A Survey on Emerging Sensor Technologies for Groundwater Detection

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Abstract- The main reason of ground water detection is to remove the reasons of scarcity in dry areas. Various authors shows the percentage of surface water as well as ground water in 2000's after green revolution adoption reaching at very low level. So, in optimization approaches for water resources the designer is responsible for the formulation of the mathematical equations with constraints as well. The search for optimal solution made the assumptions of the proposed method. For such problems designer interaction with search algorithm makes this task less complex. In this paper various techniques has been shown for ground water detection.

Keywords- Ground water Detection, Swarm Optimization, Genetic Algorithm, Sensor Technology.

I.INTRODUCTION

Water plays an important role in the development of the natural life as well as in industrial growth [1, 3]. In areas where surface water lacks, the dependency on the ground water become essential. One of the major essentiality of life is water. A review has showed up that .6% constitutes for ground water, 97% for sea water, 2% for snow and ice. The study of ground water has been increased due to the increase in the rate of the inhabitants.

Low electricity bills are the main factors that leads to the huge water usage leading to fall in water tables. In addition to that there is much rush in growing crops in fields at much faster rate also leads to the excessive utilization of the water. So there is urgent need to detect the presence of ground water [4, 6]. So this paper will review various techniques for ground water detection.

A. Clustering

Clustering can be said as distinguishing proof of comparable classes of articles. Clustering is a data mining procedure of collection set of data items into numerous gatherings or clusters so that questions inside of the cluster have high comparability, yet are exceptionally not at all like articles in alternate clusters.

1.Principle: Maximizing intra-class similarity & minimizing inter-class similarity as shown in figure 1.

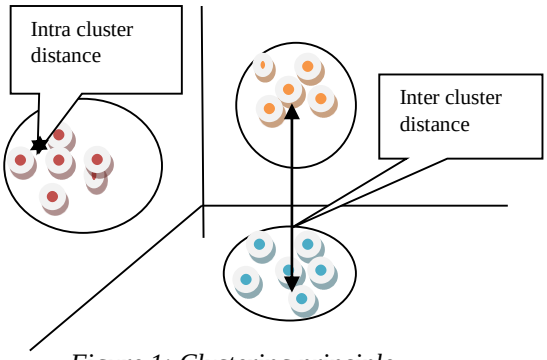

Figure.1: Clustering principle

Clustering is the most common form of unsupervised learning and is a major tool in a multiple applications in several areas of science and business. Hereby, we summarize the basic directions that how clustering is utilized.

- Discovering Alike Documents.
- Organizing Large Document Collections.
- Duplicate Content Detection.
- Search Optimization.
- Recommendation System.

We can illustrate how clustering is posses by implementing K-Mean clustering technique to generate clusters of single data set.

Lemma 1:Clustering Algorithm

Step 1: load maindata

{

X=data;

{

opts = statset('Display','final');

```
axes(handles.axes2);
axis on;
    }
                //load main data and display that
Step 2: [idx,ctrs] = kmeans(X,2,...
            'Distance','city',...
            'Replicates',5,...
            'Options',opts);
                                //k-mean pseudo
  {
plot(X(idx==1,1),X(idx==1,2),'r.','MarkerSize',12)
hold on
plot(X(idx==2,1),X(idx==2,2),'b.','MarkerSize',12)
plot(ctrs(:,1),ctrs(:,2),'kx',...
   'MarkerSize',12,'LineWidth',2)
plot(ctrs(:,1),ctrs(:,2),'ko',...
   'MarkerSize',12,'LineWidth',2)
     }
  // k-mean generate two clusters describe on plots
legend('Ground water pre phase','Other element ','Centroids',...
    'Location','NW')
                            //calculate the centroids
      {
Step 3:  gcluster(:,1)=X(idx==1,1);
 gcluster(:,2)=X(idx==1,2);
 ocluster(:,1)=X(idx==2,1);
 ocluster(:,2)=X(idx==2,2);
 axes(handles.axes1);
 cla
// two clusters, one specifying ground water and second specifying others
      }
```

```
%plot(gcluster);
hold on;
plot(ocluster);
xlabel('Total number of elements ');
ylabel('Value');
grid on;
title('Ground water cluster values');
Step 4: save('clusteringdata','gcluster');
                // save the cluster data in database
}
```

Description: K-mean clustering technique is used to generate clusters. First we load data extracted from data set. Secondly apply k-mean clustering and generate two clusters shown by draw plots with labels, Ground Water and Others. At last save data in database.

2. Data Mining: Data mining/knowledge-discovery in databases is a method of releasing conceivable data from raw information [7] and [5]. Data mining process can be extremely useful for Medical practitioners for extracting hidden medical knowledge. It would be impossible for traditional pattern matching and mapping strategies to be effective and precise in prognosis or diagnosis without application of data mining techniques. Knowledge discovery and data mining have discovered in many business and scientific domain applications. Valuable knowledge can be discovered from the various applications of data mining methods in healthcare systems too. Data pre-processing and transformation is required before one can apply data mining to clinical data. Knowledge discovery and data mining is the core step, which results in detection of concealed yet valuable knowledge as of from huge databases.

II.COMPARATIVE REVIEW

In this era, researchers have used number of techniques for detecting ground water percentage.

Existing work for detecting percentage value of water by authors is presented here**.**

[6] G.J Desouja, proposed the concepts of data clustering and image segmentation based on natural computing. The main goal of evolutionary, swarm based algorithms is to achieve the accuracy based on behavior of individuals. So this work has proposed algorithms like PSO based K-means and fuzzy K-means algorithms. Simulation has been applied on vaious datasets like Ruspini, Iris and Wine and BrainWeb.

[7] Qin Dai et.al, proposed an Ant Colony Optimization (ACO) procedure takes motivation commencing the

synchronised activities of ant swarms that has presently practical in a lot of study arenas for instance like an innovative progressing technique to resolve various kinds of optimization issues. Utilizing the ACO procedure in the direction of picture cataloguing doesn't undertake a primary statistical dispersal intended for the pixel information, the contextual data could possibly be taken into account, as well as it has resilient robustness. The research outcomes recommend that ACO technique turn out to be a new operative technique meant for information processing.

[8] X.S. Yang et.al, planned to create a novel meta-heuristic algorithm, called Cuckoo Search (CS), for solve optimization issue. This method is depending upon the make necessary clutch scrounging actions of several cuckoo varieties in amalgamation with the Levy flight actions of several birds in addition to fruit flies. They also certify the proposed technique alongside test operators and later then evaluate the aforesaid performance by means of genetic algorithms in addition to particle swarm optimization.

[9] Hongzan et.al, proposed the algorithm for the classification of hyperspectral images using ADC. In proposed work 2 algorithms has been compared i.e. K-Means clustering and ISO DATA algorithm. From result evaluation it has been measured that the proposed work has good accuracy with kappa coefficient .76 %.

[10] H Yang et.al, proposed an algorithm based on particle swarm optimization (PSO) for enhancement of SVM method by reducing the obtained features from SVM. PSO has been utilized to get the global solution.

TABLE 1: Comparative Review

Author	Techniques	C Pros:	Cons:
[6]Desouza	BBO and ABC algorithm	S_p	P_{ro}
[8]X.S. Yang	Cuckoo Search (CS)	P_{er}	C_{on}
[9]Hongzan	Computing method	A_{cc}	G_{eo}
[10]H Yang	SVM and PSO	A_{cc}	S_{ea}

Where

Sp=Speed; Pr=Probability Value; Acc= Accuracy, Per=Performance; Geo=Problem with Geographical Data Storage; Sea=Modification of searching point; Con=Consistency problem.

III. VARIOUS APPROACHES BASED ON NATURAL COMPUTING FOR GROUND WATER DETECTION

Natural Computing is the field of research that deals with computational techniques that deal with natural inspiration. It attempts to understand the world around us in terms of information processing. It's a highly interdisciplinary field that connects the natural science with computing science; both at the level of information technology and at the level of fundamental research.

A. ANN

The simplest type of Neural Network is ANN (Artificial Neural Network). ANNs are designed closely to the neural structure of the brain. Neural network mainly consists of the layers. Layers are made up of nodes. There are mainly three types of layers in the neural architecture: Input layer, hidden layer and output layer. On the basis of the output layer weights are assigned to get output accordingly to input layer. Most of the ANNs contains the learning rule that helps in maintain of the weights according output layer. There are many types of the learning rules in neural network but delta rule is common rule that has been used these days [13]. Some useful properties of ANN are:

- Adaptability
- Non-linearity
- Uniformity of analysis and project
- Mapping between Input-Output
- Fault-tolerance

B. ABC Algorithm

ABC algorithm is a new intelligent optimization algorithm implying the winged animal swarm practices, which was proposed by analyst Kennedy and Dr. Beernaert in 1995. In ABC calculation, every individual is called "Burrowing little creature COLONY", which speaks to a potential arrangement. The calculation attains to the best arrangement by the variability of a few particles in the following space. The ANT COLONYs seek in the arrangement space taking after the best ANT COLONY by changing their positions and the wellness oftentimes, the flying course and speed are controlled by the objective function.When the performance of the ABC algorithm is compared with other algorithm like GA, DE, PSO, then it founds to operate in its best efficiency.

In ABC algorithm, one bee is waiting to choose the food source then this food source is visited by one of the bee from group [14]. In this food position tells the solution available.

The position of the food is represented using following formula:

$$Ft = 1/1 + f$$

Where f is fitness calculation.

C. Genetic Algorithm

Genetic algorithm is the type of algorithm that is used to solve both constrained and non-constraint problems based on selection criteria. Genetic algorithm modifies the new population and generate new solutions until best solution has not been reached. From large set of population, genetic algorithm uses the random chromosomes to make it parent then make it to produce children. The repetition goes on until good solutions have not been achieved on the basis on the [15] fitness function. Genetic algorithm has mainly three operators:

Selection: Selection operator posses the selection of chromosomes by allowing them to pass on their genes to next generation.

Crossover: Crossover is process of taking more than one parent chromosomes and produce a child from that parent chromosomes.

Mutation: Mutation is a process in which two parents must mutate to reproduce a child.

Here we define the Genetic algothim by apply fitness function on cluster data that we generated by apply K-Mean clustering Technique.

Lemma 2: Genetic Algorithm

```
Step 1:  load('clusteringdata','gcluster');
{
  axes(handles.axes2);
%    axis on;
tic;
   cla;
    {
Step2: global GareducedFeatures
 featurecount=1;
options=gaoptimset('PopulationSize', 50,'SelectionFcn'...
,@selectionstochunif,'MutationFcn',{@mutationuniform,
0.05},'CrossoverFcn'...
    ,{@crossoverintermediate, 0.8});
    }
                                        // GA operators
Step 3:  [r,c]=size(gcluster);
              // calculate row and column of gcluster
       {
for i=1:r
   Ft=mean(gcluster(i,:));
           {
 for j=1:c
  Fs=gcluster(i,j);
     FitnessFunction = @(e)fitness_fn(e,Fs,Ft);
                }
                          // calling fitness function
 Step 4: numberOfVariables = 1;
           {
 [xfval]                                                  =
ga(FitnessFunction,numberOfVariables,[],[],[],[],[],[],[],option
s);
         }
   if x>.50
    {
     GareducedFeatures(featurecount)=Fs;
      featurecount=featurecount+1;
     }
                                        // feature count
   end
           }
   {
   Step 5: axes(handles.axes2);
   axis on;
   try
   plot(GareducedFeatures(1:i));
```

```
            //plot reduced features
    catch
    end
    }
    legend('');
    xlabel('Reduced Feature Count');
    ylabel('Reduced value');
    title(strcat('Processing R -> ',num2str(i),' / ',num2str(r),' C ->',num2str(j),' / ',num2str(c)));
    pause(.023);
    end
     }
end
 s=toc;
   }
kappa_coef=(numel(GareducedFeatures)/numel(gcluster))*(s/(numel(GareducedFeatures)/c)+numberOfVariables);
 waterdetectionpercentage=kappa_coef*100;
}
                    // Kappa coefficient calculation
 set(handles.edit1,'String',num2str(kappa_coef));
 set(handles.edit2,'String',num2str(waterdetectionpercentage));
 save('results','GareducedFeatures');
                                        // save data
```

*Description: Genetic Algorithm is apply to cluster to reduced their features and produce optimize result. Genetic Operators are perform on data and the fitness function calculated to optimize feature*s.

There is only one limitation of GA that has been shown below:

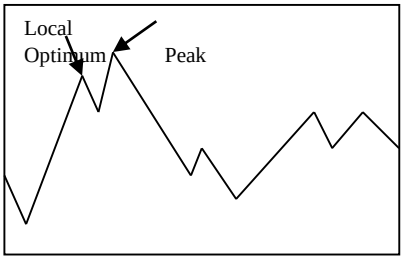

Fig.2: Genetic Algorithm Local Optimum Problem Graph

IV. SUMMARY

Due to overuse of water resources in agricultural land, ground water resources has become on the merge of the distinct. Therefore proper management is required for the management of ground water in ground water counter. One of the most central factors in flourishing recharge of groundwater possessions is locate fitting areas for this project. Therefore, site miscellany of false renew appropriate areas is very significant. Four factors namely, geology, land, soil and landform parameter were explore, secret, prejudiced and overlay using future organization. To superimpose these features, various techniques has been shown in this paper.

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