WROCLAW UNIVERSITY OF SCINECE AND TECHNOLOGY

FACULTY OF ELECTRONICS, PHOTONICS AND MICROSYSTEMS

3D printing task

Topic: “**Kinetic Energy Harvester based on the Faraday's Law”**

Description and goals:

The study highlights the potential of energy harvesting technologies and supports the development of engineering skills related to 3D print (3DP) processing in the context of electronic design and applications.

Kinetic energy harvesters (EHs) have recently become a trending research topic due to their suitable size and performance for miniaturized sensors and actuators. In particular, in the era of Internet of Things (IoT) development, there is a strong demand for small, lightweight, yet resilient power sources, as the lifetime of conventional batteries is typically limited to a maximum of five years.

This laboratory module focuses on the design, fabrication, and characterization of 3DP EH structures that - assemblied together - convert kinetic energy into usable electrical energy. The goal is to validate the performance of EHs fabricated entirely from 3DP components or implemented as hybrid setups, in which selected 3DP structures are combined with commercial magnets and/or coils.

The tools required to complete the task include CAD software and 3D-printing technologies such as Vat Photopolymerization (VPP) and Material extrusion (MEX). Commercial resins (for VPP) and filaments (for MEX) are used as materials, including filaments with magnetic or conductive properties. This approach enables a comparative analysis of the effectiveness of 3DP electronic materials in terms of performance, as well as the complexity of the assembly techniques required to form an EH system. In addtion, the portable multimeter and oscilloscope can be used to confirm the electronic parameters, such as current or voltage, and magnetic induction as well.

Emphasis is placed on understanding the relationship between application-specific design requirements and the final 3DP structures resulting from different printing techniques. In addition, students investigate the influence of 3DP structures—such as cantilever beams or coil designs—on EH performance.

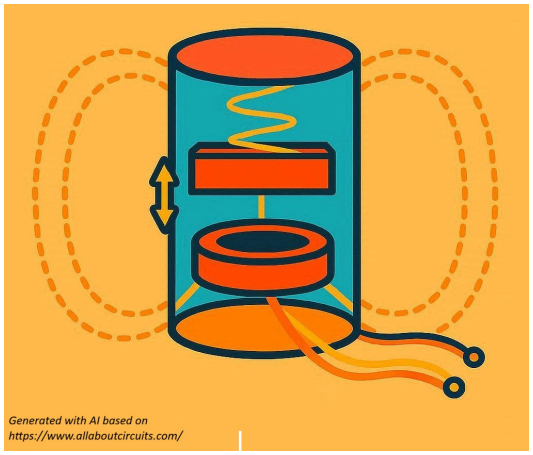

Figure 1: The EHs set-up based on the Faraday's Law using a set-up with a disc.

The subtasks:

- To confirm understanding of the basics for designing the structures:

a brief pros and cons analysis of the kinetic EHs structures based on the authorship lecture and 3 selected scientific papers (1st day)

- To know the printing techniques on hands (VPP and MEX) - the simple cantilever/disc (Fig. 1), coil design (planar) and printing process performing (2nd day)
- To know the commercial electronic parameters – the measurements method and the results analysis (2nd and 3rd days)
- To design, fabricate and examine the self-developed 3DP structures (4th - 9th days)
- To elaborate summary, conclusions and perspectives with the simultanous discussion to reveal the merits and limitations of the as-done task. (7th - 9th days)
- To prepare the presentation (8th - 9th days) and to present it (10th day)

Responsible persons:

Professor: Prof. Sergiusz Patela

Supervisor: PhD Karolina Laszczyk

Msc Eng. Weronika Chuda PhD student

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