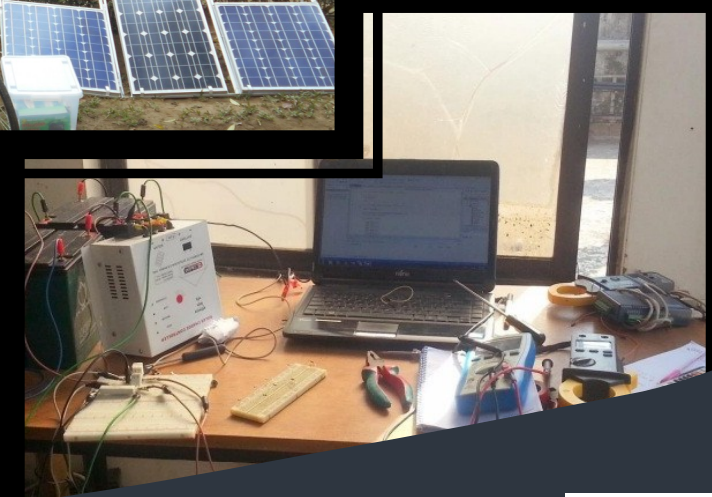


Control & Applications Research Centre (CARC)

carc
Control & Applications Research Centre



Annual Report 2016



Inspiring Excellence

Control & Applications Research Centre (CARC)

Annual Report 2016



Message from the Director of CARC

It is indeed a great honor for me as the director of Control & Applications Research Centre (CARC) to reflect upon all the breakthroughs we have had over the years on applications of solar energy in our country. With the current government encouraging such energy related research, this is truly a very appreciable approach we have taken for the country's development. 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.

CARC projects and researches precisely are concentrated on country's economy and sustainability. Despite the various steps taken by government our country's energy supply has not been sufficient for a few decades. 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. I am very proud to say that IEEE SIGHT USA has come forward to help us fund for our humanitarian research development. We have been recognized by the national level organizations such as Infrastructure Development Company Limited (IDCOL) as well for our project on solar powered electric vans. These triumphs show how innovative thinking, catalyzed by our research, brings hope to possible energy solutions. Researcher's contributions sustain the CARC unique scientific culture—one that fosters ingenuity, risk-taking and collaboration among university and industries to produce major technical advances. On behalf of everyone at the CARC, I extend my sincere thanks to you for helping us by investing in our breakthrough research.

 Regards,

Dr. A. K. M. Abdul Malek Azad

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About Us



The Control & Applications Research Centre (CARC) has expertise and activities in an area of systems and control engineering. CARC 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 Centre

Vision

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

Mission

The mission of CARC 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 Areas

CARC 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 (Robotics)
- Intelligent Control
- Biomedical Engineering (Direct Cardiac Compressor Device)
- Modelling and Simulation

People

Director of CARC

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Completed Projects



Completed Projects

Development of Torque-sensor Based Electrically Assisted Rickshaw Van

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 such as power consumption, user-friendliness, cost-effectiveness, etc.

The motivation of our project is to relieve the rickshaw van pullers from their excessive physical exhaustion which mainly occurs while initiating 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. Hence, a smart torque-sensing device is involved to determine the “need-of-assistance” and an external controller in addition to the motor



Completed Projects

Solar Electric Ambulance van to Assist the Rural Emergencies of Bangladesh- A Complete Off-Grid Solution

Rickshaws and vans are essential methods of transportation in Bangladesh especially in the less developed area. In fact most places in rural areas people are depended on these slow mode of transport for emergency hospital services of patients as well. Bearing this phenomena in mind, we proposed the concept to give a complete off-grid arrangement of torque sensor based solar electric ambulance van. The torque sensor pedal lessens the over-utilization of battery-bank. The intelligent control framework reduces the human force and diminishes the over-utilization of engine. PV panel is introduced on top of the van to share a part of the power and a solar battery charging station is installed to make the entire framework totally autonomous of national grid.

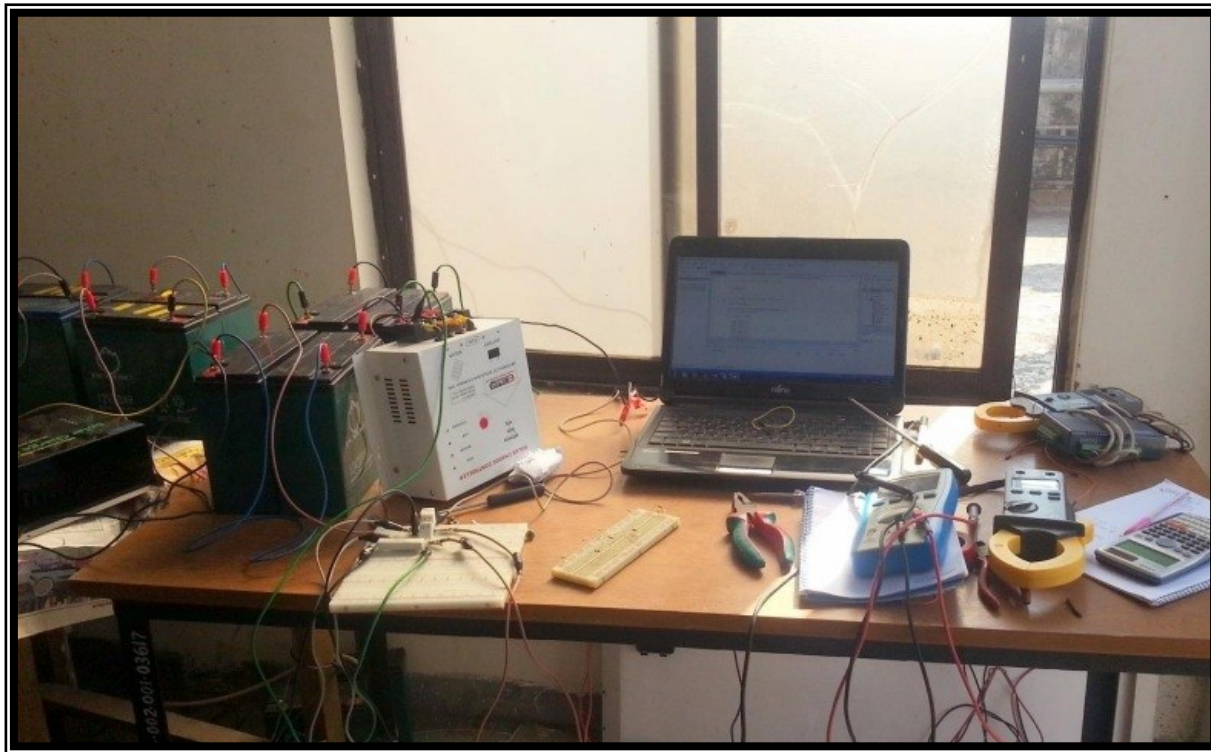
This project, in collaboration with BRAC Health Nutrition and Population Programme, consists of the design and implementation of the idea proposed by CARC as a continuation of the development of human hauler.



It has been later developed to be a part of IDCOL Project.

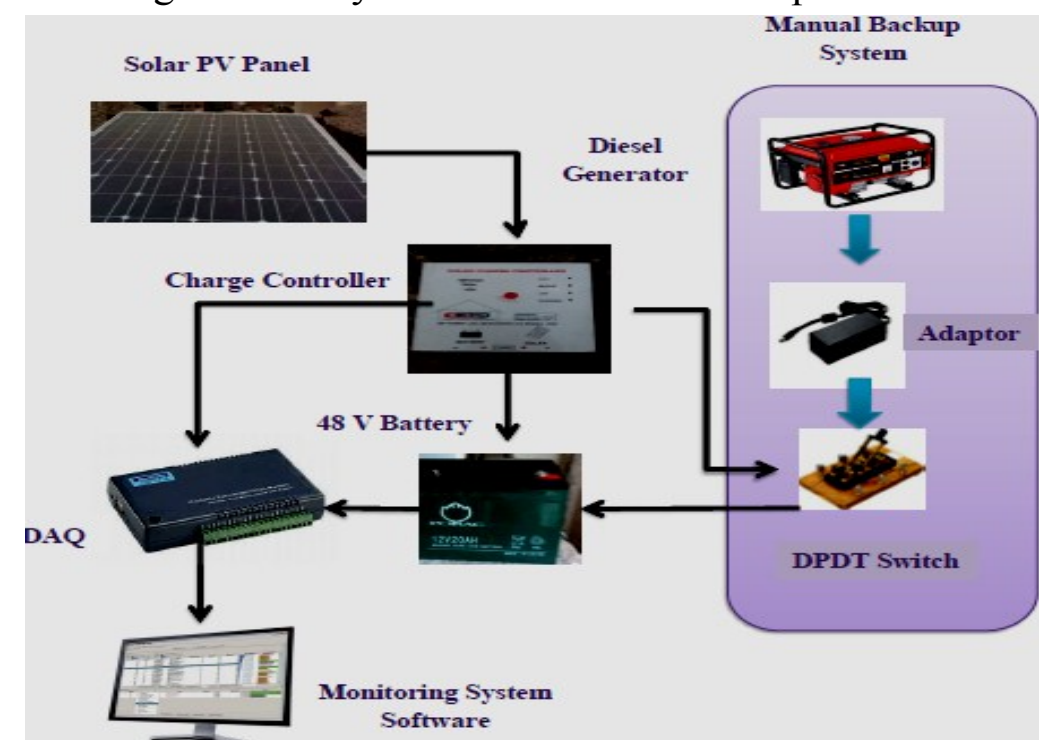
Completed Projects

Real-Time Monitoring of Solar Battery Charging Station



This project provides the process, design and implementation of solar battery charging station with real time monitoring system which can be defined as the unconventional energy source and an alternation of electricity. Today's world is moving towards environment friendly smart solutions since the concept of solar energy is very new in Bangladesh and applications for this source of energy is limited, new upgrades are required to use this renewable energy resource efficiently; such a resolution can be solar battery charging station, moreover real time monitoring makes it more gratified as it offers software monitoring system; displaying the solar voltage, solar current, the battery voltage, time remaining to charge

The software is developed using Microsoft Visual Studio 2013 with the programming language C# to monitor the real time of solar based battery charging station using data acquisition (DAQ) card through which all the analog data can be converted to digital form and display them in three layered GUI of the software. All the information regarding a battery to be charged along with the solar condition can be perceived. Solar energy is generated from sun rays converted to direct current through photovoltaic panels; hence this direct current (DC) is stored in batteries, therefore monitoring the charging status of these batteries is essential. Furthermore the project demonstrates a design of making manual switching system when there is lack of solar radiation due to climatic change or if any blunder occurs in the panels then instantly



Completed Projects

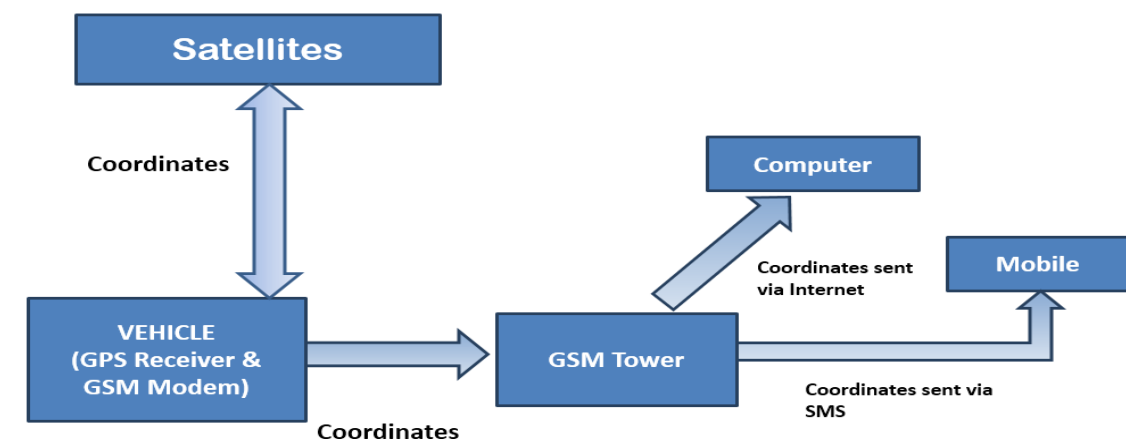
Real Time Vehicle Tracking System



Real- time tracking and management of vehicles is now one of the major concerns of every vehicle owner. It provides security for theft and many more additional features can be added to the system depending on the requirements of services.

Our project comprised of the following key features of vehicle tracking:

- To make an efficient tracking system
- To get location of target vehicles using GPS.



Completed Projects

Torque Sensor-based Solar Powered Electric Wheel-chair with a Dedicated Solar Charger Kit



Mobility of the physically disabled people is a great concern in our society. Physically disabled people are basically using some assistive devices like, crutches, artificial limbs or legs etc. and manual wheel chairs or three-wheelers for their day-to-day movements. In response to this Control and Research Applications Center (CARC) of BRAC University has conducted a research on making an electrical wheelchair with a dedicated solar charger kit. The aim of the project is to propose a system which will increase the moving distance with a better mobility for the physically disabled people in Bangladesh without consuming any power from our national grid. It is an IEEE funded project.

Currently the project is in collaboration with Centre of Rehabilitation of Paralyzed (CRP).



Completed Projects

Store and Forward based Health Monitoring System for Old Age Homes

The concept of Old Age Home is not very popular in Bangladesh due to the concern of health monitoring system. Sometimes this is not possible due to the lacking and limitation of expert staff. Hence the purpose of our project is to develop a monitoring system that can be handled with minimum number of expert staffs and less obstruction. As well as to analyse the basic health reading of aged people the system also can make a record of it serial wise for providing urgent medication to the patient when needed and thus, reduce the life risk. The project gives an analysis of how to build up a system collaborating software and hardware to obtain basic health readings like body temperature, blood-pressure, and saturation of oxygen in blood. The project will also contain video footage using IP camera through networking. In this project from the beginning a trained medical observer, who will have the basic health readings from the patient and enter the readings into the GUI developed specifically for this project. The GUI is being developed in Microsoft Visual Studio version 2012 with the help of C# coding. The GUI contains 16 blocks, each block accommodates medical data of a single patient along with the video footage. The number of blocks can be increased according to the requirement. We have used the software GUI which will contain separate blocks each containing single patient's profile. It will also show a graph of the provided readings which will help the specialized ones to monitor more easily. The target of the project is to store and forward the data to the specialized doctors through high speed internet in order to improve the monitoring system and to minimize the cost of the system. The project also promotes the mass number of people to get the advantages of such monitoring system.



Ongoing Projects

Ongoing Projects

Solar Powered Electric Cargo Hauler

The word 'climate change' has now become a serious global concern. For countries like Bangladesh, Maldives and other coastal countries, it is like a nightmare coming true as most of these countries' coastal lands, lives and natural resources will be lost due to global warming. To reduce pollution and also to conserve the natural resources people are trying to focus more on renewable energy resources. In context to that, we will be doing a project which is environment friendly, and will also prove

A cargo hauler is basically a van which helps us to transfer goods from one place to another. Traditional cargo haulers with engines use oil to run the vehicle causing pollution. Manual cargo haulers are vans that consume a lot of energy of the pullers. Our project targets the van pullers who manually drive heavily loaded vehicles. We will design a solar powered electric cargo hauler based on the manual vans' design but with a much higher efficiency and essential modifications. Such a vehicle will not only save the pullers time and energy but also benefit them more financially. Also since it's a complete off-grid solution; the country's national grid is not involved making the process more environment-friendly. Our aim is to develop and implement our design so that all the benefits become achievable. Our designed cargo hauler has been already implemented with the IDCOL project and research is now on-going about the feasibility.



Ongoing Projects

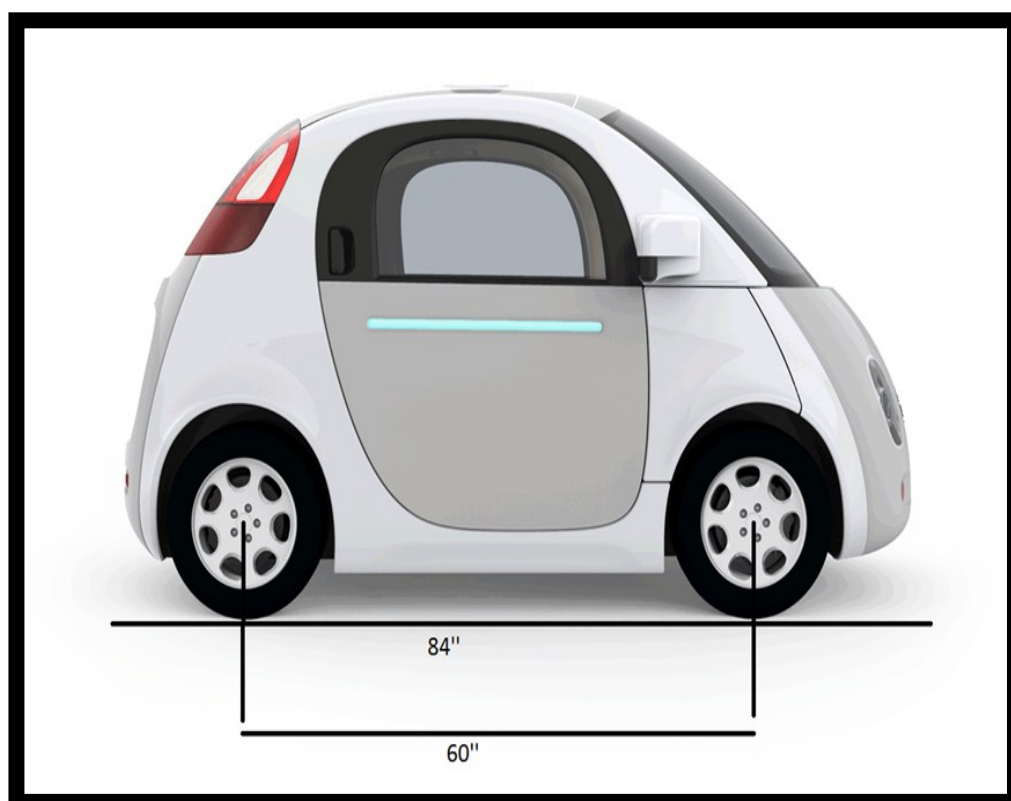
Development of Double Burner Smart Electric Stove Powered by Solar Photovoltaic Energy



Our goal is to design a project which involves the development of a solar-powered electric stove which would use sunlight as a source of power. The electricity and gas shortage in Bangladesh are strong motivators for a solar cook stove to replace the normal stoves. A successful design must be able to store solar energy, allowing the cooker to charge during the day and be used during normal cooking periods. The main components such as controller circuit, converter, solar panels, etc. would be required to create this stove. It has a double burner with a controller circuit which controls the current used for the stove. To make the most of the benefit of renewable energy the system is planned so that, the national grid will only be in action when other two inputs (solar panel, battery) are unavailable. We also look forward to minimize the time usually required for cooking in a normal stove. We hope that this design could grab the attention of the investors to invest in this project and be a great initiative for effective cooking in the households of common people.

Ongoing Projects

Urban Electric Car



This project is on urban electric car where two seated electric car can easily replace a motorbike or a scooter to carry two persons from one place to another in this increased congestion and crowd in Dhaka. Both males and females can run this car. The best thing about this car is that it will not create any nuisance on the national grid as the batteries will be charged by a solar charging kit which will also be made by another group of students of BRACU. This car is a four wheeler electric car which will be driven by a single BLDC motor with motor controller and 5 sets of Lead-Acid batteries. The batteries will be swapped by other sets of batteries while discharged. In this way the battery will help running the car. We are actually trying to create car in a cost effective way which will be smaller than TATA NANO. If the research appears to be a successful one than we would like to introduce it in the market commercially with more improvisations and added features. It is an eco-friendly, light-weight and easy-going car which is hoped to be a successful one to run on the roads of Bangladesh for the first time. The process of making this car has been started already and we are looking forward to finishing this on time.

Ongoing Projects

Microcontroller based Monitoring of the Electric Vehicle Performance with Existing Power Supply



In this project we will find how long the electric vehicle will travel with the available store energy in the source which can be a battery and/or photovoltaic panel (PV panel). The whole algorithm will go to the microcontroller as input. Here we will give the input in the micro-controller as battery, PV panel and running speed etc. electrically charged battery will show the amount of remaining charge in percentage on the display. From the solar energy, PV panel will supply the current to the motor. The speed of the motor rotation is linearly proportional to the distance of travelling; if the speed increases the vehicle will travel long distance using more stored charge. On the contrary, by decreasing speed the vehicle will travel small distance consuming a few stored charges. We are expecting to develop an algorithm to optimize the input to get desired output in the display by using micro-controller.

Solar Powered Cooling System of Deep Freezer Using DC Compressor

This project is aimed to incorporate solar power in freezing system for farming, hospitals and household in rural areas. We have designed a system that will allow connecting the solar module with the deep freezer through DC compressor. In off-grid places of Bangladesh storing the harvested crops is a major problem. Most of the crops get rotten by the time they reach to local market. Moreover, it consumes a lot of electricity for storing these crops in the grid supported area. Keeping these problems in consideration this project focus on powering the deep freezer with solar electric system supported by battery and charge controller and testing the performance -at BRAC University premises. Based on the result further extension will be one for large scale implementation.



Ongoing Projects

Digitalization and Development of Torque Sensor Based Control System and Implementation in a Microcontroller

As we are living in an advanced modernized world, a huge number of populations appreciate to work within a comfort zone, provided with more efficiency with the aid of better technology. We know human labor is required in almost every vehicle and in some mechanical job this effort is quite extreme to produce the start up power. In some cases, continuous effort is necessary. This research and development project will emphasize the terms that will lessen any excess of human labor through a torque sensor controlling system by detecting the excess power delivered by human and then assisting him in his effort with devices such as motor, etc. This will save energy as only renewable energy resources such as solar power will be used for fuel power to limit overuse of human effort. Torque sensor will be used to indicate the need of assistance felt by the labor at a particular time. As previous work has already been done on this basis, this research is taken under consideration in search of finding alternative methods to enhance the efficiency in assistive power. Moreover, the findings are to be implemented in micro-controllers for commercial purposes and can be modified appropriately for extensive uses in different sections.

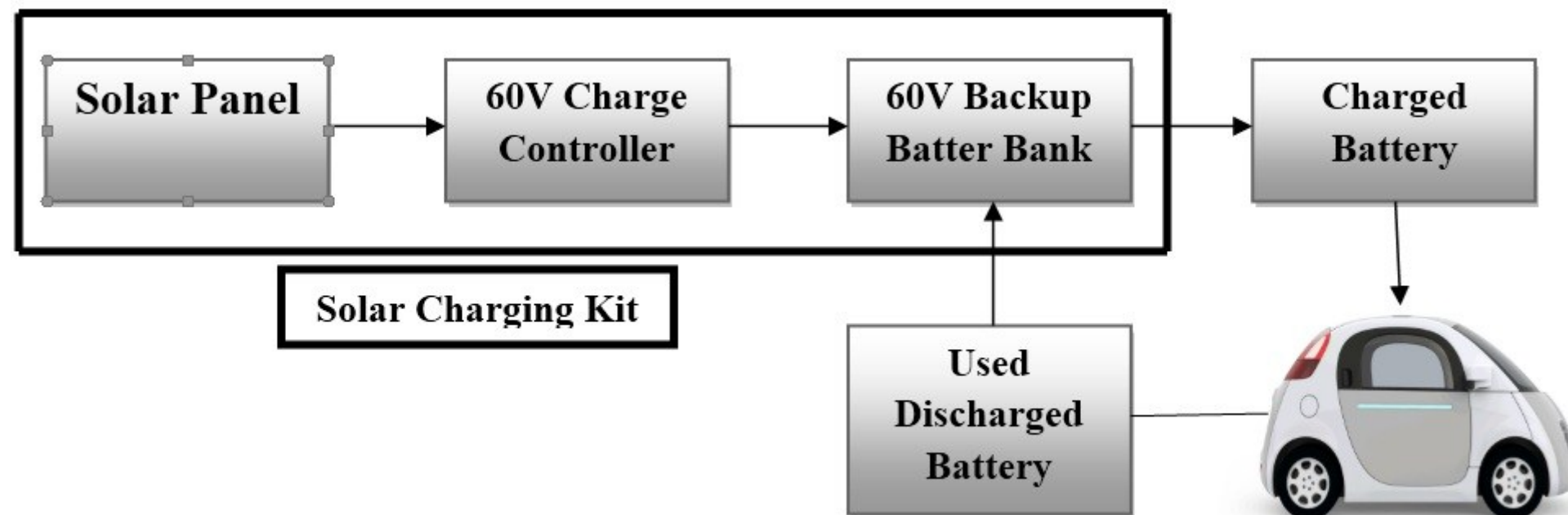


Upcoming Projects

Upcoming Projects

Urban Electric Car with Dedicated Solar Charger Kit

Fossil fuels are non-renewable energy sources that formed more than 300 million years ago during the Carboniferous Period. In today's modern world, most of the electric cars are running on fossil fuels, as a result, the concepts of electric vehicles are becoming familiar through the globe. In most of the developed countries like USA, UK, China etc. they are using electric vehicles which they are manufacturing by themselves. However, in Bangladesh, electric vehicles are not yet commercially recognized because of the lack of efficient charging mechanism. Prior to that, charging electric vehicles from national grid is unlawful in our country. So, we need to find an off grid solution so that we do not need to depend on national grid for the purpose of charging an electric car. Hence, making an effective and less time consuming solar charging mechanism has become a dire necessity in order to introduce solar driven electric car in Bangladesh. To ease the impact on the grid, we are going to design and develop a Solar Charging Kit of 60V by which the electric car batteries will be charged up by an off grid solution. A Solar Charging Kit will consist of photovoltaic panels which will be connected to a 60V charge controller and a 60V backup battery bank. The photovoltaic panel takes power from the sun which is renewable energy source and thus the whole mechanism ensure complete independence from the national grid. In this way, the whole solar charging kit ensures easy battery swapping technique and also makes the charging mechanism completely independent of the national grid. After finishing the project, we will be able to charge an electric car with full off grid solution and hope the charging kit will be useful enough to make the electric cars user friendly in Bangladesh





Post-Graduate Thesis Projects



Post-Graduate Thesis Projects

Stepper Motor Performance Under Real-Time Multitasking Environment

Wireless Instrumentation and Control System of TRIGA Mk-II Research Reactor

Mathematical Modelling of Solar Hot Water System with Multi Storage Tank

Mathematical model of Helicopter Flight Control System

Mathematical Modelling of a Discrete Linear-Quadratic Regulator (DLQR) for Perfect Tracking Control of Non-Minimum Phase System with Six-degrees of freedom.

WIMAX Implementation of Smart Grid Wide Area Distributed Generation and Demand Side Load Protection Model in MATLAB/SIMULINK

Collaborations



National Collaborations

SYNERGY Between CARC, EEE Dept. BRAC University and IDCOL

Power Conservation for Electrically Assisted Rickshaw Vans with PV Support, Torque Sensor Paddle - A

Infrastructure Development Company Limited (IDCOL) is working on a joint program with Control & Applications Research Centre (CARC) of BRAC University on “Power Conservation for Electrically Assisted Rickshaw Vans with PV Support, Torque Sensor Paddle and the Solar Battery Charging Station- A Complete Off-Grid Solution”. On August 2, 2015, **Mr. Mahmood Malik**, the CEO of IDCOL signed the agreement for collaboration. Dr. A. K. M. Abdul Malek Azad, the CARC director and a professor in the department of Electrical and Electronic Engineering was also there on behalf of BRAC University.

The project comprises of the implementation and observation of the 15 units of solar powered electric vans in the rural areas of Bangladesh. IDCOL is a government based organization promoting solar power usage in Bangladesh.



It is indeed a great achievement for CARC to get the responsibility of such project implementation. Dr. Azad and the responsible CARC key members, all are looking forward to it. Already all the 15 units have been completely manufactured of which two are ambulance van and five are human haulers.

The manufactured vans now reside in a garage in Savar provided by BRAC Health Nutrition Population Program with whom



National Collaborations

SYNERGY Between CARC, EEE Dept. BRAC University and BRAC HNPP

Solar Powered Vehicles in Savar

Control & Applications Research Centre (CARC) BRAC University and BRAC Health is undergoing a collaboration program on one of the on-going projects of the centre, solar electric ambulance van. The ambulance vans provided by CARC BRAC University through IDCOL Project will be used by Health, Nutrition and Population Programme of BRAC for their purpose. The thesis students working on Solar ambulance Van has already conducted field test and performance analysis. Based on their result an improved design of ambulance van has been made CARC is looking forward to and effective and successful collaboration of the project.



National Collaborations

SYNERGY Between CARC, EEE Dept. BRAC University and CRP

Project on Electric Wheelchair for the

On 13th December 2015 BRACU Research and Project Engineers, Ataur Rahman, Jaber Al Rashid and Sheri Jahan Chowdhury working under Control & Applications Research Centre (CARC) went to Centre of Rehabilitation for the Paralysed (CRP), Savar, for the delivery of the Torque Sensor Assisted Electric Wheelchair with Solar Charger Kit. Earlier there was a MoU signing where the Executive Director of CRP Md. Shafiq-ul Islam, and the Registrar of BRACU Muhammad Sahool Afzal agreed upon a collaboration between the two institutions for the development of the electric wheelchair. Dr. Valerie Taylor, greatly appreciated the project. For inspection she



National Collaborations

Industrial Partner Beevatech Ltd.

Since the signing of MoU in 2012 between CARC and Beevatech Ltd. Various projects have been involved with various research projects including Solar Battery Charging Station, Solar Powered Electric Vehicles, Solar powered Wheelchair and so on. The two organisations share the common goal of making the electric vehicles more available in the country removing the government ban. Several publications have been made in this regard.

Beevatech has also assisted in the manufacture of the electric vans of the IDCOL projects.



International Collaborations

Professional Affiliation with IEEE SIGHT USA

CARC is recognized in the international community as the CARG SIGHT (Bangladesh), an organisation funded by IEEE SIGHT USA for various research activities based on humanitarian projects. It provided the seed money required for research on the prototypes of the electric vans, human hauler and ambulance van namely, as well as the electric wheelchair. The successful manufacture of the prototypes of the electric vans have rendered CARC to launch pilot project in collaboration with IDCOL. CARC is looking forward to the same aftermath with all other projects with the goal of a sustainability as well as commercialization to benefit the community.



Achievement



Achievement

CARC Director Received the 2015 MGA Achievement Award

On 23rd November 2015, Dr. A K M Abdul Malek Azad received the congratulatory letter from IEEE Member and Geographic Activities (MGA) for being selected as the recipient of the MGA Achievement Award 2015 for initiating and leading the successful IEEE volunteer-led project in Bangladesh to help solve the local electricity crisis by bringing hybrid solar rickshaw technology to the local manufacturing industry, as part. The award consists of a prize money of US\$250 and a plaque.

A professor in the department of Electrical and Electronic Engineering at BRACU, Dr. Azad has been involved in various research activities on solar energy. He is the founder and director of the Control & Applications Research Centre (CARC) under the Dept. of EEE, BRACU where he has also the initiated the synergy programs. He is also an executive committee member of Educational activities in IEEE Bangladesh Section as well as the founder and counsellor for the IEEE Student Branch at BRACU.



Events

Events

CARC Attends Departmental Career Fair ECS CF 2015

On June 10 and 11 “Departmental Career Fair- ECS CF 2015” took place in BRAC University. Control & Applications Research Centre (CARC) had an active participation in the fair representing with great enthusiasm different projects and programs of the Electrical and Electronic Engineering students who have been doing different projects of CARC. Under the direction of CARC Director Dr. A. K. M. Abdul Malek Azad, Project Engineer Sheri Jahan Chowdhury arranged the stall activities with the help of the thesis students to represent their



Day 1 of the career fair mostly compiled of the various visitors including faculty members, students and other companies’ representatives coming to see the stall of CARC. Day 2 started with the same activities. At 2pm a seminar was held in the conference room of the BRAC Business School where among many speakers of the Department of Electrical and Electronic Engineering, Aatur Rahman, an undergraduate thesis final semester student involved in CARC project actively represented the major CARC activities through a short presentation. After a brief background of CARC he talked about the various synergy programs of CARC. His talk ended with a short video presentation of the Electrically Assisted Solar Powered Human Hauler, which had been his thesis work, and Ambulance Van, both of which are CARC production.

The fair was indeed a great experience especially for the alumni and the students in their final year. CARC hopes for more of such events where the engineering students have the chance to show their own activities and also meet various company representatives to know their demands or expectations from a job seeker.



Events

CARC Project Presented 3rd International Conference on Advances in Electrical Engineering (ICAEE)

On 18th December, 2015, the former thesis students, Fabiha Roshni Khan, Anika Tasnim Aurony, Ataur Rahman and Faiza Munira from the Department of Electrical and Electronic Engineering of BRAC University attended the 3rd International Conference on Advances in Electrical Engineering (ICAEE). The conference took place for three days (17-19 December) at IUB campus, Dhaka, Bangladesh. Ataur Rahman, who is current research engineer of the Control & Applications Research Centre (CARC) of BRAC University presented the paper titled “Torque Sensor Based Electrically Assisted Hybrid Rickshaw Van with PV Assistance and Solar Battery Charging Station”. The research work which is based on the authors’ thesis under Dr. A. K. M. Abdul Malek Azad has been appreciated by Prof. Syed Mofizul Islam, a keynote speaker, who is the director of Centre for Smart Grid and Sustainable Power Systems at Curtin University, Australia and also many other researchers participating in the conference.

ICAEE was co-sponsored by IEEE Bangladesh section. Many distinguished scholars and researchers from all over the world participated in the conference. They shared the latest research results, advanced research methods and many exciting new areas. It was





Publications



Journal Publications

- **“Electrification in Rural Bangladesh Using Solar Home System: Progress, Problem and Prospect” manuscript submitted to the Journal of Renewable and Sustainable Energy**

Electrification is one of the most crucial factors to ensure economic growth and industrialization in Bangladesh. Being in a developing country, people from various districts of Bangladesh have been experiencing a severe electricity crisis due to the increasing daily demand for power, which outweighs the supply of on-grid electricity. This poor energy situation is evident by the fact that only slightly more than half of the total Bangladeshi population has been able to access on-grid electricity while two-thirds of rural households have been living without. Consequently, the shortage of energy hampers socio-economic development and lowers living standards of people. Since, non-renewable sources such as fossil fuels and natural gas, the primary sources of energy production in Bangladesh, are limited, usage of renewable energy technology (RET) such as solar energy efficiently can satisfy the rising energy demand and in turn improve the existing energy shortage situation. Adopting the Solar Home System (SHS) has enabled access to electricity in households in off-grid rural areas of Bangladesh where the possibility of extending on-grid electricity is less likely in the foreseeable future. This review research paper depicts the progress of SHS in rural areas over the last one and a half decades (1996-2014) and the socio-economic as well as the environmental benefits to SHS households. This paper also presents the prospects of SHS in rural areas of Bangladesh as well as aims to explain some of the challenges which SHS has been experiencing that can hinder significant progress of SHS installations in rural households. Detailed survey results and analysis have been provided in this review paper which indicates noticeable increments in the number of SHSs installed in various rural villages in Bangladesh and the improvements in the livelihoods of SHS adopted households.

- **“Luminous Measurement of LED Lights in Cost Effective Way Using Cylindrical Method” -manuscript submitted to the Journal of MEASUREMENT – by Elsevier Science Ltd**

Because of several Solar Home System components’ manufacturers in the market, overall quality of LED lamps fluctuates from organization to organization. There is an increment in unsteady quality with the number of SHS installation and thus in the system ineffectiveness. As a result, testing of LED lamps used in SHS plays significant role in maintaining the quality. However, existing procedures i.e. integrated sphere for lumen testing is quite costly in our country’s perspective; so we have used our handmade cylindrical black box of different dimensions and sizes in CARC (previously known as CARG) lab, BRAC University. In this research we have included the testing results collected from our measurement process and also have established some relevant equations from what we have measured the total lumen of the light source. Moreover, we used

Conference Publications

- S.J.Chowdhury, R.Rahman and A.Azad, “Power Conversion for Environment Friendly Electrically Assisted Rickshaw Using Photovoltaic Technology in Bangladesh ” – Accepted and presented in 2015 IEEE Transportation Electrification Conference and Expo (ITEC 2015) and published in iee Xplore digital library -<http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=7165735>
- F. R. Khan, A. T. Aurony, A. Rahman, F. Munira, N. Halim and A. Azad “Torque Sensor Based Electrically Assisted Hybrid Rickshaw -Van with PV Assistance, and Solar Battery Charging Station” - Accepted and presented in 2015 International Conference on Advances in Electrical Engineering (ICAEE) and to be published in iee Xplore digital library.
- A. A. Chowdhury, M. K. Priyanka, B. Mahmud, S. J. Chowdhury and A. Azad “Real-Time Monitoring of Solar Battery Charging Station ” - Accepted and to be presented in the 19th Gulf Engineering Forum Conference & Exhibition with the theme “Smart Solutions for Future Cities” in Courtyard Marriot Hotel in the Kuwait City.
- R.Tareq, A.Anjum, M. A. Hoque, F. Rahman and A.Azad “Solar Electric Ambulance Van to Assist Rural Emergencies in Bangladesh - A complete off grid solution” – Submitted to 2016 IEEE Transportation Electrification Conference and Expo (ITEC 2016)
- Md. Aliuzzaman Sarder, A. K. M Abdul Malek Azad, Anisur Rahman and Md. Bodruddoza Shohag “Proposed Wireless I&C System of TRIGA Mark -II Research Reactor” – Ready to submit

Article Publications

Article Publication in IEEE Transportation Electrification January/February Newsletter

IEEE Transportation Electrification January/February Newsletter published the article “The Solar Assisted Rickshaw Van: A Complete Off-grid Solution” written by Dr. A.K.M Abdul Malek Azad, a professor in EEE department of BRACU and also the founder and director of CARC (Control and Applications Research Centre), the CARG sight of Bangladesh. The article describes one of the CARC on-going projects on solar assisted vehicle. It is available in the following link: <http://electricvehicle.ieee.org/2015/01/08/solar-assisted-rickshaw-van-complete-grid-solution/>



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 CARC members and we have already been requested for reviewing further paper in the upcoming transactions. The following are the journals that CARC has been reviewing recently.

Journal of Frugal Innovation

The ***Journal of Frugal Innovation (JFI)*** is a peer-reviewed open access journal published under the Springer Open brand. It is aimed to provide a platform facilitating timely dissemination of innovative concepts for emerging markets. JFI is an open access journal catering to the needs of a wider populace. In the Open Access model the articles are free for all once published. (Source: <http://www.springer.com/engineering/journal/40669>)

JFI welcomes various kinds of articles that will establish the basis for frugal innovation .

Journal Paper Review

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 – bio-reactions 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 – photovoltaic 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 – photovoltaic, 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

Conference Paper Review

CARC has the similar experience of reviewing by doing conference papers review recently as well. The following is one such conference where CARC members reviewed several papers on request.

4th International Conference on the Developments in Renewable Energy Technology, ICDRET 2016

After Kyoto Protocol and Cancun Conference, world community is getting closer towards a unified collaborative effort to curb Green House Gas (GHG) emission. The scale of the problem has been taken seriously by most of the developed nations. Promotion of Renewable Energy (RE) and adoption of enhanced efficiency at every stage has been envisaged. Although RE is still expensive, rapid fall in the price of the solar PV panels and other RE technologies has rejuvenated the hope for a rapid growth of RE based energy usage throughout the world. Both developed and developing world are taking equally optimistic approach towards popularizing RE technologies and working jointly to make this world livable for our next generation.

With this back drop, United International University is going to organize the 4th International Conference on the Developments in Renewable Energy Technology, ICDRET 2016, on January 7-9, 2016 at Dhaka, Bangladesh. The topics of interest include but are not limited to-

- Solar PV
- Solar thermal
- Biomass and biogas
- Wind
- Mini and micro-hydro
- Tidal, Wave, sea or River Current energy
- Geothermal and other RETs
- Socio- economic aspects of RE



Finance



Finance

CARC Finance Details 2015

As at 30 June to 31 Dec 2015	In Taka
Assets:	
Fixed Assets against requisition (Approx.)	20,00,000
Total	20,00,000
Expenses:	
IDCOL Expense by IO	51,591
BRAC health Expense in Savar	3,86,210
CARC Expense by Requisition	21,78,460
Other CARC expense	41,649
Total	26,57,910
Income:	
Fund from IEEE (2000USD, taking 1USD=80BDT)	1,60,000
Fund from IDCOL	39,20,000
Total	40,80,000
Net Surplus of Income over expense	<u>14,22, 090</u>



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