A Real-Time Monitoring System to Monitor Ground Water in Maharashtra

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1 Background and Project Rationale

Ground water is the main source of drinking water in rural India, through wells, tube wells, stand-posts and piped water supply. The level of ground water varies from season to season and hence its availability. Apart from seasonal variations, the level of ground water at a location also depends on many factors like rainfall, average temperature, pattern of use, amount of vegetation, the hydro geological characteristics of the soil and rock structure below. It is also influenced by these considerations in neighbouring areas.

Our norm for drinking water is a mere 40 liters/person/day which should be accessible within a reasonable distance. There are also specific quality norms *vis a vis* organic and inorganic contamination. With changed conditions, esp. climate change, increased groundwater extraction, increased demand, and so on, there is widespread stress in many habitations on meeting even these rudimentary norms. **Response to such situations by the state administration needs to be rapid and an important component of such a system would be a real-time monitoring system of key drinking water parameters.**

Eventually, this data will augment data currently gathered by GSDA and can be used for more long-term objectives as well, such as:

- Help manage the scare resource better
- Understand the effectiveness of existing schemes
- Highlight situations/areas where new schemes are required if current schemes are not completely successful.
- Highlight areas where ground water is severely depleted.
- Understand the impact of ground water depletion in one area on its neighbouring areas.

Thus the rationale for the project is the clear short term response and long term understanding needs of various stake-holders such as GPs, taluka officials, agencies, researchers and so on.

This project will look at two aspects of the data management and technology aspects:

(i) Technology generation for transfer, storage and reporting of real-time date.

(ii) Data-mining and model generation of existing legacy long-term data.

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2 Goals and Objectives

The main goal of the project is safe and secure supply of drinking water for all. The sub-goals of the current project are:

- To design and build a protocol and device to receive and transmit field data to and from repositories.
- To develop system architectures at repositories which will enable rapid response and analysis.
- To develop database designs and implementations at repositories which will meet reporting requirements by various stake-holders.
- To assess legacy data of GSDA and correlate it with other data such as rainfall and to develop mathematical models.

3 Project Location, Manpower, Budget, Stake holder Agencies

The observation data will be collected from sites decided with agreement of all parties. The code will be developed at IIT Bombay.

3.1 Manpower Requirement

The manpower required at IIT Bombay will consist of one system level designer and two assisting engineers.

3.2 Budget

Approximately Rs 3 lakhs per month.
Breakup: Salary 1-1.2L/month, Faculty Consultancy: 1L/month (4 days a month), IIT Overhead : 60K per month (20% of the project cost), Misc. Expenses : 20-40K a month

3.3 Timeline

Pilot Project: 4 months which will include design and protyping. Project design to be reviewed after that. [Note that if the required manpower cannot be hired, this may take more time or the scope may be limited].

3.4 Stake holder Agencies

GSDA, Jal Swarajya, IIT Bombay, Unicef.

4 Approach and Methodology

4.1 Assumptions

- One key assumption is that the format and schedule of data, the quanitities to measured etc. are fixed outside this project. Thus, the project expects a table of the type:

Attribute	Frequency	Loaction From	Location To
Well level	Weekly	Habitation name	Repository
Summary Report	Monthly	Repository	Taluka office
⋮	⋮	⋮	⋮

- The second assumption is that actual physical locations of habitations, selection of wells, etc. are done outside this project. Thus, we would expect:

Point	Habitation	Location	Coverage
Well	Gudwan	19.3456, 73.2231	No Mobile Coverage
Borewell	Naldhe	19.7677, 73.1178	Mobile Coverage
⋮	⋮	⋮	⋮

- Documents and Reports on existing protocols, their designs, outputs, and so on and the cooperation of participating agencies.
- Overall administrative framework and a data flow and control flow matrix.

4.2 Background Study

The will consist of

1. Assimilation of current framework, analysis of specifications.
2. Familiarity with basic physical attributes, field limitations and so on.
3. The study and evaluation of simple and effective ways of transmitting observed information to the repository.
4. The study and evaluation of different strategies to store the existing data and the data to be monitored in the future
5. The means and formats required to send the analysis of the data to stakeholders
6. Identification the kinds of queries that need to be supported.

4.3 Design

This will involve

1. The design of the entire system, including the data store, the dissemination protocols and formats.
2. The design of algorithms to analyse data and answer queries identified in the background study.
3. Develop models of dependence of various parameters for use in prediction.

4.4 Implementation

1. Implementation of the system.
2. Implementation of algorithms for data analysis. The implementation will begin with simple models which will be refined with time.
3. Highlight anamolies in data, if any.
4. Give an handle to view queries results over the analysed data
5. Final reporting and recommendations. Sharing back with stake holders.

The IIT-Bombay team will be led by the Department of Computer Science and Technology which specializes in the field of technology. We will also draw from expertise in other departments, such as CTARA, Civil Engg., Earth Sciences and Humanities, if required.