Senior Design Project (231)
Cooling System for Solar Panel

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TEAM 22
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Elevator Pitch

Individual solar energy users and MOE face a problem with a waste of solar energy efficiency. SO FOR Individual solar energy users and MOE, WHO need to obtain the maximum efficiency from solar energy, ANASA IS A solar energy service THAT cools the solar panels. UNLIKE ACWA POWER, ANASA Increases the efficiency of energy production by at least 12.5%.

Objective

- Reduce dependency on oil
- Increase the use of clean energy sources
- Increase the efficiency of the PV solar panel energy production
- Balance between the cooling consumption and the energy produced

Constrain

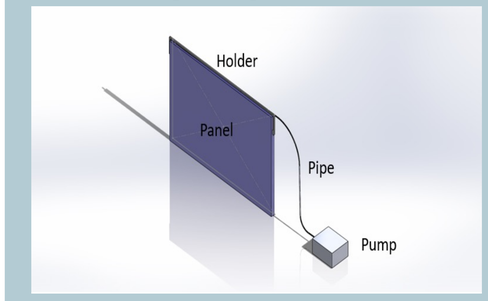
- Efficiency: Range of Temperature for solar panel should be between (25-35) °C to perform the best since it is the optimal range for energy production
- Budget: cost of the whole project doesn't exceed 6000SR which is budget allocated by university.
- The cost of operating the cooling system should not exceed the cost of the energy generated, which is 0.18SR per 1 kWh which is the selling price.
- The cooling system must not block the sun from the PV solar panel to ensure that the PV solar panel can absorb the sun light and produce energy effectively.
- The cooling system must be within the area of the PV solar panel.

Deliverables

- System design: A detailed design of the cooling system, including all the components, layout, and sizing. The design should meet the target specifications and the specific constraints of the project.
- System prototype: A working prototype of the cooling system. The prototype should be tested and evaluated to ensure that it meets the specifications.
- System performance analysis: A detailed analysis of the performance of the cooling system, including the temperature reduction achieved, the energy savings realized, and the operating efficiency.
- Economic \ cost analysis: An analysis of the cost-effectiveness of the cooling system, including the initial investment cost, operating costs, and energy savings.
- Recommendations: Recommendations for future research and development of solar PV cooling systems.

Design

Mechanical Engineering



Selecting pump:

$$\frac{P1}{\lambda}+\frac{V1^2}{2g}+z1+Hp=\frac{P2}{\lambda}+\frac{V2^2}{2g}+z2+hl$$

$$Hp=\frac{V2^2}{2g}+(z2-z1)+\sum hl$$

$$\sum hl=\frac{fLQ^2}{2gDA^2}=\frac{0.011*2.2*0.0004^2}{2*9.81*0.004064*(1.29717*10^{-5})^2}=28.6\ m$$

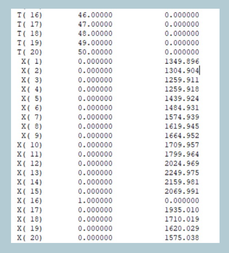
$$Hp=\frac{Q2^2}{2g*A^2}+(z2-z1)+\sum hl=\frac{0.0004^2}{2*9.81*(1.96*10^{-5})^2}+(0.67-0.25)+28.6=50.24\ m$$

$$Hp=50.24\ m$$
$$Hp=0.4926\ MPa$$

Industrial & Systems Engineering

Operation Research Model

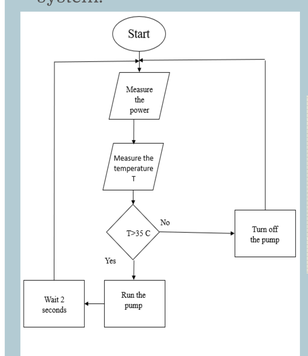
- Determining the optimal temperature to start cooling
- maximizing the energy produced
- minimizing water usage and energy consumed

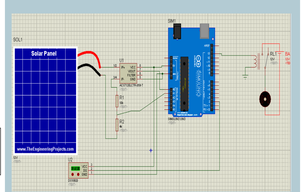


T(16)	46.00000	0.000000
T(17)	47.00000	0.000000
T(18)	48.00000	0.000000
T(19)	49.00000	0.000000
T(20)	50.00000	0.000000
X(1)	0.000000	1345.894
X(2)	0.000000	1304.904
X(3)	0.000000	1259.911
X(4)	0.000000	1259.918
X(5)	0.000000	1439.924
X(6)	0.000000	1484.931
X(7)	0.000000	1574.939
X(8)	0.000000	1619.945
X(9)	0.000000	1664.952
X(10)	0.000000	1709.957
X(11)	0.000000	1799.964
X(12)	0.000000	2024.969
X(13)	0.000000	2249.975
X(14)	0.000000	2159.981
X(15)	0.000000	2069.991
X(16)	1.000000	0.000000
X(17)	0.000000	1935.010
X(18)	0.000000	1710.019
X(19)	0.000000	1620.029
X(20)	0.000000	1575.038

Electrical Engineering

The role of electrical engineer in the team is build a control system.

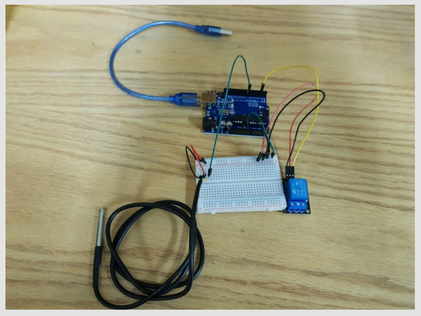




Real Prototype

Solar panel with nozzles

Control System



Specifications

Dimension:
- Dimension for cooling system pipe is 103 cm long and with diameter 0.71 cm

Temperature reduction:
- Decrease temperature of solar panel by at least 15 C

Efficiency improvement:
- Increase efficiency of energy production by at least 7.5%

Durability:
- Be able to operate for at least 10 years without major maintenance.

Cost of cooling system
- cost should be reasonable considering the energy generated