Assignment 05

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Step 2: Theory

What is the bandwidth of the optical spectrum (measured in Hz)?

The optical or visible spectrum corresponds to a band in the vicinity of 400 to 789 THz [4].

Is the visible spectrum regulated?

There is the Federal Communications Commission (FCC[1]) which is responsible for managing and licensing the electromagnetic spectrum for commercial users and for non-commercial users including: state, county and local governments. However, there is no regulation concerning frequency for the visible spectrum.

What is the difference between infrared and visible light?

Visible light has a wavelength that ranges from 380 nm to 750 nm on the electromagnetic spectrum while infrared light is beyond it. Infrared light has a frequency range of 300 GHz to 400 THz and a wavelenegth ranging from 700 nm to 1 mm, the beginning of the non-visible portion of the spectrum. As a result, infrared light cannot be seen by the human eye except with special technical equipment.

[1] https://www.fcc.gov/licensing

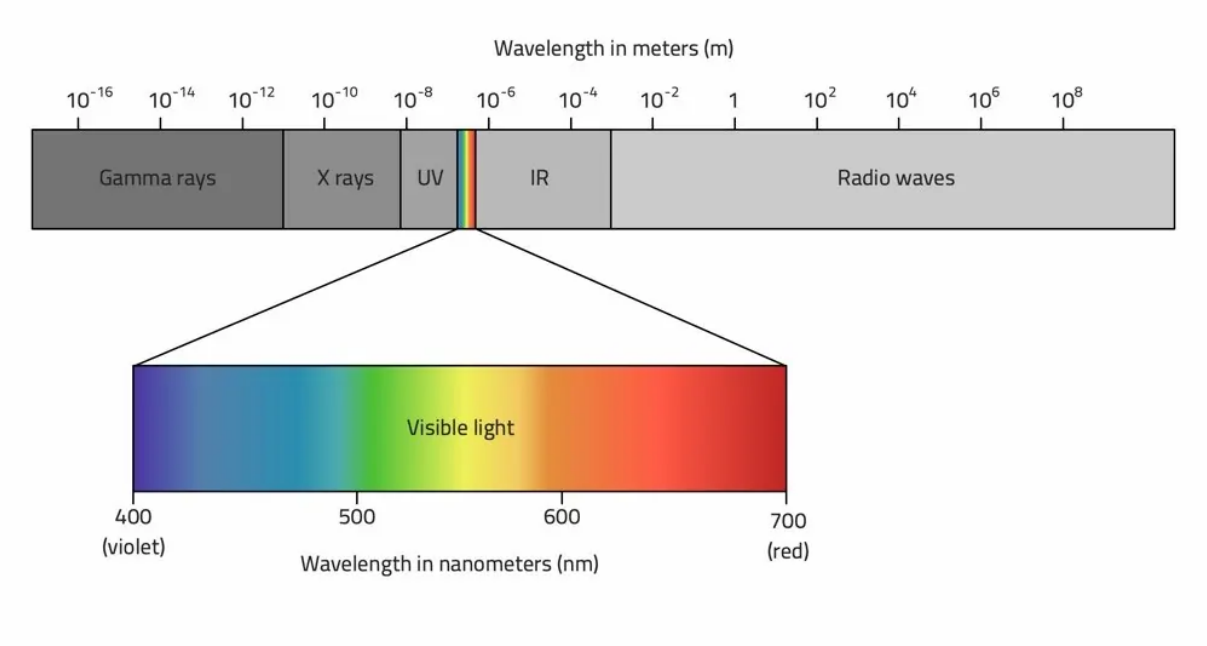

Figure 1: Components of the electromagnetic spectrum.

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Can infrared light penetrate water? Can visible light?

Light penetrating a water surface is scattered and absorbed as it passes downward. As seen in figure 2, the visible spectrum is absorbed the most in water. Within the first 10 m, water absorbs more than 50 percent of the visible light energy. Infrared light is absorbed a lot less and is therefore able to penetrate water much deeper.

Figure 2: Liquid water absorption spectrum across a wide wavelength range (image from https://en.wikipedia.org/wiki/Electromagnetic_absorption_by_water).

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What are the benefits of using an LED instead of a photodiode as a receiver in consumer electronics?

The price of consumer gadgets is quite important. We do not need to include extra hardware in the form of a photodiode if the LED can still be used as a receiver. This significantly lowers costs, especially for gadgets where it is expensive to add a hole for a photodiode. Using an LED, we simply have to change the microchip without any additional costs.

Step 4: Chat Application

Step 5: Performance Measurement at different Distances, find out the Maximum Range)

References

[1] *Light in the Ocean | manoa.hawaii.edu/ExploringOurFluidEarth*. [Online; accessed 22. Nov. 2022]. Nov. 2022. URL: https://manoa.hawaii.edu/exploringourfluidearth/physical/ocean-depths/light-ocean.

[2] Stefan Schmid et al. "EnLighting: An Indoor Visible Light Communication System Based on Networked Light Bulbs". In: *2016 13th Annual IEEE International Conference on Sensing, Communication, and Networking (SECON)*. 2016, pp. 1–9. DOI: 10.1109/SAHCN.2016.7732989.

[3] Stefan Schmid et al. "LED-to-LED Visible Light Communication Networks". In: *Proceedings of the Fourteenth ACM International Symposium on Mobile Ad Hoc Networking and Computing*. MobiHoc '13. Bangalore, India: Association for Computing Machinery, 2013, pp. 1–10. ISBN: 9781450321938. DOI: 10.1145/2491288.2491293. URL: https://doi.org/10.1145/2491288.2491293.

[4] Stefan M. Schmid. "Software-Defined Low-Complex Visible Light Communication Networks". en. Doctoral Thesis. Zürich: ETH Zurich, 2016. DOI: 10.3929/ethz-a-010811920.