PV modules operating under partially shaded conditions exhibit multiple peaks in their output power curves, which cause the majority of the maximum power point tracking (MPPT) techniques to become trapped in a local power peak. This unfortunately leads to additional energy losses that could otherwise be harvested if the global maximum power peak (GMPP) were correctly tracked. The available MPPT methods that are able to track the GMPP require periodic scanning of the PV curve, which disturbs the operation of the system and causes energy losses. A new MPPT technique is proposed in this paper that is distinguished by its ability to find the GMPP without the need for periodic curve scanning. The proposed method utilizes the mathematical model of the PV module, as well as the irradiances received by its PV cells, to analytically calculate the location of the GMPP. The required irradiances are innovatively estimated using an image of the PV module captured by an optical camera. The proposed method is also combined with the perturb and observe method to compensate for errors in the model or irradiance estimation. Experimental verifications are conducted to validate the effectiveness of the proposed MPPT method under various shading scenarios.