A MANAGEMENT INFORMATION SYSTEM FOR PUBLIC HEALTH

Frank Wang
School of Informatics & Multimedia Technology
University of North London
166-220 Holloway Road, London N7 8DB
United Kingdom
E-mail: f.wang@unl.ac.uk

Na Helian
School of Informatics & Multimedia Technology
University of North London
166-220 Holloway Road, London N7 8DB
United Kingdom
E-mail: n.helian@unl.ac.uk

Narayana Jayaram
School of Informatics and Multimedia Technology
University of North London
166-220 Holloway Road, London N7 8DB
United Kingdom
E-mail: n.jayaram@unl.ac.uk

ABSTRACT

The European Public Health and Environment Network (EPHEN) had a pressing need to change the way their work activities were conducted. The aim of this project is to create a multi-user management information system to automate the daily activities carried out by the members' of EPHEN. An integral part of the system will be the addition of a personalised internal email system to facilitate the flow of communication within the group. Also an innovative element will be integrated into the system to promote health awareness, especially as EPHEN's primary concern is to encourage public health in society.

1. INTRODUCTION

In 1999, the Third European Ministerial Conference on Environment and Health was held in London. The Conference was the culmination of five years planning since the second Conference in Helsinki in 1994. For the first time also WHO, through the UK Government, arranged an NGO 'parallel meeting', the Healthy Planet Forum. Within the framework of this Forum, and in collaboration also with the Ministerial Conference, University College London (UCL) organised a special Twinning event - 'Local Practice in Environment and Health'. Participants were invited to the event from Environment Departments and Health Departments of towns and cities in 21 European countries. European Public Health and Environment Network (EPHEN) was established, as shown in Fig.1. With public health and environment reform featuring prominently on the agendas of national and local governments in both eastern and western Europe, there is considerable opportunity for sharing experiences and learning from one other. Participants can benefit substantially from comparative assessments of cities facing similar challenges. Those in academia and public health practice, along with environment

specialists and other interested parties, can gain insight into strategies and methods of best practice through the international comparison of experience (Parvanova, 1999).

Fig.1 European Public Health and Environment Network (EPHEN) was established at UCL in 1999, which covers 21 European countries.

At present EPHEN use a traditional system of storing information in file cabinets. There are several problems with the existing system. Firstly, all of the details on employees', customers' etc were stored in a filing cabinet, which made manipulation and sharing of data, a tedious and time-consuming activity especially as most of the members' were situated in different rooms. Secondly communication between each member took place regularly via email rather than on the phone or in person as the members' spent a lot of their time at meetings and presentations. However the email system frequently had problems that affected the flow of communication amongst the members'.

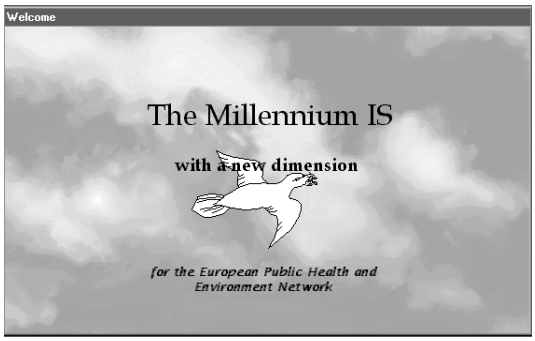

Fig.2 The introduction screen of the MIS.

The project of MIS (Millennium Information System) addresses the above issues by creating a multi-user management information system to automate the daily activities carried out by the members' of EPHEN. Fig.2 shows the introduction screen of the MIS, which is the first screen you are displayed with and automatically takes you into the login form after a few seconds. The system design and development will be discussed in depth in the paper. The project has covered all the software-engineering phases, which are vital for the successful development of most systems.

2. SYSTEM REQUIREMENT SPECIFICATION

The requirement analysis phase is the first major step towards the solution of a software problem. During this phase, the users requirements concerning the proposed application are carefully identified and documented. It is a task, which allows the software developer to refine the software allocation and build models of the data, functional and behavioural domains that will be treated by software. System requirements may be either Functional or Non-Functional.

2.1 Functional Requirements

The system is to support the following functions:

Function 1: Personal email system

The personal email system will be used only by the EPHEN members thus will run independent of the main email system. This email system will be used only for work-related purposes. The following functions should be available in the communication system with regards to email: composing, reading old and new mail, forwarding, deleting, modifying the read / unread status of the emails, notification of new / unread email, deleting, and the ability to navigate through messages received.

Function 2: View and enter new timesheet rows

For example, employee's number and project number must be unique and when entering timesheets both values must be valid references. Users must enter week numbers in the range 1 to 500 and hours in the range 1 to 70. Users input must be validated and if not in the range specified, the users must be informed of the correct range. Incorrect data must be prevented in being input, where possible. The charge field should be locked, as it should be calculated automatically, e.g. via working out what the charge rate would be for each employee depending on their job role.

Function 3: Security

The network operating system in the department, Novell version 5.0, will be used to enforce security. So that only the EPHEN members and the network manager will have access to the system. However another security layer should also be incorporated, to make the system more secure.

Function 4: Changing passwords and setting reminders

The facility of changing a new password and setting or adding a reminder should be available from a menu.

Function 5: Customer details

Users need to view and also add new customers to the customer database. It would be very helpful if a user could enter either a customer name or number in order to retrieve the customers' details and to perform other functions such as deleting data and printing out customer information. It was discussed that the users would not prefer to get help from the system in entering the customer names to search for, as this function has been previously been available in the old database and was found to be very annoying rather than helpful after a while.

Function 6: Mail merge

Frequently, customers' are sent out letters, and it is very tedious to have to open word and go through a number of steps to create a mail merge. It would be very effective to be able to have an option to create an automatic mail merge from the customer form.

Function 7: Employee details

It would be of much use if users could search for information on employees, By typing in the first name of an employee. Also there should be a facility where users' can navigate and view all

employees' details. Common functions should be clearly visible which allow the user to add, delete, undo, save and print the data.

Function 8: Skill details

It is common for members of the EPHEN, to frequently attain skills in a number of various disciplines. Thus it will be effective to have a system where we can add new skills to the database as well as displaying the skills possessed by an employee and skills required on a project. Also a facility should be made available for members to select a range of skills in order to create some form of list to display the employees who possess the selected skills. Once again the common functionalities of allowing the user to add, delete, undo, save and print the data should be made available where appropriate. Skills required on a project should also be made available for viewing and modification.

Function 9: Grade details

This form should be very similar to the previous forms discussed e.g. skills form. Users would need to be able to view, update, delete, print and add grade details.

Function 10: Different access levels

Different members should get access to different sections of the system according to their job role.

Function 11: Paper Generation

The following reports will be needed by EPHEN: EPHEN Work Paper, EPHEN Timesheet Data, Skills Possessed by Each Employee and Employees Possessing Each Skill, etc.

2.2 Non-functional Requirements

Mainly in the creation of work-related Information Systems (IS) there has always been an emphasis on automating work-related tasks in order to enhance work productivity. When manual tasks are automated work generally becomes less time consuming, time is money, thus more money is saved, data is easier to manipulate and is more secured.Fig.3 shows the Data Flow Diagram (DFD) of the MIS.

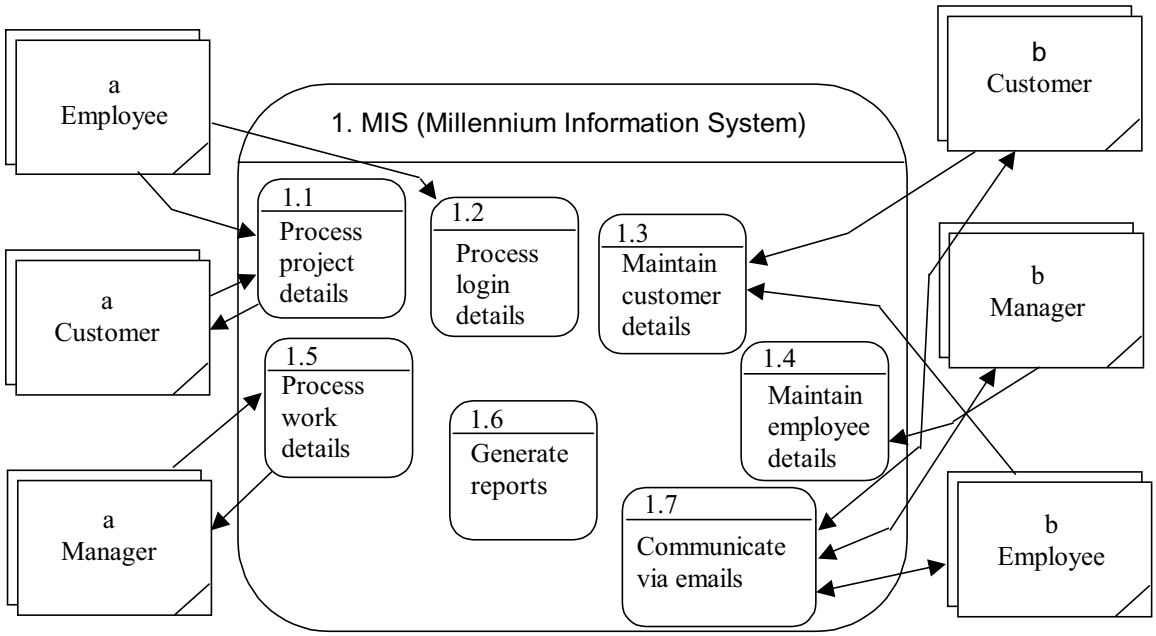

Fig.3 Data Flow Diagram (DFD) level 1 of MIS.

2.3 The Extra Dimension

It was discussed and agreed with EPHEN that an element of fun and non-work related features should be included in the system. The aim of the non-work related section would be to enhance health awareness within EPHEN, as the group is concerned primarily with public health in our society. The health system would be available for all users, thus everyone will benefit both employees and the employer. Also as it will be aimed to promote a healthy lifestyle, it is a known fact that the healthier the work force the more productive output (work) is produced, thus benefiting the employer and the company indirectly. The health section is to contain the following features:

Health Feature 1: Healthy Recipes

Providing members of the EPHEN with a variety of vegetarian and non-vegetarian healthy and low fat recipes. Also giving ideas on what can be eaten at different times of the day, e.g. breakfast, lunch and at dinner. For example, to see some healthy recipes, you need to select the type of recipe i.e. vegetarian, and the click the button labelled – Display to see the menu. To view the different menu's you can use the navigation buttons on the bottom. To view a vegetarian recipe for lunch, you click on the button labelled – Lunch (Fig.4). To return to the menu with the different types of recipe's click the button labelled – Menu. To see an image of how the prepared dish would like you click the button labelled – Image (images need to be added yet, just included for demonstration purposes).

Health Feature 2: Promote healthy shopping

To further promote users from actually trying out the recipes, a facility should be provided where users can create a shopping list, choosing items needed to make the recipe suggestions and allowing the user the flexibility in adding their own items too. To create a shopping list, click on the orange coloured basket on the top of the form, which takes you to the last option on the main menu.

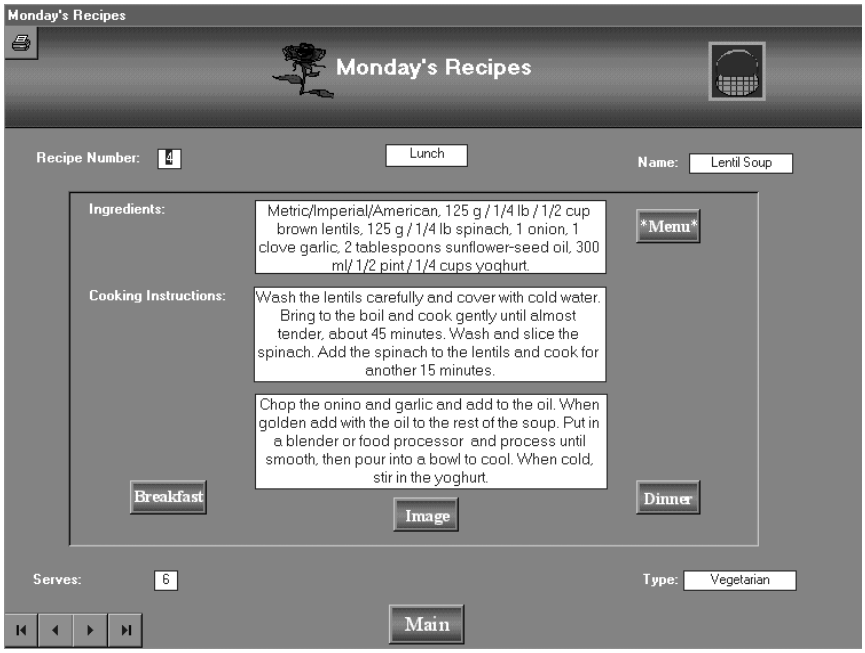

Fig.4 An example of vegetarian recipe for lunch.

Health Feature 3: Health-related informative quizzes

Health Feature 4: Personal Health Check

In order for users to find out how their general health state is, they should be able to work out their Body Mass Index (BMI) and their Basal Metabolic rate (BMR).

Health Feature 5: Health tips

Health Feature 6: Weight and height Conversion Help

A facility should be available to users to aid them in carrying out weight and height conversions.

3. IT INFRASTRUCTURE

This section describes the Information Technology (IT) infrastructure at UCL, locking mechanismin multi-user systems and validation techniques.

3.1 IT at UCL

The University College of London (UCL)'s Department of Epidemiology and Public Health is a young and fast expanding department, with 45 scientists (who have specialised in various areas including medicine, dentistry, statistics, economics, sociology and psychology) together with a further 65 research assistants, 20 PhD students and around 7 MSc students. Within the department there are different research groups for example Psychology, Diabetes (Eurodiab), Health Behaviour Unit, Dental Public Health and EPHEN. Around 180 of the staff are on a local area network, which was set up by the network manager. This network ensures access to relevant programs and facilities that may be required by the staff in the department. Most of the computers are installed with the Windows 95 operating system and each user has a computer, which has access to the Internet. Staff in the department receives help on their IT related problems and queries from the IT Help desk. The following computer programs are available for the staff to use: Microsoft Office suite (Excel, Word, PowerPoint and Access), FoxPro, Nudist, Reference Manager, SPSS, SAS, Corel 8 Suite, Pegasus Email system, Stata Transfer 5, Acrobat Reader, Enzip, F-Prot Anti-Virus, Medline (Winspirs), Clipper, PFE (Programmer's File Editor), Meeting Maker and DBMS Copy. The department has a great deal of reliance upon Information Technology as staff at UCL use many different programs in order to carry out their daily work. Most of the user's data are stored in Access databases. However some groups within the department also have their data stored physically in files and use a file-based system for their work activities. The network structure in the department enables staff to communicate with each other to share information and resources. The server is the central repository of most of the department's data, which stores all the programs and user's data.

Whenever a user accesses a program from their desktop, it is retrieved from the server not from the computer's hard disk. Programs are more easily maintained when they are stored on a server. For example if all the programs were installed on the users hard disk it would be quite a lot of work to install a new program on over 180 computers. The advantage of having all the programs stored this way is that you only need to install a program once on the server, which would then be available for all users. Another advantage is that more space is available on the users' computers. So the users computers have to do less work and thus can run more effectively(White, 1999)**.** Only a couple of advantages in having a server and storing programs on a network have been discussed, there are many more. This highlights the advantages of placing the newly built system for EPHEN on the network.

The network is installed with Novell NetWare and Novell Directory Services (NDS) software, which enables the effective maintenance and control over all IT related activities

NDS is intended to act as the central point of control for all network services in a NetWare environment. NDS is a fully functional, mature, and stable example of the kind of services that a network directory can provide(Novell Inc, 1999). The NDS database is critical to the proper functioning of a NetWare network. NDS is queried each time a network resource is accessed. When a user attempts to log onto the network, for instance, the client software submits the user's name to NDS for authentication. Later, this user might try to access some resource, such as a printer, and NDS would again be queried: first to determine whether the user had the necessary permissions and then to find the physical location of the resource. NDS is accessed during all network functions. The best way to understand NDS (or any network directory, example Active Directory) is to think of it as a database. The NDS database contains records, or objects, that represent resources such as Root, Organisation, Organisational Unit and Country (also known as container objects). There are many different types, or classes, of resources that can be managed through the NDS database. The record type for each class object has a different set of fields, or properties. As shown in Fig.5, NDS is organized logically as a hierarchical database (a tree structure). You would not, for example, need a logon name property for a printer object, because printers do not log on to the network. The big advantage about NDS is that it enables you to have a great deal of control over all the computers and users on the network, from one computer (Novell Inc, 1999)**.**

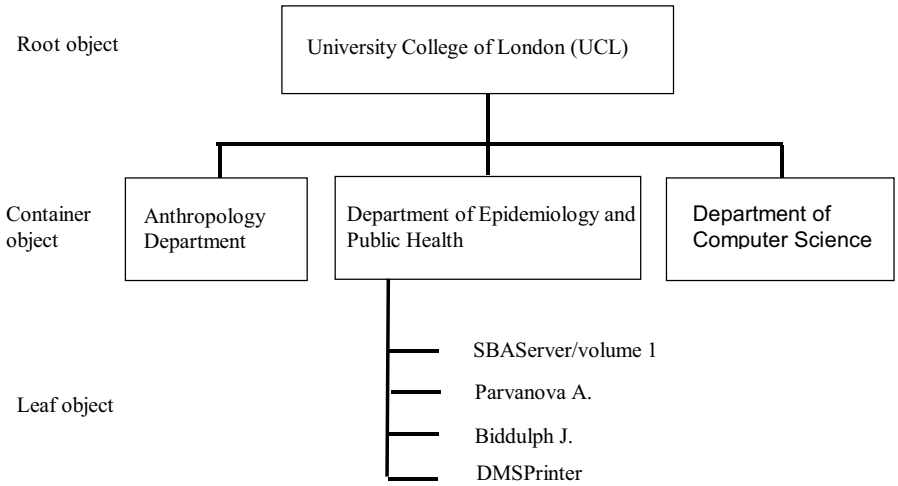

Fig.5 NDS is organized logically as a hierarchical database (a tree structure).

3.2 File Server

Access might allow multi-user access, but is still not a true client / server implementation. Microsoft database (MDB) files are what are created in Access to store data(Halvorson, 1998). When an MDB is used, you are using a file-server implementation. What happens is that a query is processed on the client side and is never sent to the server. The MDB is aware that it needs a table of data in order to process the request, and before it applies the WHERE clause of the SELECT statement it firstly makes a request for the entire table across the network. Thus if the table contained a large amount of data, then frequent requests to this table would greatly increase network traffic **(Noel, et al, 1997)**.This file-server structure can increase network traffic, especially when a large number of requests are made by many users and where the data is retrieved from very large sized tables. However for EPHEN this is not a major problem as there are not many members in EPHEN and also the tables do not contain an

excessive amount of data. However in a file-server and multi-user environment, it is necessary to take locking mechanism into consideration.

3.3 Locking Mechanism

Automatic locking mechanism occur on forms when more than one user attempts to delete the same record simultaneously or when two users execute the same action query, e.g. make-table, append-table etc. This type of shared access is known as concurrency. For example, in the testing stages of the system when two users attempted to delete their own personal mail at the same time a locking mechanism was enforced (Fig.6)**.** This is because initially, all emails for every employee was stored in the same table. The locking problem was resolved by creating separate email boxes for each user.

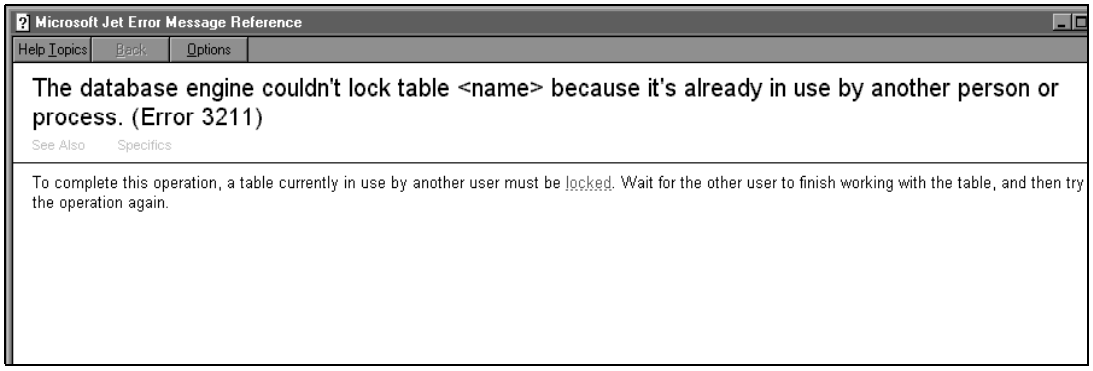

Fig.6 Microsoft jet error message from Access help file.

In the system there are a number of forms, which need the locking mechanisms, i.e. customer, employee, grade forms etc. Locking mechanism reduce the chance of errors entered in the tables. When two users begin editing data in the same record (this includes adding new records to the database), a lock is imposed on those records, preventing other users from making changes to the same record. Therefore in this instance the locking mechanism which could be invoked if two users were to update or delete the same record on the customer table are not seen as a problem. This is due to the way that the groups work activities are co-ordinated. Only one user at a time makes modifications to these forms. There exist several levels of record locking that you can fine-tune to suit how your users work with their data such as pessimistic, optimistic and entire table locking mechanism (Steve, 1996)**.** It is useful to note how the lock file is comprised of the MDB name and an extension of LDB. The solution used in overcoming the locking mechanism in the email system was also applied in the implementation of the shopping baskets in the Health Alert section. When two users' created a shopping list, an Append and a make-table query were executed, thus locking mechanism were invoked. To resolve this problem, separate shopping baskets were created for each employee.

3.4 Validation Techniques

It is very important to ensure that all data entered into the database is accurate i.e. that only letters are added in the employee fields and no numbers. Mistakes are bound to occur whilst users are inputting data and thus an effective system must reduce the chances of these mistakes occurring. There are a number of available for developers to control what data can be input into a field. The following are the validation techniques that have been used in the MIS to ensure a high level of data integrity:

Lock property - The **Lock** property is useful as you can lock a field, i.e. a primary key value like an employee's number, so that the user cannot change it**.**

Input Mask – This property controls what data what data is stored in a field. The property is available for Number, Text, Currency and Date/Time fields. A number of personalised input masks were created for the MIS. An input mask was created for the Grade field, which only allowed users to enter a grade in the correct format i.e. M1, only allowing users to first enter one letter followed by one number.

Format – This property allows you to control how you want the data displayed. There are a number of predefined formats available, which differ depending on the field's data type. Access also provides the facility for you to define your own customised formats. In the MIS, the currency format was used i.e. by using this format salary values were automatically displayed with a pound sign - £50,000.

Validation Rule – This rule property restricts what a user can place in the field. Accompanying this rule is the **validation text**.

Validation Text – The validation text is where you can define a message to display to users when they attempt to violate a **validation rule**.

A validation rule and text was used in the EPHEN Connect (*the email system*), to ensure that users only entered either a "y" or "n" in the read status field, below in Fig.7, is how this validation rule and text were used in this instance:

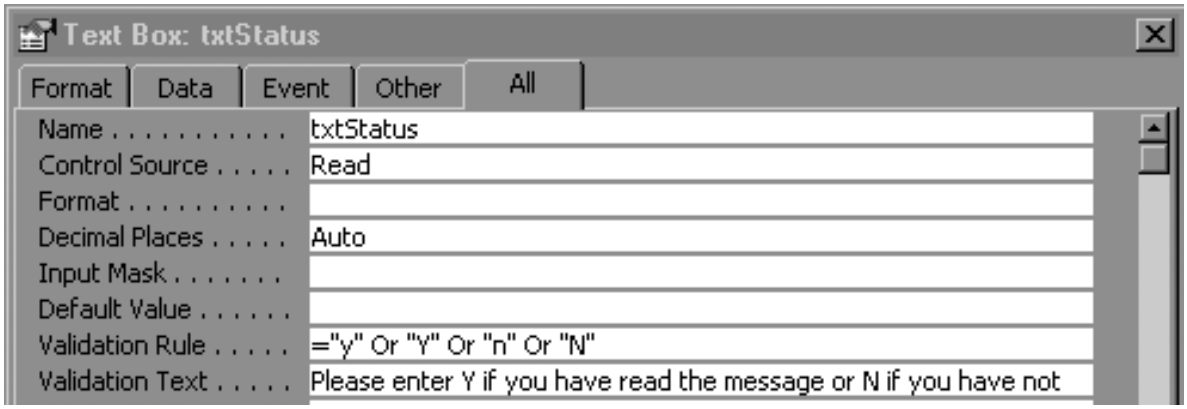

Fig.7 Shows the validation rule and the validation text, customised for the read status field.

4. TEST SPECIFICATION

A series of tests will be carried out to ensure that the system has met all the requirements set. Different sections of the system will be tested individually, before being integrated into the system and tested as a whole. All operations in each section of the system will be tested using the white box and black box testing methods to ensure that all aspects of the system have been thoroughly tested. The testing will be carried out at different stages of the design and development. Test data will be used in the testing process to help expose any errors or defects in the system. The testing will be carried out as follows:

Stage 1. Testing Different Sections

Each section will be tested on a stand-alone basis, checking for any logical errors.

Stage 2. Integration Testing

Once the different sections are integrated together, a user-based testing strategy will be used. Finally the system will be tested as a whole to ensure that all the requirements set are being fulfilled.

Stage 3. Validation Testing

This section of the testing process requires a series of black box testing to be carried out. This will demonstrate again, how the system is meeting the requirements initially set.

Stage 4. Acceptance Testing

This part of the testing will be carried out by the EPHEN members, based at the University College of London**.** In order to ensure that the system fully met the requirements set, the system was tested not only in the presence of the members but also by the members themselves. The system is new, therefore it will be under testing stages for another 3 months by the EPHEN members, to fully test it by using the system to carry out and co-ordinate their day to day work tasks. Each member of EPHEN was given a survey consisting of many questions in order to provide feedback on the MIS. This is a very important stage in the testing process, which is a well-known requirement in software engineering practices(Edward, 1995). Overall the feedback received was all very good and positive. This is very encouraging and proves that the system is very comprehensive and complete as it has fulfilled the needs of all the EPHEN members'. All the members' preferred the MIS to the original file-based system as it greatly enhanced EPHEN's work activities, communication and health awareness.

Also all the members' were more than happy with their involvement in the process, which has undoubtedly given them more confidence in using the system. It is always crucial that the graphical user interface is very well designed as this is what the members' will interact with whilst working with the system. The main reason why all the members' liked the interface a lot was due to it being customised and designed the way they wanted it. The design of the new system has proven to be very effective as all the members' find it easy to navigate through and use. There is no other system like the MIS in the whole department, thus its uniqueness and innovative touch is an added quality.

5. CONCLUSION

The MIS (Millennium Information System) automates the EPHEN's daily tasks, as well as providing a fun element for the members to use outside work hours. The project has covered all the software-engineering phases, which are vital for the successful development of most systems. Many techniques were used and adapted from a number of methodologies e.g. a rapid application development (RAD). Again, a number of techniques were applied in the data modelling stages that helped to visually represent the different processes and data flows in the system. Once the system is installed it is expected to provide the following features: Facilitate the communication between all members, make data storage and manipulation more effective and easier and Promote health awareness**.**

All the requirements and additional requirements set have all been met. The development and implementation of the innovative, multi-user, management information system, called the MIS for the EPHEN group at UCL has been successful**.** The MIS's effective and strategic incorporation within the EPHEN can now enable growth and scalability of the group's business and culture, at a faster rate and help enhance the daily work of the users. The benefit of placing the system on the network was that the system could be more easily maintained. Updates and all modifications need to be done only once and every copy of the database accessed by the users is automatically updated too. Also placing the MIS on the department's network gave the system more security as Novell's security features were applied to restrict the access only to the EPHEN members**.**

ACKNOWLEDGEMENTS

Our thanks go to Miss Ruby Sharma, Dr Antonyia Parvanova, Dr Jane Biddulph, Dr Stewart Payne, Miss. Joanna Dykes and Mr. Jake Ferguson of the European Public Health and Environment Network at the University College of London, for their help, guidance and advice.

REFERENCES

Edward, K. (1995). *Software testing in the real world*: improving the process, ACM Press, Reading

Halvorson, M.(1998). *Step by step*: Microsoft Visual Basic 6.0 Professional, Microsoft Press, Redmond

Noel, J., Jung G., and Kiely, D. (1997). Visual Basic 5 Client / Server How-To, Waite Group Press, Corte Madera

Novell Inc (1999). Supervising The Network, Novell Press, USA

Parvanova, A. (1999). Http://www.ucl.ac.uk/public-health/europe1.html

Steve, G. (1996). Information Systems Design, Thomson Computer Press, London

White, R. (1999). *How Computers Work*, millennium edition, Macmillan Computer Publishing, USA