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EFFICIENCY FOR ACCESS DESIGN CHALLENGE 2023-2024

THE CHALLENGE

The Efficiency for Access Design Challenge is a global, multi-disciplinary competition that empowers teams of university students to help accelerate clean energy access. The Challenge is delivered by research and development innovators, Efficiency for Access, in collaboration with Engineers Without Borders UK and funded by the UK government via the Transforming Energy Access platform and the IKEA Foundation.

To provide sustainable energy for all, we urgently need to enhance the efficiency and affordability of high performing appliances. The Challenge invites teams of university students to create affordable and high-performing off-grid appliances and enabling technologies.

By bringing together and inspiring students, the competition aims to foster innovation in the off-grid sector. It also seeks to help address barriers that limit market expansion in this area. Furthermore, the Challenge seeks for forge beneficial partnerships between universities, researchers and industry partners at a global level. In this way, it will further strengthen academic capacity within the off-grid sector.

PROTOTYPING

With funding provided by the IKEA Foundation, the Challenge is able to give students the opportunity to prototype their designs. Prototyping provides students with the opportunity to communicate their concepts and iterate and improve their designs by empathising with those who would use them. Through the process, students test or validate their ideas, design assumptions, and other aspects of their conceptualisation.

LEARN MORE ABOUT THE DESIGN CHALLENGE

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PIKA NA SOLAR

TEAM 2022-05

Angela Achola, Angeline Njuguna & Collins Mugwanga

THE PROBLEM

With the fast-paced world of technology and rising energy costs, there is a dire need to implement sustainable and energy-saving techniques in the cooking sector.
Many rural settlements in Kenya primarily depend on firewood, biomass, and other means for cooking that pollute the environment and pose health concerns.
Electric cookers are becoming increasingly popular but can rely on access to an electric grid. This drives the team's passion to solve this gap in the market, taking into consideration the cooking practices and types of foods commonly consumed in society.

THE SOLUTION

The need to address this challenge has driven the team to design their innovative solution, dubbed PikaNaSolar. Their design includes a battery package for pressure cookers, allowing for the storage of electricity and enabling users to cook even during off-peak sunlight hours, in comparison to conventional pressure cookers that normally use the AC outlet and have no means to store energy.

NEXT STEPS

The team are working with their battery supplier to secure a replacement battery, which will enable them to conduct further tests to ensure product durability. They will use this data to make real-time adjustments and assess the long-term impacts of their design as well as obtaining regular feedback and the sharing of knowledge to improve product implementation over time. They will continue to carry out our market research on improving their product further as they work towards the final completion of their prototype.

The team also plan to provide training on the correct use and maintenance of the product to ensure its durability and will engage with households and communities in promoting clean cooking practices.

LEARN MORE ABOUT THIS PROJECT
and contact the team

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M&S SMART IRRIGATION SOLUTIONS

TEAM 2022-20

Joy Muntet & Vallary Shinaywa

THE PROBLEM

The agricultural sector in Kenya plays a vital role in its economy, contributing 33% to the GDP and employing over 70% of the population. However, it primarily consists of small-scale rain-fed farmers, leaving them vulnerable to drought and weather-related risks. Recent threats of drought and unpredictable weather patterns, exacerbated by climate change, have resulted in crop losses, escalating poverty levels and food insecurity in the country.

THE SOLUTION

The team has developed a low-cost IoT solar-powered irrigation system, a groundbreaking innovation in agricultural water management. It integrates advanced IoT connectivity, solar energy technology, and intelligent automation to revolutionize farm irrigation practices.
Key features include autonomous detection of soil moisture levels, real-time monitoring, and data-driven decision-making for optimal water usage. Incorporating weather forecasting enhances the system's sophistication, enabling proactive adjustments to irrigation schedules based on predicted weather patterns. Additionally, programmable irrigation schedules maximise water conservation efforts, which is crucial in regions with unreliable rainfall patterns. Overall, their technology enhances agricultural productivity, resilience, and sustainability, empowering farming communities to address environmental challenges effectively.

NEXT STEPS

The team aim to have 2 pilot farms, one in Machakos and one in Narok, where they will then conduct workshops with the aim of acclimatising the farmers to their product.

During this time, they aim to test the following aspects of their product:

- Technical aspects: efficiency of the control system
- Direct effectiveness: time & water saved, quality &quantity of yields
- Individual impact
- Community impact

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ECO-DAIRY

TEAM 2023-04

AbdulAzeez Mohammed, Muhammad Mustapha, Salihu Aliyu & Rainah Haliru

THE PROBLEM

Farmers in rural communities in Nigeria, particularly in northern regions like Sokoto State, primarily rely on dairy production for their livelihood. However, the problem of poor milking practices and conditions persists, leading to a loss of income along the milk production chain. In addition to this, the process of milking cattle is conducted manually and often in unhygienic conditions, which has both efficiency and health implications.

THE SOLUTION

The students from Usmanu Danfodiyo University Sokoto have designed an energy-efficient machine to streamline the milking process, reducing the time and effort required from farmers compared to manual milking. The resulting improvement in milking efficiency will allow farmers to focus on other tasks, thereby increasing productivity and potentially increasing income. Automating the milking process with their solar-powered machine will alleviate the physical strain on farmers, particularly in regions where manual labor is predominant.

NEXT STEPS

The team plan on pitching their prototype to potential investors to get the necessary support needed to produce their design on a large scale. They also plan to partner with the Manufacturers Association of Nigeria to identify companies capable of producing the machines in line with safety standards and procedures. They team will also be liaising with international organisations and companies who are willing to facilitate the design, to provide a lasting solution to similar problems facing their regions.

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HY-POWERED

TEAM 2023-07

Andy Onyago & Trevor Atela

THE PROBLEM

The healthcare industry faces challenges in providing reliable electricity to remote institutions, leading to potential disasters for patients. The current energy infrastructure is often unreliable, and backup sources are unclean and harmful to the environment. Energy constraints hinder diagnostic capabilities, limit treatment options, and affect healthcare professionals' satisfaction with working conditions. This is especially critical for low-income healthcare facilities in regions like sub-Saharan Africa.

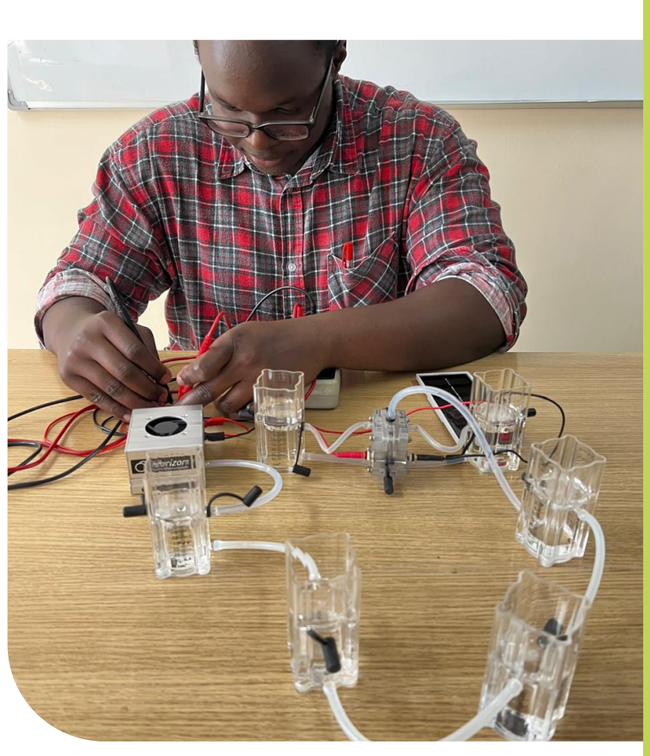
THE SOLUTION

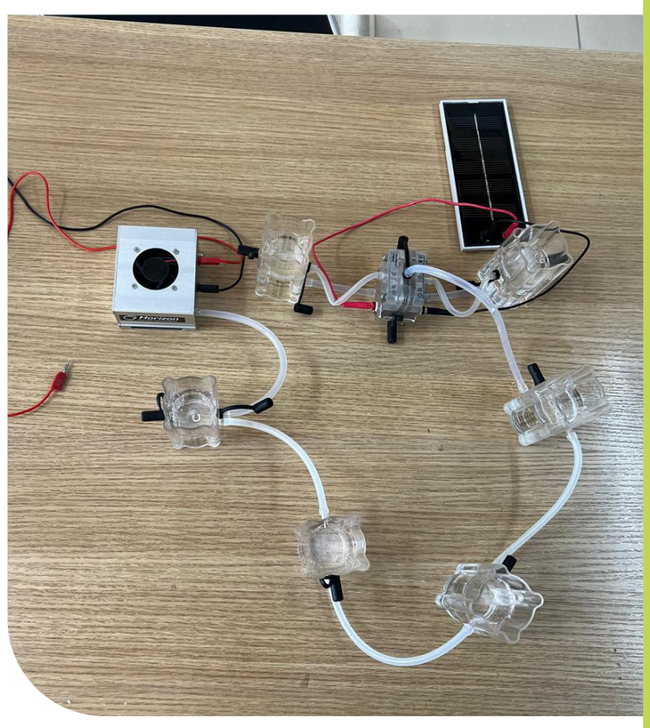
The team from Strathmore University proposed an approach to establish a green hydrogen-based power infrastructure for rural hospitals, using solar energy for electrolysis to produce and store hydrogen. Their clean energy solution aims to ensure uninterrupted power for healthcare while promoting environmental responsibility and community engagement.

NEXT STEPS

The team's main focus is to prepare for a pilot test using their current equipment, gathering important data in real healthcare settings. They also aim to connect with key figures in the climate and renewable energy fields in Kenya to gain valuable insights and grow their business effectively. These connections will help them improve their approach, anticipate challenges, and explore partnerships to accelerate their growth and impact.

> **"Join us in powering healthcare with green hydrogen. Our mission is to revolutionize healthcare in rural areas by providing clean, reliable, and sustainable power solutions. Together, we can empower communities, protect the environment, and improve lives."**





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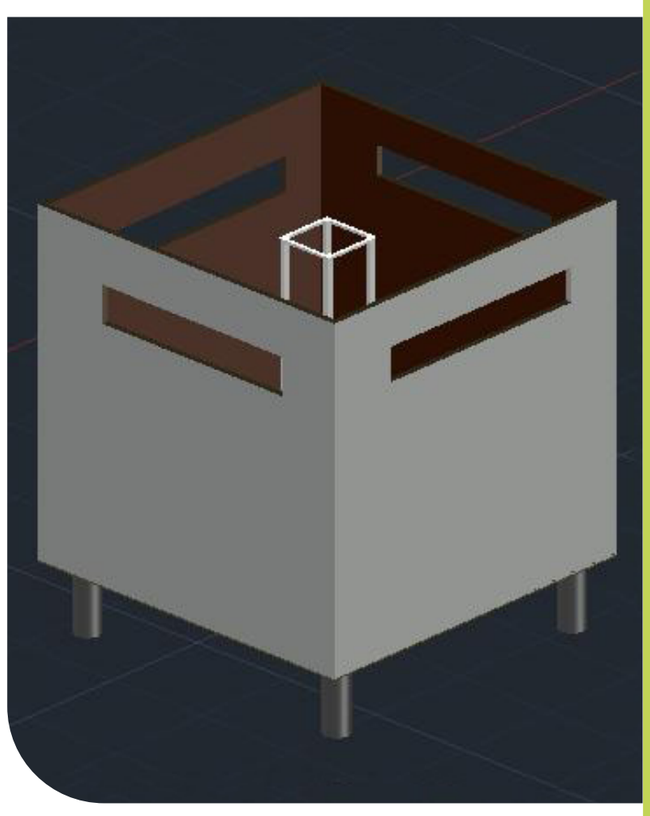
SOLAR-POWERED SMART CEREAL DRYER

TEAM 2023-11

ITEDA Agri Solutions (Job Ian Onyango, Isaiah Ochieng, Ruman Hassan, Ronit Mepani & Sintila Lekatoo Emmanuel)

THE PROBLEM

Traditional open-air sun drying methods for cereals are inefficient and lead to significant post-harvest losses, contamination, and food insecurity. Women and girls bear a disproportionate labour burden from these methods, limiting their educational and economic opportunities. Inconsistent drying increases the risk of aflatoxin contamination, posing severe health risks and economic instability for subsistence farmers.

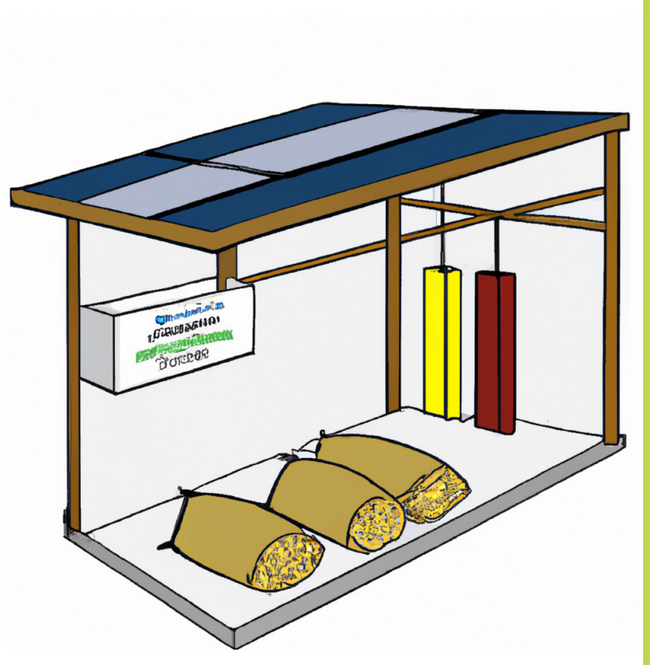


THE SOLUTION

The Strathmore University team designed a solar-powered smart cereal dryer, which provides an energy-efficient and user-friendly drying system for subsistence farmers. Powered by solar panels, the system utilises sensors to monitor and regulate humidity levels, ensuring even drying and reducing contamination risks. The design promotes gender equality by reducing labour demands, particularly for women and girls, while enhancing food security and economic stability. The product's practicality is further enhanced by its ability to integrate into the existing user model, ensuring easy adoption by farmers.

NEXT STEPS

The team's goals for this quarter are to engage further with the users of their prototypes and gather feedback in preparation for entering the market early next year. They are actively refining their design and implementation processes to ensure scalability and sustainability are seamlessly integrated within our solution. They continue to pilot the system in more communities to assess its long-term impact on post-harvest losses, food security, and gender equity. Future improvements will include scaling production and integrating more advanced analytics for farmers.



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SAS-SPRAYER

TEAM 2023-13

Innocent Nsengimana, Augustin Nkundimana, Rachel Uwagiriwubuntu, Jean Bonheur Tuyubahe & Marthe Niere

THE PROBLEM

In agricultural practices—such as the application of fertilisers and pesticides—the continued reliance on non-renewable energy sources, coupled with inefficient application methods, leads to physical strain on workers, environmental damage, and exposure to harmful chemicals. This unsustainable practice poses significant challenges to both human health and the planet.

THE SOLUTION

The team from the University of Rwanda has designed an intelligent, self-operating, solar-powered pesticide and fertiliser sprayer. By enhancing the efficiency of energy use, minimizing environmental impact, reducing labor demands, improving farmer safety, and providing solutions for remote off-grid locations, the team's design can help create a sustainable and equitable energy system that benefits both people and the planet.

NEXT STEPS

The team members are still working to develop a system designed to fully automate their farming device. Through the development of this system, the team aim to create a device that can improve farmer well-being, save time, and reduce the labour costs associated with the manual operation or pesticide and fertiliser application.

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DUAL-FUNCTIONAL INTELLIGENT FARM PRODUCE PRESERVATION

TEAM 2023-14

Chukwudi Aniegboka, Ruth Iloba, Rita Opara, Chima Echendu & Chibuze Ezebili

THE PROBLEM

Smallholder farmers, who constitute 70% of the overall farming population in developing countries, incur huge losses from controllable post-harvest losses. A 2022 Food and Agricultural Organisation report indicates that up to 50% of the total harvest in Nigeria is wasted due to a lack of efficient, technology-assisted means for produce preservation. This is a significant problem, given that over 90% of the food supply comes from smallholder farmers. There is a requirement to provide affordable and energy-efficient, high-throughput appliances to preserve food products for rural, agrarian communities that currently have no access to electricity supply.

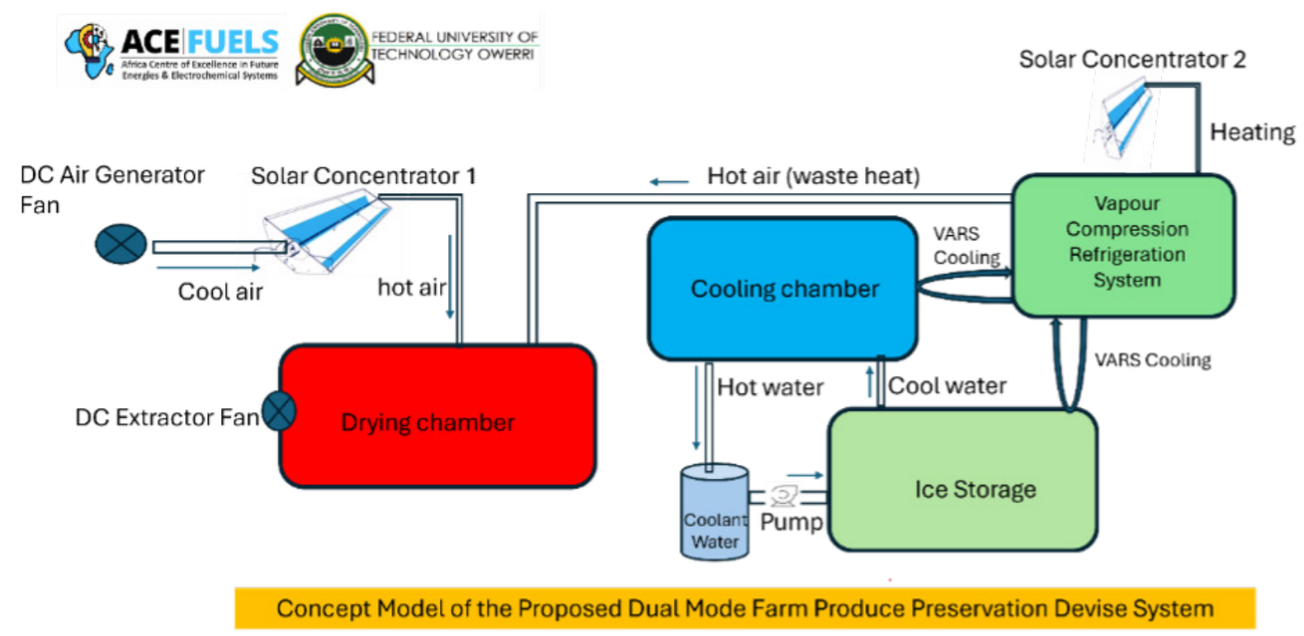
THE SOLUTION

The team from the Federal University of Technology, Owerri has designed an appliance that makes innovative use of established technologies to achieve efficient heating and cooling services for the preservation of farm produce in remote, agrarian communities where there is absolutely no access to electricity. The design eliminates the need for expensive energy storage systems, significantly reducing the cost of ownership and maintenance by up to 90% and representing a remarkable departure from the approaches used in traditional heating and refrigeration systems.

NEXT STEPS

The team's prototype development is currently being finalised. The design of the chilling unit, which is the most significant aspect of the appliance, is currently being tested. Their next steps include the optimisation and launch of the prototype.

ACE FUELS Africa Centre of Excellence in Future Energies & Electrochemical Systems | FEDERAL UNIVERSITY OF TECHNOLOGY OWERRI



Concept Model of the Proposed Dual Mode Farm Produce Preservation Devise System

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AUTOMATED SOLAR POWERED FRESH PRODUCE COOLING APPLIANCE

TEAM 2023-20

Patrick Ndayisaba, Olivier Dushimimana, Pamella Uwicyeza, Dieudonne Dushime & Divine Hatangimbabazi Ishimwe

THE PROBLEM

Post-harvest losses: According to the Food and Agriculture Organization (2011), in Sub-Saharan Africa between 45%-65% of fresh produce is lost before consumption.
Lack of access to electricity: 9.1% of World population lack Access to electricity (World Bank, 2020). According to UNCTAD, 63% of the rural population lacks access to electricity.
Lack of access to cooling service: According to the United Nations, between 1.8 up to 4.1 billion of people in Global South lack access to cooling especially in rural areas.

THE SOLUTION

Team members from the University of Rwanda have designed an automated solar-powered fresh produce cooling appliance, which integrates renewable energy, evaporative cooling technology, smart control systems, modular design, and affordability. Their project and design provide a unique and impactful innovation in the field of post-harvest preservation of fresh produce, addressing critical challenges faced by small-scale farmers, enhancing food security, and promoting sustainable agricultural practices, demonstrating the transformative potential of technology in advancing global sustainability goals.

NEXT STEPS

The next steps for the project team are to finalise their prototype by incorporating additional improvements in energy efficiency and ensuring durability for field conditions. They plan to conduct field testing with small-scale farmers to gather real-world data on performance, usability, and cooling efficiency. Feedback from these tests will help them to refine the design and make necessary adjustments. Additionally, as a team, they will focus on sourcing affordable, sustainable materials for mass production and explore partnerships with local manufacturers and distributors. Their goal is to have a market-ready version within the next 6 months, followed by a pilot phase.

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SOLAR POWERED MEDICAL CENTRIFUGE

TEAM 2023-31

Kenneth Njongwa, Hillary Okode Ochieng, Bul Ayiik Garang & Kago Agnes Nyaguthii

THE PROBLEM

Most off-grid medical dispensaries lack adequate access to medical devices, resulting in delayed or absent medical service delivery and diagnostics. Additionally, the lack of a reliable source of electricity limits the usable equipment and the number of healthcare facilities the government can set up in off-grid regions. To power any available devices, dispensaries often resort to using carbon fuels, which are both expensive and damaging to the environment. These expenses are reflected in the medical bills of patients, discouraging locals from seeking medical attention until critical stages of infection. Together, this contributes to the buildup of a myriad of infections and reduces the overall health of the population.

THE SOLUTION

To facilitate the provision of medical care in off-grid areas, medical appliances that have high power efficiency and run on green energy are essential. Such appliances lead to readily available diagnoses, fewer carbon emissions, and a healthier, happier world. To this end, the team from the University of Nairobi has designed a solar-powered medical centrifuge. Their product is an integral component when conducting tests on collected samples and is a crucial device in diagnostics.

NEXT STEPS

The team's next steps are to create a physical prototype of their design, which will allow them to test their concept and design. Once their prototype is complete, they plan to seek funds to start a mass production plant for their medical centrifuge.

**Images are AI-generated*

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SOLAR-POWERED GROUNDNUT SHELLING MACHINE

TEAM 2023-39

Kidega Fred Opiyo, Mirembe Gloria Masika & Odaga Christopher Okwanga

THE PROBLEM

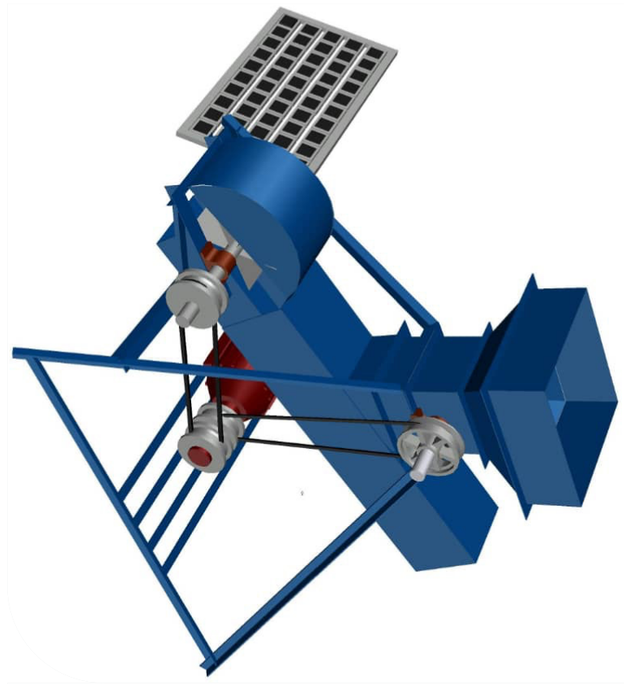
Rural areas, such as those in Uganda, face significant challenges with groundnut shelling. Manually operated, hand shelling machines are slow, labour-intensive, and cause considerable drudgery. The high cost of fossil fuels limits the use of generator-operated shelling machines, and even when they are used, they contribute to air pollution. Additionally, the limited grid power supply in these areas makes it difficult to use electricity-operated machines.

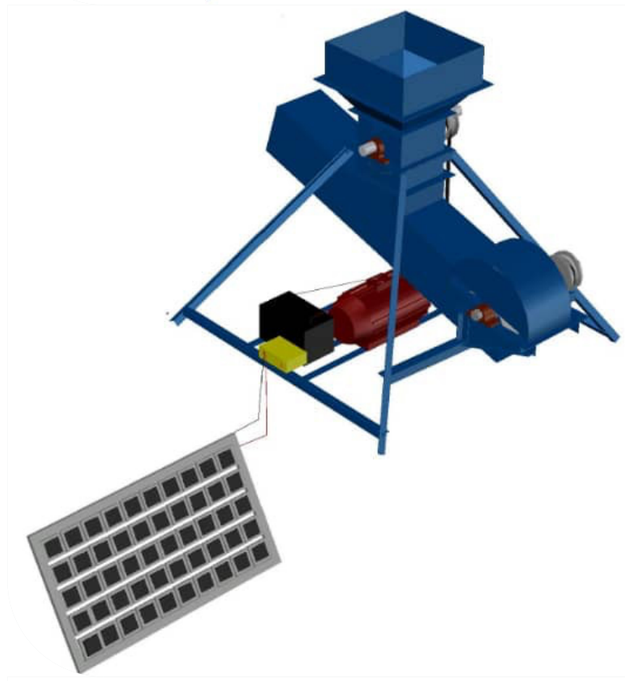
THE SOLUTION

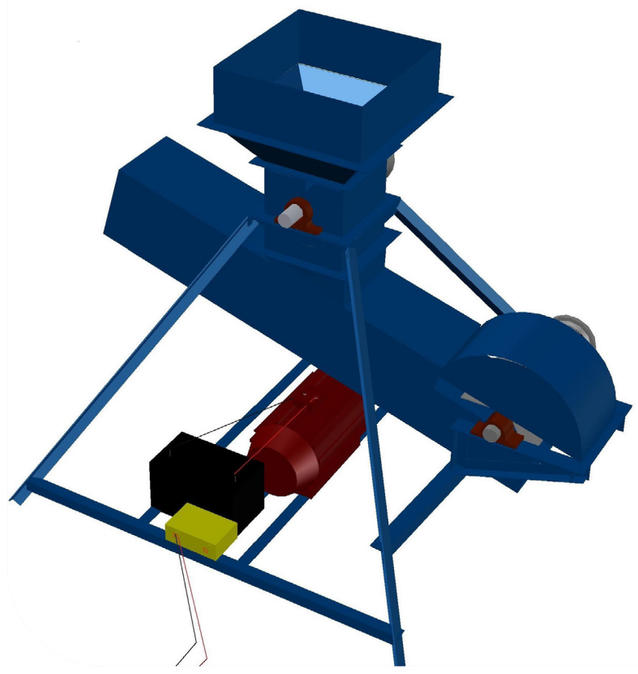
Students at Gulu University have designed a solar-powered groundnut shelling machine that facilitates access to power-driven shelling in rural areas without grid power supply. Their machine significantly reduces shelling time, labour costs, and air pollution associated with fossil fuel generators. The advantages of their design are further enhanced by its simple structure and operation, which required minimal energy.

NEXT STEPS

The team intend to commercialise the design and construction of their solar-powered groundnut shelling machine. After constructing the prototype, they plan to lobby for funding from stakeholders who buy into the idea of their project and make it available to various small-scale farmers at a fairly low cost.







> **“The team are willing to collaborate in any possible way with renewable energy industries who would like to involve them in the renewable energy sector, right from research and development of solutions to problems in the field of renewable energy.”**

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HYBRID WATER DISPENSER

WITH UV-C WATER DISINFECTION & THERMOELECTRIC WATER REFRIGERATION

TEAM 2023-43

Abraham Okee, Muhangi Alfred Joshua, Batumbya Bilali Geriga, Robin Amos Kidega & Ocayotoo Emmanuel

THE PROBLEM

Unsafe drinking water in Uganda, where about 30% of the population lacks access to clean water, significantly contributes to diarrheal diseases. Contaminated water is a leading cause of these illnesses, affecting over 33% of Ugandan children each year. Tragically, diarrheal diseases are responsible for approximately 33 deaths daily among children below the age of 5. The lack of reliable electricity further exacerbates the problem by limiting the implementation of conventional centralised water treatment.

THE SOLUTION

The team from Gulu University has designed a solar-powered UV-C water disinfection system that offers a technical solution by leveraging renewable energy for effective water purification. Their system utilises UV-C LEDs to disinfect water, effectively killing pathogens. Additionally, it incorporates thermoelectric cooling to limit bacterial regrowth, ensuring sustained water safety. By addressing both water quality and energy access issues, this system is particularly suited for regions with unreliable electricity and limited access to clean water.

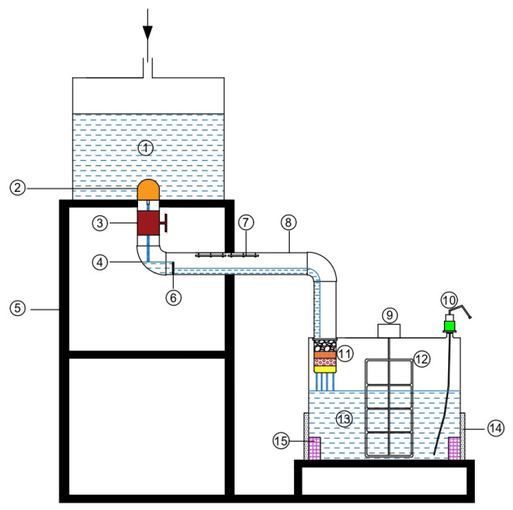
NEXT STEPS

Testing and Validation: The team will conduct comprehensive field tests to assess the UV-C LED system's effectiveness in various water conditions and ensure it meets safety standards for different water sources.

Scaling Up: The team will also develop plans to scale the prototype for larger communities or extended use, including evaluating material durability and system efficiency over long periods.

> **"UV-C LEDs offer significant advantages over UV-C lamps in both environmental impact and lifespan. They are more energy-efficient and do not contain mercury, reducing their ecological footprint and health risks. Additionally, UV-C LEDs have a much longer lifespan their durability and stable performance reduce the frequency of replacements and maintenance, leading to less waste and lower long-term costs."**

SOLAR DC UV-C WATER DISINFECTION WITH REFRIGERATION



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SOLAR SIP AFRICA

TEAM 2022-33

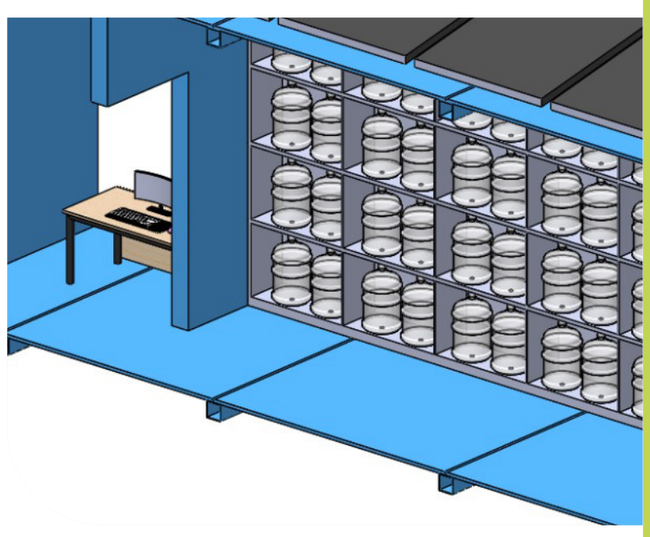
William Mwai, Dan Namasaka & Charlestone Oyoo

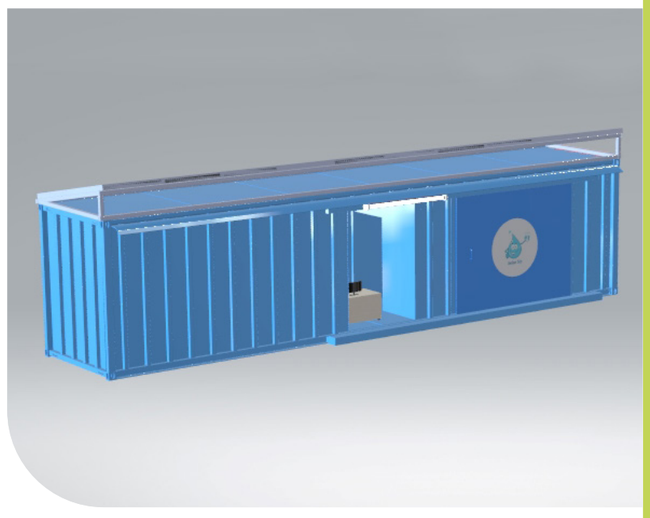
THE PROBLEM

Rapid population growth leads to higher demand for water, while climate change stresses existing water sources. Urban areas, especially informal settlements, often struggle to meet this demand due to limited infrastructure. Limited access to clean water increases the risk of waterborne diseases. Boreholes, a popular alternative, tap into groundwater, which is a finite resource. Over-extraction, which occurs in densely populated urban areas, can lead to the depletion of aquifers, making them unsustainable in the long term. In some areas, groundwater may be contaminated with pollutants or naturally occurring substances like fluoride or arsenic, making it unsafe for consumption without treatment.

THE SOLUTION

Solar Sip proposes a solar-powered atmospheric water generator kiosk to produce clean, affordable water. Solar atmospheric water generators are devices that draw water from the atmosphere using solar energy and can produce distilled water with minimal contaminants. Solar Sip intends to deploy these generators in compact shipping containers to urban areas with water challenges, creating the potential to become an ideal zero-emission business when coupled with an e-bike for water delivery services.





NEXT STEPS

Solar Sip is currently in its prototype phase with its initial prototype expected to produce 10L of distilled water. The first prototype will help gather data to give insights on design, performance and efficiency. The subsequent prototype will build on this knowledge and introduce new systems and design to improve energy efficiency. During this phase, Solar Sip intends to subject the water produced to independent laboratory tests to obtain health certifications and also plan to run a trial phase at a university, to gain more market understanding.

> **“Uniquely, the water produced by the design is pure and suitable for green hydrogen production. Electrolysis (splitting water into hydrogen and oxygen using electricity) relies on ultrapure water with small quantities of electrolyte to maintain the efficiency and longevity of the electrolyser. Thus, Solar Sip can scale to advance green hydrogen economies, especially in the transport industry for fuel cell electric heavy-duty vehicles, securing existing jobs in fossil fuel industries through green hydrogen.”**

LEARN MORE ABOUT THIS PROJECT and contact the team

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