



**CALIFORNIA STATE SCIENCE FAIR  
2013 PROJECT SUMMARY**

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| <b>Name(s)</b><br><b>Alexander L. Chen</b>  | <b>Project Number</b><br><br>33524 |
| <b>Project Title</b><br><b>A Foldable Solar Panel with an Improved Hill Climbing MPPT Circuit</b>   |                                    |
| <b>Abstract</b><br><b>Objectives/Goals</b><br>This project aimed at developing a compact, foldable solar panel with an improved hill climbing (HC) maximum power point tracker (MPPT) to address the need for efficient and portable power generators. The solar panel could be reconfigured to produce different currents and voltages.<br><b>Methods/Materials</b><br>Instead of using low efficiency solar films, this project employed more efficient Si solar cells to construct the foldable solar panel. Two 6#x6# cells were serially connected and enclosed in a thin, transparent Plexiglas case to form a module. Eight modules were mounted on a fabric to form a panel. Modules were connected to one another by bullet connectors which made the panel reconfigurable. An MPPT circuit was design and assembled to control the solar panel voltage. It included a boost converter and a microcontroller which executed the improved HC algorithm developed in this project.<br><b>Results</b><br>Two solar panels were constructed. Each had a size of 3x7.5x14 cubic inches and weighed less than 8 pounds. They produced >60W of total power. The MPPT circuit achieved >98% of electrical power that could be achieved by manually optimizing the converter duty cycle. It showed fast and robust maximum power point tracking under rapidly changing light intensities.<br><b>Conclusions/Discussion</b><br>The results were significant because the solar panel design addressed many practical needs and the improved HC MPPT algorithm addressed the deficiencies of the popular perturb-and-observe algorithm with simple modifications. The solar panel can be used as power generators for outdoor events, campers, and dwellers in remote areas where grid power is not available. |                                    |
| <b>Summary Statement</b><br>High power, foldable solar panels and an improved hill climbing maximum power point tracking circuit were developed and successful operation of the system was demonstrated.  |                                    |
| <b>Help Received</b><br>Mr. Peter Starodub, my science research teacher, guided and monitored my progress throughout this science project. Dr. Richard Moyer has also provided much helpful guidance. My parents have supported me financially and stimulated my imagination.   |                                    |