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SOLAR PANEL CLEANING BOT

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Abstract:

The Solar Power is the most abundantly available energy available on the Earth and depletion of current non-renewable sources has led to the need for efficient harnessing of this source. The Solar Panels used for the purpose are open to the environment and hence would frequently get obscured by dust and other impurities. The current methods used are risky and uneconomic hence the proposition of a "Solar Panel Cleaning Bot" is made. This doesn't require human intervention and is economic and is studied in the following paper.

Index- Introduction, Proposition, Design, Results, Future Scope.

I. INTRODUCTION

Solar photovoltaic (PV) system uses solar cells to convert energy obtained from the sun's radiation into electrical power. The system is made up using one or more panels, a battery, a charge control and the load. Solar PV panels are normally mounted on roofs and wired into a building by an inverter, which converts the direct current energy received from solar panels into alternating current. There are many types of solar PV cells available, which are mainly mono-crystalline silicon cells, multi crystalline silicon cells, thick film silicon, and amorphous silicon. The application of solar

energy has become wider, with the solar photovoltaic industry's combined global revenue of US$37 billion in 2008. Photovoltaic array installations are becoming more prevalent around the world. Each of these solar parks has an expected life-time of 20 – 25 years, and it is important to increase the power generating potential during daily service. The accumulation of dust particles and debris on the surface of photovoltaic panels has a negative effect on the performance the same way as if on a cloudy day. This is especially problematic in arid, dusty environments. Thus there is a need for an automated ing solution to this problem which can service large ground based solar arrays up to an operating park of 22,000 panels (20,000 square meters).

The impact of dust deposition can be clearly understood from following graph [2]. For different sizes of dust the solar power starts reducing and bends toward left side clearly indicating the loss of power. The Solar Panels can convert only 25% of the radiant energy and deposition of dust on the panels further drops this efficiency.

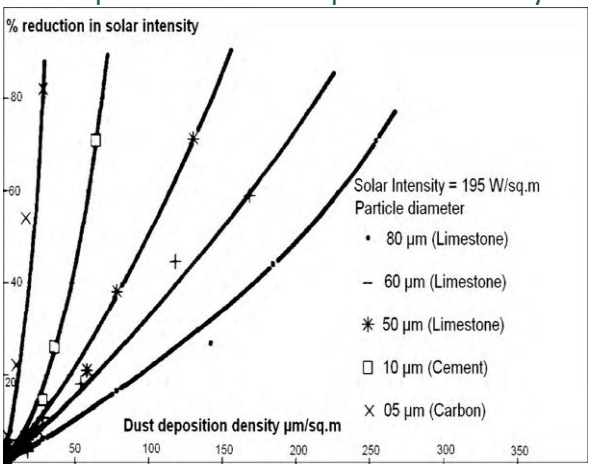

Fig 1 Solar intensity reduction in response to dust deposition

NASA uses solar cells to power many of its satellites, spacecraft, and extraterrestrial rovers there is no cleaning method in place for its extraterrestrial craft. The Mars rover in particular has to operate in harsh dusty climates. NASA has researched the decreased efficiency due to dust and buildup in relation to number of days on Mars. For a 30 day mission they account for 52.2% power loss, over 2 years they account for 89% power loss. NASA also recently announced that an unexpected Martian wind partially cleaned dust off of the Martian rover's solar panels and significantly boosted the panels' electrical output.

II PROPOSITION

The above mentioned problem can be easily solved by just simple cleaning of panels on daily basis. Solar energy generated now is on very high scale and human intervention is uneconomic and difficult. The panel cleaning is already done with the help of water tank loaded trucks for large farms and at home people clean these panels at their own. Another idea has taken form-"Solar Panel Cleaning Bot". This bot doesn't require a human intervention and are economic. The Bot will have an arm, rotatable and connected to brush through a geared motor and stick arrangement.

III DESIGN

The design of the Bot is made around the following block diagram.

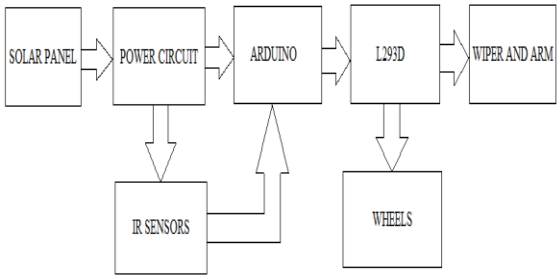

Fig 2 Block diagram

IC 7805

7805IC is a voltage regulator IC and is a member of 78xx series of fixed linear voltage regulator ICs. The voltage source in a circuit usually has fluctuations and may not give the fixed voltage output. A **voltage regulator IC** maintains the output voltage at a constant fixed value. The xx in 78xx is nothing but the fixed output voltage that it is designed to provide. Likewise 7805 provides +5V regulated power supply.

IR SENSOR

A light sensor, as its name suggests, is a device that is used to detect light. There are many different types of light sensors, each of which works in a slightly different way. A photocell or photoresistor, for example, is a small sensor that changes its resistance when light shines on it; they are used in many consumer products to determine the intensity of light. A charged coupled device (CCD) transports electrically charged signals, and is used as a light sensor in digital cameras and night-vision devices. Photomultipliers detect light and multiply it.

L293D IC

L293D is a Motor driver or Motor Driver IC which allows DC motor to run on any direction. L293D is a 16-pin IC which has ability to control a set of two DC motors at same time in any direction. It means that we can control two DC motors with a single IC, unlike ULN Driver. It's a Dual H-bridge Motor Driver integrated circuit (IC). The l293d can drive small and big motors as well.

It can be found in any electronic shop very easily and it costs around 70 Rupees (INR) or even less. You can find the necessary pin diagram as follows.

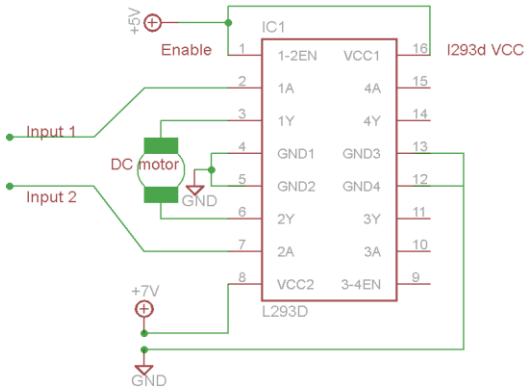

Fig 3 L293D Motor Driver IC

ARDUINO

Arduino is a single-board microcontroller, used to make the application of interactive objects or environments more available. It has an open-source hardware board designed around an 8-bit Atmel AVR microcontroller, or a 32-bit Atmel ARM. The on-board microcontroller is pre-programmed with a boot loader that will help upload of programs into our microcontroller very easy with no chip needed. Arduino boards can be purchased pre-assembled or as do-it-yourself kits.

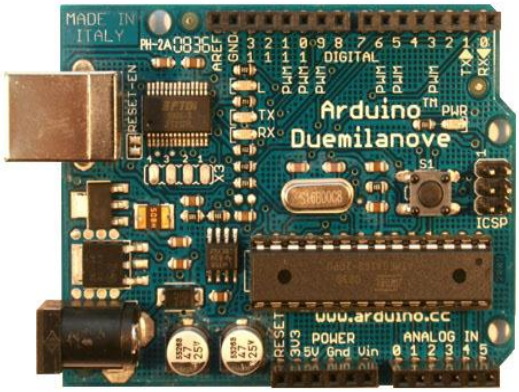

Fig 4 Arduino Board

LM358 IC

It is a Dual Op-Amp IC with high gain, frequency compensated operational amplifier with single power source. This can power our motors utilizing the signals from Arduino.

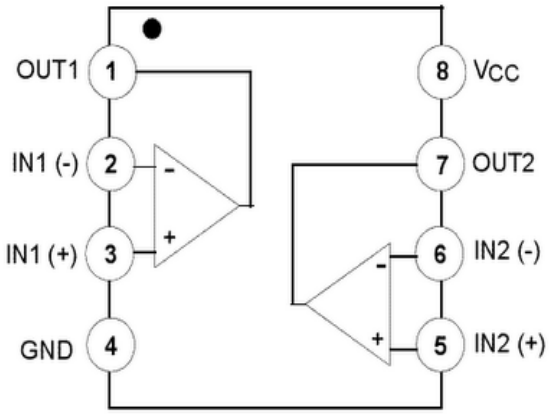

Fig 5 LM358 IC Pin Diagram

DC GEAR MOTOR

Geared DC motors can be defined as an extension of DC motor. A geared DC Motor has a gear assembly attached to the motor and the speed of motor is counted in terms of RPM. The gear assembly helps in making the torque and the speed variations with inverse relation. Utilizing the right combination of gears in this motor, its speed can be decreased to any desirable level. The concept of decreasing the speed and increasing the torque by using different gear combinations is called gear reduction. This motor will help to run our bot's four wheels, arm and wiper.

The heart of the Bot is Arduino Duemilanove. This controls every motion of the Bot and takes input from the four IR sensors pairs connected at front bottom the bot. The IR sensors are placed to apply line follower technique and are supposed to provide the outputs at its receiver sensor based on following track.

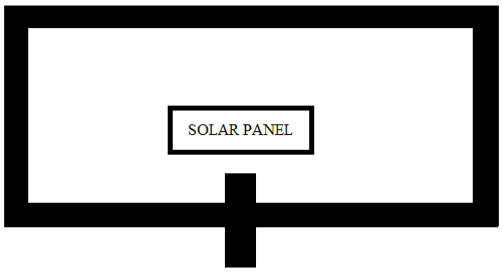

Fig 6 Line follower track

We place two LM358's to take inputs from these sensors (two pairs to each LM358 IC) and their outputs are given to Arduino. The Arduino is pre-programmed to take these outputs at its digital input pins. After analyzing these inputs the Arduino checks with commands in its program and reaches on a conclusion whether to move the bot forward (if IR Sensors are on line) or stop the bot (at the black patch on track laid). If bot is stopped at the black patch the Arduio would go into a loop for cleaning the panels of pre-specified size. The bot is featured with a duster to clean the panel and further changes can be made in accordance with the need like water based cleaning, vaccum cleaning etc. After a delay the bot will be moved out of the black patch and will be back into line following mode. Thus completing the cleaning the panel. The final

image of the bot as prepared is shown below for reference.

Fig 7 Solar Panel Cleaning Bot

Likewise a number of panels can be placed along the line and bot will be cleaning these simply by following the line and black patch logic.

IV RESULTS

The panel cleaning bot delivers the best results of cleaning the panels. The efficiency of the panels is restored to its normal level. The track has a black line which has some black patches at some spots. The black line is the one along which we assume the solar panels to be placed. The black patches indicate that the panel is available from this point forth; hence the program would stop the bot and clean the panel with its wiper. This is achievable and would indicate the success of our project. The bot is programmed to wait for fixed period of time once it comes on a black patch and then automatically take the bot forward so it can move out of the black patch and keep following the line to reach the next panel.

V FUTURE SCOPE

A bot of this kind can clean a complete solar farm as and when required. Further exciting features can be added into our bot like de-ionized water cleaning, camera for inspection and climate based cleaning. The major advantage that we acquire is of inspecting the farm with the help of this bot. also this bot in future will become more compact and light with the booming technology and would be further cheap. As these bots can be used by a layman as well their services would be further required at homes when homes will be lightened by Solar Panels. Thus giving a very good scope in future.

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