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OIL SKIMMER ROBOT USING ARTIFICIAL NEURAL NETWORKS

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ABSTRACT

Oil Skimmer Robot is a device which can be used for ocean purification by removing the oil from water surface. The system uses a photovoltaic powered conveyor belt to propel itself and collect oil. The flexible conveyor belt softly rolls over the ocean's surface, absorbing oil while deflecting water because of its hydrophobic properties. The photovoltaic cells generate enough electricity to keep the fleet moving for several weeks and provide the energy to propel the vehicles forward. As the head moves through the water the conveyor belt constantly rotates and sucks up pollution. The belt is then compressed to remove the oil. As the clean part of the belt comes out of the head it immediately begins absorbing oil, making the collection process seamless and efficient. This process is more streamlined than current ocean-skimming technologies because the robots can operate autonomously and don't need to return to the shore for constant maintenance.

Key words: PV, Robot, ANN, Water, Ocean skimming

1. Introduction

Water is the most precious resource for the humans as well for the animals. Water is a finite and unprotected natural resource. The use of water affects the quality of this resource itself and the nature in a broader sense. Sea, river and lake water is valuable for the environment, irrigation and drinking. It is fundamental to protect and fairly use the water. It is important to manage the supply and disposal of water wisely holding that clean water continues to be available to future generations at a moderate cost. This effect of plastic to human body is cause which is done by human itself. Humans are normally throw the plastic of any wafers which first they eat and the wrapper they throw into the water. Likewise plastic bottles are also thrown by human after their

use. It may eaten by marine animals which may cause their life harm and the marine animals when eaten by humans it also cause to human body. To stop the danger of garbage thrown to water, we propose the robot ship which will help to collect the garbage from water and make water harmless and clean. The ship will totally work on solar power which is totally free energy. The ship will not need any other form energy so that it save money .In day time ship will store the energy and at night time ship will start working and collect garbage. In this way we support the Swachh Bharat Abhiyan and serve the nation to make make water free from harm as well as cleanliness will maintain.

Sirichai and team developed garbage collection robot on the beach using wireless communication. The robot is built on the caterpillar wheels, sizes 52x74x17cm and the power is supplied from 12v 30Ah battery which is connected to 40w solar cells. The user can control a robot via a program developed from visual basic 2005 application based on window xp. The command from user is sent via Bluetooth to PICI8F4550 for processing. In addition it is also equipped with an IP camera with added pan/tilt capabilities which relay feedback information to the human operator via Ad-hoc system. The result of robot performances were found that the robot can move with an average speed 0.5meters per second on the sand via wireless communication and collect the garbage with side 12.5 x 49cm for example: glass bottles and plastic, etc. Conventional neural networks (CNNs) are one of the most accurate and widely used data mining processes and forecasting models. It has been shown that a network can approximate any continuous function to any desired accuracy. CNNs are nonlinear and non-parametric methods, and unlike traditional approaches, such as the Box–Jenkins or ARIMA, do not assume that the time series under study are generated from linear processes. However, they may be inappropriate if the underlying mechanism is nonlinear. In fact, real world systems are often nonlinear[3] Artificial neural networks have been found to be a viable contender to various traditional time series models.[4&5] Lapedes has reported the first attempt to model nonlinear time series with artificial neural networks.[6] Imrie et al. have reported the application of CNN for the river flow prediction.[7] Wu and Lo used the CNN to model the nonlinear relationship between accumulated input and output numerical data for the coagulation processes in water treatment.[8] Melessea et al. have presented the application of a multilayer perceptron (MLP) CNN with an error back propagation algorithm for the prediction of suspended sediment load of

river systems.[9] An CNN data driven modeling approach was used by Huo et al. to predict the water quality indicators of Lake Fuxian, the deepest lake of southwest China.[10] Patil et al. have presented a study of predicting sea surface temperature with nonlinear autoregressive neural networks.[11] In this study, we used an CNN approach to predict daily influent water characteristic to Sanandaj water treatment plant. This paper presents a data-mining approach to predict influent water characteristic in a WTP for a short-term period (one day ahead). In this work, the proposed approach is based on the classical nonlinear autoregressive time series using timelagged feed-forward networks, in which the data from the daily time series are used to forecast the next day. In this study the prediction models are developed for alkalinity (Alk), pH, calcium (Ca), carbon dioxide (CO2), temperature (T), total hardness (TH), turbidity (Tur), total dissolved solids (TDS), electrical conductivity (EC), and chloride (Cl) as the influent water characteristics. The models output is evaluated using statistical indices and observed water quality data [12].

2. Related Work

Fig. 1 basic block diagram of solar operated water cleaning boat it totally work on solar energy. This solar energy is collected through the PVC (Photo voltaic cell). The rating of PVC is 12V and 7.3AH then the energy pass through CCU (charge control unit). In between PVC and CCU there is a diode connected so power will only flow in one direction from PVC to CCU. Then this power is stored in Battery which is the rating of 12V and 2amp. This stored power is supplied to CPS (control power supply).This controlled power is provided to ECU (electronic charge unit) or RLU (relay logical unit).

This unit connects the sensor unit and driver circuit. In sensor unit there are four sensors LDR (light dependant resistor) this sensor connects to the PVC for the direction of sun. IRD (infrared detector) sensor is used for the collecting garbage from water. Micro switch S3 sensor is used for them to sence the garbage and collects it. Micro switch S4 is used to limit stop the motor. Driver circuit is used to control all motor. Motor M1 is used for the direction of motor. Motor M2 is used the forward reverse of motor. Motor M3 is used conveyer to catch the garbage. Motor M4 is used for the flapping purpose. The rating of all the four motors is 12v DC.

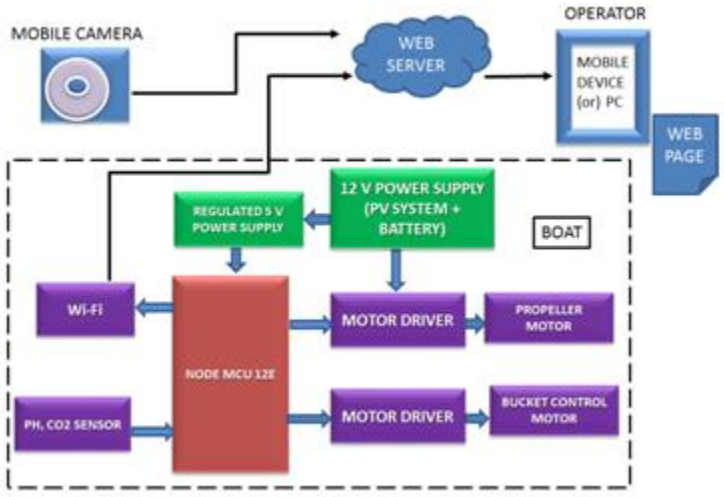

Fig. 1: Block diagram of solar operated water cleaning Boat

3. PROPOSED SYSTEM

Oil Skimmer Robot is a device which can be used for ocean purification by removing the oil from water surface. The system uses a battery powered conveyor belt to propel itself and collect oil. The flexible conveyor belt softly rolls over the ocean's surface, absorbing oil while deflecting water because of its hydrophobic properties. The battery cells generate enough electricity to keep the fleet moving for several weeks and provide the energy to propel the vehicles forward. As the head moves through the water the conveyor belt constantly rotates and sucks up pollution. The belt is then compressed to remove the oil. As the clean part of the belt comes out of the head it immediately begins absorbing oil, making the collection process seamless and efficient. This process is more streamlined than current ocean-skimming technologies because the robots can operate autonomously and don't need to return to the shore for constant maintenance.

The robot is comprised of a head, which is covered by an oil absorbing fabric covered conveyor neodiyum magnetic belt. The photovoltaic cells generate enough electricity to keep the fleet moving for several weeks and provide the energy to propel the vehicles forward. As the head moves through the water the conveyor belt constantly rotates and sucks up pollution. The fabric-

covered belt is then compressed to remove the oil. As the clean part of the belt comes out of the head it immediately begins absorbing oil, making the collection process seamless and efficient.This process is more streamlined than current ocean-skimming technologies because the robots can operate autonomously and don't need to return to the shore for constant maintenance. As the vehicles work in unison they can cover large areas and by communicating with each other and researchers on land. Measuring just 16 feet long by seven feet wide, the fleet can access hard to reach places like coastlines and estuaries.

3.1 Implementation

A Convolutional Neural Network is a class of deep learning, feed-forward artificial neural networks, and most commonly useful for several analyses. They visualize metaphors and Numerical data. It can use a difference of multilayer perceptron designed to need minimal pre-processing. It is very similar to normal Neural Networks. They are made up of neurons that have learned weights and biases. Each neuron receives several inputs, performs a dot product and optionally follows it with a non-linearity. The complete network at rest articulates to achieve the function from the raw input data on one end to achieve the class at the other end. It can make a clear hypothesis that the inputs allow us to encode certain possessions into the CNN process and then, make the forward function more efficient to implement. They very much reduce the number of parameters in the network. Neural Networks consider an input and transform it through a series of hidden layers. Each hidden layer is made up of a set of neurons, where
each neuron is fully connected to all neurons in the previous layer. Neurons in a single layer function in a completely separate manner and do not share any relations. The very last fully-connected layer is called the output layer and it represents the class achieved.
There are three main Layers that build Convolutional Neural Networks. They are Convolution Layer, Pooling Layer, and Fully-Connected Layer
The input [HxWxD] initially will hold the input values and in this case an input data of width (rows), height (columns), and depth 1 are considered. CONV layer will compute the output of neurons that are connected to local regions in the input. It has independent set of filters that work with the input and a small region is connected to in the input volume. The output volume will

be as [32x32x12] and 12 is the number of filters that were used. RELU layer applies an element wise activation function, such as max (0, x) where zero is threshold value. Here the volume size remains unchanged ([32x32x12]). POOL layer performs down sampling operation throughout the spatial dimensions (width, height). It resultant volume is[16x16x12]. Its function is to reduce the spatial size of the representation progressively. Therefore, it reduces the number of parameters and computation in the network. Fully-connected layer will compute the class scores. It results in volume of size [1x1x10], where each of the 10 numbers corresponds to a class achieve. As with ordinary Neural Networks and as the name implies, each neuron in this layer will be connected to all the numbers in the earlier volume. In this fashion, Convolutional Neural Networks transform the input raw data, layer by layer from the input raw values to the final class scores. Particularly, the Convolution and Fully Connected layers perform transformations that are a function of not only the activations in the input volume, but also of the parameters (the weights and biases of the neurons). On the other hand, the RELU layer and Pooling layer will implement a fixed function. The parameters in the Convolutional and Full-Connected layers will be qualified with gradient descent so that the class scores that the Convolution Neural Networks computes are consistent with the labels in the training set for each input. To implement convolutional neural networks a training dataset is considered as input. The dataset contains numerical values that correspond to some nominal data.

The processing of training data set using Convolutional Neural Networks resulted in calculating the risk factor in an efficient manner. Various factors contributed for fatal accidents were identified using this classification technique in a most probabilistic approach. The results obtained were used to specify fatal conditions for an accident. Thus, safety measures can be provided to people moving on roads in such conditions. During the process, various attributes like collision type, light conditions, weather conditions, surface conditions, speed, drunk driver or not were taken into consideration to find out the risk factor. The risk factor specified the possibilities of fatal accidents at different areas. The results obtained in calculating the risk factor using Convolutional Neural Networks can be shown below. Efficiency of the classification algorithm, Convolutional Neural Networks can be known by calculating accuracy, precision, recall and f-measure on resulted data. Accuracy defines the trueness of occurred result. The

actors precision and recall specify the occurrence of relevant instances over retrieved instances and total number relevant instances respectively. These three measures can be calculated based on following factors.

- True positive (TP): If the given combination matches with at least one record in base dataset along with result, that particular result corresponds to TP value.
- True Negative (TN): If the given combination matches with at least one record in base dataset but the rate doesn't match, it defines TN.
- False positive (FP): If the given combination doesn't match with any record in base dataset but the fatality rate is High, it comes under FP.
- False negative (FN): If neither the record matches nor the rate is High, its FN.

The above values TP, TN, FP and FN are compared and incremented on matching basis. Final counts of every case are jotted and following formulae calculates the values respectively.

$$Accuracy = (TP+FP)/(TP+TN+FP+FN) \quad (1)$$

$$Precision = TP/(TP + FP) \quad (2)$$

$$Recall = TP/(TP + FN) \quad (3)$$

$$F\text{-}Measure = (2*Precision*Recall)/(Precision+Recall) \quad (4)$$

Efficiency based Result for the classification techniques Naïve Bayes and Convolutional Neural Networks can be given in the below tabular for based on above calculations. A neural network is a series of algorithms that endeavours to recognize underlying relationships in a set of data through a process that mimics the way the human brain operates. In this sense, neural networks refer to systems of neurons, either organic or artificial in nature. Neural networks can adapt to changing input; so the network generates the best possible result without needing to redesign the output criteria. The concept of neural networks, which has its roots in artificial intelligence, is swiftly gaining popularity in the development of trading systems. Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other.

The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNets have the ability to learn these filters/characteristics

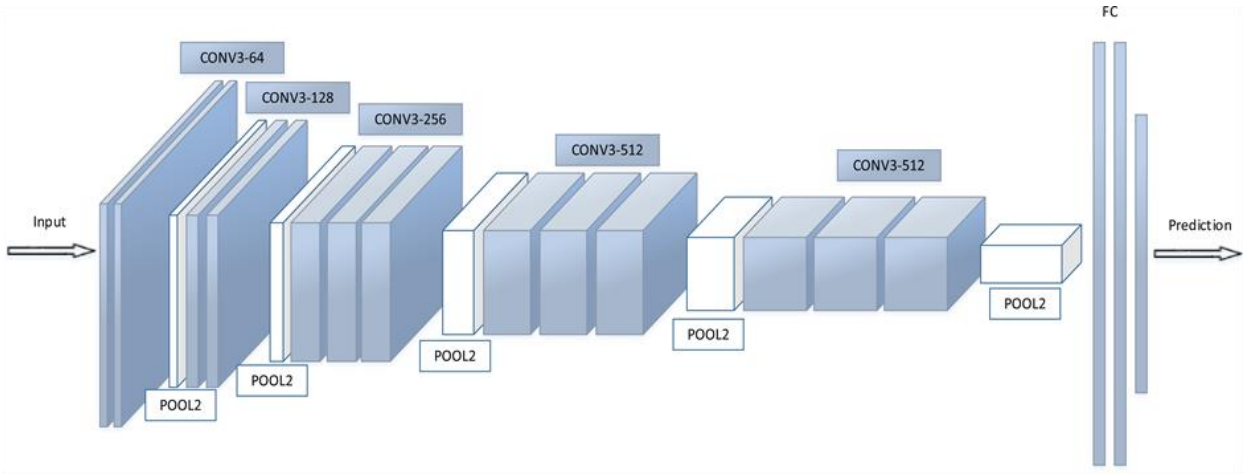

Fig. 3: **Problem with Feed forward Neural Network**

Suppose you are working with MNIST dataset, you know each image in MNIST is 28 x 28 x 1(black & white image contains only 1 channel). Total number of neurons in input layer will 28 x 28 = 784, this can be manageable. What if the size of image is 1000 x 1000 which means you need 10^6 neurons in input layer. Oh! This seems a huge number of neurons are required for operation. It is computationally ineffective right. So here comes Convolutional Neural Network or CNN. In simple word what CNN does is, it extract the feature of image and convert it into lower dimension without losing its characteristics. In the following example you can see that initial the size of the image is 224 x 224 x 3. If you proceed without convolution then you need 224 x 224 x 3 = 100, 352 numbers of neurons in input layer but after applying convolution you input tensor dimension is reduced to 1 x 1 x 1000. It means you only need 1000 neurons in first layer of feed forward neural network.

4. RESULTS AND DISCUSSIONS

It can be very effectively used for skimming away oil spills from the surface of oceans. The deep water horizon rig regions can use the Sea swarm in case of accidents. It can also be

used in oil refineries near to oceans or any other industries which dispose chemicals and other waste oils to the rivers nearby.

5. CONCLUSION

The oil skimmer robot driving mechanism is based on battery energy so problems related to its fuelling can be completely omitted and it can be a renewable source. Use of Nano fibre belts could improve the efficiency of system. This paper has proposed the autonomous distributed system/ robotic swarms as a novel concept for efficient oil spill confrontation. Instead of using a single robot, if a large no of oil skimmers are fabricated then it will have high autonomy that recover oil mechanically and are able to collect and share information with each other. The multi-unit/co-operative behaviour approach provides a more environmentally friendly, efficient, versatile and fault-tolerant means for oil spill elimination. This artificial intelligence concept is generic for marine pollution elimination; for example, its application could be easily extended for port refuse collection. The swarm recovery has been integrated in a mathematical description of the dynamics of spreading and weathering of an oil spill. Simulations of this model signify the increased efficiency and the potential of the concept.

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