networks have evolved into optical communications, making them the most powerful technology available.

1.5 Design Metrics

The conclusion is that the researcher's results are warranted after a comprehensive examination of the data or information presented in this study. We effectively transfer data from one end to the other using Laser and inexpensive and simple components as we follow the research technique or methods. We can use a wireless laser to transport data from one side to the other in this experiment. The researcher's conclusions and forecasts are entirely warranted, and the methodologies used are totally functional. This is a procedure for determining whether or not you may use Laser to transfer data from one location to another. A thorough investigation yielded positive results. The advantages of laser communication systems will be discussed in the following sections.

1.6 Problem Description

The most difficult aspect of this project was finding the proper laser to match the components

1.7 Objective of the project

The goal of this project is to develop an optical communication system that uses a laser as its light source and can send data from one location to another without the use of wires or cables. This laser communication method appeals to me since it is data loss-free, has a low possibility of error, and can send data at a rapid rate. This initiative focuses solely on short-term communication.

2. RELATED WORK

Rupali Dagade and Samadhan Lavate [2014]used the Audio Amplifier LM386 to construct a laser communication system. One of the newest aspects of the wireless communication system is laser communication. It is one of the best techniques of communicating information due to its low volume. Laser modification is now used in satellite communications in space research operations, and laser communication is one of the study topics for wireless communication due to its efficiency at low noise levels, low power, flexibility, and resistance to radio interference. The study incorporates one such application of laser communication in the exchange of data between any two devices in this procedure. The sender and receiver in laser communication must have line of sight, and laser communication systems have the advantage of not requiring broadcast rights or encrypted cables. A laser diode is frequently utilized to create the conductor for the transmission signal. One for transmission and one for reception, two parallel beams are required. In space, laser communication devices allow for wireless communication. Dedicated to lowering the degree of noise in the visual communication system Laser communication systems function similarly to fibre optic connectors, with the exception that the beam is sent across free space.The sender and receiver in laser communication must have line of sight, and laser communication systems have the advantage of not requiring broadcast rights or encrypted cables. Because laser communication systems are affordable, tiny, low-power, and do not require radio interference courses, they can be widely deployed. A laser diode is frequently utilized to create the conductor for the transmission signal. One for transmission and one for reception, two parallel beams are required. According to the poll results, 93.2 percent of the questions were correctly answered.

Himanshu Dubey, Jaipal Singh Rathore, and Prideep Paliwal[2018] presented a Free Space Laser Communication - RF waves are commonly utilized for long-distance communication in the atmosphere. Recent advancements in optics and laser technology, particularly fibre optics, have introduced a period of communication between orbits utilizing laser beams. From a few hundred kilohertz during Marconi's time to a few hundred terahertz as we use laser network firm Frequencies.The key driving force was that use-able bandwidth - and thus transmission capacity - grows in direct proportion to network company frequency. Another asset begins to seek links in the unoccupied space. The advantages are owing to the optical waves' high frequency. Since 2003, the European Space Agency (ESA) has used a 50Mbps communication link twice a day between low Earth orbit (LEO) and geostationary Earth orbit (GEO) satellites at the Semiconductor Laser Inter satellite Link Experiment (SILEX). In August 2005, the Japan Aerospace Exploration Agency (JAXA) launched the Optical Inter-orbit Communications Engineering Test Satellite (OICETS), which successfully launched the laser communication link with the SILEX terminal.Following this experiment, a ground-to- OICETS laser test with four optical ground channels (OGSs) was carried out, yielding laser beam broadcast data. One of the most significant aspects of wireless communication is laser communication. This study covers signal-level system conversion between satellites and any other two sources with analysis, optimization, design, and development. They function similarly to fibre optic connectors, with the exception that the beam is transferred through air. Although line-of-sight conditions are required for the transmitter and receiver, they have the advantage of avoiding the requirement for broadcast rights and encrypted cables. Finally, the area report and power rating are discussed.

3. SUSPENDED SYSTEM

The proposed project for this project is to design a laser communication system in which the laser diode functions as a transducer to convert digital data into laser type and transfer, and the laser transistor turns laser data back into digital form at the end of reception. The reason for employing laser is that the sender and receiver must be in linear conditions, and lasers have a higher bandwidth than radio waves, allowing them to communicate more data in less time**.** Voice transmission from one source to another can be done over a large area and at high speeds using a laser communication system. Instead of using fibre optics, the suggested method uses laser light to transfer sound.

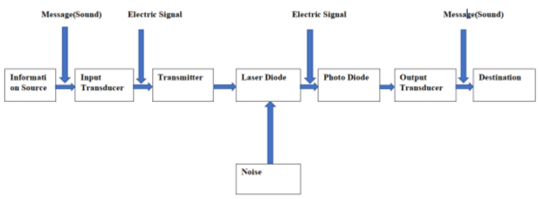

Fig.1 Architecture Of Proposed System

4. METHODOLOGY

List Of Modules

- Transmitter
- Receiver

4.1 Transmitter

I'll need my laser bias to keep the laser open at all times because I'm delivering a constant analogue stream. Even if you're delivering a digital signal, I recommend doing so since some lasers are sensitive to high-frequency waves. I'm going to set my laser at 4.5VDC and moderate it between 4V and 5V. First At 5V, measure the current drawn by the laser; my laser is drawing 29mA. This is more than many op-amps can provide for powering my laser with a voltage tracker transistor.I'll use an op-amp to mix my input signal with 4.5V and lower the signal from 2Vpp to 1Vpp to drive a voltage 19.

The signal processing circuit in the transmitter is combined with the laser diodes that form the laser beam. To ensure consistent output, laser diodes incorporate light diodes for feedback. microphone assistance With the help of an Arduino, the input spoken signal is transformed to digital data and is ready to convey data through laser beam. The lead clip is secured to the inner part of the laser, which is in contact with the battery. We now have two adhesive strips on the laser and proceed as usual.One of the lead clips is normally attached to a small spring in the laser battery area, while the other is usually attached to a 30 laser casing. We may need to create different types of settings by installing a clip that leads to better laser performance with a new external battery pack because there are different forms of laser indicators. There may be additional occasions when we need to use a rubber band and any nearby cord to hold the laser push button. Before the transformer is placed, the connection is tested.It's done to see if the laser still works with a new battery pack. If the laser does not light up during testing, the issue is most likely with the battery, which is depleted and tested again. The laser will not be harmed by this battery adjustment. The transformer, as previously said, has two sides. The first is 1000 ohm, whereas the second is 8 ohm. On the 1000ohm side, the laser and battery are connected.The 1000ohm side of the transformer has three wires coming out of it. We just use two external wires to link the laser and the battery, and the middle wire is called the centre wire wire because it is not used in this circuit. The first wire of the 1000ohm side of the transformer is connected to the first part of the laser (used lead lead), and the other to the end of the battery. On the 1000ohm side of the transformer, the negative end of the battery is connected to the third wire, while the second is left open.The two exterior wires, one call and one call, are also connected to the bi colour light emitting diode (LED). On the 1000 ohm side, there are three transformers. This component, sometimes known as an LED, serves as a laser shield, shielding the laser from high voltage spikes. The LED receives high voltages, but the laser requires low voltages to operate. The battery is used to test the laser. At this point, the laser should be operational. A connection is now created on the transformer's 8 ohm side. The earphone jack is attached to the transformer's other side.

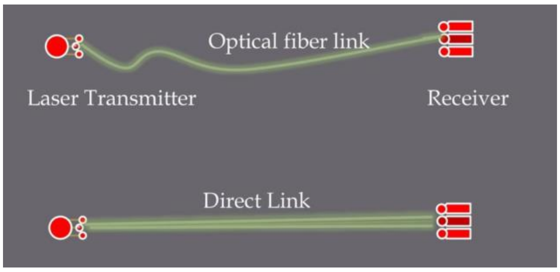

Fig.2 Optical Fiber vs Laser Transmission Link

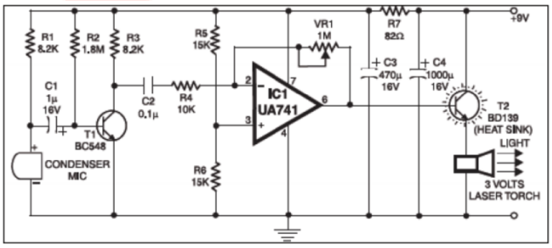

Fig.3 Transmitter Circuit

4.2 Receiver

The receiver module has circuit processing, a detector, a controller, and amplifiers for receiving transmitter output. The receiver's detector is an image diode that captures and reads the incoming laser signal from the transmitter's end. When a signal is available, read the image transistor on the signal receiver's side. A digital signal was received and converted to an analogue signal. The receiver is the most basic component of the laser communication system. All we have to do now is connect the microphone jack to the battery. The microphone jacks' two ends are connected to the battery terminals.It makes no difference how the connection is made. The transmitter is powered by a 9V battery. A 3-volt laser torch, on the other hand, can be immediately linked to the circuit-body attached to the BD139 transmitter and the spring-loaded lead that runs from within the torch to the circuit breaker. An audio input is the microphone. The coupling capacitor C1 is used to connect sound from microphones to T1.

T1 is a transistor that is used to gently amplify sound. C2 absorbs sound into IC1, amplifying it even further. T2 receives the sound from the IC and turns it to electricity for the LED. This brings the sound into focus.VR1 is a versatile IC gain optimizer blocker. The energy filters C3, C4, and R7 remove noise rather than electricity. Some resistors simply supply the proper voltage to various components.

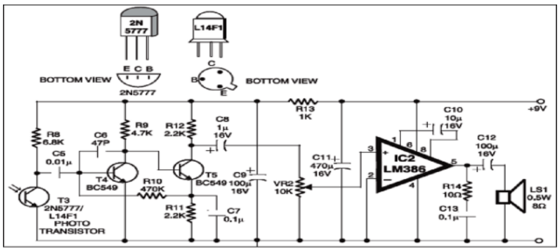

Fig.4 Receiver Circuit

Laser Voltage (V)	Resistance(ohm)
0(room light)	172k
4.0	911
4.1	842
4.2	817
4.3	775
4.4	748
4.5	718
4.6	709
4.7	692
4.8	657
4.9	648
5.0	633

Table.1 Laser Readings

5. RESULTS

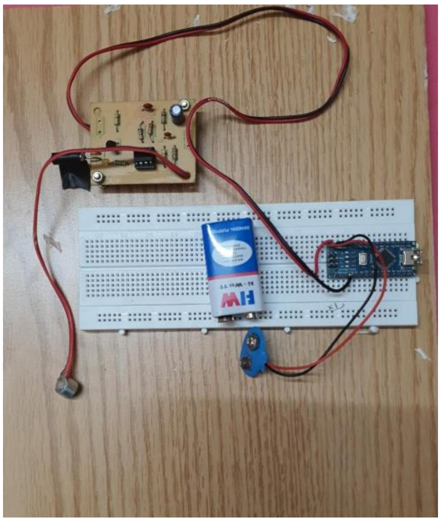

Fig.5 Transmitter Setup

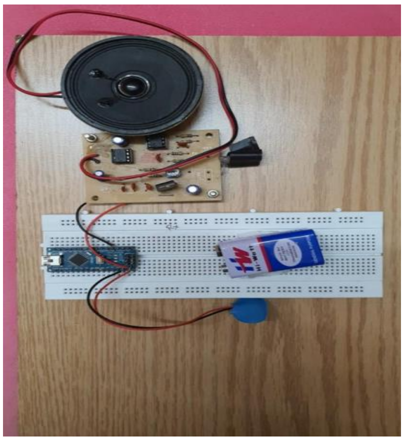

Fig.6 Receiver Setup

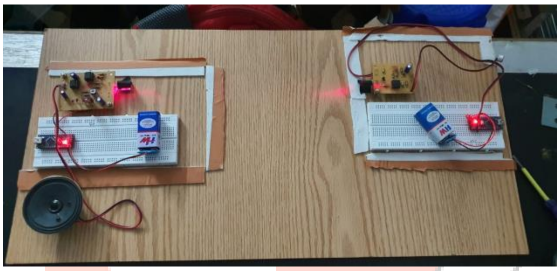

Fig. 7 Laser Communication Setup

6. WORK TO COME

The development of 5G mobile communications will become an unavoidable step in the development of high-speed information networks in the future, and the implementation of mobile networks in distant locations such as islands will be focused on constructing an integrated network. It is extremely safe and meets high bandwidth needs. Low power usage is also a significant benefit. It has the potential to become the most extensively utilized approach on the planet in the future. The significance of laser communication as a technology that allows future satellite systems is also examined in the existing and predicted trends in telecommunications. Future satellite communications system suppliers will have additional alternatives thanks to L Laser communication. This project could be another telecommunications option after its deployment.

7. CONCLUSION

Until recently, all communication systems relied on data transfer via power lines or radio frequency, among other methods. The laser communication mode, on the other hand, has come into its own and currently sends information via a laser beam in a comfortable environment. The success of this evolution will pave the way for the development of new opto-electronic devices, a field where innovation moves at "light speed."

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