

# Whenua and Whanau – Visualising People Land Relationships.

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## Abstract

Mapping relationships between people and land is complex, particularly over time. Visualisation of land blocks, and family relationships is an important component for systems that aim to facilitate research into tribal/land relationships. This paper reports on a project utilising the JADE/Java platform as a basis for building these capabilities.

*Keywords:* GENTECH, OpenGL, Maori, whakapapa, genealogy, Cemetery, Wahi Tapu, JADE, visualisation.

## 1 Introduction

Historical issues in New Zealand are heavily influenced by the personal histories of families. The relationship of the people with the land underpins historical events. Families can be constructed and reconstructed in many ways, and how one interprets family structures can have major implications for the interpretation of historical events. Mapping relationships between people and land is complex, and more so over time.

Current geovisualisation tools start with an assumption that a user's tasks will involve geovisualisation exclusively (Rhyne, 2004). We want a system that not only views spatial data but includes the temporal dimension thus allowing users to view aspatial data such as family trees and documents, images, and oral histories. Meaningfully visualising family groupings and their relationships with the land and metadata provides a unique challenge - there are no currently accepted ways of visualising such data.

This project builds upon an earlier student capstone project (Charkova et. al 2003), where the importance of group structures (not normally catered for in genealogical software) was identified. That project also identified the GENTECH genealogical data model (Anderson 2000) as an important basis for further research.

Our ultimate aim is to build a tool to assist decision-making and knowledge discovery processes for collectively owned assets.

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## 2 The Research Challenge

For Maori, there can be significant difficulties in identifying the beneficial owners of assets, and obtaining binding decisions regarding development strategies. A tool that allows identification of affected families would significantly assist decision making (for example, who do we have to consult?).

The sorts of questions we wish to be able to ask are: Given this block of land, which families are implicated in the history of that area? Given a certain genealogy, where is the land associated with these families? Given these families and these land blocks, what are the associated historical stories? A visualisation tool with these capabilities does not currently exist.

To create the capability we wish to have, we must find a way to link family structures to communally-owned land assets. This poses some significant research challenges. Typically Geographic Information Systems (GIS) link back to relational databases. However, as complexity of an application increases, a mismatch occurs between relational database systems and an application. As data model complexity increases, as more relationships are managed, the result is a large number of tables, with slow joins between them, complexity which is difficult to manage, and also resulting in significant performance losses (Objectivity 2007).

We have a complex project. To minimise issues with data access, we chose to use an object data store for our system. Object datastore systems offer not only direct reference to objects in a store, but also significant potential for caching, clustering and distributed storage, all aspects that might become important for a socially focussed system such as our application. Nonetheless, we could have chosen to build our system on a relational data model had we so chosen.

## 3 The Context - Proof of Concept.

This project is centred on an important historic church in Northland. St Michaels Church at Ngawha is built on the site of the Battle of Oheaewai of 1845. The scoria walls of the cemetery closely follow the walls of the original fighting pa purposefully constructed for the battle.

The site has considerable military significance – this pa was the first expression of the concepts of “trench warfare.” (Cowan 1935). One third of the besieging

British force died in a little over five minutes when a decision was made to attack the pa after one and a half weeks cannonading from the top of the hill. The British soldiers had muskets, the local people had trenches, rifles, heavy duty (multiple) pa walls, and one cannon, (which was fired once across the front pa wall under attack, with 8 yards of chopped up horse chain down its barrel). The soldiers who fell in that battle are buried under a memorial in the churchyard.



*Figure 1. St Michaels Anglican Church, Ohaeawai (Ngawha).*

The site has significant historical significance for Maori. The hill Puketapu (= sacred hill), on the sides of which the Church stands, was reputedly Nukutawhiti's kainga (verbal information from Dr Pat Hohepa). Nukutawhiti was a highly significant ancestor for Ngapuhi, and Kou, the senior chief of the area in the 1850's, claims descent from Nukutawhiti (Nukutawhiti Block Claim, NMB, 1867). Kou's relatives were intimately involved in the establishment of the Kotahitanga Maori Parliament in the 1890's. The first and second chairmen of that political movement are buried at this site.

The church is associated with the Maori Concert Party which went to England in the 1860's. A photograph of Reihana Tukauwau who led that concert party is inside the church. The Whare Kai "Mihiwira" at the local Ngawha Marae is named after Miss Weale. When the concert party ran into financial difficulty Dorothy Weale paid for the group to return to New Zealand. Money raised to pay back Miss Weale (who refused the repayment) was used to build a number of churches across the Hokianga, including this church.

There is currently no map, digital or otherwise, of the cemetery linking individual grave sites and family groupings. Such a link is of considerable importance to the local people and to the long term preservation of Aotearoa's heritage. While most graves are known, some have no headstones, and others are unmarked. Many of the markers are deteriorating which risks losing information over time. These same issues have been outlined by Regan-Dinius et. al. (2002) for cemeteries in Indiana, USA. The Indiana group are using standard GIS approaches to construct a spatial database for recording cemetery data.

## 4 GENTECH Data Model and JADE

The GENTECH Genealogical Data Model has been fully described (Anderson 2000). It was developed as a comprehensive logical data model for genealogical research and analysis. The GENTECH data model was designed for use with relational databases for data storage.

The JADE object store and its ability to easily create collections, is what attracts us to the use of that development environment. The GENTECH model provides for 35 different "tables" if a relational database were used. Managing such complexity makes JADE an attractive data store manager. Whilst we don't report on the use of assertions in this paper, they are the underlying reason for choosing to use the JADE object data store.

### 4.1 Assertions

The GENTECH model's use of "assertions" to relate information is a critical element for our purposes. It is important to track the "who said so" of both conclusions and assertions about relationships. Objects can be stored independently of any relationships. We model the relationships between objects with objects that we call assertions ("I assert that this is a fact, and the evidence is over there"). It is possible therefore to create many instances of an assertion object about one fact, and possible to follow the thinking that people have used to come to conclusions.

Assertions facilitate creation of many types of relationships between data, and allow for alteration of conclusions based on that data. With assertions a researcher can separate (but link) the supporting evidence from the conclusion itself. We can also have assertions about assertions, and therefore have conclusional assertions. For example, to assert that a person died on a given date, we create an instance of a date object, and insert the date into an instance of a death (an Event). We then create an assertion, to which we link the instance of the death date, and also create, if required, an evidence instance for our assertion (and any other instances of objects required for tracking the genealogical research process). Finally, we add this assertion to an array of assertions owned by the person instance. During this process, JADE automatically stores each instance of the created objects in an appropriate collection.

It is this modelling of assertions that makes the GENTECH data model suitable for the types of fuzzy information that is present in both Maori family relationships, and the relationships of those families with land.

## 5 The St Michaels Project.

Our previous study (Charkova et.al 2003) made obvious the deficiencies of existing genealogical software; investigation of large family structures such as tribal communities, and relationships with land are not provided for. We followed the Indiana group (Regan-Dinius et. al. 2002), in deciding visualisation offers a better path to the system we want.

Our approach uses the GENTECH data model as an underlying theme; we are building a foundation for storing and presenting for analysis various types of data, ranging from archival records, common oral history, to photographic documentation. The JADE object-oriented data store manages this complexity.

The visualisation software will be built as a modular system, with the cemetery visualisation forming the first module using a bespoke object-oriented model derived from the collected cemetery and genealogical data sets.

We chose this particular cemetery because :- it contains a suitable number of graves (~300); the rich historical context is suitably complex for initial prototyping; family relationships (Lomax) enable access to otherwise sensitive genealogical information under the auspices of kaumatua (tribal elders); existence of an identifiable physical boundary (stone wall) facilitated mapping the site without recourse to more complex survey equipment and personnel. We did not need a large data collection project because of the ready availability of rich genealogical and historical information. We could focus on the development of the model.

We collected the spatial cemetery data through access granted by trustees/kaumatua to the family cemetery, which is not a public place. Access to tribal accommodation made this project feasible in this context.

Our project has three major components:

1. proving the viability of the JADE/Java environment as a means of implementing the GENTECH data model.
2. creation of a bespoke system for:
  - 3D visualisation of land blocks.
  - 3D visualisation of genealogies.
3. linking via assertions these visualisations to present the historical relationship of the people and their land..

This paper reports on the first and part of the second components.

## 6 Data Collection

Base data to commence this mapping was obtained from Land Information New Zealand (LINZ) records. The most recent survey definition of the wahitapu, known as Puketapu 1A1, was in 1945 on Maori Land

plan (ML) 13285. As coordinate systems at this time were neither geodetic nor metric, updated values were calculated using more recent surveys in the area (SO55416). The boundary dimensions were also converted to metres to support verification of the physical position of the boundary.

We initially proposed to use hand-held GPS units for collection of on-site data about the grave positions. A team of four researchers travelled to Northland for two days to establish the methodology and the suitability of the GPS units. Matero and Peters (2003) suggested that hand-held GPS instruments would work, but we found that, although probably suitable for larger land blocks, the accuracy of the equipment (Garmin GPSMAP 60Cx, +/- 3 metres) was not suitable for measurement of graves given that the error from measurement to measurement was not stable.

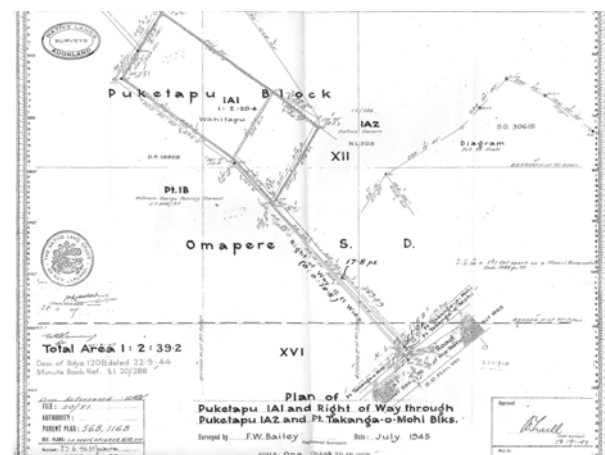


Figure 2. Survey of Puketapu 1A1 Block

GPS was used in conjunction with nearby survey marks and the stone wall to initially establish the corners of the site. From this base a grid using tent pegs and builder's string was laid out. The extremities of each grave site and the church were then measured by tape as offsets from this grid. The coordinates established in this manner were later converted to New Zealand Map Grid (NZMG) using the online conversion utility provided by LINZ (LINZ 2008) A team of two researchers subsequently took another 8 days to complete these measurements, and take photographs of each grave. This provided the data set for the visualisation.

## 7 The Development Environment

**The JADE Software Development Environment** - JADE ([www.jadeworld.com](http://www.jadeworld.com)) couples a flexible distributed processing model with an integrated Object-Oriented Database system. The use of the JADE development environment will facilitate developing the "assertion-rich" requirements of the GENTECH data model, with all its complexities for data storage. JADE eliminates much of the development effort required to move objects to and from a database, and is particularly suited to the type

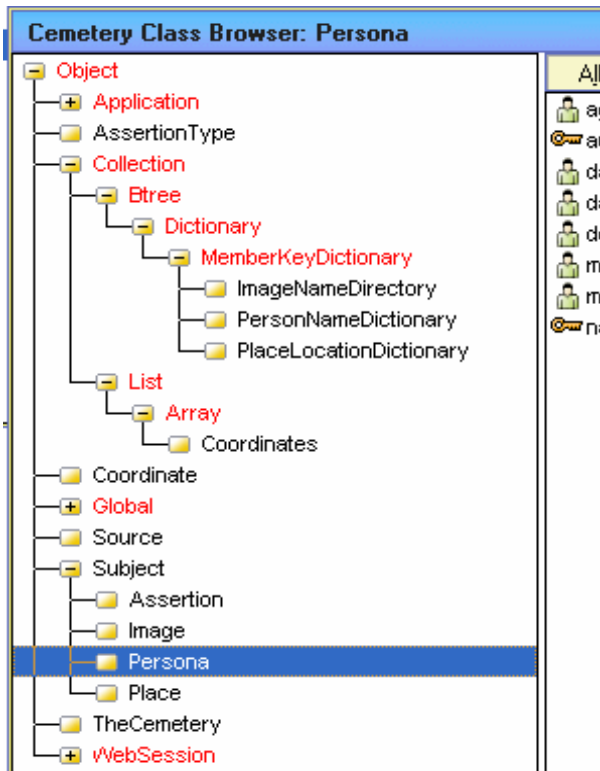


Figure 3. JADE class browser

of highly associated data we will be looking at (where most objects will be associated with multiple collections of other objects).

#### NetBeans -

NetBeans provides a full featured Java development environment which includes a Forms builder, and very recently (December 2007) a JOGL (Java™ Binding for the OpenGL® API) plugin. JOGL is designed to provide hardware-supported 3D graphics to applications written in Java. JOGL provides full access to the APIs in the OpenGL 2.0 specification as well as nearly all vendor extensions, and integrates with the AWT and Swing widget sets and allows us to develop the underlying graphics capability required for this project as well as facilitating the presentation (forms). The forms must be developed in Java as the JADE “java exposure” process removes any forms pre-built in JADE.

**JADE/JAVA Link** - JADE Software Corporation recently made available (JADE 2008) the capability for using JADE in conjunction with Java to provide an object store capability to Java. This development allowed us to explore the development of the required Assertion-Rich data structures required for this type of project. We can develop the underlying data structures in JADE thereby dealing with all the complexities inherent in genealogical data, and subsequently “expose” them to the Java environment in order to develop the visualization of the data.

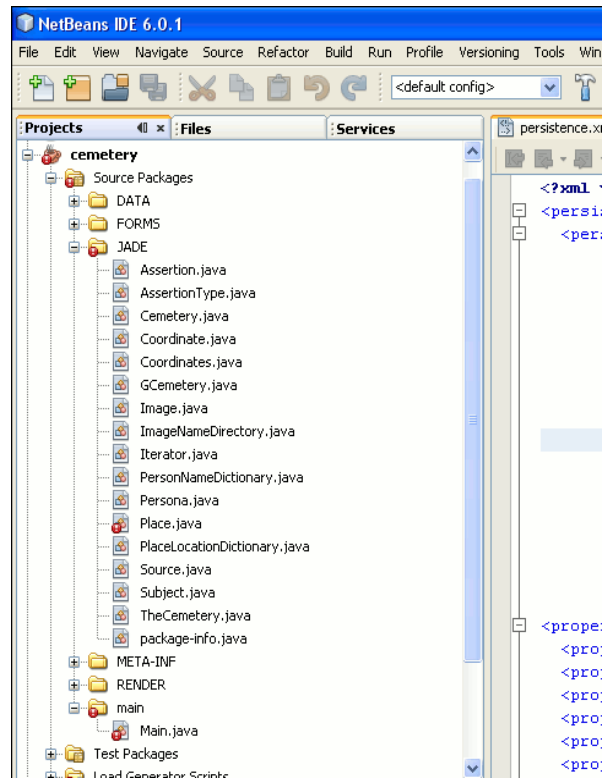


Figure 4. NetBeans class browser

## 8 Integration of Java Code with JADE

Our target for this project was to integrate land block data with an object store, and process that data using a java front end. The project has been established using JADE for the data model, including creating necessary Collections (e.g. Place, and PlaceLocationDictionary ).

NetBeans is used for the openGL development and the compilation of Java code. NetBeans requires the JOGL and Jadeworld (JAVAJOM) libraries be included in the project, along with any other necessary libraries.

Once the Attributes and Relationships between objects have been established under JADE, the data base is “exposed” to the java environment using the “Java Exposure Wizard”. The exposure process includes defining the appropriate NetBeans directory, which in our case is cemetery/src/JADE. The classes that are exposed from JADE are installed into the working director of NetBeans, and the persistence.xml file created in this process gets moved to the META-INF folder.

Schema (.scm) and database (.ddb) files are created by JADE from a command line interface and stored in the cemetery/dist folder. The source files appear in NetBeans, and can be further developed from the NetBeans IDE. The required iterator(s) for traversing the dictionary are included in JADE. New classes can be created either as NetBeans standard Java objects or created in JADE and “exposed” to Java as described above. The JADE white paper (JADE 2008) outlines the necessary steps to utilise the JADE/Java link.

To run the project from the NetBeans IDE the JADE database must be initialised and running

(server=multiUser), and an argument set for the call of the main java method. (see JADE 2008 for full details).

## 9 3D Visualisation

The visualisation is carried out using [Java OpenGL](#) (JOGL - JSR-231), a wrapper library that allows a standard graphics cross-platform API called OpenGL to be used in Java. JOGL was chosen to allow for portability, the potential to extend to application to the web and fast graphics rendering capabilities. In addition we wished in the long term to be able to:

- view the surrounding terrain in 3 dimensions
- provide realistic view of the cemetery, church and markers
- Provide the space to allow for the rendering of metadata within a novel 3D GIS desktop environment.
- To allow family trees to be rendered in relation to spatial attributes

The low level nature of the openGL API allows us to render a novel/bespoke visualisation.

A preliminary visualisation of the cemetery site has been developed using the data collected (Figure XXX) and is linked to the JADE data model.

The current visualisation allows for the usual 3D navigational facilities such as rotation, panning and zooming. In addition to these navigation facilities, the user is able to select a grave within the 3D space. While OpenGL has a renderer mode which draws the objects (giving them colour etc).OpenGLalso has a selection mode, which generates a record of objects that have been drawn, In selection mode the name of an object which a selected pixel belongs to is sent the selection buffer (Cunningham, 2007). In a 3D scenario, 3D objects can exist behind other 3D objects. It is important to get the object closest to the users view We assign an isSelected Boolean value to each object, which allows us to change the colour of an object when selected, and update relevant information for display.

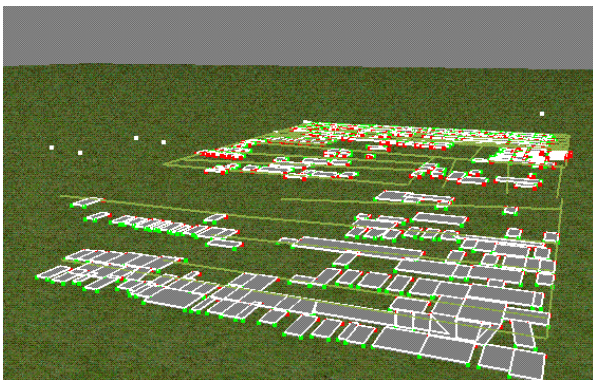


Figure 5. Open GL visualisation of cemetery.

## 10 Future work

Our project is still in its initial stages. There is considerable work involved in creating assertions linking images, people and graves. We are now working on ways of usefully visualising genealogies onscreen, and how we might integrate people information with the geographical data. Traversing genealogies for investigation of relationships between families, and dynamically tracking land information are crucial outcomes we require..

## 11 Acknowledgements

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Ethics approval for our research was granted by the AUT ethics committee (AUTECH) in November 2007.

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A project of this type cannot be carried out without the assent of hapu and whanau, and we acknowledge their permission to work onsite at Ngawha

The advice of Bishop Waihou (Ben) Te Haara (retired) and John Alexander (Coordinator for the Te Waimate-Taiaimai Alliance Treaty Claim) are much appreciated.

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