KATHMANDU UNIVERSITY

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

PROJECT PROPOSAL

SOLAR POWERED WATER PUMPING SYSTEM

A project proposal by:

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April 2013
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Introduction

Like most other developing countries the energy situation in Nepal is extremely critical. So the electricity generation from the alternative sources has become the crying need for Nepal. Nepal is blessed with renewable energy resources and the availability of alternative energy creates opportunities for utilization in power sector. Among different renewable energy sources like solar, wind, biomass and others, the abundant availability of solar energy makes it the most promising one for Nepal. Nepal is situated 28 degrees 00’ N and 84 degrees 00’ E which is an ideal location for abundant solar radiation. The daily average solar radiation in Nepal is 3.6 to 6.2KWh/m² which is better compared to many nations who are working on solar energy in a large scale.

In Nepal, nearly 40% of the population has access to electricity with a per capita availability of 100 KWh per annum. The electrification rate of rural areas in Nepal is 5%. In view of the dispersion of localities, the low demand, the cost of production, transmission and especially distribution of electricity would be prohibitively expensive for these regions. Therefore renewable energy based off grid electrification can be an alternate option for providing electricity in large remote and rural areas of Nepal.
Statement of problem

There are many systems of pumping water that are currently used including engine driven pump, grid powered pump, manual powered pump and generator driven pump. However, there are inconveniences associated with these systems as follows:

1. Due to the steady increase in the price of fuel for the past few years, most of these systems have become expensive leading to an increase in the price of water for domestic consumption and irrigation.
2. Most of these systems require high maintenance since they have many moving parts.
3. There is low grid power coverage in the country; therefore grid powered pump cannot be used in most of the parts in the country.

To overcome the inconveniences, there is a need to design and construct a solar powered water pumping system.
Background

The solar-powered pumping system can be used anywhere but it is appropriate for rural areas of Nepal which is facing energy crisis. Due to geographical position, Nepal has ample sunshine through the year which makes it ideal location for utilization of solar energy. Small farms, villages, and animal herds in developing countries require hydraulic output power of less than a kilowatt. Many of these potential users are too far from an electrical grid to economically tap that source of power, and engine-driven pumping tends to be prohibitively expensive as well as unreliable due to the high cost of purchased fuel and insufficient maintenance and repair capabilities. Though the installation cost of solar powered pumping system is more than that of gas, diesel, or propane-powered generator based pumping system but it requires far less maintenance cost. However by comparing installation costs (including labor), fuel costs and maintenance costs over 10 years with other conventional fuel based pumping system, the solar PV water pumping system can be a suitable alternate option. This system has the added advantage of storing water for use when the sun is not shining, eliminating the need for battery, simplicity and reducing overall system costs.
Objectives

The project “Solar powered water pumping system”, as the title suggests is aimed to construct a water pumping system based on solar energy.

General objectives of the project are defined as:

- To practically implement the academic knowledge in the service of rural communities.
- To apply the knowledge gained from various courses in carrying out electrical and electronic system design and its implementation.
- To develop skills in goal setting, planning, investigation and research, teamwork, implementation, assessment, report writing and presentation.
- To develop practical skills required for real engineering practice, from conceptualization to effective realization.
Methodology

1. Initial survey and planning
   The initial survey is about pumping techniques and other systems related to our project. Any work without planning is like story without any end. Planning is a very necessary and important step before starting a project. So we planned about the works and divided the works according to time basis. Detailed planning is shown in the Gantt chart in page 8.

2. Site visit and case study
   Our proposed project site is Bhandara V.D.C, ward number-01, Chitwan. We will be visiting the site and study their existing pumping technique and their problem. We shall collect information about the problems faced at the site. From site visit we will be clear about the objective of the project.

3. Collection of information and data
   Information and data relevant to project work were collected in following ways:
   a) Literature Survey
   b) Market Survey

a. Literature Survey
   Literature is reviewed through resources of print, electronic and internet for conceptual framework: Desk research/ Internet research. Based on the review of literature, the study is designed based on conceptual framework. Upon finalization of framework an inception report is prepared and presented to the advisor.

b. Market Survey
   It is to obtain information about the instruments regarding price, rating, availability, functions, performance, alternatives etc.
Battery-coupled water pumping systems consist of photovoltaic (PV) panel, charge control regulator, battery, pump controller, DC water pump, water tank and a level sensor which is shown in figure1. The electric current produced by PV panel during daylight hours charges the battery and the battery in turn supply power to the pump anytime whenever the water is needed. To determine whether the tank is full or empty level sensor is used.

The use of battery spreads the pumping over a longer period of time by providing a steady operating voltage to the DC motor of the pump.
## Gantt chart

<table>
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<tr>
<th>S.N.</th>
<th>Activity</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>July</th>
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<tbody>
<tr>
<td>1.</td>
<td>Feasibility Study</td>
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<td>2.</td>
<td>System Specification</td>
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<td>3.</td>
<td>Requirement Analysis</td>
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<td>4.</td>
<td>Design</td>
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<td>5.</td>
<td>Documentation</td>
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<td>6.</td>
<td>Testing</td>
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<td>7.</td>
<td>Implementation</td>
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Tentative Components Required

Solar Panel:
Absorb sunlight and transform to DC electricity power, provide energy for solar pump.

Solar Tracker:
Rotate solar panel to achieve maximum solar radiation.

Electronic Pump Controller:
A) Switch On/Off the pump  
B) Indication of Pump status
C) Float switch signal control
D) Pump Protection

DC PUMP:
Pumping the water from well to water tank

Water Tank:
Water storage

Float Switch:
To generate control signal to the pump controller when the water tank is full or empty.

Outlet Pipe
Water from well to water tank
## Tentative Budget

<table>
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<tr>
<th>S.No</th>
<th>Funding organization</th>
<th>Funds available</th>
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<tbody>
<tr>
<td>1.</td>
<td>Fund requested from the team</td>
<td>$600 (=approx. Rs. 50,000 @ Rs 84/$1)</td>
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<td>2.</td>
<td>Fund assured from partner school</td>
<td>Rs. 20,000</td>
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<td>3.</td>
<td>Funds collected from donations</td>
<td>Rs. 5,000</td>
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<tr>
<td>4</td>
<td>Total</td>
<td>Rs. 75,000</td>
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</table>
Conclusion

Under these circumstances of inadequate supply of electrical energy, the solar water pump can play a significant role. Solar photovoltaic pumping offers an alternate means to meet the electricity demand for irrigation in Nepal. Though the upfront cost of the solar pumping systems potentially hinder to popularize the systems in rural areas but private companies, bank, development organizations and government can provide loan, subsidy or other suitable options so that it can be widely used in rural areas. The proposed solar water pumping system has long lifetime and it is maintenance free. Together with decreasing PV module costs and increasing efficiency, PV is getting more pervasive than ever.

Issues like energy and global warming are some of the biggest challenges for humanity in the 21st century. Therefore ensuring energy resources and minimize the global warming, the utilization of renewable energy becomes a crying need for today. Among different types of renewable resources, solar energy has great prospect for utilization in electricity generation. Nepal is blessed with sun light throughout the year due to its global position. Therefore solar water pumping system has great prospect of utilization in this country.
References

https://www.practicalaction.org/solar-energy-answers/page:1
Ogata, ‘Modern Control Engineering’ PHI, 2008
https://www.homepower.com/maximum-power-point-tracking-mppt
Application essay for community based project

Location of our project would be at a community based Primary school in Bhandara V.D.C, ward number-01, Chitwan. The name of our partner school is ‘Shree Rastriya Prathamik Vidhyaliya, Sikhar’. All the students in this school are from dalits and indigenous tribes.

Sikhar is a hillock in Bhandara V.D.C which is inhibited mostly by people of indigenous tribes. It is located approximately at a distance of 2 km North-East of centre Bhandara. Bhandara is located approximately at a distance of 170 km south of capital city, Kathmandu and approximately 27 km east of Bharatpur, district headquarter of Chitwan. The approximate distance would be like this : (Kathmandu—150kmSouth---Bharatpur—27kmEast---Bhandara---2km North---Sikhar.)

We have chosen this school as our project partner because children and staff in this school are facing shortage for drinking water. Currently, water is pumped from the well (20 meter deep) located at a distance of 200 meters away from the school. Due to the effect of load shading and poor performance of motor, students and teachers aren’t able to quench their thirst. In our system electricity is produced from sunlight so there wouldn’t be the effect of load shedding and the second problem can be addressed by using brushless direct-current (DC) motor. Similarly, this school has agreed us to support the additional fund of NRs.20, 000 that is required for us to complete our project. Moreover, we believe that this type of project in school helps the community and students to get inspired about trends in development of renewable energy. Since school is the base of all higher degrees we hope that it inspires the children to innovate something and serve the community.

This school nurtures around 500 children from grade 1 to grade 5 and around 20 staffs, so the expected number of people getting benefit from our project would be around 550. 30 people over faculties, staffs and students are considered in account of visitors coming to the school.

The job of an engineer is to address the problems of the community during day-to-day life and simply them. Neither projects be neither created nor be implemented without facing challenge. As an electrical & electronics engineer, the major challenge we will be facing would be the design of charge controller and pump controller because almost all other parts are to be borrowed from the market. Another major challenge is the weather itself. During the winter season intensity of solar energy becomes less and electricity produced from the solar panel would be less. Similarly, making the plant more energy efficient would be the other challenge.
Plan for long-term use of this project

Our project ‘solar powered water pump’ is a very simple and self-controlled system. The DC motor would pump water from the tube-well until water is full in the tank. As water fills the tank, float switch triggers the actuator so water pumping stops. The state of system can be known from the controller as it has indicators for various parameters. Moreover, the brushless DC motor used in our project has a very long useful life and is almost maintenance free. So it is going to be a self—controlled system.

However, long life of project is impossible without the active involvement of the community. So we will try to develop the sense of responsibility among the students, teachers and staffs about this project. We will try to form a community that looks after this project for its long-term use. Similarly, we are planning to train some of the teachers about the working and methodology of the project so that they can solve small problems occurring during its use.