Abstract

Here there is wireless Li-Fi based communication system for the transfer of data in the underwater system. In this project we use the light channel to the communication link in free space and also in under water i.e., in water as a medium as well as air as a medium. This study of Li-Fi in the form of project bypasses the limitations involved in the use of electromagnetic waves and audile for free space and underwater communication. This study of project shows that light communication can be the best of the best solution for data transfer at high data rate at moderate distance since light travel faster than any other things. We also have designed, developed, implemented and tested our project in real time basis and provided the evaluated results.

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CHAPTER I. INTRODUCTION

Li-Fi stands for Light Fidelity.

Which means,

Fig. (1)

Li-Fi, is a wireless technology that makes the use of visible light instead of radio waves to transmit the data. The visible light spectrum used by Li-Fi is 1000 times more effective and larger than the radio spectrum. Li-Fi consists of a vast range of wavelengths and frequencies, from infrared through visible and down to the ultraviolet spectrum. The best features of Li-Fi are that it can be fitted on LED bulbs and utilized to allow the data transfer with a speed up to 224 gigabits per second, which is equivalent to a downloading speed of 18 x1.5 GB in every single second.

Basically, it's a **Visible Light Communication System** that uses LED lights to transfer data without using wires between two ends.

The system is simple, safe and hazard free because it doesn't require a base station, licensed spectrum, sophisticated transmitter, complex antenna structures etc.

Communication under water can't takes place because radio waves get quickly absorbed in water, preventing underwater radio communications. But light can penetrate for large distances underwater. Therefore, Li-Fi can enable communication between diver to diver, diver to mini-submarine, etc.

CHAPTER II. OBJECTIVE OF PROJECT

- The prime most objective of this project is to provide a secure, low cost, effective, digitally controlled and fast transfer of data technique in underwater system which is a very good alternative for conventional or existing data transfer technique i.e., Wi-Fi.
- To make a Li-Fi system (device) which works underwater for data transfer and to calculate the average frequency range for normal available led's.
- At the same instance of time this project gives the opportunity to use more productive light source i.e., LED.
- Our project also aims in the study of range at which Li-Fi works underwater.

CHAPTER III. THEORY

III.i. What is Li-Fi?

Fig. (2)

- Li-Fi is a Visible Light Communication System VLC that makes the use of Led light to transfer the data rather than wires.
- Li-Fi makes the use of visible light spectrum which is 1000 times way larger than Radio spectrum.
- Which means capacity of Li-Fi network is limitless.

III.ii. Li-Fi: The History

Truly, this technology was introduced during the 1990's in some advanced countries like Germany, Korea and Japan of that time. Where they discovered led can be furnished to send information.

Professor Herald Haas introduced the term Li-Fi at his TED Global Talk held in the year 2011. In this talk he introduced the idea of "wireless data transfer from every light"

Fig. (3)

He is the Professor of Mobile Communications at the University of Edinburgh. He along with is partner Dr. Mostafa Afgan founded pureLiFi and he is the co-founder of pureLiFi.

III.iii. Li-Fi V/S Wi-Fi

S.No.	Parameters	Wireless Technology	
		Light Fidelity	**Wireless Fidelity**
1.	Speed of data transfer	Faster transfer speed (>1 Gbps)	Data transfer speed (150 Mbps)
2.	Medium through which data transfers occurs	Used light as a carrier	Used Radio spectrum
3.	Spectrum Range	Visible light spectrum has 10000-time broad spectrum in comparison to radio frequency	Radio frequency spectrum range is less than visible light spectrum
4.	Cost	Cheaper than Wi-Fi because free band doesn't need license and it uses light	Expensive in comparison to Li-Fi because it uses radio spectrum
5.	Network topology	Point to point	Point to point
6.	Operating frequency	Hundreds of Tera Hz	2.4 GHz

CHAPTER IV. COMPONENTS

1. Arduino Uno
2. Led
3. LDR (Light Dependent Resister)
4. 4x3 Matrix Keypad
5. LCD Display
6. Resistors
7. Jumper wires
8. Plastic Box

CHAPTER V. COMPONENTS DESCRIPTION

1. Arduino Uno

Fig. (4)

It is used in the receiver section to switch ON the 16x2 LCD and to display the output of the transmitter section. By giving code from Arduino IDE. Here the software used for programming the Arduino is the Arduino IDE. And also, both the transmitter and the receiver side are programmed with the help of Arduino IDE software to make our project work.

2. LED

Fig. (5)

The main and the best use of this LED is for communication between Transmitter section and the Receiver section. The data will be transferred from this led to the receiver section

3. LDR Sensor

Fig. (6)

The acronym of LDR is light dependent resister. It is basically used in the receiver side. This sensor basically receives the light form the LED which is in the transmitter section. This LED sends the light to the receiver side hence we get the output with the help of LDR sensor.

4. 4X3 Matrix Keypad

Fig. (7)

This device here is used to give the input in our project. Basically, this 4X3 Keypad is placed in the transmitter side. Through this, input is given and the signal or pulse goes to the LED and the LDR module catches the signal and we get the output.

5. LCD Display

Fig. (8)

The LCD Display is used as a display device. The input from the transmitter section which travel from LED than LDR Module is displayed on to the LCD display screen

6. Resistors

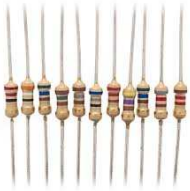

Fig. (9)

This thing is basically used to control the current of our project. There is different type of resisters has been used. The resistor is used to resist the current so that our project doesn't get destroyed and also it is prevented from damage.

7. Jumper Wires –

Fig. (10)

These jumper wires are used for the connection between the components.

8. Plastic Box –

Fig. (11)

This plastic box is used to carry the components and also the water is poured in this box to create a water medium between the LDR and the LED.

CHAPTER VI. WORKING OF PROJECT

This Li-Fi system basically works on model same as that of the Wi-Fi. In Wi-Fi radio waves are used to send information where as in this Li-Fi project, light is medium for the transfer of data. As we all know that light is the safest and most fast medium. So, it is more convenient for data transfer as compared to Wi-Fi existing system.

In this Li-Fi project from the transmitter section there is one 4x3 matrix keypad interface with Arduino from this keypad the key is pressed the information is than processed in the Arduino board and from there with the help of LED the data is transferred to the receiving section and the LDR sensor on the receiving side catches the light from the LED and the LCD interface with Arduino board shows the number which we have pressed in the transmitter section. And hence this is how our project works

CHAPTER VII. CIRCUIT DIAGRAM

VII.i. Block Diagram

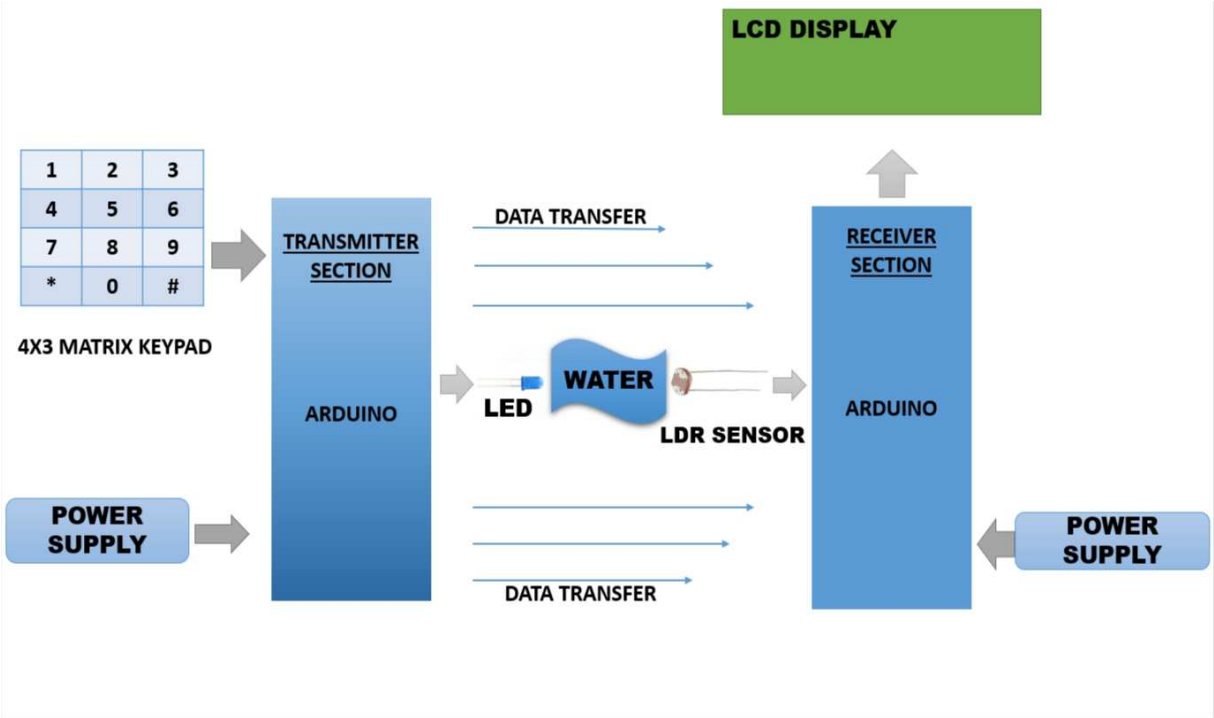

Fig. (12)

VII.ii. Circuit Diagram –

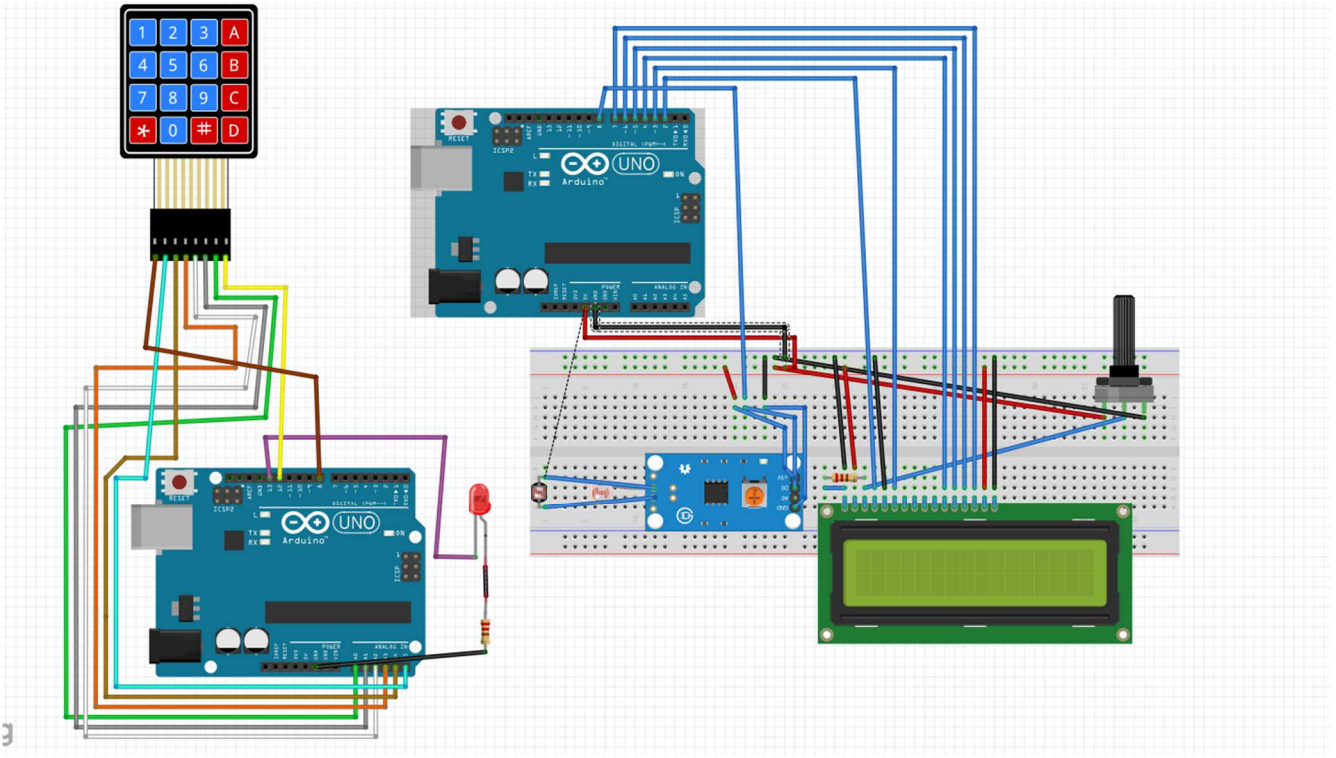

Fig. (13)

VII.ii.a. Circuit Description –

According to the circuit diagram, there are two sections,

a) Transmission Section
b) Receiving Section

a) Transmission Section – This section consists of a resistor, 4x3 Matrix Keypad, LED and an Arduino.

Here the 4x3 Matrix keypad is connected to the 8 and 12 pins on the digital side and A0, A1, A2, A3 and A4 pins on the analog side. Then LED's one end is connected to resistor's one end and another end of resister is connected to the ground of Arduino. And another end of the LED is than connected to the 13th pin of Arduino on the digital side.

b) Receiving Section – Here in this section the components are Arduino, LDR, LCD display, resistor and a 10k pot.

In this section, the 1st and 12th pins of LCD display is connected to ground and the second pin is connected to 5V power supply. Then the 3rd, 4th, 5th and 6th pin of the LCD display is connected to the 4, 5, 6 and 7 pins of the Arduino on the digital side of Arduino. 11 and 13 pins are connected to 5 and 6 pins on Arduino. 14th pin is connected to the 10k pot and one side of 10k pot is connected to ground and another to 5V power supply.

CHAPTER VIII. CODING

VIII.i. Receiving Section -

```
int ldrPin = 3;
void setup()
{
   pinMode(6, INPUT);
    Serial.begin(9600);
     Serial.print("Starting\n");
    //pinMode(LED_PIN, OUTPUT);
    //pinMode(2, INPUT);
}

void loop()
{
  //long duration = analogRead(A0);
  unsigned long duration = pulseIn(6,HIGH);
  Serial.println(duration);

  if (duration > 10000 && duration < 19000)
  {

    Serial.print("Received: 1         ");
  }
```

```
else if (duration > 20000 && duration < 29000)
{

  Serial.print("Received: 2         ");
}
else if (duration > 30000 && duration < 38000)
{

  Serial.print("Received: 3         ");
}
else if (duration > 40000 && duration < 48000)
{

  Serial.print("Received: 4         ");
}
else if (duration > 50000 && duration < 58000)
{

  Serial.print("Received: 5         ");
}
else if (duration > 60000 && duration < 68000)
{

  Serial.print("Received: 6         ");
}
else if (duration > 70000 && duration < 78000)
```

```
{

  Serial.print("Received: 7         ");
}
else if (duration > 80000 && duration < 88000)
{

  Serial.print("Received: 8         ");
}
else if (duration > 90000 && duration < 98000)
{

  Serial.print("Received: 9         ");
}
else if (duration > 100000 && duration < 108000)
{

  Serial.print("Received: 0         ");
}

else if (duration > 130000 && duration < 138000)
{

  Serial.print("Received: *         ");
}
```

```
  else if (duration > 160000 && duration < 168000)
  {

    Serial.print("Received: #          ");
  }
}
```

CHAPTER IX. HARDWARE PICTURE

IX.i. Implementation on Breadboard –

a.) Receiver

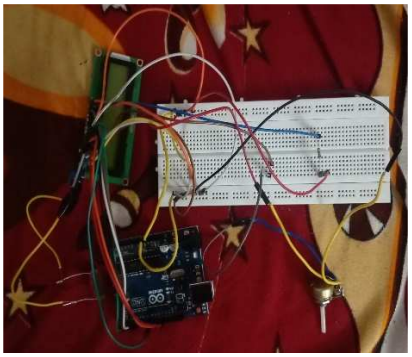

Fig. (15)

b.) Transmitter

Fig. (16)

c.) Combine

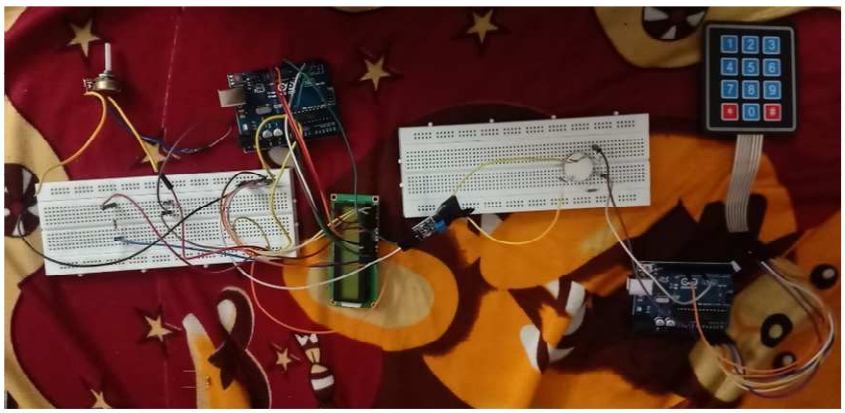

Fig. (17)

IX.ii. Implementing Prototype –

a.) Side view

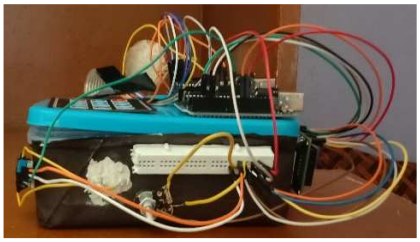

Fig. (18)

b.) Side View

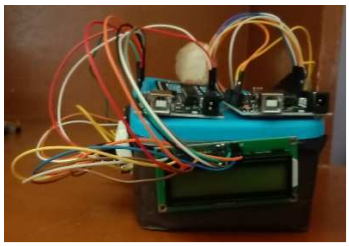

Fig. (19)

c.) Side view

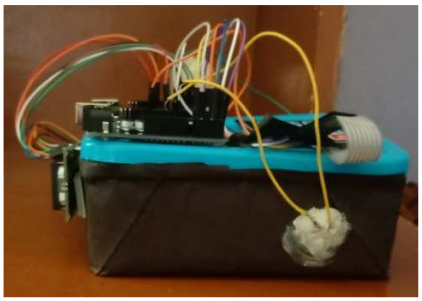

Fig. (20)

d.) Top view

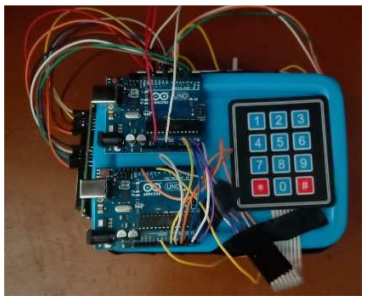

Fig. (21)

e.) Inside view

Fig. (22)

CHAPTER X. CONCLUSION

- Hence the study of Li-Fi technology was successfully done by making this project.
- The project was also innovated by putting the it underwater.
- The speed, distance and various parameters was also obtained.
- And also, a fastest and more convenient mode of data transfer underwater is obtained.
- Through this technology we can obtain the communication between two submarines in underwater system.
- Also, we can establish communication between two divers, etc.

CHAPTER XI. APPLICATION

- **In Submarines:** The information between two submarines can be shared or communication between two submarines can be established and any obstacle between them can be known.

- **Fisherman Security:** The fisherman can establish communication between his ship and other ship if he detects any problem in the sea than he can warn the other ship and vice versa.

- **In Defence Operations:** If there is any disturbance due to unknown ship or submarines in the sea than information can be send to the central authority.

- **For speech transmission:** This technology is very much useful between sea divers for speech transmission between them.

CHAPTER XII. BIBLIOGRAPHY

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- Underwater Communication through Light Waves G. Pravin Raj1 and P. Prabakaran2 1 PG student, Department of Electronics and communication engineering CK college of engineering & Technology, Cuddalore, India, 1 gpravinraj@gmail.com.