Motorised Solar Tracker: A STEM Based Community Welfare Project

Project Report by Arnav Gupta

Project duration: 18 months

PROJECT SUMMARY

Conservation of energy is essential in creating a sustainable environment for the future. The purpose of my project is to generate a reliable, emission-free and a renewable energy source. For this, I have developed a 'Motorised Solar Tracker', which will enhance the efficiency of the traditional solar panel by harnessing the sun's energy to generate electricity. This energy generated will provide electricity and improve the infrastructure across rural settlements and schools where the grid supply is either lacking or inadequate. My project is also an initiative to promote STEM education amongst students and teach them how clean and an alternate energy source can be generated cost-effectively.

THE COMMUNITY CHALLENGE & MY SOLUTION

The current electricity supply in India still relies mainly on coal as an energy source. As our awareness of climate change continues to expand, it is well known that coal is neither renewable nor clean when used. Hence, India as a country needs to reduce its dependence on fossil fuels and develop an alternative energy source to move towards a more sustainable future. My initiative is a small step in solving the shortage of electricity supply in schools and rural communities by providing a simple yet dependable energy source. The tracker is developed to support the children of an NGO ‘Manav Mandir Mission Trust’ since the intermittent power supply limits their learning experience. My first set-up was installed at their location in Sarai Kale Khan, New Delhi. The positive feedback from the students and the school administration motivated me to eventually develop three more projects and install them at other locations, thereby making a beneficial impact on the community.

COMMUNITY IMPACT OF MY PROJECT

I installed the Motorised Solar Tracker in different locations and local communities; the impact of these installations is listed below.

- 2 Motorised Solar Trackers at 'Manav Mandir Mission Trust' schools at Sarai Kale Khan and Majnu ka Tilla in Delhi ensure that 60 students can study un-interrupted.
- To fund the NGO installations, I raised INR 1,36,000 through the online crowdfunding platform of 'Milaap.'
- My pilot prototype, installed in Sahibabad, currently powers an activity centre for 35 students to use for academic and extra-curricular activities.
- 2 Motorised Solar Trackers were donated for use by 15,000+ residents to the community centres at Kilokari Village and Sunlight Colony with the support of local MLA, Mr Praveen Kumar. The cost of these installations was covered by CSR funds donated by solar company 'Twincity Sunlife.'

SOCIAL MEDIA AND NEWSPAPER COVERAGE

https://www.sarita.in/society/science-projects-instill-confidence-in-students
https://www.sarassalil.in/society/science-projects-instill-confidence-in-students
https://manavmandirgurukul.org/mortised-solar-tracker-for-gurukul/
https://www.youtube.com/watch?v=tLim4wiDJHc
https://www.youtube.com/watch?v=YSsSPJxRDZ4

PILOT PROJECT STAGE

I discussed my idea of developing the tracker with my father through basic drawings on paper, its design concept, making a list of components, the measurements of the shaft assembly and the stand. Then we drew a solar circuit electricity diagram to connect the components in the correct sequence. In addition to the solar panels, a charge controller, battery and inverter were required. The purpose of the inverter is to convert the DC generated by the solar charged battery to usable AC. After procurement of the components from the local market, I started working on building the prototype.

KEY FEATURES OF THE TRACKER

1. Automated Tracking System
2. Solar Panel directly facing the sun at all times
3. Increased efficiency even on cloudy and dusty days
4. Reduction of the annual energy consumption and generation of monthly savings
5. A fully charged battery can power up to 60 LED lights and 30 fans for 6 hours under optimal conditions
6. It is maintenance free, only daily cleaning of the solar panel is required
7. The life of a good battery is almost 5 years, and for the rest of the components it is 10 years
8. Recovery of initial investment cost of ₹35,000 per installation is within one year

Optimal Conditions
The battery will continue to operate as per its rating over 5 years
The components used in the set-up will not require any maintenance
The solar panel will be cleaned daily
The weather conditions will be conducive to fully charging the battery
There are no energy losses in the voltage regulator and the invertor

FUNDRAISING FOR THE PROJECT

https://milaap.org/fundraisers/support-stem-education-in-lower-income-groups

I have been working with 'Manav Mandir Mission Trust' NGO to teach children science through simple experiments and help them with their homework. In my visits to the school, I observed that the children had a tough time studying comfortably due to the disruptive power supply and the sweltering heat in summer. Under guidance from my parents, I set about raising funds to purchase a solar panel for installation at the school. Initially, I approached family and friends, but I found this to be limiting and time consuming. Hence I decided to list my initiative on 'Milaap', an online crowdfunding platform and raised Rs.1,35,000. This opened up my fundraising campaign to the public while facilitating funds transfer directly to the NGO.

OBTAINING SPONSORSHIP

Although solar energy is gaining popularity in India, its initial installation is cost-intensive. For my campaign to succeed, I needed investments to initiate the process. My single set-up costs approximately Rs.35,000 at MRP; bulk prices are significantly reduced. While sourcing the components for my project, I contacted a Mumbai based solar equipment supplier. Recognising my campaign's potential to improve electricity supply in under-privileged settlements, 'Twincity Sunlife Pvt. Ltd.' supported my initiative by providing technical support, guidance, and sponsored installation materials worth Rs.75,000

LIST OF COMPONENTS USED IN THE DEVICE

No.	Item	Quantity	Price / Unit	Price	Specification
1	Sensor Solar Panel	3	500	1,500	5 W / 9V
2	Solar Panel (Electricity Generator)	1	10,800	10,800	250W / 12 V (1346 X 986 X 40 mm)
3	DC Geared Motor	1	1,380	1,380	DC / 3.5 RPM
4	Voltmeter	1	350	350	Measure Voltage of Battery
5	Bearings	2	500	1,000	F204
6	Steel Shaft	1	200	200	20 mm Diameter, 16 inch length
7	Fabricated Steel Stand	1	1,500	1,500	
8	Charge Controller	1	4,200	4,200	12 Volts
9	Battery	1	6,800	6,800	12 Volts DC 80 AH
10	Invertor (DC to AC Convertor)	1	7,000	7,000	12 Volts / 300 VA
11	Electrical Wire	1	270	270	

PROJECT MECHANISM

Traditional solar panels are installed in a southward-facing direction. This placement limits their efficiency because the sun's position changes throughout the day. My 'Motorised Solar Tracker' senses the sun's location and rotates in sync, optimally positioning the solar panel to face the sun at all times. In doing so, a rotating solar panel generates a higher voltage and DC than a fixed solar panel. There are two components of the tracker:

1. Sun Location Sensor & Rotating Mechanism
2. Electrical Circuit & Components

Sun Location Sensor & Rotating Mechanism

The ***Motorised Solar Tracker*** has ***three identical small solar panels*** of 5 Watts each (A, B, C). They are located at 60 degrees to each other and form the three sides of an equilateral triangle. The three solar panels (A,B,C) are wired to a single geared ***DC motor*** to generate opposing voltage. In other words, the voltage generated by one solar panel cancels out the voltage generated by another solar panel. Therefore, depending upon the sun's position, one of the three (A,B,C) solar sensors generates higher voltage and current compared to the other two sensors, thereby rotating the DC motor in its direction. The DC motor, in turn, rotates a steel shaft. A large ***electricity-generating solar panel*** is mounted on the ***steel shaft***. ***Two bearings*** support the steel shaft**.** The entire assembly is mounted on a ***steel frame***.

Electrical Circuit & Components

The ***large solar panel*** converts the solar energy into DC electrical current. The wires from the solar panel are connected to a 12-volt ***voltage regulator***. The voltage regulator monitors the charging of a ***12-volt / 80 Ampere-Hour battery.*** A ***voltmeter*** constantly shows the battery's voltage and indicates its charge level. The charge generated by the solar panel flows through the voltage regulator to charge the battery. Since the battery generates DC, and all our appliances run on AC, it needs to be converted to AC. To achieve this, an ***inverter*** is connected to the battery. This converts the 12 Volts DC of the battery into 230 volts AC.

PROJECT INSTALLATIONS

Pilot Project: A-11/1, Site 4 Industrial Area, Sahibabad, Uttar Pradesh- 201010

Location 1: Manav Mandir Mission Trust
KH-57, Sarai Kale Khan, New Delhi- 110013

Location 2: Manav Mandir Mission Trust
Manju-ka-Tilla, Signature Bridge, Delhi- 110094

Location 3: Community Center, under Delhi Government, near Subhash Park,
Kilokari Village, Sunlight Colony, New Delhi- 110014

Location 4: RWA office in MCD Park, near mother dairy,
Sunlight Colony-2, New Delhi-110014

FUTURE SCOPE OF THIS PROJECT

Some of the donations received through online fundraising will be used in setting up future projects by the NGO in the rural villages of Himachal Pradesh and Uttarakhand. So far, I have received support from an MLA to install my device in his legislative assembly, but this is only the first step. He acknowledged that through these small initiatives, India's target of achieving Net Zero emissions by 2070 and meeting our 50% energy requirements from renewable sources would be achievable. I hope to pitch my idea to other influential and eminent government members for further installations.