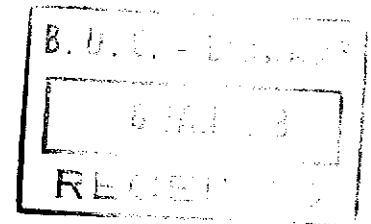


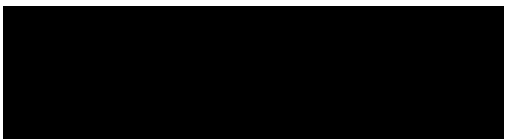
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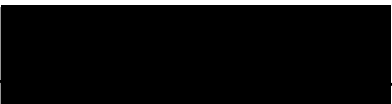
An Interactive Resource Management Tool for Makassed Association

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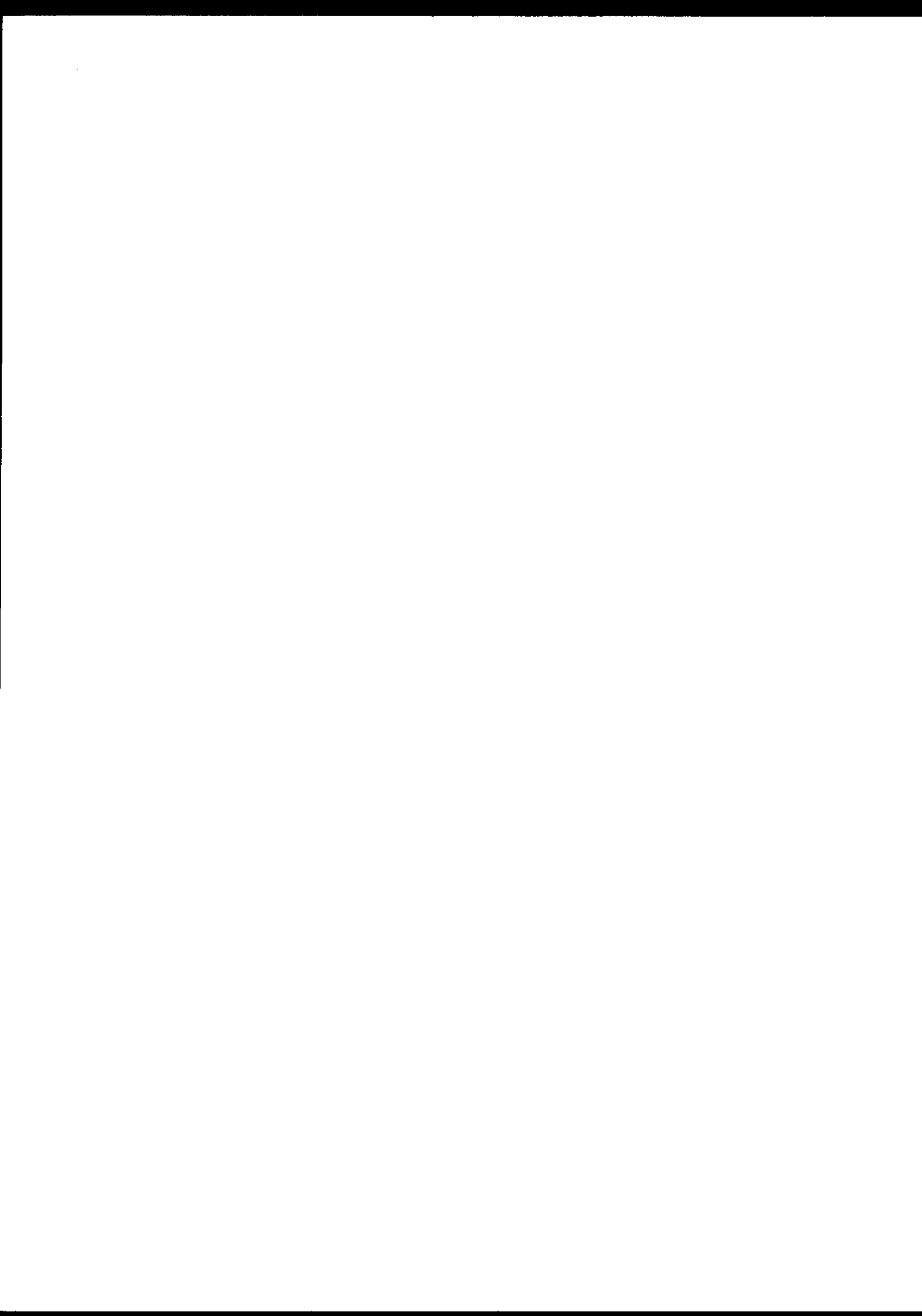


Table of Contents

Chapter 1	Introduction	1-1
Chapter 2	Geographic Information System	2-1
	1. Geography	2-1
	2. Information	2-1
	3. Geographic Information Systems	2-1
	4. Components of GIS	2-2
	5. GIS Functional Elements	2-2
Chapter 3	Makassed Association	3-1
	1. The past	3-1
	2. The Present	3-2
	2.1 The General Assembly	3-2
	2.2 The Board of Trustees	3-2
	2.3 Administrations	3-2
	3. Education	3-4
	4. Higher Education	3-4
	5. Cultural Services and Broadcasting	3-4
	6. Medical and Health Care	3-4
	7. Social and Community Services	3-5
	8. Vocational Education	3-5
	9. Affiliated Association	3-5
Chapter 4	Data Models and Data Capture	4-1
	1. Coverages and Data Dictionary	4-1
	1.2 Tics Coverage	4-1
	1.3 Polygon Coverages	4-2
	1.4 Label Coverages	4-2
	1.5 Arc Coverages	4-4
Chapter 5	Interactive Makassed Geographical Resources	5-1
	1. Feature of the Project	5-1
	2. Design and Implementation Phase	5-1
	2.1 Geographic Presentation of Beirut	5-1
	2.2 Geographic Distribution of Makassed Resources	5-2
	2.3 Hyperlinks to Multimedia Overview	5-2
	2.3.1 Data Components	5-2
	2.4 Computerized Coverage of Bachoura	5-3
	2.4.1 Purpose	5-3
	2.4.2 Process Followed	5-3
	2.5 Optimization of Personnel Resources	5-4
	2.5.1 Problems Description	5-4
	2.5.2 Hospital Problem Formulation	5-5
	2.5.3 Schools Problem Formulation	5-5
	2.5.4 Problems Solution	5-6

2.6 Optimal Financial Budgeting Facilities	5-7
2.6.1 Budgeting Problem Formulation	5-7
3. Difficulties Encountered	5-8
4. Hardware and Software Requirements	5-9
Chapter 6	
Experimental Results	6-1
1. Hospital Experimental Results	6-1
2. Schools Experimental Results	6-2
3. Budgeting Experimental Results	6-3
Chapter 7	
Conclusion	7-1
References	R-1

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Abstract

The system presented herein aims at putting together a decision support tool that functions on a GIS platform. The project has been specifically tailored for Makassed which is a philanthropic association, with many institutions that have been founded in order to provide services to the Moslem groups in Lebanon. Makassed needs a tool that could be used as a reference in order to allow people to have a general idea about its institutions and about what they offer. The best method found to achieve this objective is to use Geographic Information Systems (GIS), because a GIS can handle spatial data in addition, to aspatial data. So by using GIS we will be able to relate the locations of these institutions (spatial data) to any data that describe them (aspatial data). The project consists of a multimedia tool, a capital budgeting tool, a scheduling tool, and finally a grave identification tool.

Chapter 1

Introduction

In this Chapter, we will try to give a brief explanation of the tool we are developing and why the Makassed association needs it. Finally we will give a brief description of each chapter.

Makassed association is a philanthropic institution that provides services to people and has many institutions such as schools, mosques, dispensaries, and a hospital. Makassed needs a tool that captures all of these institutions in an organized and structured form. In addition, it needs a tool that could handle budgeting, and scheduling problems. The importance of this project stems from the computerized method used in order to represent all of these information together especially that there will be a direct link between the geographic location of each institution and relevant visual information.

The project consists of a multimedia tool that gives a brief description of each institution using different media, a Capital budgeting tool that will be decision tool about which investment Makassed should go for, a scheduling tool that determines the minimum number of employees Makassed should hire, and finally a grave identification tool, that helps determining the location of each grave in the Bachoura cemetery.

In chapter 2, we will discuss in detail what a geographic information system is. In chapter 3, we will try to give a detailed explanation of Makassed association, its purpose, and the fields of activities of the association and its institutions.

In chapter 4, we will talk about the data capture process, how we divided the map into coverages, what each coverage consists of, and what are its features. In chapter 5, we will discuss the problem description, the feature of the project, the steps each feature passed through, and the difficulties we have encountered in the development process. In chapter 6 we included our experimental results. Finally, in chapter 7 we include our conclusion.

Chapter 2

Geographic Information Systems

1. Geography

The word geography may be defined in terms of its parts : geo and graphy. Geo refers to the earth, and graphy indicates a process of writing; thus geography means writing about earth.

2. Information Systems

The function of an information system is to improve one's ability to make decisions. An information system is that chain of operations that takes us from planning the observation and collection of data, to storage and analysis of the data, to the use of information in some decision making process[4].

3. Geographic Information Systems

About 25 years ago, a number of geographers conceived a system for storing and organizing spatial information system in a computer. This technology has come to be known as Geographic Information System (GIS). From high quality cartography to land planning, natural resource management, environmental assessment and planning, tax mapping, ecological research, demographic research , GIS promises to be one of the largest computer applications ever to emerge.

A Geographic Information System is an information system that is designed to work with data referenced by spatial or geographic coordinates. In other words, GIS is both a database system with specific capabilities for spatially-referenced data, as

well a set of operations for working with the data. In a sense, a GIS may be thought of as a higher order map.

4. Components of a GIS

Several Component comprise a GIS :

- Users
- Software tools
- Database
- Abstraction or simplification of a real world.

5. GIS Functional Elements

There are five essential elements that a GIS must contain: data acquisition, preprocessing, data management, manipulation and analysis and product generation.

Data acquisition is the process of identifying and gathering data required for your application. This involves a number of procedures. One procedure might be to gather new data by preparing large scale maps of natural vegetation from field observations, or by contracting for aerial photography. Other procedure for data acquisition may include locating and acquiring existing data such as maps, aerial and ground photography.

Preprocessing involves manipulating the data in several ways so that it may be entered into the GIS. Two of the principal tasks of preprocessing include data format conversion and identifying the locations of objects in the original data in a systematic way. A second key task of the preprocessing phase is to establish a consistent system for recording and specifying the locations of objects in the data sets.

Data management functions govern the creation of, and access to, the database itself. These functions provide consistent method for data entry, update, deletion, and retrieval. Modern database management systems isolate the users from the details of data storage.

Manipulation and analysis are often the focus of attention for a user of the system. In this portion of the system are the analytic operators that works with the database contents to derive new information.

Product generation is the phase where final outputs from the GIS are created. These output might include statistical reports, maps, and graphics of various kinds.

Chapter 3

Makassed Association

1. The Past

During the latter part of the 19th century, as Lebanon emerged from war, Beirut developed into an important commercial and cultural center within the Ottoman Empire. On the 16 July 1878, a group of dedicated citizens, founded the Makassed Philanthropic Islamic Association.

The first president of the Association, Sheikh Abdul Kader Kabani, wrote "If I can improve the education of the new generation, I promise you I can reform the world". During the first part of the 20th century, and between the two World Wars. Many schools were opened in Beirut and in the rural areas. In 1926 a community hospital was built in Beirut.

After World War II Makassed reinforced its school system and opened several schools for boys and for girls in Beirut, and the number of elementary schools in the rural district reached 74 schools. The nursing school was opened, the hospital was enlarged to 200 beds. The institute for teachers training was founded in 1966. The Makassed publishing house and the Higher Institute of Islamic Studies were also established in 1980. Makassed Civil Defense Corps of Volunteers began its role in 1982. In 1984 Makassed Radio station "Voice of the Nation" went on the air.

2. The Present

Makassed has developed its work within the community in education, social services, and health and medical care. The Makassed Islamic Association is a non-profit independent organization composed of a general assembly and a board of trustees and the administration.

2.1 The General Assembly

It is constituted of approximately 1000 subscribed members from Beirut who support social welfare in the community.

2.2 The Board of Trustees

It is composed of 24 members elected by the general assembly once every four years. It sets the policies of the association, approves its budget and monitors the progress of the administration.

2.3 Administrations

2.3.1 The General Directorates

To achieve efficient administration and optimal control of Makassed's activities, a decentralized system of administration is adopted with seven general directorates two of which are central directorates.

2.3.2 The Central General Directorate of Administration

It regulates the progress of the association's activities and oversees the implementation of projects in accordance with the approved policies.

2.3.3 The Central General Directorate of Planning

It proposes new strategies and plans, develops and monitors Management Information Systems and is the internal auditor of the Association.

2.3.4 The General Directorate of Education

It develops and monitors all the educational policies and program of the Association. It provides the necessary guidance to the teaching staff to uphold the required standard. It proposes the opening of new schools.

2.3.5 The Central General Directorate of Health

It supervises the administration and operation of the Makassed General Hospital and the medical programs of the Makassed dispensaries, mobile clinics and the school health program.

2.3.6 The General Directorate of Research information

It maintains a cultural relationship with the community through its publication program and it supervises the broadcasting station

2.3.7 The General Directorate of Social services

It is responsible for a wide range of services offered by the association. It organizes activities for social work as well as the scouts and the civil defense and it is responsible for the mosques, and social centers.

2.3.8 The General Directorate of Investment

It is responsible for the real estate and property of the association. It prepares feasibility studies and proposes investment for the Association.

3. Education

Makassed comprehensive schools are well dispersed in the country with a total of 22000 students in Beirut and the rural area. In Beirut there are 20 schools while there are 35 schools in the rural areas. In the occupied zone there are 11 schools which are closed since 1982.

4. Higher Education

There are three higher institutes that belong to Makassed Association.

The Institute of Nursing offers a BS of nursing and BS in medical lab., the BT in nursing and the diploma of practical nurse .

The Institute of Islamic Studies offers the degree of BA and MA in Islamic Studies.

The Institute of Teachers Training offers the teaching diploma, and sports teacher diploma.

5. Cultural Services and Broadcasting

Makassed Printing Press established in 1952 as a vocational training center for the youth out of school, prints all Makassed publication and other printing matters for the association.

Voice of the Nation Makassed opened its broadcasting station "Voice of the Nation" in 1984. It is on the air 20 hours per day.

6. Medical and Health Care

Makassed General Hospital is a leading community hospital offering medical care in Tarik al Jadidah area in Beirut. It is a 230 bed hospital with 120 medical

specialists, 74 medical residents and interns, 183 nursing staff and 343 administrative staff.

Medical Dispensaries There are six dispensaries located in different area of Beirut and they offer medical care to the community.

7. Social and Community Services

Mosques and Social Centers Makassed has provided facilities and help in religious, understanding and practices.

Cemeteries The duty of burial services was given to Makassed. The Association has kept three main cemeteries in Beirut.

8. Vocational Education

The Abdul Haddy Debs Vocational Center was established in 1994. The programs are designed for a total number of 480 students with a view to give them training in the various trades as electronics, electrical installations, and interior design.

9. Affiliated Associations

The Union of Islamic Makassed Scouts Association derives its membership from the Makassed schools youth.

Makassed Civil Defense with young women and men volunteers to help citizens.

Chapter 4

Data Models and Data Capture

1. Coverage and Data Dictionary

The first step in this project is to digitize the map of Beirut using the Arc/info Application. The process of digitizing requires that the map be divided into several coverages, each coverage consists of a single feature; e.g. some coverages consist of arcs, others consist of polygons, and others consist of labels. So we have divided the map into eighteen coverages, each coverage represents a specific feature. In this chapter we will try to define each coverage, what it represents, what are its features, and the steps that passed through, so we could use it in our application.

1.1 Tics Coverage

Coverage Name	Tics			
Definition	The tics coverage Ticcov is the most important coverage and according to which all the coverages are build. This coverage contains points that represent the (x, y) coordinates of the map in the longitude and latitude system.			
Ticc # 22	35 ⁰ 28'	33 ⁰ 54'15''	35,467	33,904
Ticc # 33	35 ⁰ 32'50''	33 ⁰ 54'15''	35,547	33,904
Ticc # 44	35 ⁰ 28'	33 ⁰ 52'	35,467	33,867
Ticc # 66	35 ⁰ 32'50''	33 ⁰ 52'	35,547	33,867

1.2 Polygon Coverages

Coverage Name	Cover1
Cover1	Created
Cover2	Built, Cleaned
Cover3	Edited
Tcover4	Transformed
Definition	The Cover coverage represents the boundaries of Beirut

Coverage Name	Park3
Park1	Created
Park2	Built, Cleaned
Park3	Edited
Tpark4	Transformed
Definition	The Park coverage represents the green areas in Beirut like parks.

Coverage Name	Zone5
Zone1	Created
Zone2	Built, Cleaned
Zone 3	Edited
Tzone4	Transformed
Definition	The Zone coverage represents the area that are populated.

1.3 Label Coverages

Coverage Name	Cities1
Cities1	Created
Cities2	Built
Tcities3	Transformed
Definition	The Cities coverage indicates the different area in Beirut city; e.g. the Hamra, Verdun area

Coverage Name	Grave
Grave	Created
Grave	Built
Grave	Transformed
Definition	The Grave coverage is used to represent the Bachoura Cemetery in Beirut

Coverage Name	Hospal
Hospital	Created
Hospital	Built
Hospital	Transformed
Definition	The Hospital coverage indicates the location of Makassed Hospital in Beirut city;

Coverage Name	PreShl
PreShl	Created
PreShl	Built
PreShl	Transformed
Definition	The PreShl coverage indicates the location of the preliminary schools of Makassed in Beirut

Coverage Name	SecShl
SecShl	Created
SecShl	Built
SecShl	Transformed
Definition	The SecShl coverage indicates the location of the secondary schools of Makassed in Beirut

Coverage Name	HighShl
HighShl	Created
HighShl	Built
HighShl	Transformed
Definition	The HighShl coverage indicates the location of the high schools like "school of nursing" of Makassed in Beirut

Coverage Name	Disp
Disp	Created
Disp	Built
Tdisp	Transformed
Definition	The Tdisp coverage indicates the location of the Medical Dispensaries of Makassed in Beirut

Coverage Name	Mosq
Mosq	Created
Mosq	Built
Tmosq	Transformed
Definition	The Tmosq coverage indicates the location of Mosques of Makassed in Beirut

Coverage Name	Makdiff
Makdiff	Created
Makdiff	Built
Tmakdiff	Transformed
Definition	The Tmakdiff coverage indicates the location of the other institution of Makassed in Beirut like Maassed Center, Voice of Nation, Scouts,...

1.4 Arc Coverages

Coverage Name	Proute
Proute	Created
Proute	Built
Proute	Edited
Tproute	Transformed
Definition	The Tproute coverage represents the main roads in Beirut. E.g. Damascus road

Coverage Name	Troute
Troute	Created
Troute	Built
Troute	Edited
Ttroute	Transformed
Definition	The Ttroute coverage represents the two way direction roads in Beirut.

Coverage Name	Aroute
Aroute	Created
Aroute	Built
Aroute	Edited
Taroute	Transformed
Definition	The Taroute coverage represents main streets in Beirut.

Coverage Name	Sroute
Sroute	Created
Sroute	Built
Sroute	Edited
Tsroute	Transformed
Definition	The Tsroute coverage represents the secondary streets in Beirut.

Coverage Name	River
River	Created
River	Built
River	Edited
Triver	Transformed
Definition	The Triver coverage represents Beirut river.

These tables represent the name of each coverage we have used, in addition to the kind of operations we have applied on it. After transforming each coverage from the (x, y) coordinates that are initially held in digitizer measurement to real world coordinates we can use them in our application. And that what will try in the next Chapter.

Chapter 5

Interactive Makassed Geographical Resources

This project highlights and maintains the geographical distribution of the Makassed various resources. It provides a hyperlink to multimedia coverage of the institutions controlled by Makassed.

1. Features of the Project

In order to be able to describe the entity of our project we need to pinpoint its features. The project embodies :

- Geographic presentation of Beirut metropolitan area.
- Geographic distribution of Makassed resources.
- Hyperlinks to multimedia overviews.
- Computerized coverage of Bachoura with graves details.
- Optimization of personnel resources(Schools/ Hospital).
- Optimal financial budgeting facilities.

2. Design and Implementation Phase

Our design and implementation phase was divided into several parts, each part concentrates on a specific Feature of the project :

2.1 Geographic Presentation of Beirut

This part represents Beirut metropolitan area, so the user of the application has the opportunity to explore Beirut's geography.

2.2 Geographic Distribution of Makassed Resources

This part represents the different resources of Makassed on the map of Beirut. These resources are digitized separately, then they are overlaid onto the map, so the user has the ability to identify their locations separately and in conjunction with the geographic features on the base map. Since Makassed Association has many resources, we have divided them into separate coverages according to careful categorization, such as schools, mosques, ... (see chapter 3).

2.3 Hyperlinks to Multimedia Overview

The multimedia applications are used in order to build a complete browsing system to inform people about the different institutions of the Makassed Association. These applications have been created using the Director Macromedia software.

2.3.1 Multimedia Data Components

The multimedia project will reference each institution separately using pictures, sounds, and movies. The institutions represented in the multimedia system are :

- Schools
- Dispensaries
- Mosques
- Makassed General Hospital
- High school of teaching, nursing, and Islamic studies
- Debs vocational center
- Makassed civil defense
- Makassed scout boys association
- Voice of nation station

- Makassed Publishing house
- Cemeteries

All of these are linked as objects to ArcView. The links are digitized as label points coverages. The point attribute table (PAT) of these label points are used to link each label to its corresponding application in the Director Macromedia software.

2.4 Computerized Coverage of Bachoura

2.4.1 Purpose

This study was proposed by Makassed association in order to be able to identify each grave location and the family it belongs to. The importance of solving this problem is due to the years of war. During that period of time several graves were destroyed and no one could identify to which family a particular grave belongs. After the war the situation in Bachoura could be summarized in one word chaos. This study was done first by a group of persons who were able to determine the location of each grave and who was buried in it, but all the works were done manually. Each time a grave to be located a lengthy process through paper has to be carries out. That's why GIS is the right tool, since it provides us with a general view of the whole platform, so the users will be able to get its information by just clicking the mouse.

2.4.2 Process Followed

The process to be followed will consist of digitizing the graves map, and this was accomplished by representing each grave as a label point. However digitizing a map of 9000 graves using the digitizer will be costly in term of time. The problem was solved by using the (x, y) coordinates of each grave that were previously entered on an Excel sheet. The next step was to transform these coordinates into label points using the <Generate> function on ArcInfo. After generating the label points and

having the graves map, we need to link the point attribute file of the graves map to another database file that contains the names of dead persons. Both of these file have the grave number as a primary key.

By using this link we could, by just clicking on the grave map, know who is the person that was buried. In addition, to the grave location we could be located by just looking on the computer screen.

2.5 Optimization of Personnel Resources

Makassed Association is a big institution with a large number employees in each of its institutions. Our analysis part, will be based on finding the minimum number of employees in each institution, such that no redundancy occurs. The problem is formulated as a linear programming problem.

2.5.1 Problems Description

Our analysis will concentrate on Makassed hospital, and on schools. In the hospital we have different number of full time nurses who work in shifts on different days of the weeks. The number of full time nurses required on each day varies. The hospital rule state that each full time nurse must works five consecutive days and then receives two days off. For example, a nurse who works Monday to Friday must be off on Saturday and Sunday. However, in schools each teacher could teach different classes per day. For example, a teacher could teach two hour per day in one Class, and go to another Class to teach another two hours instead of employing another teacher to teach the same course. The solution will be based on finding the minimum number of employees needed, and it is formulated as an integer programming problem.

2.5.2 Hospital Problem Formulation

The key to formulate this problem is to realize that our objective is not to determine how many people each day we need, but rather how many people begin work on each day of the week.

Let's define : x_i = number of nurses beginning work on day i

For example, x_1 is the number of nurses beginning work on Monday (These nurses work from Monday to Friday). To determine the objective function, note that (number of full-time nurses) = (number of nurses who start work on Monday) + ... + (number of nurses who start work on Sunday). So the objective function is :

$$\min z = x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7$$

The hospital must ensure that enough nurses are working on each day of the week.

The nurses working on Monday are everybody except the nurses who begin work on Tuesday or on Wednesday. In order to ensure that at least 20 nurses are working on Monday, we require that the constraint $x_1 + x_4 + x_5 + x_6 + x_7 \geq 20$ be satisfied.

Adding similar constraint for the other six day we got the following problem formulation.

$$\begin{array}{rll} \min z = x_1 + x_2 + x_3 & + x_4 + x_5 + x_6 + x_7 & \\ x_1 + & + x_4 + x_5 + x_6 + x_7 & \geq 20 \\ x_1 + x_2 & + x_5 + x_6 + x_7 & \geq 15 \\ x_1 + x_2 + x_3 & + x_6 + x_7 & \geq 14 \\ x_1 + x_2 + x_3 & + x_4 & + x_7 & \geq 17 \\ x_1 + x_2 + x_3 & + x_4 + x_5 & \geq 12 \\ + x_2 + x_3 & + x_4 + x_5 + x_6 & \geq 10 \\ + x_3 & + x_4 + x_5 + x_6 + x_7 & \geq 13 \end{array}$$

2.5.3 Schools Problem Formulation

The key to formulate this problem is to realize that our object is to determine how many teachers each day a school needs. Let's define :

to another until the optimum point is eventually reached.”[3] The implementation has been done using the programming language Avenue. However, Avenue is an object oriented language that was dedicated to ArcView. The emphasis in Avenue, as in all object oriented systems, is on identifying objects and then sending them requests. In Avenue, instead of calling functions explicitly with arguments, you send a request to an object. When an object receives this requests it perform some action. So the language is completely different from Pascal and C and does not have any of the features they have. Avenue for example, does not contains arrays, pointers, and trees. And this what made the situation difficult for an application that needs all of these functions. So what we had to do is to make this language be able to solve a problem like the integer programming problem using simplex method.

2.6 Optimal Financial Budgeting Facilities

Each year Makassed Association consider several investments. Our financial budgeting analysis part, will be based on finding the best investment the association should invest in. The problem is formulated as a linear programming problem. And the solution will be based on the Simplex method solution.

2.6.1 Budgeting Problem Formulation

Before we start our analysis we must explain briefly the concept of the net present value (NPV), which can be used to compare the desirability of different investments. Suppose there is an investment for which 1\$ invested at a given time will yield $(1 + r)$ \$ one year from now. So $1\$ \text{ now} = (1 + r)\$ \text{ one year from now} = (1 + r)^2\$ \text{ two years from now}$, and $1\$ \text{ now} = (1 + r)^k\$ \text{ k years from now}$.

Dividing both side by $(1 + r)^k$ shows that $1\$ \text{ received yeas from now} = (1 + r)^{-k}\$ \text{ now}$. A dollar received k years from now is equivalent to receiving $(1 + r)^{-k}\$ \text{ now}$.

Suppose an investment requires a cash outlay of 10,000\$ at time 0 (now) and a cash outlay of 14,000\$ two years from now and yields a cash flow of 24,000\$ one year from now, assuming that $r = 0.2$, we can compute the NPV for the investment

$$NPV = 10,000 + (24,000/(1 + 0.2)) - (14,000/(1 + 0.2)^2) = 2777.78\$$$

The next step suppose that hospital or any institution is considering 3 investments and the institution has 40\$ million available for investment at present time(time 0), and 20\$ million will be available for investment one year from now (time1).

	Inv1	Inv2	Inv3
Time 0 cash flow	11\$	53\$	5\$
Time 1 cash flow	3\$	6\$	5\$
NPV	13\$	16\$	16\$

The institution must determine what fraction of each investment to purchase in order to maximize its NPV. In order to solve our problem we got the following problem formulation.

$$\min z = 13x_1 + 16x_2 + 16x_3$$

$$\begin{array}{rcl} 11x_1 + 53x_2 + 5x_3 & \leq & 40 \\ 3x_1 + 6x_2 + 5x_3 & \leq & 20 \\ x_1 & \leq & 1 \\ & x_2 & \leq 1 \\ & & x_3 \leq 1 \end{array}$$

3. Difficulties Encountered

While developing this system several problems were encountered. The first problem we have faced is finding a real map of Beirut in order to be digitized in other words a map that contains the real world coordinates of Beirut. And this was in some way impossible, so we accepted to work on a tourist map that has many deficiencies one of which is the map was not up to dated.

The second problem we encountered is the digitizing process which took us three month of hard work in order to be able to complete it. In our opinion we believe that the digitizing process is not efficient to be applied on big maps, we believe that it is applied on small application of specific nature in addition to small and non-complicated map, while big and complicated map require scanner.

The third problem we encountered is the process of collecting data especially that one important part of the system is the multimedia application and this parts requires pictures, movies, and sounds. And what did make the situation worst is that the Makassed Association has a lack of material about its institutions especially pictures and movies and this was a very big deficiency the big associations has and I hope they will passed it. So what we did is that we have to several places and ask several people in order to get our needed information.

4. Hardware and Software Requirements

Our application was developed on a PC environment, the tools we have used in order to start the development process were :

Pentium PC 133 MHz.

Complete multimedia kit.

Digitizer.

Video.

Concerning the software part we have used three software .

Director (Multimedia package).

ArcInfo (GIS software under DOS).

ArcView (GIS software under Windows).

Each of these software was used for a specific purpose :

Director :This package was used in order to run multimedia part .

ArcInfo :This package was used in order to digitize Beirut map, in addition, to the cleaning, editing, and transforming processes.

ArcView :It was used to provide a hyperlink to multimedia, in addition, to the development of the Simplex Method solution using Avenue.

Chapter 6

Experimental Results

1. Hospital Experimental Results

$$\begin{array}{rcl}
 \min z = x_1 + x_2 + x_3 & + x_4 + x_5 + x_6 + x_7 & \\
 x_1 + & + x_4 + x_5 + x_6 + x_7 & \geq 17 \\
 x_1 + x_2 & + x_5 + x_6 + x_7 & \geq 13 \\
 x_1 + x_2 + x_3 & + x_6 + x_7 & \geq 15 \\
 x_1 + x_2 + x_3 & + x_4 & + x_7 \geq 19 \\
 x_1 + x_2 + x_3 & + x_4 + x_5 & \geq 14 \\
 & + x_2 + x_3 & + x_4 + x_5 + x_6 \geq 16 \\
 & + x_3 & + x_4 + x_5 + x_6 + x_7 \geq 11
 \end{array}$$

Nurses starting work at :

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
x_1	x_2	x_3	x_4	x_5	x_6	x_7
17	13	15	19	14	16	11

Computational Results :

The Minimum number of nurses requirde (Z) = 67/3

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
x_1	x_2	x_3	x_4	x_5	x_6	x_7
4/3	10/3	2	22/3	0	10/3	7

Applying the Integer Programming to the Simplex Method Results :

The Minimum number of nurses requirde (Z) = 23

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
x_1	x_2	x_3	x_4	x_5	x_6	x_7
4	4	2	6	0	4	3

2. Schools Experimental Results

x_{MM} = number of Math teachers working on Monday.

x_{MT} = number of Math teachers working on Tuesday.

x_{MW} = number of Math teachers working on Wednesday.

x_{MTh} = number of Math teachers working on Thursday.

x_{MS} = number of Math teachers working on Saturday.

x_{AM} = number of Arabic teachers working on Monday.

x_{AT} = number of Arabic teachers working on Tuesday.

x_{AW} = number of Arabic teachers working on Wednesday.

x_{ATh} = number of Arabic teachers working on Thursday.

x_{AS} = number of Arabic teachers working on Saturday.

$$\min z = x_{MM} + x_{MT} + x_{MW} + x_{MTh} + x_{MS} + x_{AM} + x_{AT} + x_{AW} + x_{ATh} + x_{AS}$$

$$\begin{array}{rcl} x_{MM} & & \geq 2 \\ & x_{MT} & \geq 3 \\ & & x_{MW} & \geq 1 \\ & & & x_{MTh} & \geq 4 \\ & & & & x_{MS} & \geq 2 \\ & & & & & x_{AM} & \geq 1 \\ & & & & & & x_{AT} & \geq 3 \\ & & & & & & & x_{AW} & \geq 4 \\ & & & & & & & & x_{ATh} & \geq 1 \\ & & & & & & & & & x_{AS} & \geq 1 \end{array}$$

Teachers Working at :

Monday		Tuesday		Wednesday		Thursday		Saturday	
x_{MM}	x_{AM}	x_{MT}	x_{AT}	x_{AW}	x_{ATh}	x_{MTh}	x_{ATh}	x_{MS}	x_{AS}
2	1	3	3	1	4	4	1	2	1

Computational Results :

The Minimum number of nurses requirde (Z) = 22

Monday		Tuesday		Wednesday		Thursday		Saturday	
X _{MM}	X _{AM}	X _{MT}	X _{AT}	X _{AW}	X _{Ath}	X _{MTh}	X _{ATh}	X _{MS}	X _{AS}
2	1	3	3	1	4	4	1	2	1

3. Budgeting Experimental Results

	Inv1	Inv2	Inv3	Inv 4	Inv5
Time 0 cash flow	11\$	53\$	5\$	5\$	29\$
Time 1 cash flow	3\$	6\$	5\$	1\$	34\$
NPV	13\$	16\$	16\$	14\$	39\$

The institution must determine what fraction of each investment to purchase in order to maximize its NPV. In order to solve our problem we got the following problem formulation.

x_i = fraction of investment i purchased by the institution.

$$\min z = 13x_1 + 16x_2 + 16x_3 + 14x_4 + 39x_5$$

$$11x_1 + 53x_2 + 5x_3 + 5x_4 + 29x_5 \leq 40$$

$$3x_1 + 6x_2 + 5x_3 + 1x_4 + 34x_5 \leq 20$$

$$x_1 \leq 1$$

$$x_2 \leq 1$$

$$x_3 \leq 1$$

$$x_4 \leq 1$$

$$x_5 \leq 1$$

	Inv1	Inv2	Inv3	Inv 4	Inv5
Fraction of invest.	x_1	x_2	x_3	x_4	x_5
	1	0.201	1	1	0.288
Total NPV	57.449				

Chapter 7

Conclusion

In Conclusion, the project will be applicable in each institution of Makassed association as a reference tool, so that any user can use it in order to get supplementary information about the institution he works for. The efficiency of this project stems from the computerized method used in order to represent the geographic location of each institution and visual information. In addition, the project will handle budgeting and scheduling problems and it will represent Beirut metropolitan area, so the user of the application has the opportunity to explore Beirut's geographic Features.

Finally, This project introduced us to the world of GIS which is a database system for management of urban, environmental, other planning data suitable for data analysis, plan preparation, and decision making. In addition, the project introduced us to the language of ArcView "Avenue".

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