1. INTRODUCTION

1.1. Overview:

Currently, many alternative energy sources appear to be technically useful. One of them is solar energy. The panels are the fundamental solar-energy conversion component. Conventional solar panels, fixed with a certain angle, limit their area of exposure from the sun during the course of the day. Therefore, the average solar energy is not always maximized. Sun-tracking systems are essential for many applications such as thermal energy storage systems and solar energy based power generation systems in order toimprove system performance. The system always keepsthat the plane of the panel normal to the directionof the sun. By doing so, maximum irradiation and thermal energy would be taken from the sun. The elevation angle of the sun remains almost invariant in a month and varies little (latitude ± 10°) in a year. Therefore, a single axis position control scheme may be sufficient for the collection of solar energy in some applications. In flat-panel photovoltaic (PV) applications, trackers are used to minimize the angle of incidence between the incoming sunlight and a photovoltaic panel. This increases the amount of energy produced from a fixed amount of installed power generating capacity. In concentrated photovoltaic (CPV) and concentrated solar thermal (CSP) applications, trackers are used to enable the optical components in the CPV and CSP systems. The optics in concentrated solar applications accepts the direct component of sunlight light and therefore must be oriented appropriately to collect energy. Tracking systems are found in all concentrator applications because such systems do not produce energy unless pointed at the sun. [1]

Global power consumption currently stands at approximately 15 TW (1 TW = 1012 W), the vast majority of which is generated by the combustion of fossil fuels. The associated release of CO_2 from these anthropogenic sources has dramatically altered the composition of the atmosphere and may detrimentally impact global temperature, sea levels, and weather patterns. The terawatt challenge is the effort to supply up to 30 TW of carbon-free power by the mid 21st century.1 Assuming that all this power will be supplied by photovoltaics (PV) and the lifetime of solar cells is 30 years, this translates to PV production of ~ 1 TW/year. While all renewable resources will be important, only solar can meet this level of demand. The practical global potential of other renewable energy sources such as wind, hydroelectric, biomass and geothermal is estimated to be less than 10 TW.2 Of the >105 TW of sunlight hitting the earth, it is estimated that harnessing up to 600 TW is technically feasible. Solar energy may be harvested through its conversion to heat (solar thermal), electrons (PV), or chemicals (solar fuels). The former is perhaps the most straightforward, with installations ranging in scale from 1 kW household water heaters to 50 MW power plants located in areas of high solar insolation.3 Common approaches to solar fuels include the photoelectrochemical splitting of water to produce H_2 and the reduction of CO_2 into liquid fuels such as methanol.4 Solar fuels remains the least developed strategy to harness solar energy, and is currently the focus of renewed efforts at the basic research level. [3]

The subject of this article is solar photovoltaics, which has been growing at an average rate of >40% per year over the past decade, with annual shipments exceeding 8 GW in 2009. That number is projected to double in 2010. Moreover, the market is poised 4 for further expansion in the next decade as PV transitions from a subsidized commodity to one that provides outright economic advantage. Figure 1 compares the levelized cost of solar electricity with that produced by conventional sources. In 2009, the average cost of grid-supplied electricity in the

United States was 9.5 ₵/kWhr, and this value will continue to rise due to increased demand or at potentially higher rates if measures such as carbon taxation are introduced. The current price of electricity generated using solar cells remains 2 to 3 times greater than grid-supplied electricity, but PV costs continue to decrease. A crossover, commonly called "grid-parity", is expected sometime during the next decade. In fact, grid parity has been reached in areas such as Southern California where solar insolation and the marginal cost of electricity are high. We also note that projected grid-parity does not require any technological breakthroughs, but is simply an extrapolation of the learning curve that the PV industry has been following for several decades, along with the inevitable increase in the cost of fossil fuel derived electricity.[6]

Despite this amazing success, PV manufacturing must be further expanded by two orders of magnitude to TW/year production levels in order to transform our society from one that relies on burning fossil fuels to one that uses sustainable energy sources. The challenge is daunting, but the opportunities are equally boundless. The sun continuously provides power to the planet with an average flux of 1000 W/m^2. If one assumes 10% net conversion efficiency (generation, transportation, storage), ~10^{12} square meters would be required to supply 30 TW of clean energy. Assuming 30 year panel life times, this translates into the production of ~5 x 10^{10} m^2/year. To put this number in perspective, the global production of all flat glass, which is currently dominated by the construction and automotive sectors, is about 6 x 10^9 m^2/year. Glass is an appropriate comparison since it 45 is common to the majority of current PV platforms, accounting for a substantial fraction of the weight and cost of PV panels. [2]

In May 2010, the United States National Science Foundation (NSF) organized a workshop on the theme of catalyzing innovation in PV manufacturing to help address the challenges described above. The workshop was co-sponsored by four divisions including Chemical, Bioengineering, Environmental, and Transport Systems, Industrial Innovation and Partnerships, Chemistry, and Materials Research. The objectives of the workshop were as follows.

• Identify the potential technologies and innovations that offer *low-cost, high-conversion-efficiency and sustainable* photovoltaics materials.

• Determine the current and potential technical challenges in preparation and/or manufacture of above photovoltaics materials.

• Facilitate effective and efficient collaborations between small businesses and universities or large companies in the efforts to overcome these challenges.

The event was organized and hosted by Colorado School of Mines in Golden, Colorado. To address this diverse set of goals 60 leaders were invited, with nearly equal representation between industry and academia. Scientists from National laboratories including the National Renewable Energy Laboratory (NREL) and the National Institute of Standards and Technology (NIST) were also present. A full list of participants, topics, and presentations from the workshop are available online.7 In this article, we highlight the major outcomes of the workshop. They begin by briefly summarizing the current status of PV manufacturing, and then assess the major 6 challenges and opportunities with respect to the major PV manufacturing technologies. The aggressive goal of TW/year production capacity necessitated the discussion of the important issue of materials availability for existing technologies. Lastly, recommendations are made for research investment, with an emphasis on those areas that are expected to have cross-cutting impact. [7]

This project aim to step forward the sun energy as an alternative energy source. SUDAN is a sunny country, thus building this system will make the use of maximum sun energy during the day and moreover during the year.

1.4. Problem statement:

The fixed amounting of solar reduces saving of sun energy by a great amount, the curve of sun energy absorption appears with a hump at midday. As a result the output voltage of a solar panel with ratings 36W~3A varies from 3V~18V, the DC regulator connected can maintain 14V output for the range 10V~18V i.e. during the hump.

That with single axis does not senses the travelling of the sun from north to south and back during the year.

The dual axis tracker takes time to adjust the panel on the correct position.

1.5. Proposed solution:

The proposed solution is by design a control circuit as sun tracking system that can correctly adjust the panel in a very short time , increase the hump time and sensing maximum sun energy, by using PID controller.

1.6. Objective:

The main objective is to design a sun tracking system to utilize the maximum solar energy through solar panel. To achieve this objective:-

1. A control circuit for tracking the sun using sensors will be proposed.
2. Control algorithm will be used so as to minimize the error.
3. Simulation of the proposed system will be run.

4. Implementation of a pro-type system will be done
5. Performance evaluation for the system will be done

The proposed system should satisfy the following points:-

1- Minimum energy consumption, through the maximization of global efficiency of the installation and optimum performance-cost ratio.

2- Reliability in operation, under different perturbation conditions (wind, dust, rain, important temperature variations).

3- Simplicity of movement solution (motor, gears, sensors), to diminish thecost and to increase the viability.

4- Possibility of system integration in a monitoring and control centralizedstructure, which means a digital control solution.

1.7. Scope:

The system covers controlling of circular or linear motion along the X and Y coordinates. A **solar tracker** is a device that orients a payload toward the sun. Payloads can be photovoltaic panels, reflectors, lenses or other optical devices.