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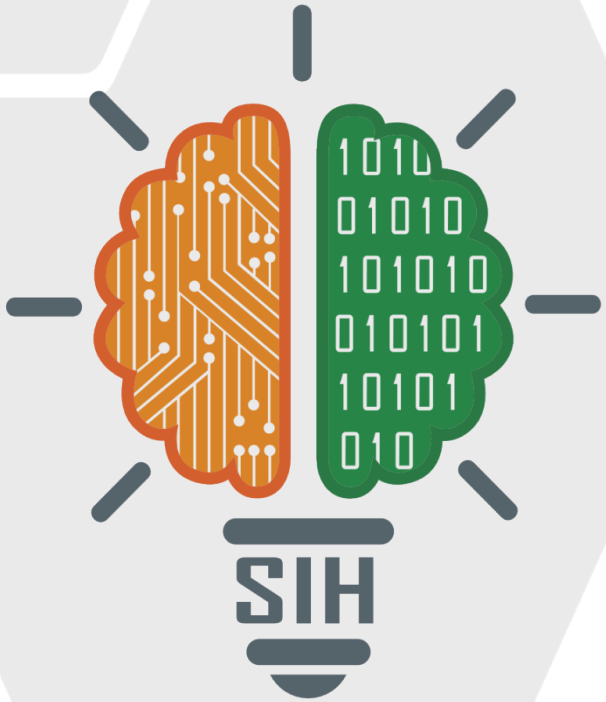
TITLE PAGE

- **Problem Statement ID -** SIH1572
- **Problem Statement Title -** Design/Development of an efficient Energy Storage System (ESS) to integrate intermittent Renewable Energy sources and to support/stabilize the grid
- **Theme -** Renewable / Sustainable Energy
- **PS Category -** Hardware
- **Team ID –** 33281
- **Team Name -** BUGS DENIED



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IDEA TITLE

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Proposed Solution :

- Peer-to-peer (P2P) energy trading platform “URRJA”.
- Houses with excess energy from solar panels share it with their neighborhood via blockchain technology.
- Energy is traded using a digital token system ensuring transparency and real-time transactions.

Adressing the problem :

- Solves grid instability and storage inefficiencies by promoting localized energy trading.
- Reduces central grid pressure by allowing renewable energy to be consumed locally, minimizing transmission losses.
- Promotes the use of renewable energy during peak or intermittent production times.

Unique Value Proposition :

- Decentralized, blockchain-driven platform puts energy management in the hands of communities.
- Real-time energy trading with dynamic pricing.
- Digital energy credits incentivize renewable resource creation.

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TECHNICAL APPROACH

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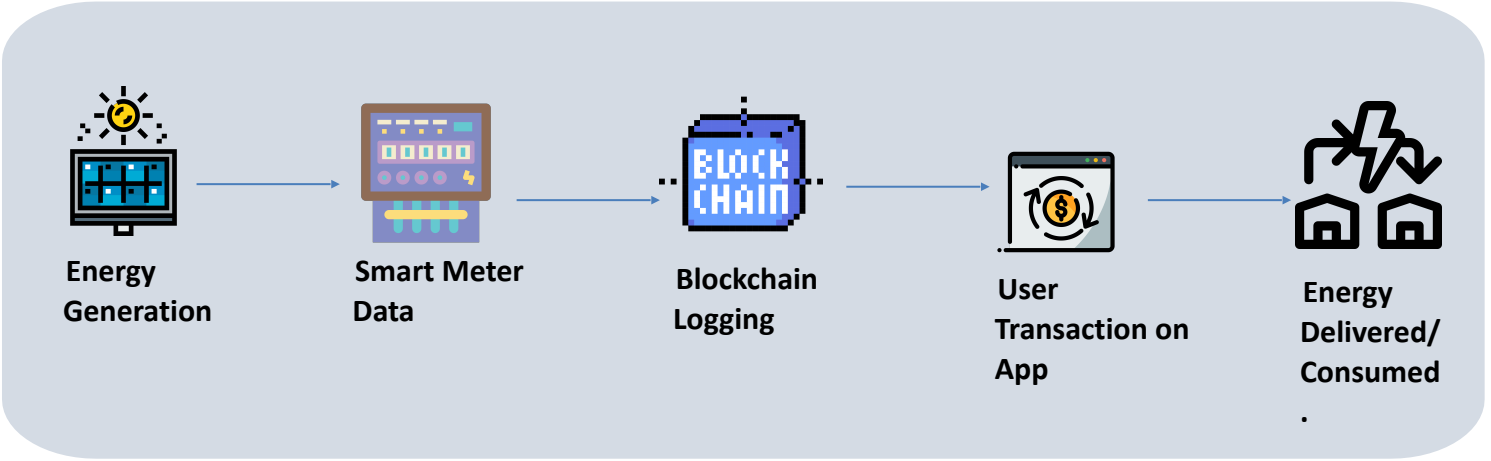
Algorithm Development :

- **Step 1:** Install smart meters at premises for energy monitoring.
- **Step 2:** Send real-time data to a cloud server, log surplus in blockchain.
- **Step 3:** Users access URRJA app for energy credits and conduct P2P energy trades.
- **Step 4:** Blockchain secures transaction settlements.

Flow Chart :



Technologies used :

- **Programming**: Python, JavaScript, Solidity (for blockchain development).
- **Frameworks**: Hyperledger for backend, ReactJS for frontend.
- **Blockchain Protocol**: Hyperledger or Ethereum for energy transactions.
- **Hardware**: IoT-enabled smart meters for energy measurement, edge devices for data gathering.

Product Status :

56% Completed.

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FEASIBILITY & VIABILITY

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Feasibility and Viability :

- Proven technologies like IoT, blockchain, and renewable energy make URRJA highly feasible.
- Successful P2P energy trading cases like SOLShare in Bangladesh highlight its viability.
  URRJA scales easily from local networks to larger regional grids.
- URRJA's blockchain architecture fits seamlessly into India’s existing traditional and renewable energy systems.

Challenges & Risks :

- Regulatory Barriers: India’s energy policy doesn’t fully allow P2P trading.
- Adoption Resistance: Low tech-awareness may hinder initial adoption.
- Grid Compatibility: Old grid architecture poses integration challenges.

Strategies :.

- Policy Advocacy: Promote policy changes to support decentralized trading.
- Community Engagement: Raise awareness of economic and environmental benefits.
- Tech Innovation: Develop hybrid systems that integrate smoothly with existing grids.

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IMPACTS AND BENEFITS

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Impacts:

- Encourages communities to **generate and share their own energy**, also reduces the dependency on central grids .
- **Reduced energy bills** by allowing households to sell their surplus power.
- Opens **new economic opportunities** in renewable energy production and management sectors
- **Minimises energy loss during transmission** which contributes to cleaner, greener urban and rural environments
- **Reduces the dependency on fossil fuel** consumption

Benefits :

- Helps create a **new income generating path** for households producing excess energy
- **Promotes clean energy over fossil fuels** but cutting down on carbon emissions
- **Strengthens community ties** and paves the way for expanding decentralised energy solutions across regions
- Increases **energy accessibility in off grid or rural areas** and reduces strains on national grid by balancing local energy generation
- **Community self reliance** i.e helps local communities to manage their energy needs independently

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RESEARCH AND REFERENCES

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SL.no	Title/Description/Year of Publication	Author/Publisher	Contribution	Limitation
1	Peer-to-Peer Energy Trading meets IOTA: Toward a Scalable, Low-Cost, and Efficient Trading System (2022)	Conor Mullaney Adnan Aijaz Nathan Sealey Ben Holden	• Development of a P2P energy trading system based on IOTA Tangle and smart contracts. • Introduction of a hierarchical routing structure for interconnected micro-grids	• Conventional blockchain technologies face scalability and energy efficiency challenges. • Some consensus mechanisms are too energy expensive or slow.
2	Peer-to-Peer Energy Trading through Swarm Intelligent Stackelberg Game (2023)	Chathurangi Edussuriya Umar Marikkar Subash Wickramasinghe Upul Jayasinghe Janaka Alawatugoda	• Decentralised energy trading network using blockchain technology. • Swarm intelligence technique for optimising energy trading among intelligent agents	• Traditional neural networks had low efficiency and accuracy. • Existing models needed noise reduction and parameter adjustment for improvement.
3	Grid-connected versus stand-alone energy systems for decentralized power—A review of literature(2009)	Deepak Paramashivan Kaundinya P Balachandra N Ravindranath	• Review of 102 articles on decentralized power systems. • Assessment of techno-economic feasibility for grid-connected and stand-alone systems	• Poor performance due to sizing and systemic issues. • Limited coverage on generalized assessment methods
4	A Decentralized System for Green Energy Distribution in a Smart Grid(2020)	Romana Talat Muhammad Muzammal Qiang Qu Wei Zhou Muhammad Najam-Ul-Islam Hosseini Bamakan Jiangnan Qiu	• Novel proof of distribution protocol for decentralized energy transfer. • Digital certificates ensure security in energy distribution protocol	• Security and fault tolerance cannot be achieved simultaneously. • Malicious generators may claim energy transfer without generation.
5	Decentralized operating modes for electrical distribution systems with distributed energy resources (2009)	Nouredine Hadjsaid Raphael Carie Bertrand Raison	• Development of decentralized operating modes for EDS management. • Validation of self-healing functionalities in micro distribution networks	• Centralized management limits handling of DER integration. • Legacy systems complicate transition to decentralized operations