Solar Cell Powered Solid-state Street Light [CP2-06]

Supervisor: Professor Philip Chan

Project Members:
- FU Ka Chung 04686802
- IM Tak Wai 04606682
- LEE Kin Fai 04691429
PROJECT OVERVIEW

Introduction
Photovoltaic panels are widely used, because the following advantages:
- Renewable energy sources
- Environmentally friendly
- Low/ no maintenance

Aim
In this project, a medium size solar cell powered streetlight (lawn’s beacon light) utilizing high power light emitting diodes (LED) was designed to instead of traditional electrical street light.
- To implement new generation lighting system
- Using an algorithm named Maximum Power Point Tracking

Block Diagram

System Block Diagram – Solar Cell Powered Solid State Street Light
IMPLEMENTATION

Implementation
PV modules still have relatively low conversion efficiency. A very common power tracking technique is Maximum Power Point Tracking (MPPT):
- Sensing the input voltage and power
- Adjust the boost converter’s duty cycle
- Achieve the solar panel having maximum power output

MPPT Algorithm

1. Set initial $V[k], I[k], P[k]$
2. Measure $V[k+1], I[k+1]$
3. Calculate $P[k+1]$
4. If $P[k+1] = P[k]$, then:
   - If $V[k+1] > V[k]$, then $D = D + dx$
   - Otherwise, $D = D - dx$
5. Else:
   - If $P[k+1] > P[k]$, then $V[k] = V[k+1]$ and $I[k] = I[k+1]$
   - Otherwise, $D = D - dx$
IMPLEMENTATION & RESULTS

Boost Converter
The output voltage can be calculated as \( V_{\text{out}} = \frac{V_{\text{in}}}{1-D} \).

Result

- Using a solar cell panel to collect and convert solar energy
- MPPT algorithm implemented by the boost converter with over 80% efficiency
- Using high-power LED light module provide around 100 lumens in each direction
- Electronic circuits to control the LED light module, day light sensing and dimming

Further Developments

- Using a motion detector to achieve power saving
- Two protection circuits - Over-voltage protection and Under-voltage switching) are included for safety issue