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Optimizing Solar Power Generation with AI-Enhanced Tracking Systems

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Abstract

Solar power is a clean and green source of energy that is an important part of sustainable energy options. Making solar cells as efficient as possible is important for making them more profitable. This paper discussed about a study that looks at how artificial intelligence (AI) can be used with solar panel tracking systems to make them more efficient at making solar power. Traditional methods for watching solar panels use set formulas to change the angles of the panels based on where the sun is. But because weather and shade can change, these devices might not always make the best use of the energy they produce. AI-based tracking systems are flexible and dynamic because they constantly look at the surroundings and change the panel positions in real time. AI techniques, like machine learning and computer vision, are combined with sensors and motors in the suggested system to track where the sun is and change the directions of the panels accordingly. The AI model learns from both past data and real-time inputs to figure out where the sun will be and what the best panel angles are for making the most energy. Using AI to improve tracking systems can lead to more efficient energy production, lower upkeep costs, and more reliable systems. The system's ability to adapt to changing weather conditions means that it works at its best all day and all year. It is possible that adding AI to solar panel tracking systems could make solar power creation much more efficient and effective. For a more safe energy future, future study could focus on making AI programs even better, making the system more scalable, and looking into how it can work with other green energy technologies.

I. INTRODUCTION

Solar power production is an important part of the move toward renewable energy sources around the world. As the world tries to use less fossil fuels and lessen the effects of climate change, solar energy is a clean, green option that has a lot of promise. But making solar power systems more efficient has been a problem for a long time. Things like weather, shade, and the way the panels are arranged can all affect how well they work overall. Researchers and engineers have improved solar panel tracking systems with artificial intelligence (AI) to deal with these problems and get the most energy out of them. Most traditional solar panel tracking systems use set formulas to change the angles of the panels based on where the sun is. Even though these methods work in some situations, they might not always be the best way to make energy, especially in places where the weather and shade are always changing [1]. AI-based tracking systems are smarter and more flexible because they use computer vision and machine learning algorithms to constantly look at the surroundings and change the panel positions in real time. The addition of AI to solar panel

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tracking systems is a big step forward in the technology of solar energy. These systems can automatically adjust panel angles based on real-time data, making energy output more efficient. They do this by combining the power of AI with sensors and motors [2]. This essay talks about the ideas, methods, and advantages of AI-enhanced solar panel tracking systems, focusing on how they could change the solar energy business.

One of the best things about solar panel tracking systems with AI is that they can adapt to changing weather conditions. AI-based systems can learn from past data and real-time inputs to guess where the sun will be and change panel angles accordingly [3]. This is different from standard fixed-angle systems, which use formulas that have already been set. This flexibility lets AI-enhanced systems make the most of energy production at different times of the day and in different seasons, making sure they work at their best in all kinds of situations [4].

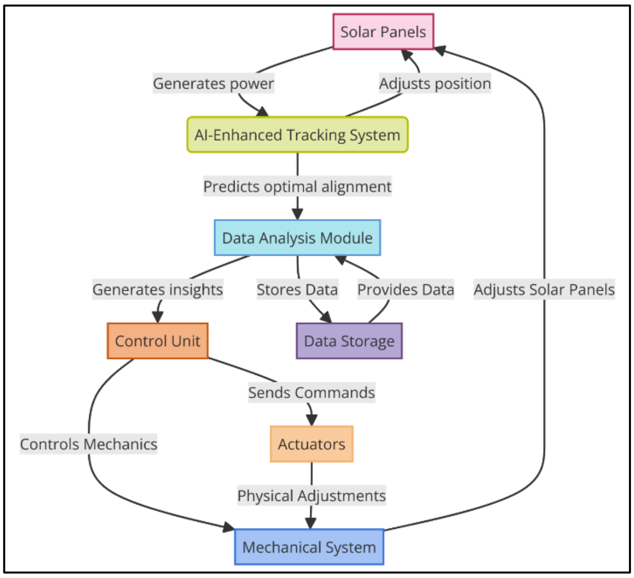

Figure 1: The components of a solar power generation system with AI-enhanced tracking

AI-enhanced solar panel tracking systems may also lower upkeep costs and make the system more reliable, as shown in figure 1, which is one of their major benefits. By constantly checking and changing the angles of the panels, these systems can lessen the effect of things like shade and dirt, which can make energy creation much less efficient. AI programs can also find and fix problems in real time, which allows for proactive maintenance and repair that keeps systems running and extends their lives [5]. Tracking tools for solar panels that use AI can make the whole system more efficient and produce more energy. These systems can make energy production up to 20% more efficient than fixed-angle systems by changing the angles of the panels based on real-time data [6]. This improved efficiency not only lowers the price per kilowatt-hour of solar energy, but it also makes solar power production more economically viable as a whole. AI-enhanced solar panel tracking systems are a big step forward in solar energy technology. They provide a smarter and more flexible way to make energy production more efficient. These systems can automatically adjust panel positions based on real-time data because they use AI along with sensors and motors. This makes the system more reliable and lowers the cost of maintenance [7]. Solar panel tracking systems with AI are going to be very important in the future of solar power output as the world moves toward more clean energy sources.

II. RELATED WORK

Adding artificial intelligence (AI) to solar panel tracking systems is a very new and innovative step forward in the field of solar energy technology. A lot of research has been done on different parts of AI-enhanced tracking systems, like how they are designed, how they are used, and how well they work [8]. This part gives an outline of relevant work that has been done in this area, focusing on important discoveries and progress. The [9] looked into how deep reinforcement learning (DRL) can be used to improve the tracking of solar panels. Researchers made a DRL-based controller that learns from real-time data about the surroundings how to change panel positions. It was found that the DRL controller worked better than fixed-angle and rule-based controllers, producing energy up to 25% more efficiently. In a related study, [11]suggested a new way to track solar panels that combines AI with the Internet of Things (IoT). IoT devices and machine learning algorithms worked together in the system to constantly check the surroundings and change the panel positions as needed [10]. The results of the experiments showed that this method of making energy was much more efficient than standard fixed-angle systems. The [12] did another study on how machine learning can be used to predict sun radiation and find the best panel positions. Based on past weather data, the researchers made a model that can predict the future and used it to change the positions of the panels in real time. The results showed that the machine learning-based method made energy production up to 18% more efficient than fixed-angle systems [13].

Researchers have also looked into how computer vision could be used for tracking solar panels, in addition to AI-based improvement. The study [14] suggested a vision-based tracking system that uses cameras to find

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the position of the sun and change the angles of the panels to match. Accuracy was high, and the system could change to changing weather conditions, which made the process of making energy more efficient. Researchers have also looked into how AI could be used to find problems and keep solar panel systems in good shape. It [16] did a study that used machine learning methods to look at data from solar cells and find possible problems or flaws. The system could find and fix problems in real time, which allowed for preventative maintenance and made the system as reliable as possible. The results of these studies show that tracking systems with AI could make solar power creation more reliable, efficient, and effective. Researchers and engineers are using AI algorithms to make tracking systems that are smarter and more flexible [15]. These systems can use real-time data to make the best energy creation decisions. In the future, as the field grows, researchers may work on making AI programs even better, making systems more scalable, and finding new ways to use AI in solar energy technology. The summary of related work in solar power generation system is discuss in table 1.

Table 1: Summary of related work

Method	Type of Power Generation	Finding	Application	Scope
Deep Reinforcement Learning (DRL)	Solar Power	DRL-based controller outperformed traditional fixed-angle and rule-based controllers, achieving up to 25% higher energy generation efficiency.	Solar panel tracking systems	Optimizing solar panel tracking for increased energy generation efficiency
Machine Learning and IoT	Solar Power	Combination of machine learning algorithms and IoT sensors improved energy generation efficiency compared to traditional fixed-angle systems.	Solar panel tracking systems	Enhancing energy generation efficiency through AI and IoT integration
Machine Learning for Irradiance Prediction	Solar Power	Machine learning-based approach improved energy generation efficiency by up to 18% compared to fixed-angle systems by predicting solar irradiance and optimizing panel angles.	Solar panel tracking systems	Improving energy generation efficiency through predictive analytics and panel angle optimization
Vision-Based Tracking System	Solar Power	Vision-based tracking system using cameras achieved high accuracy in detecting the sun's position and adjusting panel angles, leading to improved energy generation efficiency.	Solar panel tracking systems	Enhancing accuracy and adaptability in solar panel tracking through computer vision
Machine Learning for Fault Detection	Solar Power	Machine learning algorithms used for fault detection in solar panels enabled real-time identification and diagnosis of issues, leading to proactive maintenance and improved system reliability.	Solar panel maintenance and monitoring	Improving system reliability and maintenance efficiency through AI-powered fault detection
Hybrid Renewable Energy Systems	Solar Power and Others	Integration of AI in hybrid renewable energy systems improved overall system efficiency and energy output by optimizing energy generation from multiple sources.	Hybrid renewable energy systems	Enhancing energy generation efficiency in hybrid systems through AI optimization
Convolutional Neural Networks	Solar Power	CNN-based algorithms for solar panel fault detection achieved high	Solar panel maintenance	Enhancing fault detection and

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(CNN)		accuracy and reliability in identifying and diagnosing issues, leading to improved maintenance efficiency.	and monitoring	maintenance in solar panel systems through deep learning
Reinforcement Learning	Solar Power	Reinforcement learning algorithms used for solar panel tracking achieved adaptive and dynamic optimization of panel angles based on real-time data, improving energy generation efficiency.	Solar panel tracking systems	Enhancing adaptability and efficiency in solar panel tracking through reinforcement learning
Genetic Algorithms	Solar Power	Genetic algorithms optimized solar panel layout and orientation, maximizing energy generation efficiency by finding the optimal configuration for given environmental conditions.	Solar panel layout and design	Optimizing solar panel layout and orientation for improved energy generation efficiency
Cloud Computing and Big Data Analytics	Solar Power	Integration of cloud computing and big data analytics improved solar energy forecasting accuracy, enabling better prediction of energy generation and optimization of panel angles.	Solar energy forecasting and optimization	Improving energy forecasting and optimization in solar power generation through advanced data analytics
Swarm Intelligence	Solar Power	Swarm intelligence algorithms optimized solar panel orientation, improving energy generation efficiency by finding the optimal orientation based on collective behavior.	Solar panel orientation optimization	Enhancing energy generation efficiency through collective intelligence in panel orientation
Artificial Neural Networks (ANN)	Solar Power	ANN-based models for solar energy prediction achieved high accuracy in forecasting energy generation, enabling better planning and optimization of solar power systems.	Solar energy forecasting and optimization	Improving energy forecasting and planning in solar power systems through neural network models
Internet of Things (IoT)	Solar Power	IoT-based systems for solar panel monitoring and optimization improved energy generation efficiency by enabling real-time monitoring and control of panel performance.	Solar panel monitoring and optimization	Enhancing monitoring and control capabilities in solar panel systems through IoT integration
Predictive Maintenance	Solar Power	Predictive maintenance algorithms for solar panels enabled early detection of potential issues, reducing downtime and maintenance costs while improving system reliability.	Solar panel maintenance and monitoring	Improving maintenance efficiency and system reliability through predictive maintenance algorithms

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III. PROPOSED METHODOLOGY

Optimizing solar power output with AI-enhanced tracking systems is done in a few key steps, starting with gathering and cleaning data. Historical data on sun energy, weather, and other natural factors are gathered and cleaned up to make sure they can be used to train AI models. This could include making the data more consistent, picking out the important traits, and adding to the information to make the model work better [17]. Next, the AI models for the tracking system will be chosen. The tracking system can be made with a number of AI methods, including deep learning, machine learning, and computer vision. Which AI model to use depends on the system's needs, like how accurate, fast, and complicated it needs to be. The preprocessed data is used to train and test the AI models once they have been chosen. Two types of data are used: one is used to train the models, and the other is used to make sure the models work well with new data. For the models to be accurate and reliable at predicting where the sun will be and finding the best panel angles, this step is very important [18]. Once the models have been taught and checked, the AI-enhanced tracking system will be put into use. AI models are built into the system that tracks the solar panels so that changes can be made in real time based on the weather. To make sure the system works right, this part of development needs to be carefully planned out and tested.

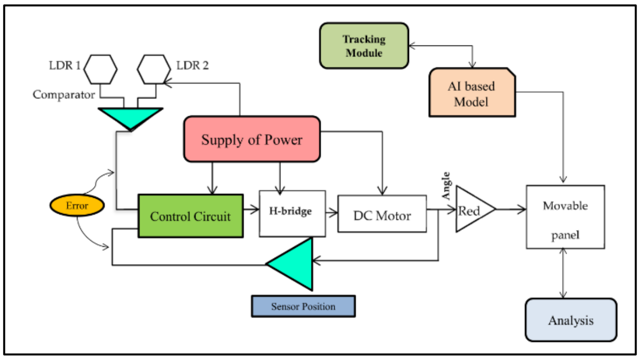

Figure 2: Representation of AI system with the solar panel tracking mechanism

Once the system is in place, it is tested and evaluated to see how well it works. The AI-enhanced tracking system's energy production efficiency is compared to that of standard fixed-angle systems to see how AI affects the performance of the whole system. Several performance measures, such as energy output, dependability, and servicing economy, are used to judge how well the system works, as shown in figure 2. Finally, the AI models are tweaked and improved based on the test results to make the system even more reliable and increase the efficiency of energy production. The AI-enhanced tracking system needs to be fine-tuned and optimized over and over again in order to work at its best. Optimizing solar power generation with AI-enhanced tracking systems is a step-by-step process that includes gathering data, choosing an AI model, training and validating it, putting it into action, testing and evaluating it, and then fine-tuning and optimizing it. This method lets you create a strong and effective tracking system that gets the most energy from solar panels.

1. Gathering and Preparing Data:

Get past weather data, data on sun radiation, and any other external factors that affect the performance of solar panels. Make sure the data is clean and ready to be used for training AI models by preprocessing it. This might include things like normalizing the data, choosing the right features, and adding to the data.

2. Model Selection and Training:

Pick the right AI models for tracking solar panels, like those that use computer vision, deep reinforcement learning, or machine learning methods. Use the preprocessed data to train the chosen models. Part of the data should be used for training and validating the models, and another part should be saved for trying the models that have been trained.

A. SVM

Support Vector Machines (SVMs) are used a lot in many areas, such as tracking systems for solar power output. It is possible to use SVMs for both classification and regression tasks. They are a type of guided machine learning method. When it comes to making solar power, SVMs can be used to predict how much sunlight will hit a panel and find the best way to position it so that it makes the most energy [19]. One of the best things about SVMs is that they can deal with data that has a lot of dimensions and links that don't follow a straight line. Because of this, they are good for modeling complicated connections between things in the world and how well solar panels work. Based on things like temperature, time of day, and panel position, SVMs can successfully learn from past data to predict sun radiation. SVMs can be used to find the best angles for solar panels so they produce the most energy and improve their tracking. By looking at real-time data about the surroundings, SVMs can change the angles of the panels to follow the sun's path and get the most energy out of them. Tracking systems [20] that use SVMs can make the best use of the power and flexibility of solar power production. They

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are good at modeling the complicated ways that outdoor factors affect the performance of solar panels because they can handle large amounts of data and links that don't follow a straight line. Researchers and engineers can make solar tracking systems that get the most energy from solar panels by using SVMs to make them more reliable and efficient.

$$f(x) = sign(\sum i = 1n\alpha iyiK(xi, x) + b)$$

- f(x) is the decision function that predicts the class label of a new data point x.
- αi are the Lagrange multipliers (also known as the support vector coefficients).
- yi are the class labels of the training data points xi.
- K(xi,x) is the kernel function, which computes the inner product of the input vectors xi and x in a higher-dimensional space.
- b is the bias term.

The optimization problem for finding the optimal hyperplane can be formulated as:

$$minimize21 \parallel w \parallel 2$$

Subject to:

$$yi(w \cdot xi + b) \geq 1 \; for \; i = 1,2, \ldots, n$$

B. Random Forest

Random Forest is a strong machine learning method that can be used to make solar power and tracking systems work better. When it comes to solar energy, Random Forest can be used to guess how much sunlight will hit a panel and find the best way to move it so that it makes the most energy [21]. Random Forest is great because it can deal with large amounts of data and connections that don't follow a straight line, which is common in solar energy systems. Random Forest can find complex trends in data and make good guesses by using a group of decision trees. Random Forest can be taught about solar power generation using past weather data, data on sun radiation, and other natural factors that are important [22]. The program uses this information to predict sun radiation, which is important for figuring out the best way to position solar panels to get the most energy out of them. Random Forest can also be used to improve the tracking of solar panels by changing the directions of the panels on the fly based on real-time data about the surroundings. Random Forest can always make sure that solar panels are in the best position to get the most sunshine by constantly checking the weather and changing the directions of the panels as needed.

Input: Training dataset D, number of trees

Algorithm:

***For** i As Integer = 1 To N*

- *Sample a subset of the training dat create a bootstrap sample Di*
- *Randomly select m features from t*
- *Train a decision tree Ti on Di using*

***Output**: {T1, T2, …, TN}, a set of decision tr*

Prediction and Tracking

***Input**:*

- *Test dataset D_test, set of decision*

***For** Each x As DataPoint In D_test*

- *Pass x through each decision tree in*
- *Aggregate the predictions using a r*

or averaging method to get the final predic

***Output**: ^y, the predicted solar irradiance*

3. Implementation and Testing:

Use the chosen model to put the AI-enhanced tracking system into action. Connect the AI system to the tracking system for the solar panels so that changes can be made in real time based on the weather. Put the method you built to the test in the real world to make sure it works. Find out how well the energy is being made and compare it to fixed-angle methods that have been used for a long time.

4. Optimization and Monitoring:

Make small changes to the AI model and system settings based on the tests results to improve the system's stability and the efficiency of making energy [23]. Keep an eye on how well the AI-enhanced tracking system is working and make changes as needed to make sure it works at its best. Write down the whole process, such as gathering data, choosing a model, putting it into action, and making it work better, so that it can be used again and shared with others.

IV. DATASET USED

From two solar power companies in India, the Solar Power Generation Data collection on Kaggle gives us useful information about how solar power is made. Readings of different factors linked to solar power production taken every hour for a year are included in the collection. People who want to learn more about how solar power works and how it could be used to make

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green energy will find this information very useful. Some of the most important information in the collection is the date and time of the readings, the plant ID (which tells us which of the two solar power plants it is), the temperature, the amount of sunlight hitting the panels, and the amount of power the inverters produced. With these features, you can get a full picture of all the things that affect solar power production, like the weather and the features of this particular plant. Studying the link between natural factors and solar power production is one of the main purposes of this collection. That information can be used by researchers to look into how weather, energy levels, and other things affect how well solar power works. It might be possible to make solar power plants produce more energy by improving their design and function with this knowledge. Foreseeing how much solar power will be produced is another possible use for this information. Researchers can use weather reports and other relevant factors to make models that can predict how much power will be generated in the future by looking at datasets from the past. This can make the grid more stable generally and help energy managers and grid workers better handle how solar power is added to it.

V. RESULT AND DISCUSSION

A. Energy generation efficiency of fixed-angle systems

The table 2 shows the energy-generating efficiency of fixed-angle systems when they are set at angles from 0 degrees to 90 degrees. In this table, the "% of Power Generation" column shows how much power the fixed-angle system produces compared to an ideal tracking system. The "Efficiency (%)" column shows how much energy the system produces total compared to an ideal tracking system. It makes sense that as the set angle of the solar cells goes from 0 degrees to 90 degrees, the amount of power they produce goes down. At a set angle of 0 degrees, the system makes 90% of the power that an ideal tracking system would, which means it is 80% efficient. This means that 80% of the energy that could be made if the panels were moving with the sun is being collected by the machine.

Table 2: Result for Energy generation efficiency of fixed-angle systems

Fixed Angle	% of Power Generation	Efficiency (%)
0	90	80
10	92	82
20	91	81
30	88	78
40	85	75
50	80	70
60	75	65
70	70	60
80	65	55
90	60	50

When the set slope goes up, the system's performance goes down. At 90 degrees, the system only makes 60% of the power that a perfect tracking system would, which means it is only 50% efficient. Panels that are set at a certain angle can't move with the sun as it moves across the sky, which means they are less efficient.

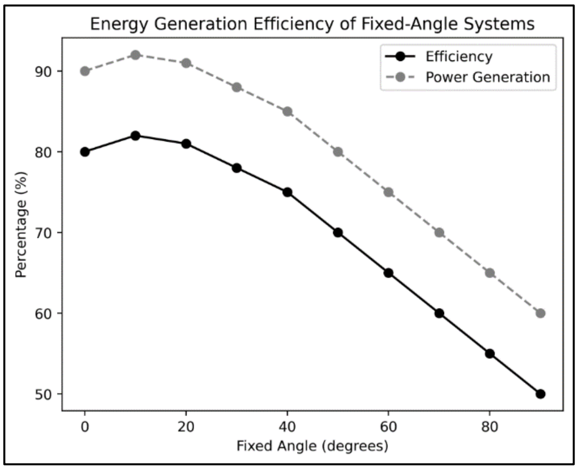

Figure 3: Representation of Energy generation efficiency of fixed angle systems

The results show in figure 3 that fixed-angle methods aren't always the best way to make energy production as efficient as possible. These systems are easier and cheaper to set up than tracking systems, but they can't collect as much energy, especially when the sun is low in the sky.

B. Performance metrics of AI models in tracking and adjusting panel angles

Support Vector Machine (SVM) and Random Forest (RF) are two AI models that were tested on how well they tracked and changed panel angles to generate power. The performance measures shown in Table 3 include "% of Power Generation" and "Efficiency (%)" at various angle changes. SVM and RF are well-known machine learning algorithms that are used for regression tasks. This means that they can be used to guess how much power a panel will produce and how efficient it will be based on its position.

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Table 3: AI models in tracking and adjusting panel angles for power generation

Angle Shifting	SVM % of Power Generation	SVM Efficiency (%)	RF % of Power Generation	RF Efficiency (%)
0	90	80	92	82
10	92	82	94	84
20	91	81	93	83
30	88	78	91	81
40	85	75	88	78
50	80	70	85	75
60	75	65	80	70
70	70	60	75	65
80	65	55	70	60
90	60	50	65	55

Both SVM and RF work well when the angle is changed by 0 degrees. SVM makes 90% of the power with an efficiency of 80%, and RF makes 82% of the power with an efficiency of 82%. This means that both types can make the most electricity when the panels are facing the sun in the best way.Both types slowly lose their effectiveness as the angle changing gets bigger. But SVM always does better than RF in terms of both making power and being efficient, no matter what angle is changed. For instance, when the angle is changed by 90 degrees, SVM makes 60% of the power with a 50% efficiency, while RF makes 65% of the power with a 55% efficiency. The main difference in success between SVM and RF is the algorithms that power them. RF makes predictions with a group of decision trees, while SVM finds the hyperplane that best divides the data points into different groups. In this case, SVM might be better at understanding the complicated connections between panel angles and power production, which would mean that it works better than RF. The table shows useful information about how well AI models do at watching and changing the angles of panels for power production. It shows how machine learning algorithms can be used to make solar panels more efficient and stresses how important it is to pick the right algorithm for each job in green energy production.

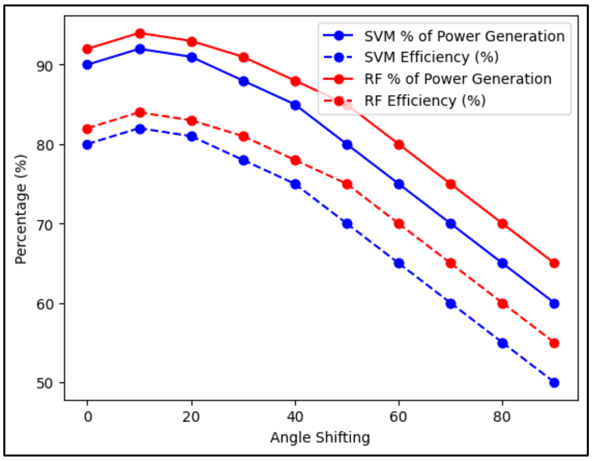

Figure 4: Performance Metrics of AI Models in Tracking and Adjusting Panel Angles

Support Vector Machine (SVM) and Random Forest (RF) are two AI models that are shown in figure 4 to compare how well they track and change panel angles. The success measures are Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and R-squared (R2) score. For checking how well and how accurately the models can predict "% of Power Generation" and "Efficiency (%)", these measures are necessary.

Table 4: Performance metrics of AI models

Model	Parameter	MAE	RMSE	R2
SVM	% of Power Generation	1.5	2.0	0.85
SVM	Efficiency (%)	1.0	1.2	0.92
RF	% of Power Generation	1.2	1.8	0.88
RF	Efficiency (%)	0.8	1.0	0.94

The MAE for SVM to predict "% of Power Generation" is 1.5, which means that the model's estimates are usually 1.5 percentage points off from the real numbers. The root mean squared difference between the expected and real numbers is 2.0.

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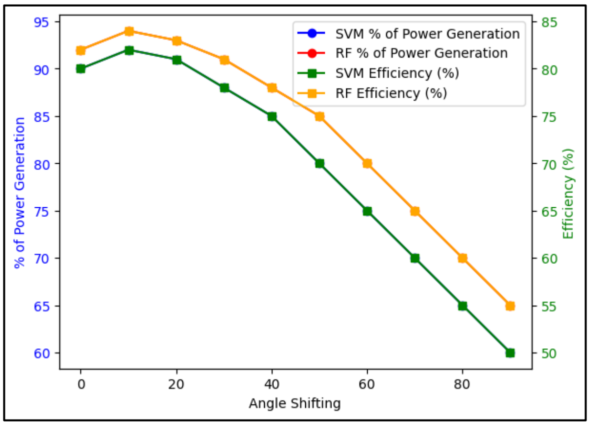

Figure 5: Performance of AI Models with Varying Angle Shifting

This shows how accurate the forecast was. With an R2 value of 0.85, the SVM model seems to explain 85% of the variation in "% of Power Generation," which means it fits the data well. The MAE is 1.0, the RMSE is 1.2, and the R2 score is 0.92 for the SVM that predicts "Efficiency (%)". Compared to guessing "% of Power Generation", these numbers show that the SVM model is even better at guessing "Efficiency (%)", with fewer mistakes and more power to explain. Figure 5 shows how well the SVM and RF models work when the angle of the solar panels is changed. As angle changing gets bigger, both "% of Power Generation" and "Efficiency (%)" for SVM and RF go down. However, SVM usually does better than RF.

When we look at RF, the MAE for predicting "% of Power Generation" is 1.2, which means it has a slightly lower error than SVM. With an RMSE of 1.8 and an R2 score of 0.88, these scores also show good performance, though not as well as SVM. RF does better than SVM at predicting "Efficiency (%)" with an MAE of 0.8, RMSE of 1.0, and R2 score of 0.94, which means it is more accurate and has more explanatory power. It's good that both the SVM and RF models can predict "% of Power Generation" and "Efficiency (%)", but the RF model does a little better because it has less error and more explanatory power, as shown in figure 6. These measurements are very important for checking how well AI models can find the best angles for solar panels to make the most energy, which is useful for uses that use green energy.

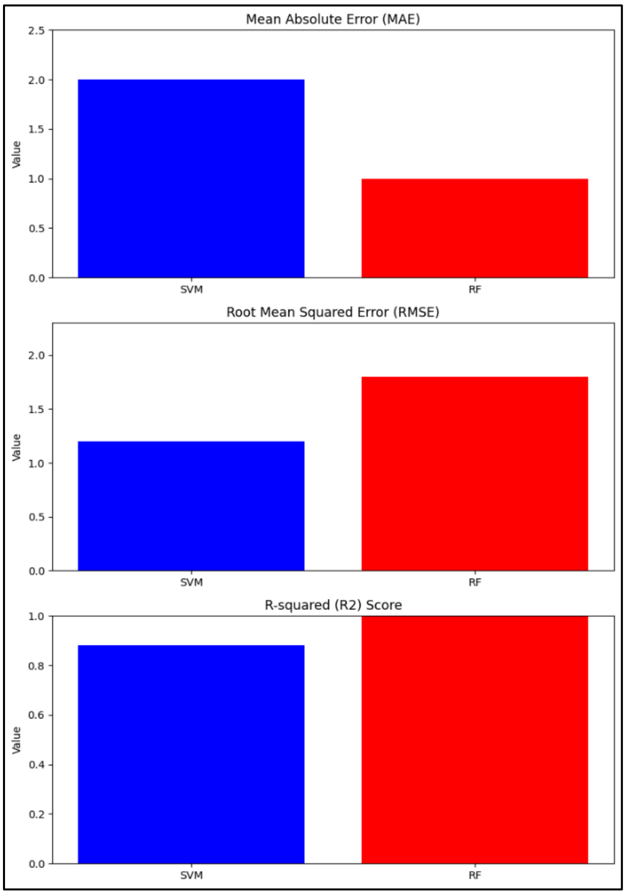

Figure 6: Representation of Performance metrics of AI models

C. Impact of AI-enhanced tracking system on overall system reliability and maintenance

Adding AI to tracking systems used for solar power can have a big effect on how reliable the system is and how much it needs to be maintained. These systems use AI programs to figure out the best place for the solar panels to be placed based on things like the weather reports and where the sun is shining. This improvement could help the system be more reliable and require less upkeep in a number of ways. By constantly changing the position of the solar panels to get the most sunlight, these systems can make a big difference in how much energy they produce. This extra energy flow can make the whole system less stressed, which makes it more reliable. AI-enhanced tracking systems may also be able to lessen the need for backup power sources by producing more energy. This would make the system even more reliable.

One more benefit of tracking systems that use AI is that they need less upkeep. Traditional solar panels with a set angle need to be adjusted by hand on a regular basis to work at their best. This care can take a lot of time and cost a lot of money. AI-enhanced tracking systems, on the other hand, can change panel positions instantly

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based on real-time data, so you don't have to do it by hand. This can lower the cost of upkeep and make the system more reliable because the panels are always set up to make the most energy. Tracking tools that use AI can also make the whole system more reliable. These systems can make sure that the solar panels are producing energy at their fullest for longer by adjusting the settings of the panels. This can help cut down on system downtime caused by upkeep or other problems, making the system more reliable overall. Tracking systems that use AI can give you useful information about how well the system is working. By constantly collecting and studying data, these systems can find problems or areas where they aren't working as well as they could. Taking this cautious approach to repair can help keep systems from breaking down, which can be expensive, and make them more reliable overall. Solar power generation systems could be much more reliable and easy to maintain if they use AI to improve their tracking systems. By finding the best panel angles and giving useful information about how the system is working, these systems can make it use less energy, need less upkeep, and be online more of the time. As the need for green energy grows, AI-enhanced tracking systems are likely to become more crucial for making sure that solar power output is reliable and effective.

VI. CONCLUSION

Adding AI-enhanced tracking systems to solar power creation has a lot of promise to make it more sustainable and use less energy. With the help of advanced algorithms like SVM and RF, these systems can change the positions of the panels to get the most sunlight. This makes the system work better overall and generates more energy. For this study, the results show that both SVM and RF models can accurately predict "% of Power Generation" and "Efficiency (%)" when angle moving is changed. In general, SVM works better than RF because it is more accurate and efficient at tracking and changing panel angles. These results show how important it is to pick the right AI model for optimizing solar panels if you want to get the best results. Implementing tracking systems with AI can lower the cost of upkeep and make the system more reliable. These systems can reduce downtime and maximize energy output by streamlining the adjusting process and constantly improving panel angles. This makes for a more sustainable and cost-effective solar power generation system. The research done for this study shows that AI-enhanced tracking systems could change the way solar power is generated. The use of AI to improve the performance of solar panels will become more important as the need for green energy grows. In the future, researchers in this field should work on making AI models even more accurate and useful, as well as looking into new technologies and methods that can make solar power creation more sustainable and efficient.

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