

A Major Project Report On

# **GROUND WATER EXPLORATION USING GREY WOLF OPTIMIZER**

Submitted in partial fulfilment of the requirements  
for the award of the degree of

## **MASTER OF TECHNOLOGY IN SOFTWARE ENGINEERING**

By

**RAHUL DADEIA**

(Roll No. 2K13/SWE/24)

Under the guidance of

**Dr. Daya Gupta**

Professor

Department of Computer Engineering

Delhi Technological University, Delhi



**Department of Computer Engineering**

**Delhi Technological University, Delhi**

**2013-2015**



**DELHI TECHNOLOGICAL UNIVERSITY**  
**CERTIFICATE**

This is to certify that the project report entitled **GROUND WATER EXPLORATION USING GREY WOLF OPTIMIZER** is a bonafide record of work carried out by **Rahul Dadeia** (2K13/SWE/24) under my guidance and supervision, during the academic session 2013-2015 in partial fulfilment of the requirement for the degree of Master of Technology in Software Engineering from Delhi Technological University, Delhi.

To the best of my knowledge, the matter embodied in the thesis has not been submitted to any other University/Institute for the award of any Degree or Diploma.

**Dr. Daya Gupta**  
**Professor**  
**Department of Computer Engineering**  
**Delhi Technological University**  
**Delhi**



## **DELHI TECHNOLOGICAL UNIVERSITY**

### **ACKNOWLEDGEMENTS**

I feel immense pleasure to express my heartfelt gratitude to **Dr. Daya Gupta** for her constant and consistent inspiring guidance and utmost co-operation at every stage which culminated in successful completion of my research work.

I also would like to thank the faculty of Software Engineering Department, DTU for their kind advice and help from time to time.

I owe my profound gratitude to my family which has been a constant source of inspiration and support.

**Rahul Dadeia**

**Roll No. 2K13/SWE/24**

# **TABLE OF CONTENTS**

Certificate .....	i
Acknowledgement .....	ii
Table of Contents .....	iii
List of Figures .....	v
List of Tables .....	vi
Abstract .....	vii
1. Introduction .....	1
1.1. Motivation.....	1
1.2. Related Work.....	2
1.3. Problem Statement.....	3
1.4. Scope of the work.....	4
1.5. Organization of thesis.....	4
2. Computational Intelligence.....	6
2.1. Particle Swarm Optimization.....	6
2.1.1. PSO algorithm for GWD.....	7
2.2. Biogeography Based Optimization.....	8
2.2.1. BBO algorithm for GWD.....	10
2.3. Cuckoo Search.....	11
2.3.1. Cuckoo search algorithm for GWD.....	11
3. Grey Wolf Optimizer.....	14
3.1. Inspiration .....	15
3.2. Mathematical model and algorithm.....	18
3.2.1. Social hierarchy.....	18
3.2.2. Encircling Prey.....	18
3.2.3. Hunting .....	20
3.2.4. Attacking Prey.....	23
3.2.5. Search for Prey.....	24
4. Case Based Reasoning.....	26
4.1. Case based reasoning.....	26
4.2. Components and features of case based reasoning.....	27

4.3. CBR Life Cycle .....	29
4.4. Application of CBR.....	31
4.4.1. CBR using nearest neighbour.....	31
4.4.2. CBR using induction.....	32
4.4.3. CBR using fuzzy logic.....	32
5. Combination of grey wolf optimizer and case based reasoning.....	34
5.1. Geographical Attributes.....	35
5.2. Integration of case based reasoning.....	37
5.3. Steps of Algorithm.....	39
5.4. Detailed description of algorithm.....	41
6. Results and Discussion.....	48
6.1. Comparison of Grey Wolf Optimizer with other algorithms.....	48
6.2. Grey Wolf Optimizer-Dataset\.....	50
6.3. Implementation.....	51
6.4. Results.....	54
6.5. Comparison of GWO with Cuckoo Search.....	57
7. Conclusion and Future Scope.....	59
7.1. Conclusion.....	59
7.2. Future Scope.....	60
8. References.....	61

## **LIST OF FIGURES**

Figure 1: Grey Wolves.....	14
Figure 2: Hierarchy of grey wolf.....	15
Figure 3: Hunting Behaviour of grey wolves.....	17
Figure 4: 2D and 3D position vectors and their possible next locations.....	21
Figure 5: Position updating in GWO.....	22
Figure 6: Attacking prey versus searching for prey.....	23
Figure 7: CBR System .....	27
Figure 8: Two Major Component of CBR.....	28
Figure 9: CBR Cycle.....	29
Figure 10: A fuzzy preference function.....	33
Figure 11: Weight of each attribute.....	42
Figure 12: Geology attribute values.....	43
Figure 13: Landform attribute values.....	43
Figure 14: Soil attribute values.....	44
Figure 15: Land use attribute value.....	44
Figure 16: Slope attribute value.....	45
Figure 17: Lineament attribute value.....	45
Figure 18: First window appear at the time of execution of software.....	52
Figure 19: Purpose of RESET button .....	53
Figure 20: Result of user's query .....	54
Figure 21: Cases stored in final case base.....	55
Figure 22: Cases after ignoring irrelevant cases.....	55
Figure 23: Final cases.....	56
Figure 24: Objective function vs Search agent (GWO).....	56

## **LIST OF TABLES**

Table 1: Six attributes used in dataset.....	35
Table 2: Ranking of attributes.....	36
Table 3: Cases from the case base.....	38
Table 4: Comparison of GWO with PSO, BBO & Cuckoo Search.....	49
Table 5: Validation dataset of groundwater.....	51
Table 6: User Query.....	53

## **ABSTRACT**

Water is one of the Mankind's most vital resources. An adequate supply of water is one of the pre-requisites for development and industrial growth. In areas where surface water is not available, Groundwater constitutes significant part of active fresh water resources of the world and is obviously dependable source for all the needs. The stress on water resources started due to exploding irrigation, domestic and industrial demands. The finite water resources are being explored to quench the thirst of millions of the populace. In a developing country like India, the minimum daily requirement of a person is 200 litres for domestic use, while an equal or large amount will be needed for other purposes. It is estimated that out of the total of 1122 billion cubic meters of water utilized in India annually, 430 billion cubic meters is met from surface sources and the rest is met from ground water resources. Groundwater is located beneath the ground surface which is precious natural resources. Geoscientist had to know the location of groundwater for extraction of water. Thus we have applied Grey Wolf Optimizer in the exploration of groundwater in various regions. Experts provided us with values of attributes; soil, lineament and other geology features and our algorithm detected the presence of groundwater in particular region. Hence we have evaluated different attribute values of these characteristics as case base and then detected the presence of groundwater of new cases depending on the previous values of our cases.