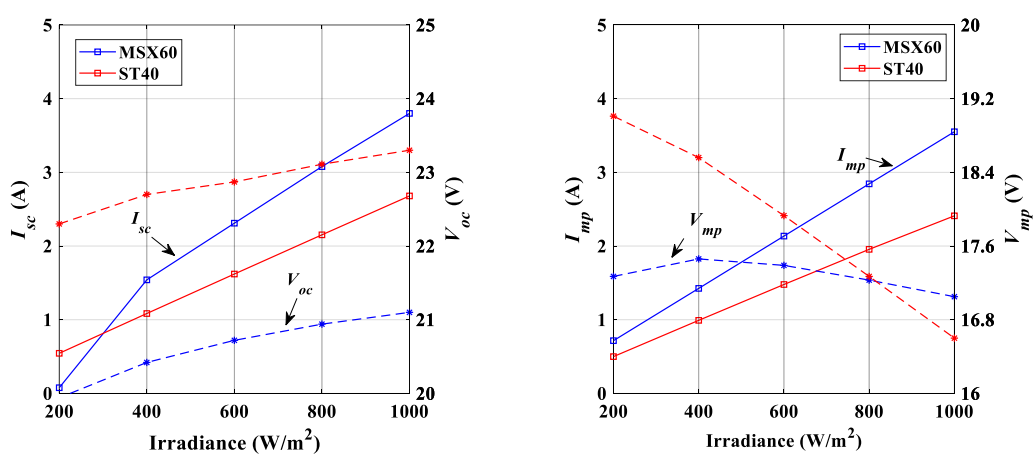
Supplementary material

Modeling and Simulation of Modified MPPT Techniques under Varying Operating Climatic Conditions

Doaa Khodair, Saad Motahhir, Hazem H. Mostafa, Ahmed Shaker, Hossam Abd El Munim, Mohamed Abouelatta and Ahmed Saeed

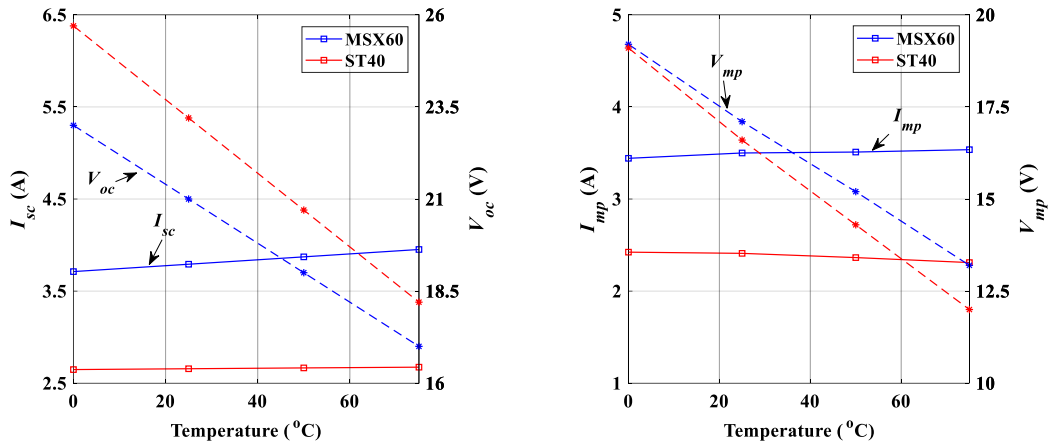
As demonstrated in Figure S1, the MSX60 and ST40 panels are regulated for different values of solar irradiance at a constant temperature of 25 °C. Here, both V_{oc} and I_{sc} are directly related to solar irradiation as evident from Figure S1(a). Hence, the panel current is mainly affected by the irradiance. Furthermore, PV panels are simulated for various temperatures at fixed irradiance (G = 1000 W/m^2) to present the temperature variation effect, where the obtained I–V and P–V curves are illustrated in Figure S2.

It is noted that when the temperature rises for fixed solar irradiation, the V_{oc} declines, and the I_{sc} marginally rises. Subsequently, the temperature change only impacts the PV panel voltage. With the rise in solar irradiance, the V_{oc} increases logarithmically, whereas the I_{sc} rises linearly and, consequently, an enhancement in the output power occurs. Another important factor in deciding solar cell performance and efficiency is temperature. As the temperature rises, both the photogeneration rate and bandgap decrease; hence, the reverse saturation current significantly increases. As a result, this causes minor changes in current and significant differences in voltage. The temperature harms solar cell efficiency and affects their performance. As a result, solar cells work best and fully perform on cold sunny days rather than hot sunny days.



(**a**) (**b**)

Figure S1. Solar Irradiance variation (at fixed T = 25 °C) impact on (a) V_{oc} and I_{sc} and (b) voltage and current at MPP.



(**a**) (**b**)

Figure S2. Temperature variation (at fixed G = 1000 W/m^2) impact on (a) V_{oc} and I_{sc} and (b) voltage and current at MPP.

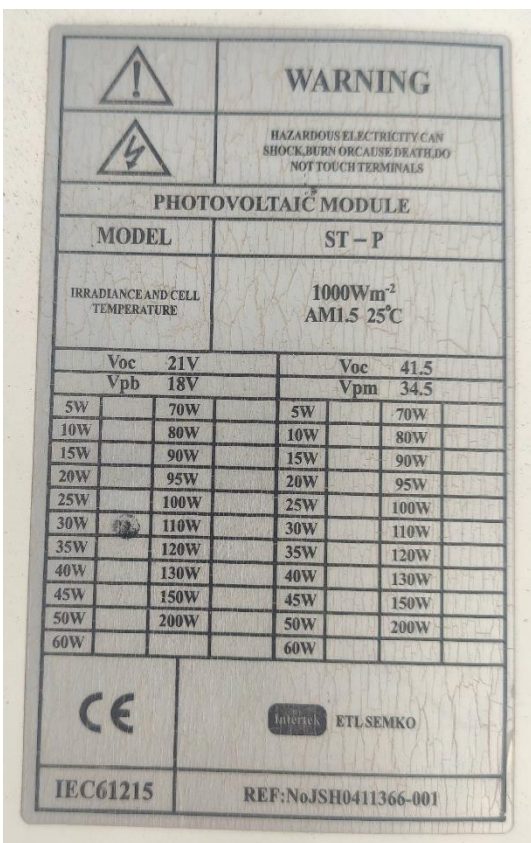


Figure S3. Datasheet of the PV module used in the hardware implementation.