ITU Kaleidoscope 2011
The fully networked human?
Innovations for future networks and services

SM²: SOLAR MONITORING SYSTEM IN MALAWI

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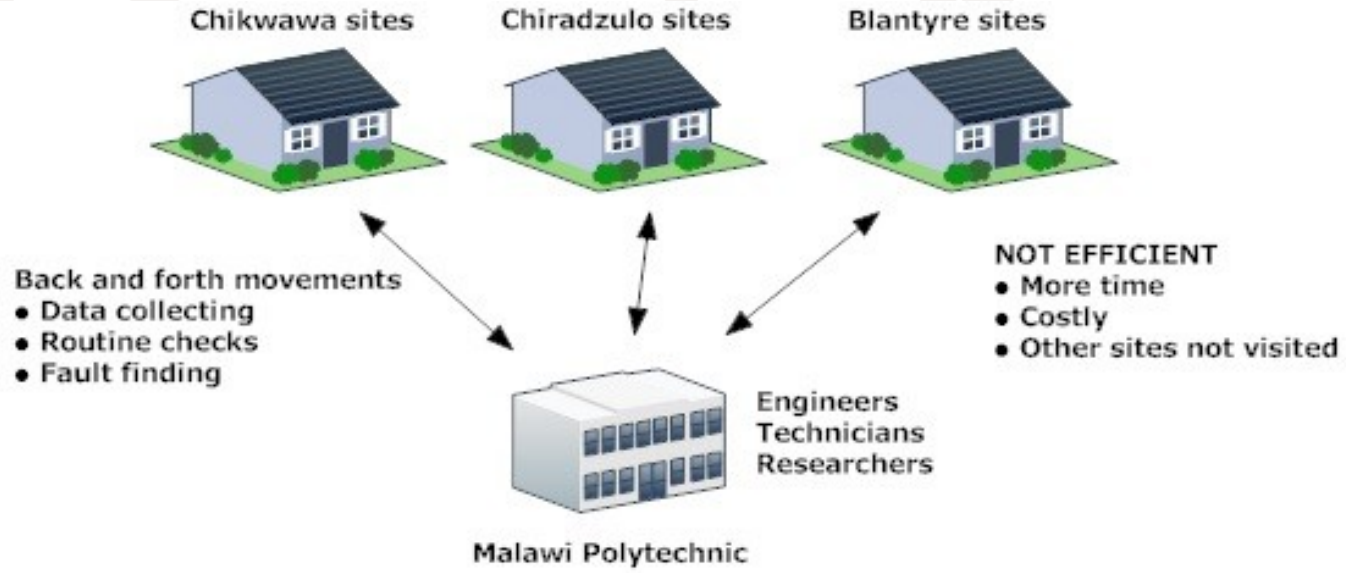
Cape Town, South Africa
12–14 December 2011

Problem definition

- Challenges met by solar PV maintenance team at Polytechnic
  - Long distance between sites
  - Poor road networks
- Consequences
  - Most rural sites are not adequately maintained

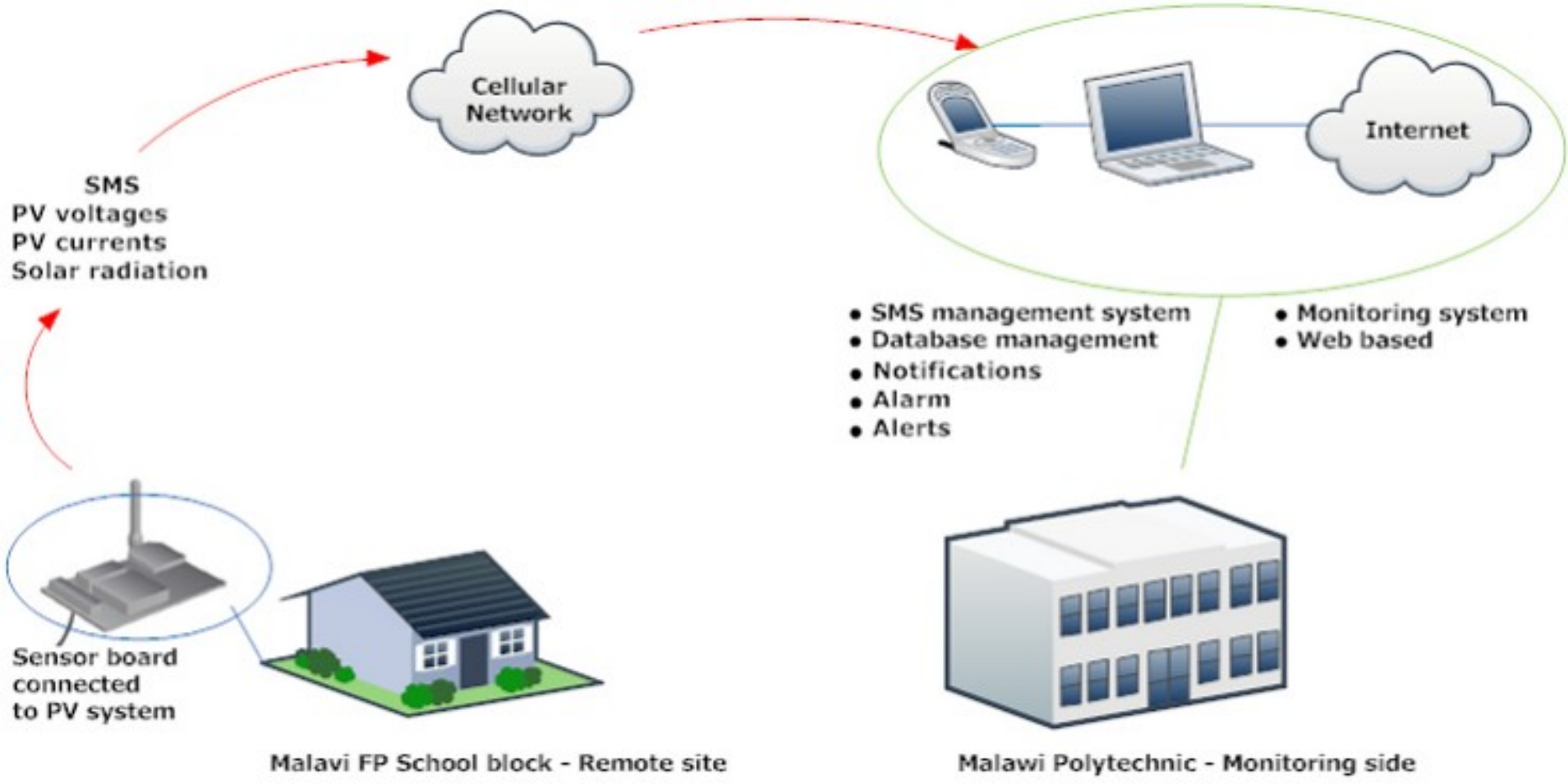


Project goal

- Develop a cost effective wireless based remote monitoring system that continuously presents remote energy yields and performance measures
  - Test bed setup at
    - Malavi Primary School in Chiradzulo
      - Solar PV Electrical system
    - Malawi Polytechnic
      - Central management system

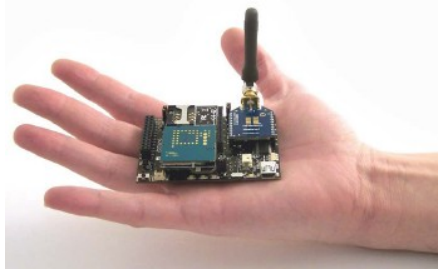
Pictorial view of Malavi Primary School

System architecture

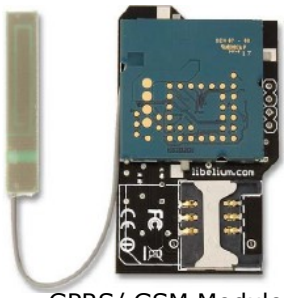


System architecture – Remote site

- WSN based approach
- Waspmote sensor board utilized
  - Arduino based device
  - Modular architecture
    - Communication modules
      - GPRS – incorporated for SMS transactions, Zigbee
  - 7 input accessible pin outs to capture outside voltages
    - Phidget 1117 voltage sensor grafted to read solar PV voltages



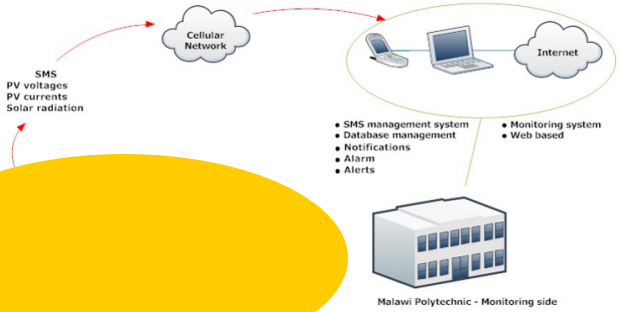
Waspmote Sensor Mote

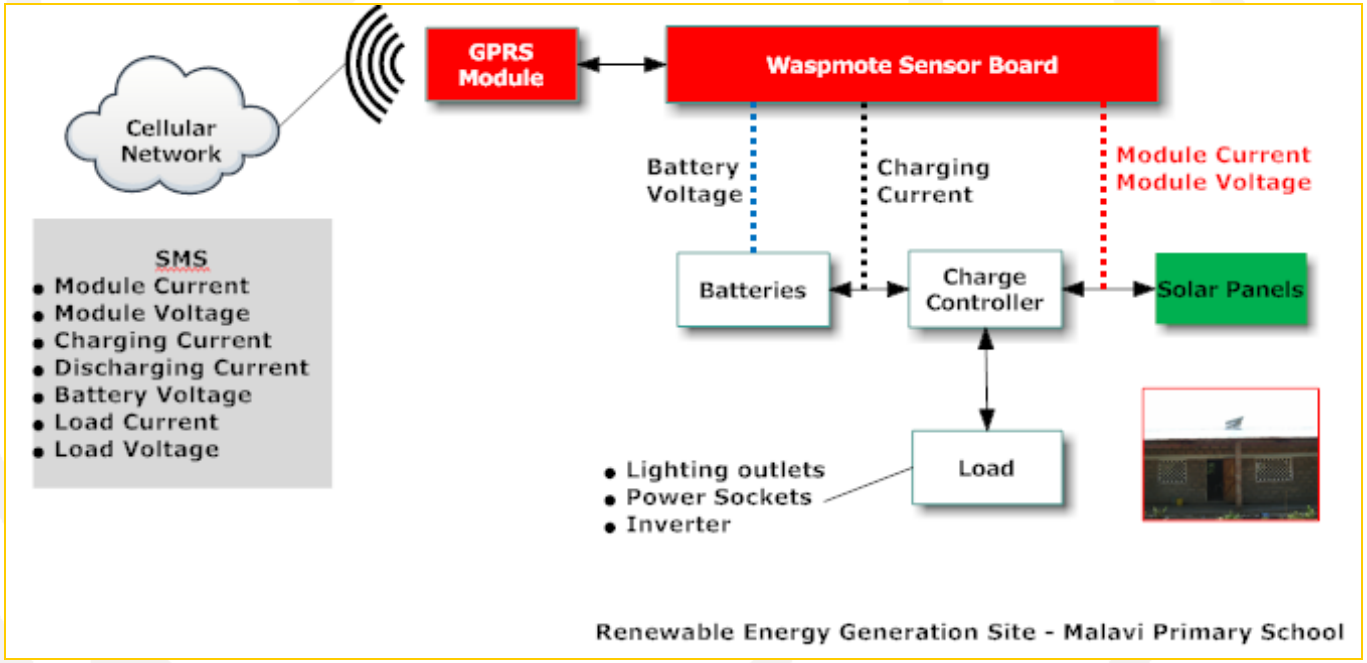


GPRS/ GSM Module

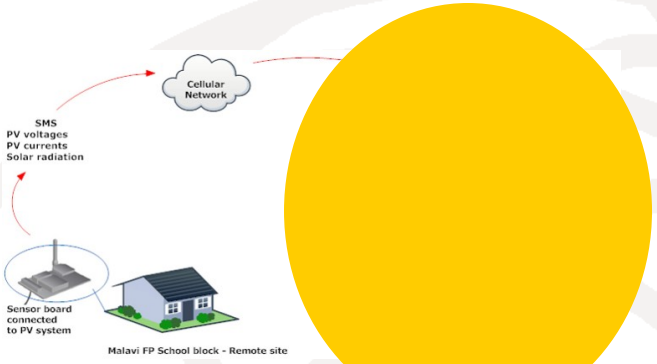
System architecture – Remote site

- Remote sensing mechanism





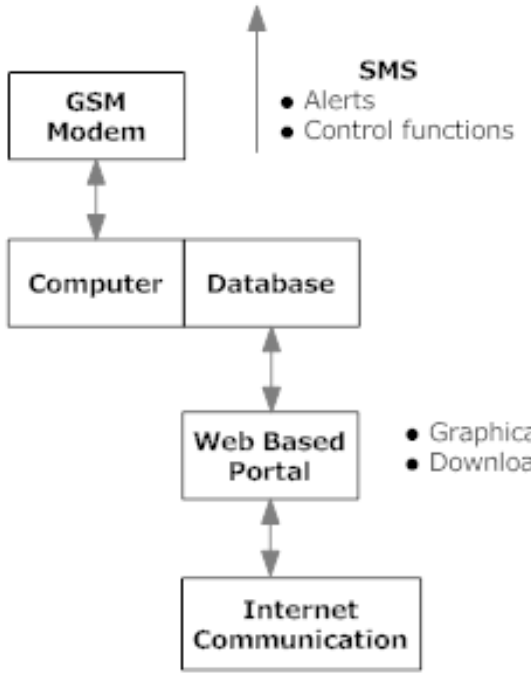
System architecture – Central site



- System building blocks
  - SMS gateway
  - Management system

SMS
- Module Current
- Module Voltage
- Charging Current
- Discharging Current
- Battery Voltage
- Load Current
- Load Voltage

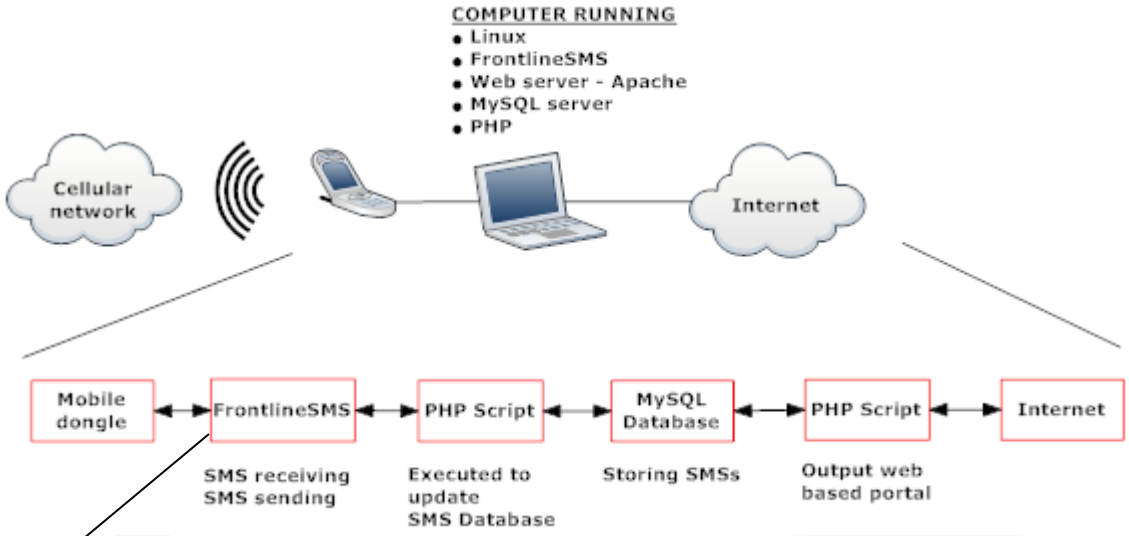
- Data gathering
- Data analysis
- Alert generation
- Logs

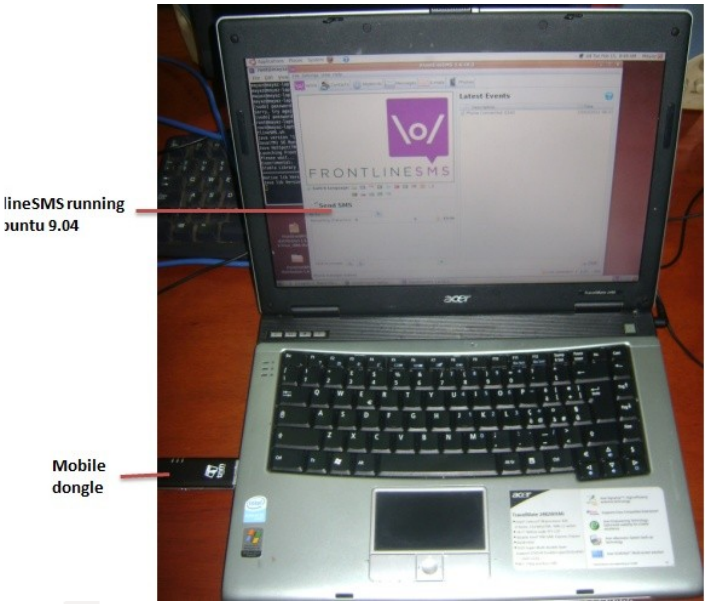


Management Site - Malawi Polytechnic

System architecture – Central site

- Linux based SMS gateway building blocks
- All in one machine





- **Free Software**
- **Windows and Linux based versions available**
- **Worked with simplicity**
  - **With available dongle and laptop**
- **Can interact with other external programs**
  - **Shell commands, HTTP requests, Scripting languages, etc**

System key benefits

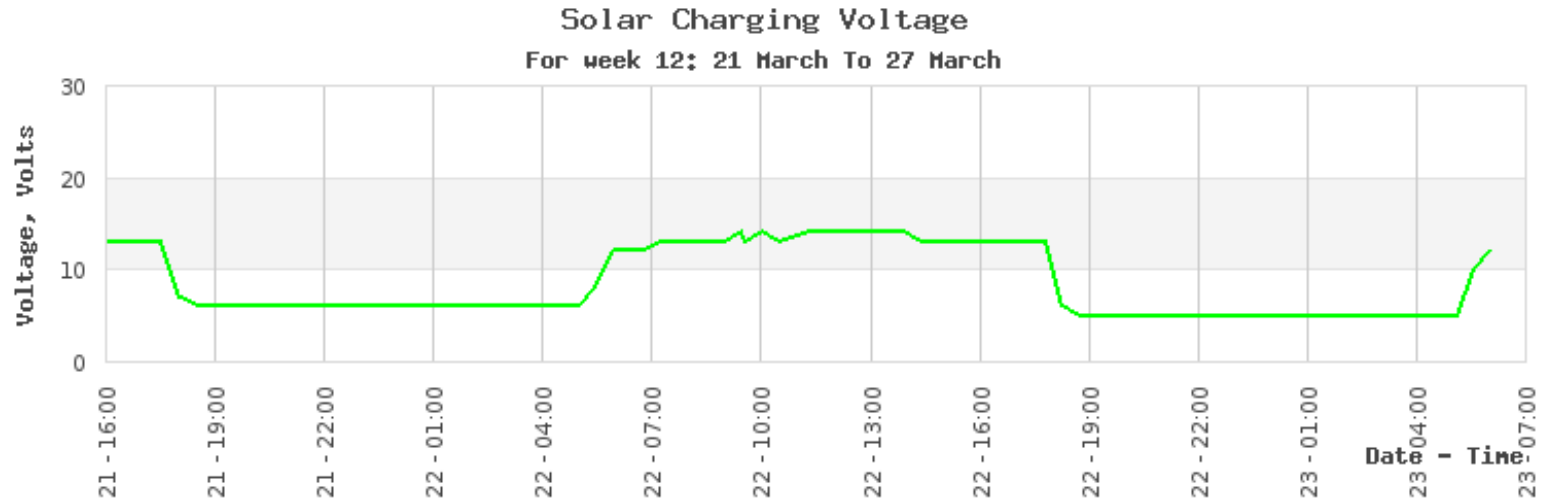
- Access to PV system performance from anywhere through the use of internet
- Reports of power output and energy production trends
- Verification of system operation
- Collection of data for service and maintenance planning
- Use of open devices which lower the cost and enable the replicability of the solution

Web portal


Gmail - Inbox (20) - mnk...
Zimbra: Sent
Remote Monitoring of So...
10.10.48.235/project/index.php
Suggested Sites
Web Slice Gallery
University of Malawi...
Other bookmarks
Home
Background
Objectives
Test bed
Solutions
Team
Reports
Today
This Week
This Month
This Year
MALAVI F.P. SCHOOL
ENTRANCE
MONITORING & CONTROL OF PHOTOVOLTAIC SYSTEMS:
NEW INNOVATION IN RENEWABLE SYSTEMS: I2IT Master of Technology (M.Tech) research project work
Monitoring and control of photovoltaic (PV) systems is essential for reliable functioning and maximum yield of any solar system. Furthermore, this management and maintenance exercise is critical to the longevity of the system which can extend up to 20 years of operation. However in Malawi, a typical example of a developing country, high costs of transportation, poor road networks and long distances between sites make it more challenging for technicians to visit all sites and effectively monitor system performance, as such most rural systems are not adequately maintained.
PROJECT DETAILS
Objectives
Test bed
Solutions
Team
LIVE MONITOR
Today
This week
This month
This year
Chikwawa sites
Chiradzulo sites
Blantyre sites
Back and forth movements
• Data collecting
• Routine checks
• Fault finding
NOT EFFICIENT
• More time
• Costly
• Other sites not visited
Engineers
Technicians
Researchers
Malawi Polytechnic
March '11
S M T W T F S
01 02 03 04 05
06 07 08 09 10 11 12
13 14 15 16 17 18 19
20 21 22 23 24 25 26
07:57
23-Mar-11

Preliminary experimental results

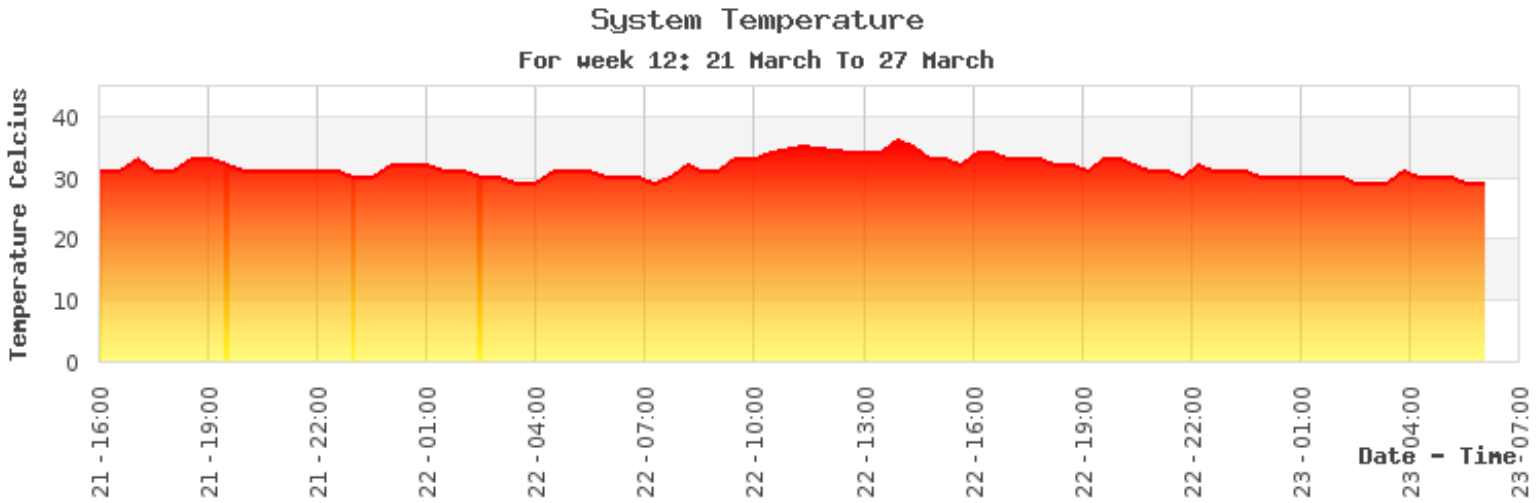
- Voltage obtained from solar panels



- Voltage follows a day/ night pattern
  - Solar panels provide voltage during the day and little voltage during the night

Preliminary experimental results

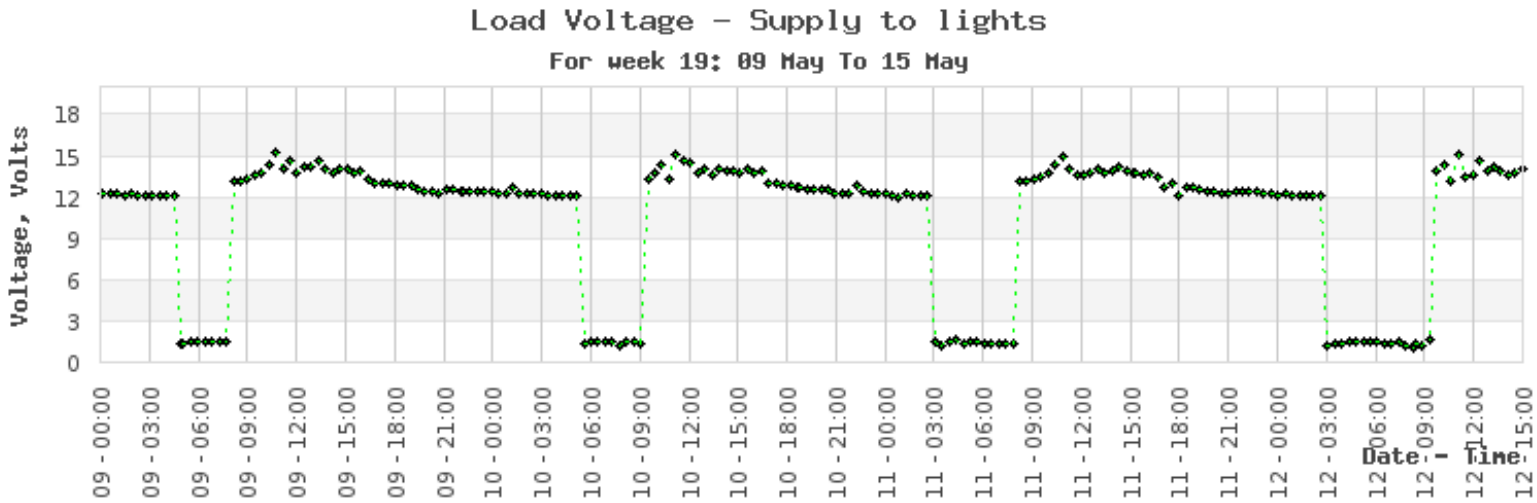
- Sensor board temperature



- Monitored to check if the board is not exposed to excessive heat

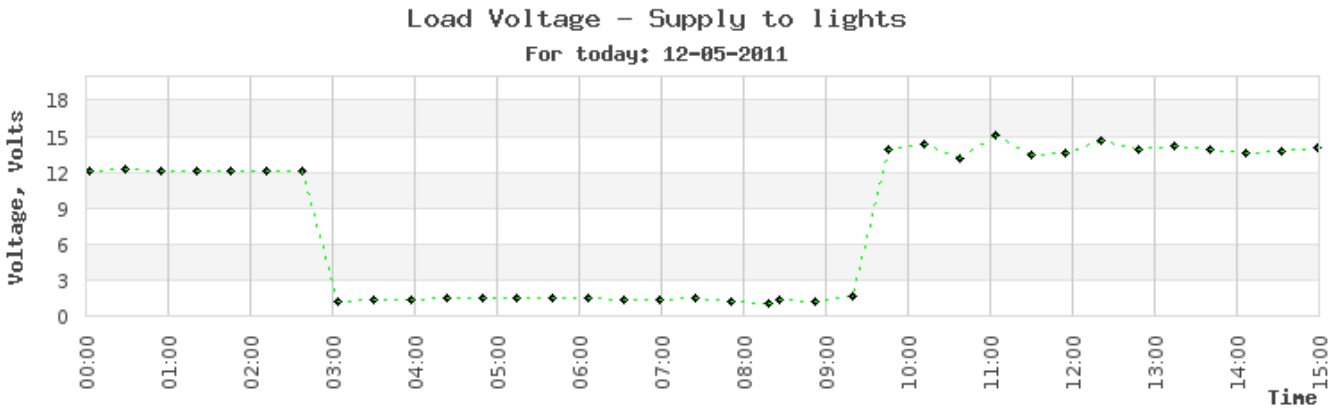
Preliminary experimental results

- Voltage supplied to electrical appliances; lights and sockets



Preliminary experimental results

- Voltage supplied to electrical appliances



  - During the night appliances obtain a constant 12v from batteries
  - Battery voltage not sufficient enough to supply power throughout period of little solar energy
    - At 3am equipment is switched OFF by the charge controller due to battery voltage drops. Evidently observed at the school block with complete power outage. Battery charging commences
    - At 10 am power comes ON, battery fully charged, energy obtained directly from panels

Conclusion and future work

- Proposed system is currently running and has proved to lower management costs
- Timely information reaches the Polytechnic group right in front of their work station
- Can assist in alerting technical team of remote circumstances
  - Also ease researchers study time

Conclusion and future work

- Results obtained logically agree with what is expected as the trend for solar module voltage during the day and night
- System functionality and design specifications can be verified
  - The one presented is under designed
- There is room for future work
  - Expand to measure more performance parameters
  - GSM communication attribute allow easy system replication to other remote rural plants
  - The system can be extended to allow for a smooth switchover between electrical and solar power supply depending on time-of-the-day power needs

Thank you