

powerWING Redesign: Conceptual and Electronic Overhaul of the WING Artifact

Degree programme : BSc in Industrial Engineering and Management Science

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As a multifunctional and multi-module product, the powerWING aims to provide the functionality of a traditional powerbank, while allowing for extensive customization due to its rigourously modular concept - from changing or adding functionality via the additon of extensions, or simple repair and adaptation via replaceable battery and charger modules.

Introduction and Objectives

The powerWING is a modular and multifunctional powerbank developed by Industrial Engineering students at the BFHs department of Engineering and Computer Science. Previous iterations have focused on the integration of customer requirements into different modules, as well as the latter's assembly and mechanical connection. In turn, this work focuses on the integration of sustainable design principles, as well as a complete overhaul of the product's electronics with the goal of improving its functionality, durability, safety, and reliability.

Research Design

Preparatory steps included the formulation of design considerations based on sustainable design concepts such as DfD and DfR, as well as the elaboration and application of a comparative system FMEA (failure modes and effects analysis) methodology to aid in the evaluation of the redesign's concept and solution maturity, with regards to the mitigation of possible risks and failures. These measures and considerations were thereafter integrated into the redesign, which followed iterative design principles. To allow for continued evaluation and improvement, the FMEA method was reapplied to the latest design iteration, this time additionally comprising new or significantly altered features of the electronic circuitry such as battery management and protection. Another important factor during the design process was the continuous communication with and review by the project supervisors and external senior hardware design engineers.

Results

The resulting prototype consists of several connectable modules (PCBs)(Figure: 1). A particular focus was put on key design aspects such as previously-mentioned sustainable design (durability, disassemblability, repairability and compliance with regulations as to e.g. the avoidance of harmful chemicals, etc.), along with the safe integration of a Li-Ion/LiPo battery including self-developed monitoring and protec-

tion circuitry, the application of EMC-centered design considerations to ensure signal integrity, as well as the evaluation of the connectors as to their mechanical stability and tamper protection (e.g. reverse polarity - Poka Yoke) to ensure both the safe and reversible connection of the modules. Additional monitoring measures as to e.g. thermal protection, rugged industrial design of the exposed electrical interfaces (e.g. overvoltage, -current and ESD protection), resetable fused supply rails for external modules, and according audio-visual signaling in the case of the detection of unacceptable parameters were integrated into the entire design.

Implications and Recommendations

The powerWING is as of yet still in its prototyping stage, therefore requiring further evaluation and optimisation of the different functions, which could include the reapplication of the FMEA analysis. Additionally, an overhaul of the mechanical and external aspects such as the case is currently in development to account for the dimensions and arrangement of the redesigned printed circuit boards. As to the aspect of sustainability, future works may focus on EOL measures such as the integration of a take-back scheme, didactic aspects related to both sustainable and PCB design. In its final release, the power WING embodies an essential platform for building professional competencies and their integration into an useful and versatile artifact.



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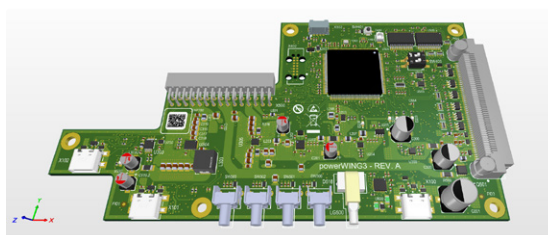


Figure 1: The power management module