A SPECIAL-PURPOSE NAVIGATION INSTRUMENT FOR GEOSPATIAL DATA PROCESSING

Sara Zandi, Philip Sallis & Akbar Ghobakhlou
Geoinformatics Research Centre, Auckland University Of Technology, Auckland, New Zealand

Geoinformatics Research Centre

INTRODUCTION

This study devises a framework for integration of spatial data, environmental data and qualitative data that is described in a research project of the Geoinformatics Research Centre at AUT called ***Eno-Humanas***. The quest of this project is to provide scientifically based information crop production improvement, product quality and yield through the synthesis of environmental and human sensory perception data.

MOTIVATION & OBJECTIVES

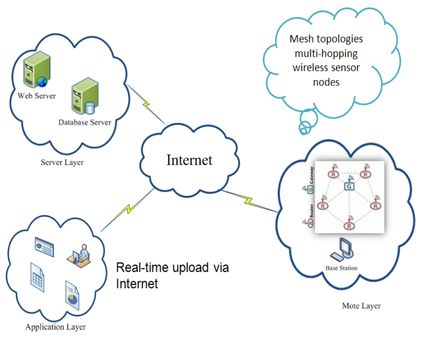
Most existing GIS applications have focused on the integration of specific types of data. There is however, the prospect of integrating attribute data with geospatial sources for knowledge that can be extracted and modelled.

A software navigation instrument in geospatial data processing is proposed for integrating a large set of environmental data which influences crop production.

The application efficiently exploits a large variation of data types to generate:
- •sophisticated data modelling,
- •visualizations
- •production of thematic maps.

Statistical and contemporary Software Engineering methods (including neural network simulations) and other data mining techniques are used to process the available data to extract information about the most efficient variables to model scenarios for desired optimal cultivation management outcomes. The results can be used to modify and optimize both growing and production methods

VINEYARD MONITORING CASE STUDY



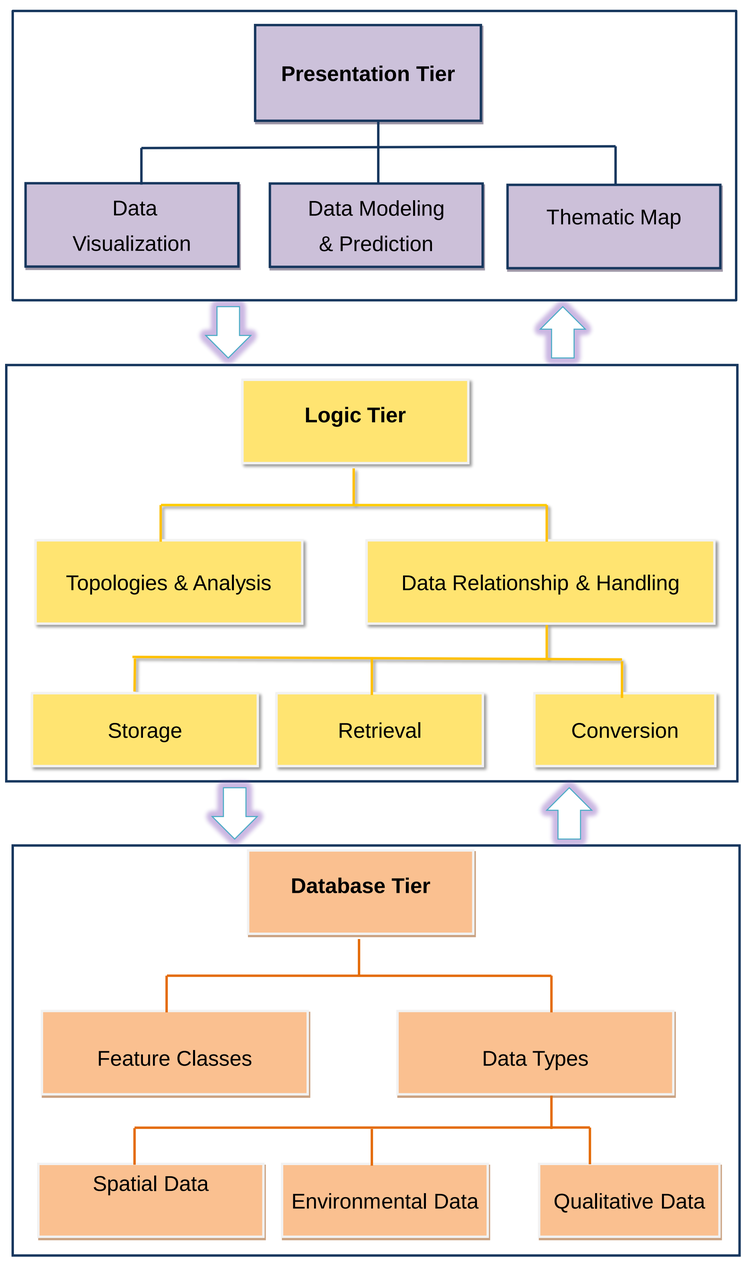
Enometrica is a combination of hardware and software components that is built by Geoinformatics Research Centre using 'ground-up' components for sensors, data loggers, base-stations and end-user data depiction and visualisation. In prototype it consists of a field set of instruments with sensors for monitoring climate, atmosphere, soil and plant conditions. The nodes are wirelessly connected to the base-station.

The data logged from these sensors is pre-processed by the base station device and transmitted via the Internet to a remote, where the data is ingested to the main database.

Integration of sensor data and spatial data provides the geographic information required for mapping the parameters of environmental influence phenomena.

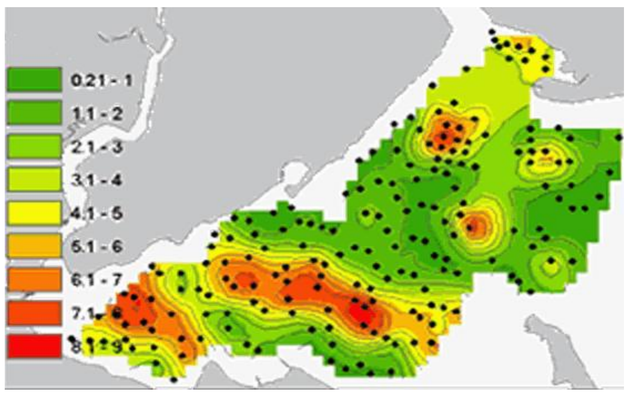
ARCHITECTURE

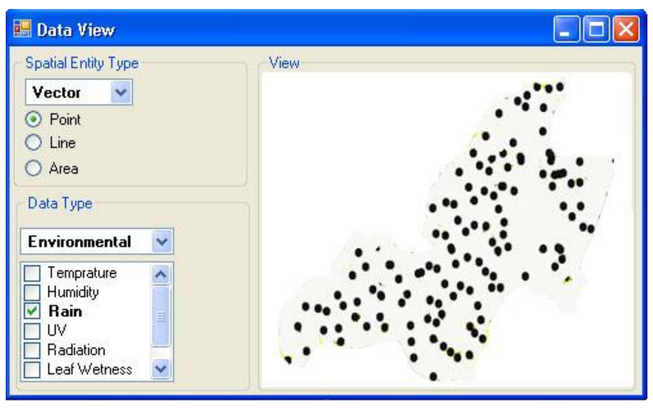
The proposed software architecture is composed of three layers: Data tier, Logic tier and Presentation tier



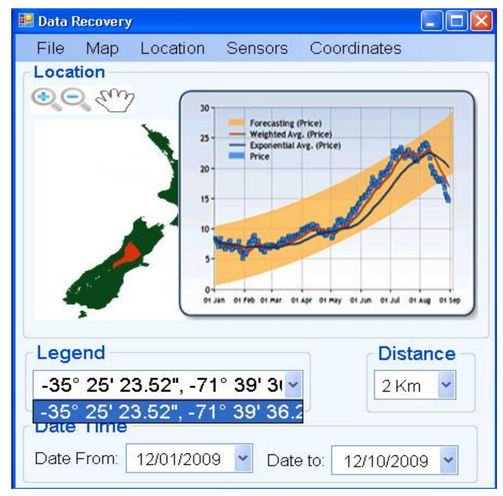
The presentation tier enables producing thematic maps with different types of legends and visualising of maps and images .

Rainfall data appeared to be spatially correlated and geo-statistical techniques such as "kriging" provides rainfall predictions at un-sampled locations.

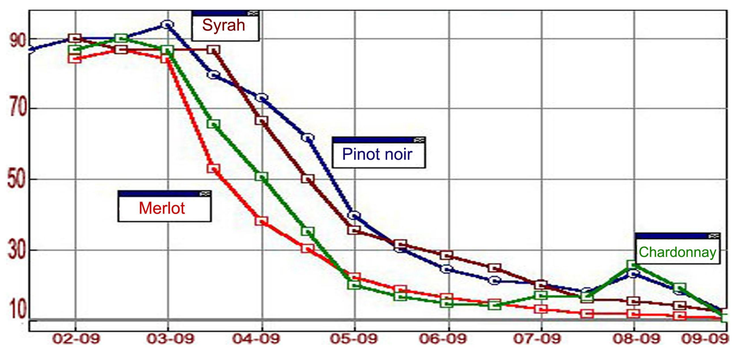




The locations of environmental gauges(e.g. Rainfall) through the area of interest's map as point coverage.

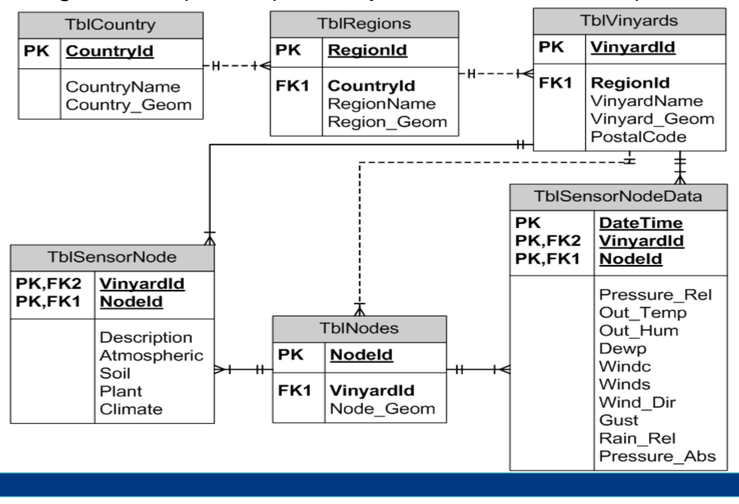


Using Nearest Neighbour Search (NNS) methods to recovering missing data in a station(e.g. vineyard) by supplying the points (nodes) of a polygon(e.g. vineyard) and running a spatial query to pull back all points contained by that polygon and all related data that fall within that polygon.



Graphs that illustrates information about wine variety and quality in a region by providing information about the geometry information of different vineyards .

The logic tier incorporates spatial analysis tool to enables ad hoc queries which integrate non-spatial data with a spatial attribute and vice versa.



TOPOLOGY

Integrity rules that define the behaviour of geographically integrated features and enforces geometric relationships .

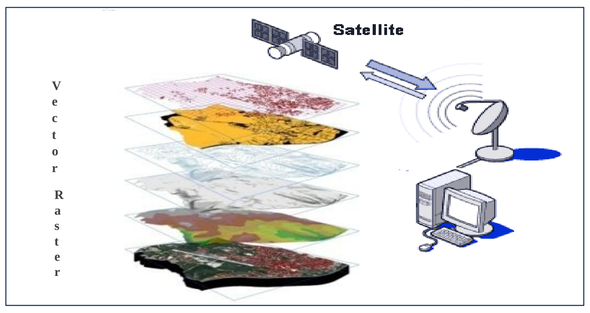
RELATIONSHIPS

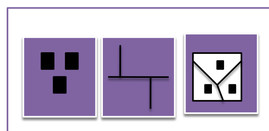
Associate object from feature class or table to objects in another class or table.

The Data tier facilitates the access of geo-referenced data.

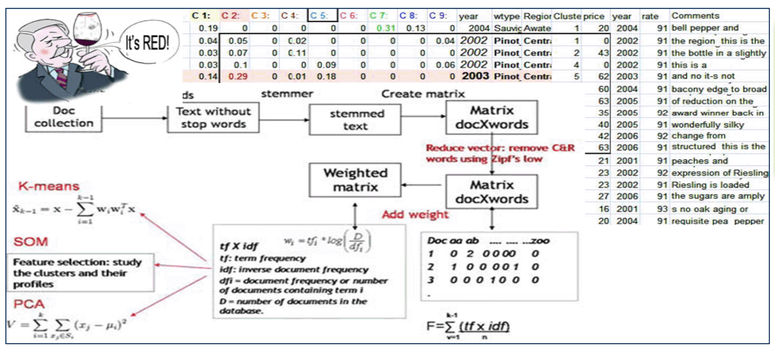
SPATIAL DATA

Spatial data describes both the location of a geographic feature and it's attributes.





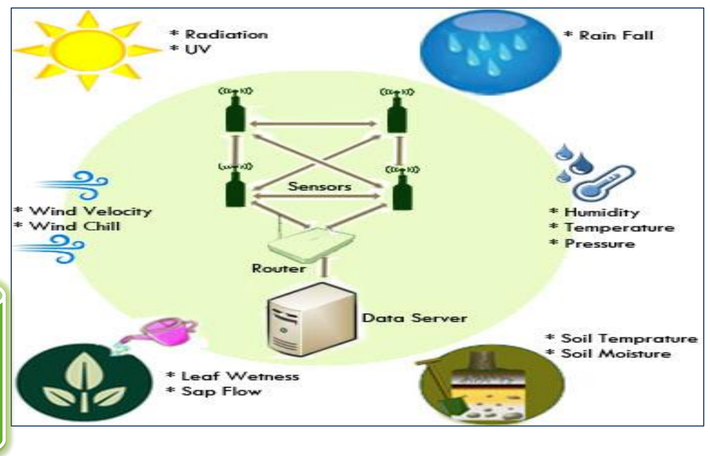
Feature Class
Tables with a shape field contacting point, line or polygon geometries for geographic features



Geospatial Database

ENVIRONMENTAL DATA

Environmental data are related to climatic and environmental aspects (e.g. temperature measurement at a given geographical location and time as a DECIMAL). The data logged from these sensors is pre-processed by the base-station device and transmitted via the Internet to the GRC server.



QUALITATIVE DATA

Qualitative data are associated with sensory perception which can be retrieved from textual resources using existing methods such as Self Organising Map SOM based text mining method.

CONCLUSIONS

Special purpose tool would bring together locational data from different sensor stations and thus provide an integral component for the management and analysis of the logged data.

In addition, this application can be developed to provide access that is intuitive and representational for users' of spatial data and its analysis without them having to be experts in a GIS language. Data can be observed in different time periods or manipulated in various ways in order to build crop management scenarios that are environmental influence oriented.

REFERENCES

Sallis, P.J., Shanmuganathan, S., Pavesi, and L., and Jarur, M., *"A system architecture for collaborative environmental modelling research",* International Symposium on Collaborative Technologies and Systems (CTS 2008), Eds., Waleed W. Samari and William McQuay, A publication of the IEEE, New Jersey, USA. ISBN: 978-1-4244-2248-7, Irvine, California, May 19-23 2008 pp 39-47.

Ghobakhlou, A., Shanmuganthan, S., and Sallis, P. (2009). "*Wireless sensor networks for climate data management systems".* In B. Anderssen et al. (eds) /18th IMACS World Congress - MODSIM09 International Congress on Modelling and Simulation/, 13-17 July 2009, Cairns, Australia. ISBN: 978-0-9758400-7-8. pp. 959-965.