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OSMIA

Title:	Open Source Medical Image Analysis
Acronym:	OSMIA
Date:	16th October 2001
Proposal Number:	IST-2001-34512
Type:	Trial
Component:	Part B
IST Program:	IST-2001-4.3.3 Free Software: Towards Critical Mass
Call Part ID	IST-01-7-1B
Call Date:	7th July 2001

Contents

1 Objectives

1.1 Why Open Source Medical Image Analysis (OSMIA)?

Image analysis is now an established and invaluable field of medical technology. Advances in magnetic resonance, absorbsion and emission tomographies and ultrasound imaging have transformed many areas of medical diagnosis and treatment. Today medical imaging is a multi-billion dollar world wide business with some of the worlds largest companies (General Electric, Siemens and Philips) gaining substantial revenue from sales of scanner and supporting services. A recent study of computed tomography (CT) sales showed that in 1997 approximately 3,300 scanners were sold world-wide with a revenue representing 1.5 Billion US dollars. The quantities of image data becoming available for diagnosis already exceed what realistically can be interpreted by a clinician. Developing techniques to analyse such a wealth of image data and present clinicians with the most useful diagnostic results requires a concerted effort by the international community of medical image analysts.

The development of medical imaging software for leading edge clinical research is almost exclusively a commercial endeavour, resulting in proprietary code which has a low visibility (restricted access to source code). This is inhibits dissemination and duplication of experimental results, which are the very cornerstones of scientific research. Failing to understand the consequences of using alternative packages prohibits comparative evaluation of results. Fortunately in a field such as medical image analysis the entire experimental apparatus is encapsulated within the software and data. Thus, the free distribution of code would give other researchers the opportunity to recreate experiments and evaluate techniques under fair circumstances. Un-hindered availability would also promote the use of a consistent environment within which researchers could benefit from and contribute to, the work of others. Open source software development and community based interaction are concepts which resonate with the ideals of scientific research.

A lot of research is conducted with short or medium term objectives (3 years). All too often practical results are lost because the expertise is not retained (such as Ph.D. students) or cannot be utilised by others in smaller or isolated university departments. The potential for commercial development of techniques has a very small window of opportunity even though the approaches themselves may represent the state of the art for many years. Encapsulating the work of individual projects in a widely used, open environment would greatly improve the robustness of such project work by virtue of a support community. Researchers utilising such a resource would have a greater chance of increasing the longevity of their work beyond the lifetime of the funding. This would also facilitate the co-operative achievement of long term objectives despite the transient nature of the funding and personnel.

If the rate at which research techniques become available to clinical groups is to improve then the barriers which inhibit commercial exploitation of research technologies need to be removed. Freely distributing research software under a public license, within a common environment, would ensure that the work of contributors enjoys the greatest possible exposure to the widest of audiences. This would enable commercial organisations to review and evaluate such techniques more rapidly and efficiently felping to overcome the conventional obstacles in commercial up-take of new technologies.

A recent article in the British Medical Journal (BMJ 2000;321:976) by an associated editor highlighted many of the benefits of employing the open source model in medical software. The high visibility of open source software being praised in terms of improving medical knowledge (fewer software secrets) and also in reducing costs by ensuring that the systems installed in clinical environments can continue to be developed regardless of the supporting company.

1.2 The task

The aim of this project to provide an open source software development environment for medical image analysis research which facilitates the free and open exchange of ideas and techniques (dissemination) with a minimum of effort. An infrastructure within which long term research objectives can be achieved, co-operatively via incremental stages. Mechanisms will exist which enable clinical end users (non-developers) to access these state-of-the-art techniques at early stages, using interfaces appropriate to their level of expertise. These mechanisms will also provide commercially interested parties with the opportunity to rapidly assess the potential of research technologies for custom integration into applications, without the need to re-implement. This represents a co-operative model for open source and commercial developers to collaborate without restricting either community.

1.3 Background

Medical image analysis software may be broadly categorised as either a **solution** or an **environment**. Solutions focus on delivering a relatively complete package targeted at enabling the user to tackle particular analysis tasks, often providing a range of supporting tools (integration into patient databases, support for common file formats, online help, etc) but with a specific (limited) set of analysis techniques. In comparison, environments are typically less functional as standard. Instead they provide a language and set of tools with which the user is expected to develop applications themselves. Although this encourages a wide variety of applications to arise, they rarely form a coherent suite and usually require familiarity with the processes of software development in order to be used.

In the past 15 years TINA (an existing medical image analysis **environment** described later in section 3) has been used, developed and contributed to by over 50 developers at several sites within the UK. It has provided the software basis to many funded research projects most recently on NOVICE (EP26342), IERAPSI (IST-1999-12175) and the UK national 4 site Medical Research Council multidisciplinary IRC project. The algorithms within TINA have formed the basis of over 200 peer reviewed publications. All this work has been achieved at just a few institutions around 50 developers. With the support of this project this consortium expects the full potential of an open source approach to research to benefit the entire community, potentially thousands of developers and for them to benefit it.

It is important to identify the categories of individuals who will benefit from this work. Table 1 summaries broadly how the different categories of user relate to the software types described earlier and how this enables us to identify members of the open source **community** group and of the **commercial** group (some individuals may fall into both). The **Contribution** field shows how that category of user utilises that class of software, often as both a user and a supplier (the dominant method is given first).

Category	**Software type**	**Class of Software**	**Contribution**
Academic developer	Environment	Open Source	Supplier/User
Hospital developer	Environment/Solution	Open Source/Commercial	User/Supplier
Commercial developer	Solution	Commercial	Supplier
Academic clinical	Environment/Solution	Open Source/Commercial	User
Hospital clinical	Solution	Commercial	User

Table 1: User categories for medical image software development

1.4 The project aims

Using TINA as a basis the consortium aims to establish OSMIA as the environment of choice for researchers into medical image analysis. This will be done in a way which facilitates the greater up-take of research algorithms by commercial organisations whilst allowing each area of work, research and business, to continue working in its current model.

The current distribution of TINA does not have some of the important attributes expected of open source software. In particular it lacks features such as auto-configuration, repository services for distribution and contribution, automated test schemes and complete documentation. This consortium will address these issues in order to increase the ease of adoption, to attract the largest possible number of users to OSMIA. Specifically it shall;

- Setup a centralised access point for source code distribution and contribution, supporting a number of access protocols including HTTP, FTP, CVS and RSYNC. ISBE will also reduce the manual configuration needs of the software to a minimum, streamline the software into a more efficient codebase and produce a packaged demonstrations of particular algorithms.
- Establish a community framework for external developers to contribute to the libraries and provide infrastructure (email lists, messaging systems, etc) to allow effective communication. Also to maintain up to date documentation and support material, such as example datasets.
- Promote and disseminate OSMIA both electronically (indexing to various search and catalogue web sites) and at academic and industrial conferences and exhibitions throughout Europe (such as the European Congress of Radiology).

To promote algorithms within OSMIA to **commercial organisations** the partners shall develop a generic interface mechanism which will allow access by third party applications and facilitate data transfer between them. This work will be done in conjunction with commercial partner Voxar, who will produce a compatible system for their medical image visualisation software, Plug n View 3D (PnV). These interfaces will enable PnV to become a clinical front-end to functionality in an open source research environment. Once in place, this interface mechanism will provide PnV users with access to current and future developments. The specifications and code for the OSMIA interface will be integrated as open source and will thus be available to other organisations who wish to develop similar interfaces. Voxar will use this mechanism to evaluate existing algorithms within TINA for full custom integration into their software. Further, Voxar will promote the use of OSMIA as a development environment to appropriate customers by including distributions with special releases of their software.

To ensure that the procedures adopted are appropriate for the wider community the academic partners at the Vision Systems Lab, Dublin City University (VSL) and the Computer Science Dept., University of Western Ontario (UoWO) will act as example **community developers**. They will assess the software, including all aspects of the community releases under typical working practices. This will involving integrating existing software from the partners, providing functionality currently not present in TINA. They will provide regular feedback which will be used to refine the community release of the software.

The project manager will also organise a user group with both participants and representatives from other algorithmic developers, clinical end users and manufacturers of other software systems. This user group will assist in reviewing documents and advice in establishing the specifics of the OSMIA open source license. It will also assist in establishing the non-exclusive license mechanisms for algorithms identified as potentially useful, ensuring they can be exploited at reasonable cost without loss to the open source distribution. Ultimately this user group will form the basis of the OSMIA open source community.

The table below summarises the objectives of this project together with the criteria for assessing each objective.

Objective	**Assessment Criteria**
- Open source release of OSMIA based on TINA	Delivery of distribution
- Promote OSMIA as a platform for medical image analysis	Numbers of enquiries
- Demonstrate research use of OSMIA	Output from community evaluation projects
- Demonstrate commercial use of OSMIA	Increased sales of PnV
- Establish developer community	Number of developers

2 Contribution to Key Action Objectives

The strategic objective of the IST programme is to **realise the benefits of an information society for Europe both by accelerating its emergence and by ensuring that the needs of individuals and enterprises are met.** This project directly addresses this objective by supporting an environment within which new medical image analysis research techniques can be developed co-operatively. It provides new access routes into such techniques allowing more rapid and efficient commercial exploitation and clinical exposure.

The work in this proposal clearly constitutes a trial by **enhancing the effects of RTD work**. In fact it achieves this at two levels. Firstly, it supports the development of an environment for algorithmic research which improves the potential for take-up by commercial organisations of current and future RTD work. Secondly, the mechanisms used in this project represent a trial of a more generic model of open source/proprietary partnerships which may be applicable to other areas of business.

TINA is a proven technology in the field of machine vision and medical image analysis and already provides extensive functionality for medical image analysis research. However, until now it has been under utilised within the field due to the limited resources available for infrastructure development. The quality of the algorithms which already exist should encourage other developers in the community group to work with, and contribute to its continuing success. Funding this proposal will enable us to establish OSMIA as **the open source medical image analysis package**, an area which is poorly served in the open source software community. Once this project is completed the hundreds of other medical image analysis research groups throughout Europe will have continuing, shared access to this premiere development environment. This directly addresses the primary objective of this action line, **fostering in Europe development of a much needed free software environment**.

This proposal mainly targets the **Trials of free software development** focus in particlar the fields of **co-operative information production and sharing** and **usability**. A consistent development framework facilitates the **co-operative working** of research groups, throughout Europe and the rest of the world, which is becoming vital in performing larger scale trials of medical imaging techniques, often involving several remote sites. Unifying a dispersed array of community developers within one environment enables the software to acquire a **critical mass** which is easier to support and to facilitate for. This is important in open source software and critical in research, where the community is as important as the code. A common environment also supports the **dissemination of scientific results** in a practical fashion which complements the traditional publication method.

Providing an interface which enables the often complex image analysis algorithms to be driven from a familiar system greatly improves **usability** and broadens the base of potential users. In turn this will enable those academic clinical and hospital clinical, who do not have the support of algorithmic developers, to gain access to state-of-the-art algorithms earlier in development and to work in areas otherwise outside their availability. This improves opportunities for **co-operative information production and sharing** in ways which allows larger and more varied groups of clinical users to participate.

The open interface mechanism will permit commercial organisations involved in medical image analysis software development to evaluate a broader range of algorithms more rapidly than would otherwise be possible. This would be of particular benefit to **SME's** (of which there are many in this field) for whom speculative market analysis is often a prohibitively expensive endeavour. The ability to acquire ‘alpha quality’ examples of software freely would enable companies to assess either themselves or in collaboration with customers (who also have access to the software) which algorithms are worth focusing development on. The combination of freely available research software driven from commercially established front-ends should widen the appeal of both platforms; commercial and open source methods working synergistically.

Commercial exploitation of algorithms would be achieved under licenses which do not affect the open source nature of OSMIA (nor the loss of algorithms). This would provide revenue to the contributors who would be in a position to negotiate development as external contractors or act as consultants in the process of recoding. In this way development within OSMIA becomes a promotional tool, presenting the techniques developed by research groups. Success in this would, in turn, attract others developers.

In summary, by establishing OSMIA as the open source medical image analysis environment the Commission would be **making available a European based support service for medical image research free software projects** within one environment, which fulfils the second objective of this action line.

3 Innovation

3.1 Status of the technology

Development of TINA[1] *[http://www.tina-vision.net]* began in 1986 at the Artificial Intelligence Vision Research Unit at the University of Sheffield, UK. Development continues today at the Division of Imaging Science and Biomedical Engineering (ISBE) at the University of Manchester, UK.

Essentially TINA is a collection of over 150K lines of 'C' code organised into libraries providing the facilities necessary for developing image analysis algorithms. These include; data structures for images, mathematical, statistical and geometric constructs; higher level vision primitives; functions to read/write data in many formats; GUI for building 'tools' used to operate algorithms and display, modify and analyse data; an extensive array of image processing, numerical and statistical operations, including a range of familiar as well as many novel pattern recognition and data analysis techniques; solutions to low-level (feature extraction, primitive fitting) and high-level (object recognition, depth estimation) vision problems. In the last 4 years TINA has been developed at ISBE, an interdisciplinary 5* rated (highest research rating in UK) university research group, where it has been used to tackle many problems in medical imaging, particularly in magnetic resonance imaging (MRI). Functionality has been introduced to support this work at both the low-level, such as file readers and writers for popular medical image formats such as DICOM and ANALYZE, and at the higher level including; automated rigid body volume co-registration together with fast reslice; fMRI BOLD signal analysis with motion artifact analysis; single and multi-spectral tissue segmentation; arterial blood flow, tissue perfusion and permeability analysis; semi-automated brain structure segmentation.

TINA is currently provided as open source under the lesser-GPL license. It is known to work on several UNIX platforms including Solaris and Linux using either the Xview or Motif (Lesstif 1.2) GUI toolkits. The code is currently distributed as snapshots of the ISBE directory tree captured irregularly. Documentation is provided in the form of 3 postscript manuals which provide user support (how to drive some of the tools to do useful work), the programmers guide and the algorithms guide (a collection of papers).

Plug N View 3D (PnV) is a high performance medical image visualisation package which runs on desktop PC hardware. Originally released in January 2000 PnV has gained international recognition for both technical superiority (quality and speed of rendering) and cost effectiveness requiring only a standard PC (as opposed to a dedicated workstation). PnV provides full DICOM support including retrieval and transmission to standard hospital patient access systems; 2D multi-planar reformatted views of volume data; 3D iso-surface and volume rendering of data with preset mappings for analysis such as colonic screening; supporting functions for radiological report creation. In the last financial year Voxar sales of Plug n View 3D reached 1.5 million dollars. Projections for the coming financial year are 4.5 million dollars.

NeatVision *[http://www.neatvision.com/]* is a Java based image analysis and software development environment. Developed by the Vision Systems Lab. at the Dublin City University it provides over 200 image and general data processing algorithms in a visual programming environment. It is primarily intended as a resource for constructing system solutions from sets of existing analysis components. thus would greatly benefit from the inclusion of OSMIA functionality, augmenting this resource with many new advanced functions specifically the medical image analysis techniques described earlier. NeatVision is currently provided as shareware.

3.2 Competition

The environments which could be regarded as being in competition with this project fall into two categories. **Full environments** which define both a language and the functionality available to the user and **libraries** which augment an existing operating system and compiler setup.

The classic full environment example is Matlab *[http://www.mathworks.com]*. Some medical image software has been produced using Matlab, a good example being SPM *[http://www.fil.ion.bpmf.ac.uk/spm/spm99.html]* a system designed for functional neuro-image analysis. IDL *[http://www.rsinc.com]* is another environment which is often used in medical image analysis. Both are commercial packages. Cost aside this introduces a dependence on a commercial system which is subject to business demands, i.e. modifications not necessarily driven by technical merit. There are freeware/open source alternatives such as Octave *[http://www.octave.org]* an environment 'mostly compatible with' Matlab and R *[http://www.r-project.org]* an open source statistical analysis environment syntactically equivalent to S *[http://insightful.com]*. However, the use of a proprietary language greatly restricts the direct commercial exploitation of algorithms demanding a complete software rewrite. Further, although convenient for initial algorithmic development and test, such environments hinder development, particularly as the

[1] In a manner similar to GNU, TINA expands to **T**INA **I**s **N**o **A**cronym

complexity of the system increases. For instance, by imposing some development limitation e.g. performance, or in failing to support important core or peripheral hardware.

TINA is an example of a library environment providing a range of functionality to the programmer. As such it makes few assumptions of the system ('C' can be regarded as an almost universal computer language) and imposes few limitations on how the user makes use of the functionality as the library functions can be called in virtually any programming language. There are a variety of libraries available to support scientific data processing some of which have utility in medical image analysis. These include; handling formatted data interaction (HDF *[http://hdf.ncsa.uiuc.edu/]*, DICOM *[http://www.offis.uni-oldenburg.de]*); visualisation (PLPLOT *[http://plplot.sourceforge.net]*, VTK *[http://www.kitware.com]*); numerical and statistical analysis routines (STATLib *[http://lib.stat.cmu.edu]*, NETLib *[http://www.netlib.org/]*). However, these libraries provide low-level support to a specific area in a manner which has broad appeal to a range of disciplines. Much of TINA functionality is at a higher-level than is available elsewhere, although there are many opportunities for TINA to work in conjuction with such systems.

The Image Understanding Environment (IUE) *[http://www.aai.com/AAI/IUE/IUE.html]* project specifically aimed to produce a package which would become the preffered environment for general image analysis research. Unfortunately, the lack of practically useful algorithms and the poor integration of IUE with other systems (other commonly used software) meant the project was unsuccessful. The IUE project recently mutated into a package called VXL *[http://www.robots.ox.ac.uk/vxl/]*, which unfortunately does nothing to address these deficiencies. Also by operating a restricted source policy (developer acceptance is required), VXL remains a package which the majority of researchers will be unable/unwilling to exploit. In comparison, TINA has evolved within an ongoing programme of research as a mechanism to enhance productivity, under constant assesment and modification adapting to the needs of the users.

An effort by Intel to introduce an open source library of functions for computer vision optimised for Intel devices has been more successful *[http://www.intel.com]*. The motivation however, is to support the development of Intel devices and so, although the code is provided as 'C' source it is optimized for this family of processors. More importantly the functionality within the library is limited to a subset of algorithms which Intel believe would provide useful components for the next generation of Human-Computer Interfaces. Code which does not attend to Intel's plan is not integrated into the system (all optimisation is done by Intel employees). There are no provisions for medical image analsysis algorithms, what little generic functionaility is provided is better served by other mathematical and statistical function libraries (BLAS, LAPACK).

Analyze *[http://www.mayo.edu/bir]* a medical image analysis and visualisation system is the only package known to adopt a similar approach to that proposed for OSMIA. However, Analyze is a commercial package and is usually provided as a GUI driven toolkit. To develop Analyze requires acceptance of a submitted proposal, however this does not, under normal circumstances, include access to original source code. This is regarded as a severe limitation in terms of research worthiness as it does not promote the understanding of algorithms or the open exchange of research ideas. It also reduces the number of contributors to a select few and thus focuses the functional content on specific areas in medical imaging. Of more concern is the way in which closed source restricts access to the specific implementation details of algorithms. As outlined at the start of the document, the lack of such details can lead researchers working co-operatively to form invalid assumptions making such work difficult and potentially dangerous. Finally Analyze does not benefit from the diversity of machine vision and generic pattern recognition techniques already present in TINA, many of which have already been found useful in medical image analysis.

3.3 Innovative aspects

There are three major innovations which this project presents;

- A full open source release of OSMIA would provide **a unique resource to the medical imaging community**, providing a proven array of established and original medical imaging, machine vision and pattern recognition algorithms in a flexible and consistent environment. Further, OSMIA will allow short term projects to be developed in a framework which sustains useful algorithms beyond the lifetime of directed funding. Such an approach will allow the larger problems in medical imaging to be addressed in an incremental fashion.

- The third party software interface would facilitate **rapid prototyping of commercial grade software directly from research implementations**. This gives commercial organisations access to a wide range of research software in one situation, without the need to re-code, greatly reducing the lead time in clinical up-take. In turn this would allow less technically able clinical users to experience and evaluate research techniques within the setting of a familiar environment.

- The approach to be adopted provides an **novel interface between open source and commercial software development**, one that does not attempt to redefine how either are performed. It will use the OSMIA library mechanism as a 'scoop' for analysis techniques, presenting them in a unified system and channelling them towards commercial exploitation and has the potential to return funding to open source community. This model has the possibility to work in other areas where open source and commercial solutions co-exist.

3.4 Business cases

Open source developers

In this situation open source developers of medical image analysis techniques can be regarded as both **users** and **suppliers** (utilising or contributing value to OSMIA). To the user OSMIA will increase research productivity by providing both a robust infrastructure upon which new algorithms can be developed as well as providing access to a large resource of pre-developed techniques. The open source nature of OSMIA together with the modular use of a ‘C’ library structure will provide easy access to software in a flexible manner. This is obviously attractive to users who can integrate OSMIA into their current working practice without large development overhead. It will also be of benefit to suppliers for whom integration of code is relatively straight forward. Further, open source allows the work of suppliers to be presented to a wide audience which is important in research if ideas are to become adopted by both peers and commercial organisations.

The addition of a third party software interface means that suppliers contributing code have the potential for their work to be recognised by organisations not directly associated with the research community. Many in research have constrained their working practises so as to appeal to companies who might exploit their work. Buffering the interaction between research and commercial exploitation will allow developers to embrace the practises of open source development and the freedom it brings, whilst retaining the potential for exploitation.

Commercial organisations

The role of commercial organisations such as Voxar is one of **users** (next person in the value chain) of OSMIA technology. Many of the analysis problems of interest to Voxar have been solved by algorithms already present in TINA and they are keen to exploit some of these algorithms. Developing a generic interface scheme will allow any algorithm to be evaluated, both current and future. This longer term view demonstrates the degree of confidence that Voxar have in OSMIA as an research platform. OSMIA will enable Voxar to collaborate with academic and hospital developers and give them a competitive advantage. It does this by providing Voxar with early access to algorithms in development, allowing Voxar to demonstrate these techniques to the clinical organisations and generally becoming involved in shaping the adoption of new algorithms. Linking OSMIA and PnV will help extend sales of PnV into academic medical facilities by promoting PnV as a user friendly front end to the state-of-the-art techniques in OSMIA. Voxar have already received interest from some of their clinical customers regarding the opportunities for developing their own code in PnV. Voxar envisage OSMIA as one mechanism with which this could be achieved. Although the potential market for sales to such clinical developers is projected to be in the region of only 10’s of units/year penetrating such a market will help Voxar improve the quality of their product.

Voxar understand that as an open source resource, the algorithms in OSMIA will be freely available to anyone, including their competitors. Despite this, Voxar recognise the need to improve the quality of all clinical software and are confident with OSMIA they can be competitive in a more technically advanced market.

4 Project Workplan

4.1 Introduction

The objectives of this project are summarised by the diagrams of figure 1. The diagram on the left of figure 1 demonstrates the relationship between the software environment OSMIA and the open source and commercial development communities. The goal is to establish two working mechanisms, each of which exposes OSMIA functionality in a manner appropriate to the particular community. To the open source community OSMIA is presented via a source code repository service through which members of the open source community can get access and contribute to it. To commercial organisations OSMIA is accessed through an software interface mechanism, allowing algorithms within OSMIA to be executed directly from third party software.

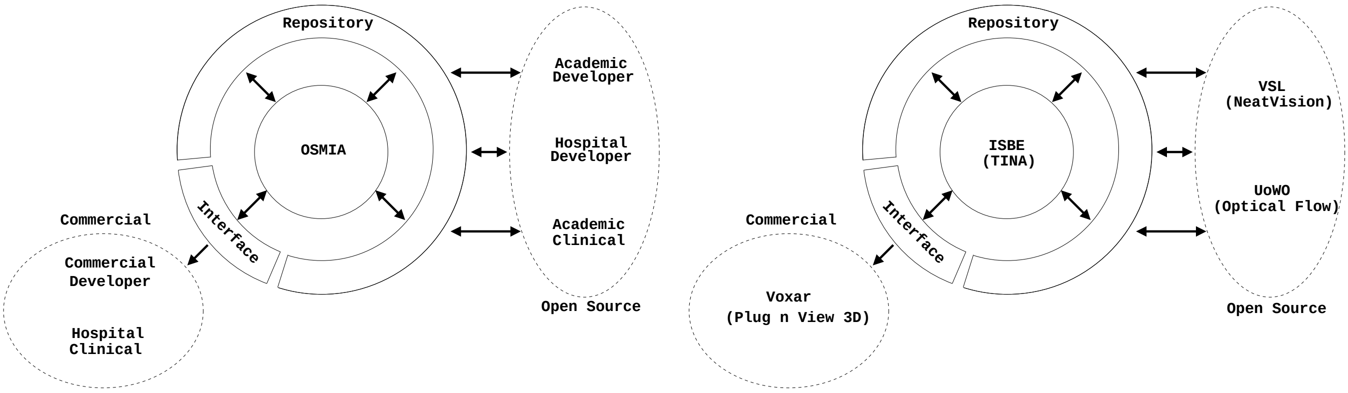


Figure 1: Overview of software relationships (left), overview of partner relationships (right)

The diagram on the right of figure 1 describes how each of the project partners relates to this objective model and identifies what software they currently provide which will be used in this project. For several years ISBE has been providing TINA as an open source environment for image analysis research. Until now, however, the facilities and support necessary to establish TINA within the larger community have never been adequately provided. This project will inject the funds necessary for ISBE to reorganise the code distribution, introduce new access points to the algorithms and establish a full complement of support mechanisms. When the project is completed OSMIA (as it will become known) will be ready to support world-wide collaborations of medical image analysis researchers. This work is the focus of workpackage 2 and is summarised in terms of the objective model in the diagram of figure 2.

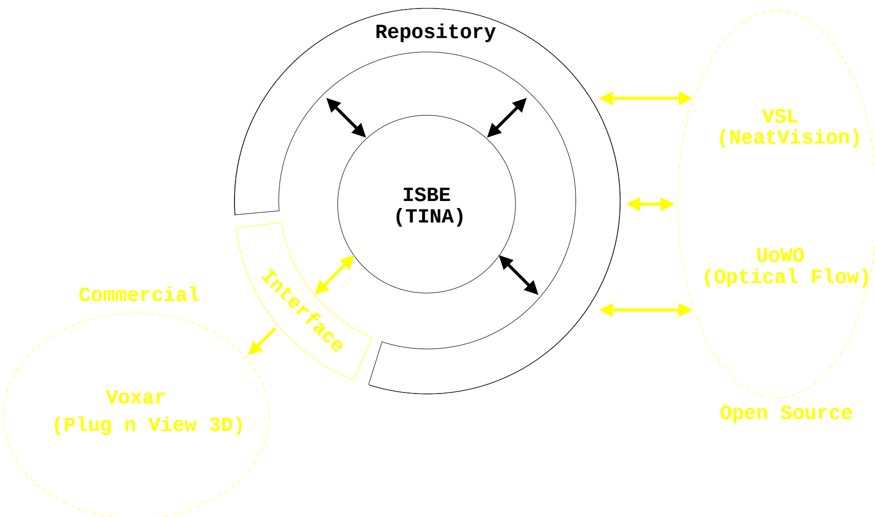


Figure 2: Parts of objective model which form workpackage 2

ISBE will also be jointly involved in the development of the software interface system which will enable third party software to execute OSMIA algorithms directly. This will be adopted by a leading medical image visualisation company (Voxar). It will greatly improving the accessibility of algorithms to both commercial organisations interested in exploitation and clinical users who wish to trial state-of-the-art techniques. This will enable them to evaluate techniques directly, using the original OSMIA implementation as a prototype. Once complete Voxar will evaluate OSMIA as a resource for commercial organisations to exploit, identifying algorithms Voxar would be interested in exploiting. This work is the focus of workpackage 3 and is summarised in terms of the objective model in the diagram of figure 3

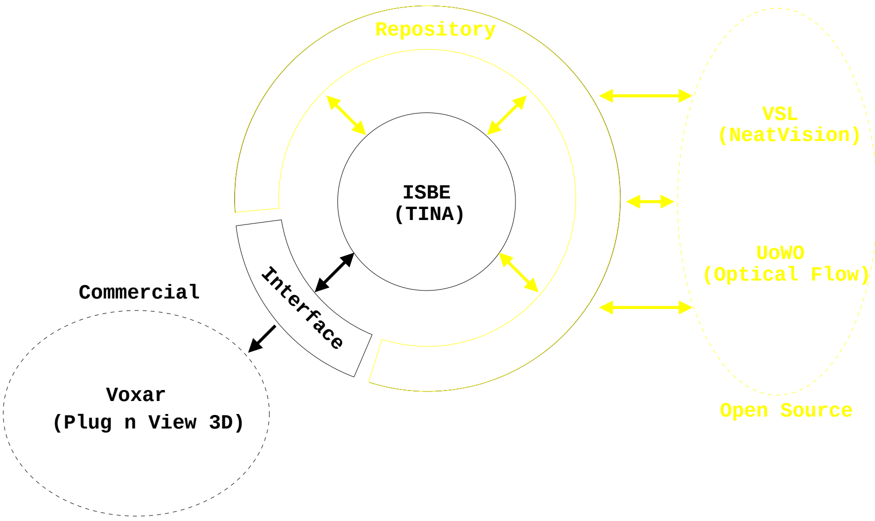


Figure 3: Parts of objective model which form workpackage 3

The third portion of the project involves VSL and UoWO (both leading academic figures in the image analysis communities). They will take on the role of evaluating the OSMIA open source environment, reporting on the quality of the software, the distribution mechanisms and the supporting community infrastructure. To do this, they will perform evaluation projects. UoWO will contribute to OSMIA by integrating optical flow software which they have previously developed (currently not present in TINA). VSL on the other hand will integrating OSMIA into their own system, NeatVision. These exercises evaluate the two potential modes of operation of OSMIA, user or supplier. VSL and UoWO will also be instrumental in establishing the user community. This work is the focus of workpackage 4 and is summarised in terms of the objective model in the diagram of figure 4

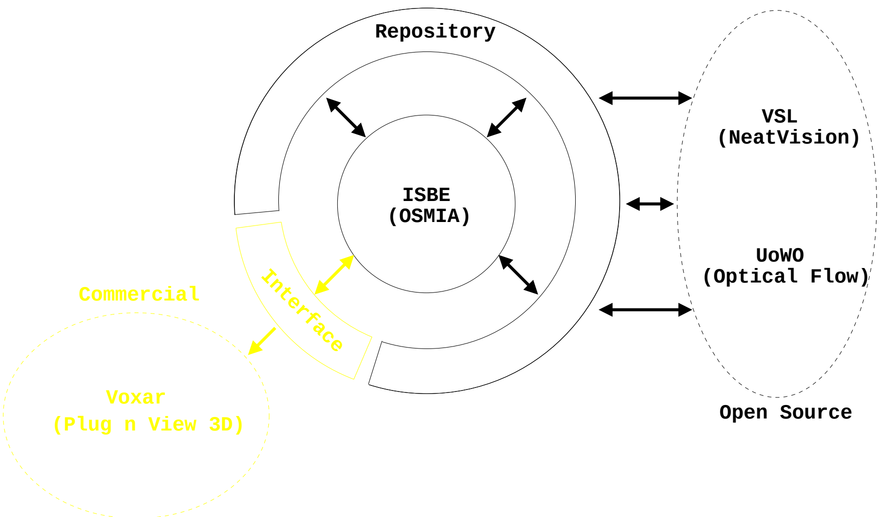


Figure 4: Parts of objective model which form workpackage 4

The workpackages identified above will enable the consortium to implement the objectives defined in the model of figure 1. To ensure that this work is done to the satisfaction of the other categories of user as defined in section 1 (those included in the left diagram of figure 1 the consortium will establish a user group. This group will include representatives from each member of the consortium plus members representing the hospital clinical, hospital developer and academic clinical groups not involved in the implementation of the objectives. This group will be given the task of reviewing documentation and assessing the stages of the project in order to understand the mechanisms provided and to identify and correct potential problems. Ultimately, once this project is complete this group will form the basis of the community so important to the success of any open source project.

The designations and roles of each of the project participants is summarised in table 2 below.

Participant No.	**Participant Name**	**Abbreviation**	**Expertise**	**Role**
P1	ISBE, University of Manchester, UK	ISBE	Machine vision and medical image analysis research with clinical support	Supplier
P2	Vision Systems Lab., Dublin City University, IE	VSL	Machine vision research	User
P3	Computer Science Dept., University of Western Ontario, CA	UoWO	Generic Image analysis research	Supplier
P4	Voxar Ltd. UK	Voxar	Development of medical visualisation software	User

Table 2: Participants

4.2 Workpackages

The diagram of figure 5 breaks down each of the workpackages outlined in figures 2, 3 and 4 into a series of tasks and shows the relationship between of each of the major technical components.

The workpackages are summarised the **workpackage list** in table 3, below.

Workpackage No.	**Workpackage Title**	**Lead Contractor**	**Person-months**	**Start Month**	**End Month**	**Deliverable No.**
wp1	Project Management	ISBE	4	0	18	D1
wp2	Open Source Distribution	ISBE	8	0	18	D2
wp3	Commercial Interface	Voxar	23	0	18	D3
wp4	Community Evaluation	VSL	32	0	18	D4
wp5	Dissemination and Exploitation	Voxar	8	0	18	D5

Table 3: Workpackage list

The individual effort breakdown for each partner is summarised in table 4.

Partner	ISBE	Voxar	VSL	UoWO	**Total**
wp1	4	0	0	0	4
wp2	8	0	0	0	8
wp3	7	16	0	0	23
wp4	0	0	16	16	32
wp5	2	2	2	2	8
Total:	22	18	18	18	76

Table 4: Effort breakdown

The project deliverables are summarised in the **deliverable list** of table 5, below.

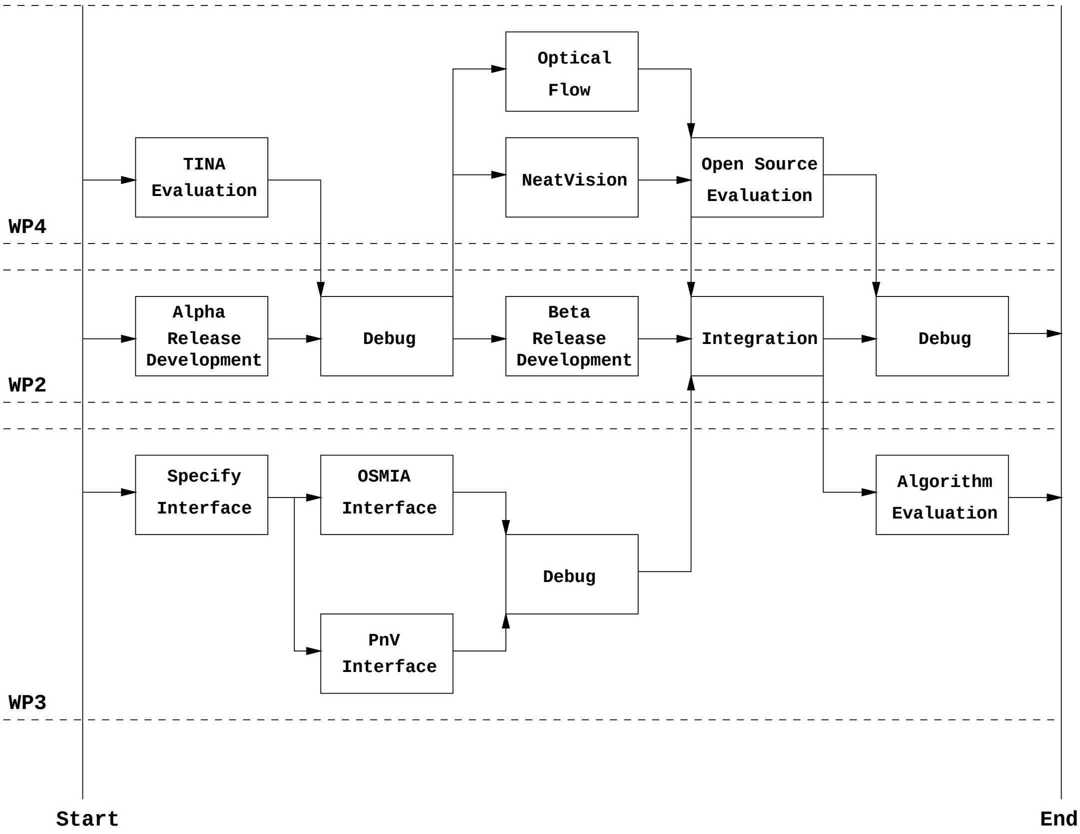


Figure 5: Diagram of technical component dependencies (PERT)

In the following sections each workpackage is discussed in detail. Each section begins with a workpackage description form which summarises the actions and objectives of the workpackage. This is followed by a more in depth analysis of the workpackage including, where appropriate, a workpackage gantt chart.

4.2.1 WP1: Project Management

The details of the project management are discussed in the Part C document.

4.2.2 WP2: Open Source Distribution

The objective of this workpackage is to transform the current software distribution into a self consistent, easily maintained, uncluttered codebase with a robust installation procedure available on a wide variety of platforms. This work will be done exclusively at ISBE. The distribution will incorporate all of the features expected of a high quality open source application, including simplified configuration utilities and accessibility through several distribution mechanisms (such as FTP and CVS). ISBE will also ensure that clear and adequate documentation are provided so that inexperienced users can quickly and efficiently start to the utilise the power of this resource. ISBE will put in place a full and complete framework of communication and collaboration mechanisms to ensure that the establishing community is adequately supported. All the facilities put in place will be evaluated by work in WP4 and the feedback used to debug and improve the distribution and resources.

To ensure the longevity of OSMIA as an open source environment once the project is complete, it is vital that a burden of management is not introduced, requiring unrealistic levels of time or money. ISBE have considered the resources that will be available once this project is complete and have focused attention on simplifying working practices and automating tasks. ISBE will make extensive use of other, well supported open source software in order to manage and maintain OSMIA, whilst being careful not to introduce unnecessary technological dependencies. For example in the re-development of the TINA website (the focal point of the community resource) ISBE will use the PHP language *[http://www.php.net]* for server-side webpage generation, as opposed to developing static webpages. Adopting a dynamic approach to webpage design is more complex

Deliverable No.	Deliverable Title	Delivery Date (Month)	Nature	Dissemination level
D1.1	Project review	6	R	PP
D1.2	Project review	12	R	PP
D1.3	Project review	18	R	PP
D2.1	Alpha open source distribution of OSMIA	2	D	PP
D2.2	Release of repository systems	6	D	PP
D2.3	Release of developer website	12	D	PP
D2.4	Release of improved codebase	17	D	PP
D2.5	Open source distribution of OSMIA	18	D	PU
D3.1	Working specification for interface	1	R	PP
D3.2	Interface system for OSMIA	13	D	PU
D3.3	Interface system for Plug N View 3D	13	D	PP
D3.4	Public release of interface specification	13	R	PU
D3.5	Algorithm evaluation report	18	R	PP
D4.1	Assesment of TINA technology	2	R	PP
D4.2	OSMIA integrated with Neatvision	15	D	PU
D4.3	Optical flow techniques in OSMIA	15	D	PU
D4.4	Assessment of OSMIA	18	R	PU
D4.5	Documentation for software	18	R	PU
D5.1	Dissemination plan	2	R	PP
D5.2	Dissemination report	18	R	PU

Table 5: Deliverable list

than writing static webpages, however it provides many advantages in semi-automated site management. Similarly, ISBE will not burden ourselves or site visitors with heavy client-side scripting or imagemaps for navigation. ISBE shall ensure that the resource is available to the largest audience possible limiting the requirements on site visitors. Simplifying processes and considering the broader issues, also helps to promote robustness, a feature of the upmost importance in an information resources such as these. ISBE are confident that once this project is complete they will be able to manage the new distribution of OSMIA with a minimum of effort, potentially funded, in part, from income generated by commercial take up of analysis techniques.

Tasks

The gantt chart in table 7 in section 5 shows the tasks in WP2. After acquiring the repository hardware in **wp2.t1** webpages and information resources will be installed on the system in **wp2.t2**. This includes exporting the current TINA codebase to new repositories for use by CVS and RSYNC. The existing web pages will also be moved to this server together with the manuals and other information resources. This resource will be situated in ISBE at the University of Manchester where ISBE has the rooms and infrastructure to support such as system, including a Gigabit ethernet direct fibre-optic link onto JANET (internet backbone in the UK) and permanent support and maintenence personnel. Retaining control over the primary host is also prefered if a professional, robust infrastructure is to be managed. Completion of this task signifies that the milestone **wp2.m1** alpha open source release will have been reached. Feedback from community developers in WP3 will be used to debug and improve the repository in **wp2.t3**.

The objective of **wp2.t4** is to introduce software release strategies and improve the client installation process. This will simplify access to OSMIA for new users and improve the robustness of installations (increasing confidence in the software). ISBE will evaluate technologies such as GNU autoconfigure and introduce mechanisms for automated configuration of the code once installed on client machines. ISBE will also establish protocols for handling and redistributing contributor code. In order to retain management of the software tree ISBE will install a CVS layer to act as a *shell*. This will be separate from the core directory tree and provide an interface for the community to acquire the latest code. ISBE will install automated systems to reconcile this layer with the core distribution tree on a regular (daily) basis. However, this will also allow us to disseminate information regarding code changes to the community in order to promote support activities such as third person code trawling. Although code management system such as CVS can provide massive advantages for multi-user code management, they cannot replace manual code analysis.

In **wp2.t5**, the development of the supporting information and access resources will be done. Specifically ISBE will establish a *developer website* with dedicated facilities for community developers including access to code contribution and exchange areas (based on the protocols developed in **wp2.t4**), logs of contributions to the CVS repositories and email lists. Another area of development will be the documentation which will be updated to represent the release structure of OSMIA. The documentation will be represented in a contribution framework so that, like the code, it can be kept updated by community wide action. The webpages will be updated to reflect the resource changes and will be re-engineered to increase levels of automation. This will include providing facilities to ensure that the latest information, code changes and developments are presented to the users as quickly and efficiently as possible.

In **wp2.t6** ISBE will implement a series of rationalisation exercises aimed at simplifying and improving the robustness of the existing code. ISBE shall also introduce code testing strategies which will allow the integrity of the codebase to be evaluated automatically when updates are performed. As part of this task ISBE will also produce a series of focused applications which demonstrate the capabilities of OSMIA in a specific domains. These will be useful in demonstrating the capabilities of OSMIA (at a functional level) to potential users as well as developers who, currently, have a particular application or application need in mind. By demonstrating OSMIA in this way we may attract *creeper* groups, i.e. those who come to OSMIA for specific use purposes then slowly make use of more of the software. Typical applications include standalone versions of the image calculator for prototyping image processing algorithms; the volume-to-volume co-registration and reslice tool for automated co-alignment of medical datasets; the tissue segmentation tools for identifying the quantities of different tissue types in neuro-images. These demonstrations have been selected on the basis of our experience regarding quantitative analysis requirements in clinical research projects. The appeal of these demonstrators will be enhanced by augmenting the existing graphical interfaces (Xview/Motif) with GTK+ *[http://www.gtk.org]* and Tcl/Tk *[http://www.scriptics.com]* interfaces which operate on a broader range of platforms. We shall use these interfaces to enable OSMIA to run on non X-Windows platforms including Microsoft Windows.

The interface system developed in WP3 will be integrated into the codebase in **wp2.t7** The documentation and webpages will be updated with the details of how this system can be utilised. Once this task is complete the second milestone **m2** the beta open source release will have been reached. In **wp2.t8** the repository and community resources will be debugged, based on the assesment and feedback from WP4. Completion of this tasks results in the delivery of the first public release of the software which forms deliverable **D2**.

4.2.3 WP3: Commercial Interface

The rate at which new medical image analysis techniques are adopted by commercial software can be addressed by improving the visibility of research ideas. Tackling this problem in OSMIA is the objective of WP2. The aim is to develop an software interface mechanism which will allow algorithms to be accessed without the need to program, setup or interact with OSMIA directly. The interface developed in this workpackage will provide an alternative control mechanism for the executing toolkits. Toolkits are executable applications which are produced during the development of the underlying algorithm as a way of evaluating and controlling that area of functionality. Much of the infrastructure they provide is targeted at the developer and is often confusing for the non-expert user and, from the user point of view, unnecessary. The interface system will allow functionality in an OSMIA application (a suite of toolkits) to be invoked remotely from a third party application. It will also enable data to be transfered between the two. The specification for this interface scheme will be made available and open source in order to promote the idea so others may make use of this scheme.

Once such an interface is established Voxar will be able to more rapidly assess the performance of algorithms within OSMIA, than if they were required to integrate the code directly. This is because the interface mechanism would work at the very highest level, exposing only the functionality required to operate the overall system. New algorithms in OSMIA will become almost instantly accessible from PnV, providing Voxar with a prototype. From this point Voxar would be free to assess the general behaviour of the algorithm from within PnV. If satisfied with this stage, they could move on to develop a more appropriate (better integrated, targeted at particular users) interface to the OSMIA algorithm, at the PnV side. This could involve introducing levels of automation such as utilising information regarding the data capture process in order to reduce the number of configuration parameters. At each stage Voxar would have access to a working model of the completed system. Indeed the complete integration of sets of algorithms in OSMIA could be assessed and prototyped without the need to include any non-PnV specific code, requiring only that the interfaces be developed. Once Voxar are satisfied with the performance of the system they can consider full integration of the algorithm. Even at this stage the prototype has use as a 'gold standard' for comparison to the final implementation.

The interface mechanism will also allow Voxar to distribute potential new techniques to interested third parties (clinical or developer) for external evaluation. Similarly, resources developed by groups associated with Voxar could be presented using OSMIA as the transport mechanism.

Tasks

The first part of this workpackage **wp3.t1** will focus on producing the specification of the interface protocols. A collaborative effort between ISBE and Voxar will identify the technologies which will be used to achieve this. This includes reviewing object brooker schemes such as CORBA and COM, as well as the potential to use a Java API to implement a client-server system and also object protocols such as SOAP. At the start of the project the developer from Voxar assigned to the project will be seconded to work at ISBE for a period of one week. During this time the personnel will be familiarised with the technology within TINA in particular mechanisms relevant to the interface development. The developer at ISBE will then work for a similar period at Voxar becoming familiar with the technologies used. This training will be used to assist in establishing the specifications for the interface mechanisms. Voxar and ISBE will work together on identifying the technology and the protocols for the interface. At the end of this task the working specification for the interface will be delivered, **D3.1**.

In tasks **wp3.t2** and **wp3.t4** work will commence on realising the interfaces in both OSMIA and PnV. Monthly reviews, including site visits by partners will ensure the synchronisation of this work. During **wp3.t3** and **wp3.t5** both teams will enter the software debugging phase. At the end of this phase both Voxar and ISBE will provide beta release software for the other partner. This will also include presentations by each partner on the details of the final implementation. This information will be used to define the final trials which need to be performed before the interface can be released. In **wp3.t6** the two teams will commence a program of joint debugging. During this phase each of the trials outlined in the previous task will be completed to the satisfaction of both partners. Only once this series of trials is complete will the interface systems be released. This release will coincide with the public release of the interface specification.

Tasks **wp3.t7** and **wp3.t8** will be conducted by Voxar. During **wp3.t7** Voxar will survey the algorithms currently available in OSMIA in comparison to their product development "roadmap". From this Voxar will select between four and eight algorithms which are of interest and which they would consider to provide suitable extra functionality for their products. In this stage Voxar will also consider market suitability which will take the form of consultations with current clinical customers. Voxar will then specify a set of requirements for these algorithms and, using the newly developed interface system, evaluate these algorithms in task **wp3.t8**. The following general criteria will be used in their assesment;

- Stability: As a company producing commercial clinical software, it is necessary to ensure any code integrated into each application is as stable as technically possible. This will not focus on the stability of the implementation (which in a fully integrated version would be different) rather the stability of the results in relation to the input data.
- Statistical accuracy: Voxar has a responsibility to provide clinical customers and their patients with software that is accurate.
- Complexity of integration task: One of Voxar's greatest strengths is code optimisation. Voxar will investigate the code implementations to assess the potential for speed improvements. They will also produce estimates of the timescales on which code could be integrated into PnV.

4.2.4 WP4: Community Evaluation Projects

To properly assess the suitability of the open source releases of OSMIA for community development two evaluation projects will be run. Both of which follow this workpackage structure. The work by the VSL at the Dublin City University will involving using OSMIA algorithms in an existing software system. The second will involve contributing existing code into OSMIA. This combination tests the two ways in which OSMIA can be used, as a supplier and user of OSMIA. Whilst conducting their work both sites will be required to feedback results of OSMIA trials, both software and procedural. The communication between ISBE and VSL and UoWO will be conducted frequently using email and regular (weekly) Internet Relay Chat (IRC) meetings. At many stages of this workpackage findings will be communicated immediately to ISBE in order to improve or repair aspects of the open source facilities.

Tasks

In **wp4.t1** the community developers will evaluate the current TINA distribution and prepare a brief summary of the key components which need to be added, deliverable **D4.1**. This process will allow the partners to become more familiar with TINA and to help prioritise the actions to be taken in developing the support infrastructure in WP2. In **wp4.t2** whilst the repository system is being established the example community developers will attempt remote interaction with the system at regular (controlled) intervals. They will perform a series of trial download-configure-install cycles and feedback their results in order to optimise the performance of the system. Residual issues will be addressed by ISBE in the debugging phase of **wp2.t3**

The next step will be for the VSL and UoWO to evaluate how they intend to integrate OSMIA with their technologies, **wp4.t3** and **wp4.t4**. Assistance in understanding OSMIA technology will be given by ISBE in the form of community support (IRC meetings and email communications) as well as providing a two day hands on workshop during this phase of the evaluations, **wp4.m1**. The details of which are discussed in workpackage 5.

The major component of work by the example community developers will focus on the contribution of existing code into the OSMIA system in **wp4.t5-wp4.t9**. The process of contribution of software back into the open source framework is to be tested by a medical data analysis project relating to Magnetic Resonance data of the heart. This project has been chosen on the basis of timeliness and the interest and expertise of the partners.

Modern magnetic resonance systems are now capable of generating moving sequences of images of the chest cavity, showing the beating of the heart. Though potentially very useful for clinical diagnosis these images are very difficult to understand, even for radiologists, because of the complex physiology. Quantitative techniques are needed in order to extract summary variables relating to efficiency and normality of heart movement. The variables generally referred to include, ejection fraction, diastolic volume, systolic volume, ventricular volumes and masses. In addition it is potentially possible to extract quite comprehensive variables relating to heart deformation elasticity and strain. Computing such variables automatically is a very difficult problem which has been the focus of many research groups, but should still be considered as unsolved [Frangi et.al.].

Prof. John Barron, at the UoWO, has worked in the area of machine vision for many years and is widely regarded as an expert in this field. He has developed techniques for the quantitative measurement of movement using algorithms based upon the concept of optical flow. These techniques combine the information present in sequences of images together with constraints on possible motion in order to resolve the problem of establishing the most probably movement giving rise to the differences observed between two sets of data. Prof. Barron has identified the possibility of applying these techniques to magnetic resonance data of the heart in order to measure the 3D movement of ventricular walls directly. The intention on this project is to facilitate a contribution of existing software for this task to the open source software repository. Optical flow algorithms will be provided as set of C functions which have been modified to conform to a minimal set of OSMIA data structures.

Prof. Paul Whelan, at VSL, also has many years of experience working in the area of machine systems, constructing entire vision systems for industrial processes. He intends to evaluate the extent to which the open source libraries can be integrated with his own research software for the purposes of volumetric segmentation of heart ventricles, using the same magnetic resonance data sets as Prof. Barron. Again this will result in useful information regarding the difficulty of the software integration process. In addition the intention is for John Barron and Paul Whelan to exchange ideas and data analysis techniques thus allowing an assesment of the merits of working with a joint research environment. This will help us to judge the minimum level of integration necessary between software packages in order to maintain research efficiency and should also inform us of possible improvements to the initial process.

The work of integrating OSMIA into NeatVision will be conducted during **wp4.t5** and **wp4.t6**. The optical flow software will be integrated into OSMIA during **wp4.t7** and **wp4.t8**. One extra step required by the UoWO will be to actually contribute the results of their work into the newly established code repositories. This will also be used as an opportunity to debug many of these systems in WP2. During **wp4.t10** the groups at VSL and UoWO will assess success of the previous work by performing collaborative data analysis with the NeatVision system using the UoWO optical flow algorithms all connected via OSMIA. They will use this as the basis of assesment reports of OSMIA. Both VSL and UoWO will produce a report detailing their assesment of the capabilities of OSMIA which will form the deliverable **D4.4** Finally in **wp4.t11** the teams will document both the software and their assesments.

References

[1] A.F. Frangi, W.J. Niessen, M.A.Viergever, Three Dimensional Modelling for Functional Analysis of Cardiac Images: A Review. IEEE, Trans on Medical Imaging, Vol. 20, No.1, 2001.

4.2.5 WP5: Dissemination and Exploitation

The objectives of the dissemination activities target three levels.

Consortium

First there is the dissemination of information amongst the consortium members. The activities in this area include;

- ISBE to provide a 2 day workshop for other members of the consortium. The objective of the workshop is to provide the consortium members with insight into the fundamentals of the environment with which they will work.

  The first day of this workshop will involve a series of lectures by the members of ISBE responsible for developing TINA.

These lectures will explain the philosophy of the environment (why it was designed the way it was), the basics of what the system provides together with demonstrations of the results of many areas of the research. The objective of the first day is to ensure that the consortium members understand the origins of OSMIA and have a detailed overview of the facilities it provides. the second day of the workshop will involve hands on experience of working with the current TINA environment. The work undertaken on this day will be driven by the needs of the consortium but will allow the members to learn about the practical realities of working with the environment. The second day will also include a series of discussions of how the environment could be improved.

Documentation will be provided to the consortium members and will be used as the basis of a tutorial introduction to OSMIA provided on the website.

- Voxar an ISBE to second personnel. To establish an understanding of each others technology the Voxar developer will spend a period of one week working at ISBE. During this week the Voxar representative will be taught how the TINA environment was constructed, what technologies have been used and how the environment is used. This will be followed by a week were the ISBE personnel is seconded to Voxar for a similar induction into the technology behind Plug N View 3D. In both cases this process will focus on establishing sufficient understanding to enable the interface specification process of WP3 to be better achieved.

- Establishing an email list. To encourage more informal communication between partners the use of an email list will be introduced. This will allow discussions to happen in an open fashion, allowing all members of the consortium the opportunity to contribute. ISBE will establish the resources necessary for the mailing list which will be used as part of the community infrastructure in WP2.

- Timetable regular (weekly) Internet Relay Chat (IRC) meetings. IRC will be used to allow more impromptu discussions between groups to be conducted in real time. A regular (weekly) IRC discussion will be timetabled involving a representative from each member of the consortium will, providing the opportunity for any matters arising to be aired. The nature of IRC technology insures that such meetings can be conducted quickly (taking no more time than a phone conversation) and allows text to be logged providing a convenient method of capturing the minutes of meetings. ISBE will establish the resource necessary for the IRC meetings under the guidance of the project manager.

IST Programme and User Group

The second level of dissemination is to other projects in the IST programme and the user group. Community support of open source software is critical. The dissemination activities at this level will focus on establishing a user community for OSMIA. The project manager will establish a user group which will include the project manager and representatives from each of the project partners (this does not necessarily have to be the person funded). This group will also include representatives from the clinical end users in the form of a representative from Hope Hospital in Manchester, UK. It will also include a representative from Philips Medical Systems, Hamburg, Germany, and others who develop scanning hardware and analysis software. This group will have the following responsibilities;

- to review all the report deliverables before submission to the commission,
- to advise on the formulation of the open source license used to cover OSMIA,
- to advise on specifying the conditions under which algorithms within OSMIA can be commercially exploited.

This group will meet once every 6 months to review the status of the project. Once the project is over the size and format of the user group will change allowing the group to be used to **bootstrap** establishing the OSMIA user and developer community.

ISBE will present a seminar to the clinical representative and to the representative from Philips summarising the objectives of the project and the technologies involved.

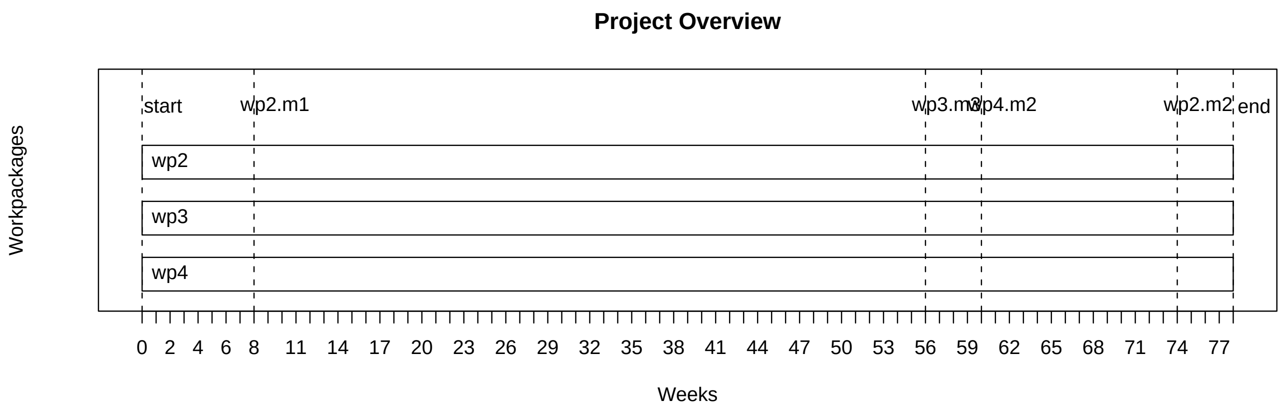
Universal

The final level of dissemination is the universal dissemination of results to all. Activities in this area will continue throughout the project when appropriate. They will include but may not be limited to;

- ISBE and VSL to present OSMIA at conferences in Europe such as the British Machine Vision Conference (BMVC), Medical Image Understanding (MIUA) and Medical Image Computing and Computer-Assisted Intervention (MICCAI). ISBE and VSL will provide tutorial style presentations at at least two such meetings.

- ISBE and Voxar will present OSMIA and Plug N View 3D at the European Congress of Radiology (ECR). The ECR is Europe's premiere meeting for the dissemination of clinical and technical results. It also represents one of the largest exhibitions of medical image analysis hardware and software with all the major manufacturers exhibiting systems. The average delegate attendance is 7000 over the 5 days.
- UoWO will present OSMIA to relevant conferences and workshops in Canada and the Northern US such as Image Processing and Medical Imaging (IPMI) and Computer Assisted Radiography (CARs).
- ISBE to approach the major Linux distributors to include OSMIA with future distributions
- ISBE to ensure OSMIA is highly ranked on all the major web search engines as well as on index sites such as SAL (Scientific Applications on Linux)
- Voxar will distribute versions of OSMIA freely with Plug n View 3D. This may include freely distributing OSMIA with PnV on the CD but will at least involving advertising and linking OSMIA onto the Voxar website.

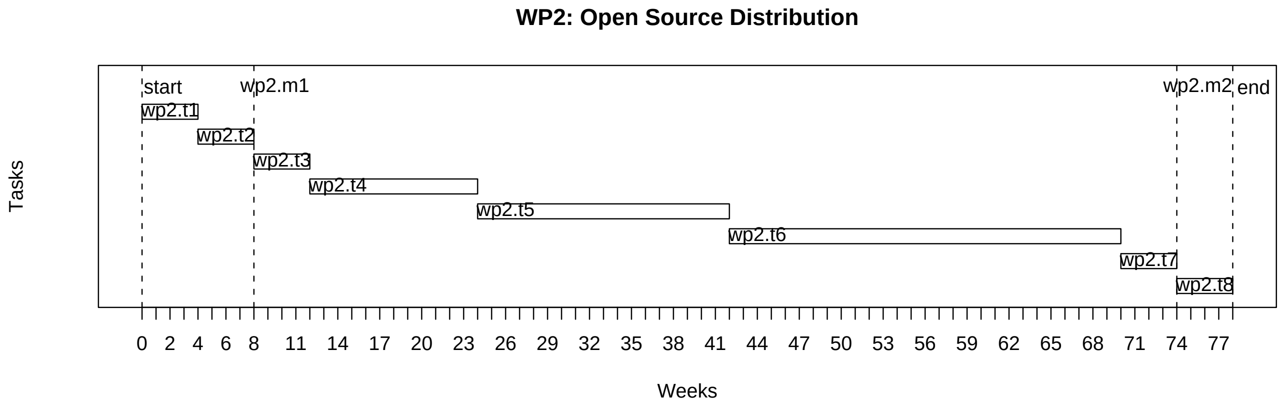
5 Gantt Charts



Task	Who	Title	Start Week	Duration (Weeks)
wp2	ISBE	OS Distribution	0	78
wp3	ISBE, Voxar	Commercial Interface	0	78
wp4	UoD, UoWO	Evaluation Projects	0	78

Milestone	Title	Date (Week)
start	Project Start	0
wp2.m1	Alpha OSMIA Release	8
wp2.m2	Beta OSMIA Release	74
wp3.m3	Interfaces Released	56
wp4.m2	OF and NeatVision Integration Complete	60
end	Project End	78

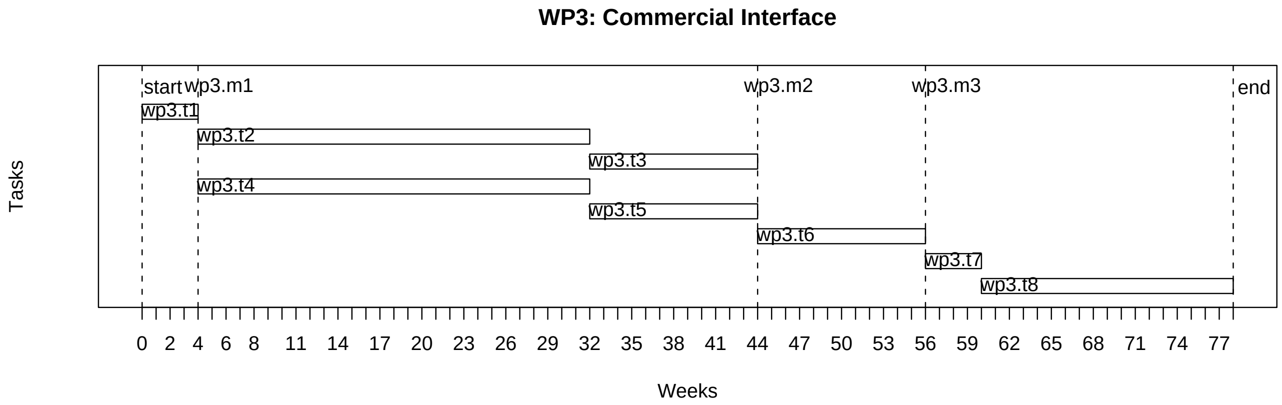
Table 6: Project Overview



Task	Who	Title	Start Week	Duration (Weeks)
wp2.t1	ISBE	Server Config.	0	4
wp2.t2	ISBE	Respository Config.	4	4
wp2.t3	ISBE	Alpha Release Debug	8	4
wp2.t4	ISBE	Release Mechanisms	12	12
wp2.t5	ISBE	Community Resources	24	18
wp2.t6	ISBE	Code Update	42	28
wp2.t7	ISBE	Integration	70	4
wp2.t8	ISBE	Beta Release Debug	74	4

Milestone	Title	Date (Week)
start	Project Start	0
wp2.m1	Alpha OSMIA Release	8
wp2.m2	Beta OSMIA Release	74
end	Project End	78

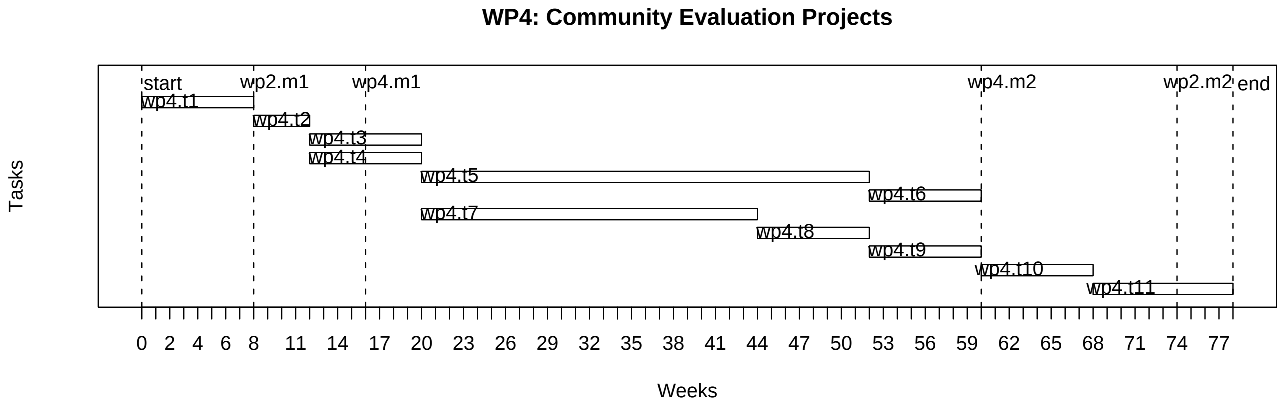
Table 7: WP2: Open Source Distribution



Task	Who	Title	Start Week	Duration (Weeks)
wp3.t1	ISBE,Voxar	Specification	0	4
wp3.t2	Voxar	PnV Interface Dev.	4	28
wp3.t3	Voxar	PnV Interface Debug	32	12
wp3.t4	ISBE	OSMIA Interface Dev.	4	28
wp3.t5	Voxar	OSMIA Interface Debug	32	12
wp3.t6	ISBE,Voxar	Joint Debug	44	12
wp3.t7	Voxar	Algorithm Ident.	56	4
wp3.t8	Voxar	Algorithm Eval.	60	18

Milestone	Title	Date (Week)
start	Project Start	0
wp3.m1	Working Specification	4
wp3.m2	Trial Requirements	44
wp3.m3	Interfaces Released	56
end	Project End	78

Table 8: WP3: Commercial Interface



Task	Who	Title	Start Week	Duration (Weeks)
wp4.t1	UoD, UoWO	TINA eval.	0	8
wp4.t2	UoD, UoWO	Feedback	8	4
wp4.t3	UoD	NeatVision Assesment	12	8
wp4.t4	UoWO	OF Assesment	12	8
wp4.t5	UoD	NeatVision Integration	20	32
wp4.t6	UoWO	NeatVision Debug	52	8
wp4.t7	UoWO	OF Integration	20	24
wp4.t8	UoWO	OF Debug	44	8
wp4.t9	UoWO	OF Contribution	52	8
wp4.t10	UoD, UoWO	Assesment	60	8
wp4.t11	UoD, UoWO	Documentation	68	10

Milestone	Title	Date (Week)
start	Project Start	0
wp2.m1	Alpha OSMIA Release	8
wp4.m1	OSMIA Workshop	16
wp4.m2	OF and NeatVision Integration Complete	60
wp2.m2	Beta OSMIA Release	74
end	Project End	78

Table 9: WP4: Community Evaluation Projects

6 Workpackage Forms

Workpackage Description

Workpackage No. :	WP1	**Start Date**		Month 0
Participant No. :	ISBE	Voxar	VSL	UoWO
Person-months per participant	4	0	0	0

Objectives

- Ensure compliance with contractual obligations
- Ensure the smooth running of the project to the satisfaction of the EU and the project partners
- Provide technical and administrative management
- Liase with the EU officer

Description of work

A more detailed description of the project management aspect of this project appears in the Part C documentation.

- Form a project management committee
- Establish a quality plan
- Organise regular review meetings
- Instigate a user group

Deliverables

D1.1: Project review report (6 Month) **(D\PP)**
D1.2: Project review report (12 Month) **(D\PP)**
D1.3: Project review report (18 Month) **(D\PP)**

Milestones and expected results

Workpackage Description

Workpackage No. :	WP2	**Start Date**		Month 0
Participant No. :	ISBE	Voxar	VSL	UoWO
Person-months per participant	8	0	0	0

Objectives

- Transform the existing TINA codebase into **the** open source environment for medical image analysis research.
- Provide supporting infrastructure for efficient distribution and contribution of code.
- Provide documentation and information resources to establish and support the user community

Description of work

With reference to the WP2 gantt chart table 7 the main tasks are;

wp2.t1: Install and configure server hardware
wp2.t2: Install and configure OSMIA in the repositories together with all existing webpages and documentation
wp2.m1: Alpha release of OSMIA
wp2.t3: Debug alpha release with feedback from WP4
wp2.t4: Introduce release control strategies, auto-configuration and contributor repository services
wp2.t5: Introduce developer website and upgrade documentation
wp2.t6: Rationalise codebase, introduce automated test scripts, provide demonstrations and new GUI's
wp2.t7: Integrate commercial interface software
wp2.m2: Beta release of open source OSMIA
wp2.t8: Debug beta release with feedback from WP4

Deliverables

D2.1: Alpha open source distribution of OSMIA **(D\PP)**
D2.2: Release of repository systems **(D\PP)**
D2.3: Release of developer website**(D\PP)**
D2.4: Release of improved codebase**(D\PP)**
D2.5: Open source distribution of OSMIA **(D\PU)**

Milestones and expected results

wp2.m1: Alpha release of open source OSMIA
wp2.m2: Beta release of open source OSMIA

Workpackage Description

Workpackage No. :	WP3	**Start Date**		Month 0
Participant No. :	ISBE	Voxar	VSL	UoWO
Person-months per participant	7	16	0	0

Objectives

- Specify an interface layer to OSMIA which allows the algorithms to be accessed and controlled directly from third party applications.
- Produce and open source implementation of the communication layer in OSMIA.
- Implement a compatible interface in Plug N View 3D.
- Evaluate the potential usability of several algorithms already in TINA using the interface mechanisms.

Description of work

With reference to the WP3 gantt chart table 8 the main tasks are;

wp3.t1:	Design interface specifications	Voxar, ISBE @ 1MM effort
	wp3.m1: Working specification	
wp3.t2:	Development of Plug N View 3D interface	Voxar @ 6MM effort
wp3.t3:	Debug of Plug N View 3D interface	Voxar @ 3MM effort
wp3.t4:	Development of OSMIA interface	ISBE @ 3MM effort
wp3.t5:	Debug of OSMIA interface	ISBE @ 1 MM effort
	wp3.m2: Requirements for evaluation trials	
wp3.t6:	Joint debug of interface systems	Voxar, ISBE @ 2MM effort
	wp3.m3: Interface system released to relevant users	
wp3.t7:	Identification of algorithms of interest	
wp3.t8:	Evaluation of TINA algorithms	

Deliverables

D3.1: Working specification of interface (**R****PP**)
D3.2: Interface system for OSMIA (**D****PU**)
D3.3: Interface system for Plug N View 3D (**D****PP**)
D3.4: Public release of interface specification (**R****PU**)
D3.5: Algorithms evaluation report (**R****PP**)

Milestones and expected results

wp3.m1: Interface system released to relevant users

Workpackage Description

Workpackage No. :	WP4	Start Date		Month 0
Participant No. :	ISBE	Voxar	VSL	UoWO
Person-months per participant	0	0	16	16

Objectives

- Evaluation of open source release of OSMIA.
- Integration of OSMIA algorithms into Neatvision system.
- Integration of optical flow techniques into OSMIA.

Description of work

With reference to the WP4 gantt chart table 9 the main tasks are;

wp4.t1:	Download, install and evaluate existing TINA distribution	
wp4.t2:	Trial and provide feedback for repository debugging	
wp4.t3:	Assessment of NeatVision integration task	
wp4.t4:	Assessment of optical flow integration task	
	wp4.m1 OSMIA workshop	
wp4.t5:	Integration of OSMIA algorithms into Neatvision	VSL @ 8MM effort
wp4.t6:	Neatvision debug	VSL @ 2MM effort
wp4.t7:	Integration of optical flow techniques into OSMIA	UoWO @ 6MM effort
wp4.t8:	Optical flow debug	UoWO @ 2MM effort
wp4.t9:	Optical flow updates contributed to repositories	UoWO @ 2MM effort
	wp4.m2 Optical flow integration	
wp4.t10:	Assessment of final techniques	
wp4.t11:	Documentation	

Deliverables

D4.1: Assessment of TINA technology(**R**\ **PP**)
D4.2: OSMIA integrated with Neatvision (**D**\ **PU**)
D4.3: Optical flow techniques in OSMIA (**D**\ **PU**)
D4.4: Assessment of OSMIA (**R**\ **PU**)
D4.5: Documentation for software (**R**\ **PU**)

Milestones and expected results

wp4.m1: OSMIA workshop
wp4.m2: Optical flow integration

Workpackage Description

Workpackage No. :	WP5	**Start Date**		Month 0
Participant No. :	ISBE	Voxar	VSL	UoWO
Person-months per participant	2	2	2	2

Objectives

- Disseminate information to all members of the consortium in order to minimise technical problems,
- Form a user group to bootstrap a support community,
- Disseminate results through a user group to improve the worth of such information,
- Filter user group responses back to the consortium to improve the benefits of the work,
- Disseminate project achievements to the wider community,

Description of work

The work pattern will have the following flow;

▷ Project manager forms user group
▷ Project manager establishes working practise for mailing lists and IRC meetings
▷ Voxar second personnel to ISBE
▷ ISBE second personnel to Voxar
▷ ISBE seminar to clinical representative on user group
▷ ISBE seminar to Philips representative on user group
▷ ISBE run 2 day workshop for consortium
▷ User group review evaluation reports from WP3 and WP4
▷ User group assist in establishing open source license
▷ User group assist in exploitation conditions
▷ ISBE and VSL OSMIA tutorials at conferences
▷ ISBE and Voxar OSMIA/PnV exhibit at ECR
▷ UoWO demonstrations of OSMIA at conferences
▷ Voxar provide OSMIA to customers

Deliverables

D5.1: Dissemination plan (**R**\ **PP**)
D5.2: Dissemination report (**R**\ **PU**)

Milestones and expected results