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Data Communication Security Issues of Wi-Fi over Li-Fi

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Abstract- Visible Light Communications (VLC) system is called Light Fidelity One such example, analog data is passed to a LED (Light-Emitting Diode) bulb (using signal processing technology), after that it transmits data (which is implanted in its beam) to the detector or photodiode. The small commutes in the brisk feeble of LED bulbs is modulated by the receiver circuit into electrical signal. The signal is then reversed into a duplex data runnel that could be recognized in the same way that of audio, video and web programs that run on devices that has internet enabled. Wi-Fi is vulnerable to breaches involving various security issues such as Rouge Access Points, Denial of Service, Wireless Trespasser, Data Interruption, End point attacks etc. To overcome such restrictions, this paper proposes application level substructure for data communication using Li-Fi (Light Fidelity) Technology. By using LED lights as a transmission medium, the indoor wireless communication is achieved in much faster rate than the one Wi-Fi (Wireless Fidelity) can provide.

Keywords- Security, Wi-Fi, Li-Fi and Data Transmission

I. INTRODUCTION

Li-Fi signals cannot pass through wall which tends to have its pros and cons. Pros include security, it's all the way more secure from hackers who tend to bypass Wi-Fi in a jiffy. Li-Fi is safe from vulnerable IOT devices. Wi-Fi with WEP protocol was way less secure. Nowadays Wi-Fi routers come with WPA2 PSK protocol which has advanced security features.

For the sake to relish complete connectivity, efficient LED bulbs are to be deployed around the space. To remember, Li-Fi requires that the light bulb should be on at all times to provide undisrupted connectivity, also means that the lights are to be kept switched on during daylight.

Due to short range it can achieve very high speeds. It's recorded that the fastest Wi-Fi speed has reached a theoretical of 1 Gbps, where those limits are never reported in real world performance. The mean United States internet connection speed was found 18.7 Mbps in the first quarter of 2017. Laboratory tests have noted that Li-Fi on the other hand could possibly reach speeds of 220 Gbps, and the real world speed test already crossed the theoretical 1 Gbps of Wi-Fi.

Li-Fi's illumination area is limited up to about 10m2. Whereas a typical wireless router in an indoor P2P environment will have a range around 32m. Li-Fi is constrained to the bounds of a room and requires direct communication.

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Li-Fi also helps to solve a core issue of Wi-Fi i.e. "the wireless spectrum crunch". The Wi-Fi relay technology is based on data interchange between 2.4 to 5 GHz frequency bands. As we know Li-Fi operates in visible light the frequency range is 400 to 800 THz.

Radio signals get easily soaked in water, interrupting radio communications inside water but light overcomes this difficulty and can penetrate to large distances.

II. LITERATURE SURVEY

[1]. Light Fidelity (Li-Fi): Towards All-Optical Networking

Prompted along the emerging radio frequency (RF) spectrum crisis, the research draft focuses on showing that optical wireless communication (OWC) has now achieved a state where it can be demonstrated that it is a matured and reasonable answer for this elemental issue. Specifically, in inside data communications where mostly smartphone data is used up, Li-Fi which is a visible light communication (VLC) technology gives innumerable key benefits, and productive answers to the problems that have constituted from the past decade. The research also ponders most leading module technologies needed to perceive optical cellular communication systems called in the paper as optical attocell networks. Optical attocell's are following the steps in the continuation towards building ever tinier cells, a continuation investigated as one of the highest noteworthy distributer to the refinement in network insubstantial productivities in radio frequency wireless networks.

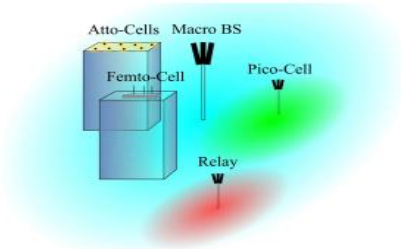

Fig. 1: Based on Visible Light Communication, a small cellular network.

[2]. An Indoor Wireless Visual Sensor Network basing on Light-Fidelity Comunication

Wireless Visual Sensor Network tells that it is a collaborative network of apex's made up by cameras and leveraged by batteries. All these apex's are able of accumulating, organizing, communicating huge quantity of video/audio/image bytes among them. In arrangement for expanding the lifespan like this grid, it's a necessity to lower some energy consumed in both transference and processing functions.

An inside Wireless Visual Sensor Network is presented by this research that utilizes Li-Fi engineering for transferring and accepting data streams. The suggested demo fortifies an elevated extent of dependability, excessive rate of information conveyance, little power utilization and an exemplary optical standard for the hypermedia. In summation, it also can be utilized for inspection in RF constricted and hyper-reactive habitat.

[3]. A Framework of a Hybrid Wave Communication Channel for Transmitting Voice Over Light-Fidelity (VoLF)

The 2100s witnessed the emergence of Visible Light Communication (VLC) nexus. Light Fidelity is a wholly webbed transmission technology which works wirelessly and is also a subgroup of Optical Wireless Communication (OWC). Also being a Bifacial, fast turbulence network, it could be an appendage to Wireless Fidelity networks or even a workable substitution. Suggested abstract of Voice over Li-F, postulates the utilization of an unparalleled wave. The mentioned wave holds a capability allowing the communication of Analog and Digital information over Visible Light in collateral. This wave could carry digital piece of bits along with the analog part of sound. Digital information hence could be conveyed with no mislaying data and therefore, lossless transmission of analog data is achieved.

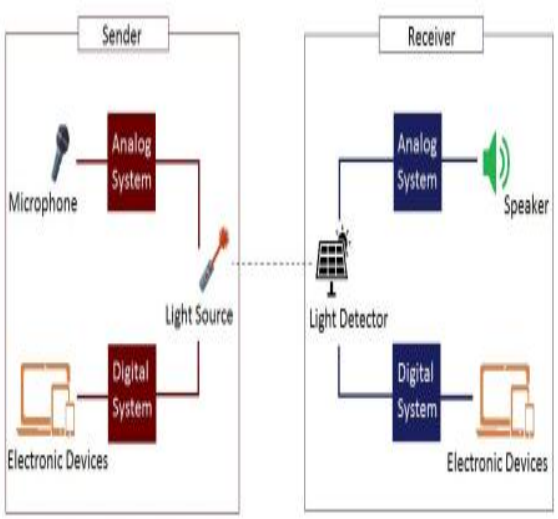

Fig. 2: Client-Server Architecture of Li-Fi based communication.

[4]. Home Intercommunication System Using Visible Light Communications

Visible light communications (VLC) is the speedy emerging trends of wireless data transference over the radiance of light emitting diodes (LEDs). The trendy technology utilizes visible light over a wireless domain as the bearer for channel signals. VLC utilizes the visible light spectrum to achieve data transference and the major benefits of visible light communications over RF based communications is that Visible Light Communication is immune to electric signal intervention. The research tells that VLC can be used to transfers audio signals over an optical wireless domain. This can be gotten by outlining with instrumenting a simplex intercom arrangement that constitutes a transmitter, wireless network and a receiver and hence the proposed structure transfers audio signals through the visible light using key modulation like on-off. In this scenario, the strength of light is tuned by switching on-off the LED at a very high frequency which makes the process not deductible by the ordinary eye. The final results of the paper show that audio can be transmitted through visible light.

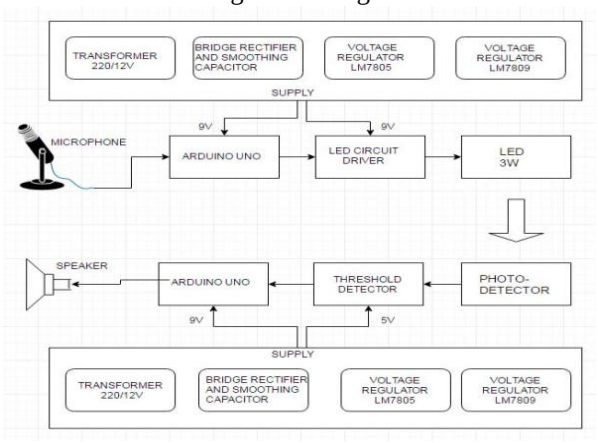

Fig. 3: Li-Fi based sound communication using Arduino Uno.

[5]. Access Point Assignment in Hybrid Li-Fi and Wi-Fi Networks in Consideration of Li-Fi Channel Blockage

As an assuring addition to the expanding crowded technologies like Wi-Fi and Li-Fi have recently brought immense recognition in accordance to the vast and unregulated visible light spectrum. The visible light waves cannot perforate barriers which allows interference eluding in chambers. Li-Fi's access points are very miniscule relative to Wi-Fi's access points. Proposed hybrid webbed system merges the large-speed transference of Li-Fi and also the omnipresence exploration of Wi-Fi. In this completely overspreading analysis of contrasting networks access point assignment becomes dangerous. In reckoning, Li-Fi is vulnerable to blockage of communication due to non-transparent objects, inclosing problems to access point assignment (APA). In this research, a decent APA technique is suggested for Wi-Fi combined with Li-Fi system in the deliberation of Li-Fi channel blockage. By utilizing users' mathematical data of channel blockage, the suggested mechanism devices the affair that attenuates the network turnout over an interval of time. A suggested method is depicted from the results that can shift up the turnout by 90% in accordance with the standard load stability method.

III. ABOUT THE ISSUE

A. General Security issues in Wi-Fi

Data Interception: Some Wi-Fi products articulate Temporal Key Integrity protocol (TKIP) which is resilient to message integrity check (MIC) that permit a set of spoofed support frames to be inserted.

Denial of Service (DOS): Wlans are very much threatened to Dos. Messages from phone are sent to users that are disconnected, consume resources of AP, and keep all the channels busy.

Rouge Access Point (AP): Unauthorized Aps or business network penetration by unknown have been a major problem. The classification between harmless neighbors, personal hotspots and network connected rouges is a skill which the WLAN has yet to perfect.

Wireless Intruders: WIPS sensors must satisfy to both detection and prevention of malicious Wi-Fi clients.

Endpoint attacks: Various number of vulnerabilities have published to take advantage over WiFi drivers having bugs, where arbitrary commands are executed using buffer overflows. Automatic attack tools such as Metasploit can be used to launch WiFi endpoint vulnerabilities with very less effort.

B. Equipment's in Hospitals using Wi-Fi

Increasingly and interestingly, more medical devices are put into design that can be over WiFi, like glucose monitors and insulin pumps. This pattern is destined to enlarge in near future, given the growth of what is informally called as IOT "Internet of things."

Machines like water coolers and coffee makers are receiving the ability to boost their functionality by getting access to Wi-Fi. At last, hospitals shall get such equipment's and also they will be containing some advanced medical equipment's working on their wireless network. So facilities need to have adequate capabilities so that they can operate on all of these devices.

Several healthcare monitoring systems are upgrading their wireless network to 802.11ac technology that provides faster speed and an increased capability that can transmit without bogging down wireless connection, large amounts of data. This therefore reduces the likelihood that the network outage will cripple any hospital operations.

Fig. 4: Wireless Infusion Pumps used in Hospitals

Fig. 5: Modern Glucose meter

C. Security issues in Hospitals using Wi-Fi

On both networks that is the head one and client one, it is critical for the hospitals to stick to best safety measures. This way, it will keep it away from any HIPAA breaches that are caused due to data breaches. With this in our mind, the main wireless network of the hospital is encrypted to just limit outside access to protected health information of the patient. It is also very important to set some strict requirements so that only certain type of devices can be connected to wireless networks of hospital. Everyone's tools claimed by medical staff shall be allowed to know persistent information on emergency clinic's system in confined circumstances – and on the off chance that they are legitimately encoded to avoid unaccepted information reach to. Also with regard to visitor's system, families of patients went onto keep a note of who all can get access to the data and details of information's, including restorative store information's, as it is can be easily violated when gone into wrong hands.

Insulin pump vulnerable to hacking: It has been learnt about a vulnerability of security in one type of insulin pumps that any hacker can easily exploit to overdose or under dose diabetic patients with insulin, although there is low risk in this.

Wireless syringe pumps that are being used in many hospitals are vulnerable to various security breaches: Wireless syringe pumps that are used to deliver drugs to patients in hospitals all around the world has several flaws which are vulnerable to hackers, a researcher has found out.

Any Hacker can easily send fatal doses to drug pumps at hospital: It has been found various vulnerabilities in very popular infusion pump for drug which would allow any hacker to increase or decrease the dosage limit on medications delivered to any patient, there is little cause for concern.

IV. PROPOSED SYSTEM

Our chip that is ESP8266 shall act as Access point (AP Mode), means it shall be providing access to our WiFi network to all the devices, stations and will also connect each one to a wired network. There are ample ways to make use of ESP866 for communication purpose. The system followed by us is shown in the figure below:

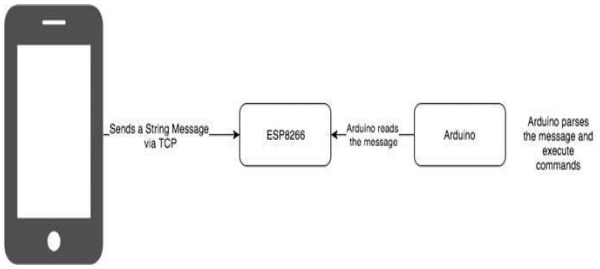

Fig. 6: Connection of Wi-Fi module in Arduino with a Smartphone.

Connections in Arduino:

1. Connect red colored wire to VIN (3.3V) to +3.3V power from micro-controller.
2. Connect black colored wire to the ground.
3. Connect green colored wire to TX of Wi-Fi module and micro-controller
4. Connect yellow colored wire to RX of Wi-Fi module and micro-controller

ESP8266 has to be strictly powered to 3.3 V. More than it, the module will be destroyed. Connect VIN to 3.3V for powering it up and ENABLE pin for enabling the module.

Connect TX to RX which actually means what all we have to transmit into ESP8266 shall be gathered by Arduino UNO. And otherwise in case of RX to TX. After building this circuit, we are ready to start WI-FI with Arduino UNO.

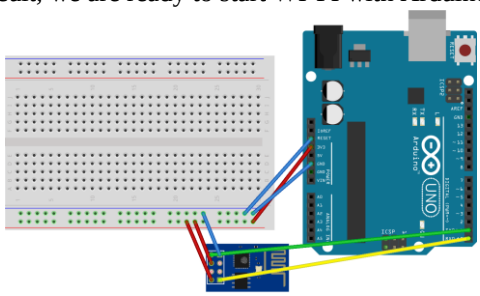

Fig. 7: Pin diagram of ESP8266 connection with Arduino

This system can be breached as it works with Wi-Fi. Using Kali Linux we can pen test our model. A tool called aircrack-ng is used to achieve this.

Things required:

1. Successful install of Linux (Kali)

2. A wireless adapter which is capable of monitor mode or injection

Commands to be followed:

- *airmon-ng*
- *airmon-ng start wlan0*
- *airodump-ng mon0*

Copy BSSID of network of our Wi-Fi module

- *airodump-ng -c 10 --bssid 00:16:BE:F0:G8:C5 -w / root / Deskto p/ mon0*
- *aireplay-ng –0 2 –a [router bssid] –c [client bssid] mon0*
- *aircrack-ng –a2 –b 00:16:BE:F0:G8:C5 –w /root/wpb.txt /root/Desktop/*.cap*

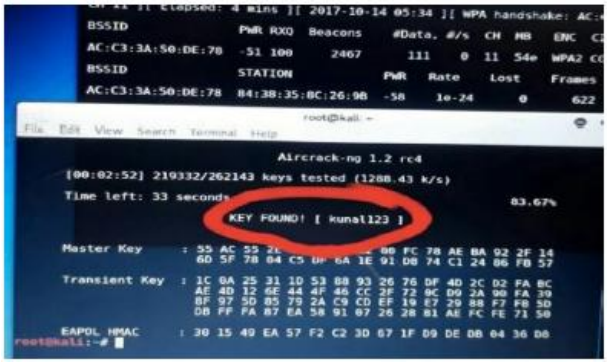

Fig. 8: ARP spoofing of our own made Access Point.

The last part is the demonstration of a Li-Fi circuit to transfer data. This circuit comprises of two parts, which are one is the receiver and other the transmitter.

Components of transmitter are:

Transistor – BC337
Capacitor – 2.2 uF
Resistor
DC 12V battery
Bread Board
Audio Jack (f) – 3.5 mm
Audio Jack – 3.5 mm
LED

Receiver components:

Solar panel
Transformer (Step Down)
Potentiometer
Speaker

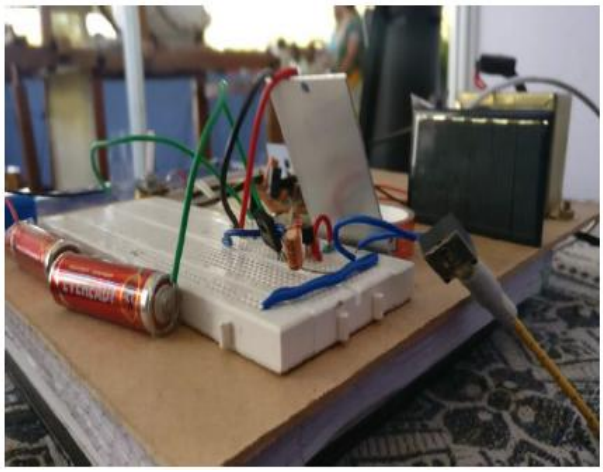

Fig. 9: Our very own made Li-Fi demonstrating model. Focuses on the primary circuit.

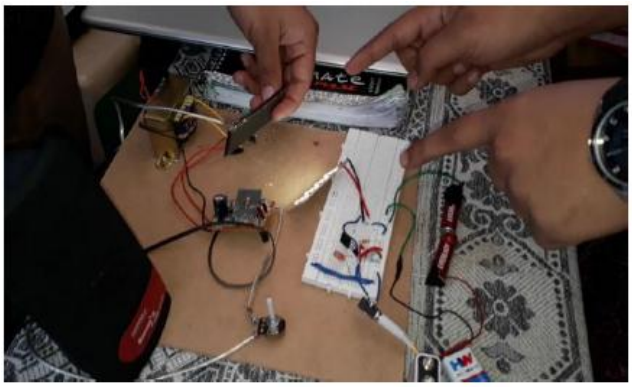

Fig. 10: Li-Fi model showcasing both the transmitter receiver.

V. ARCHITECTURE

The main circuit basically comprises of two parts, which are the receiver and other a transmitter. The transmitter part streams content which is transmitted via LED's. On the other end a photo detector is attached which acts as a receiver which is then amplified and processed.

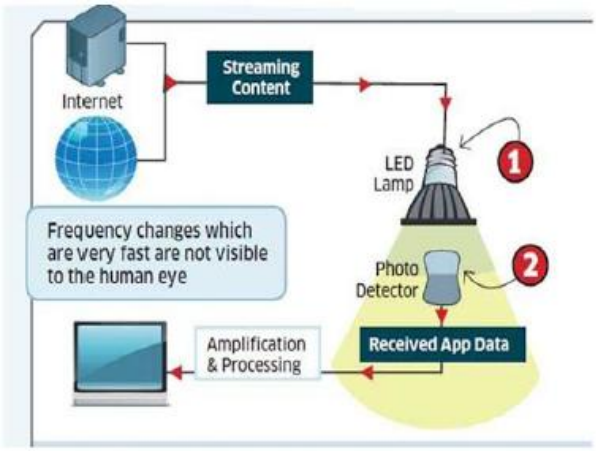

Fig. 11: Basic architecture of a Li-Fi circuit.

In case of Hospitals,

To compare Li-Fi with Wi-Fi and conclude advantages of Li-Fi a survey was conducted with a device called **WIRELESS INFUSION PUMP** which is used in Hospitals. The block diagram of one such pump is shown below:

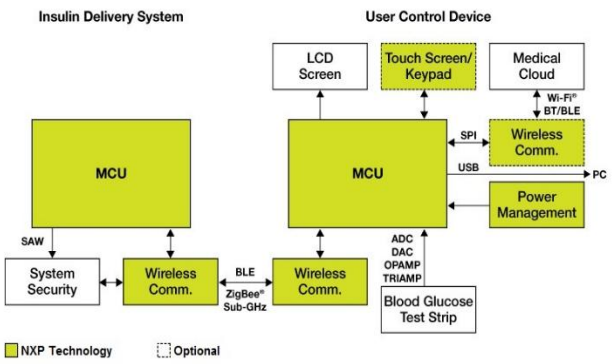

Fig. 12: Circuit diagram of a wireless Infusion Pump.

VI. ANALYSIS

In hospital buildings especially in intensive care units, Wi-Fi usage must be limited (or completely prohibited) due to the interference by radio frequency. If the operation of the medical equipment is interfered, it may malfunction and can jeopardize patients' lives. Through this paper we have tested the vulnerabilities of W-Fi and how it is dangerous to use in sensitive environments such as Hospitals and large data centers.

In addition, it is cost effective as we can use current infrastructure by adding few Li-Fi ready components. More importantly, it is faster than Wi-Fi.

Some areas which can benefit from Li-Fi:

1. Meeting room environment
2. Dense urban environment as in artificial lighting
3. Cellular communication in city lamps
4. Augmented reality i.e. in museums and galleries
5. Underwater communication e.g. Diver to diver, diver to mini-sub etc.
6. Intelligent transport systems
7. Sensitive data
8. Indoor Navigation

VII. CONCLUSION

Through this paper, we have discussed data communication security issues of Wi-Fi over Li-Fi. We have concentrated on benefits of usage of Li-Fi in different fields in form of literature surveys i.e. Optical networking, Visual Sensor networking, Hybrid Wave communication channel, Home inter-communication system, Access point assignment. Then we have discussed general issues pertaining in Wi-Fi and have thoroughly observed the medical equipment using Wi-Fi and how vulnerable they are to unethical access. Following that, we have proposed a system that can solve this issue using Li-Fi as we have shown Wi-Fi spoofing in the beforehand mentioned devices. We have also demonstrated a basic Li-Fi circuit to transfer data and how it is much safer than Wi-Fi. In addition to that, we have also underlined the architecture of Li-Fi.

With the help of google and its GPS (Global Positioning System) technology we can pin point the exact location of a device but can we do it indoors? Li-Fi can achieve that. By identifying all types of light example, with the use of the MAC codes used by computers and data routers), it's possible to provide a better and smarter means to indicate a mobile user their exact co-ordinates/position as they walk inside a corridor.

VIII. FUTURE WORK

Next generation 'Wi-Fi' is about to be launched soon with a cheaper price range. Apple has already included the parameter of Li-Fi in its code so it will implement in its upcoming devices. Also Philips has released its light with Li-Fi enables.

From this current 5G Light Fidelity Technology, one can infer that this technology is an advancement towards design, probably the better designs of internet caused by reduction of device size which transfers data and also implementation – by installing more than 1.5-2 million light sources all around the globe and if possible gets replace by such LEDs and provide us with easy access. Hence there are few disadvantages too, they shall be eradicated by careful research further. LiFi definitely has provided us with a forward invention in the field of drastically growing communicating methods, which is very much safe to all types of bio-diversity that is including homo sapiens progressing towards a greener, better and much better future of Technologies.

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