A Review on the Estimationof Groundwater Possibility

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Abstract— Groundwater is among the precious resource of earth and is reliable source of water for a majority of the world's population, especially in the arid and semi-arid regions of the world, where surface water is either scanty or strongly seasonal in occurrence. Due to increasing use and decreasing water resources, there is the need to find regions having groundwater possibility. The strategy to find the groundwater resources should be automatic instead of manual that can tell the possible occurrence of groundwater in a particular region. There exists various methods for the exploration of groundwater possibility like case based reasoning, wave of swarm method, robotic perception based method and cuckoo search based method. In this paper, we are presenting a review on the existing methods to detect groundwater possibility. In most of the cases, the dataset considered for the experimentation comprise of attributes like slope, soil type, geology, land form, lineament and land use.

Keywords— Groundwater Exploration, Swarm Intelligence, water resources, nature inspired computing, situation awareness.

I. INTRODUCTION

Water is pivotal natural resource for existence of life. From existence of humans on earth it is water that guides the settlements that decide what to grow and what to sow, people need it, fight for it and above all can't survive without it. We can say human existence on earth is directly proportional to water availability.It is fundamental right of every human, animal and plant to have access to the requisite quantity water.In India, groundwater is a major source of water supply for agriculture and domestic use in many states, with all this in view, efficient management and quantification of groundwater is the need of the hour to withstand the growing stress on this precious resource [1].

Groundwater constitutes only 0.6% of all the water on this earth planet, 97.4% accounts for seawater and 2% for snow and ice on the poles [2]. Hence groundwater is an important commodity which we use for various purposes such as domestic, industrial and agricultural use but with the increase in population its resources are depleting and hence the necessity to find its resources arises.

From earth to interplanetary mission, the major objective is to locate the water on the planetary surfaces. So, groundwater exploration is one of the hot research topics in various fields of science.

This paper presents a review on the existing methods of groundwater exploration. Here, we have explained the existing methods of groundwater exploration like integrated approach of WA-SVR model, amalgamated model of autonomic computing & robotic perception, cuckoo search based approach and wave of swarm approach etc.

Rest of the paper is organized in the following manner.Section II describes the basic concepts. Section III presents the literature survey of the existing work. Section IV describes the information about the research gap in the methods. Section V concludes the paper.

II. BASIC CONCEPTS

In this paper, we have considered the concepts of WA-SVR model, amalgamated model of autonomic computing & robotic perception, cuckoo search based approach and wave of swarm approach for groundwater possibility detection. For this, the considered basic concepts are discussed as below:

A. Support Vector Machine

Support Vector machine works on the three steps based mechanism. First step is to take input data in a training phase, second step is to build a model using the input data and final step is output with a hypothesis that can predict the function with future data [3]. SVM is supervised learning model with associated learning algorithms that analyse data and recognize patterns, used for classification and regression analysis. Support Vector Machines, instead of being based on heuristics or analogies with natural learning systems, are based on results from statistical learning theory. The goal of SVM is to produce a model which predicts target value of data instances in the testing set which are given only the attributes.

B. Robotic Perception

Robotic perception is the process by which the machine perceives the information from a given set of external conditions. It is an intermediate stage for the robots that tells us about the way in which robots perceive the knowledge from the set of data samples. Robotic perception is similar to human perception but the results that a human perceives are dependent upon the human tendency to extract information from data samples. In case of robots, the results fixed as per rules and given output in the form of required parameters. The information is thus extracted from the samples of data and provided to the machine for the purpose of evaluation and manipulation to locate the ground water [4]. Thus, here comes the work of machines.

C. Case Based Reasoning

Case-based reasoning is an Artificial Intelligence based approach but it works differently as compare to other AI based approaches in the manner that CBR uses previously experience based knowledge instead of solely dependent on problem domain, their description and available resources. The previous experienced based knowledge is considered as the cases for the problem solution. These cases are considered as the iterations to solve the problem. In most CBR systems, the case-based reasoning mechanism, alternatively referred to as the problem solver or reasoned. The internal structure of CBR mechanism is categorized into components: case reasoner and the case retriever [5].

D. Wave of Swarm

Wave of swarm is modified form of Particle swarm optimization. PSO is a nature inspired technique that came in existence by the optimization behaviour & sharing behaviour of the population of the flying birds [6]. In Particle Swarm Optimization, particles are considered as the flock of birds that are the main agents of the optimization techniques. The two main optimization factors of this technique are local search and global search optimization features. In local search, particles get their own individual best optimized solution using their own experiences. In global search, the experience of one bird is shared with the experience of another bird and finally gets result as a global best solution.

E. Cuckoo Search

Cuckoo Search (CS) is nature inspired optimization algorithm that came under the category of Swarm Intelligence & introduced by Yang and Deb [7]. The optimization feature of cuckoo bird is based on the shrewd behaviour of cuckoo bird to find its solution. Cuckoo bird works individually and stores their egg in the nest of another bird's nest by pursuing their clever behaviour. The way to lay the reproductive egg in a parasitic manner is one of the important feature of cuckoo bird. There may be chances to strike by other bird if the host bird found the different egg in their nest, then the host bird can destroy the egg. So, the main focus of cuckoo bird is to find the optimized solution that can easily match their living environment and this can be easily completed by the notion of random walk of Lévy flight [8]. In the end, best optimized solution match is found as per the problem

III. EXISTING WORK

Suryanarayana et al. [9] has proposed an integrated approach of Wavelet transform model and Support vector Machine for the detection of groundwater level. Data has been decomposed into wavelet series using the discrete wavelet transform with two coefficients. The method proposed namely Wavelet-Support Vector Regression (WA-SVR) has been used for predicting ground water level variations for wells of Visakhapatnam, India viz, Sivajipalem, Madhurawada and Gullalapalem. The dataset is considered with the parameters of monthly precipitation, groundwater depth, mean temperature and maximum temperature. Its performance has been compared with other SVR, ANN traditional Auto Regressive Integrated Moving Average (ARIMA) models. It proved to be efficient in the prediction by giving good accuracy results. Based on the statistical parameters and error percentage, the proposed concept shows better results as compare to SVR, ANN and ARIMA but still need of improvement for better accuracy.

Gupta et al. [10] proposed an amalgamated novel approach of autonomic computing and robotic perception for groundwater detection. The author has considered the attributes of geomorphology, slope, land type, lithology, soil type and lineament for the probability estimation of groundwater existence. Boolean probability functions were used for detecting the probability of ground water and the solution were stored as experience in the history table. When partial perceptions were considered, first learning is performed and the action regarding whether to drill the area is done in the last. The data used for perception is stored in the microprocessors. Further the results are calculated in the form of depth of the groundwater level. There is the need of at least three input parameters for the calculation of results. The robot perceives the drilling action only if the calculating probability is above 60% otherwise learning is performed.

Panchal et al. [11] proposed a new groundwater possibility detection system based on particle swarm optimization (PSO) and case based reasoning (CBR). A new concept of waves of swarm (WOS) derived from PSO is introduced in this study that operates on the problem case. Geological features (Geology, Landform, Soil Type, Land Use, Lineament, and Slope) and their respective solutions i.e. the possibility of ground water in fuzzy terms of high, moderate, or low are stored as cases in the case base. These features are selected as input parameters as they play a crucial role in detecting the groundwater potential. Each PSO particle is the intersection of multidimensional search space. They have assumed that each PSO particle is a set of geological features of groundwater cases. Rules are developed to refine the WOS for each iteration. The integration approach proposed here improves the retrieval accuracy of CBR using WOS.

Panchal et al. [12] has further proposed case based reasoning system with cuckoo search algorithm for the prediction of groundwater possibility. The dataset is considered in the form of attributes of slope, land form, lineament, land use, geology and soil. Authors have calculated the possibility in the form of low, moderate and high solutions. The main assumption considered for this low, moderate and high concept is existence of host nest iteration as per cuckoo bird. So, the concept of groundwater possibility low, high and moderate is based on the existing habitat iteration of solution by cuckoo bird. Case retrieval method is applied to find out the best match from the emigrated species to an input species. Thus solution class of a best matched species is transferred to an input species as its solution class. For the considered cases of cuckoo nest with case based author claims to achieve a great level of accuracy as compare to wave of swarm method [11] but still there are so many problems to calculate the accurate results.

Table 1: Comparison of Different Groundwater estimation techniques

Author Name	Technique	Remarks
Ch. Suryanarayanaa, Ch. Sudheer, VazeerMahammood, B.K. Panigrahi	Wavelet-Support Vector Regression (WA-SVR)	• Data has been decomposed into wavelet series using the discrete wavelet transform with two coefficients. • Improved efficiency/performance as compare to SVR, ANN and Auto Regressive Integrated Moving Average (ARIMA).
Apoorva Gupta, V.K. Panchal, Nidhi Chandra	Amalgamation of Robotic Perception & Autonomous Computing	• When partial perceptions were considered, first learning is performed and the action regarding whether to drill the area is done in the last. The data used for perception is stored in the microprocessors. • The robot perceives the drilling action only if the calculating probability is above 60% otherwise learning is performed
V.K. Panchal, Harish Kundra, NavpreetKaur	Waves of Swarm	• Geological features like Geology, Landform, Soil Type, Land Use, Lineament, and Slope has been used for detecting ground water potential. • The integration approach proposed here improves the retrieval accuracy of CBR using WOS.
V.K. Panchal, Bidisha Das, Daya Gupta	Cuckoo Search & Case based Reasoning	• Case retrieval method is applied to find out the best match from the emigrated species to an input species. Thus solution class of a best matched species is transferred to an input species as its solution class • Shows improved results as compare to Wave of Swarm method.

IV. Research Gap

As per existing methods of groundwater exploration like integrated approach of WA-SVR model, amalgamated model of autonomic computing & robotic perception, cuckoo search based approach and wave of swarm approach etc. Entire methods claims to have the accuracy at its best or as compare to other methods. The WA-SVR model shows its efficient accuracy level as compare to SVR, ARIMA and ANN. Amalgamated autonomic & robotic concept shows accuracy for perception based Boolean cases with input dataset. Cuckoo Search shows improvement as compare to wave of swarm method with greater le The main drawback in the entire methods is that none of the method have detected whether the output results are accurate as per expert knowledge or not. Authors have just calculated the accuracy for the groundwater level but they are not familiar with the accuracy that they have achieved is true/false. There is need of some efficient method/parameters with which we can detect the true positive and true negative values of the output results.

For the efficiency of groundwater exploration, we need to calculate the parameters of Specificity, Sensitivity and then accuracy. These parameters can give the actual existence of groundwater level. Also we can consider groundwater levels with low, moderate and high possibility vectors.

V. Conclusions

Groundwater is the essential and major resource of water on earth for the life. But the population is increasing day by day which results in more consumption of water and more possibility of polluted water. So, many steps have been taken to save water. But there is the requirement to search more possible water resources. There is the need of method that should be automatic and can predict the water resource without digging the bore wells.

In this paper, we have presented a survey for the prediction of groundwater resources. In the existing work, authors has used many techniques like integrated approach of WA-SVR model, amalgamated model of autonomic computing & robotic perception, cuckoo search based approach and wave of swarm approach. The results of these

existing techniques are limited to their case bases and assumptions. There is the need of some efficient approach that can check the groundwater possibility with great accuracy.

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