**Environmental Decision Support System for drinking water treatment plant**

**Abstract**

Drinking water quality is a very important global issue, so, a decision support system infrastructure has been designed to provide access to simulation and experimental results on flow water-quality conditions and to provide sophisticated scenario testing capabilities for drinking water treatment plant research and planning via a graphical user interface with known controls.

 The design of a drinking water treatment plant in Enviromintal decision support system depends on the raw water’s characteristics and water quality parameters. The project presents a number of strategies to manage water quality and water pollution in order to protect human health. This is achieved by building a decision support system to help a water supply station authority to find information about water management.

This research presents an approach to the creation of a decision support system assessment system to determine the environmental impact upon human health, as indicators of the environmental impact of water pollution.

The water quality service uses a set of (20) water-quality parameters according to the water quality index (WQI) analysis, as well as (30) water-pollution parameters. The system suggests a water treatment decision.

A decision support system provides testing of water resource management stations data by using mathematical models. Decision trees and data mining are used to build the decision making system in this research. The test results are presented in the form of time series graphs and email reports. Using text messages as email reports, the system automatically sends warnings when water pollution levels are exceeded. Data mining, knowledge discovery tools and software packages are used in a water resource management.

The main contribution of this study is the provision of an efficient tool that aids researchers working on drinking water treatment plants finding information resources. We have designed an application that contains a database, alert messages, water treatment advice, optimization algorithms based on decision trees and water pollution causes.

**Introduction**

The use of decision support systems to support decision making is an important water resource management tool, as it allows water supply providers to quickly gather information and process it in various ways in order to assist in diagnosing and making treatment decisions in the event of water pollution accidents.

The areas in which these systems could help is diverse,from storing and retrieval of water quality records, storing and retrieval of key treatments from pollution causes, examination of real-time data gathered from documents,water parameter value information, analysis of correlation criteria that affect water status, status history analysis for the purpose water related disease identification and analysis of its effect on human health, and analyzing the results of water quality and water pollution calculations in many other stations.

The necessity of the research described in this thesis is fundamented by the fact that environmental pollution, resulting from water pollution, adversely affects health. The term (water pollution) includes factors such as Organic chemicals, Infectious agents, Inorganic chemicals, Sediment, Plant nutrients, Oxygen-demanding wastes and Thermal.

This research considers the need to assist the responsible drinking water supplier authorities in their decision-making process. As there are many approaches to decision making, and because of the wide range of fields in which decisions are made, the decision support system (DSS) concept is very broad. A DSS can take many different forms.

In general, it is accepted that a DSS is a computerized system that aids in decision-making. A decision is a choice between alternatives based on the estimates of those alternatives’ values. We have proposed building a model integrating a decision support system, data mining and an agent system. An approach to develop a decision support system which will make decisions under complex environments has been made.

Designing an effective decision-support system has become crucial in recent years. Systems have to be able to deal with uncertain information. The systems have the ability to learn and adapt to new environmental conditions.

Data mining is the process of extracting hidden predictive information from large databases.It is a powerful technology with great potential in aiding organizations focus on the most important information in their data warehouses. The automated, prospective analyses offered by data mining goes beyond the analyzing past events, which is provided by retrospective tools typical of decision support systems. Data mining is one of the tasks make up the discovery knowledge process starting from data. The data stored in the database is used to discover data patterns, which are then interpreted by applying knowledge in the field. Data mining applications can be generic or domain specific.

The generic application must be an intelligent system that can make certain decisions on its own, such as: data selection, selection of the data mining method, presentation and interpretation of the results. DSS are computer programs that aid users within problem solving or decision-making environments. These systems support a specific decision problem by making use of data models, algorithms, knowledge bases, user interfaces, and control mechanisms.

Various researches have shown the uses of DSS in order to handle complex decision modeling and management processes. New approaches of researching agent based decision support system (ABDSS) have appeared, following the rapid progress of agent systems and network technology. Thus there emerged a wide range of works dedicated to environment and human health implemented as multi-agent systems (MAS), which have been the center of active research for more than ten years and have resulted in many successful applications.

The aim of this research is to present an environment DSS in detail, including water resource management issues. DSS provides methods of calculating water quality and water pollution starting from documents, methods of finding water pollution result solutions, computing the effect of climate on water quality factors, and means of avoiding the risks of water pollution on human health. These models typically use mathematical process representations.

Formally, the Water Quality Index (WQI) is the processes of calculating water quality parameters to find information about water status, carried out in text files or by using the manual method. In other words, the final result of the WQI will attempt to automatically provide a list of water statuses, such as: Excellent (the water status is excellent), good water (the water status is good), poor water (the water status is poor and is unsuitable for human supply), very poor water (the water status is very poor and unsuitable for human supply), and lastly, water unsuitable for drinking (the water status is very bad and unsuitable for human supply).

According to DSS automatic WQI calculation evaluations, the process calculation task must contain the identification parameters mentioned. As mentioned above, our concern was to have a system that automatically calculates the water quality index. Such a system will pass the result to the next agent that is responsible for calculating water pollution parameters from different sources using all tagged attributes in order to analyze and build a system specific to water pollution causes.

Furthermore, the selected pollution cause must mainly contain treatment events. Due to this fact, it was very easy to find a proper medication-based treatment and a suitable way to handle each type of water pollution.

* 1. **Research Problem and Objectives**

The main research problem that is addressed this thesis is the design and implementation of a decision support system that presents the regional and local water authorities. Such a system must provide systematic information analysis in order to build an appropriate decision.

DSS supports water managers, decision makers and crisis teams by providing them with accurate information and analysis tools for evaluating strategies to prevent the effects of water pollution resulting from industrial waste, and to provide (human health centers )with suitable information about the disease related to water pollution and the ways of treating it.

The system should, ideally, provide an efficient tool that helps users find information resources.The evaluation of the agent DSS discusses the effect of water quality index management on water pollution.

The system detects the pollution causes and types and suggests a water treatment decision. So that it can be usable by humans. The framework of the water pollution and water quality DSS is based on a mathematical model. The results support the primary decision in emergency cases and offer suggestions for the application of a suitable water treatment method.

The system must record, store and export this information to metadata centers for further analysis and evaluation, in order to help water control station authorities make a suitable water quality decision, understand water pollution causes and their treatments, also to analyze the final water quality results.

Furthermore, the system outcomes may be able to aid in predicting the appropriate decisions concerning the supply of water to people, depending on the stored historical data.

* 1. **Main Contributions**

One of the main methods used for designing the DSS software are supervised classification algorithms. Supervised classification algorithms are one of the most popular machine learning techniques, whose objective is to predict the category of new observations based on patterns identified in the labels dataset. Supervised classification algorithms are sensitive to the characteristics and structure of the input datasets.

In this regard, the knowledge-driven (knowledge discovery from data) KDDDM& decision tree (DT) is used together with the Meta learning-based algorithm for developing the water management decision support system. Publicly available results from two water stations are available as datasets.

The software uses the different features of a decision support system by creating a framework for assessing new decision strategies in a competitive ecosystem environment. The practicality of the software is confirmed by comparing accuracy of its estimations with those of other methods (e.g., Association Rules), which used the decision tree technique with 50 parameters to find an optimal drinking water status. In the past, the majority of studies concentrated on DSS systems as one river approaches, and most of them were built for rivers other than one river.