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Design, Structural Analysis and Implementation of Photovoltaic Dual-Axis Solar Tracking System

Mohammed. Ahmed[1], Syed Azam Pasha Quadri[2]
[1]*M.Tech Student,* [2]*Assistant Professor, Me Dept Lords Institute of Engineering & Technology*

Abstract: ***Keeping in mind the end goal to meet the planet's developing energy needs while constraining carbon emission levels, the utilization of clean energy is vital. One such energy source is the sun. Saddling the energy of sunbeams and hand over it into power is finished utilizing photovoltaic cells. In any case, since the efficiency of these cells is at most 25%, researchers have planned concentrated photovoltaic tracker frameworks, which can achieve record level sunlight based efficiencies of 46% (Fraunhofer, Soitec). This task contemplates the impact of twist stacking on a sun based panels and presumes that it is steady at wind speeds achieving 30m/s and for a tilt edge of 80°.***
Fabrication Model In the setup of the hardware for the more prominent utilization of this project, the LDRs must be put on the surface of a substantial shape. What's more, the instrument ought to be done as such that any prompt two LDRs stay dynamic at once. What's more, the stepper motor will take after the bit example of the and the sunlight based panels associated on the pole of the GEAR MOTOR will dependably face the sun ordinarily. The LDR combination assumes the crucial part. As a matter of fact these combinations of signals are nourished to the microcontroller 8051 and this coordinates the motor related to it.
Keywords: CFD Flow Simulation, Dual axis solar tracker, 8051 board, LDR Sensors, dc gear motor,

I. INTRODUCTION

A standout amongst the most encouraging renewable energy sources portrayed by a gigantic capability of change into electrical power is the sun based energy. The change of sun based radiation into electrical energy by Photo-Voltaic (PV) impact is an exceptionally encouraging innovation, being perfect, quiet and dependable, with little support expenses and little biological effect. The energy for the Photo Voltaic change frameworks is unmistakably reflected by the exponential expansion of offers in this market territory with a solid headway projection for the following decades. According to late Statistical Reviewing Reports did by European Photovoltaic Industry Association (EPIA), the total presented energy of PV change equipment extended from around 1 GW in 2001up to very nearly 23 GW in 2009.The relentless progression of the development chose an oversaw addition of the change adequacy of PV panels, yet in any case, the most bit of the business panels have efficiencies near 20%.A consistent research distraction of the specialized group associated with the sunlight based energy tackling innovation alludes to different answers for increment the PV panels change effectiveness. Among PV effectiveness enhancing arrangements we can say: sun oriented following, streamlining of sunlight based cells geometry, improvement of light catching ability, utilization of new materials, and so on. The yield control created by the PV panels depends firmly on the episode light radiation. The ceaseless adjustment of the sun-earth relative position decides a persistently changing of occurrence radiation on a settled PV panels. The purpose of greatest got energy is achieved when the bearing of sun powered radiation is opposite on the panels surface. In this manner an expansion of the yield energy of a given PV panels can be acquired by mounting the panels on a sunlight based GPS beacon that takes after the sun direction. Dissimilar to the established settled PV panels, the versatile ones driven by sun powered trackers are kept under ideal insulation for all places of the Sun, boosting hence the PV transformation effectiveness of the framework. The yield energy of PV panels outfitted with sun powered trackers may increment with various percents, particularly amidst the pre-summer when the energy saddled from the sun is more essential. Photo-Voltaic or PV cells, insinuated ordinarily as sun powered cells, change over the energy from daylight into DC power. PVs offer included purposes of enthusiasm over other renewable energy sources in that they transmit no uproar and require in every way that really matters no upkeep. A following framework must have the capacity to take after the sun with a specific level of precision, restore the gatherer to its unique position by the day's end and furthermore track amid times of cover over.

II. BACKGROUND

A Solar Tracker is a gadget onto which sun powered panels are fitted which tracks the movement of the sun over the sky guaranteeing that the most extreme amount of daylight strikes the panels for the duration of the day. The Solar Tracker will endeavor to explore to the best point of introduction of light from the sun. This report expects to give the peruser a chance to

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comprehend the undertaking work which I have done. A short preface to Solar Panel and Solar Tracker is cleared up in the Literature Research portion. Basically the Solar Tracker is parceled into two essential classes, gear and programming. It is also subdivided into six guideline functionalities: Method of Tracker Mount, Drives, Sensors, RTC, Motors, and Power Supply of the Solar Tracker is similarly elucidated and explored. The peruse would then be brief with some analysis and impression of the information.

III. LITERATURE RESEARCH

Energy is a property of articles, transferable among them by means of basic associations, which can be changed over into various structures yet not made or demolished.

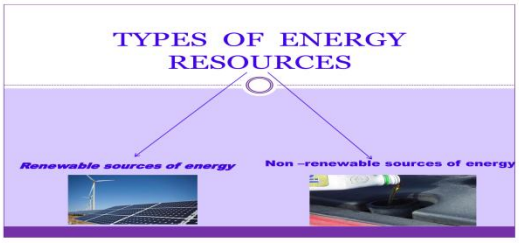


Fig: 2.1. Renewable energy

Renewable energy is all things considered described as energy that begins from resources which are ordinarily revived on a human timescale, for instance, light, wind, rain, waves and geothermal warmth.
Renewable energy replaces traditional energizes in four unmistakable regions: generation of electricity, high temp water/space warming, motor fuels, and rural(off-grid) energy services.



Fig: 2.2. Renewable resource forms

A. Block Diagram

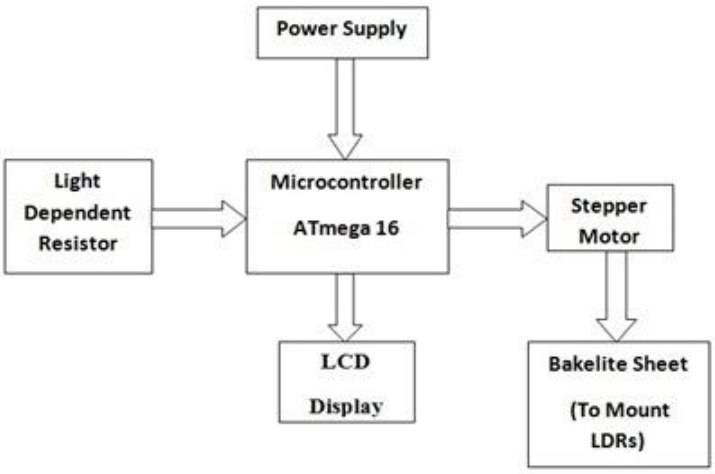


Fig 3.1 Block Diagram of Project

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B. Schematic Diagram

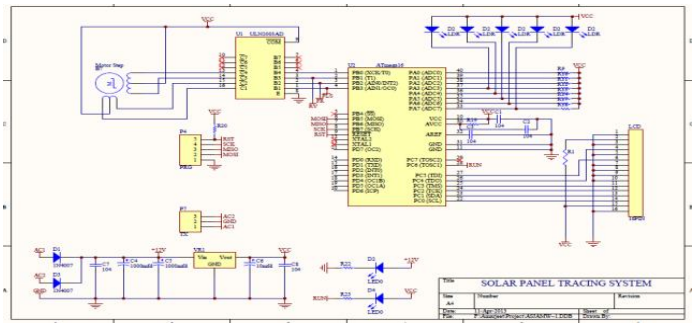


Fig 3.2 Schematic Diagram of Project Experimental Dual Axis Solar Tracking System

IV. EXPERIMENTAL SETUP

"Fig. 1." demonstrates the total set-up of the structure of sun following framework. Here the entire structure and its segments rundown and costs are depicted in the "Table 1". The structure contains Solar-Cells plate, Stand, Gears, Motors, Electrical Circuit and different frill. Here the component of the two hub framework is appeared into the "Fig. 1.(a)", here the structure can be turn in two hub as from its hub opposite to the earth and other is parallel to the earth. In "Fig.1. (b)", the total setup is appeared and the total get together with circuit is appeared. There are a few sorts of Dual Axis Solar Tracking System [7]. Here as the development demonstrates that there is two sort of movement of the panel, so that amid the day era it will takes after the sun as indicated by the sensors and power is put away to the battery [8] and amid the night it will close down also and in the wake of turning around the panel it will again went to its underlying position.

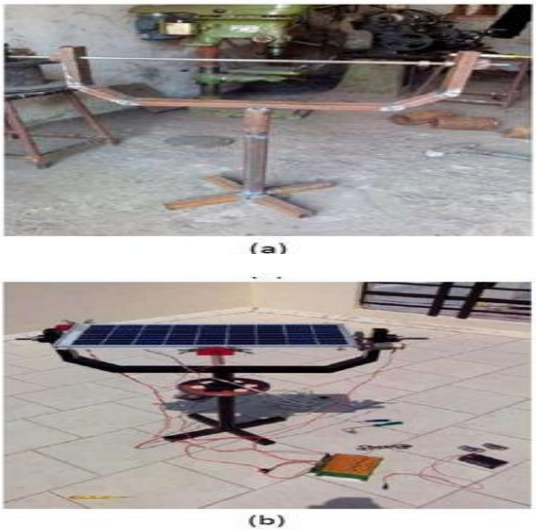


Fig.5.1. (a) Initial Structure of the system mechanism (b) Final Structure of the System



Fig.5.2. 8051 Flasher Panels

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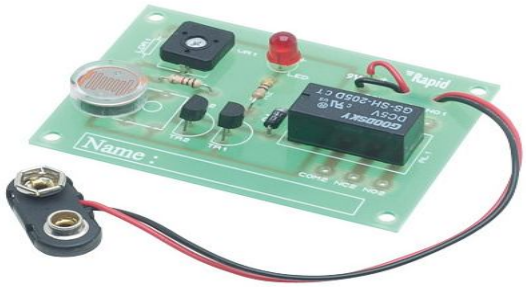


Fig.5.3. ldr circuit panels

Here the setup contains the motors, circuit, structure, sensors and so forth so as the framework is beginning than the tracking is occurred and sun is trailed by this way [9]. As the LDR sensors are faculties the solar radiation power with the goal that the circuit is faculties the initiation code as indicated by pre-setup of the solar force and it will beginning the motors and ran the motors. Here the plan is finished by the prerequisites power and setups [10]. We have outline this framework as indicated by the setup prerequisites and tallness and material accessible premise. The plan has mainly influenced by the enhancement. So as make minimal effort the points of interest are altered and influenced the task to work. By utilizing this technique the sparing of cash assume an essential part in it as well.

V. COMPONENT WIND STABILITY ANALYSIS

The outcomes get from the test examines on the framework; it can be communicated in the few courses as by the diagrams, tables, correlations of the outcomes get from the examination, legitimate considering, and so on [13]. Here we can express our outcomes by utilizing the diagrams of the outcomes as: Voltage V/S Time, Current V/S/Time, Power V/S Time, Comparison of the distinctive outcomes with each other. Those outcomes demonstrate to us the real shot of the framework and centrality too of the double tracking framework.

Altogether, three assemblies were assembled. The first had the panels settled at 0° from the flat. The second was at 45° from the flat, and the third was at 80° from the level, since alternate segments of the tracker keep the get together from achieving 90° flawlessly. The 31 just changes that were made for every gathering were the velocity of the wind amid each CFD Flow Simulation. The simulations took approximatively 3 hours by and large to process and explain. Aftereffects of the simulation were bundled in view of the velocity of wind following up on the tracker. .

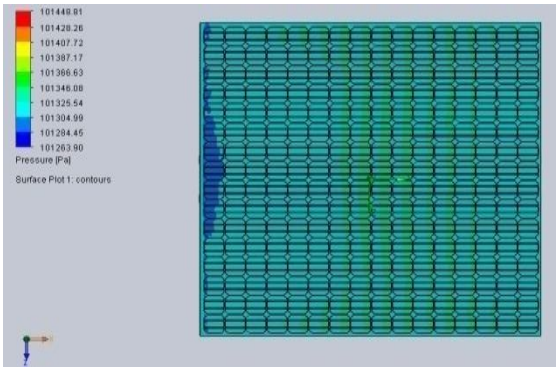


Fig: 7.1 Top Views

only changes that were made for each assembly were the velocity of the wind during each CFD Flow Simulation. The simulations took approximatively 3 hours on average to compute and solve. Results of the simulation were bunched based on the velocity of wind acting on the tracker.

A. Simulation results

At 7.5 m/s:

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For the panel at a 0° from the horizontal

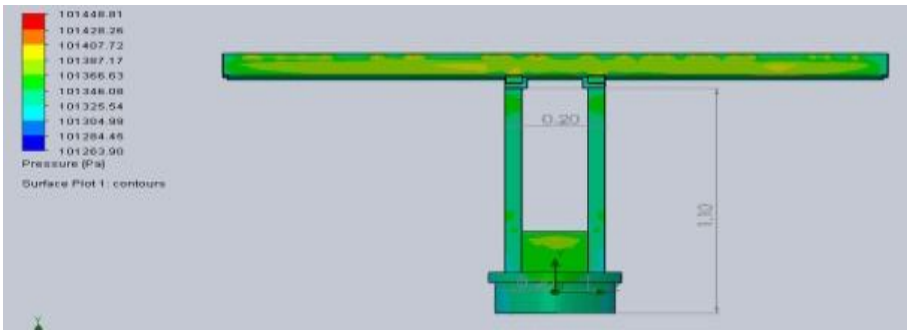


Figure: 7.2. Front View

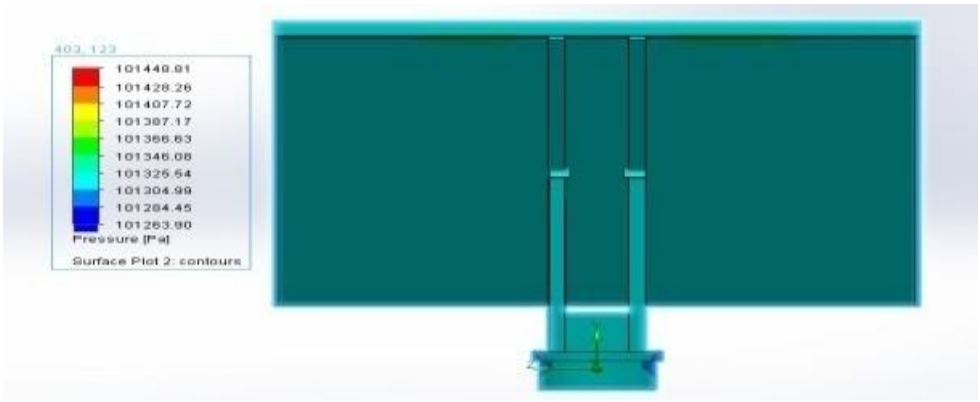


Figure: 7.3. Rear view

For the panel at 45° from the horizontal

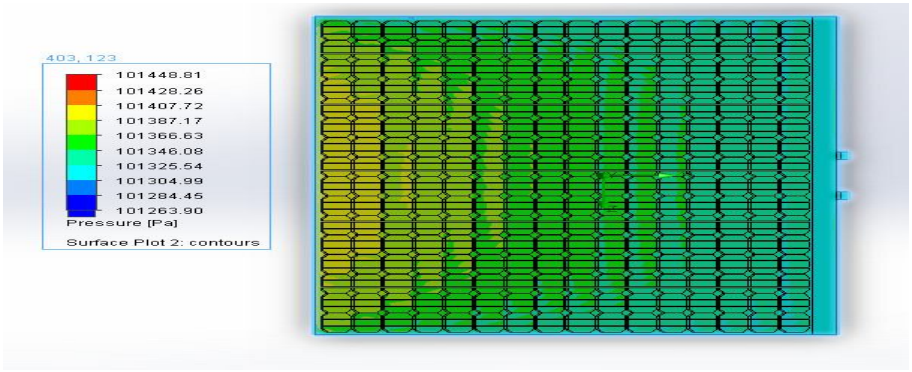


Figure7.4. Top view:

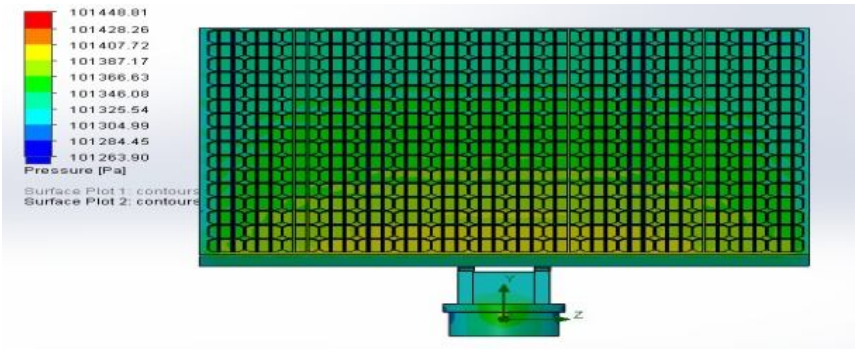


Figure:7.5Front view

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Figure7.6. Side view

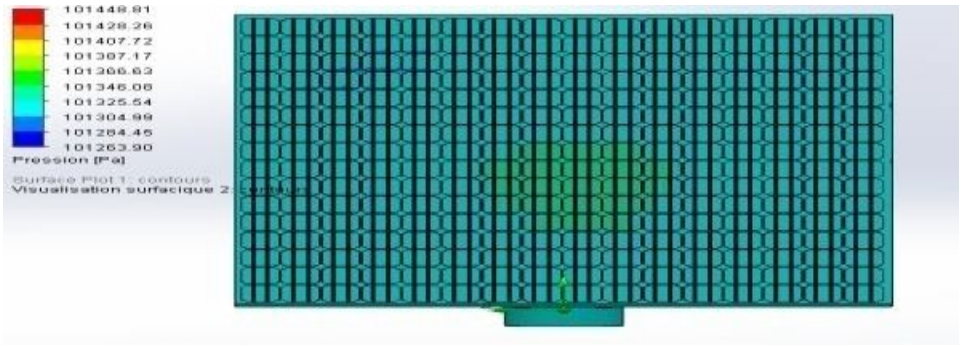


Figure:7.7. Front view

For the panel at 80°from the horizontal:
For a wind velocity of 7.5 m/s, the maximal anxiety doesn't surpass 101,407kPa. This maximal esteem happens towards the base of the solar panels when it is at an angle of 45°.

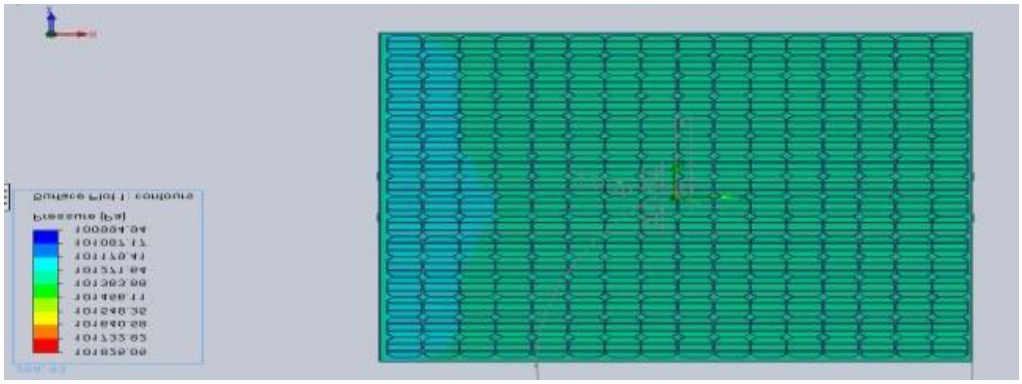


Figure:7.8. Upper view:

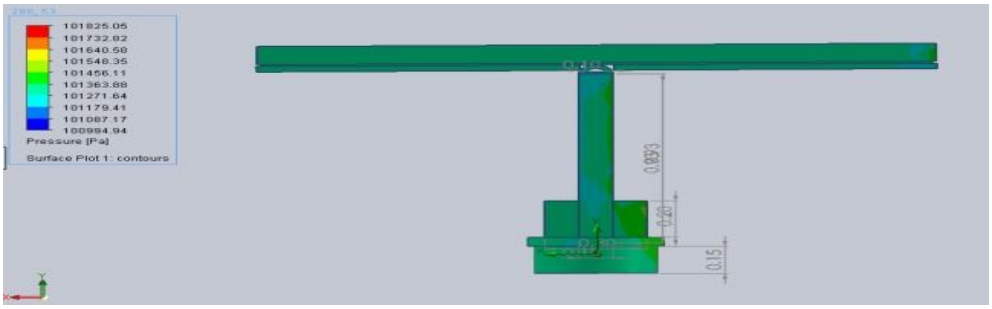


Figure:7.9. Side view:

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B. At 15 m/s:

For the panel at 0° from the horizontal:

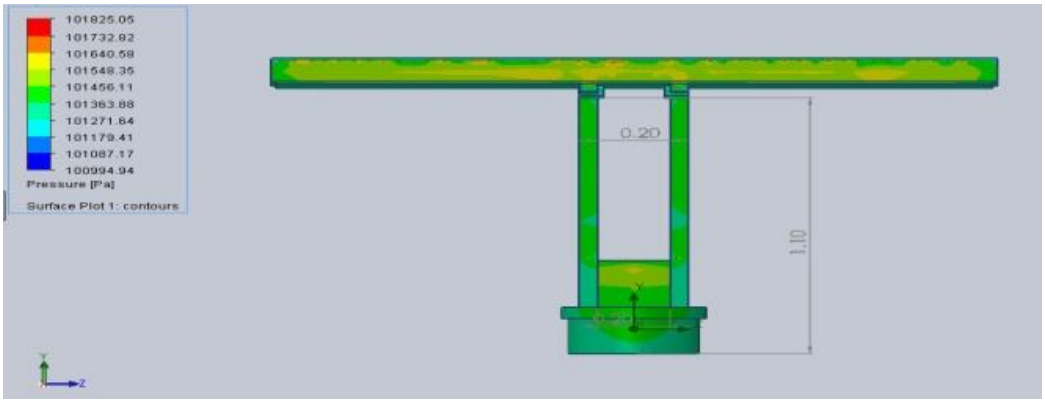


Figure: 7.10. Frontal view:

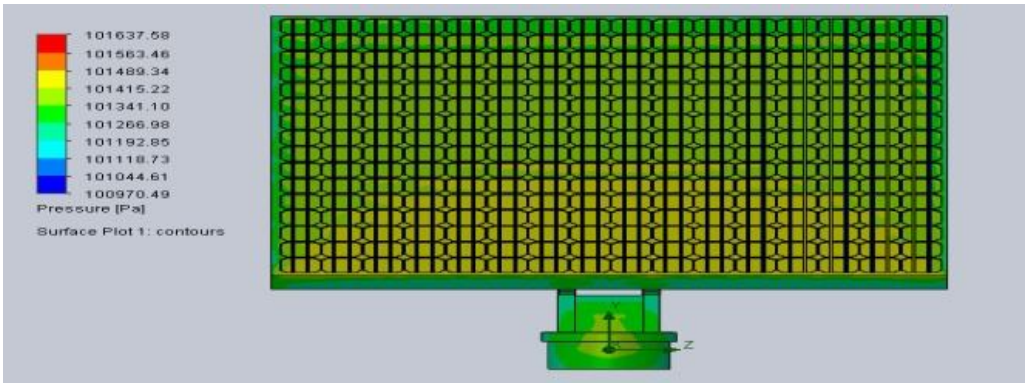


Figure:7.11. Frontal view:

For the panel at 45° from the horizontal:

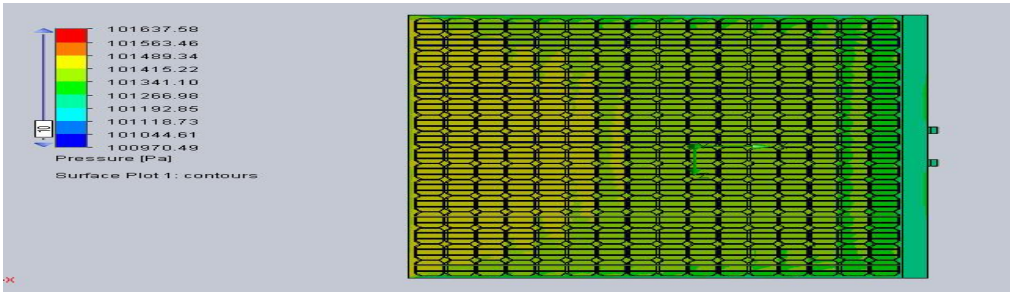


Figure:7.12. Top view

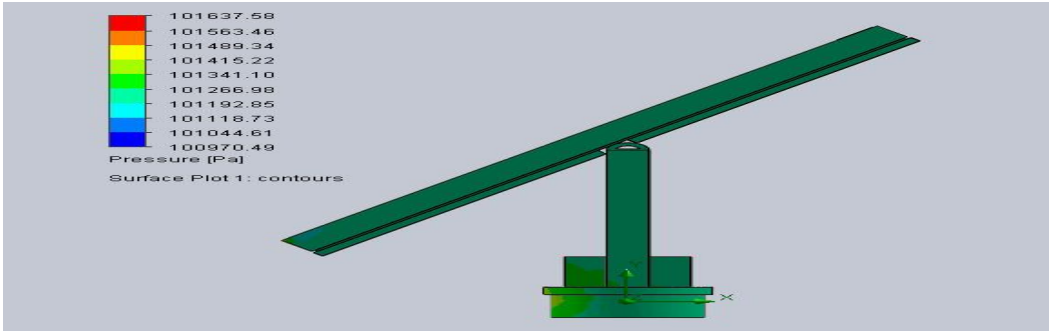


Figure:7.13 Side view

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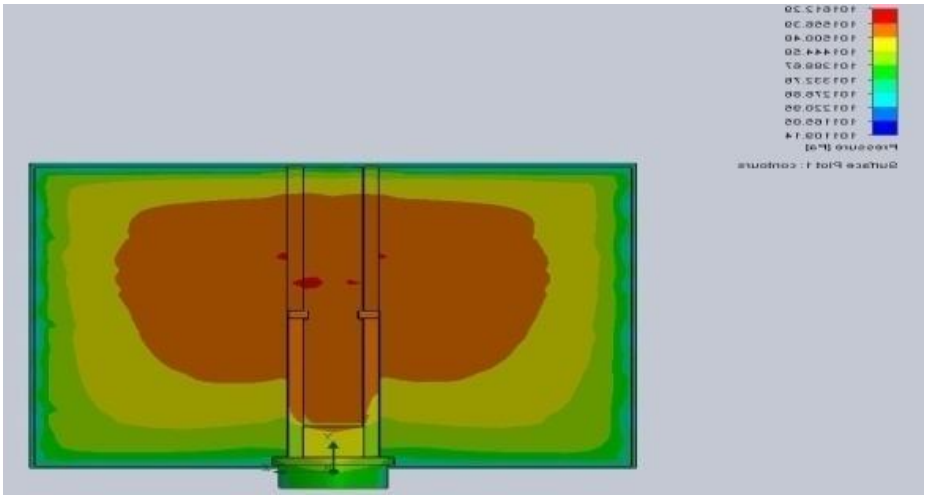


Figure:7.14Back view

For a panel at 80°from the horizontal:

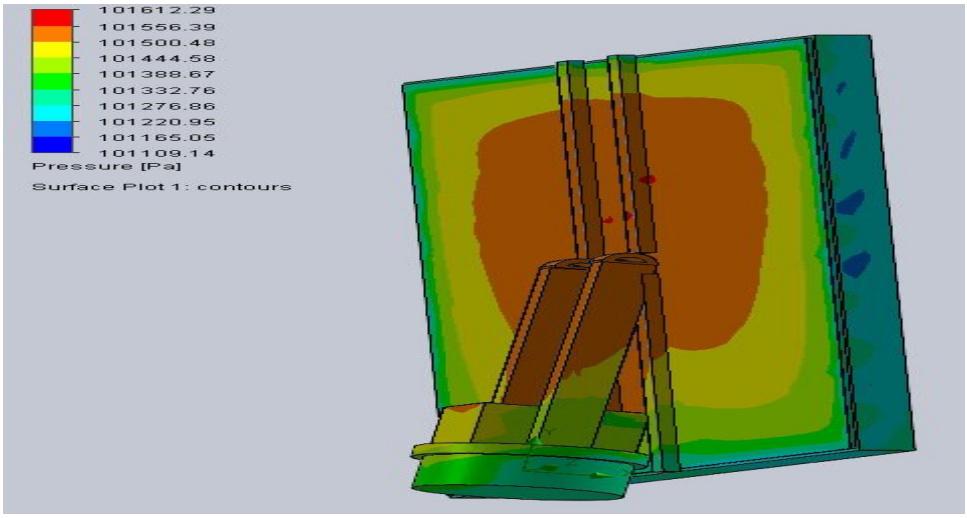


Figure: 7.15. Side frame view

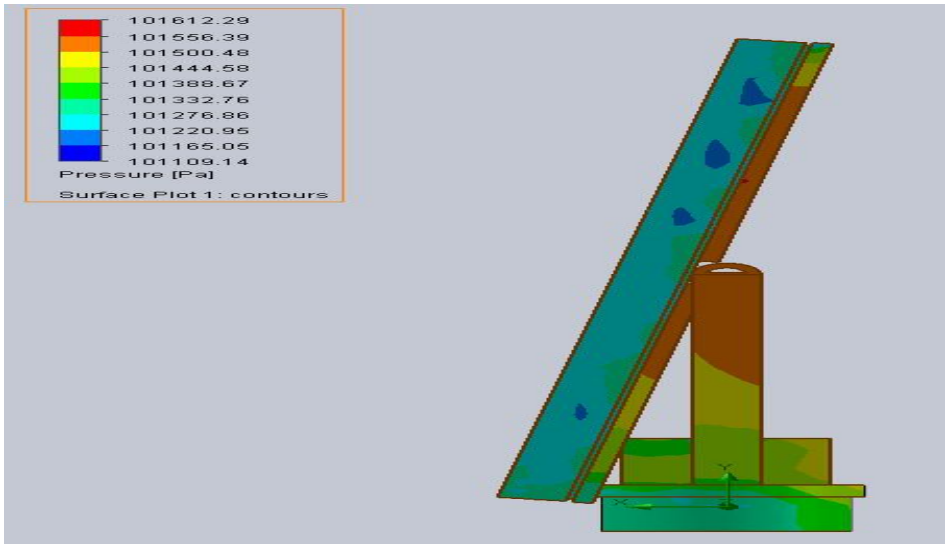


Figure:7.16Side frame view

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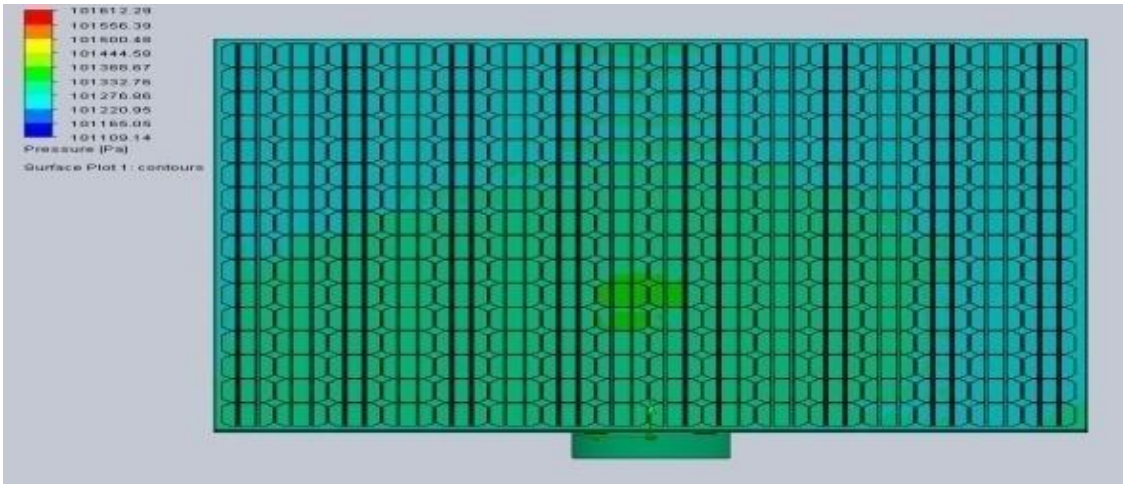


Figure:7.17Front view

For a wind speed of 15m/s, we see an expansion in the anxiety level, particularly for panels that are at a 80° angle with the even plane. The anxiety approaches the numerical estimation of 101.556 kPa, and achieves the estimation of 101.612 kPa at the solar panels's support shafts. This shows at a wind speed of 15m/s, which is not high, the support light emissions solar panels ought to be continually checked so as to avoid disappointment.

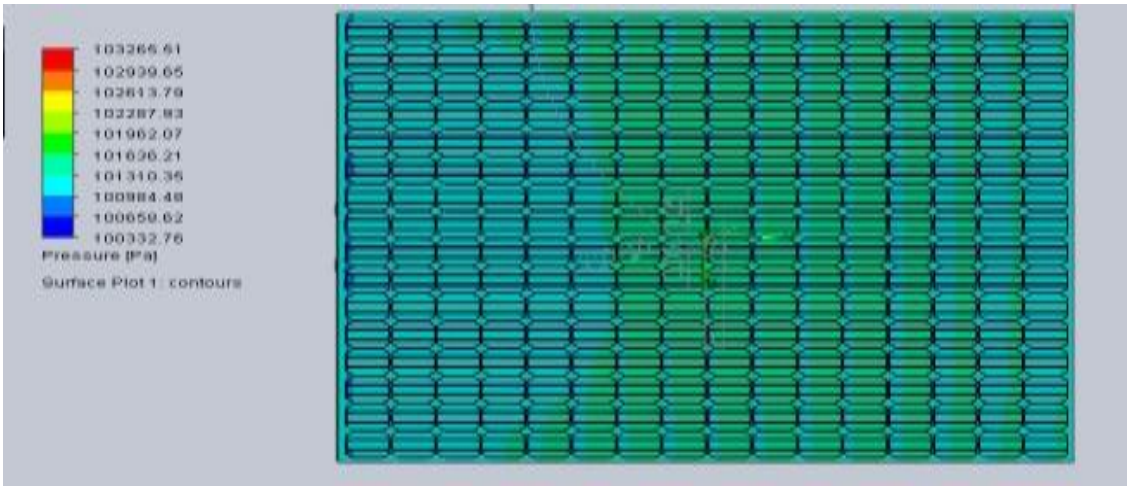


Figure:7.18Top view

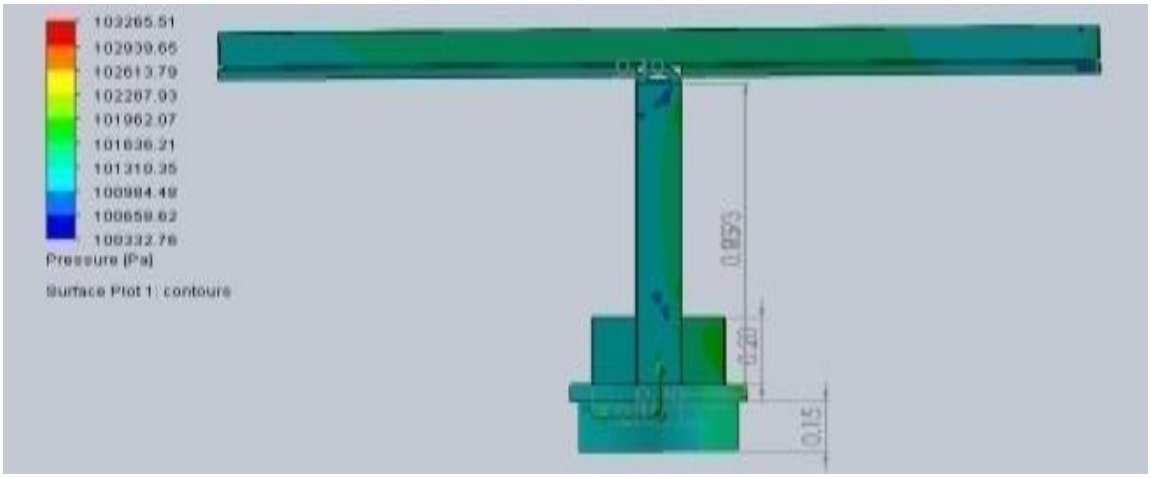


Figure: 7.19 Side view

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C. At 30 m/s:

If the panel is at 0° from the horizontal plane:

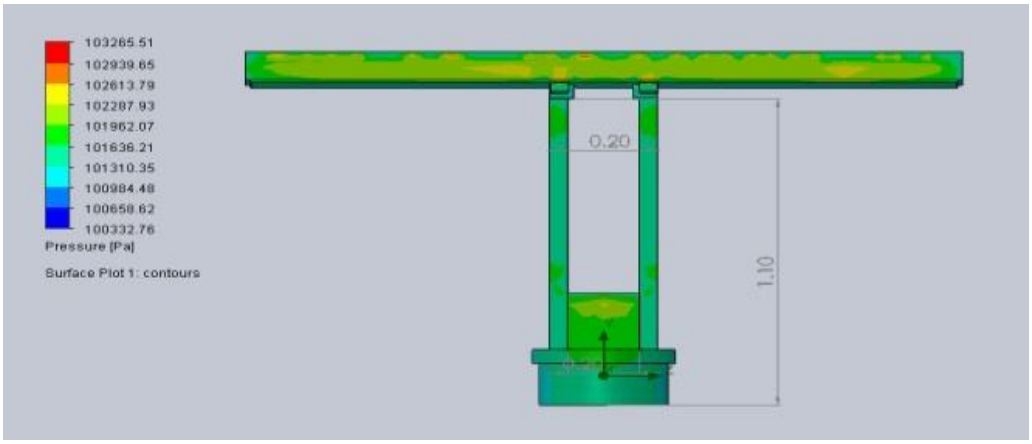


Figure:7.20Front view

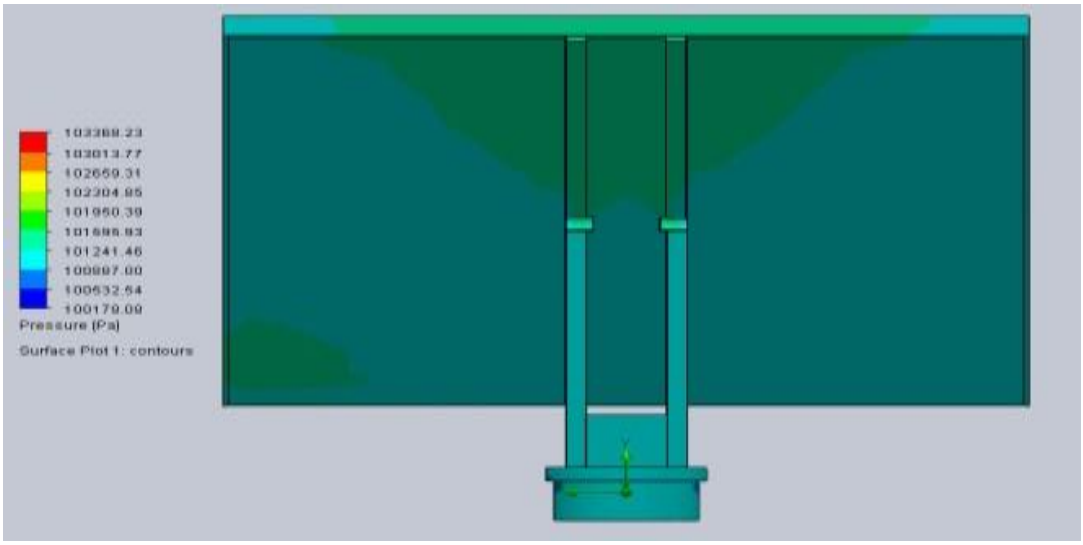


Figure:7.21. Back view

If the panel is at 45° from the horizontal plane:

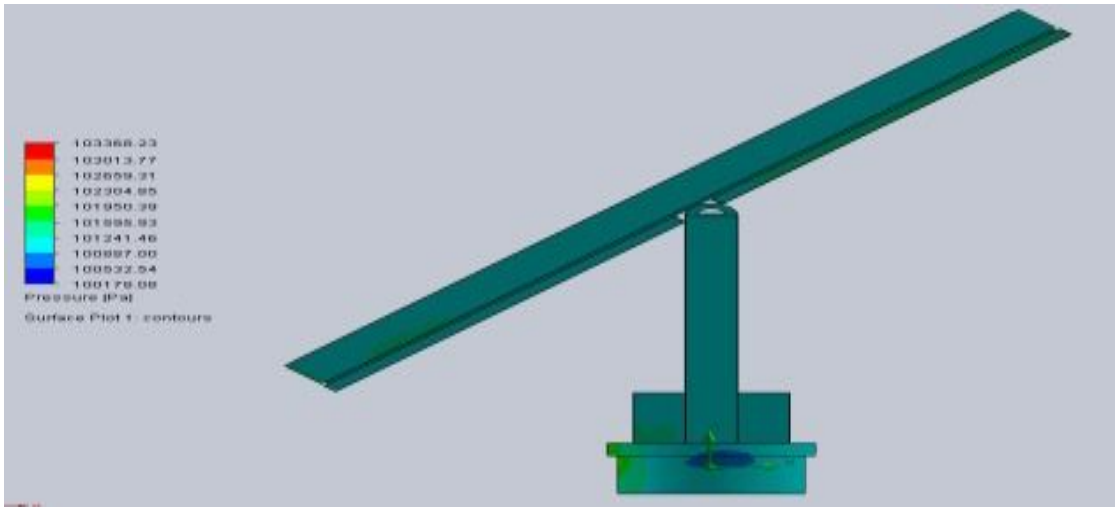


Figure:7.22. Side view

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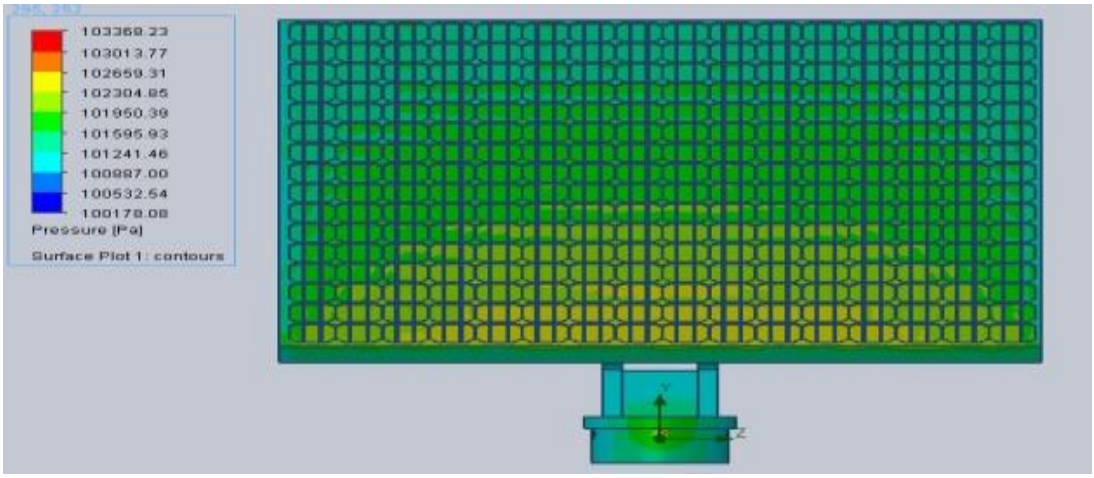


Figure: 7.23 Front view

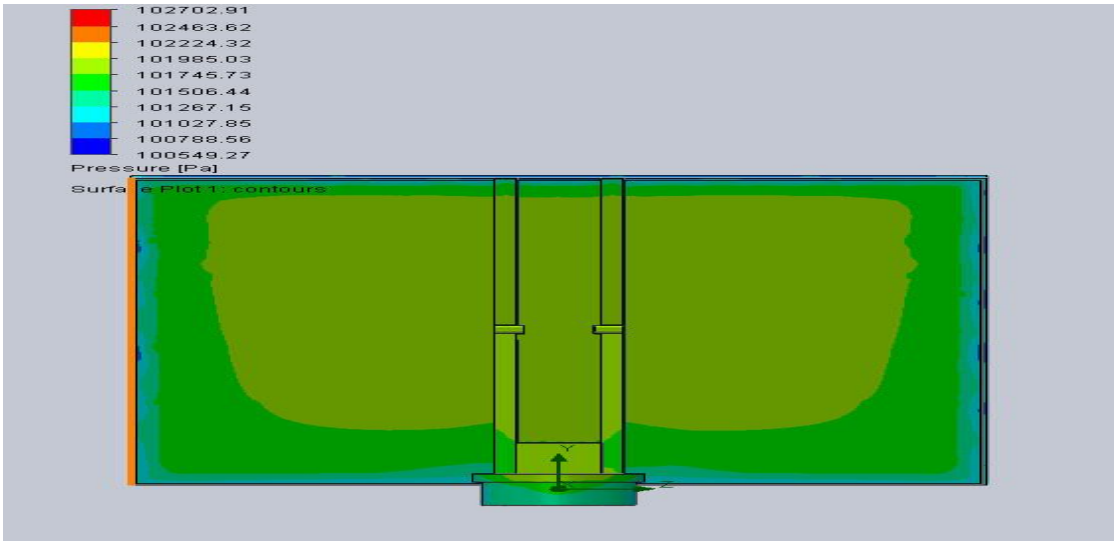


Figure:7.24 Back view

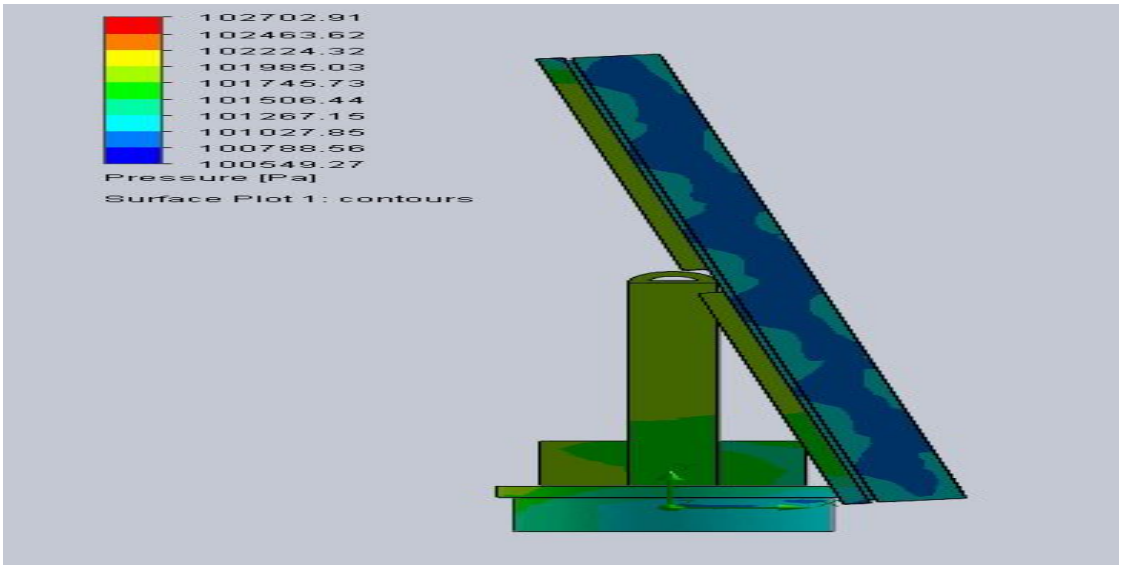


Figure:7.25. Side view

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If the panel is at 80° from the horizontal plane:

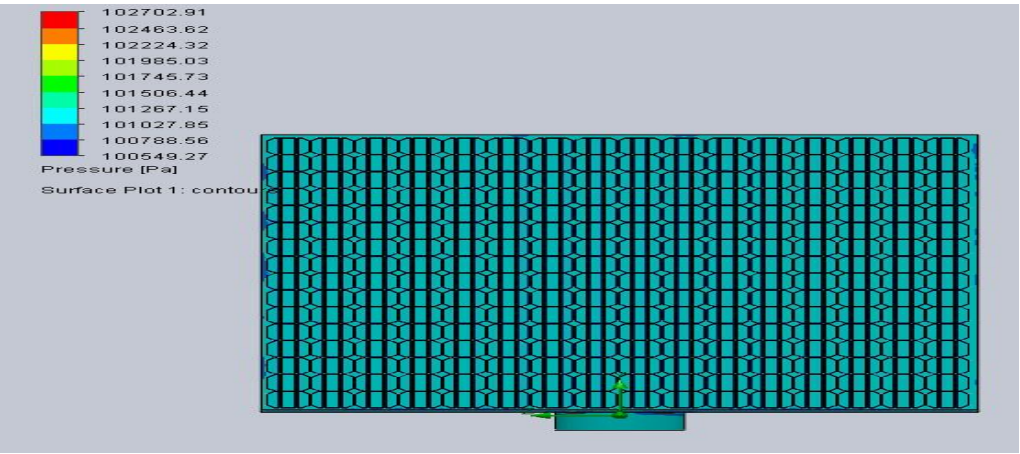


Figure:7.26. Front view

For a wind velocity of 30m/s, the two angles at which the tracker is most focused are 45° and 80°. At a 45° angle, the panels witnesses push loads moving toward 102.474 kPa. This significant amount of stress coordinated towards the panels must be contemplated when arranging and planning a solar tracker.

D. Drag and lift forces

As we improved the situation the diagnostic approach, we consolidated the consequences of the simulations in an Excel document. The following are cases of the subsequent powers in various setups.

To begin with, we looked at the force connected on the whole framework and on the panels alone. As expected before in the report, there is a little contrast between the two, which is for the most part because of the huge size of the panels.

Table7.2.- Proportion of panels force from all tracker loading force

Table 6- Proportion of panel force from all tracker loading force

Panel tilt (°)	Panel loading (N)	Tracker Loading (N)	Percentage (%)
0	13,844	20,858	66,3726148
45	146.994	145.184	101,246694
80	196.51	194.681	100,939486

Second, we think about the simulation and explanatory outcomes for the wind loading at a wind speed of 7.5 m/s.

Table .7.3. - Variation of wind loading forces on various panels tilts at a wind speed of 7.5 m/s

Table 7 - Variation of wind loading forces on different panel tilts at a wind speed of 7.5 m/s

Wind Velocity (m/s)	Panel tilt (°)	Simulation force on the panel (N)
7,5	0°	13,844
	45°	145.167
	80°	194.647

We likewise think about the simulation and investigative aftereffects of wind loading for a solar panels at a 80° tilt.

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Table 7.4. - Variation of wind loading with wind speeds for a panels at a 80° tilt 48

Panel tilt (°)	Wind Velocity (m/s)	Simulation force on the panel
80	7,5	194.647
	15	738.652
	30	2583.93

VI. RESULT

A. *Analytical and simulation result analysis*

Keeping in mind the end goal to analyze the estimations of the loading force acquired utilizing the reenactment and logically, we plotted the two outcomes on a similar diagram. In the following table, the forces for a panels tilted at a 80° edge were fundamentally the same as for the two techniques.

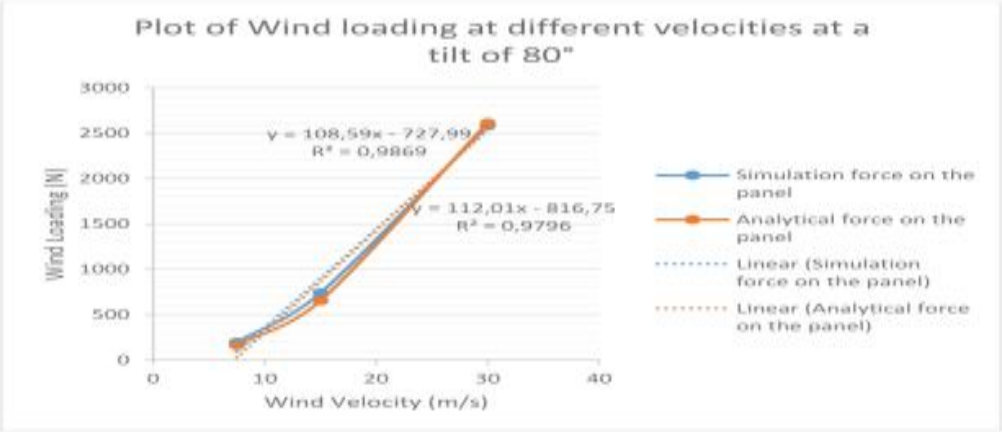


Figure: 7.27. forces for a panel tilted at an 80° angle

We additionally plotted the distinction is wind loading comes about amongst simulation .

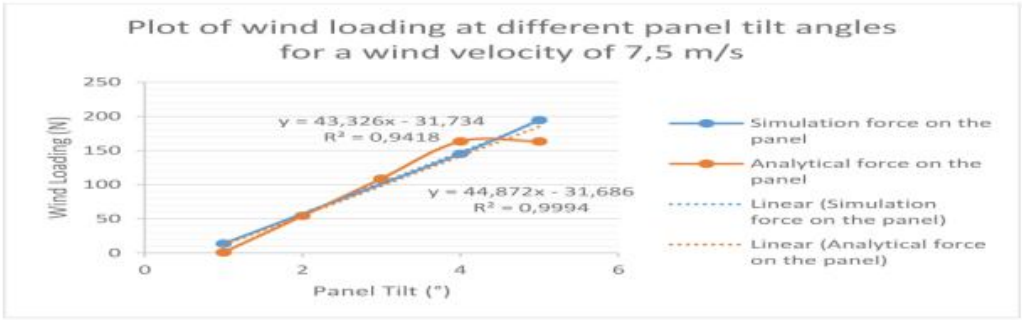


Figure 7.28.And analytical results for a wind velocity of 7.5 m/s at different tilts

VII. CONCLUSION

Solar trackers are an absolute necessity for the proficient working of any CPV framework. That is the reason planning them to the highest norms is critical. So as to merit the additional interest in a both a tracker and CPV innovation, the CPV Tracker framework musts be sufficiently solid to withstand the powers and stresses caused by the wind. As the wind speed increments, and the rakish position of the solar panels builds, the anxiety caused by the wind will increment. In any case, the recreations demonstrate that we mustn't just concentrate on the biggest edges, since some direct points can cause high anxiety and in the long run, conceivable exhaustion and disappointment.

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The solidness reenactment demonstrates that the CAD configuration isn't influenced by the wind loading power of wind speeds of 30m/s. In this manner, in the Moroccan setting in any event, we can rest guaranteed that the solar tracker won't be moved by the wind. The cost analysis of the tracker alone demonstrates that the present cost of the unit doesn't prompt a positive NPV. Consequently, more research ought to be put into limiting the cost of the solar tracker's different segments, mulling over effectiveness augmentation and life span alongside coordinate obtaining of the segments from makers.

The target of the present work is to configuration, manufacture and introduced a little solar cell to work as self-changing light sensors, outfitting a variable sign of their corresponding point to the sun by distinguishing their voltage yield. By the present procedure, the solar tracking framework was fruitful in maintaining a solar cell at an adequately opposite edge to the sun. In this manner, the solar cell works productively with the double hub solar tracker. In this task, the sun tracking framework is produced in view of 8051 microcontroller. The microcontroller 8051 based circuit is utilized as a part of this framework with a base number of segments and the utilization of stepper motors empowers exact tracking of the sun. In the wake of looking at the data got in the information table area and in plotted diagram, It has been demonstrated that the sun tracking frameworks can gather most extreme energy than a settled panels framework gathers and high productivity is accomplished through this tracker, one might say that the proposed sun tracking framework is an achievable technique for augmenting the light energy got from sun. This is a productive tracking framework for solar energy accumulation.

VIII. FUTURE SCOPE

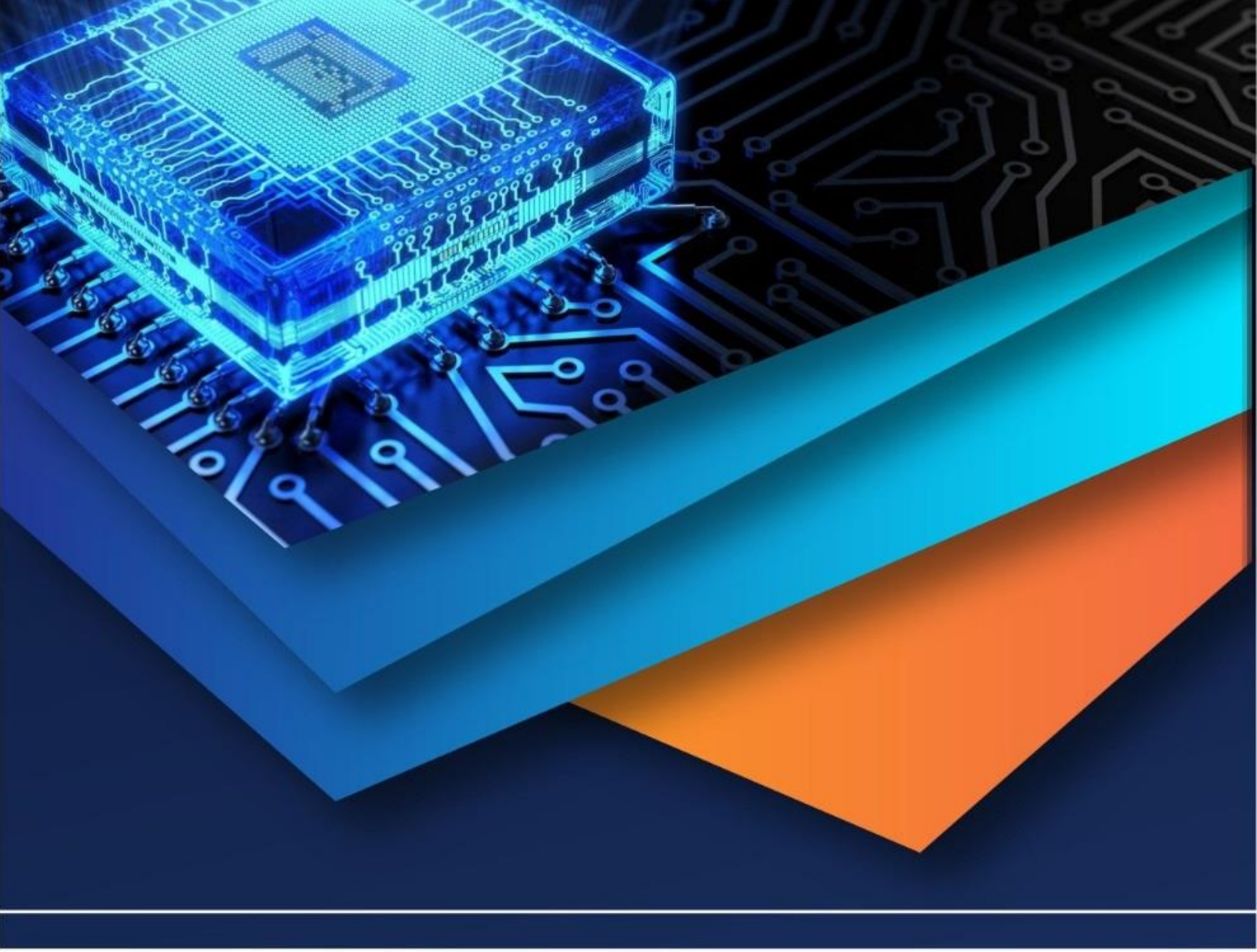
The advancement of a precise calculation or algorithm that would tilt the solar panels in a wellbeing position for the situation solid wind or gust without causing extensive misfortunes in sun introduction.

Ceaseless change of the motion system Joining the two activities into one actuator would be extremely green and exceptionally successful. A point by point gust analysis must be performed notwithstanding the wind load analysis with a specific end goal to evaluate the maximal loads on the tracker at any given time. More research ought to be put into the minimization of the cost of the tracker parts keeping in mind the end goal to render the NPV positive and legitimize the interest in a solar tracker. Here we can incorporate the three hub framework for hitter power creation and compelling and productive way. We can incorporate the motors with the end goal that which doesn't required LDR sensors, in this way complicate circuit is

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