

# Photonics and electronics are all around you



*Our lives have become much easier thanks to science, innovation and technology. Nowadays we come across a myriad of electronics and photonics devices every day, but most people rarely wonder about whether these devices are utilising photonics, electronics, or both. The aim of this article is to highlight the major role of photonics and electronics in our daily lives, and, since we live in a power crisis, to make people aware of how we can sometimes use light energy instead of electricity.*

Developments in the field of electrical engineering known as microelectronics and photonics have been a major driving force behind the enormous advancements in computers, personal electronics, electronic automobile systems, smartphones and lasers. The creation of electronic and photonic devices that produce, detect, transmit, distribute, modulate and magnify electrical energy and information is the focus of this field.

## Electronics

When the word electronics is uttered, the first thing that springs to mind is anything to do with little components or circuits of electrical equipment. Typically, computer parts, transition radios or mobile gadgets come to mind. While these are closely connected, electronics can be defined as a discipline of physics and engineering that studies electron behavior, flow, and control under various conditions.

## How do electronic systems work?

Understanding how electronic systems work necessitates understanding the origins of energy and how it is delivered to households so that people can utilise it to power their devices. Because it must be manufactured or generated, electrical energy is not freely available in nature for

consumption. Most of the power is produced from fossil fuels such as natural gas, coal and nuclear energy. According to science, energy can only be changed in its form; it cannot be created or destroyed. For instance, a home with solar panels on the roof transforms solar thermal energy into usable energy that can be used to power appliances such as lights and computers.

## Types of electronics

Electronics come in a variety of forms that can be grouped based on internal design. Input devices, information processing devices, and output devices are three types



of devices. Among the various types of input devices are keyboards, microphones, and switches. Additionally, information-processing devices include motherboards, sound cards, and video cards, and lastly, printers, projector screens and headphones are examples of output devices.

### Photonics

The physical science of light waves is known as photonics. It is associated with the science of production, transmission, emission, processing of signals, detection and sensing of light. Photonics is responsible for many of the inventions that over the past few years have changed the way we live. Examples of photonics include optical fibres, lasers, our phones' cameras and screens, the lights in our houses, and optical tweezers, cars, televisions, and computers.

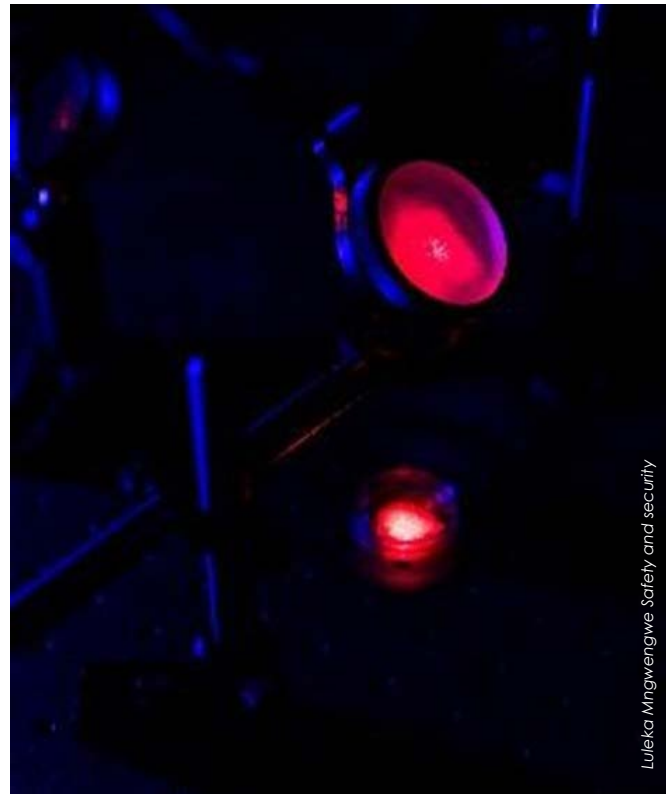
The way we take photos has changed significantly because of photonic-based detectors such as complementary metal oxide semiconductor (CMOS) image sensors (CIS) that are compact, robust and lightweight, and have made it possible for anything from cell phones to cars to now have small, high-quality cameras. Devices for photonics have a very broad variety of applications. Fibre optic networks, which considerably increase the capacity and speed of internet connections all the way down to the home, are primarily reliant on photonic devices for telecommunications. The development of powerful, inexpensive LEDs that reduce power usage while delivering high-quality, flexible lighting options has revolutionised lighting. Solid-state lasers are currently widely used in applications ranging from industrial to medical.

### Photonics and daily life

Photonics plays an important role in driving innovation across an increasing number of fields. The use of photonics covers several industries, including manufacturing, life sciences, healthcare, security and safety, as well as optical data transmission, imaging, lighting, and displays. Where current conventional technologies are reaching their speed, capacity, and accuracy limits, photonics provides novel options. Photonics has a profound impact on how we live our daily lives.

### Health

Light can quickly, sensitively and accurately detect and measure diseases, and in this sense photonics has the potential to revolutionise healthcare. The study of optical methods in biological systems, including both naturally occurring and bioengineered materials, is known as biophotonics. Imaging and sensing cells and tissue are a crucial component of this kind of science. Injecting fluorescent markers into a biological system is one way to monitor drug delivery and cell dynamics. Biophotonics also includes shining low-energy laser light onto or through biological materials. Depending on the type of material being investigated, the light can be reflected, absorbed, scattered, transmitted, or a combination of these. A clearer



Luleka Mngwengwe Safety and security

### Laser light shining on a Petri dish with cells for therapeutic purposes as captured in the biophotonics laboratory.

understanding of how processes operate at the molecular level is made possible by biophotonics, enabling illness prevention and the development of new treatments. In addition, photonic technologies including pacemakers, artificial bones, endoscopes and the tiny cameras used in in-vivo procedures have a significant impact on solving the demands of our aging society.

Photonics enhances the safety and security of people, goods and the environment. Photonics technologies are used in security applications such as biometric and border security systems, video surveillance systems, and tools for the detection of illicit or dangerous items.

### Conclusion

Since we are facing a power crisis as a country, using light instead of electricity is a possible solution to the crisis we are facing. Although photonics are common in daily life, photonic devices frequently go unnoticed. For the design and production of tools, platforms, and integrated circuits for use in high-speed data transmission, sophisticated sensing and imaging, photonics represents a significant opportunity. So, take a look around and try to spot all the photonics devices that make your daily life easier or more enjoyable. There are a lot more than you might think.

*Article written by Luleka Mngwengwe, Dr. Masixole Lugongolo, and Dr Patience Thenjiwe Mthunzi-Kufa , who are affiliated with the National Laser Centre at the Council of Scientific and Industrial Research (CSIR).*

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