

# Automatic Cleaning of Solar Panel

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**Abstract-**Solar energy is the most abundant source of energy for all the forms of life on the planet Earth. It is also the basic source for all the sources of energy except Nuclear Energy. This paper aims at increasing the efficiency of solar power plants by solving the problem of accumulation of object on the surface of solar panel which leads to reduction in plant output and overall plant efficiency. It proposes to develop a Solar Panel Cleaning System which could remove the accumulated dust (or objects) on its surface on a regular basis and maintain the solar power plant output. This paper also aims to reduce the human involvement in the process of solar panel cleaning as it is a very hazardous environment for them in scorching sun.

**Keywords-** Cleaning, Liquid crystal display, Microcontroller, IR sensor , photovoltaic panel .

## I INTRODUCTION

### 1.1 Overview

There is urgency in improving the efficiency of solar power generation. Current solar panels setups take a major power loss when unwanted obstructions cover the surface of the panels. The obstruction turns the shaded cell into a resistor, causing it to heat up and consume extra power. To address this issue, we have successfully engineered a self-cleaning solar panel. This specific panel detects the obstruction with an object detection Unit. It makes the decision from the Microcontroller unit to either clean the panel with the Wiper and Sprayer Mechanism or continue to stay in idle state. Our mechanism to combat the power loss is unique, self reliant, and easy to use. With about 300 clear, sunny days in a year, the theoretically calculated solar energy incidence on India's land area is about 5000 trillion kilowatt-hours (kWh) per year. The solar energy available in a year exceeds the possible energy output of all fossil fuel energy reserves in India. The daily average solar power plant generation capacity over India is 0.20 kWh per m<sup>2</sup> of used land area, which is equivalent to about 1400-1800 peak (rated) capacity operating hours in a year with the available commercially-proven technologies. The accumulation of dust on the surface of the photovoltaic modules decreases the incoming irradiance to the cell and produces power losses. After the invention of the solar cell the solar Technology reached skies with the implementation of Solar panel which use the solar energy to generate electrical energy. The renewable energy usage is growing in all the areas

of industries etc; they use huge number of solar panels in the form of an array. In the same time due to the rapid growth in the robotic industry it has taken a place in everyday life and the industry too. Now the problem with the implementation of solar panels is their maintenance. The cleaning of dust particles on the solar panel is a huge job and a time taking process and requires lot of man power and money. To remove this limitation robotics is a good choice for no man operations, it also economical and autonomous as it requires no man to monitor.



Fig.1.1: Manual cleaning process

### 1.2 Objectives

- Design a mechanism to detect obstacles on solar panels causing significant loss of power.
- Improve overall solar panel efficiency.

This project aims at increasing the efficiency of solar power plants by solving the problem of accumulation of object on the surface of solar panel which leads to reduction in plant output and overall plant efficiency. It proposes to develop a Solar Panel Cleaning System which could remove the accumulated dust on its surface on a regular basis and maintain the solar power plant output.

## II LITERATURE SURVEY

Solar industry has shown an accelerated growth over the last decades, however solar panel cleaning and contingency planning has attracted very least amount of centre of attentions the author Vamsi Krishna et al, have explained the concept of clean the dust on the solar panel only during night time. M. Mani et al, have explained the Impact of dust on solar photovoltaic performance [1]. It provides an appraisal on the current status of research in studying the impact of dust on PV system performance. Kutaiba Sabah et al , have explained the Self cleaning solar panels to avoid the effect of accumulated dust on solar panels transmittance this research is a combination of two ideas. The first one is the idea of the reduction of the effects of accumulated dust on the flat solar

plate. The second one is using an auto-cleaning robot to reduce the accumulated dust[2]. J. Zorrilla-Casanova et al, have discuss the Analysis of dust losses in photovoltaic modules the objective of this work is to quantify losses caused by the accumulation of dust on the surface of PV modules .with this aim ,irradiance values measured by two mSi cells have been recorded every ten minutes during a year[3]. K.A Moharram et al, have explained the Influence of cleaning using water and surfactants on the performance of photovoltaic panels The objective of this research is to remove dust deposited on PV panels using the minimum amount of water and energy, in this research the influence of cleaning on the PV panels using water as well as a surfactant was investigated experimentally using non pressurized water system[5]. This is help us to study the influence of cleaning on the performance of PV panels. S.A. Sulaiman et al, have explain the Effects of Dust on the Performance of PV Panels in this two types of artificial dust; i.e. dried mud and talcum powder, were used instead of real dust to represent the dust accumulation. The use of natural dust accumulation was avoided because it might not be well distributed on the surface of solar PV panel, since it would be exposed naturally to the environment and the dust settlement could be subjected to the wind effect[8]. J.K. Kaldellis et al , have discussed Quantifying the decrease of the photovoltaic panels energy yield due to phenomena of natural air pollution disposal in this PV applications, gaining worldwide interest during the last years, comprise a promising renewable energy based solution, able to considerably contribute to the constantly increasing energy demand of our planet. Currently, residential applications possess a considerable share of the global PV market since fiscal and practical incentives have reinforced their promotion. [10]. A.M. Pavan et al, have explained the effect of soiling on energy production for large-scale photovoltaic plants. This can help us to study the operation and maintenance responsible in choosing the proper washing schedule and method for their plants and avoid wasting money and this work aims to evaluate the effect of soiling on energy production for large-scale ground mounted PV plants in the countryside of southern Italy. The results presented in this work show that both the soil type and the washing technique influence the losses due to the pollution.[11]

### III METHODOLOGY

Figure 1.1 shows the block diagram of Robust Automatic solar panel cleaning using robot. First it displays the message on Liquid crystal displays as welcome to solar panel clean then IR sensor detect the dust accumulated or object detected on panel, when there is no object is detected then IR sensor send logic 0 signal to the microcontroller and it display on LCD display as no object is detected. When object fall on solar panel then IR sensor sends logic 1 signal to the microcontroller and hence it displays on LCD display Object is detected and clean the panel. Microcontroller takes action by sprinkle the water on solar panel and it drives the drive mechanism with in control of limit sensor and make one complete cycle for cleaning .after further check IR module

check for dust on panel if it is clean then wait for dust to be accumulated as on cycle is going on.

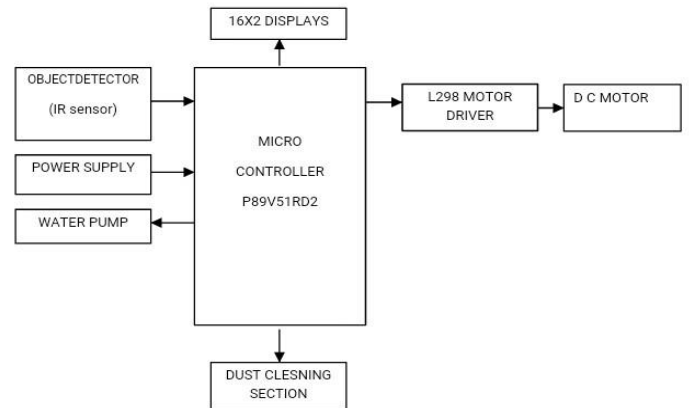


Figure 1.1 Block diagram

### FLOW CHART

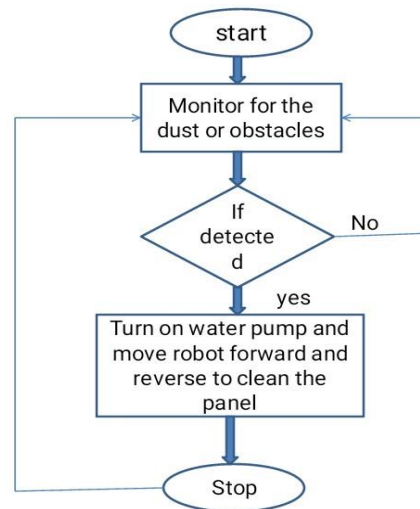


Figure 1.2 flowchart to clean solar panel

The flowchart of the program is as shown in the figure 1.2. The first step is to monitor the dust or obstacles (sea salt, bird dropping, pollen) on the solar panel and this obstacles detected by IR sensor. If obstacles detected then robot move forward and reverse to clean the panel. If no it will go to first step.

### 4.1.2 Steps for Programming

1. Select the Project from the menu bar.
2. Select New Project.
3. Give the File Name. A project with extension of .uv2 will be created
4. After giving the file name the device list windows opens.
5. Select the respective company's microcontroller IC that is going to be implemented in hardware.

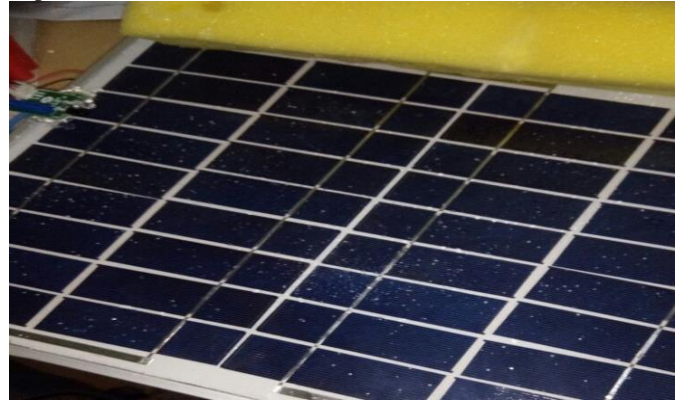
6. From the drop down arrow, we get a list of all the chips from that particular manufacturer. Choose the appropriate one.
7. Now the target is ready.
8. The data sheets and user manuals are automatically added.
9. Right Click on Target to view the options for Target 1.
10. The Target tab enables to give the Starting address and size of RAM and ROM. We also have to specify the frequency of the crystal used which in our case is 11.0592Hz.
11. The Output tab has the option to create the HEX file. Confirm the check box given beside it.
12. The A166 and C51 tabs shows the compiler options.
13. After the Target is created the source group is added to it.
14. Select the file menu and choose the 'New' option in it to get a page. Save the same with a .a51 or .asm extension. These assembler files are the ones recognized by the compiler.
15. Right click on source group and select add files to include the program. Select the assembler files created earlier and confirm the action. The selected files appear in the left-hand side project window.
16. These files will contain your actual program in assembly or in embedded C language.
17. Options for source group includes the compilers C51 and A51 paths.
18. Any number of sub programs can be added to source group.
19. To run the program right click on it and select Build Target. When you build an application with syntax errors,  $\mu$ Vision2 will display errors and warning messages in the Output Window – Build page. A double click on a message line opens the source file on the correct location in a  $\mu$ Vision2 editor window.
20. Then select rebuild all the target files too. With the Rebuild Target command, all source files are translated, regardless of modifications.
21. After the target is built, debugging is done.
22. After all the debugging the file is built again which creates a hex file. This hex file is then used to download to the microcontroller using a programmer kit.

### RESULTS AND DISCUSSIONS

This will give the overall results and conclusion of the proposed system.

### RESULTS

The result for different objects have taken and verified with expected result



### CONCLUSION AND FUTURE WORK

This paper highlights the effect of dust, dirt, pollen, sea salt, and bird droppings on the Photo voltaic systems efficiency. However, the development of the cleaning system can solve above those problems. The automatic cleaning system is an innovative technology used to clean the accumulated dust, dirt, pollen, sea salt and bird dropping on the solar panel. It reduces the human interference and in future it may have scope to detect more obstacles i.e. oil, snow fog, soil.

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