

WinSola

Cost Effective Adjustable PV Cleaning Robot

Dr. Amr Abdelkader

Motivation

The energy production of photovoltaic panels is strongly affected by many factors, such as wind speed and direction, solar radiation, shading, temperature, cleanliness, and air pollution, as well. Dust can accumulate during a certain period on the photovoltaic panels based on several environmental factors such as the type of dust, location, wind speed, percentage of air pollution, air humidity, as well as the installation of the solar power plant. Moreover, the tilt angle of the photovoltaic panel also affects the rate of dust deposition on its surface.

The efficiency of solar panels is affected by the size and weight of dust particles deposited on the surface of the panel. Several studies have shown that the smaller the size of the deposited dust particles, the more radiation is blocked on the surface of the photovoltaic module, and therefore, the more obvious the decrease in power output. Recent reports have indicated the development of hot spots on PV panels due to such soiling effect which will shorten the lifespan of the solar panels.

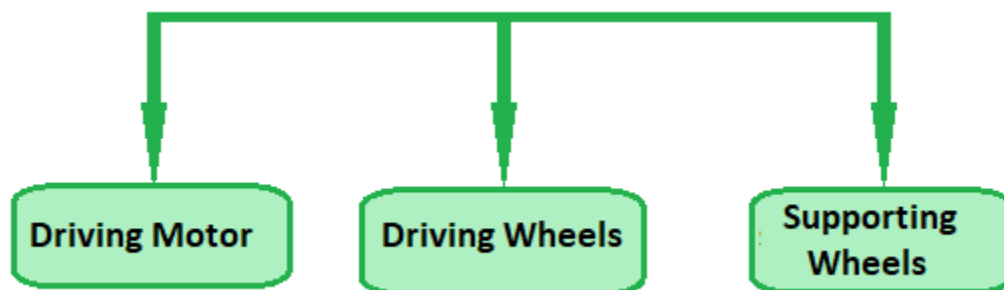
Actual measurements show that the problem of dust accumulation on photovoltaic panels is very severe in the Middle East and North Africa region. The monthly deterioration in efficiency because of the dust accumulation problem in Egypt can range from 11 to 17%, which means that the efficiency of photovoltaic panels can decrease by 50% in a period of 3 to 5 months, which indicates the need to clean photovoltaic panels, for maintaining efficiency and electrical energy production. Consequently, the PV soiling problem constitutes an area of increasing concern regarding the reliability of electrical energy production from solar panels. Therefore, removing photovoltaic panels dust is one of the main aspects of maintenance required to improve the performance of photovoltaic panels and increase their productivity.

System Brief Description

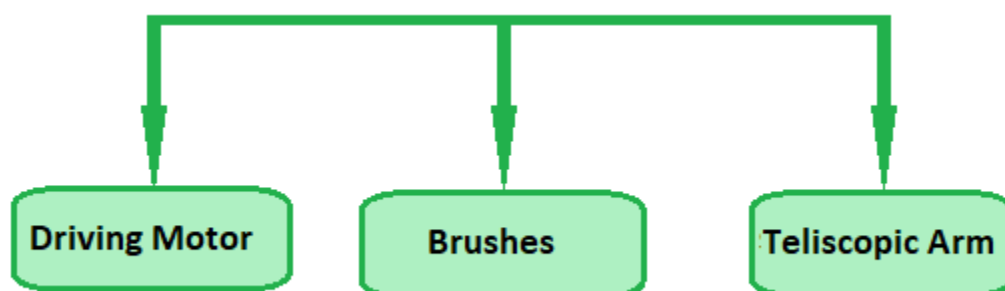
It is a cost-effective robot developed by WinSola that performs automatic dry cleaning of solar panels. It can be set and programmed to work on various dimensions of PV strings by employing a telescopic arm. Moreover, it can clean frameless PV panels. Cleaning is performed by soft nylon brushes that ensure effective cleaning without causing any scratches to the PV panels. The robot is equipped with two proximity sensors and a processing unit that allow the detection of the boundaries of the PV string. On the other hand, the processing unit can either stop the driving motor or reverse its direction of rotation for start another cleaning task. All driving motors are powered by a 24 volts lithium battery, alternatively, a PV panel could be integrated with the robot for continuous charging of the battery.

Main Subsystems of the Robot

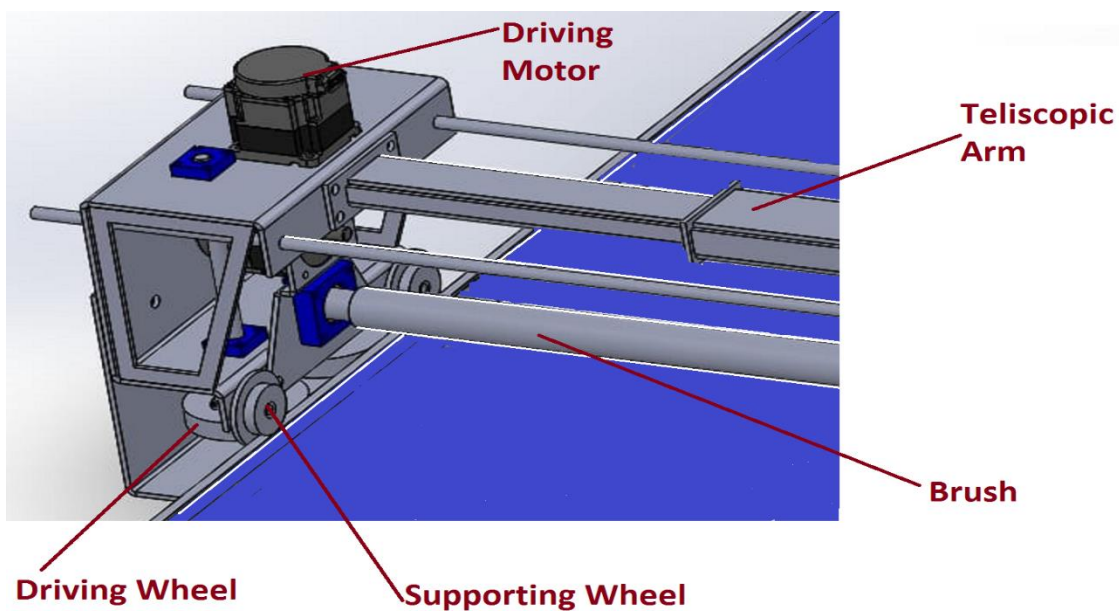
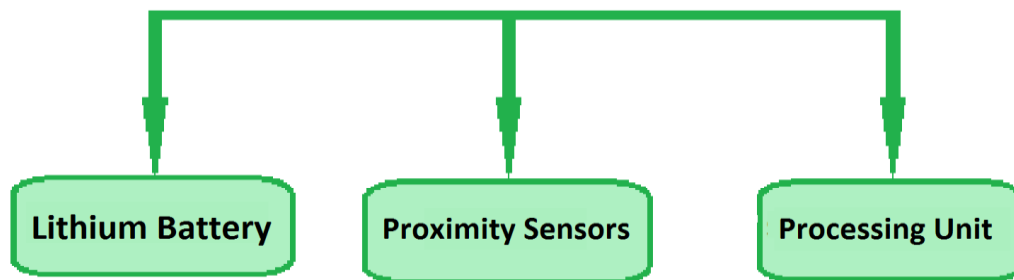
Driving Subsystem



Cleaning Subsystem



Power and Control Subsystem



Main Technical Specifications

Robot Travel Speed	: 10-12 m/s
Minimum String Width	: 1650 mm
Maximum String Width	: 3350 mm
Motors Power	: 100 watts
Motors Speed	: 200 r.p.m
Robot Overall Weight	: 30 Kg
Brushes Material	: Nylon