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LiFi: For Better Medical Treatment

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***Abstract:** In recent times, monitoring health round the clock is crucial. These data must be transferred to the hospital in real-time, which is usually done with the help of Wi-Fi. There can be delays in transferring due to various reasons. To tackle this, we can use Light Fidelity (Li-Fi). Li-Fi uses light as a medium to transfer data. As the speed of light is faster, the data can be transferred very quickly. This will help by alerting the medical staff early and letting help get to the needed in a faster period. In rural areas, there may be fewer facilities having a Wi-Fi connection, but light will be easily available. So, by using Li-Fi, the senior citizens, or a person in need of round-the-clock care with have better care.*
***Index Terms:** IOT, Li-Fi, Medical, Oximeter, heart rate, senior citizen, elderly people, medical attendants*

I. INTRODUCTION

Nowadays people's dependent on round-the-clock medical attention are increasing. These people can be an elderly person who has different ailments or an infant baby who is born with different types of disability. In the traditional method, a nurse or a medical attendant would be assigned to them, who will be taking care of their patient without taking an off day. This causes a lot of trouble to the medical personnel who is attending. If the patient doesn't receive enough attention, then the medical attendants are blamed. Using Li-Fi, we can reduce the work of medical attendants to an extent. IoT-enabled devices which are connected to Li-Fi can be used for their monitoring. These devices can send alerts whenever required.

II. OBJECTIVES

1) Round the clock monitoring
2) Getting medical assistance by sending alerts to the nearest facility.

III. LIGHT FIDELITY

LiFi is the Internet that moves at the speed of light. LiFi technology allows you to connect to the Internet using light from a projector lamp, streetlamp, or LED TV. It's cheaper, safer, and faster than WiFi, and it doesn't require a router. Just point your phone or tablet at the light bulb to browse the web. Light Fidelity (LiFi), a two-way wireless system that uses LEDs or infrared light to transmit data. LiFi technology was first introduced in 2011, unlike WiFi which uses radio frequencies, only a light source with a chip is needed to transmit Internet signals through light waves. This is a step forward in today's wireless networks. LiFi increments the speed and bandwidth of WiFi, 3G, and 4G. The latter has a limited capacity and becomes saturated as the number of users browsing the web increases, resulting in crashes, slowdowns, and loss of connections. However, with LiFi, the 200,000 GHz bandwidth is 100 times faster than WiFi frequencies up to 5 GHz and can transmit more information per second.

Li-Fi is the emergence of optical wireless communications (OWC) technology, which uses light from light-emitting diodes (LEDs) as a means of delivering network communication, mobile, much faster than Wi-Fi. Visible light communications (VLC) works by turning off the current in LEDs and opening at high speeds, too fast to be detected by the human eye, and therefore, does not produce any flashes. Although Li-Fi LEDs will need to be stored to transmit data, they can be blurred under human visibility while emitting enough light to carry data. This is also a great bottle of technology when based on visual acuity, as it is limited to the purpose of lighting and is not properly adjusted for the purpose of mobile communication. Technology that allows roaming between different Li-Fi cells, also known as supply, may allow for easy switching between Li-Fi. The light waves cannot penetrate the walls translating into a much shorter range, and lower bandwidth, Wi-Fi-related robberies. A direct line of sight is not required for Li-Fi to transmit signal; the visible light on the walls can reach up to 70 Mbit / s. Li-Fi has the advantage of being useful in sensitive magnetic fields such as airports, hospitals, and nuclear power plants without causing magnetic disturbances. Both Wi-Fi and Li-Fi transmit data via electrical spectrum, but while Wi-Fi uses radio waves, Li-Fi uses visible light, ultraviolet, and infrared. While the U.S. Federal Communications Commission has warned of a potential disaster because Wi-Fi is close to full capacity, Li-Fi has almost no capacity limit.

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The visible light spectrum is 10,000 times greater than the spectrum of the entire radio. Researchers reached more than 224 Gbit / s data rates, much faster than normal broadband in 2013. Li-Fi is expected to be ten times cheaper than Wi-Fi. Short distance, low reliability, and high installation costs are the most likely problems.

PureLiFi showcased the first commercial Li-Fi system. Bg-Fi is a Li-Fi program that integrates a mobile device application, as well as a simple consumer product, such as an IoT (Internet of Things) device, with a color sensor, microcontroller, and embedded software. The light from the mobile device display affects the color sensor on the consumer product, which converts light into digital information. Light-emitting diodes enable the consumer product to communicate in conjunction with a portable device.

IV. IOT

Internet of Things (IoT) defines tangible objects (or groups of such objects), embedded in sensors, processing capabilities, software, and other technologies, and that connects and exchanges data with other devices and applications via the Internet, and or other network networks.



Fig 1: Benefits of IoT

Internet of Things is a complete system of networks, devices, and computers with unique identifiers connected. They have the ability to transport data to and from various terminals without the need for human-to-person or computer communication. In today's technologically driven world of digital technology, the Internet of Things has emerged as a breakthrough that enhances communication, communication, and information sharing between local and remote terminals in an advanced environment. The level of interaction with their internal, as well as external spaces.

IoT has great business potential, especially in terms of simplification and efficiency. It also allows for improved compliance control by automatically signing security agreements so that authorities can be notified automatically when, say, a firefighter is blocked in a building, or if a criminal tries to access your private data records. It also makes it easier for businesses to perform real-time A / B surveillance using connected cameras and sensors to monitor customer interactions with their products.

The data generated by IoT and handheld devices like mobile phones, laptops are humongous. WiFi alone won't be able to transfer such an amount of data. This is where LiFi comes into the picture. LiFi can transfer a huge amount of data as it relies on the visible light spectrum, it provides a faster transmission speed, higher bandwidth and it has the ability to work in spaces with electromagnetic inference like airplanes, hospitals, or highly-sensitive industries.

V. MODEL SYSTEM

As a patient who needs round-the-clock care, he/she would be having an oximeter or a Heart Rate Monitor (HRM) attached to them constantly. These devices constantly track the patient's oxygen level and pulse rate. An alerting system can be programmed into these devices. This will help in sending alerts to the medical care personnel. Since these devices track the vitals all the time, live data will be recorded and alerts will be sent accordingly.

A person's healthy heart rate would be considered between 72 to 85 bpm. This may vary according to various medical conditions. Some patients might have a heart rate of 90 considered normal due to the different medications they are on. An alert will be sent if HRM records an entry higher than the normal heart rate at least thrice in a given period of time. This alert will be received at a hospital under which the patient is registered or at the hospital near to that patient. The doctors can check the alerts received to them and then decide what course of action can be taken.

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This eliminates the need for a medical attendant to be physically present with the patient and the need for the patient to be admitted to the hospital. As these alerts will be sent with the help of LiFi, there won't be a delay in transferring the records to the hospital. This is beneficial in rural areas, where WiFi is not as active due to various reasons like not having a radio tower near them or having a low range for radio waves to travel. By using LiFi, these issues can be solved as there is at least one light source in every house. The oximeter and HRM can make use of this light source to transfer the data and send alerts to the hospital. Hence eliminating the issue of connectivity over the internet.

VI. RESEARCH METHODOLOGIES

A model can include both descriptive and analytical components. A descriptive model's logical relationships can be examined and conclusions can be drawn. The logical analysis draws quite different conclusions than the quantitative investigations of the properties.

We conducted an online poll utilizing an online form creator and data collection service to acquire information regarding people's awareness.

VII. PUBLIC SURVEY

We deployed our data gathering facility, to a variety of people of all age ranges to collect information on various faces of their understanding of how LiFi will help to make their life better.

A. Questionnaire

1) What is your age range?
2) Are you aware of LiFi?
3) Which one do you think is more secure: Li-Fi or Wi-Fi?
4) Do you believe that Li-Fi can bring major changes to the Healthcare Sector?
5) Would you be willing to transfer your medical data through Li-Fi for better treatment?

B. Responses

The major age group who responded id from 18-40 years (71%) followed by 40-65 years (16%) and people less than 18 years (7%)

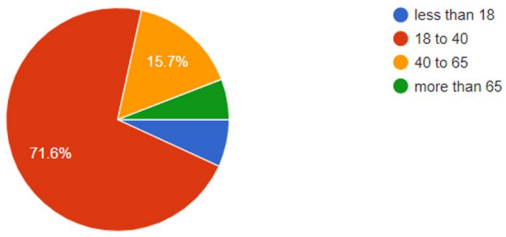


Chart 1: Age group

The respondents who knew about Li-Fi were 71% of the total and 15% were somewhat aware of Li-Fi and the rest were not aware of Li-Fi.

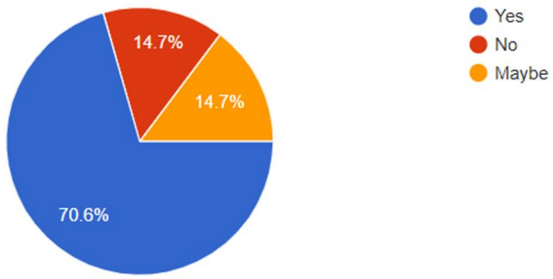


Chart 2: Li-Fi awareness

72% of the respondents thought that Li-Fi was more secure than Wi-fi and the rest favored Wi-Fi being more secure.

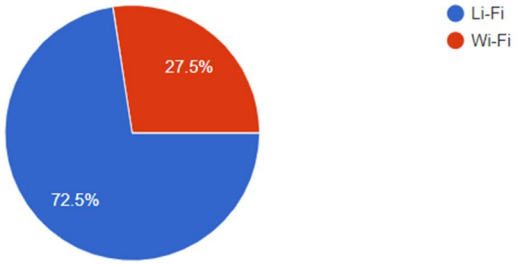


Chart 3: More secure

64% of the respondents believed that Li-Fi can bring more changes to the current healthcare system whereas 32% were unsure about it.

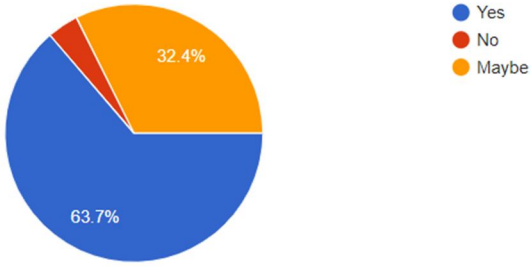


Chart 4: Li-Fi bringing changes

67% of the respondents are ready to share their medical data through Li-Fi with the hospitals for better treatment and 27% were unsure whether they will be willing to share.

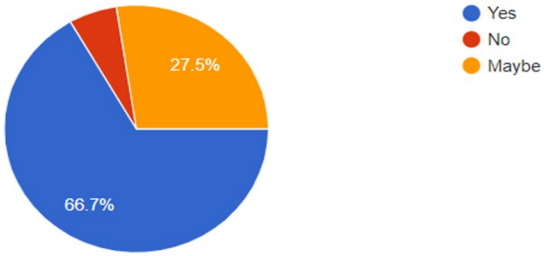


Chart 5: Willingness to share data

VIII. HYPOTHESIS TESTING

Hypothesis testing is a systematic process of determining whether research findings support a particular theory that applies to humans. The hypothesis test uses sample data to test a population-based opinion.

The hypothesis testing examines how rare the outcome is, whether the variance is reasonable or whether the outcome is too extreme to be considered a variance of luck.

There are two types of hypotheses:

1) Null Hypothesis (denoted H0)

2) Alternate or Research Hypothesis (denoted Ha)

For this paper,

H0: Li-Fi can improve healthcare

Ha: Li-Fi cannot improve healthcare

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A. Test (Statistics)

There are three tests available to determine if the null hypothesis is to be accepted or not. They are:

1) Chi-squared Test
2) T-Student test (T-test)
3) Fisher's Z Test

In this paper, I'll be using the Two-Tailed T-student test.

A t-test is an inferential statistic that determines if there is a significant difference in the means of two groups that are related in some manner.

→ Level of Significance

The chance of rejecting the null hypothesis when it is true is the significance level (also known as alpha or α). A significance level of 0.05, for example, means there's a 5% probability of discovering a difference when there is none. Lower significance levels indicate that more evidence is required to reject the null hypothesis.

→ Level of Confidence

The Confidence level indicates the probability that the location of a statistical parameter such as the arithmetic means measured in the sample survey is also true for the entire population.

Sr. No	Data
1	71.6
2	70.6
3	72.5
4	63.7
5	66.7
Mean (x)	69.02
Standard Deviation (s)	3.706

Level of Significance =0.05 i.e. 5%

Level of Confidence= 95%

A t-score (t-value) is the number of standard deviations away from the mean distributions.

The formula to find the t-score is:

$t=(x-\mu) / (s/\sqrt{n})$

where x is the sample mean,

μ is the hypothesized mean,

s is the sample standard deviation,

and n is the sample size.

The Probability value, also known as the p-value, indicates how probable your data is under the null hypothesis. Once we have the value of 't', we can calculate the p-value. If the p-value is less than the alpha level, then we can reject the null hypothesis and conclude that Li-Fi cannot improve healthcare.

→ Calculating 't' value:

Step 1: Determine the Null and Alternate hypothesis

Null Hypothesis (H0): Li-Fi can improve healthcare

Alternate Hypothesis (Ha): Li-Fi cannot improve healthcare

Step 2: Find the test statistic:

In this case, the hypothesized mean is considered 0.

Therefore,

$t=(x-\mu) / (s/\sqrt{n}) = (69.02-0)/(3.706/\sqrt{5})$

$=41.644$

t-value=41.644

→ Calculating p-value:

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Step 3: Calculate the test statistic's p-value.

The t-distribution table with n-1 degrees of freedom is used to calculate the p-value. In this paper, the sample size is n=5, so n-1=4. By feeding the observed value into the calculator, we got the p-value which is 0.00000198. The p-value is less than 0.00001.

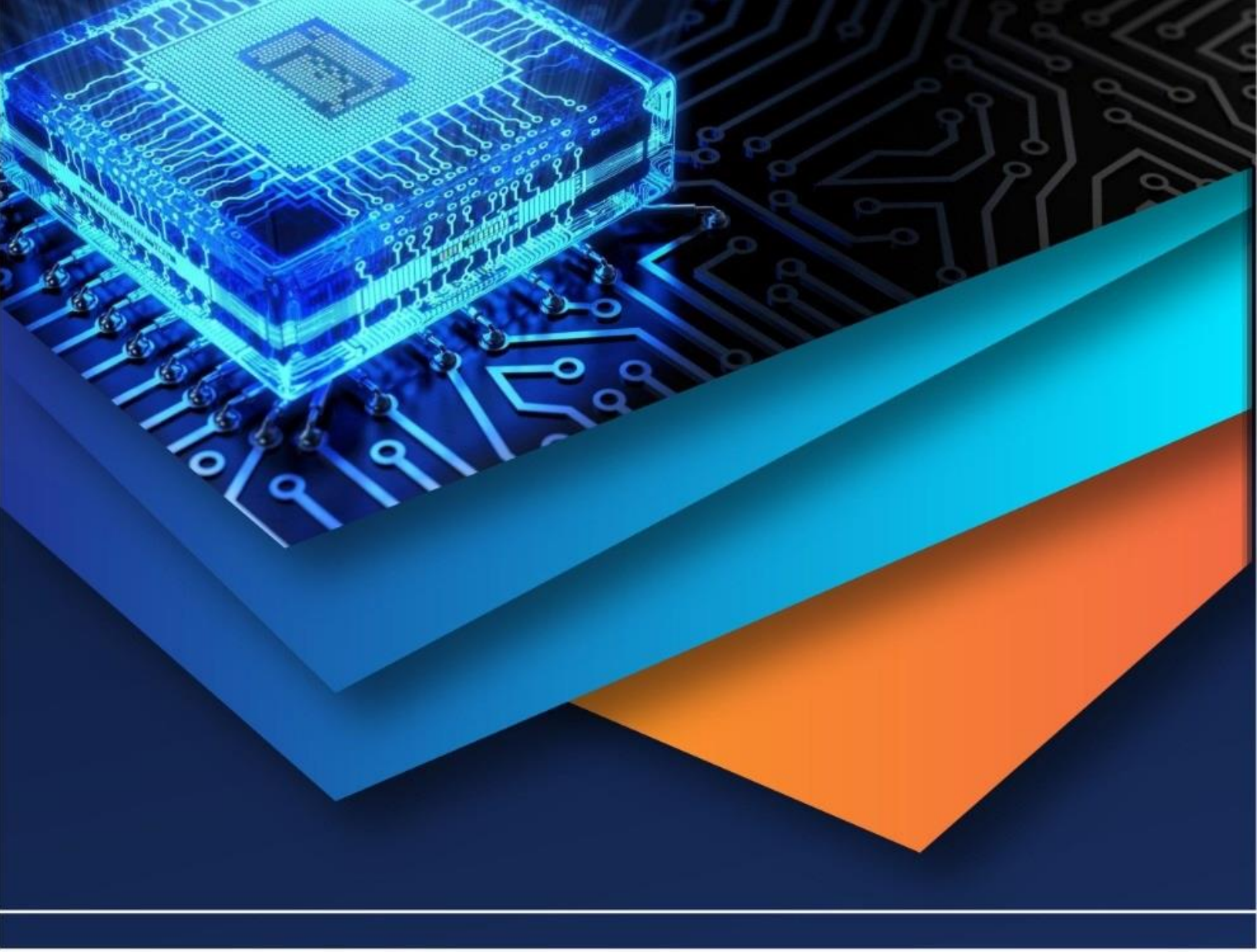
Since this p-value is less than our selected alpha level of 0.005, we can reject the null hypothesis. Therefore we can conclude that we have enough evidence to say that Li-Fi cannot improve healthcare.

IX. CONCLUSION

Li-Fi might not completely improve healthcare but it surely can improve the quality of life by sending appropriate alerts to the doctors at the correct time. As Li-Fi is using Light as a medium to transfer the data, there will be little to no delay with reference to Wi-Fi which uses radio waves as the medium. It is the responsibility of the users to keep their medical history and medical data up-to-date so that they will be provided with the correct treatment and course of action.

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