

Details of Infrastructure developed for Consultancy:

1. Solar radiation (global, beam) measuring system

Dual arm sun tracker mounted with Pyrheliometer and Pyranometer having Universal Data logger.

A Centre of Excellence in Solar Thermal Technology by setting up a major Solar Thermal Test Bed Facility which can be used to carry out frontline research work in an academic environment on solar thermal energy around all key research challenges and engineering issues. This is in line with aim to create a research and development hub which will have the potential to meet critical human resource development as well as development of basic and applied research in solar thermal power technology.

	
<p>Dual arm sun tracker mounted Pyrheliometer, Pyranometer for measurement of solar radiation</p>	<p>Universal Data logger for storage of data.</p>

2. Design, development and Performance Evaluation Facility of solar dryers for long run storage of agriculture produce

Drying is a universal method for preserving food material at minimum storage cost. It helps to achieve better product quality, longer safe storage period. In the present context, current trends towards higher cost of fossil fuels and uncertainty regarding future cost and availability, applications of solar energy utilization in drying agricultural produces will probably increase and become more economically feasible in the near future. It gives faster drying rates by heating the air to 10-30°C above ambient, which causes the air to move faster through the dryer, reduces its humidity and deters insects. Drying is a complex process involving heat and mass transfer between the product surface and its surrounding medium and within the product.

Execution Methodology of designing of solar dryers according to customer need:

- Collection of Preliminary Data
- Site Visit
- Pre-feasibility Report

- Design And Tender
- Execution of Work
- Monitoring
- User Training



Moisture Analyzer: Measurement of moisture and evaporation rate at different operating temperatures.



Solar Dryer laboratory test setup: Determine the optimum operating parameter for agriculture produce to design the solar dryer



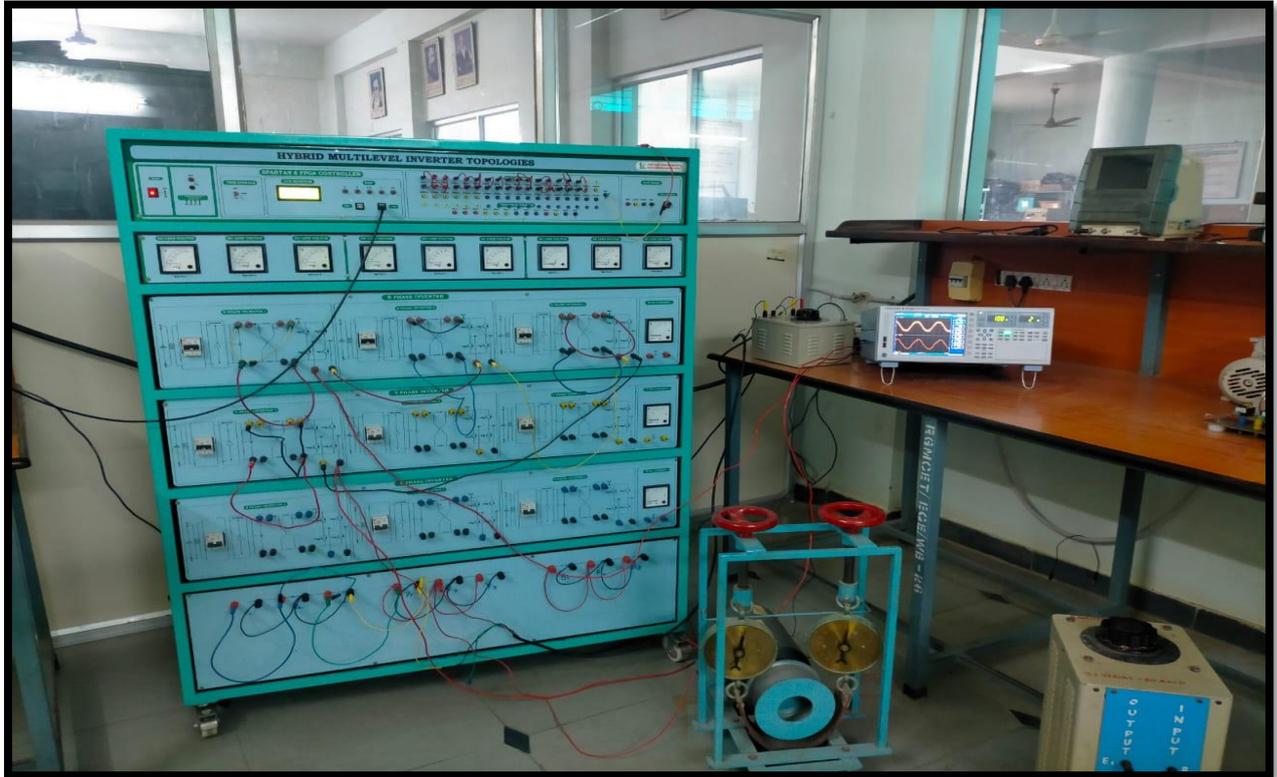
3. Design & Development of PV-based Hybrid Multilevel Inverter topologies for Agricultural Motor and feeding to grid

The setup proposed, fabricated and installed has immense applications and possibilities of innovative topologies that produce as low as possible THD at the output voltage. So that applications can be implemented in agricultural and grid integration sectors. The photovoltaic power systems have made a successful transition from a stand-alone feature to large grid-connected systems. Grid-connected PV systems can vary in size, but these systems have common components. In addition to the PV systems components, the grid connected elements necessitated to be appeared here are the current controller and output inverter filter, as well as metering equipment to monitor the power that is fed in to the grid and vice versa.

- **Novelty in designing various Hybrid MLI topologies.**

The main objective of MI is to consider the limitations of renewable sources based on the intermittent nature of supply i.e. the energy can only be harness during a particular part of the day, like daytime for solar energy and windy conditions for harnessing wind energy, also these conditions cannot be controlled. Another objective is to integrate solar PV system with smart grid concepts with the suitable protection mechanism with the grid during such unpredictable energy sources, it is necessary to have a grid that is highly adaptive (in terms of supply as well as demand). Hence, the opportunities for building Smart Grids are immense, as reliable electric supply is one of the key infrastructure requirements to support overall development. Motivated by the contexts of MI, Our immediate motivation is to develop intelligent techniques for reduction in leakage currents and parasitic effect in grid connected solar PV Inverters.

Challenging parameters of Grid side converters are harmonic distortion content, power factors, and dc components, the output current of grid connected power converters must comply with the requirements of electricity supply companies. Recently, converter topologies employing a high-frequency transformer instead of a line frequency one have been investigated in order to reduce size and weight. The tradeoff between high efficiency and low cost is a hard task for these architectures because they require several power stages. Moreover, these topologies are usually characterized by a strong reduction of the switching voltages across the power switches, allowing the reduction of switching power losses and electromagnetic interference (EMI). This project concerns the use of hybrid multilevel topologies for Grid side converters.



Hybrid Multilevel Inverter Topologies : Generating a 9-Level waveform at output with reduced number of switches and reduced THD

4. Standard Penetration Test (SPT)

The Standard Penetration Test, also known as SPT, is an in-situ test of soil to evaluate the soil properties. Around the world, it is the most popular test of soil for subsurface exploration. The measure of soil penetration resistance and collected soil sample is used for foundation design. The standard penetration test is coming under the category of penetrometer tests. This test (IS: 2131-1981) is performed in a clean hole 55mm to 150mm in dia. A casing or drilling mud can be used to support the sides of the hole. A thick-wall split-tube sampler, 50.8 mm Outer dia and 35 mm Inner dia, is driven into the undisturbed soil into the bottom of the hole under the blows of a 63.5 kg drive weight with 75 cm free fall. An empirical penetration correlation is derived between the soil properties and the penetration resistance. The minimum open length of the sample should be 60 cm.

The followings are the major advantages of the Standard Penetration Test.

- It is an inexpensive test.
- The test can be done quickly.
- The test procedure is relatively simple to perform.
- Collected soil samples can be used for soil type identification.
- The compressibility and relative strength index of the soil can be established from SPT data.
- Able to penetrate dense layers, gravel, and tilt.
- With SPT-N values, the method based on this history can reflect actual soil behavior during earthquakes, which cannot be simulated in a lab.

The followings are the disadvantages or limitations of the Standard Penetration Test.

- The type of soils impacts the usefulness of the obtained result. Most useful results can be achieved in fine-grained sands.
- Non-disturbed samples cannot be collected. The samples are highly disturbed.
- The test requires borehole preparation.

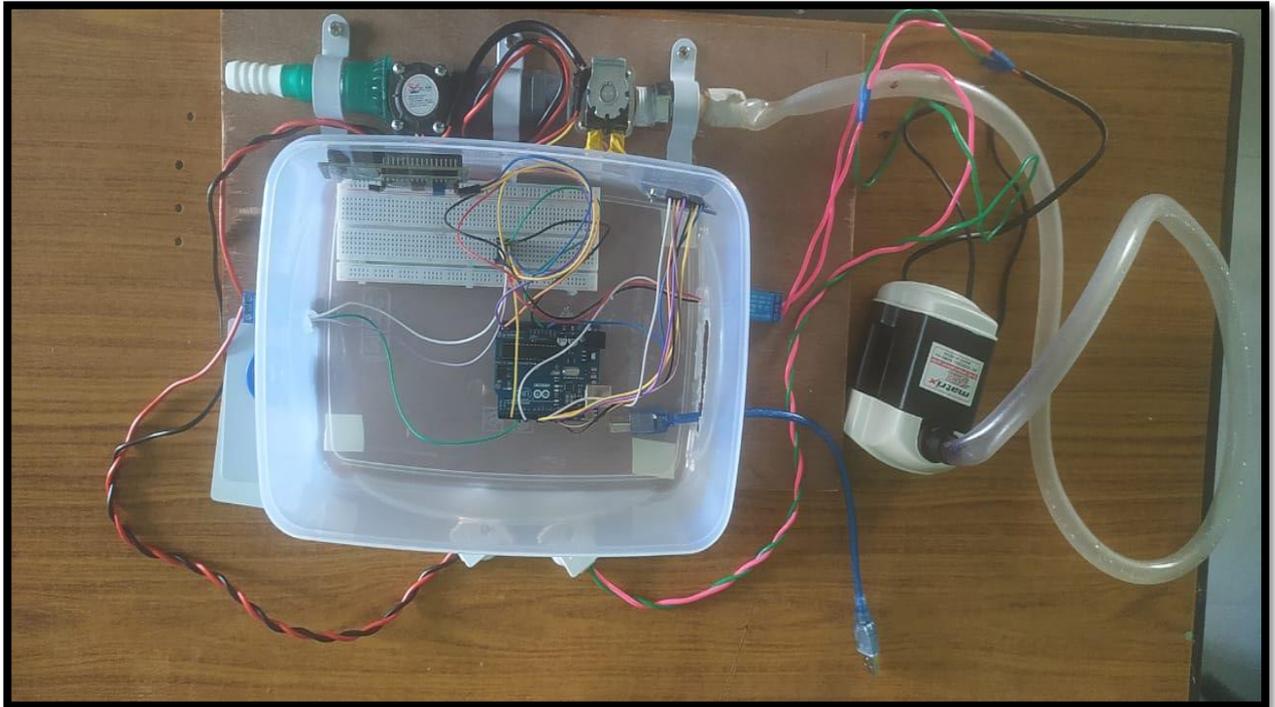


Demo session on SPT test for students at RGM CET (Dept. of Civil)

5. Embedded Automation Setup:

a) Design and Development of RFID Based Water management and distribution system for municipalities and gram panchayats.

Water is the most important source of life on Earth. Every country is facing acute water problems. The main cause for it is the unaccounted usage and freely available natural resource. This is the time where in strict norms of usage and accountability for usage has to be brought in globally. This project provides the solution by incorporating automated water access system based on RFID, which is linked to water distribution systems of villages and cities. The objective is to restrict the usage of water and to provide water for household purposes on ration basis for example 500 litres per day. This quantity will be fixed per day so that everyone will get equal amount of water per day. The water access is only through a RFID card issued by the local authorities, in case he needs excess water than the prescribed quota he can access it at an additional usage charges. The system uses NI myRIO, flowmeters, solenoid valves, GSM mechanism. This project also provides the analysis and estimation of future demands of water which will help in effective planning by the authorities.

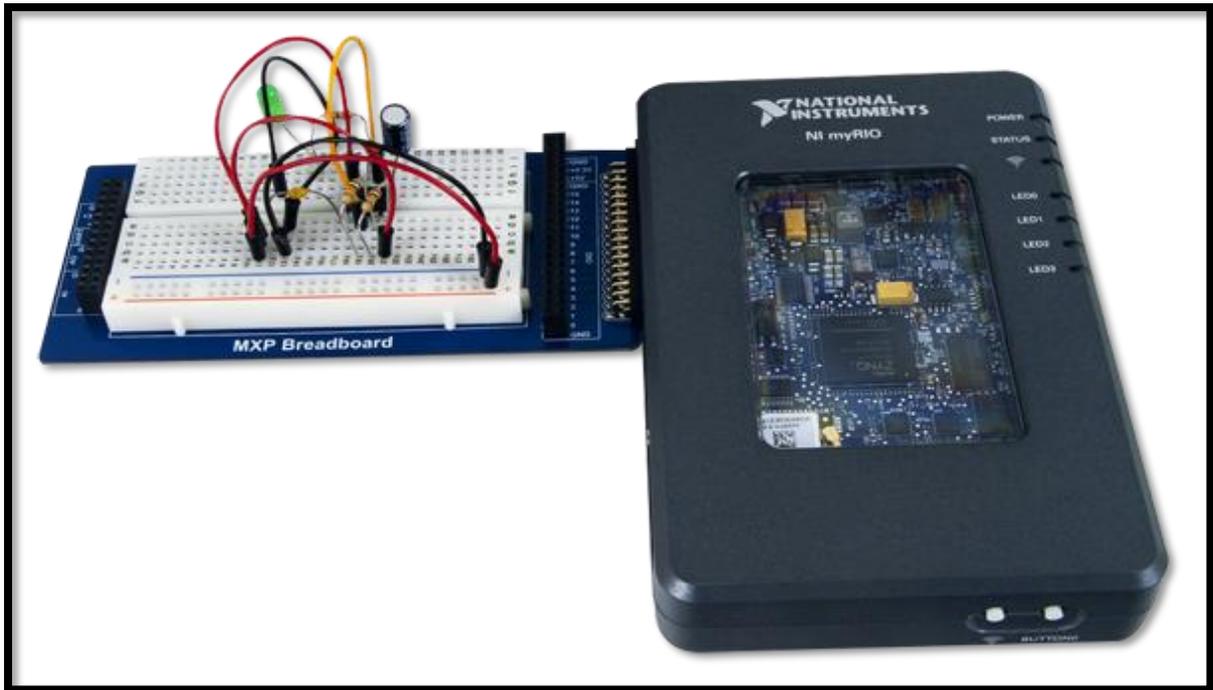


b) Design and Development of system for Protection of agricultural field irrigation infrastructure:

The major source of water for irrigation is the ground water, which is extracted by drilling holes into the earth surface and with the help of motors the water is pumped. The motors are installed somewhere around 100 feet from the surface. The water is distributed into the agriculture field through network of pipes either laid on the earth surface or beneath the earth surface. This process is a financial intensive activity to the farmer. Protecting the laid infrastructure of pipes and motors is a prominent issue, as farmers may not have capacity to invest again and again. The major causes of failure of the system is burning of the motor because of excess load and bursting of pipes because of excess water pressure on them.

The above mentioned issues can be overcome by maintaining the water pressure through the pipes as per the specified ratings of pressure handling and operating the motor under standard and safe conditions. The protection for irrigation infrastructures is based on using a pressure device used for measuring the pressure on the surface of the pipes due to flow of water in them. The flow rate of water in the pipes may be affected due to different reasons viz. Compression of pipes because of root penetrations of the plants/trees, soil seepage under the pipes, heavy load vehicles moving on the location where the pipes are laid, clogging of the inner surface of pipes with foreign elements etc. This leads to an increase in water pressure inside the pipes as a result of reduction in the flow rate as the motor pumps water at a constant discharge rate. The result of the above circumstances is bursting of the pipes. The pressure sensor placed at the location closer to the motor continuously monitors the pressure profile in the pipes and is updated to the controller/processor through a transmitter. If a variation is detected in the pressure profile from the specified safe limits either in upward or downward direction the motor is turned off, safeguarding the motor and the pipes. The controller/processor are useful to an extent that they communicate with other devices such as sensors and are used as a brain to control the output. The information relating to safety failure is intimated to the farmer. This system can be adopted to water distribution

systems in metros like Bengaluru, Hyderabad etc preventing frequent burst of water supply pipelines saving gallons of water a precious resource.



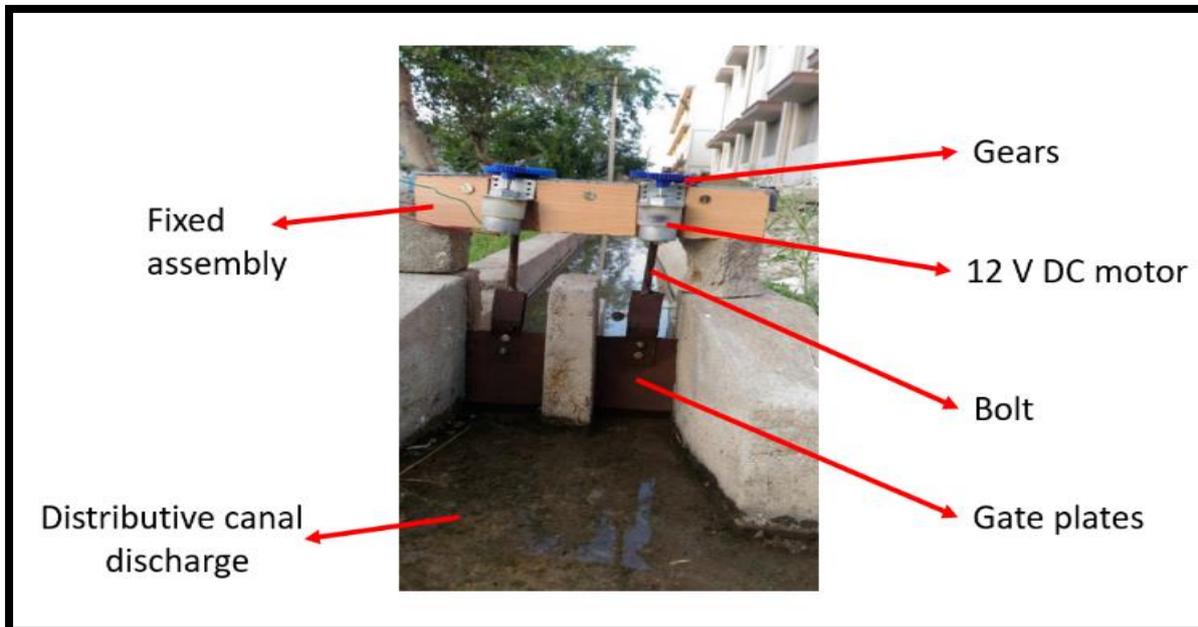
c) Design and Development of system for Agricultural Field and Crop Health monitoring using Wireless sensor networking

In semi arid and arid regions water is very scarce and there is a need for sophisticated irrigation techniques. Farmers with their mere knowledge could not estimate the correct amount of water supply to the plant. So, there arises two major problems such as over supply and deficient supply of water. Too much supply of water may suffocate plant roots and plants could not survive with deficit supply of water. This project helps farmers in effective utilization of water and thereby achieving good crop yield. With this sensor technology it provides the ease of monitoring the field and the crop and generating effective decisions for improved productivity.

Health monitoring unit has temperature, humidity, soil moisture sensors, controller and transceiver. The units are placed in the premises of the agricultural field in the form of STAR topology. This creates a wireless sensor network, where the units use wireless communication medium. The health information of the crop and the soil is collected at each unit, is transmitted to the central unit using wireless transceivers. Different crops require various levels of soil moisture, temperature humidity. Based on the requirements of a crop and the information received from the units distributed in the field the central control unit takes the necessary decisions viz. when to irrigate the crop, rate of water supply to the crop and how long it should be irrigated, depth of water seepage to reach the roots of the crop etc. The decisions of the controller are incorporated in the form of switching of the motor, regulation of the valves etc. This system can be added with additional features to taking into consideration the weather forecast information from the metrological department to enhance the decision making.

An additional feature of soil fertility need of addition of nutrients in the form of fertilizers can be considered.

d) Design and development of water regulation system for irrigation canals



Water is a vital resource for survival on the earth. It is an important factor that cannot be eliminated and the potential scarcity of water in the future is a concern to one and all. Its storage, distribution and usage is, therefore, of utmost importance. Another issue arising with the passage of time is the requirement of energy and water, as it is increasing with increase in population day by day. Hence to cater to the above mentioned problems dams are built as a medium of storage and distribution sources of water. The available water is to be stored and regulated dynamically. Water inflow to the dam mainly depends on the total amount of water released by the corresponding linked dams which are located in the upstream. Recent, disputes among the states in India viz. Karnataka and Tamil Nadu, Andhra Pradesh and Telangana, Karnataka and Goa, Haryana and Punjab are mainly because of water. The main reasons cited for the disputes are false claim of availability of water, usage of water and demand need of water. To avoid water disputes among the states and for proper utilization and sharing of water, the entire process has to be incorporated with modern technology, i.e., automation of the process with provisions for manual operation under unavoidable circumstances. The objective is to provide an automated solution for regulating the storage, the distribution of water as per the demand and share proportions with consideration of possible future demand. Specifically the work concentrates on implementing water management, so that water disputes can be eliminated. Water in dams are regulated using gates which are operated manually which involves complications such as accuracy, threat to life of the workers etc. This can be avoided with automizing the operation of gates, using the available modern technologies and tools.



e) **DARSANIYA KRISHI YANTRA:** A multi utility autonomous agriculture vehicle

In India majority of the farmers are marginal farmers and they cannot afford large machinery as it does not suite their needs. This raises a need of portable multi utility machinery which will be a friendly companion augmenting the labour difficulties and which provides solution to the farmer for the process of seed sowing, weed management, pest management, and water management till the harvest.

This work aims at design and development of a multi utility agriculture vehicle “DARSANIYA KRISHI YANTRA” also known as “KARSHAKA MITRA”, which is an autonomous vehicle, with features of seeding, weeding, pesticide spraying, and intercrop ploughing.

DARSANIYA KRISHI YANTRA incorporates the intelligence through a microcontroller, which is the brain of the unit. The farmer feeds the requirement as seeding, ploughing, weeding, pesticide spraying etc by selection of the switches. The sensors mounted on the YANTRA will provide the necessary feedback mechanism to the microcontroller for proper decision making.

- a. Seeding: The seed distance both length and breadth wise can be adjusted, a slit is formed for insertion of the seed and the seed is covered instantaneously with the soil.
- b. Transportation: This can also be used for relocation of agriculture tools and produce autonomously.
- c. Pesticide Spraying: The pesticide is sprayed in two mechanisms continuous and event based. The spraying is done only when the plant is identified, reducing the wastage of the pesticide and its harmful effects.

- d. Ploughing/ Weeding: The inter crop ploughing for water and air percolation for healthy growth of the crop and also weed removal is carried out.

All the mentioned activities are carried out autonomously with selection of the activities as per the need and requirement, thus reducing the need of the labour and the farmer alone can manage his entire field and crop, thus increasing the yield and making agriculture sustainable. This will attract more people into agriculture.





3

Consultancy

3.5.2

3.5.2 Additional Information

3.5.2 Total amount spent on developing facilities, training teachers and staff for undertaking consultancy during the last five years (INR in Lakhs).

S.No	Description	Link
1	Audited Statements 2017-18	
2	Audited Statements 2018-19	
3	Audited Statements 2019-20	
4	Audited Statements 2020-21	
5	Income & Expenditure 2021-22	