ANALYSIS OF CHEMICAL AND PHYSICAL PROPERTIES OF SARGASSO BLOOM FOR RENEWABLE ENERGY GENERATION WITH ARTIFICIAL INTELLIGENCE MODELING

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Abstract
The harmful effects of various algae blooms on human and marine life are well-known globally. It is necessary to invent the utilization of such algae bloom for betterment of society and hence proposed research provided multiple benefits. As a supportive tool, Artificial Intelligence (AI) is becoming the high potential area for the fast analysis and predictions in almost all research areas. Also, a microbial fuel cell (MFC) is a relatively new type of bioreactor for wastewater treatment. As there is a need for invention of new renewable energy sources, we invented Sargassum as a new media for energy generation and therefore this research is the first time using Sargassum samples in a single-chambered MFC. This paper presents the development of new deep learning algorithm SargassoCNN to identify the various types of Sargassum bloom samples which further can be analyzed for selection of sample for best electricity generation medium using deep learning image processing algorithm.

Keywords: Hazardous Algae; Health Restoration, Artificial Intelligence; energy automation; Microbial Fuel Cell.

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DOI: - 10.48047/ecb/2022.11.10.35

1. Introduction

Authors are Presently, the world's overall economy is innately based mostly on the competent methods of electric power generation, relevant administration as well as , distribution. The classic solutions of energy development hold a considerable complication on the universal climate and climate transformations [1,2]. Corresponding to lately publicized information by the International Energy Agency (IEA) Energy-related greenhouse gas (GHG) exhausts may tweaked to substantial climate deterioration because of an average 6 °C global warming [3]. Subsequently, the clean energy is the possible alternative to make the globe healthier and energy efficient. It is eco-friendly credited to the lowest CO2 contaminants, that is the primary strategy of the green house influence accountable for topographical deterioration [4,5]. Statistics from alternative energy systems getting innately loud are good prospect concerns to be managed by AI [6].

AI evaluation is structured on earlier track record data of a model and so is subsequently appropriate to be better perceived and preferred by engineers than other assumptive and scientific strategies. AI is utilized in almost every category of RE (wind, solar, geothermal, hydro, ocean, bio, hydrogen and hybrid) intended for the designing, optimizing it, evaluation, administration, distribution, as well as , policy [7]. Genetic Algorithm (GA) in maximum power point tracking (MPPT) of PV array hooked up to the battery pack. The overall performance of the GA [8] is investigated by the classic perturb and observe (PO) algorithm [9]. In relation to the proposed research, we evaluated literature about Sargasso Sea. The Sargasso Sea is an area of the Atlantic Ocean bordered by 4

currents, creating an ocean gyre. In contrast to all several other territories referred to as seas, it offers no land boundaries. It is distinguished from several other parts of the Atlantic Ocean by means of its characteristic brownish Sargassum ocean weed as well as frequently boasts blue water [10,11].

The problem of handling of such huge Sargassum bloom is well known worldwide as it costs more to remove such blooms which are harmful for human and marine life. Hence, to utilize these harmful blooms, the energy generation with natural catalyst material was executed. As is difficult and expensive to collect Sargassum bloom samples and tests experimentally, we developed AI model to predict the quality of Sargassum samples by using images. In this paper, section 2 discusses literature review where relational computational algorithms and energy system issues are discussed. Section 3 provides the overview of functional areas of microbial fuel cell (MFC), section 4 provides newly developed convolution neural network algorithm. Section 5 discusses the results of research and section 6 concludes the research.

2. Literature Review

A microbial fuel cell is a unit that transforms inorganic energy into electrical energy with the help of the catalytic effect of bacteria. A microbial fuel cell comprises anode as well as cathode chambers segregated by means of a particular membrane layer [12]. As several microbial cells are electrochemically sedentary, electron transmission by microbial cells to the electrode is triggered by the aid of mediators, including methyl, humic acid, and so forth. Seeing that several of the mediators are costly as well as harmful, a microbial fuel cell utilizing mediator is not launched [13]. In the event that anaerobic sludge is employed as an inoculum for MFCs, approaches need to be invented to limit the development of methanogens and so to improve the progress of the electrochemically activated microbe on the anode. Many reviews have explained MFCs inoculated with sludge, however, they commonly employed residual methods structured on the addition of an inoculum right into the anode solution [14].

In one research, it was discovered that enrichment of a microbe on the anode of a MFC lead in improved electric power outcome and a transformation in the microbial community, although a comparability of diverse transmission methods for MFCs has not been formed [15]. Among the actual issues in several transmission strategies are the rivals of a microbe for space on the electrode. non-growing microbe that affix to the electrode may inhabit electrode location that may preferably be applied by means of electrochemically established microbe [16]. In classic MFC-based biosensors, the sensing impulses are completely electric current, potential, conductance or impedance. Current densities coming from solitary chamber air-cathode MFCs with a several supply of substrates were accumulated from earlier research [17,18,19] and consequently normalized to anode specifications. MFC current density is commonly influenced through various reasons, just like reactor setting, electrode resources, as well as , electrode space, and functional predicament.

To assist in data visualization and then boost operation effectiveness, random forest [20] variable importance activities are employed to identify the effect of every predictor variable separately along with in multivariate relationships with different predictor variables. To determine as well as discover the relationship amongst microbial populace abundance as well as supply substrate, machine learning algorithms XGBOOST [21], KNN [22] and SVM [23] were trained and re-evaluated regarding the potential to forecast substrate structure from the numerous taxonomic positions of genomic data. The trained and validated methods productively discriminated amongst the 3 supply substrates, as anticipated. The superior accuracy of base classification types structured on the graded datasets recommended that the ideal operation variables for determining feed substrate may be attained by means of developing more particular microbes' organizations. According to author, a neural network is an extremely simultaneous distributed processor that has a natural tendency for holding experiential training and so building it obtainable for usage. It is similar to the human brain in two aspects; the knowledge is attained by means of the network simply by a learning procedure, and inter-neuron association advantages alluded to as synaptic weights are employed to keep the knowledge. ANN models can be employed as an alternate approach in engineering analysis as well as forecasts. ANN imitates somewhat the learning procedure of a human brain. These function just like a "black box" unit, looking for no specified details about the system [24].

Many algorithms are typically employed to accomplish the minimal error in the least time. Certainly, there are even various substitute ways of neural networking systems and so various distinctive approaches in which they may be

utilized to a provided issue. The appropriateness of an right paradigm as well as methodology for application is extremely established on the category of issue to be fixed. The best well-known learning algorithms are the back-propagation (BP) as well as its variants [25]. The BP algorithm is among the very potent learning algorithms in neural networks and so is a lean descent procedure. It attempts to boost the overall performance of the neural network by means of lowering the ultimate error by swapping the weights around its obliquity.

3. Significance of Microbial Fuel Cell

The overall performance of a MFC can be impacted by means of many elements. They are the costs of resource oxidation as well as electron balance transfer to the electrode through the microorganisms, the level of resistance of the circuit, proton transportation to the cathode with the aid of the membrane layer, as well as oxygen source and decrease in the cathode [26]. Lately, initiatives have been made to employ local sewage as a fuel for MFCs because of topographical problems and so the need to recycle waste materials. Anaerobic sewerage sludge is a strong choice for inoculating a MFC considering that it is conveniently acquired from a sewage management plant and so it includes remarkably diversified microbial communities that include electrochemically productive traces of microbe. The number of microbe in standard anaerobic sewage sludge is presumed to consist of fermentative microbe, methanogens, as well as sulfate reducers [27]. Modeling as well as simulation is powerful means to figure out the procedure approach and validate the results of maximum regulation strategies of MFC. Electricity generation in MFCs has been patterned by a few researchers. Author recommended a two-population model expounding on the rivals of acidophilic as well as methanogenic microbes masses for a prevalent substrate in a single chamber MFC [28].

4. Significance

In order to invent new renewable energy source, proposed research investigated for Sargassum samples as a media for energy generation. Till date, many AI models have been developed by researchers including NASA team for identification of location of Sargassum blooms flowing through sea but this is first research focusing on micro-level analysis of Sargassum with the intention of using it as a media for energy generation. The Sargassum sample identification is sorted on the basis of image differences using the following newly developed deep learning convolution neural network (CNN) algorithm named SargassoCNN.

Algorithm: SargassoCNN

Input: Sargassum images

Data: C: convolution layers, D: deconvolution layers, $P_{pooling}\{0,n\}$: pooling layers

Result: SargassoCNN: a proposed model is trained and validated model for sample Sargassum

1. Set the hyper-parameter H_p=(all)
If batch Sargasso _sample==all
Else batch_task== invalid_sample
2. Create $\text{Sargasso\_cnn\_0}\ (C, P_{pooling})$: $\text{Sargasso\_cnn\_n}\ (C, P_{pooling})$ #Create the first training loop
3. $\text{Sargasso\_cnn\_n} = (\text{Sargasso}_{cnn_0(C, P_{pooling})} + \text{AddLayer})$ # Run the training using Concat Layer to identify accuracy parameter.
4. While $(P_{pooling} != 0)$ do
$\text{losses} = \text{AllPixel} - \text{Noice}$
5. AddLayer
$\text{Sargasso\_cnn\_n} = P_{pooling+}\ \text{Sargasso\_cnn\_n}(C, P_{pooling}) - \text{losses}$ # Remove losses for enhancement of clear prediction
6. Activate rectified linear unit $\text{Sargasso\_cnn\_n}_{relu()}$
7. Adding a new Sargassum Image $(C, P_{pooling})$
8. Sargasso_cnn_n (0 to n) = $\sum_0^n \text{Sargasso\_cnn\_n}_{relu()_{pooling}}$

The accuracy can be calculated by using standard formula as shown below:

$$\text{Accuracy} = \frac{T_P + T_N}{(T_P + T_N) + (F_P + F_N)}\ X\ 100 \quad (1)$$

Where true positive (TP), true negative (TN), false positive (FP), and false negative (FN). The execution results are discussed in next Section 4.

5. Results

As this is first research for energy generation using Sargassum sp, there is no dataset available for images of Sargassum at the micro-level; we used 6 samples from different locations as shown in figure 1 below. The objective of this micro-level analysis is to identify the probability of fruit classification and the final output is based on fresh and rotten Sargassum samples. As per actual laboratory tests, fresh Sargassum generates more energy and acts as a natural catalysis where rotten Sargassum leads to release of harmful gases. Using SargassoCNN model, the prediction of selection of Sargassum sample becomes easy and saves time that requires for actual laboratory test. The output of model is the final predictive classification, which can suggest which sample is better for microbial fuel cell energy generation.

Fig. 1 Samples of Sargassum sp. from 6 locations

Further, we identified visual differences in samples and noted the details after execution of deep learning model with the new convolution neural network algorithm SargassoCNN as shown in Table-1 below.

Layer	Feature Maps	Kernel Size	Stride
Input		6	
Convolution Layer-1	5	1	3
Pooling Layer-1	1	2	-
Convolution Layer-2	4	2	1
Pooling Layer-2	1	3	-
Convolution Layer-3	3	3	1
Pooling Layer-3	1	4	-
Convolution Layer-4	4	2	1
Pooling Layer-4	1	5	-

Table-1: SargassoCNN execution results

The SargassoCNN algorithm model consists of four convolutional layers and 4 pooling layers among the convolution layers. Since the SargassoCNN model aims to classify six types of Sargassum sample images, the last fully connected layer has six channels after de-convolution. As the dataset size is small, we labeled six images repeatedly to test it randomly and epoch size is taken 50. The sequence of execution done by convolution and again recurrent de-convolution of samples which gives more accuracy after training and validation, as shown in figure 2 below.

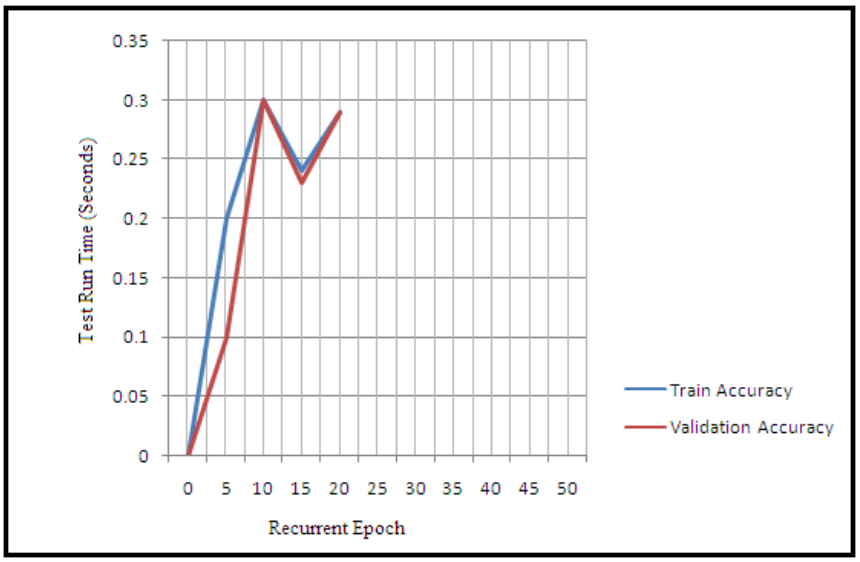

Fig. 2 Comparison of Recurrent Training and Validation Accuracy for Proposed SargassoCNN Algorithm

The accuracy curves shown in Figure 2 above are common indices utilized to examine self designed data sets' learning overall performance. Figure 2 symbolizes the accuracy significance of the SargassoCNN model training as well as , validation. The graph reveals the performance of the SargassoCNN algorithm for Sargassum sample model. The model can be employed to discover the level of quality of Sargassum samples for further utilization of energy generation employing microbial fuel cell.

6. Conclusion

In this paper, the purpose of research is focused on a fast prediction of Sargassum sample, which further can be utilized for energy generation. The SargassoCNN algorithm is better in accuracy during training of dataset and validation too. This saves the time for Sargassum collection from different geographical locations and also saves the laboratory expenses. Using this research, researchers can identify quality of samples which can be used for energy generation using microbial fuel cell. This research provides multiple benefits as managing and utilizing Sargassum blooms in coastal areas which can be used as a rural electrification, coastal electrification, and boats can use it as a fuel for on-board electrification. Sargassum utilization can also lead to new policy development. Future research needs to analyze the performance of dried Sargassum samples for energy generation.

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