Project Reference Number: 46S_MCA_003

Project Title: AR APPLICATION TO VISUALISE BIOGAS PLANT

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Introduction

The world is facing an ever-growing energy demand that is increasingly difficult to meet with traditional fossil fuels. At the same time, the negative environmental impacts associated with the extraction and burning of these fuels are becoming more apparent and concerning. In response, there has been a growing interest in developing and promoting renewable energy sources that can meet the world's energy needs in a more sustainable and environmentally friendly way. Biogas is one such renewable energy source that is particularly well-suited for rural and semi-rural societies.

Biogas is a versatile and cost-effective renewable energy source that is produced from the anaerobic digestion of organic matter, such as agricultural waste, food waste, and animal manure. The process of biogas production involves the conversion of organic matter into a mixture of gases, primarily methane and carbon dioxide, which can then be used as a fuel for various applications, including electricity generation, transportation fuels, cooking, and heating.

According to a recent study sponsored by MNRE, India's biomass availability is estimated at 750 million metric tonnes annually, with a surplus of 230 million metric tonnes. This surplus biomass, mainly agricultural residues, has the potential to generate around 28 GW of power. Additionally, if sugar mills adopt optimal cogeneration levels, an extra 14 GW can be generated through bagasse-based cogeneration. Biomass is an underestimated and abundant resource globally. Waste incineration and landfill contradict sustainability principles. The circular economy aims to achieve waste-free and emission-free uses, while only the recycling economy is sustainable in our resource-limited world. Organic residues and waste from various sources can be converted into clean energy, valuable organic fertilizer, and compost, promoting a sustainable cycle.

One of the most significant advantages of biogas is that it can be produced locally, which makes it an ideal energy source for rural areas that lack access to reliable and affordable electricity. Rural areas often have an abundance of organic waste that can be used as feedstock for biogas production, and biogas plants can provide rural communities with a reliable and sustainable source of energy, reducing their dependence on expensive and polluting fossil fuels.

To promote the adoption of biogas plants in rural areas, an Augmented Reality (AR) application has been developed that provides a complete visualization of the biogas plant and describes the workflow of the plant in producing biogas from biowaste. The application aims to educate and inform rural villagers about the potential applications of biogas plants and how they can benefit from this technology by learning about the complete implementation of the biogas plant.

The AR application offers a user-friendly and interactive platform that helps users understand the working of the plant and how to easily replicate it or adopt it in their area. By acting as an educational resource and source of information about bioenergy for rural villagers, the project aims to promote the adoption of biogas plants in rural areas and empower rural communities to become self-sufficient and reduce their dependence on expensive and polluting fossil fuels.

In conclusion, the biogas is a highly efficient and affordable renewable source of energy that can bring numerous benefits to rural communities. The AR application developed as a part of this project provides a comprehensive visualization of the biogas plant that can help educate rural villagers about the potential applications of biogas plants and promote their adoption in rural areas. The project aims to provide a sustainable and environmentally friendly energy source that can meet the growing energy demand of rural communities while also addressing the environmental challenges associated with traditional fossil fuels.

Scope and Objectives

Scope: The scope of this project is to develop an AR application that visualizes the working of a biogas plant. The application will provide educational resources and information about bioenergy for rural villagers.

Objectives:

- Develop a 3D model of a bioenergy system using Blender software.
- Implement augmented reality (AR) functionality using Unity Engine.
- Create an interactive AR model of the biogas plant that allows for visualization and understanding of the working of the system.
- Provide educational resources and information about bioenergy, including the potential applications of biogas plants, to rural villagers through the AR model.
- Recommend ways to implement biogas plants in rural areas based on the results of the project.

Methodology

Phase I: Model creation and animation using Blender

In this phase, the 3D model of the biogas plant will be created using Blender, a 3D modelling software. The model will be created based on the specifications provided by the client. The model will also be animated to showcase the processes involved in producing biogas in the plant. The animation will include details such as the flow of materials and gases through the different parts of the plant.

Phase II: Tracking, positioning, scaling of objects and UI creation using Unity

In this phase, Unity will be used to create an AR experience. The 3D model created in Blender will be imported into Unity, and the tracking and positioning of the model will be set up. The scaling of the model will be adjusted to fit the physical world. A user interface will also be created in Unity to provide the necessary information and controls to the user. The UI will include options such as starting and stopping the animation, selecting different viewpoints, and accessing information about the biogas plant.

Phase III: Building an Android Application

In this phase, the AR experience created in Unity will be exported as an Android application. The application will be tested on different Android devices to ensure compatibility. The application will be designed to be user-friendly, easy to navigate, and informative. The application will allow users to view the biogas plant in AR and explore the different processes involved in producing biogas. The application will also provide information on the benefits of biogas production and its importance in sustainable energy.

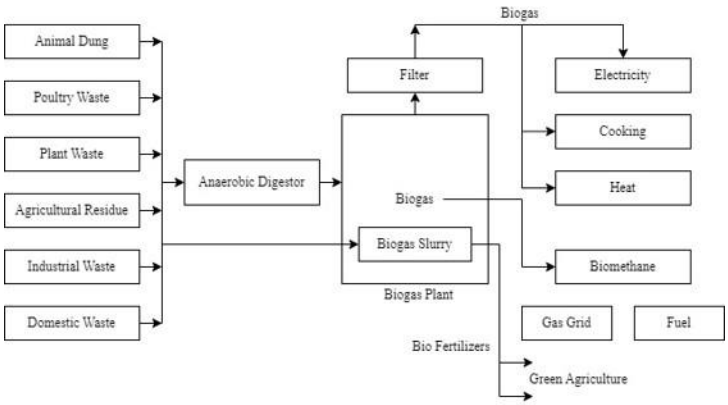

Fig. 1.1 Block Diagram

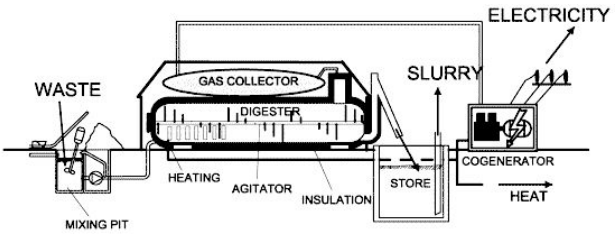

Fig. 1.3 Reference Model

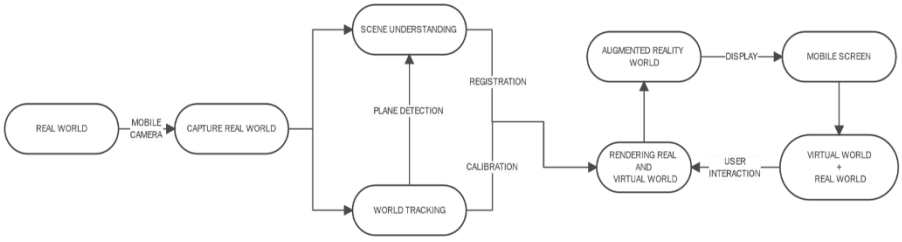

Fig. 1.2 Architecture

Modules (Details of the work carried out)

1. Real World Capturing through AR Camera

Purpose: To capture the real world environment and provide the base for overlaying the 3D models of the biogas plant and its components.

Input: The camera of the user's smartphone or tablet.

Process: The camera captures the real-world environment and feeds the data to the AR application.

Output: The real-world environment is displayed on the screen.

2. Plane Detection

Purpose: To detect horizontal surfaces in the real world where the 3D models can be overlaid.

Input: Data from the camera.

Process: The application processes the camera data to detect horizontal surfaces and create virtual planes.

Output: The virtual planes are displayed on the screen.

3. Tracking, Registration, and Calibration Module

Purpose: To track the position and orientation of the camera in real time, and register virtual objects with the real world environment.

Input: Information about the detected planes from the Plane Detection module, as well as sensor data from the device (such as accelerometer and gyroscope data).

Process: Uses computer vision algorithms to track the position and orientation of the camera, and registers virtual objects with the detected planes to create a seamless AR experience.

Output: Information about the position and orientation of the camera, as well as the registered virtual objects.

4. User Interface (UI)

Purpose: To provide a user-friendly interface for users to interact with the AR application and the biogas plant components.

Input: User interaction with the UI.

Process: The application provides a user-friendly interface with controls and information to help users interact with the biogas plant components and learn about the biogas production process.

Output: The user can interact with the biogas plant components and learn about the biogas production process in a user-friendly and interactive way.

Project Innovativeness

The novel aspect of this project lies in the development of an Augmented Reality (AR) application focused on biogas, specifically designed to cater to rural areas. By leveraging AR technology, this application serves as an effective tool for raising awareness about the advantages of biogas as a clean and renewable energy source. It offers an interactive and engaging learning experience, enabling rural communities to grasp the functioning of a biogas plant more effectively. As a result, the project aims to drive greater adoption of biogas technology in rural areas, leading to reduced reliance on conventional energy sources and an overall improvement in the quality of life for rural residents.

Results and Conclusion

The result of this project is the development of an Augmented Reality (AR) application that visualizes the working of a biogas plant. The application provides a comprehensive and interactive platform for rural villagers to understand the potential applications of biogas plants and learn about the complete implementation of the plant. The AR model showcases the processes involved in producing biogas from biowaste, offering a user-friendly and informative experience.

The AR application successfully educates rural villagers about the benefits and importance of biogas as a renewable energy source. It promotes the adoption of biogas plants in rural areas, empowering communities to become self-sufficient and reduce their dependence on expensive and polluting fossil fuels. By providing a sustainable and environmentally friendly energy option,

the project addresses the growing energy demand of rural communities while mitigating the environmental impacts associated with traditional fuels.

In conclusion, the development of the AR application has achieved its objective of providing an educational resource and source of information for rural villagers. The application effectively visualizes the working of a biogas plant, conveying the potential applications and benefits of biogas production. By empowering rural communities with knowledge about biogas plants, the project contributes to the transition towards renewable and environmentally friendly energy sources, promoting sustainability in rural areas.

Scope of future work

- Enhancing interactivity and realism can involve utilizing virtual reality or augmented reality technologies to simulate real-world scenarios and provide a hands-on experience in the training and application of biogas technology.
- Developing specific training modules and safety protocols ensures that workers are well-educated on the proper use and maintenance of biogas technology, promoting safety and efficient operation.
- Enabling multiplayer collaboration allows for shared learning and teamwork, where individuals can engage in interactive exercises and problem-solving activities together, enhancing their understanding and skills in biogas technology.
- Incorporating language localization ensures that training materials and resources are accessible to a global audience, facilitating broader adoption and understanding of biogas technology in different regions.
- Collaborating with industrial plants and research institutions helps to stay updated with the latest advancements in biogas technology, ensuring that training and educational materials remain relevant and reflect the current state of the industry.
- By contributing to effective training, increased efficiency, and wider adoption of biogas technology, the aim is to promote sustainable energy practices, mitigate environmental impacts, and improve the socio-economic conditions in developing countries.