

# **TEKNOFEST**

## **AEROSPACE AND TECHNOLOGY FESTIVAL**

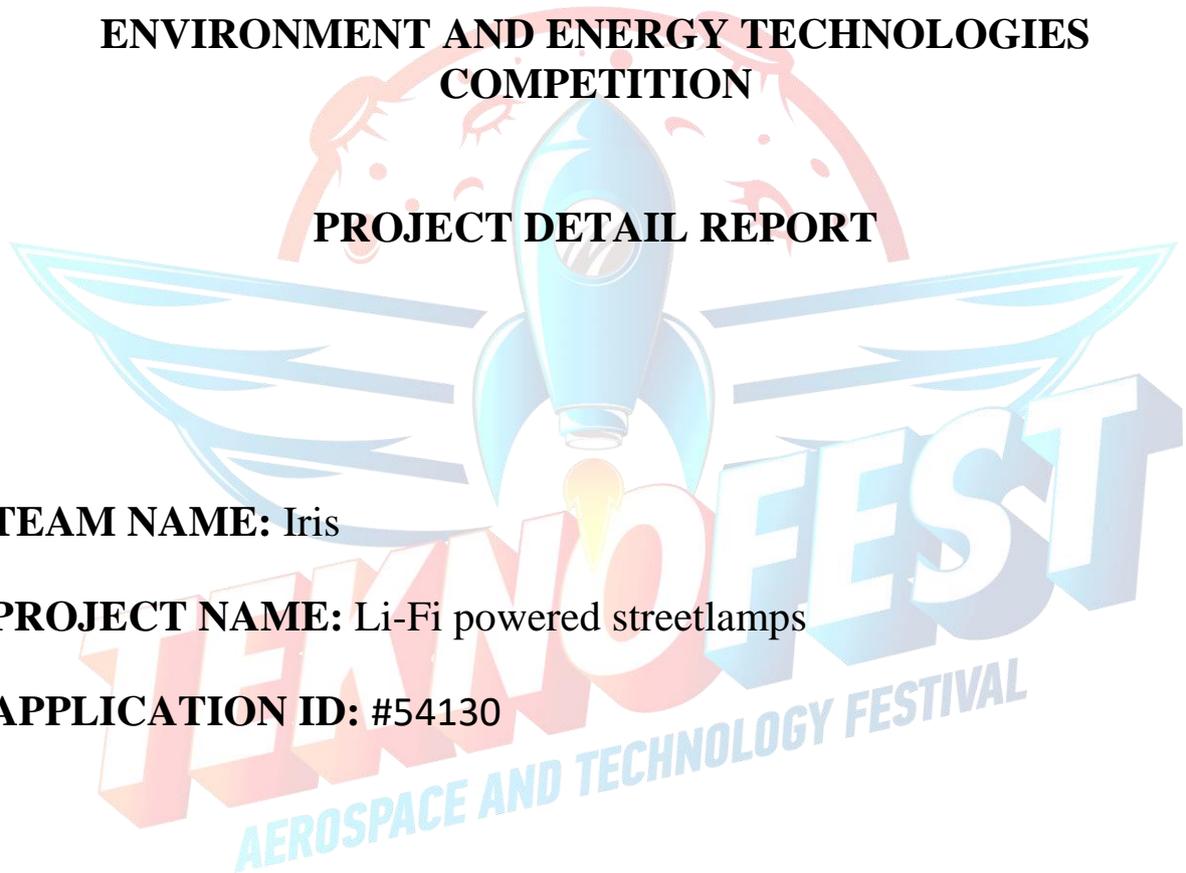
### **ENVIRONMENT AND ENERGY TECHNOLOGIES COMPETITION**

#### **PROJECT DETAIL REPORT**

**TEAM NAME:** Iris

**PROJECT NAME:** Li-Fi powered streetlamps

**APPLICATION ID:** #54130



## **Project Detail Report**

### **1. Project Summary:**

High-speed Wi-Fi has been decreed as a necessity in the modern world. This project proposes the use of the visible light spectrum to transmit and receive data. Using this technology, every LED bulb can be converted to a Wi-Fi router and can be utilized in the same way as a traditional internet router. An ideal spot for the use of this technology are streetlights. This project applies this technology to these lamps and proposes to use them to transmit and receive data at very high speeds. This technology has been named “Li-Fi”. It is several hundred times faster than the fastest broadband services available today.

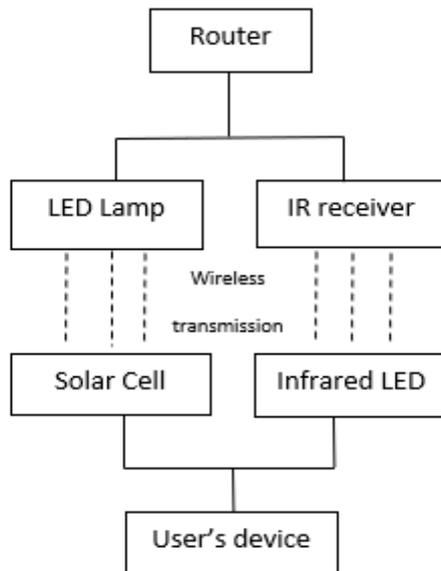
### **2. Problem/ Issue:**

Access to high-speed internet is a fundamental requirement to thrive in the modern world. Broadband networks that provide internet at slow speeds is perhaps the most egregious failure of today’s world. Latency is a major issue for those who use the internet on a daily basis and for all people in general. Another complication that occurs when dealing with Wi-Fi is the risk of interruption. As Wi-Fi uses radio frequencies to transmit data, these frequencies can be interrupted by other devices or instruments that employ the use of this technology. This imposes certain limitations on the usage of Wi-Fi since it cannot be used in several places such as a hospital, an aircraft or underwater. Moreover, in the last decade, the number of devices connected to the internet has increased exponentially a world. This results in the radio spectrum becoming thinner, and with the available bandwidth, it eventually would restrict the amount of data that can be transmitted via radio frequencies. Most importantly, where all our information has been converted to digital data, security breaches pose a potential threat to all users around the globe. Thus, Wi-Fi is vulnerable and unsuited for areas such as Defence where security is of utmost importance.

### **3. Solution**

This project proposes the use of the visible light spectrum as a means of transmitting and receiving data at very high speeds. This technology has been named ‘Li-Fi’. The system shall include Light Emitting Diodes (LEDs) photovoltaic solar cell, an Infrared LED and a receiver. This shall be bi-directional.

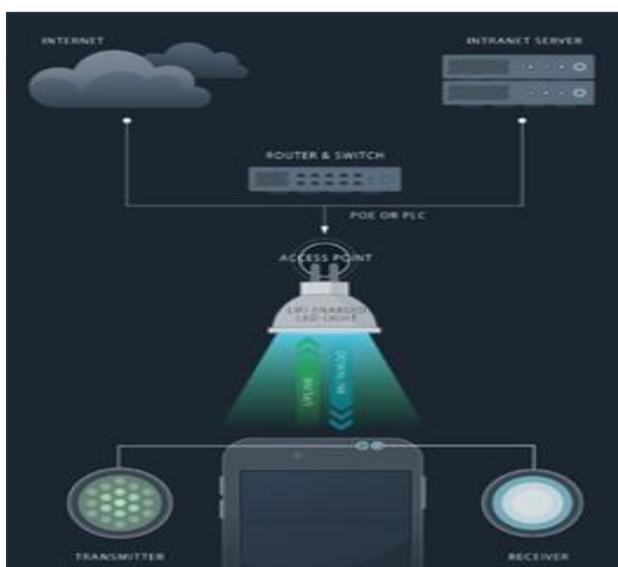
Transmission through light shall enable users to download and share large files at increasingly high speeds. Next, as light does not interfere with any other electromagnetic rays, it can be used at a wide variety of areas such as hospitals and even airplanes. Furthermore, Li-Fi opens up a thousand times more bandwidth which allows even more devices to be connected to the internet and the Internet of Things. Above all, using light, offers better security than other technology proposed before. As light can be confined to a specified area, it becomes impossible for another person to hack into the user’s service, along with allowing the user to employ advanced geofencing.



#### 4. Method

The method proposed implies having an LED lamp connected to a router, that shall grant it access to the internet. The data shall be transmitted through the fluctuation of the LED. An LED turns on and off simultaneously, however it is too quick to be seen by the human eyes. Through this fluctuation, the data shall be transmitted across in binary, that is, in 0s and 1s. This shall be received by a photovoltaic solar cell. The solar cell shall decode the data and send it to the computer which shall then detect an internet signal. The data uploaded by the computer to the internet shall be delivered uplink by an infrared light emitting diode. This shall employ the same principle as the LED lamp. The data shall be received by an infrared light receiver.

To apply the proposed technology to streetlamps, a dongle-like device shall be plugged into the user's device. This 'Li-Fi dongle' shall contain the receiving end of the wireless system, that is, the solar cell and the Infrared light source. This shall allow the user download and upload data to and from the internet.



## 5. Innovative Aspect

The concept of transmitting and receiving data using the visible part of the light spectrum is a theory that has never before been used as a method of communication. The use of an LED lamp to transmit data and a solar cell, to receive and decode this data is an innovative method of using existing hardware to transfer information. Moreover, by employing an Infra-red LED to send the data uplink, and to be received by an IR light receiver, converts the proposed mechanism to a high-speed bidirectional network. Current methods applied in this field lack the security and the plethora of applications that Li-Fi has to offer. If implemented in the correct manner, the technology could help bring the world of data transmission to a new era.

## 6. Applicability

The project can be easily applied to a multitude of different areas and situations, as the infrastructure required to implement it already exists. Li-Fi can be used in every territory that has access to LEDs by simply connecting them to a router. Li-Fi can bring about radical changes in areas where light is used in abundance such as a football stadium. If the lights present in the stadium were connected to a router, the light would provide a high-speed network to the spectators. In the future, the receivers of this data could be installed in the device itself. Furthermore, the technology can be applied in areas that restrict the utilization of Wi-Fi, which gives it a major advantage over it. This project focuses on the application of this technology on streetlamps by connecting them to a router. Thus, the light emitted from these shall provide a high-speed internet connection to the people on the sidewalk.

## 7. Estimated cost and Project Scheduling

Sr.no.	Item	Qty	USD \$	TL
1.	LED Lamp	3	5.79	50.25
2.	Infrared LED	3	2.85	24.70
3.	Solar Cell	3	11.95	103.58
4.	Wires	2m	0.64	5.55
5.	HDMI cables	3	22.80	197.63
6.	Infrared receiver	3	5.85	50.72
7.	Arduino Uno	1	22.95	198.93
8.	Breadboard	2	11.90	103.15
	<b>Total</b>	-	<b>\$84.73</b>	<b>734.51</b>

The estimated project budget, for the prototype to be presented, is 85 to 90 US Dollars. This is fairly low as it is a novel service that shall fulfil several public demands. To apply this technology to one office, for instance, would require nearly the same amount of money as the prototype

apart from the cost of an Internet Service Provider, which is necessary to connect a device to the internet.

The prototype of the proposed technology to take form shall take from a month to three months at most. Research and materials shall be gathered in the first two to three weeks. Most of the expense shall be done in this time period. The next two weeks shall be employed in the testing and assemblage period of the prototype. And another week shall be required where any materials that are short or any malfunctions in the project’s execution shall be eradicated. Since, this is a novel method of data transmission, there are no similar projects in the market, which highlights its innovation.

**8. Target Group of the Project Idea (Users):**

This project is aimed to aid people to use the internet on daily basis, which, in the modern society, is nearly all of the population. Since the project eradicates problems such as latency and security, it can be used in all departments that require a Wi-Fi service with high-connectivity and bandwidth. Since, the project is focused on the application of this technology on streetlamps, the main users of it shall be pedestrians and passer-by’s, allowing them to use it for purposes such as navigating the streets or any other use the wireless network.

**9. Risks**

Probability/ Impact	Electricity cut-off (0.9)	Range (0.5)
Electricity cut-off (0.01)	Low impact (0.09)	Low impact (0.05)
Range (0.3)	Moderate Impact (0.27)	Moderate impact (0.15)

The proposed technology is a relatively low-risk project. Unexpected electricity outage may adversely affect the smooth flow of data. All the LEDs would be turned off, which would disrupt the flow of data by stopping it completely. However, this can be easily overcome through by using a backup power source, such as batteries, to keep the lights on and the system running. Since, the probability of the occurrence of such an event are scarce, it shall not employ much of the team’s time, as using an auxiliary power source shall help in avoiding it. Another risk to be kept in mind is the range of light. Although the range is sufficient to provide internet access to an average-sized room, it may fail to provide data efficiently to all users in a large hall. Thus, by installing several access points in a single room, this risk shall be eradicated.

The project is fairly simple and inexpensive to implement, since the infrastructure and components required for it to function smoothly are already installed and available in the local market.

## 10. Resources and Report Layout

Infrared LED

[https://www.sparkfun.com/products/9349?\\_ga=2.175908898.1249377032.1622896200-866971820.1622896200](https://www.sparkfun.com/products/9349?_ga=2.175908898.1249377032.1622896200-866971820.1622896200)

Infrared receiver diode

[https://www.sparkfun.com/products/10266?\\_ga=2.175908898.1249377032.1622896200-866971820.1622896200](https://www.sparkfun.com/products/10266?_ga=2.175908898.1249377032.1622896200-866971820.1622896200)

Solar cell

[https://www.amazon.com/Treedix-Polysilicon-Polycrystalline-Encapsulated-Waterproof/dp/B0831CMJB9/ref=sr\\_1\\_7?dchild=1&keywords=mini+solar+cell&qid=1622906933&sr=8-7](https://www.amazon.com/Treedix-Polysilicon-Polycrystalline-Encapsulated-Waterproof/dp/B0831CMJB9/ref=sr_1_7?dchild=1&keywords=mini+solar+cell&qid=1622906933&sr=8-7)

USB cables and wires

[https://www.amazon.com/AmazonBasics-Type-C-USB-Male-Cable/dp/B01GGKYKQM/ref=sr\\_1\\_15?encoding=UTF8&c=ts&dchild=1&keywords=USB+Cables&qid=1622995579&s=pc&sr=1-15&ts\\_id=464394](https://www.amazon.com/AmazonBasics-Type-C-USB-Male-Cable/dp/B01GGKYKQM/ref=sr_1_15?encoding=UTF8&c=ts&dchild=1&keywords=USB+Cables&qid=1622995579&s=pc&sr=1-15&ts_id=464394)

Breadboard

<https://www.sparkfun.com/products/12615>

Arduino Uno

<https://www.sparkfun.com/products/11021>

LED Light

<https://starwire-led.en.made-in-china.com/product/qZUTfLuruaVE/China-Ceiling-Light-Fixture-GU10-Fixtures.html>

