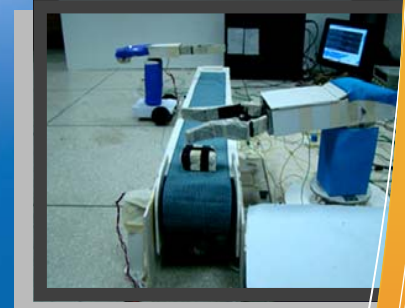


Control & Applications Research Group (CARG)



Control & Applications Research Group (CARG)

Annual Report 2012



Message from the Head of CARG

One of the privileges of my position as head of Control & Applications Research Group (CARG) is to reflect each year on the many ways in which our latest breakthroughs lead to improve solar and control applications. It is both rewarding and deeply humbling to know our research impacts our country's technology. Another privilege I particularly enjoy is thanking the many organizations and individuals who support this research center. Breakthroughs happen here because generous benefactors like you give our pioneering researchers the scope to create and explore innovative ideas with the potential for profound impact.

CARG projects and researches precisely are concentrated on country's economy and sustainability. For the last two decades, our country is going through extreme energy crises in terms of electricity generation. Although, government has engaged with several steps towards solution, we are lagging behind to solve the overall situation with our limited ability. This catastrophe has driven us towards effective projects like solar home system evaluation, hybrid rickshaw, solar home system component testing lab, solar hot water system research and so on. Simultaneous publications have already proven our international eminence. These triumphs show how innovative thinking, catalyzed by our research, brings hope to possible energy solutions. Researcher's contributions sustain the CARG unique scientific culture—one that fosters ingenuity, risk-taking and collaboration among university and industries to produce major technical advances. Our research center is really humble to BRAC UNIVERSITY for their rigorous funding.

On behalf of everyone at the CARG, I extend my sincere thanks to you for helping us by investing in our breakthrough research.

Best regards,



Dr. AKM Abdul Malek Azad

Head

Control & Applications Research Group (CARG)

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About Us



The Control & Applications Research Group has expertise and activities in an area of systems and control engineering. CARG has a strong practical focus to the work, and many of the projects involve close collaboration with industrial organizations. We emphasis upon the application requirements and exercise established theoretical techniques to provide solutions though technological demonstration.

Control & Applications Research Group (CARG)

Vision

Serve Bangladesh as a valuable resource for industry and society through excellence in scientific and technical research.

Mission

The mission of CARG is to generate, apply, and disseminate research findings, build capacity in the field by training the next generation of researchers and to create collaboration and synergy programs with different institutes.

Research Area

CARG specialises in several fields of Electrical and Electronic Engineering. Our research field includes:

- Renewable Energy
- Industrial applications of Control Systems
- Algorithm and Architecture for Real-Time Controllers
- Supervisory Control And Data Acquisition (SCADA)
- Mechatronics
- Intelligent Control
- Biomedical Engineering
- Modelling and Simulation

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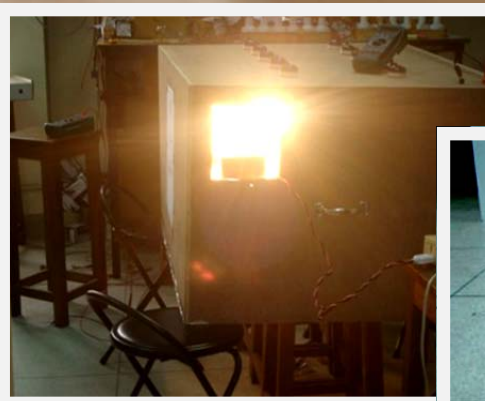
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Completed Projects



Completed Projects

Development of Torque-sensor based Electrically Assisted Hybrid Rickshaw



This project aims at modernizing and hybridizing the current design of “Rickshaw” (passenger carrying tricycle) by introducing power-assistive-technology. We are designing an intelligent control system that would make the rickshaw pulling task easier-to-feel by ‘assisting’ the human power with a motor. Being entirely ‘muscle-powered’ and thus ‘a slow-speed’ vehicle, Rickshaws are often blamed to be the cause of Traffic Jam in cities like Dhaka and also practically a reason for low-earning of the puller-community because of the tremendous amount of physical stress associated with it. However, considering its contribution to employ a mass number of underprivileged people of Bangladesh, this project gives a vision towards a massive automation of this hugely-

popular vehicle considering all the practical factors associated with it like- power consumption, user-friendliness, cost-effectiveness etc. The motivation of our project is to relieve the rickshaw pullers from their excessive physical exhaustion which mainly occurs while initi-



ating the momentum from rest to a low speed. A motor helping the puller only during this particular time eradicates this exhaustion to a great extent. A normal throttle-controlled-fully-automatic motor-rickshaw could be thought about if energy-supply was unlimited! So a smart-sensing capability is needed to control the power-consumption, because we have to optimize and limit the power consumption factor. So a smart torque-sensing device is involved to determine the “need-of-assistance” and an external controller in addition to the motor controller was designed and implemented. A budget of Tk.75,000/- was funded by BRAC University for this project.

Completed Projects

Automatic Solar Hot Water System with Additional Storage Tank



Hot water system using solar energy can be a very good application. As of today hot water is needed in different places like hospitals, hotels, and pharmaceuticals. In hospital hot water usually use for sterilization and wash laundry and for hotel they need hot water for cooking, commercial wash. It is a daily basis need. Source of energy to produce this hot water come solely from electrical power which consumes a lot of energy and lot of money.

This project is aimed to incorporate solar energy which would allow the user to attain hot water in an efficient and cheap manner. This automated system would allow the user to get hot water from the solar water heater

as long as the solar water heater can supply hot water above the desired temperature. If the solar water heater is unable to supply water above the set temperature, then only will the electric water heater come into action. The project cost Tk.275,000/- which was, very kindly, provided by BRAC University.



An alternative Solar Water Heater project has been developed for ENERGY PAC Bangladesh. We have already completed making the controller and this unit is under testing in ENERGY PAC facility.

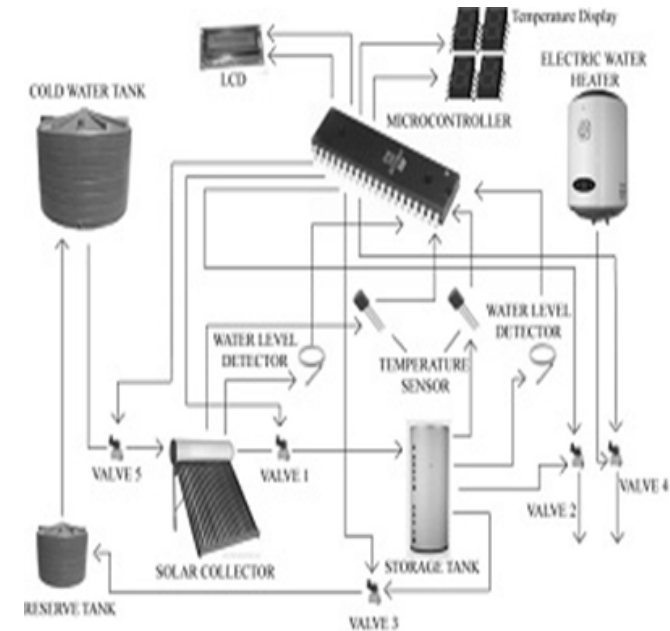
Completed Projects

Performance Improvement of SHWS by Increasing Thermal Efficiency Using Insulation Materials and Optimum Position of Solar Collectors



A Solar Hot Water System (SHWS) has been already designed and further implementation has been done by working on its insulation at variable time, temperature and solar radiation so that there is a minimum temperature drop over night decreases. A suitable material is found for insulation which is feasible, cost effective and available. For this project an instrument named “Pyranometer” has been used to measure solar radiation flux density (in watts per meter square) and the experimental data collected from pyranometer was used to find the optimum position of SHWS.

Thermal insulation is the reduction of the effects of the various processes of heat transfer between objects in thermal contact or in range of radiative influence.



Thermal insulation provides a means to maintain a gradient of temperature, by providing a region of insulation in which heat flow is reduced or thermal radiation is reflected rather than absorbed. We did survey in different types of insulation material like- cork, rock wool, glass wool, aluminium foil, rubber, polystyrene etc. Depending on the cost, availability and resources cork and aluminium foil is installed.

Completed Projects

Improvement of Efficiency for Solar Photovoltaic Cell Applications

Renewable energy solution has achieved a great demand today to meet the energy crisis prevailing everywhere. Solar energy is rapidly gaining its popularity as an important source of this renewable energy. In order to obtain the maximum output from this solar



cell it should be ensured that the solar panel is getting maximum light intensity from the sun which is only possible if the solar panel can be kept orthogonal with the sun position. So a model of automatic sun tracking system was designed to improve the output power of the solar panel. The proposed methodology has been tested for different parameters such as current-voltage characteristics of the panel, effect of shadows on the panel and also comparison has been shown for two different types of panel (3 watt and 50 watt panel) to verify the output power improvement of the movable photovoltaic array compared to the fixed array.

A Multitasking PC Based Robotic Arm Manipulator Control System in RT-Linux Environment

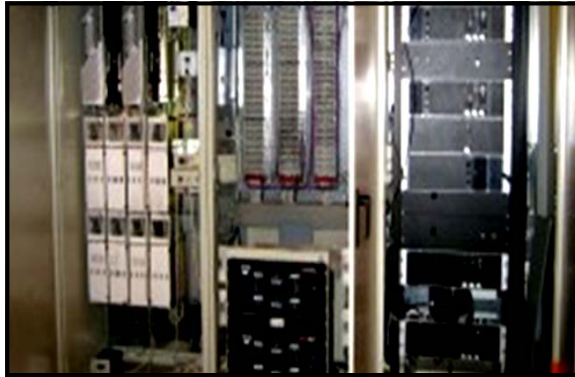
Every year, notable amount of works get injured because of working in hazardous environments. Keeping these in mind, two projects on robotic arm manipulators were implemented in BRAC University. The concepts developed in



these projects are believed to be efficient than human workers and can work in dangerous conditions without any risk of life. The two projects includes one with independent mobile robotic arm manipulator which will execute the command which is built within the microcontroller of its circuit and the other which consists of an independent mobile robotic arm and another arm controlled by Linux. The mobile robotic arm manipulator was build for industries, which require movable arms to carry heavy loads from one place to another. This arm is programmable where the program is downloaded in the microcontroller. The multitasking arm manipulator, as mentioned earlier, consists of a mobile arm manipulator for carrying objects from one place to another and the other arm is an stationary one which is controlled by RT Linux for transporting or assembling objects within a limited radius.

Completed Projects

New Approach to Improve the Reliability of DPDC SCADA Communication Systems



Supervisory Control and Data Acquisition (SCADA) is used broadly to portray control and management solutions in a wide range of industries. SCADA system failure may lead to disastrous consequences since the health and the safety of the public as the economic viability of the community it serves depends on it.

After its introduction in DPDC over a decade ago, the SCADA system hardly had any performance up gradation. Currently the microwave link in SCADA Communication is observing problems that are rendering the entire structure obsolete.

This paper revises the possibility to implement a new communication technology and proposes Free Space Optical (FSO) Communication to enhance SCADA system reliability. FSO refers to the transmission of modulated visible or infrared (IR) beams through the air to obtain optical communication. Like optical fibre, FSO also uses lasers to transmit data, but instead of enclosing the data stream in a glass fibre, the data is transmitted through the air. It is a secure, cost-effective alternative to other wireless connectivity options.

Performance Improvement of DPDC SCADA System Using Hard Real-Time OS

Supervisory Control and Data Acquisition SCADA system is extensively used in power systems specifically for monitoring different power parameters, operating and controlling power electronics as well as other high voltage elements. SCADA system failure can be an outcome of inevitable consequences which include equipment damage, customer load losses even life losses. Dhaka Power Distribution Company Ltd. (DPDC) former DESA has been using SCADA over a decade which was developed by ABB.

Completed Projects



At the early stage ABB came across some limitations which later on were solved in such a way that may not convene the time precision that present technological development demands. ABB used soft real time operating system UNIX. This OS usually responses with high latency which sometimes caused some remote power elements to fail in certain time frame. Evaluating these consequences, the research indicated some drawbacks of current DPDC, SCADA system and proposed Hard RT Linux as an operating system of current DPDC SCADA to provide the appropriate level of reliability of the SCADA system.

Performance Comparison of CPLD and PLD Based Traffic Light Control System



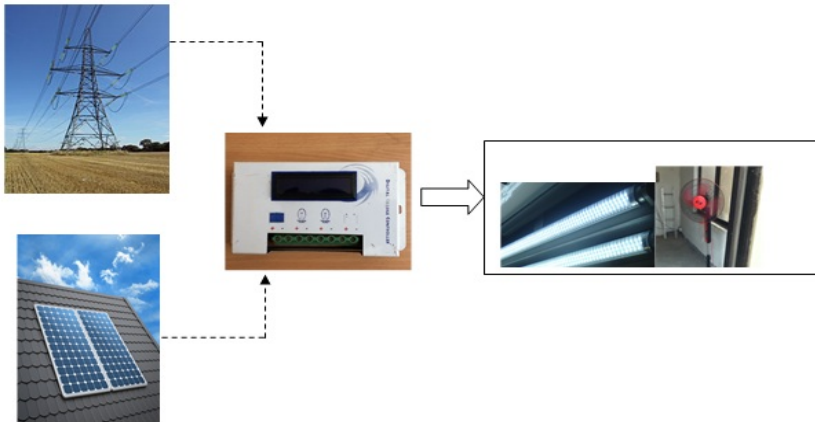
PLD and CPLD have been extensively used for custom made circuits. That is why they are perfect for designing traffic light control systems. This project represents the performance comparison of a traffic light control system designed on GAL (Generic Array Logic) using Programmable Logic Device (PLD) and on FPGA (Field Programmable Gate Array)

using Complex Programmable Logic Device (CPLD). For our PLD implementation, we have considered GAL (16V8) chips, which can be reprogrammed and erased. For the CPLD implementation, we have considered FPGA (Altera's Flex 10k family's EPF10K10TC144-4) chip, which is a 144 pin SRAM. The CPLD design was developed using the CPLD programming software MAX PLUS2 v 9.23. The traffic light controller consists of traffic signals (Red, Yellow/Amber & Green). We have designed the traffic controller using both CPLD and PLD. Then we have taken the real time waveform as well as the simulated waveform for different frequencies. The Digital Storage Oscilloscope (DSO) was used to generate the real time wave from the traffic controllers. The results from the real time waveform clearly illustrates that CPLD has the better performance over the PLD technology. Furthermore we have designed complex circuits for automated detection of railway crossing and A Five road junction controlling Traffic light system.

Hybridization of Solar Energy with National Grid to Supply DC Class Room Loads (prototype version)

The fact that our country has serious deficit of electrical energy needs no further proving. CARG has thus been pushing its researches towards developing and implementing renewable energy systems that could help fight this deficit. This project is a consequence of these researches and holds promises of contribution towards growth of the power sector of

Completed Projects



Bangladesh. The primary aim of the project is to reduce electricity consumption from the national grid through replacing the existing lighting and fans of one of the class rooms of BRAC University with solar LED lamps and DC fans which are far less power consuming than the traditional (existing) system. A prototype system has been designed and tests were carried out on 75W system with 7 LED lamps (3.5W each) and 1 DC fan (15W). The test was performed on the prototype in the month of February. The maximum total irradiation of the month is 701Wh/m^2 (1) which corresponds to 52.57W (70% of 75W) of power.

Through our experiment it is observed that more than 60% of the electricity bill can be saved only in the month of February. What is more important is that, 60% of electrical energy is being saved from the national grid.

DESIGN AND DEVELOPMENT OF MICROCONTROLLER BASED ECG SIMULATOR



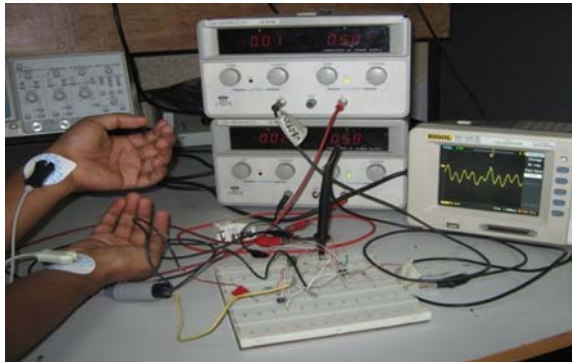
Electrocardiogram (ECG) is a graphic recording of the electrical potentials rhythmically produced by the heart muscle. For the training of doctors as well as for design, development and testing of automatic ECG machines, a subject with a known abnormality of heart is essentially required. Using human beings as test subjects has been made illegal and considered unethical in many countries. CARG research group has developed an ECG simulator that can simulate such subject for the above-mentioned purpose. The significance of the ECG simulator is that the subject has been replaced. The simulator is a useful tool for electrocardiograph calibration and monitoring, to incorporate in educational tasks and clinical environments for early detection of faulty behavior. The device is based on a microcontroller and generates the basic ECG wave

Completed Projects

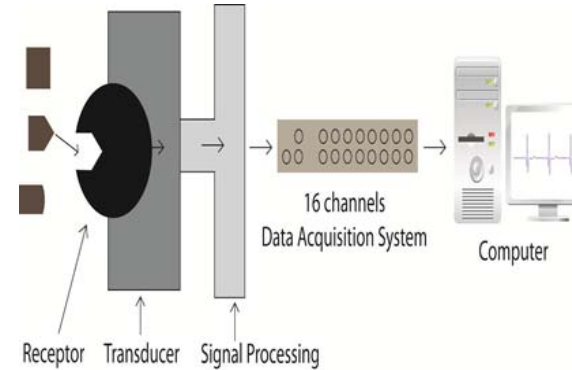
with variable BPM and arrhythmia waves. These signals are fed as an input to the ECG machine. The signals can be used for testing, servicing, calibration, and development of the ECG monitoring instruments. The same simulator can be implemented and developed to have a 3 lead or a 12 lead output to connect all 12 leads of the ECG machine to the simulator. The commercially available ECG simulators cost in the range of 200 USD to 1000 USD. These simulators have many more features and are far more sophisticated. Our ECG simulator fulfills the low range simulator features. In addition, the cost is far cheaper. It is only about 11.35 USD.

Time-Delay Analysis of Bio Signal Analyzer in Hard Real-Time Environment

This thesis presents a biosensor based animal testing laboratory set up for research purpose. The motivation for establishment of such a system came from the scarcity of animal testing laboratory



in the South Asian region. The proposed sampled data system will receive different physiological signal such as temperature, ECG, respiratory rate etc through biosensors and the signal will be transferred to the computer



via 16 channels USB-4716 data acquisition card in different operating systems. In this thesis a clear overview of five sensors to be used to measure different physiological condition

and the required signal processing circuitry is presented. Experiments are conducted on two sensors and results are shown in GUI developed under windows platform. Total time delay is compared in general purpose, soft real-time and hard real-time operating systems. Theoretical analysis is done on time delay analysis of sampled data system, which is very important to design any sophisticated control system. The mathematical model for building the controller of the multi-rate sampled data system is also developed.

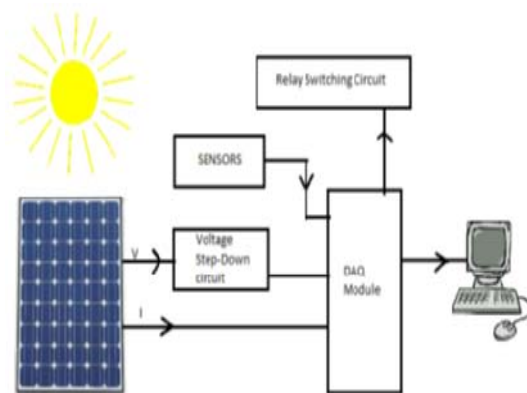
Completed Projects

Implementation of hardware and software of solar panel testing parameters



This project has been carried out to study and find a reliable and comparatively cheaper alternative to the Solar Simulator which would test the quality of the

solar panels. This project focused on a computer operated system by developing software that would directly accumulate the different panel parameters automatically which are required for the assurance of quality. This experiment required the use of solar simulator which is not economically feasible for our country and also lacks accuracy since the best evaluation of the panel parameters would be obtained if exposed under the sun using sun as the simulator. So our purpose was to come up with a cheaper yet reliable alternative which would challenge the solar



simulator as well as have the potential to be used as a significant tool in solar parameter application.

Stepper Motor Performance Under Real-Time Multitasking Environment



Multitasking is a very important factor in our computerized world. But it will be more efficient when it is uninterrupted. On the other hand accuracy is another unavoidable factor. So in this paper we want to implement an open loop system for stepper motor using RT-LINUX in case of multitasking.

Completed Projects

In this work we have used a RT-Linux which controls the whole system in real-time method. A Data Acquisition Card (DAQ) card is used to send and receive data from the hardware interface and multiple tasks can be controlled. ULN2003 is used as a driver circuit, which takes data from the DAQ card and helps to drive the unipolar stepper motor.

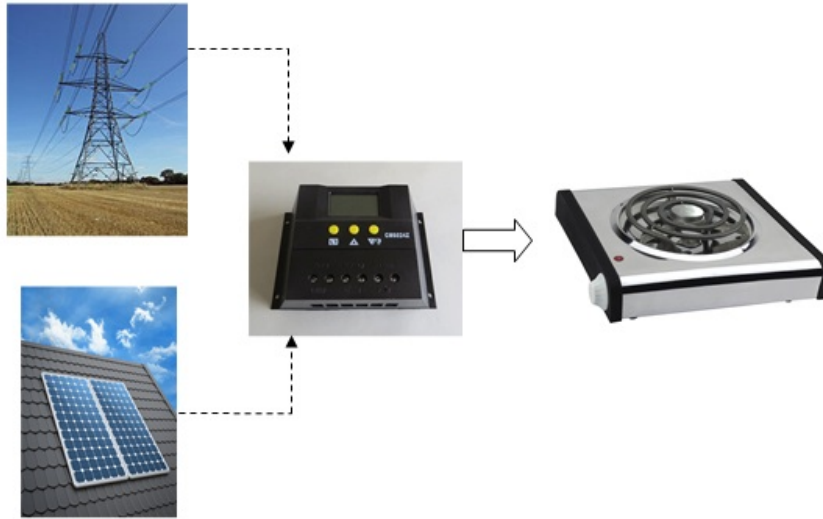
In this project work on open loop control of stepper motor is considered under general purpose (Windows), Soft (Linux) and hard (RT-Linux) real-time operating systems. The same controller program was used to operate the stepper motor in different operating system under multitasking environment.

We found RT-Linux (RTOS) based program provides better performance than soft real-time and general purposes OS from time delay and stability point of view.

On-going Projects

On-going Projects

Hybrid Electrical Stove



rectified to DC power, rather than DC power converted to AC, to avoid complications of synchronization of the phase and frequency of the two inputs, increased complexity, size and cost of circuitry. The project will focus on finding the feasibility of the system from the amount of load taken off the national grid and national gas supply. Daily average energy requirements for cooking will be determined through surveys, tests and experiments. The optimum system size of the whole system will be determined through consideration of average energy required per day, initial cost, and amount of load taken off the respected national supplies.

This project concentrates on developing an alternative solution for cooking through the use of the most abundant source of energy in Bangladesh- solar energy. It will concentrate on design, implementation and both economic and technical prospects of a solar powered DC hybrid stove in Bangladesh in an effort to reduce gas usage, lessen expense and risks of explosion (for people who uses gas cylinders) and fire for users and providing green and free renewable energy.

In the proposed design, a coil will be supplied with 500W DC power. Part of that power will be supplied from the PV modules and the rest balanced by the national grid. The AC power from the national grid will

On-going Projects

Panel-backed electrically assisted rickshaw

Electrically assisted power rickshaws have gained a huge amount of popularity in Bangladesh since their inception. But the electricity needed to charge these rickshaws come at an expense of depleting gas resources. Thus a ban has been put on these rickshaws in spite of their travel comfort and reduced travelling time. This project addresses this problem by mounting a panel on top of these rickshaws that would share the power needed for running these rickshaws and would supply charging power for the batteries when the rickshaws are at rest.



A pair of hands holds a pair of round, thin-framed glasses in front of a sign that reads "FUTURE". The sign is made of large, blocky letters and is slightly out of focus. The background is a warm, brownish-gold color with a textured, stone-like appearance. On the left side of the image, there are several curved, concentric lines in dark blue and gold, suggesting a design element or a page border.

FUTURE

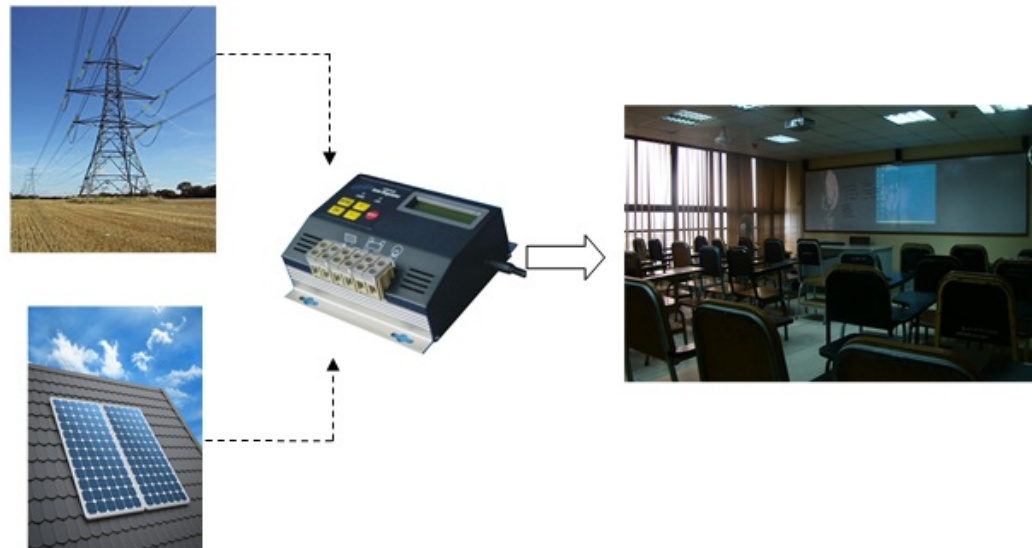
Upcoming Projects

Upcoming Projects

Hybridization of solar energy with national grid to supply dc class room loads

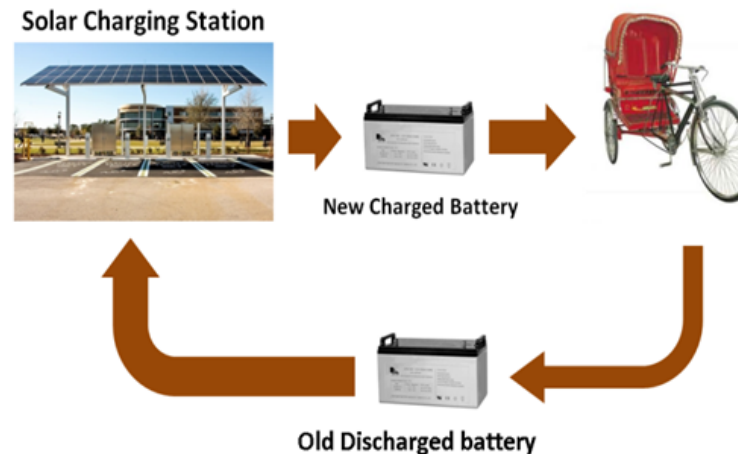
The project focuses mainly on replacing the existing lights in one of the class rooms of BRAC University with low energy consuming DC LED lamps and powering these loads with hybridized power sources. The hybridization is done between solar power and national grid where the solar power is the primary source of energy and the national grid in the supplementary. 500W of DC lamps and DC fans will be powered by solar power primarily and any deficit in supply by the solar power will be met by the national grid. The system will be further supplemented with insulations on the windows that could reduce as much as half the heat energy that may enter the room during day time while allowing about 50-60% visible light and 0% ultraviolet to enter the room. This simple but effective method helps reducing energy consumption needed to keep the room cool by the air conditioner to a high extent.

Our experiments with the developed prototype version show that more than 60% of the electricity bill can be saved only in the month of February. What is more important is that, 60% of electrical energy is being saved from the national grid.



Upcoming Projects

Solar Battery Charging Station



Control & Applications Research Group (CARG), BRAC University has designed and developed a Solar Battery Charging Station for charging the batteries in the electrically assisted power rickshaws, launched by Beevatech Ltd., which would be completely independent of the national grid. A pilot project is being planned, which focuses on setting up a solar charging station that can charge the power rickshaws using a renewable energy source.

The pilot project features an 800W solar powered station that would charge two 48V, 25Ah batteries. The project not only takes a significant load off the national grid but opens up a way for CARG to build an industrial link with BEEVATECH LTD who is the pioneer in launching the power rickshaws. The pilot project would lead to implementation of the main Solar Battery Charging Station project in real life scale to remote places in Bangladesh that would boost socio-economic condition in the region by providing cheap electricity.

The components do not have a very high maintenance cost, making the system an ideal source for electricity in rural areas. This system is particularly suitable and convenient for the widely dispersed areas where battery operated vehicles have a viable prospect. We strongly believe the successful achievement of our goal is going to make a significant change to the lives of many in our country especially in the underdeveloped regions thus enhancing the socio-economic development of regions where it is much needed.

Knowledge Management

- Like all of us in the real world, the graduates must have the ability for knowledge management such
- Ability to know what the knowledge you seeking?
- Ability to access the knowledge.
- Ability to know the knowledge is using.

Lectures and Seminars

- Ability to expand the knowledge into new knowledge and ideas leading to new innovation.
- Ability to share and communicate the knowledge.



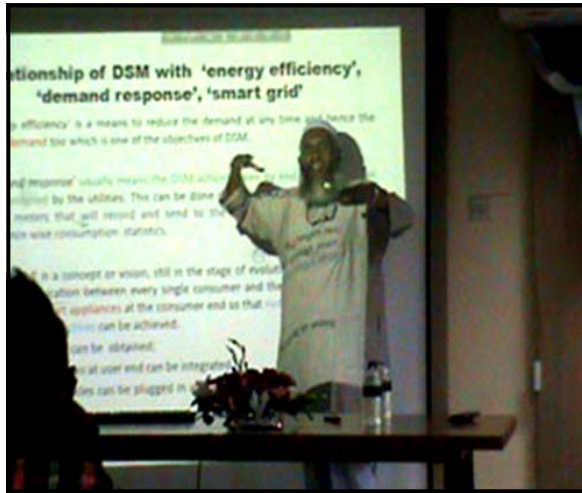
OUTCOMES

Presented by
THE MAC UNIVERSITY
Dated 1/1/2023



Lectures and Seminars

CARG Arranged Seminar on Smart Grid



CARG and IEEE student branch jointly arranged a seminar entitled "Demand Side Management in Smart Grid Perspectives", which was presented by **Dr. S. Shahnawaz Ahmed**, Visiting Research Professor, Department of Electrical and Electronic Engineering.

In this seminar, **Dr. S. Shahnawaz Ahmed** discussed the state-of-the-art overview of various programs being used for DSM (Demand Side Management) with special focus on the recently merging vision for a Smart Grid and their potentials for a developing and energy starved country in terms of ease of implementation, sustainability, affordability and acceptability among common people.

December-2010 : IEEE Distinguished Lecture On "Outcome-based Education for Learning To Learn" By Prof. Rashid

On the fabulous evening of 23rd December, a seminar on a very unique topic was organized by IEEE BRAC University Student Branch in collaboration with Control and Applications Research Group (CARG). "Outcome-based Education for Learning to Learn" was the topic of the seminar and the speaker was Professor Muhammad H. Rashid.

Dr. Rashid is a renowned personality in the field of electronics & power engineering. He published more than a dozen of books, has more than 130 technical



papers bearing his name, and has taught in many universities in different countries like University of Connecticut, Concordia University, Purdue University and King Fahd University.

Lectures and Seminars

Dr. Rashid is a renowned personality in the field of electronics & power engineering. He published more than a dozen of books, has more than 130 technical papers bearing his name, and has taught in many universities in different countries like University of Connecticut, Concordia University, Purdue University and King Fahd University. He was also involved with Brush Electrical Machines Ltd. and Lucas Group Research Centre. At the very beginning, students who attended the seminar were confused with the topic, which is very obvious, because of its elusiveness. And that curiosity brought in unexpected amount of attendees in the MNS seminar room. At the start of the seminar, Dr. Azad gave an introductory opening speech and the chairperson of the EEE department, Dr. Sayeed Salam, presented a crest and a welcome gift to Dr. Rashid. During the seminar, many other faculty members from School of Electrical and Computer Science together with many enthusiastic students were present.

The topic of the seminar became clear when Dr. Rashid started his presentation which was filled with motivations to progress in life, how to think like an engineer, how one



should prepare and chose the path and many other inspirational talks. Like the last three words of the seminar topic said "Learning to learn", the presentation was all about how we should be learning; a very unique presentation and the least that we can expect from an engineer. During the seminar, he also showed a very popular book of him named "Microelectronics-Circuits, Analysis and Design" which is being followed in many engineering schools around the world.



When the question and answer session came at the end of the presentation, he was showered with questions from faculty members and student alike. Dr. Rashid, being like a fatherly figure to most of us who were present

during the seminar, answered all of them with patience, examples and wonderful suggestions. After the end of the seminar, he happily interacted with the faculties and few curious students despite being a person with a very tight schedule. Upon leaving the room, it was understandable that he was very pleased with the response that his speech received. At the end of the event, it was a great success and a moment of joy for IEEE BRAC University Student Branch and CARG. It would not have been possible without the immense contribution and hard work of the organizers. All in all, it was a seminar with a difference.

Lectures and Seminars

Jun 2010 : EEE Seminar on Performance Study of Photovoltaic Solar Panel and its Application

An internal seminar was held on June 21, 2010 at the seminar room of MNS department. The seminar was focused on "Performance Study of Photovoltaic Solar Panel and its Application", which was presented by Mr. Shariful Islam, M.Sc. student of department of physics, University of Chittagong. He was supervised by Professor Nurul Islam, University of Chittagong and later on sent to BRAC University to be additionally supervised by Dr. AKM Abdul Malek Azad, Associate Professor of Department of EEE. Mr. Sharif had conducted his M.Sc. thesis research with the help of CARG (Control and Applications Research Group) renewable energy project resources.





Journal Publications

- **M. Azad, C. M. I. Hussain and M. Alam, "A Different Approach to Improve the Performance of DPDC SCADA System" Accepted to be appeared in International Journal of Energy and Power Engineering, David Publishing, USA, 2013.**

Supervisory Control And Data Acquisition (SCADA) system is extensively used in power systems specifically for monitoring different power parameters, operating and controlling power electronics as well as other high voltage elements, for example breakers tripping or constant data procurement from current, voltage or power transformers. SCADA system failure can be an effect of inevitable consequences which include equipment damage, customer load losses even life losses. Dhaka Power Distribution Company Ltd. (DPDC) former DESA has been using SCADA over a decade which was developed by ABB. After its introduction in DPDC, the SCADA system hardly had any performance upgrade. At the early stage ABB came across some limitations which later on were solved in such a way that may not convene the time precision that present technological development demands. ABB used soft real-time operating system UNIX. This OS usually responses with high latency which sometimes caused some remote power elements (breakers) to fail in certain time frame. Evaluating these consequences, this paper presents some draw backs of current DPDC, SCADA system and proposed Hard RT Linux as an operating system.

- **Adnan Al Moshi, Salwa Salam Cynthia, Eftakhairul Islam, Rumana Rahman and Akm Abdul Malek Azad, "A Performance Analysis of Robotic Arm Manipulators Control System under Multitasking Environment" published in International Journal of Energy and Power Engineering, May 2012, Vol.: 2, Number: 5, Pages:327 - 331, ISSN 2159- 5275 (Print) and ISSN 2159-5283 (Online), David Publishing, USA**

This work is to observe the performance of PC based robot manipulator under general purpose (Windows), Soft (Linux) and Hard (RT Linux) Real Time Operating Systems (OS). The same open loop control system is observed in different operating systems with and without multitasking environment. The Data Acquisition (DAQ, PLC-812PG) card is used as a hardware interface. From the experiment, it could be seen that in the non real time operating system (Windows), the delay of the control system is larger than the Soft Real Time OS (Linux). Further, the authors observed the same control system under Hard Real Time OS (RT-Linux). At this point, the experiment showed that the real time error (jitter) is minimum in RT-Linux OS than the both of the previous OS. It is because the RT-Linux OS kernel can set the priority level and the control system was given the highest priority. The same experiment was observed under multitasking environment and the comparison of delay was similar to the preceding evaluation.

- **Jannatul Ferdous, Md Sanzidul Islam, Nabil Shaker, Bonny Amin Khan, A. Azad, "Performance Improvement of SHWS by Increasing Thermal Efficiency Using Insulation Materials and Optimum Position of Solar Collectors" published in International Journal of Advance Renewable Energy Research, 2012, Vol.: 1, Issue: 1, Pages:78 - 83, IJARER, Germany**

The word itself “Solar” describes that we are dealing with some renewable energy source for a hot water system. A Solar Hot Water System (SHWS) has been already designed, further implementation has been done by working on its insulation at variable time, temperature and solar radiation so that there is a minimum temperature drop over night decreases. A suitable material is found for insulation which is feasible, cost effective and available. For this project an instrument named “Pyranometer” has been used to measure solar radiation flux density (in watts per meter square) and the experimental data collected from pyranometer will be used to find the optimum position of SHWS.

- **C. Basak, C. M. I. Hussain and A. M. Azad, "A New Approach to Improve the Reliability of DPDC SCADA Communication Systems" published in International Journal of Energy and Power Engineering, July 2010, Vol.: 4, Number: 7, Pages:48 - 54, ISSN 1934-8975, David Publishing, USA**

Supervisory Control and Data Acquisition (SCADA) is used broadly to portray control and management solutions in a wide range of industries. SCADA system failure may lead to disastrous consequences since the health and the safety of the public as the economic viability of the community it serves depends on it. After its introduction in DPDC over a decade ago, the SCADA system hardly had any performance upgradation. Currently, the microwave link in SCADA Communication is observing problems that are rendering the entire structure obsolete. This paper revises the possibility to implement a new communication technology and proposes Free Space Optical (FSO) communication to enhance SCADA system reliability. FSO refers to the transmission of modulated visible or infrared (IR) beams through the air to obtain optical communication.



Conference Publications

Conference Publications

- M. Alam, J. Saha, N. Farha, U. Mou and A. Azad, "Implementation of hardware and software of solar panel testing parameters" Accepted to be appeared in IEEE TENCON Spring 2013 Conference, 17-19 April 2013, Sydney, Australia
- Sabbir Ahmed Khan, Rafiur Rahman and A. Azad, "Effect of Components on Solar Home System Output Power in Bangladesh Perspective" Accepted to be appeared in IEEE TENCON Spring 2013 Conference, 17-19 April 2013, Sydney, Australia
- S. A. Khan, R. Rahman and A. Azad, "Solar Home System Components Qualification Testing Procedure and Its Effect In Bangladesh Perspective" IEEE Global Humanitarian Technology Conference (GHTC 2012) - Technology for the Benefit of Humanity, October 21 - October 24, 2012, Seattle, Washington, USA
- T. Faraz and A. Azad, "Solar Battery Charging Station and Torque Sensor Based Electrically Assisted Tricycle" IEEE Global Humanitarian Technology Conference (GHTC 2012) - Technology for the Benefit of Humanity, October 21 - October 24, 2012, Seattle, Washington, USA
- M. R. Hasan, A. Rahman and A. Azad, "Feasibility and Importance of an Automatic Controller for Solar Hot Water System" Proceedings of IEEE Global Humanitarian Technology Conference (GHTC 2011) - Technology for the Benefit of Humanity, October 30 - November 1, 2011, Seattle, Washington, USA
- Asad, A. A. Moshi, J. Ferdous and A. Azad, "Comparative Study And Performance Analysis of Solar Panels Using Solar Simulator" Proceedings of International Conference of Renewable Energy: Generation and Application 2012, Al-Ain, UAE, March 4-7, 2012
- M. Alam and A. Azad, "Time Delay Analysis of Biomedical Signal Analyzer in Hard Real-Time Linux Environment" 4th International Conference on Intelligent and Advanced System (ICIAS-12), 12th - 14th June, Malaysia 2012
- M. Alam and A. Azad, "Development of Biomedical Data Acquisition System in Hard Real-Time Linux Environment" International Conference on Biomedical Engineering (ICoBE-12), pp.436-440, 27-28 Feb. 2012, Malaysia
- J. Ferdous, M. S. Islam, N. Shaker, B. A. Khan and A. Azad, "Performance improvement of SHWS by increasing thermal efficiency using insulation materials and optimum position of solar collectors" Proceedings of the 2nd IEEE International Conference on the Developments in Renewable Energy Technology, Bangladesh, January 2012
- M. R. Hasan, K. Arifin, A. Rahman, A. Azad, "Design, implementation and performance of a controller for uninterruptible solar hot water system" Proceedings of IEEE 18th International Conference on Industrial Engineering and Engineering Management (IE&EM), China, September 2011

Conference Publications

- Moshi, S. S. Cynthia, E. Islam, R. Rahman and A. M. Azad, "Performance Analysis of Robotic Arm Manipulators Control System Under Multitasking Environment" Proceedings of IEEE 18th International Conference on Industrial Engineering and Engineering Management (IE&EM), China, September 2011
- D. Paul, K. R. Urzoshi, R. S. Datta, A. Arsalan and A. M. Azad, "Design and Development of Microcontroller Based ECG Simulator" IFMBE Proceedings of the 5th Kuala Lumpur International Conference on Biomedical Engineering, Malaysia, June 2011
- K. Arefin, M. R. Hasan and A. Azad, "Characteristics and Cost Analysis of an Automatic Solar Hot Water System in Bangladesh" Proceedings of 2nd IEEE International Conference on Environmental Science and Technology, ICEST 2011, Singapore, February 26-28, 2011
- Asad, M. T. Sobhan, K. M. S. Morshed, M. Asaduzzaman and A. M. Azad, "Performance Comparison of Traffic Light Control System Using GAL and FPGA " Proceedings of International Conference on Control and Applications, IASTED 2010, Banff, Alberta, Canada, July 15-17, 2010
- Alam, M. R. Hasan, R. Ahmed and A. Azad, "Output Power Improvement of Photovoltaic Cell Using Automatic Sun Tracking System" Proceedings of International Conference of Renewable Energy: Generation and Application 2010, Al-Ain, UAE, March 8-10, 2010
- Hossain, E. Mohith and A. Azad, "Solar Home Systems in Bangladesh - A case study in Gazipur, Kapasia" Proceedings of International Conference of Renewable Energy: Generation and Application 2010, Al-Ain, UAE, March 8-10, 2010
- S. Sadrin, M. Hossain, E. Mohith and A. Azad, "Alternative Solar Water Heater for Domestic Purpose" Proceedings of International Conference of Renewable Energy: Generation and Application 2010, Al-Ain, UAE, March 8-10, 2010
- Basak, C. M. I. Hussain and A. M. Azad, "Improving Reliability for DPDC SCADA Communication Systems" Proceedings of International Conference Electrical Energy & Industrial Electronic Systems, EEIES 2009, Parkroyal Penang, Malaysia, December 7-8, 2009
- Amin, A. A. Faruk, M. A. Alam and A. M. Azad, "Stepper Motor Performance Under Real-Time Multitasking Environment" The TENCON 2009, Singapore, November 23-26, 2009
- A. Azad, C. M. I. Hussain and M. Alam, "Effect of Hard RTOS on DPDC SCADA System Performance" The IET China-Ireland International Conference on Information and Communications Technologies CIICT2009, National University of Ireland, Maynooth, pp. 98-105, August 19-21, 2009

Conference Publications

- M. I. Hussain, M. Alam and A. M. Azad, "Performance Improvement of DPDC SCADA System Using Hard Real-Time OS" International Conference on Electrical and Computer Engineering (ICECE2008), Malaka, Malaysia. June2-4, 2009
- M. I. Hussain M. Alam and A. M. Azad, "Performance of PID Controller Both in Hard and Soft RTOS" The IET China-Ireland International Conference on Information and Communications Technologies, Beijing, China, pp.732-736 September 26-28, 2008
- M. Azad , M. Alam and C. M. I. Hussain, "Delay Analysis of Sampled-Data Systems in Hard RTOS" Proceedings of World Academy of Science, Engineering and Technology, Volume 32 August 2008 ISSN 2070-3740, Singapore, pp.297-302, August 29-31 and September 01, 2008
- M. Azad, "Multi-Rate Sampled-Data Systems With Decentralized Control Structure" The IET China-Ireland International Conference on Information and Communications Technologies, Dublin, Ireland, pp.129-136, August 28-29, 2007

Journal Paper Review

Journal Paper Review

The honor of reviewing journal publications has also been given to CARG by a couple of journal publishers. Several papers have already been reviewed by the CARG members and we have already been requested for reviewing further paper in the upcoming transactions. The following are the journals that CARG is currently reviewing

Journal of Renewable and Sustainable Energy

JRSE, published by the American Institute of Physics, is an interdisciplinary, peer-reviewed journal covering all areas of renewable and sustainable energy-related fields that apply to the physical science and engineering communities. Content is published online daily, collected into bimonthly issues (6 times a year). As an electronic-only, web-based journal with rapid publication time, JRSE is responsive to the many new developments expected in this field. The interdisciplinary approach of the publication ensures that the editors draw from researchers worldwide in a diverse range of fields.

jrse.aip.org

Topics covered include:

1. Bioenergy – bioreactions and bioengineering
2. Geothermal energy – geysers, heat pumps, and novel devices
3. Marine and hydroelectric energy – waves, tides, and dams
4. Nuclear energy – fission, fusion, and related materials
5. Solar energy – photovoltaics and solar thermal converters
6. Wind energy – turbines and electrical systems and controls
7. Energy conversion – solid oxide and proton exchange membrane fuel cells and novel devices
8. Energy efficient buildings – photovoltaics, solar thermal converters, and passive solar approaches
9. Energy storage – hydrogen and batteries
10. Power distribution – conventional and superconducting transmission, fluctuating loads, and controls
11. Renewable energy resource assessment
12. Transportation – hydrogen, batteries, fuel cells, bioenergy, and vehicles

Journal Paper Review

Journal of Earth Science Research

Journal of Earth Science Research is a new publication for the geoscience community of scholars and researchers focusing on the developing trends and the latest research results in the areas of earth science. The journal publishes full length articles and letters from researchers in academia and industry in addition to featuring comments and forums dedicated to advancing earth science research. JESR strives to keep a record of the state-of-the-art research and to promote study, research and improvement within its various specialties. (www.bowenpublishing.com/jesr)

The topics of interest for the special issue include but are not limited to: (Multidisciplinary subjects are especially encouraged.)

- Atmospheric Science
- Cartography
- Coal Geology
- Environmental geology and Hazard Geology
- Geochemistry
- Geographical Information systems
- Geology of Petroleum and Natural Gas
- Hydrogeology
- Marine Sciences
- Mineral Deposits
- Physical Geography
- Physics of the Earth and Space Physics
- Sedimentary Basin dynamics
- Soil Science
- Stratigraphy
- Tectonics

Conference Paper Review

Conference Paper Review

CARG paper review process has been valued by several conferences for a long time. It has served several different renowned conferences like the International Conference on Informatics, Electronics & Vision, IEEE Global Humanitarian Technology Conference, International Conference on Electrical and Computer Engineering. Numerous papers have been assigned to CARG for reviewing by these conferences in the past and provisions for assignment has already made for the upcoming conferences.

The Global Humanitarian Technology Conference

GHTC, organized by IEEE, is a voice amplifier and a forum for hot technological, social, and philosophical debates on the world's urgent human necessities. The cross-disciplinary annual conference brings together communities and individuals – engineering, science, technology, industry, academe, government agencies, NGOs, charities, funders – interested in applying technology to develop effective solutions for the challenges facing the world's underserved. The conference aims to foster exchange of information, networking, and cooperation in the humanitarian field and focus attention of businesses on emerging market opportunities and related technology enablers. (www.ieeeghtc.org)

The International Conference on Electrical and Computer Engineering

The Department of Electrical and Electronic Engineering (EEE) of Bangladesh University of Engineering and Technology (BUET) organizes ICECE in every two years with IEEE Bangladesh section as technical co-sponsor. ICECE brings together individuals from academia, research organizations, government, and industry, to discuss and exchange ideas in the fields of Electrical and Computer Engineering. Prospective authors are invited to submit original technical papers for presentation at the conference and publication in the conference proceedings. (www.buet.ac.bd/icece/index.php)

The International Conference on Informatics, Electronics & Vision

The ICIEV, technically co-sponsored by the IEEE and organized by the University of Dhaka, provides vibrant opportunities for researchers, industry practitioners and students to share their research experiences, research results, ideas, review of various aspects and practical development experiences on Informatics, Electronics, Computer Vision and related fields. Through various presentations from peer-reviewed accepted papers, Special Talks and networking - the ICIEV provides the avenue to share knowledge, make networks, and develop a community for the new researchers - based on the experiences of experts. The ICIEV will open doors for challenging research areas for future. (<http://iciev.org/>)



Events



The first thesis defence from the Master of Science (M. Sc) in Electrical and Electronic Engineering of BRAC University

BRAC University is, proudly, the first to start Master of Science (M.Sc.)/Master of Engineering (M.Engg) in Electrical and Electronic Engineering program among the private Universities in Bangladesh. Ms. Marzia Alam is the first graduate from the Master of Science (M.Sc.) in Electrical and Electronic Engineering program to complete her thesis research. And the first thesis defence from the Master of Science (M.Sc.) in Electrical and Electronic Engineering of BRAC University took place on Wednesday (21-11-12) in the GDLN centre of BRAC University.



In front of a panel board, consisting of Prof. Shahnawaz Ahmed (visiting research professor, BUET), Prof. Sayeed Salam (Chairperson, School of Engineering and Computer Science), Mr. Tarem Ahmed (Senior lecturer, SECS) and Mrs. Sadia Kazi (Assistant Professor, SECS), Marzia Alam defended her M.Sc. thesis supervised by Dr. AKM Abdul Malek Azad on "Time-Delay Analysis of a Bio-Signal Analyzer for Designing a Closed Loop Controller". This thesis presents a biosensor based animal testing laboratory set up for research purpose. The proposed will receive different physiological signal such as temperature, ECG, respiratory rate etc through biosensors and the signal will be transferred to the computer via 16 channels USB-4716 Data Acquisition Card under different operating systems (Windows, Linux and RT-Linux). The motivation for establishment of such a system came from the scarcity of animal testing laboratory in the South Asian region.

The Master of Science (M.Sc.)/Master of Engineering (M.Engg) in Electrical and Electronic Engineering program was launched in 2010 as a response to the ever growing demand of EEE graduates in our country and has been successfully conducted with a growing number of students in the department of EEE in BRAC University.

Participation in the 7th meeting of the working group of D8 on Industrial Cooperation 2012



The third D-8 (developing-eight) Ministerial Meeting on Industries and the seventh meeting, first of its kind in Bangladesh, of the working group on Industrial Cooperation was held on Monday (Oct 8), aiming to create a stronger platform for giving a boost to the establishment of an **Auto-motive Industry** in Bangladesh, and trade and investment within the member countries. Mr. Dilip Barua, Hon'ble Minister for Industries was the chief guest of the conference. CARG, BRAC University was a proud

the chief guest of the conference. CARG, BRAC University was a proud participant of the program (**Automotive working group**) that was chaired by Prof. Ainun Nishat himself. The conference was attended by representatives from the member countries of the D8 summit. Dr. AKM Abdul Malek Azad was invited to participate the conference from CARG as a resource person, which contributed to the making of the policy guidelines for the automotive industry through the D8 meetings held at the Winter Garden, Ruposhi Bangla Hotel. Such participations are creating industrial links with our University and helping us push the researches at CARG a step further.

Conference IEEE GHTC 2012



In the 2nd annual IEEE Global Humanitarian Technology Conference - GHTC 2012, held on October 21-24, 2012 Seattle, Washington, USA that attracted over 250 attendees from 22 countries, CARG (Control and Applications Research Group) of BRAC University has presented two successful research papers: "*Solar Battery Charging Station and Torque Sensor Based Electrically Assisted Tricycle*", and

"The Solar Home System Component Testing". The papers were presented by **Dr. AKM Abdul Malek Azad**, who headed these researches.



The presentation was followed by a conference where **Dr. Azad** had met the director of UN Sustainable Energy, **Mr. Knut Aanstad**, to discuss further prospects of CARG researches. These papers add to tally of the thirty-three researches that have already been successfully completed and appraised as novel and contributions made to the country through these researches has been praiseworthy. The IEEE GHTC conference aims in bringing together individuals who are working to improve the lives of the billions of people around the world living at the bottom of the economic pyramid.

CARG Member Attended Training of Trainers at IDCOL

In August 2012, Rafiur Rahman, Asaduzzaman Al Faruq and Ishtiaque Asad, members of CARG attended to a three day TOT (training of

trainers) training session for arranged by IDCOL with the purpose of creating professional solar home system installation engineers. In day one, basics of PV systems were discussed. Day two focused on the installation of the system itself and finally in day three common problems and there solution was discussed. This session was conducted by Geoff Stapleton, Director & Principal Consultant, Global Sustainable Energy Solutions (GSES) Pty Ltd, Australia, who is an expert on PV system installation. It should also be noted that he is a part time faculty of UNSW (University of New South Wales), Australia.

CARG Member Attended ICIAS'2012 Conference

Marzia Alam, one of the research member of CARG as well as a faculty of EEE department , attended a three days long International Conference on Intelligent and Advanced System (ICIAS'2012) from June 12th to 14th in Kuala Lumpur, Malaysia. She was invited to present her paper "Time Delay Analysis of Biomedical Signal Analyzer in Hard Real-Time Linux Environment". The conference was organized by University Teknologi Petronas (UTP), one of the leading Universities in Malaysia.

Control Application Research Group (CARG) of BRAC University had submitted one of their research papers and to the consequence of that, **Marzia Alam** had the privilege to attend that conference and present the paper. ICIAS'2012 conference is mainly sponsored by IEEE Malaysia Signal Processing Society with a joint collaboration with University Teknologi Petronas (UTP) to provide an excellent platform to share the advanced technological expertise and development for knowledge exchange between researcher, scientist, academicians and engineers. **Marzia Alam** was the only participant from Bangladesh other than people coming from India, Iran, Ghana, Singapore and UK. The opening of the ICIAS'2012 was chaired by **Professor Dr. Micheal A Celia**, Princeton University, USA.

5th Kuala Lumpur International Conference on Biomedical Engineering

Control and Applications Research Group (CARG) of Electrical and Electronics Department is proud to inform that this month, one of its members, Raska Urzoshi, participated and presented her paper on "Micro controller based ECG simulator", in the 5th Kuala Lumpur International Conference on Biomedical Engineering.



The International Conference was held in the capital of Malaysia, Kuala Lumpur. This conference was in conjunction with 8th Asian Pacific Conference on Medical and Biological Engineering which held on the 20th to the 23th of June 2011 at Berjaya

Time Square Hotel located in the city heart. It was organized by the Department of Biomedical Engineering, University of Malaya. This was a great event which brought together academics and practitioners in Engineering and medicine in this ever progressing field. Around two hundred paper was published in the event. Among them fifty percent was international.

The conference had a fantastic start with an inauguration speech by Dr. Michael R. Neumann on 'Sensors and Instrumentation to meet clinical needs'. After that the oral session started. There were all together four hall rooms for oral sessions. Each session were chaired by experienced professors such as M. R. Neumann, F. Ibrahim, and W.A. B. Abas and so on. There were paper presentations starting from undergraduate level to PhD level. Different category papers were presented. Some were on Bio-signal processing, Biomedical Instrumentation, Bio-nanotechnology and so on. People from different countries like Malaysia, Taiwan, Saudi Arabia, Libya, and India were participating.

CARG Member Going Abroad For Higher Studies

Tahsin Faraz

Our CARG project engineer, **Tahsin Faraz**, is going abroad to study in the Erasmus Mundus Joint Master's Programme in Environomical Pathways for Sustainable Energy, under an Erasmus Mundus Master's Course Category A scholarship. The programme is a joint degree initiative between the Royal Institute of Technology in Sweden (KTH), Eindhoven University of Technology in the Netherlands (TU/E), Technical University of Barcelona, Spain (UPC), Polytechnic University of Turin, Italy (PoliTo), Instituto Superior Tecnico in Portugal (IST), Aalto University School of Science and Technology in Finland (Aalto) and AGH University of Science and Technology in Poland (AGH). The master's programme offers advanced education in the field of sustainable energy systems for the future, namely solar, wind, geothermal, biomass, hydro, fuel cells etc.

Raied Hassan

CARG project engineer has been accepted for his M.Sc for the Electrical Engineering at the University of Calgary, Canada.

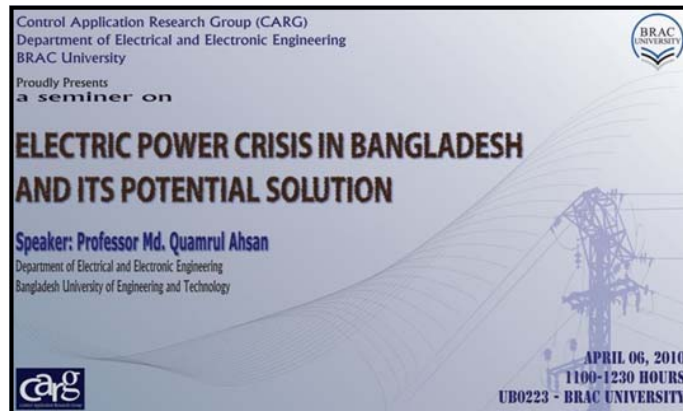
2nd International Conference on Environmental Science and Technology

In January, 2011, 2nd International Conference on Environmental Science and Technology, ICEST 2011 has accepted a paper which is titled "Characteristics and Cost Analysis of an Automatic Solar Hot Water System in Bangladesh" which is based on the CARG project "Automatic Solar Hot Water Heater". In this paper, a comparative analysis has been presented for different types of ETSC. Besides that, the characteristic of a solar hot water system is investigated though out a year. The experimental data have been used to determine the optimum operating temperature for the solar hot water system. Alongside, we also have calculated the payback of the system to determine its feasibility. The result shows that, our system can store the heat energy for 24 hours with a negligible 4% temperature drop in the stored hot water, which is perfectly accurate for the development of automatic solar hot water system. In terms of longevity, annual expenditure and maintenance cost, the solar hot water system is more cost effective than ordinary electric water heater (geyser).

CARG project engineer attends a seven-day solar camp in USA

Md. Raied Hasan, the project engineer of CARG went to USA to attend a seven-day solar camp, which was attended by lots of researchers, investors and learners of solar energy.

Inauguration of CARG, Dept. of EEE, A New Beginning



On the 6th of this month Professor Md. Quamrul Ahsan presented his research findings on "Electric Power Crisis in Bangladesh and Its Potential Solutions" at BRAC University. The Event was organized by Control Application Research Group (CARG), Department of Electrical and

Electronic Engineering (EEE), BRAC University. CARG is a rather young research group with expertise and activities in an area of system and control engineering. The event was especially important because the official website of CARG (<http://carg.bracu.ac.bd>) was launched by Professor Md. Sayeed Salam, Chairman, Department of EEE, BRAC University, at the beginning of the event.



The general outline of the event was, the website launching ceremony then the presentation and finally a lively discussion session between the speaker and the invited guests, mostly distinguished personals from major organizations from the power sector of Bangladesh. The first event organized by CARG was wrapped with a Vote of Thanks from Marzia Alam, lecturer at the department of EEE, BRAC University.

The paper presents the unmet demand of a typical summer and a winter day and the annual maximum un-served demand of last few years. To present an idea about the magnitude of economic impact due to un-served energy in the society the paper evaluates the annual power

interruption cost. The generation capacity expansion is a solution to meet the growing demand and to reduce the un-served energy. However, the installation of generating units requires time. To reduce the present crisis some of the factors regarding system operation, (i) optimal economic operation of thermal units and (ii) exhaustive use of hydro resources, are discussed along with their impacts on the reduction of the present crisis.



Along with the strategies to reduce the present electric power crisis the generation expansion is also an option to meet the growing demand. This paper discusses the generation expansion planning procedure. In expansion analysis, the major issues are the fuel for producing electricity and the money for the implementation of the optimal plan.

These two issues for BPS are critically analyzed in the paper to arrive at a conclusion. It is expected that the analysis will help system planners derive options for fuels and generation of fund.

Finally, this month has been very eventful for CARG as a major conference IASTED 2010, International Conference on Control and Applications, has recently accepted a paper titled "Performance Comparison of Traffic Light Control System Using GAL and FPGA". It is considered to be a major achievement for CARG.



Collaboration

SYNERGY Program between EEE Department, BRAC University and BRAC Solar

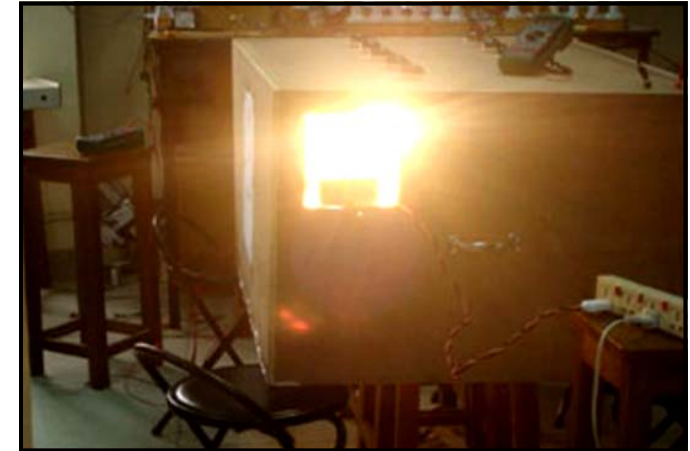
Performance Analysis of BRAC Solar Project

Bangladesh is a country, where the people in the remote rural areas have to rely on fuel basically kerosene based lighting to bring minimal lighting services in their homes. The replacement of fuel based lighting can be done in a sustainable way by using the existing and environmentally friendly renewable energy sources like solar PV technology. This sustainable way of lighting many villages in Bangladesh is expected to improve the general living standard of the communities, contributing significantly to health, education. To provide electricity in the rural areas BRAC Solar Energy Program is initiated under BRAC foundation in 1998. In this study we emphasized on the performance of BRAC



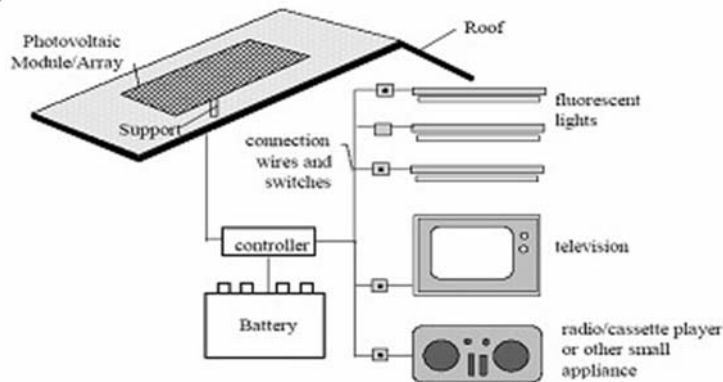
CARG (Control & Applications Research Group) undertook the first synergy assignment in collaboration with BRAC Solar and completed the project within one week. For the purpose of this assignment, BRAC Solar provided CARG with fourteen solar panels from three different companies, in order to determine

performance of each panel. The power rating of these panels varied from 40W to 85W. In order to complete this project, we created a testing environment in our electronics lab.



The testing environment consisted of a sun simulator, which is a box was wrapped with aluminium paper from inside. Instead of using sun light, bulbs were installed inside the box. The sun simulator is used as a light source to provide incident radiation (100,000 Lux) to excite the solar panel. Other equipments such as a 2KW power supply, lux-meter, multi-meter etc. were also used to complete the experiment. After taking the data for all panels, we submitted a full scale report along with I-V characteristics curve, P-V characteristics curve for each panel and also a comparative study of all the Solar Panels. The project was successfully completed, and we hope that in future we will have more opportunities to work in such projects with BRAC Solar.

Authorized testing laboratory of Solar Home System components for IDCOL



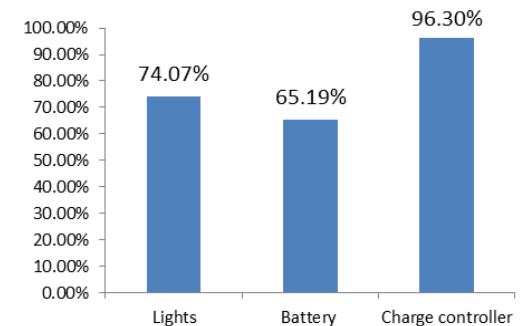
The Solar Energy Program launched by the Infrastructure Development Company Ltd. (IDCOL) has the mission of fulfilling the basic electrical needs of rural regions of Bangladesh through wide spreading the use of Solar Home Systems (SHS) by the year 2020. IDCOL through discharging social responsibility of the government, their Partner Organizations (POs) through their access to grass root levels, private suppliers through their dynamism and academics through their professionalism and research have contributed in designing a system which has so far been very well accepted by the target group.

But due to the numerous components manufacturers (local and foreign) the resulting system contains components that vary greatly in all

parameters varying the overall quality from organization to organization creating instability in the quality of the system. This instability in product quality is increasing with the increase number of SHS installation and thus the system efficiency, reliability and popularity is failing.

CARG has been conducting research on quality development and sustainable utility of renewable energy by providing quality testing. It is recognized testing author-

ity of SHS components for IDCOL. The laboratories of the Department of Electrical and Electronic Engineering and at BRAC University are authorized to perform tests on the SHS



components (PV module, charge controller, battery and lights) to determine quality of a device. CARG has put together a team, head by Dr. AKM Abdul Malek Azad, to develop procedures meeting the international standards e.g. CIE, IEEE, etc. and perform tests of the SHS components.

Testing of SHS Components

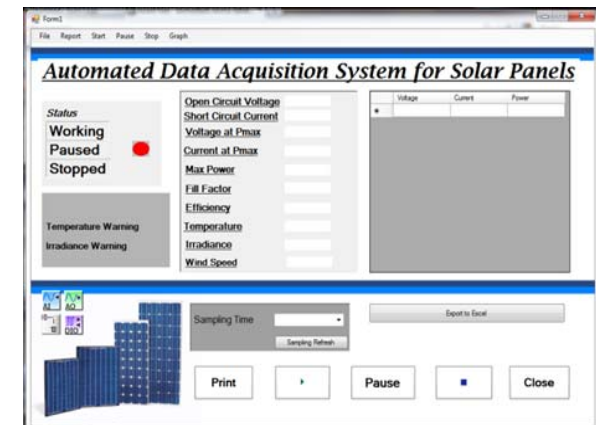
PV Module



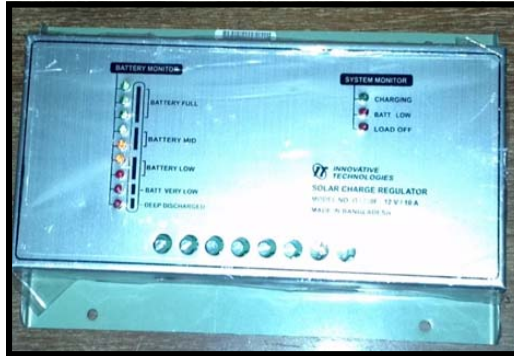
Quality assurance of the PV module is perhaps of the greatest importance as it is the most expensive of all the components and as it is the device that supplies the whole system with clean and green energy. PV modules are tested for their performance, basically, in terms of maximum power supply capability and the module's energy conversion efficiency. The tests are conducted directly under the sun to ensure that the proper testing conditions, as specified by IDCOL, are complied with.

An automated system has been developed by a research group under CARG for measuring, logging and processing the data to provide the necessary results. Characteristic graphs are then derived from the results to show the performance of the PV module. The system has built in sensors that give the user a measurement of the irradiation, temperature and air flow around the PV module which is vital for monitoring the testing conditions.

CARG has been conducting research on quality development and sustainable utility of renewable energy by providing quality testing. It is recognized testing authority of SHS components for IDCOL. The laboratories of the Department of Electrical and Electronic Engineering and at BRAC University are authorized to perform tests on the SHS components (PV module, charge controller, battery and lights) to determine quality of a device. CARG has put together a team, head by Dr. AKM Abdul Malek Azad, to develop procedures meeting the international standards e.g. CIE, IEEE, etc. and perform tests of



Charge Controllers



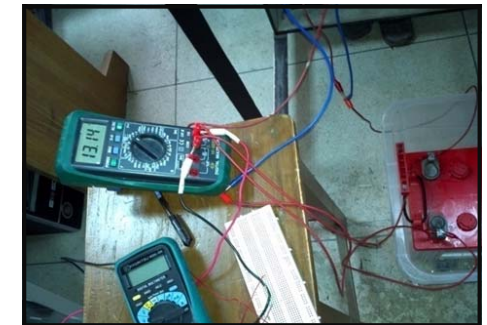
The charge controller is the brain and as well as the most error prone device of the solar home system and development of controllers has been a focus of CARG. It determines the flow of energy converted from the sun to the battery and/or the loads and controls the charging-discharging cycles of the battery. Connecting and disconnecting the battery at the proper charge state is of absolute vitality for keeping the battery out of harm's way. Its inability to protect itself and from preventing any fire due to short circuit in case the battery is connected is reverse or due to a high current surge can prove fatal for the system user.



Manufactured mostly locally, charge controllers have the highest instability in their performance. Tests are performed to check the above parameter in very controlled manner inside the laboratories of BRAC University to determine its quality. Specifications for testing charge controller are supplied by IDCOL.

Battery

Batteries are the most troublesome of all the components as improper use and maintenance of it can not only cost a lot but may cause health hazards. It is very important to accurately determine a batteries nominal



capacity to know its operational limits. Determining its charging and discharging thresholds is perhaps of utmost important as operating the battery beyond those boundaries may cause permanent and serious damage to the battery.



Procedures to determine each of these parameters need to be repeated numerous charge-discharge cycles to be performed in different patterns and conditions.

Testing of a battery could take days or weeks depending of the test being performed. Although numerous research on battery characteristics have been performed it is till today one of the most difficult components of SHS to characterize and perform tests on.

Fluorescent and LED Lamps

Solar home systems have lamps specially designed for the purpose. Though these lights are low powered compared to regular fluorescent lamps, they can supply relatively high measure of lumen. The ballasts/driver circuits used in these lamps need to be highly efficient to prevent power loss and at the same time have to be able to protect itself during



faulty connections. Tests are also performed to confirm a lamp's rated power consumption, efficiency and in case of the Fluorescent lamps the ballast output wave shapes



LED lights need the colour of their lamps checked out as LED lamps can emit light over a wide range of colour. These LED lights in particular have very high life time, high efficacy (lumen per watt) and low power consumption, which makes them very ideal for solar home systems.

Signing of MoU between CARG and BEEVATECH LTD

Furthering the industry-university links formed by BRAC University, Control & Applications Research Group (CARG) has signed a memorandum of understanding (MoU) between CARG and BEEVATECH LTD. This is in concern with the Solar Battery Charging Station (SBCS) project that CARG has undertaken with the purpose of designing a solar powered battery charging station for electrically assisted power rickshaws that BEEVATECH LTD has pioneered in Bangladesh. BEEVATECH LTD, established in 2001, is the first professional electrically assist rickshaw manufacturer in Bangladesh.



Electrically assisted power rickshaws have gained tremendous popularity in Dhaka city due to their speed and low fare. But it has been claimed, by the Ministries of Industries, as highly parasitic on the already overloaded national electricity grid and thus mass usage of the rickshaw has not yet been approved. In response to this situation, CARG has designed a solar power battery charging station that frees the national grid from charging the rickshaws and plans on initiating a 6 month long pilot project on their design on the BRACU campus. Several publications have already been made on the research done for this project. Reports of this pilot project will be presented to the Ministry of Industries in an effort to gain the approval for launching the rickshaws throughout the whole country.





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