PROJECT REPORT: IEEE EPICS-High

Pilot Project 2009

Report compiled by:

Nana-Ampofo Ampofo-Anti, Graduate Student Member, IEEE
Technical Input: Justin Alvey, Student Member, IEEE
Project Finances: Mzabalazo Lupupa, Graduate Student Member, IEEE

UNIVERSITY OF CAPE TOWN (UCT), SOUTH AFRICA

E-mail: nampofo@ieee.org

Reviewed by:

Saurabh Sinha, Senior Member, IEEE

IEEE SOUTH AFRICA SECTION

E-mail: ssinha@ieee.org
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1 Background

1.1 Introduction

EPICS (Engineering Projects in Community Service)-High is an IEEE initiative that organizes High school students (known more formally as learners in South Africa) to work with University students to solve engineering problems. While the concept of EPICS is not entirely unique (introduced by Purdue University), the edge that the IEEE has added, relates to linking EPICS with High Schools, and this opportunity is envisaged to be eventually carried out by IEEE Organizational Units world-wide. In 2009, the IEEE South Africa Section gave the University of Cape Town (UCT) IEEE Student Branch (SB) an opportunity to execute an EPICS-High pilot project. The UCT IEEE SB has therefore carried out an EPICS-High project in conjunction with Westerford & Thandokhulu High Schools. A Projects Committee was setup to plan and oversee Project execution. The committee was composed of UCT IEEE SB members. In this way, the University of Cape Town, along with the IEEE Student Branch, Drexel University, PA, USA is one of the first student branches globally to carry out the IEEE EPICS-High initiative.

The theme of the Pilot Project was renewable energy; this theme was seen as ideal given the climate of Cape Town, which is very well-suited to Wind Power. The Projects Committee also felt it would be an ideal opportunity to educate participating learners about the importance of Renewable Energy, given the global shift towards cleaner energy sources. The Project Team looked at ways and means to develop green technology that have a positive impact on community.

The remainder of this report outlines the planning and execution of the EPICS-High Pilot Project as carried out by the various collaborators.

1.2 Project Selection Process

In order to identify an appropriate project that would allow for learner collaboration, a task team was setup by UCT IEEE SB Chairperson (2009) Ms. Veronica Sentongo. The
task team was composed of Projects Committee members and IEEE SB members. The task team assessed undergraduate honours topics as issued by the Department of Electrical Engineering to find suitable project(s) that could act as the basis for the EPICS-High Pilot Project. The supervisors & students working on the candidate pilot projects were then approached to determine their interest in participating.

The projects identified – with reference to the agreement between UCT and the IEEE South Africa Section Annexure A.

A  Design and prototyping of a wind-generator from scrap

B  Power Harvesting Module

The task team held discussions with the supervisors and students attached to these two projects. Though Project supervisor Ms. Robyn Verrinder participated in the EPICS-High Pilot Project, the undergraduate honours student did not fully participate. It should therefore be noted to that due to the latter reason and a general lack of time, Project B was not included in the final scope of the EPICS-High Pilot Project.

As Project A was the undergraduate thesis assigned to Mr. Justin Alvey – a UCT undergraduate honours student – he was asked to participate in the EPICS-High Pilot Project along with his supervisor Dr. Azeem Khan. Both agreed and therefore Mr. Alvey became a Projects Committee member, acting as a technical expert. Dr. Khan, already the mentor for the UCT IEEE SB, continued to act as an advisor for the duration of the Pilot Project. The connection between Mr. Alvey’s undergraduate thesis work and the EPICS-High Pilot Project is outlined in Section 2 of this report. An abstract of Mr. Alvey’s Project is provided as Annexure B.

1.3  High School Selection Process

As aforementioned, the EPICS-High initiative organizes High School learners to work with University students. One of the critical tasks of the Projects Committee was therefore to identify schools that would act as collaborators through their learners
participating in the project. The Projects Committee consulted Ms. Renéé Smit, Academic Development Lecturer for the UCT Department of Electrical Engineering.

As Academic Development Lecturer, Ms. Smit is responsible for building relationships between High Schools and UCT. After discussions with Ms. Smit and the UCT IEEE SB Executive Committee, it was concluded that it would be best to approach at least 2 schools in the general vicinity of UCT to ascertain their interest in collaborating on the EPICS-High Pilot Project. Ms. Smit was previously a teacher at Westerford High School; she therefore volunteered to make contact with the latter institution regarding possible participation. Thandokhulu High School was also identified as a potential collaborator given its proximity and a pre-existing relationship with a nearby UCT residence. The two schools (Westerford and Thandokhulu) were seen as an ideal mix of two distinct socio-economic communities. Westerford High School has traditionally serviced middle-upper income communities whereas Thandokhulu High learners were mostly from less privileged communities.

Ms. Smit contacted both schools and both immediately took an interest in the Pilot Project. It was decided that Grade 10 learners would be ideal candidates as the Grade 11 and Grade 12 pupils would most likely have too heavy a workload given the fact that it was already the second half of 2009. The Projects Committee therefore presented at both schools to interested Grade 10 learners. The presentations were organized by school science teachers, namely Mr. Tokyo Mcunu at Thandokhulu High and Ms. Lou Knutson for Westerford High. The teachers were then asked to select 5 learners from the interested groups at their discretion. The number of learners was fixed to 10 as this was seen as a large enough number to still allow for individual interaction. In addition to this, managing 10 learners was seen as an appropriate maximum in terms of logistics.
1.4 The selected High Schools

Thandokhulu High School and Westerford High Schools are both public schools and are situated in Mowbray and Rosebank, Cape Town respectively. Though both schools are public schools, there is a considerable gap in terms of resource availability and Thandokhulu is considered a historically disadvantaged school. Westerford on the other hand was recently ranked the top public school – by academic results – in South Africa. The Projects Committee felt the inclusion of the 2 schools – with pupils from vastly different socio-economic backgrounds – would act as a further form of community outreach in itself. More information on Westerford High School is provided in Appendix C.

Figure 1 – The Learners from Westerford and Thandokhulu with the Projects Committee Chair
2 Project Outline

2.1 Project Scope Definition

The aim of the EPICS-High Pilot Project was to involve High School learners in the Design and Prototyping of a wind generator from scrap (see item A, Section 1.2) and to explore the benefits of this technology in the context of community service. Given the level of the learners involved in the Project (Grade 10) and the fact that the Project was selected from an undergraduate Thesis topic; it was decided that the learners would contribute the specification and design of the Turbine Blades. The UCT members of the Project Team would therefore guide the learners through the process of specifying and designing these blades and Mr. Alvey would develop his Thesis project independently. The final output of the Project therefore consists of Justin Alvey’s generator and the Turbine blades developed by the Project Team.

As a secondary objective, the Project Team explored ways and means to incorporate the Power Harvesting Module Project (item B, section 1.2) in the overall Project. The initial idea was to develop a simple Solar Panel system to incorporate as part a hybrid renewable-energy-based power system. Due to time constraints and reasons outlined in section 1.2, this portion of the Project was only discussed but not implemented during the Project Execution Stage.
2.2 Project Planning

The Project Team organized informal planning sessions during which an outline of the Project Scope was developed. Also present at these informal planning sessions were UCT Academic Staff and Project contributors Dr. Azeem Khan and Mr. Ashwill Van Wyk. The planning process allowed the team to ascertain the following:

1. The role of the learners in the Project (detailed in section 2.1)
2. The execution format of the Project
3. The approximate number of Project sessions required
4. An idea of what costs would be involved

2.3 Project Team

The EPICS-High Project Team was composed of the UCT IEEE SB Projects Committee, Westerford and Thandokhulu High learners, UCT Academic staff and various UCT IEEE SB members that assisted throughout the project execution phase. Table 1 lists the Project team members:

<table>
<thead>
<tr>
<th>Title</th>
<th>Name</th>
<th>Organization</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr</td>
<td>Nana-Ampofo Amfo-Anti</td>
<td>UCT IEEE SB Projects Committee</td>
<td>Projects Committee Chairperson and EPICS-High Project Manager</td>
</tr>
<tr>
<td>Mr</td>
<td>Milton Edimu</td>
<td>UCT IEEE SB Projects Committee</td>
<td>Technical Supervision</td>
</tr>
<tr>
<td>Mr</td>
<td>Allan Kweli</td>
<td>UCT IEEE SB Projects Committee</td>
<td>Logistics</td>
</tr>
<tr>
<td>Mr</td>
<td>Tawanda Minya</td>
<td>UCT IEEE SB Projects Committee</td>
<td>Logistics (Planning stage only)</td>
</tr>
<tr>
<td>Mr</td>
<td>Justin Alvey</td>
<td>UCT IEEE SB Projects Committee</td>
<td>Technical Expert</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------</td>
<td>--------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Ms</td>
<td>Robyn Verrinder</td>
<td>UCT Academic Staff</td>
<td>Technical Expert</td>
</tr>
<tr>
<td>Mr</td>
<td>Mzabalazo Lupupa</td>
<td>UCT IEEE SB Executive Committee</td>
<td>UCT IEEE SB Treasurer and Project Financial Administrator (Execution Stage)</td>
</tr>
<tr>
<td>Ms</td>
<td>Chelsea Schuin</td>
<td>Westerford High School</td>
<td>Learner Collaborator</td>
</tr>
<tr>
<td>Mr</td>
<td>Olwethu Dyarhiwe</td>
<td>Thandokhulu High School</td>
<td>Learner Collaborator</td>
</tr>
<tr>
<td>Ms</td>
<td>Lilliana Ruiters</td>
<td>Westerford High School</td>
<td>Learner Collaborator</td>
</tr>
<tr>
<td>Mr</td>
<td>Qoyise Afikile</td>
<td>Thandokhulu High School</td>
<td>Learner Collaborator</td>
</tr>
<tr>
<td>Mr</td>
<td>David Van Wyk</td>
<td>Westerford High School</td>
<td>Learner Collaborator</td>
</tr>
<tr>
<td>Mr</td>
<td>Vuyisa Kolisi</td>
<td>Thandokhulu High School</td>
<td>Learner Collaborator</td>
</tr>
<tr>
<td>Mr</td>
<td>Khanyiso Gxekwa</td>
<td>Thandokhulu High School</td>
<td>Learner Collaborator</td>
</tr>
<tr>
<td>Ms</td>
<td>Eve Wicksteed</td>
<td>Westerford High School</td>
<td>Learner Collaborator</td>
</tr>
<tr>
<td>Ms</td>
<td>Buhle Samantha James</td>
<td>Thandokhulu High School</td>
<td>Learner Collaborator</td>
</tr>
<tr>
<td>Mr</td>
<td>Jason Lee</td>
<td>Westerford High School</td>
<td>Learner Collaborator</td>
</tr>
</tbody>
</table>

Table 1: Project Team List
2.4 Project Timeline

As aforementioned, the Project was planned such that it could be executed in a number of sessions. The sessions took place over a number of weeks. The team would meet on Fridays as this was identified as the generally most suitable day of week for all Team members. The first session was held on Friday, 18th September 2009. The list of events can be found in Table 2 below.

<table>
<thead>
<tr>
<th>Session Number/Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session 1</td>
<td>18th September 2009</td>
</tr>
<tr>
<td>Session 2</td>
<td>2nd October 2009</td>
</tr>
<tr>
<td>Session 3</td>
<td>9th October 2009</td>
</tr>
<tr>
<td>Session 4</td>
<td>16th October 2009</td>
</tr>
<tr>
<td>Session 5</td>
<td>23rd October 2009</td>
</tr>
<tr>
<td>Session 6</td>
<td>30th October 2009</td>
</tr>
<tr>
<td>Session 7</td>
<td>6th November 2009</td>
</tr>
<tr>
<td>Session X – Preparation for Closing Function</td>
<td>27th November 2009</td>
</tr>
<tr>
<td>Closing Function</td>
<td>3rd December 2009</td>
</tr>
</tbody>
</table>

Table 2: List of Project Events
3 Project Execution

The EPICS-High Pilot Project was executed between September and November 2009 and run in the form of collaborative sessions (as detailed in section 2.4). Due to the complex structure of contract work in a University such as UCT, the process to setup a contract between the IEEE South Africa Section and the University took much longer than expected. It should be noted that the IEEE UCT SB is also a registered society of the University, and obliged to follow financial and administrative processes established by the University. However, a contract was drafted uniquely for engagements such as this one, and future contracts should therefore finalize more swiftly. During each session, Project team members would interact with set session objectives in mind. The remainder of this section gives an overview of the Project Execution Stage.

Each session discussed took place at Upper Campus, UCT. Transport to and from Upper Campus was organized through SHAWCO (a charity organization based at UCT).

3.1 Session Format

Each Project Session was run by the Project Manager; sessions were generally informal in nature allowing the learners to interact freely with the UCT student members of the Project team. Sessions 1 and 2 served as ice-breaking and introduction sessions respectively. During these sessions the team members got to know each other and the learners in particular, some background information on the technical aspects of Wind Generators and Solar Panels was provided by the Team’s Technical Experts. Sessions 3 to 7 were the development and implementation sessions. The latter sessions typically had the following format:

1. Welcome by Project Manager
2. Briefing by Technical Expert
3. Briefing by Learners (regarding assigned tasks/research)
4. Review – “Eco Report” – of new technologies/ideas and items of interest in the area of Renewable Energy by Project Manager. This closing segment showcased products and ideas, drawn from various sources.

![Figure 2 – A snapshot of one of the Project sessions](image)

3.2 Session Summaries

What follows is a brief description of what was accomplished in Sessions 3 - 7

3.2.1 Session 3

After the icebreaking session (Session 1) and the semi-technical introductory session (Session 2), the focus of Session 3 was getting feedback from the learners. In this session the Team’s Technical Experts gave further technical insight into the workings of Solar and Wind Power. The learners also gave feedback on what they had found out about Renewable Energy. This session helped build the foundation for subsequent sessions.

3.2.2 Session 4

Session 4, along with the previous session, formed the technical foundation of the Project Execution Stage. Session 4 was led by talks from Justin Alvey and Milton Edimu on Turbine Blade design. The learners also gave feedback on what
they had learnt in the past week. Some of the community issues surrounding Renewable Energy were also briefly explored, namely: possible cost savings and placement of the final Project Output.

3.2.3 Session 5

This session was led by Milton Edimu as he reviewed the key points of Turbine Blade design and specification. The focal point of the Session was to develop basic specifications (shape, material, length) from the learners. The learners also presented some of their conceptual drawings of possible Wind Generator designs. Some of the designs attempted to incorporate solar panel technology in various ways. The specification developed in this session is discussed in the following section (3.3).

3.2.4 Session 6

In Session 6, Justin Alvey presented the Turbine Blades. These Blades were fabricated by Mr. Alvey based on the learner’s specifications (see Section 3.3 for more detail). A major focus of this session was the community issues surrounding the use of renewable energy. Some of the items covered were an appropriate place to mount the Generator, ownership and maintenance of the Generator.

3.2.5 Session 7

Session 7 was the final planned session (an 8th Session was organized ad hoc to help the learners prepare for their presentations at the closing function), it effectively wrapped up the Project and concluded with a photo session of the Project Team and the final Project Output: The working Wind Generator assembled from scrap material. A final discussion took place regarding ways and means the Project can be used to spread the word on the ease of construction of a Wind Generator. This Session also highlighted safety issues surrounding mounting of such a Generator.
Figure 3 – The learners test out the Turbine

Figure 4 – The Project Team give the Generator the ‘Thumbs Up’
3.3 Technical Specifications

As aforementioned, the designing and prototyping of the Wind Generator was done by Justin Alvey. However, a simple description of the workings of a Wind Generator and the design of Turbine Blades was explored with the learners. Supplementary learning material was also provided from a variety of sources. For completeness, some of the key specifications for the Wind Generator are provided below:

- Rectified output voltage: 12 V at 120 RPM
- Stator resistance: 2 Ohms

![Figure 5 – The Turbine before the blades were mounted in Session 7](image)

The learners provided the initial specifications, which were discussed in detail in Session 5. The specifications originally outlined by the learners with guidance from Milton Edimu were as follows:

- Length: 0.5 m
- **Shape**: wing-like
- **Material**: PVC piping

Due to safety-related restrictions on the use of UCT facilities by the learners, the specified blades were assembled by Justin Alvey. In order to better fit the blades to the Wind Generator, they were lengthened slightly to 0.8 m. The final blades had a tip-speed ratio of approximately 5. Due to safety concerns, the final Wind Generator was never mounted for extensive testing but the estimated output power was found to be 50 W.
3.4 Community Service

As a Pilot Project, the 2009 EPICS-High Project was executed with Community Service and development in mind. However the final Project Output was not suitable for mounting. The Project did however contribute strongly by raising generating awareness amongst the learners about issues such as Renewable Energy and Sustainable Development. The Projects Committee believes the benefit for the Thandokhulu learners in particular was exposure to information that would otherwise not likely be readily accessible. As far as both sets of learners are concerned, being thought the workings of a Wind Generator and how it could simply be assembled from scrap materials has given them truly useful knowledge that they can share with their respective communities. This is reflected in the evaluation forms filled in by the learners themselves.

With regards to community issues discussed and reported on by the learners, a brief outline is provided below:

3.4.1 Ownership

The issue of who would own the Generator if it was to be mounted in a community was seen as a controversial one. In the end, the Project Team recommended that ownership remain with the community to which the Generator was donated to with maintenance to be shared amongst IEEE volunteers and community members (refer to Section 3.4.2)

3.4.2 Security and Maintenance

It was decided that the security of the Generator would be the responsibility of the community taking ownership. Maintenance could be performed by volunteers from the UCT IEEE. Over time, community members would be trained to maintain the Generator independently.
3.4.3 Mounting

The learners suggested either mounting the Generator in an open field or between two tall structures to create a wind tunnel effect.

![Figure 6 – Justin Alvey talks about the completed Wind Generator in Session 7](image)

3.4.4 What would it Power?

The Team discussed a number of possibilities:

- Providing power for lighting at a school
- Providing power for a mobile clinic

Providing power for a wireless webcam mounted at a particular vantage point that would upload pictures regularly to illustrate the efficacy of Wind Power

3.4.5 Safety

It was noted in Session 7 that safety concerns around the mounting of such a Generator would prohibit mounting in open areas. This was due to the fact that
Wind Generator remained largely untested in as far as possible failure scenarios were concerned. This particular insight was highlighted by the Department of Electrical Engineering’s Safety Officer Mr. Chris Wozniak.
4 Conclusions and Recommendations

4.1 Project Outcomes Review

The EPICS-High Pilot Project was a tremendous success, the only low point perhaps that the final Output was not mounted for use in the general community. The UCT IEEE SB was approached by the one of the Thandokhulu learners, Mr. Qoyise Afikile, at the close of the project to discuss the possibility of developing a similar system for a community in the Eastern Cape. The latter discussion will be revisited in 2010 when the learners return to school. The UCT IEEE SB intends to, where possible, provide assistance to this learner as a continuation of the EPICS-High Pilot Project. The UCT IEEE SB will also explore the possibility of registering UCT as an EPICS University through the University of Purdue EPICS Programme.

The Execution of the EPICS-High Pilot Project proved to be a great learning experience for both the learners and participating UCT IEEE SB members. The initiative seems to have been highly effective in engaging the learners as the commentary in the evaluation forms was largely positive. Most of the learners (8 out of 10 learners completed and submitted forms) indicated an interest in taking up engineering and all of them took an interest in Renewable Energy.

Amongst the recommendations from the learners, some of the highlights include:

• A request to organize a ‘roadshow’ in 2010 to share the findings of the project with learners at their own schools and perhaps even with other schools. This will be followed up in 2010 when the learners return to school.

• Exploration of the feasibility of some sort of mounting of the Generator for demonstration purposes and to promote Renewable Energy

• Future EPICS-High Projects should include a component that allows learners to build or assemble a portion or all of the final Project Output
The learners were also exposed to the IEEE as an organization through their work in the Project Team. It can be safely stated that both the learners and indeed their science teachers now have knowledge of the IEEE whereas this was previously not the case. The EPICS-High Pilot Project therefore contributed positively to spreading the brand of the IEEE and information about the organization to the broader Cape Town community.

In spite of the differences in the socio-economic background of the learners, interaction between learners from different schools did not prove to be an obstacle. The latter outcome can perhaps be attributed to the use of the 1st Project meeting (Session 1) as an ice-breaking session, which allowed the learners to get to know each other. Friendships blossomed between the learners from different schools and indeed between the different members of the Project Team.

![Figure 7 – The Project Team with the Wind Generator](image)

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In terms of Project Management and Team assembly EPICS-High projects, the key recommendations from the Projects Committee and other collaborators were as follows:

- The addition of an “EPICS seniors” programme whereby a select group of learners would be invited to stay on for a second year, bringing a new dimension of continuity and oversight. The ‘seniors’ would assist in guiding the new Team of learners and also take a more involved role in the Project.

- Working with SHAWCO – UCT’s Community Outreach Organization in identifying candidate schools and projects.

- Working with Department of Electrical Engineering academic staff to develop the EPICS-High Project as a fully-fledged undergraduate Thesis topic.

Figure 8 – The learners were awarded certificates for participation.

A closing function was organized for the project during which the learners presented on what they had learnt and reflected on their experience working with the rest of the...
Project Team. The learners were presented small gifts and certificates to mark their participation in the EPICS-High Pilot Project. Key stakeholders were present at this function to mark the official closing of the EPICS-High Pilot Project.

Figure 8 – The Project Team shows off the Wind Generator at the closing function
4.2 Review of targeted Project Obligations

The focus of this section is to provide an overview of the obligations of the EPICS-High Project Team as per the contract concluded between UCT and the IEEE South Africa Section (hereafter referred to as UCT-IEEE South Africa Section Agreement). Table 3 (See below) provides an outline of the aforementioned obligations, indicating what obligations were met in terms of section 5 of the UCT-IEEE South Africa Section Agreement (Annexure A). Item numbers are with reference to Annexure A.

<table>
<thead>
<tr>
<th>Item</th>
<th>Details</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Prof. Barry Downing to supervise UCT IEEE SB in accordance with Annexure A</td>
<td>Project Finances were handled through the Electrical Engineering Department, this obligation was therefore met</td>
</tr>
<tr>
<td>5.2</td>
<td>The participants should include IEEE student members and high school learners</td>
<td>Refer to composition of Project Team outlined in Section 2.3, this obligation was met</td>
</tr>
<tr>
<td>5.3</td>
<td>The Project should benefit the community</td>
<td>Refer to section 4.1, this obligation was met and further benefit for the community is to be investigated in 2010 as outlined</td>
</tr>
<tr>
<td>5.4</td>
<td>Final Project Proposals shall be due on 31 August 2009</td>
<td>Obligation met</td>
</tr>
<tr>
<td>5.5</td>
<td>UCT to provide PPT presentation not later than Oct showing progress</td>
<td>Initial update PPT presentation was sent 21/09/2009; obligation met</td>
</tr>
<tr>
<td>5.6</td>
<td>A final report or PPT presentation shall be delivered</td>
<td>This document is sufficient to meet this obligation</td>
</tr>
</tbody>
</table>

Table 3 – Targeted Obligations Review
4.3 **Project Finances Review**

This section details the expenditure on the Project and analyses how the funds deposited by the IEEE South Africa Section were spent. Table 4 (see below) provides an itemised statement of Project expenditure; each item in the Table is analysed in detail in the discussion that follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE membership discounts</td>
<td>R 400.00</td>
</tr>
<tr>
<td>Refreshments</td>
<td>R 6,447.70</td>
</tr>
<tr>
<td>Petrol</td>
<td>R 300.00</td>
</tr>
<tr>
<td>Printing, Photocopies &amp; Stationery</td>
<td>R 1,100.46</td>
</tr>
<tr>
<td>Transport</td>
<td>R 3,247.50</td>
</tr>
<tr>
<td>Materials</td>
<td>R 51.00</td>
</tr>
<tr>
<td>Learning Materials - Book</td>
<td>R 383.10</td>
</tr>
<tr>
<td>Gift for Justin Alvey</td>
<td>R 1,000.00</td>
</tr>
<tr>
<td>Gifts - Closing</td>
<td>R 943.20</td>
</tr>
<tr>
<td><strong>Total Expenditure</strong></td>
<td><strong>R 13,872.96</strong></td>
</tr>
</tbody>
</table>

It should be noted that material costs were low in proportion to overall expenditure. Amongst the reasons for the latter outcome is the fact that UCT supplied much of the required material to Mr. Alvey as part of his undergraduate honours thesis. For future projects, a higher proportion of overall spend will be set aside for materials in keeping with the spirit of the EPICS-High initiative.

**4.3.1 Refreshments**

Given the time of the Project sessions (held in the afternoons after the learners had finished school for the day), the UCT IEEE SB felt it prudent to provide the learners with refreshments given the time of day. Refreshments were also provided at the EPICS-High Pilot Project closing function.

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4.3.2 Fuel/transportation

Petrol expenses reflect reimbursements to UCT IEEE SB members for trips made for on behalf of the Project Team. Distances covered were generally about 5 km round trip. Trips were made to and from the schools and from shopping areas to pickup refreshments.

4.3.3 Printing, Photocopies & Stationery

These costs include the printing of evaluation forms and supplementary materials provided to learners. A Project File was purchased and stationery was distributed to learners for making notes during sessions.

4.3.4 Transport

Transport costs were incurred during the Project due the need to transport the learners to and from UCT campus for each session and for the closing function. All transport payments were authorized after the receipt of invoices. These invoices are available upon request.

4.3.5 Materials & Learning Materials

Material costs include the purchase of wood for the mounting of the Turbine blades. A book was purchased on the advice of Mr. Justin Alvey, this book contained information on the design and construction from scrap of Wind Generators. Material from this book was used as a learning resource for the participating learners. The book remains an asset of the UCT IEEE SB.

4.3.6 Gifts

As a token of appreciation for their participation in the project, gifts were purchased for the High School learners and certain UCT staff members. The latter staff members were critical to the development of the Project and the UCT IEEE felt it prudent that they receive a small gift of thanks. A per-head budget of approximately R50.00 (approximately $7) per head was set for each gift issued.
A separate gift was issued to Justin Alvey as thanks for his contribution to the project. The IEEE South Africa Section had initially authorized a small portion of the funds to be used as a scholarship for the participating undergraduate student (Mr. Alvey). The scholarship intention was to attract a good student to the new initiative. However, it was found that the scholarship idea would no longer be relevant given that it was the end of the academic year. A gift voucher to the value of R1000.00 (approximately $150) was issued as an alternative.
5 Acknowledgements

The UCT IEEE SB would like to thank the following people for their contribution to the EPICS-High Pilot Project:

Prof. Barry Downing (UCT Department of Electrical Engineering Head of Department)

Mr Martin Braae (UCT Department of Electrical Engineering Senior Lecturer)

All Participating Westerford and Thandokhulu High learners

Ms Lou Knutson (Westerford High Science Teacher)

Mr Tokyo Mcunu (Thandokhulu High Science Teacher)

Ms Renee Smit (Academic Development Lecturer – UCT Department of Electrical Engineering)

Dr Azeem Khan (UCT IEEE SB Mentor and Project Team Member)

Ms Robyn Verrinder (Project Team Member)

Mr Chris Wozniak (UCT Department of Electrical Engineering Safety Officer)

Ms Marlene Joubert (UCT Department of Electrical Engineering Financial Administrator)

Ms Nicole Moodley (UCT Department of Electrical Engineering Head of Department Secretary)

UCT SHAWCO (Transport services provided)

Participating UCT IEEE SB Members
ANNEXURE A

SPONSORSHIP AGREEMENT

MADE AND ENTERED INTO BY AND BETWEEN:

THE UNIVERSITY OF CAPE TOWN
A university established in terms of the Higher Education Act, 1997, as amended
(hereinafter referred to as “the University”)

and

THE INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS, through
its IEEE South Africa Section
(hereinafter referred to as “the Sponsor”)

(collectively hereinafter referred to as the “Parties”)
PREAMBLE

WHEREAS the University IEEE Student Branch would like to implement a community-oriented project(s) with a view to stimulating interest in Electrical Engineering amongst High School learners;

AND WHEREAS the IEEE would like to make funding available to the University in order to facilitate such community-orientated project(s);

AND WHEREAS The University, through its Department of Electrical Engineers is prepared to manage such funding and allocate it to the UCT IEEE Student Brach for purposes of running the project(s)

NOW THEREFORE THE PARTIES HEREBY AGREE AS FOLLOWS:

1. INTERPRETATION

1.1. In this Agreement, unless the context otherwise indicates:-

1.2. the headings to clauses of this Agreement are inserted for reference purposes only and shall not govern or affect the interpretation thereof;

1.3. any annexures to this Agreement form an integral part hereof and words and expressions defined in this Agreement shall bear, unless the context otherwise requires, the same meaning in such annexures;

1.4. unless the context clearly indicates a contrary intention, words importing the singular shall include the plural and vice versa;

1.5. reference to any one gender shall include the other gender and any reference to a natural person shall include a legal persona and vice versa;

1.6. where the day on or by which anything is to be done is not a business day, it shall be done on or by the first business day thereafter;

1.7. where any number of days is prescribed in this Agreement, these shall be reckoned as calendar days, exclusively of the first, inclusively of the last day, unless the last day falls on a weekend or on a public holiday, in which case the last day shall be the next succeeding day which is not a weekend or a public holiday.

2. DEFINITIONS

2.1. In this agreement, unless clearly inconsistent with or otherwise indicated by the context, the definitions set out hereinbelow shall apply:
2.2. “this Agreement” means the agreement between the Parties captured in this document, together with any annexures, which are incorporated herein by reference;

2.3. “Effective Date” means the date when this Agreement becomes effective which shall be the date of last signature hereto by the Parties;

2.4. “Project” means the community-oriented project(s) intended to stimulate interest in electrical engineering amongst high school learners research which shall be undertaken by the University IEEE Student Branch, under the supervision of Prof. Barry Downing of the University Department of Electrical Engineering as set out in the proposal attached hereto and marked Annexure “A”

2.5. “Milestones” mean the deliverables that are depicted in clause 7 (Seven) herein below.

3. DURATION

3.1. The Project shall commence on 1 August 2009 and shall continue until the estimated completion date of 31 December 2009, unless extended under terms which are mutually agreed upon in writing by the Parties.

4. PAYMENTS

4.1. The Sponsor shall provide funding to the University for direct and indirect costs incurred in the performance of the Project, to a total of US$3,500.

4.2. Payments shall be made according to the following schedule:

4.2.1. USD 1,750 - upon signing of agreement;

4.2.2. USD 1,750 - upon delivery of proposals due on 31 August 2009;

4.3. All payments shall be made within 30 (Thirty) days of delivery the relevant invoice.

5. RESPONSIBILITIES OF UCT

5.1. Prof. Barry Downing of the University’s Department of Electrical Engineering, acting as the University’s Principal Investigator shall supervise students of the UCT Branch of the IEEE in completing the Project in accordance with Annexure A.

5.2. The participants should include University IEEE student members and high school learners.
5.3. The project should benefit the community (Engineering projects in "community services")

5.4. Final project proposals shall be due on 31 August 2009, and shall be drawn up according to University project / undergraduate technical project thesis guidelines and may be submitted electronically;

5.5. The University shall provide the Sponsor with an electronic copy of a presentation (PPT) towards mid-September; not later than Oct. that shows progress

5.6. A final report shall be delivered or, if this is found not to be feasible, a PPT presentation shall be given, as requested.

6. CONFIDENTIALITY

6.1. Information disclosed by one Party ("the Disclosing Party") to the other ("the Receiving Party") and designated as confidential, shall be treated as confidential by the Receiving Party and shall not be disclosed, in whole or in part, to any third party, unless prior written approval has been obtained from the Disclosing Party.

6.2. Information which:

6.2.1. can be shown to have been known by the Receiving Party prior to disclosure by the Disclosing Party; and/or

6.2.2. was in the public domain prior to this Agreement coming into force; and/or

6.2.3. enters the public domain once this Agreement is effective, through no breach of this clause on the part of the Receiving Party; and/or

6.2.4. is lawfully made available to the Receiving Party by a third party,

shall be excluded from the information defined in clause 6.1.

7. PUBLICATION RIGHTS

7.1. The Parties share a common interest in publishing the Project research results to advance the state of knowledge in the field.

7.2. The University shall be entitled to publish the results of its research in respect of the Project, provided that the University shall be obliged to furnish the Sponsor with a copy of the proposed paper, presentation or other material, excluding theses or dissertations, 1 (One) month prior to the publication date, whereafter the Sponsor
shall be entitled to comment on the proposed publication within 3 (Three) weeks of receiving same.

7.3. The Parties undertake to cooperate to allow the timely submission, examination, publication and defence of any dissertation or thesis for a degree.

7.4. In the event that the proposed publication contains information concerning an invention or discovery which the parties which to patent, the parties shall negotiate a delay in publishing, which delay shall not exceed 3 (three) months, in order to allow a provisional patent application to be filed.

8. INTELLECTUAL PROPERTY RIGHTS

8.1. Rights in inventions and discoveries arising during the course of the Project ("Project IP") shall vest in the University.

8.2. The University agrees to grant the Sponsor non-exclusive rights to the University's interest in the Project IP, the terms of which shall be set out in an agreement between the Parties ("Licence Agreement"), which:

8.2.1. the Parties shall endeavour to negotiate and execute within 6 (six) months of the disclosure of any Project IP to the Sponsor;

8.2.2. shall without limitation provide for the payment of a reasonable royalty to the University by the Sponsor.

8.2.3. During the term of the Project, the University shall promptly disclose any Project IP to the Sponsor.

8.2.4. The University shall retain the right to use the Project IP internally for teaching and research.

9. PUBLICITY

9.1. The Parties agree that they shall not use the name of the other party for marketing and publicity purposes without prior written approval. The Parties acknowledge that the Project is being conducted solely with the aim of furthering scientific knowledge and not for the purpose of endorsing any particular commercial product or range of products.
9.2. Notwithstanding the above, any publication resulting from the Project shall duly acknowledge the New Initiatives Committee of the IEEE as the source of funding enabling the Project.

10. **INDEMNITY**

The Sponsor indemnifies the University against any claims which may arise as a result of the Sponsor’s non-compliance with any provision of this Agreement or any negligent act or omission by the Sponsor, its employees or representatives. The University indemnifies the Sponsor against any claims which may arise as a result of the University’s non-compliance with any provision of this Agreement or any negligent act or omission by the University or its employees.

11. **GOVERNING LAW**

11.1. This Agreement shall be governed in all respects by the laws of the Republic of South Africa.

12. **TERMINATION**

12.1. Should either Party fail to fulfil any of their obligations undertaken by them in terms of this Agreement and fail to remedy the breach within a period of 14 (Fourteen) days after receiving written notification from the other Party demanding that the breach be rectified, the Party giving notice shall be entitled to cancel this Agreement.

12.2. This Agreement may be terminated at any time by mutual written agreement of the Parties.

13. **ARBITRATION**

13.1. The Parties shall use all reasonable efforts to resolve any dispute that may arise under this Agreement through good faith negotiations.

13.2. In the event that the Parties are unable to reach a settlement, such dispute shall be submitted to and decided by arbitration in Cape Town and shall be heard by an arbitrator to be agreed between them, failing which one shall be nominated by the President of the Law Society of Cape Town.

13.3. The arbitration shall commence within 30 (Thirty) days of the appointment of the arbitrator.
13.4. The decision of the arbitrator shall be final and binding, and may at the request of either of the Parties be made an Order of Court, in a Court of competent jurisdiction, which shall include an order on legal costs.

14. FORCE MAJEURE

14.1. Neither Party shall be responsible to the other for failure to perform any of its obligations under this Agreement, if such non-performance is caused by acts of God, rain, out venues, riots, civil insurrection, acts of a public enemy, accidents, acts of a civil or military authority, floods, earthquakes or winds, or similar situations beyond the reasonable control of the Party concerned.

14.2. The Party incapable of performing shall exercise due diligence to shorten the duration of and/or avoid the cause of the inability to perform.

15. REQUIRED NOTICES

15.1. Any notice required to be given under this Agreement, shall be deemed made if given by registered or certified mail, postage prepaid, and addressed either to the address given below or to such other address as may hereafter be specified in writing by the Parties:

15.2. If to the Sponsor:

Saurabh Sinha, Chairperson, IEEE South Africa Section
Jacques van Wyk, Treasurer, IEEE South Africa Section
c/o Dept.: Electrical, Electronic & Computer Engineering
University of Pretoria, Corner: University Road & Lynnwood Road
Pretoria 0002 ssinha@ieee.org / jhvanwyk@ieee.org

15.3. If to the University:

The Director: Research Contracts & IP Services
University of Cape Town
2 Rhodes Ave
Mowbray, 7700

16. GENERAL
16.1. Each provision of this Agreement is severable from the entire Agreement and, if any provision is declared invalid, the remaining provisions shall nevertheless remain in effect.

16.2. No waiver, alteration or modification of the provisions in this Agreement shall be binding unless mutually agreed upon and in writing.

16.3. Neither this Agreement nor any right, remedy, obligation or liability arising hereunder or by reason hereof shall be assignable by either Party without the prior written consent of the other.

16.4. No indulgence, leniency or extension of time which any Party ('the grantor') may grant or show to the other, shall in any way prejudice the grantor or preclude the grantor from exercising any of its rights in the future.

SIGNED at CAPE TOWN on this the 26th day of AUGUST 2009 for and on behalf of the UNIVERSITY OF CAPE TOWN

Signature
Name: Roger Wallace
Title: Research Contracts Manager

SIGNED at Pretoria on this the 25 day of August 2009 for and on behalf of the IEEE SOUTH AFRICA SECTION

Signature
Name: Saurabh Sinha
Title: Chairperson
Annexure A (Annexure of the agreement, not of the report)

The UCT IEEE Student Branch would like to implement two community-oriented projects with a view to stimulating interest in Electrical Engineering amongst High School learners.

Background

EPICS-High (Engineering Projects in Community Service) is an IEEE community-outreach project based on collaboration between undergraduate students and high school learners. As aforementioned, the focus of the project is to develop learner interest in Electrical Engineering. The EPICS-High project is fully-funded by the IEEE and has already been successfully implemented by University-High School partnerships in the USA.

The SA Section of the IEEE has requested the implementation of an EPICS-High project in the University of Cape Town by the IEEE student branch. The project will be implemented during the course of the second semester (August-November 2009). The project will be implemented by a team of undergraduate students, supervised by one or more postgraduate students depending on the nature of the projects.

The cost centre will be under the leadership of a full-time staff member, Prof Barry Downing. The proposed projects so far (see below) contain the vertical integration that the EPICS-high project requires, i.e. definite engagement of both IEEE student members and scholars (high/secondary school).

What type of project is suitable for EPICS-High implementation?

The UCT IEEE Student branch has proposed candidate projects that have community-oriented objectives and scope for the inclusion of high school learners for participation in relatively involved engineering-related tasks e.g. Research into appropriate material to be used for construction of project. The projects have a small enough scope that they can be completed within the specified time frame (August-November 2009).

Proposed Project

A. Design and prototyping of a wind generator from scrap

Technical Supervisor: M.A Khan
Project executor: - 3rd year Electrical Engineering class – 2009

As the title implies, a permanent magnet wind generator is to be built from junk. An abundant source of scrap for the magnets in these generators is from computer hard drives. These magnets are high energy product NdFeB rear-earth magnets and have a peculiar magnetisation direction. A machine topology was devised last year to use the magnets to demonstrate an elementary machine. However the wind turbine and power electronic converter was not attempted.
DETERMINABLES:

This thesis will involve the following:

1) Improving/optimising the design of the elementary machine.
2) Design and prototype turbine blades from scrap material (to be done by high school students).
3) Design, prototype and test a converter for battery charging applications.
4) Implement control strategy for battery charging applications.

B. Power Harvesting Module (Pending willingness of student to participate)

Technical Supervisor: R.A. Verrinder
Project executor (4th year student): Lee, Chum-Liang

The increasing use of wireless sensors in industry is hampered by the fact that even though wireless sensors don't need network cables, they still need power, which must come either from a power cable or from batteries. Most of these systems use extremely small amounts of power - less than 1mW is not uncommon. So, if we can harvest just a small amount of power from the environment, we can avoid using batteries or cables. Available environmental power is in the form of light, motion, and electromagnetic fields. Light can be harvested with solar cells. Motion, and particularly vibration, can be harvested using piezoelectric or electromagnetic devices (think about how automatic-winding or "kinetic" watches work). Stray electromagnetic flux can be harvested with antennas or coils. In this project, an investigation is required into designing and building a harvesting module that could provide 1mW of power continuously for a wireless sensor in an industrial environment, by making use of all three of these possibilities. A full evaluation of the available energy in a typical situation must be performed, after which a working system must be built and its performance must be evaluated.

DETERMINABLES:

1) An evaluation of the power available in a typical industrial environment.
2) A working power harvesting module.
3) Actual implementation of device that runs on power generated by the Power harvesting module (to be done by high school students).

Conclusion

- IEEE student branch members interact with pre-university students (with one or two schools), in an effort to solve a "real-life" engineering problem.
- This is a kind of a "vertical-integration" - so the project is sometimes called EPICS-High.
- The money is to be used for paying transport costs, component costs, etc for the project; maybe even for a social or two. A very small amount can be used as a 'bursary' for the students running it.
ANNEXURE B

This undergraduate study report / thesis looked into the feasibility of using scrap and low-cost material to build a wind generator to provide sustainable power. Neodymium magnets found in computer hard drives are analysed as a possible alternative to more expensive commercial neodymium magnets in an axial-flux permanent magnet generator. A stator design was proposed to simplify the construction of the turbine and to cater for the unusual nature of the magnets. The stator design was successfully tested and simulated with the proposed magnet layout. Two prototypes of the design are constructed. An electronic controller was built and tested, using a DC- DC switched mode converter, so that the generator can be run at various voltages while still being able to charge a fixed voltage battery. The final prototype, when matched with an appropriate turbine, was rated at approximately 50 W.
EXCLUSIVE: We reveal...

SA'S TOP SCHOOLS

Single-sex institutions lead field, girls smarter than boys in our survey
SINGLE-sex schools are better than co-ed, girls are smarter than boys. Afrikaans schools do extraordinarily well and Gauteng has the most top state schools.

These are some of the dramatic findings of the Sunday Times Top 100 Schools survey, based on data provided by the Department of Education.

Combined, 25 all-girls' and 19 all-boys' schools make up 44% of the schools that cracked the Top 100 list.

The survey also found that girls are outstripping their male counterparts, with 9 536 having bagged an astounding 18 771 As, including more than 2 000 for maths alone in last year's matric exams. In comparison, the 8 062 boys produced only 11 194 As.

Last done in 1999, the survey placed 28 schools in Gauteng among the top 100. 24 in the Western Cape. 19 in KwaZulu-Natal and nine in the Eastern Cape and Free State.

Cape Town's Westerford High School was rated the top school in South Africa, followed by Westville Girls' High in Durban and Pretoria's Afrikaanse Hoër Meisieskool.

Mbilwi Secondary, a rural Limpopo school, secured the eighth spot in the country and the honour of being the country's top science school.

In addition, the survey confirmed that former model C schools are still top performers, with 94 of them making the list out of roughly 6 000 high schools.

With the exception of Mbilwi Secondary and two other rural Limpopo schools — Harry Oppenheimer and Dendron Secondary — townships schools did not feature in the top 100 list.

Two other schools in the top 100 which were not former model C schools were Metropolitan-Raucall in Johannesburg — also the country's top maths school — and the Cape Academy of Mathematics, Science and Technology in Cape Town.

The matrix of 2008, on whom the survey is based, are the first graduates of the new outcomes-based curriculum introduced in stages, starting 12 years ago.

Schools in the top 100 were selected on the basis of five criteria, including their outstanding maths and science performances, which are critical government priorities.

Results highlighted by the survey include:

- 87% of pupils in these schools achieved a university entrance pass;
- Only 27 of the 17 430 pupils in the top 100 schools failed the exams; and
- Racial integration in particularly Afrikaans-medium schools was extremely varied, ranging from 1% to 70%.

Although 32 Afrikaans schools and eight parallel-medium schools featured in the top 100, only 818 black matriculants were enrolled in these schools compared with 6 911 white pupils.

Paul Colditz, chief executive of the Federation of Governing Bodies of South African Schools, said Afrikaans schools were top performers because pupils were taught in their mother tongue from Grade R to matric.

"It may be a risky comment to make but generally you will find that the level of participation in the affairs of the school by Afrikaans-speaking parents is a little higher.

"There is also a little more concern about the education of their children," he said.
Township schools hurt by migration

From Page 1

A total of 11,654 pupils out of the 17,420 from the top 100 schools were white compared with 3,210 black, 1,220 coloured and 1,305 Indian pupils. Of the remaining 31 candidates, 21 were Asian, while the races of the other 10 were unknown.

The minister of basic education, Angie Motshekga, said she was proud of the achievements of the Afrikaans-medium schools, adding that she was ready to consult with their management teams to "learn and adapt some of their systems" to help struggling schools.

Motshekga commended the Sunday Times on the project, adding it would help the department to provide adequate support to schools.

Helen Perry, a visiting researcher at the University of the Witwatersrand, who was commissioned by the Sunday Times to conduct the survey, ranked the schools according to an index which included a combination of the matric pass rate; the percentage of pupils with a university entrance pass; the average number of A symbols; and the number of maths and science candidates achieving over 50% as a percentage of all candidates at the school.

Only schools with 50 matric pupils or more were considered.

Perry said a major constraint of the survey was basing the index solely on the school's academic results.

"The ranking of the best schools is always controversial since an enormous proportion of school outcomes are determined by social class, families' access to resources and the quality of the school environment."

Although she was expecting criticism mainly of the "constraints of the index", she was satisfied that Westerford High met all the criteria to be considered the top state school.

The Sunday Times revived the Top 100 Schools survey to give readers the information necessary to make "the single most important decision parents will make — where to educate their children", said Sunday Times editor Mondli Makhanya.

"We also want to celebrate schools that have achieved excellence, demonstrate why they performed so well, and highlight the top schools as role models for others to learn from."

All matric at Westerford High passed matric last year, with 166 of its 168 candidates qualifying for university admission.

The school produced 575 subject distinctions, 19 pupils with seven, nine with six and 18 with five.

Westerford principal Rob le Roux said being top was "an amazing honour."

"But there are so many other schools that could be No.1 as well. We don't profess to be the best school in the country, although it's lovely to have that accolade."

Commenting on the reason why township schools do not feature on the list, Motshekga said they would await a research report to "indicate the kind of support" the department would give.

But Limpopo's top three schools, Mbilwi, Harry Oppenheimer and Dendron, proved that inadequately resourced schools can still excel.

At Mbilwi, 187 of the school's 201 candidates qualified for university admission and the school produced 309 subject distinctions.

Wits University professor of education policy Brahm Fleisch said a lack of grounding in literacy and numeracy was a problem that "disproportionately" affected black pupils.

"The overwhelming majority of South Africa's children are set up for failure in the secondary schools, as they are simply not adequately prepared," he said.

Speaking in his personal capacity, Professor Grain Soudien, acting deputy vice-chancellor at the University of Cape Town, said the migration of black middle-class pupils from township to former model C schools left historically disadvantaged schools poorer.