

Solar Power Auto Irrigation System Using Artificial Neural Network Based On Random Forest Algorithm Techniques

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ABSTRACT

This research examines and describes the creation of a controller for an intelligent voltage source inverter that is based on artificial neural networks. It is an automated irrigation system powered by solar energy and artificial neural networks and random forest algorithms. Then input parameters for the artificial neural network-based controller in this project include moisture, solar irradiation, the value of the Buck boost converter, and the output value of the inverter. PWM pulses are produced using an ANN-based control algorithm to increase system efficiency. This technique was created to optimize the usage of water for agricultural crops during irrigation. Numerous algorithms were employed as a control approach for PWM generating in earlier methods. In this proposed system developed based on the concept of Because of the following benefits, a random forest delivers accurate predictions that are simple to comprehend. Larger at sets can be efficiently handled by it. The random forest algorithm performs predictions more accurately than the decision tree method.

Keywords: MATLAB, Artificial Neural Network (ANN), Pulse Duration Modulation (PDM), Random Forest Algorithm (RFA).

INTRODUCTION

Advanced technologies are required in modern agriculture to increase crop quality and production effectiveness while preserving the environment. Agricultural plants have a minimum yearly water need for maximum crop output as well as a minimum water requirement for survival. On the other side, if the field receives excessive irrigation, the plant may perish as a result. The most important thing is to not add any more water than is necessary for proper plant growth, nor to add any less water than is also necessary. Only 1% of the water on Earth is fresh and usable. Due to its limited availability, there is a strong incentive to decrease its consumption in all contexts. Turf, commonly referred to as grass, is the largest

irrigated crop in North America It has a surface area of more than 128 000 km, and in 2015, it was calculated to ask more than 9 billion gallons of freshwater daily. Improved irrigation efficiency at this vast size can help ease the burden on out limited fresh water sources as the western United States experiences a record drought, which follows a comparable shortfall in the south-east United States. The major objective of modern irrigation systems is to preserve plant health, even though we want to use as little water as feasible. An appropriate amount of water must be applied on a regular basis to maintain healthy lawn. Turf that receives insufficient water will wilt and turn brown. Traditional irrigation control methods frequently over irrigate in order to be safe, but this can have its own issues. Excessive surface water

can destroy a plant by causing root rot and additional waste due to desertion and run off. Additionally, incorrect irrigation is the source of these problems, as overwatering can cause the soil around plants to erode and even leach dangerous fertilizer chemicals. In many different environments, automatic irrigation systems are a crucial tool for ensuring that plants and crops are properly watered. They provide a number of advantages, such as increased plant and animal health, time savings, and water conservation. They make available a number of advantages, such as increased plant and crop health, time savings, and water conservation. To ensure the system's continuous proper operation, it is crucial to choose the appropriate system and components, install the system correctly, and maintain the system frequently.

PROBLEM STATEMENT

The biological neural networks that comprise up the human brain's architecture are wherever the term "artificial neural network" starts to appear. Similar to how neurons in the human brain are associated to one another across several network levels, artificial neural networks likewise contain neurons that are attached to each another at these levels. Nodes are the name for these neurons. To the project's primary goal is to maximize the utilization of water. Water conservation is now more critical than ever because water wasting has grown to be a serious, global problem. The overflow of water is one of the frequent forms of waste we experience. Improving the duty cycle for the charge controller, converter, and inverter by designing the ANN-random forest technique. To increase the SOC's precision. Restoring the inverter.

PROPOSED SYSTEM

This chapter focuses with explaining the block diagram and the hardware description. Understanding the block diagram's explanation will help you understand how the system works and precision of the model. The suggested technique generates PWM signals for a voltage source inverter using ANN-based Random Forest methodology. Figure 1 displays the entire system. The battery receives the solar energy that is supplied to the back boost converter to increase

the signal's loudness. Using a voltage source inverter, the DC signal is transformed into an AC signal. The suggested ANN-based control algorithm regulates the gate pulses. Based on random forest, ANN algorithm is used to generated PWM signals which is given to voltage source inverter. Final AC signal is given to the load A collection of solar cells that are photovoltaic mounted on a frame (typically rectangular) is referred to as a solar power panel, photovoltaic electrical panel, photo-voltaic (PV) part, PV panel, or solar. A rationally organized group of PV panels is referred to as a photovoltaic system, often known as solar arrays. Sunlight is used by photovoltaic cells to collect solar electricity, which is subsequently transformed into DC (direct current) power. Renewable energy can be generated through photovoltaic system arrays and either used to directly power appliances that use electricity or supplied back into the alternating current (AC) grid. Sunlight, a clean renewable energy solar energy can be generated via photovoltaic system arrays and either used to directly power electrical equipment or provided back into the alternating current (AC) grid. Solar environmentally friendly energy source, to turn it into electricity that may then be used to power various here, moving on to the converters, which can act as a DC-to-DC to DC Step-Down or Step-Up converter based on the duty cycle, D. Utilizing pulse-width modulations (PWM) or the pulse-duration modulated (PDM), the average energy of an electrical signal can be reduced. Controlling the normal amounts of energy (and current) given to the load requires quickly flipping the switch that turns on and off the supply and the loads. The load receives more power overall when the switch on the device is on for an extended period duration than when it is off.

RANDOM FOREST ALGORITHM

Random Forest is the name of the common supervised learning method used in artificial intelligence. It can be applied to regression- and classification-related ML problems. It is based on the idea of learning in ensembles, a method for combining many approaches to tackle a challenging problem and increase the usefulness of the model that is produced. According to what its name implies, "Random Forest is a predictor that incorporates many decision trees on different

subsets of the provided dataset and selects the average to enhance the expected accuracy for that dataset". Using forecasts starting each decision tree and the greater part votes of those projections, the random forest predicts the outcome rather than depending solely on one decision tree. Since there are more trees in the wooded area, the accuracy is higher and the over fitting issue is avoided.

Assumptions for Random Forest Backtracking and Back propagation Multiple layers:

- It is possible that some of the selected trees will correctly anticipate the conclusion while others won't when using the random forest strategy, which combines several trees to forecast the categories of the data set. But when every component is taken into account, they are able to accurately predict the outcome. The two following hypotheses for a better Random Forest classifier is the result.

- In order for the classifier to predict genuine outcomes rather than merely a guess, the feature parameter in the dataset must have some real values.

- Every tree's prediction must have incredibly low correlations.

- The two parts of Randomly Forest's operations are: (1) constructing a random forest by combining N selection trees; and (2) generating forecasts for one of the trees constructed in the initial phase.

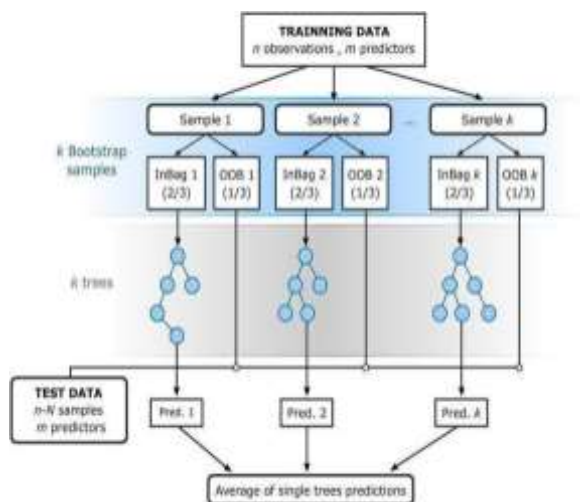


Figure 2: Block Diagram of Random Forest Algorithm

The processes and diagrams below can be utilized to demonstrate how the process of working operates:

Step- 1: From the training set, choose K data points at random.

Step-2: Create the decision trees connected to the subsets of data that you have chosen.

Step-3: Choose N for all the trees you plan to build.

Step-4: Steps 1 and 2 should be repeated.

Step-5: To assign the freshly obtained information to the group that receives the most votes, find predictions for the decision tree of each new data point.

Step-6: Selection stages of feed forward -Gj (xi-N) and (yi-K) value (Ui...UJ) get N-neural node value

Step-7: Back propagate error correction method of report step1&2 prediction of G1 and fk value choose decisions trees for random algorithm for backtracking mode

Step-8: For hidden input layer of (W*nk+1) and [W*nN-1] mode choose for error reduction mode [fi<gi>Yi*nk+1]

Step-9: To apply stage2 node [W^m+kn-an+2] selection for artificial neural network algorithm for hidden output layer $W^m(k+1) = W^m(K - \text{Alpha } S^m(a^{m-1})^Tg)$ value output.

Step-10: Select the final output node solution of (Zjn-1(1÷Tn1÷2)) value b01 and...w11

Step-11: Repeat stage2 value again to choose hidden input layer channel node execute.

Random Forest applications:

Random forest is mostly utilized in four industries:

Investment: For assessing loan risk, the financial services industry usually employs this method.

Medicine: This approach can be used to spot patterns of disease and possible concerns.

Land Use: This technique allows us to locate places with comparable land usage.

Marketer: To identify marketing trends, utilize this algorithm.

Benefits of Random Forest:

Regression and classification tasks can both be handled by Random Forest.

The model's accuracy is improved and avoids the issue of over fitting problem.

RESULTS AND DISCUSSION

The study of simulation of a water pumping system driven by an ANN with a random forest of induction motors are presented in this chapter. Today, one of the finest techniques to analyze system or circuit behavior without causing harm is through simulation. It should be emphasized that computer simulation and a proof-of-concept model for hardware in a lab are complementary in power systems. This chapter mainly presents the results of the simulation output and analysis of solar panel, battery performance output power derives in hybrid co-operative process using MATLAB output for graphical view representations diagram.

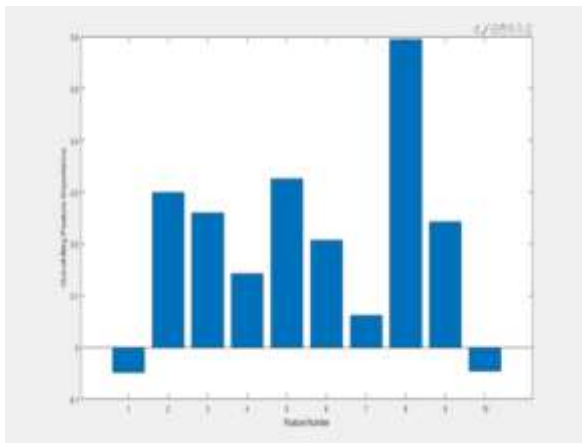


Figure 3: ANN - Random Forest Feature Extraction Chart

The implementation and verification of the operation of an artificial neural network on a random forest-based induction water pumping system was done in the MATLAB environment, and the complete simulation of solar auto irrigation utilizing the ANN-model and RFA approaches is illustrated in Figure 3. Backtracking line search optimization (BLSO) is primarily used to increase system effectiveness and protect water resources. The output of the feature error finder predicts and responding model on trying to target unexcelled in accuracy of among input variable decision trees error reduction on output will indicate results, as shown, of the tree-based learning algorithm XG boost, which comes with feature importance attributes. The working on ANN random based forest algorithm using to output for induction motor water pumping system

to implement and verify in MATLAB output to Environment and overall representation is displayed. The Random Forest algorithm to selection graph output view for out of bad classification error occurred in Proposed for curve in output result view to selection stages one out of bad square mean value to error correction method to indicates result in output stage one. Results are provided with which an improvement in the operation of induction motors and battery charging can be observed which is shown in Current Output Graph of an Inverter Gate pulses are managed by the suggested ANN-based method, and the RF is employed to produce the PWM signals that are provided to the VSI then the inverter current load is provided the final AC signal. Motor Speeds and Torque Graph The inverse proportionality governs the relationship between torque and speed. A motor's rated output power is a predefined amount. As a speed rises, the amount of possible output torque falls, proportionally three phase category to simulation represented $T_r = K(s_i(s))E^2R^2 + (I_1 + V_1 \sqrt{I_2V_2})$ $T = K I_2 \cos(\pi/2)$ into three phase output. A material's water content or wetness is the amount of water it contains. Examples include rock, soil, pottery, crops, and woods. Figure 9 illustrates the range of the ratio used to describe water content in scientific and technological fields, which ranges from zero to the porosity of the material at saturate.

CONCLUSION

Utilizing an autonomous irrigation system allows farmers to use less human labor while yet using water more efficiently by avoiding loss. Solar panel excess energy can also be supplied to the grid in tiny amounts. Changes to the system circuit that might increase a farmer's income, promoting agriculture and providing a remedy for the energy crisis at the same time. Solar pumps also deliver clean solutions without the chance of borehole contamination. The project describes the results of the measurements to continuously monitor the state of the soil in the air and the temperature during the time of continually updating in cloud store server page to notify the simulation output. graphical representations of the speed, torque, and output efficiency of a single-phase induction motor and the random-based forest algorithm using the stage 1 and stage 2

representations of output error correction and reduction ANN is used to solve issues like estimating the stability of the power system. The estimation error accuracy of the induction motor control and power electronics system is evaluated due to its A two-level inverter-based induction engine drive output application quickly implements the pulse width modulation (SVM) based on an ANN. Until the entire output (ANN) based model process is accomplished, testing data is supplied via each split node by transmitting either right or left, using output visual representations for the RF regression by the reduction of the mean square error (MSE) output the findings.

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