Photovoltaic (PV) Energy as Recharge Source for Portable Devices such as Mobile Phones

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Outline

• Motivation of the research
• Photovoltaic (PV) energy
• PV charger
  • conventional PV chargers
  • user requirements
  • improved PV chargers
• Conclusion
Motivation of the Research (1/2)

Solar radiation [kWh/m²]

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Motivation of the Research

Electricity Production

- Nuclear power 30%
- Natural gas 14%
- Coal and oil 12%
- Peat 8%
- Wastes 1%
- Water and wind power 23%
- Biomass 12%

35% renewables

Source: Statistic Finland, 2008

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Photovoltaic Energy (1/3)

I-V (Current-Voltage) curve

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Photovoltaic Energy (2/3)

I-V (Current-Voltage) curve

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Photovoltaic Energy (3/3)

P-V (Power-Voltage) curve

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Conventional PV Charger (1/2)
Conventional PV Charger (2/2)

USB $\rightarrow V_{DD,\text{in}}$ → battery → power converter → $V_{DD,\text{out}}$
Charging Requirements by Users

- focus on recharges during the day
- quick recharge favoured

Source: Ferreira et al. 2011

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Charging Capabilities

- AC Charger: 5.5 W
- USB 2.0: 2.5 W
- PV Charger: 0.5 W

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Problems (1/2)

- users require quick recharge
- about 10 times longer charging time with conventional PV charger (under ideal conditions)
Problems (2/2)

Worse than useless, 10 Oct 2011
By Marj "Marj" (UK)
This review is from: August SPC1500 Portable Mobile Phone Charger - Emergency 1500mAh Solar and USB Powered Battery for Mobiles / MP3 Players (Electronics)
I charged it up, and plugged in my Android phone, which showed a 33% charge. When I came back an hour later, the phone showed a charge of only 17%.
The most expensive torch I've ever bought.

Total Rubbish, 29 Aug 2011
By Susan
This review is from: August SPC1500 Portable Mobile Phone Charger - Emergency 1500mAh Solar and USB Powered Battery for Mobiles / MP3 Players (Electronics)
Although the item arrived promptly and well packaged the item did not work from day one.

Source: amazon.com
Improved PV chargers (1/4)

- photovoltaics with higher output power (about 5 Watt or higher)
- fulfil user requirements

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Improved PV chargers (2/4)

- use power converters and maximum power point tracking (MPPT)
- enhance and optimise degree of efficiency
Improved PV chargers \( (3/4) \)

- at least 19 different MPPT algorithms
  - type and amount of sensors
    (voltage, current, temperature, solar radiation)
  - costs
  - control complexity
  - convergence speed
  - power converter structure
  - periodic tuning

Source: Esram et al. 2007
Improved PV chargers (4/4)

- Voltage-based maximum power point tracking (VMPPT)

\[ \approx M_I \cdot I_{sc} \quad P_{mpp} \]

\[ \approx M_V \cdot V_{oc} \]

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Conclusion

• possible to recharge mobile phones with PV energy
• current conventional PV chargers do not fulfil user requirements
• battery capacity increases in future
• use more powerful photovoltaics with power converter and MPPT (with suitable algorithms for portable devices)

Nokia Lumia 920
2000 mAh (BP-4GW)
Thank you for your attention.

Do you have any questions?