INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: **Development of Product Integrated PV (PIPV) Products for Rural Communities of India – An Industrial Design Approach**

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SHORT ABSTRACT

Energy in the form of electricity is a crucial need in the day-to-day life of humans. There are several generation technologies from which electricity is generated and distributed to the different user locations, which majorly happens through the electricity grid. In India, around 69 per cent of the total population stays in villages, and around 300 million people still have no access to basic electricity. Sparsely distributed population, uneven terrain and geographical conditions make it challenging to distribute electricity through the grid to the users residing in villages of India. Hence electrification is still one of the biggest challenges in rural India.

Solar photovoltaic energy is the renewable and viable option to address this issue. Product-integrated photovoltaic (PIPV) refers to the products and systems in which the solar panel is integrated into a product's casing or another surface. There is the use of energy generated by PV cells for the energy requirement of the product during its function. Such products directly interact with their user and primarily aim for grid-independent applications, making them ideal for use in rural and remote areas associated with the lack of access to electricity.

Industrial design is a strategic problem-solving process that drives innovation, builds business success and leads to a better quality of life through innovative products, systems, services and experiences. It will play an essential role in envisaging the new applications of solar PV energy through PIPV product interventions to fulfil various electricity needs of India's rural population. The research study acts at the intersections of three main pillars; PIPV, Industrial design and the needs of rural communities of India.

Considering the phases involved in designing PIPV products to address the various needs of the users from the rural communities of India, the research study is divided into three sub-studies which address the respective research questions to find insights in each phase. Based on the earlier literature, field studies and case studies, the opportunities and critical areas for the Intervention of PIPV products are identified. PIPV Product interventions available in the market, Grassroot innovations and attempts to innovate are identified to map them based on the user needs to be addressed by them. At the same time, the open-ended design Exercise is conducted with industrial designers to understand the interventions conceptualized by them, which are also mapped to identify the addressed user needs. This study identifies the crucial needs of the users to focus on for the PIPV product intervention. In the next phase, the process of design and development of the PIPV product is observed and studied through scenario-based design experiments with industrial designers. The need for an active feedback system and an interface between various stakeholders associated with various phases of PIPV product design is realized. Also, the transition of the PIPV product from its ideation phase to the realization phase is observed. During the entire research, to evaluate the PIPV product with its users from rural areas, the spiderweb evaluation model was adopted and tested to evaluate the PIPV interventions and identify their improvement areas. Based on all the findings, the approach for designing and developing PIPV products in rural India is proposed, which is then validated through the design, development and field testing of PIPV product for agricultural use.

Research explores Industrial Design as an intervention area and focuses on PIPV products in the context of Rural India. As there are limited studies that address these three aspects together, the research contributes by generating new knowledge which will help Industrial designers, Design Engineers, and Product executors who are willing to design PIPV products for rural communities in India.