

Product Development

Dr. Biswajit Mandal and his research team actively involved in few industry sponsored research. The following products and devices are the outcome of those projects.

2024-25

1. Dual-axis solar tracker PV system for power generation.

The primary objective of the “The development of a dual-axis solar tracker PV system primarily addresses SDG 7 (Affordable and Clean Energy) by improving the utilization of solar energy for electricity generation. The project also supports SDG 9 (Industry, Innovation and Infrastructure) through the development of an innovative automated solar-tracking technology, and SDG 13 (Climate Action) by promoting renewable energy and contributing to the reduction of greenhouse-gas emissions.”

The project also support SDG 12 (Responsible Consumption and Production) due to more efficient utilization of available solar energy supports resource efficiency and sustainable energy production. Moreover, it support SDG 8 (Decent Work and Economic Growth) because its development, manufacturing, installation and maintenance of renewable-energy technologies can support green skills, employment and economic activity.



Laboratory scale.



Industrial scale

2. Extracted natural sweetener from stevia.

Primary objective of the project was to extract natural sweetener from stevia involves soaking dried leaves in hot water to dissolve sweet compounds called steviol glycosides, then filtering and purifying the liquid. The active compounds, called **steviol glycosides** (mainly stevioside and rebaudioside A), are 200 to 400 times sweeter than regular table sugar. It has zero calories

and a low glycemic index, meaning it does not raise blood sugar levels. The plant is native to South America (primarily Paraguay and Brazil), where indigenous people used it for centuries. The pure extracted glycosides are heat-stable, non-fermentable, and safe for daily use by individuals managing diabetes or weight.

3. Development of Novel Polymeric Membrane for Proton-Exchange Membrane Fuel Cells (PEMFC) and regenerative fuel cell (RFC)

Primary objective of the present development is to provide a polymeric membrane which would be capable of producing hydrogen from water as in the mode of solid polymer electrolyser and as a proton exchange membrane in the mode of fuel cell to convert hydrogen to electricity and thus would be suitable for construction of proton exchange membrane fuel cell as well as regenerative fuel cell

Another preferred objective of the present product development is to provide said membrane based on PVOH matrix modified with poly (acrylic acid-co-acryl amide) wherein acryl amide will be major part of poly acrylic acid-co-acryl amide polymer.

Moreover the present research and development is to provide said membrane which would be stable and selectively allow passing protons when used in a fuel cell.

2023-24

1. Development of IOT integrated industrial and domestic air pollution monitoring device

This development is about an IOT Based air health monitoring system for domestic uses such as in indoor Auditoriums, conference rooms, indoor stadium, cinema hall, multiplex, etc. The said system could be used in the industry to monitor its gaseous emission as flue gas. The flue gas mostly contains SOX, NOX, CO₂, CO and SPM present in a chimney stack of a factory which are harmful for the environment and needs to be controlled, this is the major reason for this development. It is seen many times that the CO₂ concentration in indoor exceeds the safe limit and become fatal. The gas analyzing systems are generally categorized into contact and non-contact system, both have their respective merits and de-merits. Performance of pollution control strategies mainly depends on the accuracy of the analyzer. It has been observed that the contact mode of gas analyser is able to detect the components more accurately than non-contact sensors. Our analyser consists of a sensor box and IOT control panel. The sensor box and control panel is designed to install in any factory without major modification. There are many new features introduced in this device and also uniqueness in design.

a. Research Laboratories:

An initiative to develop a Multi-disciplinary research laboratory in Chemical Engineering Department has been taken dated on 15.12.2021, with the aim to execute research to roll out products. The number of industries such as, Sunkonnect Pte Ltd., Singapore, Terra Green Technologies Pvt. Ltd. Kolkata, Sunny Ray Solution, Kolkata, Oster Chemicals & Pharmaceutical Works Pvt. Ltd, expressed their interest to sign memorandum of understanding to exchange expertise and knowledge to develop various models and to resolve the technical issues related to industries.

To promote the Multi-disciplinary research and awareness among the faculty members, a faculty development program on “ Scope for Multidisciplinary Research and Education (SMRE 2022)”, organized by Dept. of Chemical Engineering in association with Haldia Regional Centre, IChE dated on 3rd July – 14th August, 2022 which concluded with formation of two multi-disciplinary and multi- institutional consortiums on “ Research & Technology Development for Blending of Agro-Residues with Coal in Thermal Power Plants” of amount Rs. 4.63 Cores and “Hydrogen Valley Research and Development Platform at Haldia Industrial Cluster” of amount - Rs. 14.62 Core dated on 31.09.2022 and 03.05.2023 respectively to DST, Technology Mission Division, Govt. of India, New Delhi.

The journey of the above mentioned collaborations was started with the first project entitled “ Machine learning of real-time images analysis of solar modules” jointly with Sunkonnect Pte Ltd, Singapore on 4th April, 2022. The first phase of project budget was Rs. 40,000/- and the multi-disciplinary group consists of Chemical Engineering and Computer Science and Engineering.

Another project entitled “Development of IOT integrated industrial and domestic air pollution monitoring device” sanctioned by Terra Green Technologies Pvt. Ltd. Kolkata dated 21/09/2022 to short out an industrial problem for real-time monitoring. The first phase of project budget was Rs. 15,000/-. This project was designed to form a consortium of two colleges, Haldia institute of Technology and Heritage Institute of Technology. A device was developed and tested its reliability in laboratory as well as, sent for trial in industry. After successful field trial, a patent application was filed on 03/03/2023 to protect the novelty and finally, technology transfer agreement was signed dated on 09/11/2023.

Moreover, another multi-disciplinary group consisting of experts from Chemical Engg., AI ML, CSE and AEIE was also formed to execute an important project entitled “IOT based water health monitoring system for pisciculture” dated on 18th July, 2023 from Five Star Logistics Pvt. Ltd. The laboratory-developed device has already been tested in reliability and ready to transfer for field use.

In continuation to the research work related to Proton Exchange Membrane Fuel Cell (PEMFC) and Regenerative Fuel Cell (RFC), a new polymeric membrane was also developed in the research laboratories in Chemical Engineering Dept. to be recognized as an alternative membrane for such electrochemical devices. A patent was filed to protect the innovativeness dated on 03/05/2022.

b. Working models/Charts/monograms etc.

2024-25

1. Solar-wind hybrid stand-alone power generating system with improved capacity factor.

Sunlight is at its peak during summers. A single solar or wind system installed in your home will produce ample electricity in summer. The efficiency, sadly, will drop in the winter season. During winters, a single energy system cannot operate at its maximum efficiency. Hence, the better choice is to install a hybrid solar wind system. Omnidirectional wind turbines can operate at low wind speeds and have good selfstarting performance. It has Low noise levels, independent of wind direction. The design poses uniqueness to operate in turbulent wind flow as well as low wind speed. The wind turbine integrated with solar PV will be effective even in city road or roof to power lights, signaling system or the mesh network system in small scale. Moreover, this system can be utilize and install on rooftop to power home appliances.

Unique feature of the project was to design of an omnidirectional wind turbine that rotates irrespective of wind direction due to venturi effect. The system was tested with customized savonious as well as omnidirectional type wind turbines for efficiency analysis and reliability test. The permanent magnet alternator was fitted with customized turbine below a bifacial solar photovoltaic cell for integration.

After successful integration of the customized wind turbine with alternator and bifacial solar photovoltaic cell in a customize structure, it was connected with hybrid charge controller for charging battery and provide output to the load.

1. IOT based water health monitoring system for pisciculture

The present development of working model pertains to the field of aquatic ecosystem management and IoT-based environmental monitoring systems. More specifically, the development relates to a novel IoT-based smart fish water health monitoring and automatic aerator control system employing LoRaWAN communication technology. The working model encompasses a comprehensive solution for real-time monitoring of water parameters (dissolved oxygen [DO], pH, temperature, and nutrient levels [NPK]) and the automated adjustment of aeration in fish water bodies, facilitated by innovative sensor technology, remote control functionality, and LoRaWAN enabled efficient communication protocols.

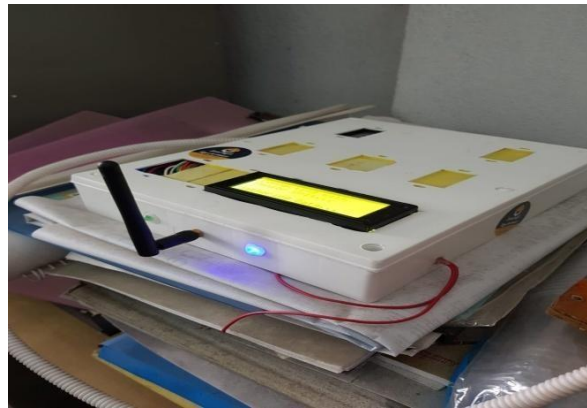


Fig. 1: LORA IOT device



Fig. 2: IOT Sensor for water health monitoring

1. IOT integrated industrial and domestic air pollution monitoring device

The rapid industrialization and urbanization of modern society have led to increased concerns about air quality and environmental pollution. As a response to these challenges, we present an innovative IoT-based Air Health Analyzer System designed to accurately measure and monitor gas emissions in the stack of industrial chimneys. This system integrates high-quality gas sensors to detect a comprehensive range of pollutants, including sulphur oxides (SOX), nitrogen oxides (NOX), carbon oxides (COX), particulate matter of sizes PM 2.5 and PM 10, as well as volatile organic compounds (VOC). The key feature of our system lies in its ability to provide real-time and accurate data on gas emissions, enabling industries to actively manage and mitigate their environmental impact. The incorporation of state-of-the-art sensors ensures the highest level of precision in gas measurements, thereby facilitating compliance with regulatory standards and fostering sustainable industrial practices. To facilitate seamless communication and data transfer, the IoT-based Air Health Analyzer System employs Long Range Wide Area Network (LoRaWAN) technology. This wireless communication protocol enables efficient and low-power data exchange between the sensor unit, control unit, and display unit. LoRaWAN ensures reliable connectivity over long distances, making it ideal for industrial applications where chimneys may be situated in remote or challenging locations.



Fig. 3: Domestic air pollution monitoring device



Fig. 4: IOT Air controller