A Geographical Database for the College of Technology in Sudan University of Science and Technology using (GIS)

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ABSTRACT- This paper aims to create a geographical database for the Sudan University of Science and Technology, College of Technology, by means of Geographic Information Systems (GIS), by using the ArcGIS program, to be used in analysis, planning, inquiry, and decision-making support. A paper map of the study area was obtained and scanned, and a digital map was obtained. Field measurements were taken for some features that are not on the paper map, and then included in the digital map. The main college features have been covered in order to be classified into layers. All data given by the features were collected. And some images of these features were also obtained. Resultant data has been included in ArcMap 10.3 and many analyzes were done on it. The paper concluded that possibility of creating a geographical database with its own attributes data, hence clarify importance of using the database in academic institutions for planning and decision-making support.

Keywords: File Geo Data Base, Feature Data Set, Feature Classes, Fields, Data.

المستخلص- تهدف هذه الورقة إلى إنشاء قاعدة بيانات جغرافية لكلية التكنولوجيا – جامعة السودان للعلوم والتكنولوجيا بواسطة نظم المعلومات الجغرافية عن طريق استخدام برنامج (ArcGIS) بغرض الاستفادة منها في التحليل والتخطيط والاستفسار ودعم اتخاذ القرار. تم الحصول على خريطة ورقية لمنطقة الدراسة وعمل لها مسح ضوئي وبهذا تم الحصول على خريطة رقمية، وأخذت القياسات لبعض المعالم غير الموجودة في الخريطة وأدرجت في الخريطة الرقمية. صنفت الكلية إلى عدة طبقات كما تم تغطية معالم الكلية الرئيسية وجمعت كافة البيانات الخاصة بكل المعالم، وتم الحصول أيضا على بعض صور المعالم وأدرجت كل هذه النتائج في برنامج ArcMap 10.3 ثم اجريت عليها العديد من التحليلات. وقد توصلت الورقة إلى إمكانية إنشاء قاعدة بيانات جغرافية مع البيانات الوصفية الخاصة بها، وبالتالي توضح أهمية استخدام قاعدة البيانات في المؤسسات الأكاديمية بغرض التخطيط ودعم اتخاذ القرار.

INTRODUCTION

It has become necessary to call this era the era of the information revolution, especially after the great increase in the flow of information in all different fields, and due to the huge amount of information it becomes difficult to deal with, absorb and benefit from it manually. All this led to the emergence of geographic information systems, as GIS provide ways to organize, classify and summarize information, and this information is stored in databases that can be dealt with automatically and utilized without prejudice to this abbreviation, brevity and storage of its accuracy, correctness or significance.

The rapid increase of using computers in mappings and related applications has created a rich variety of information on maps and their related attributes. Such information is required to be stored and handled in the proper manner. Accordingly, the use of Database management systems (DBMS) can be used to solve such data handling problems [1].

Geographic information system is an integrated system consisting of the software, hardware, data and people who enter, process, analyze and present information related to locations on the surface of the earth to be used in support of decision-making [2].

Basically, geographic information systems deal with a large amount of data as it is stored in it and it must be available to several users. Database management systems are generally designed to easily store and retrieve the large data sets, protect, secure, and make them available to multiple users. Thus, these services must be available in geographic information systems through their own database management systems, and they must be of

high performance further than the normal systems. We find that DBMS designed for commercial use are not suitable with geographic information systems because they do not deal with spatial data [3].

A database generally is a file or group of data files or tables stored in an organized manner that is easy to deal with. The GIS database has the advantage over the regular database in its ability to store, process, retrieve and display spatial data [4].

Based on all of the above, this paper has been made, where it aims to:

create a geographical database for the College of Technology in Sudan University of Science and Technology using GIS in order to benefit from it in support of academic and administrative decision-making for the college, in addition to it representing a building block towards preparing a geographical database for the Sudan University of Science and Technology as a whole.

LITERATURE REVIEW

Maps have been used since a long time to represent the environment, where it is used to illustrate locations, distances, directions, sizes, geographical relationships, patterns, and other phenomena. Maps are used in many areas, as they are used for navigation, exploration and illustration in all sectors. Based on all of this, maps are an indispensable tool in many professional and academic aspects, as they are used in many areas of scientific research [5].

The remarkable development of information technology has gained its importance due to its low cost and efficiency. Naturally, the development in computer and information systems, especially data management systems, has a direct and broad impact on geographic information systems, as data management is one of the most important parts of GIS [6].

With the beginning of the nineties, the geographic information system became a sophisticated system in maintained and analyzing spatial and thematic information. Consequently, the importance of database management systems increases, which has become a basic requirement in geographic information systems. Spatial data is an important part of a complete work and information process. In many organizations, there is a need to implement database management systems based on geographic information systems, as spatial and alphanumerical data are maintained in one integrated environment. Consequently, DBMS play an important role in the GIS architecture [7].

MATERIAL AND METHODS

A digital map of the study area was prepared by obtaining a paper map for the College of Technology and making a scan for it. Measurements were taken for some of the college's features that not introduced by the paper map, then these measurements were added to the digital map to obtain a complete digital map for the college.

The college explored well, all its features were identified and classified, and then the attribute data of the various departments of the college was collected and all data entered into Arc Map 10.3 for the purpose of building the required geographical database.

The College of Technology was classified into several parts, as it included the following:

1. Waste Water, it includes manholes, sewage wells and a sewage network that you get with the help of a specialist.
2. Toilets, it includes all toilets within the college.
3. Frame, it includes the outside frame of the college.
4. Services, it includes college mosque, student and worker lounges, student services centers, cafeteria and libraries in the college.
5. Power, it includes generators, electricity illiteracy and meters room.
6. Offices, it includes all administrative offices except for the offices located on the first and second floors of the administration building.
7. Labs, it includes computer labs as well as a glass forming workshop.
8. Healthy Water, it includes collars, washbasin, water tank and refractory brick cooler.
9. Botanic Cover, it includes vegetation in the college.
10. Halls, it includes all halls in the college.
11. Builds, it includes shop, University Pharmacy, SUST Travel and Tourism Agency, Markets, Store, as well as Youth Microfinance Foundation.
12. Security, it includes all offices of security and safety.
13. First Story, it includes administrative offices on the first floor.
14. Second Story, it includes administrative offices on the second floor.

After the college was classified into layers, each layer was divided into fields.
And then, all the data for all the fields were collected and downloaded in tables (Table 1 to 12).

RESULTS AND DISCUSSIONS

The digital map of the study area was inserted in the Arc Map 10.3 program, a File Geo Data Base was created, and inside it a Feature Data Set was created, after which the coordinate projection was chosen (UTM WGS 1984 Zone 36N) and then each Feature Classes was created according to its type (point or a polygon such as (Buildings Layer) or a line such as (Toilets Layer)) and thus all the layers for the study area have been inserted.
All the features were traced for all layers, and then all fields for each layer were inserted in the attribute table for each layer separately by entering the name and type of each field, after that all the data for each field to all layer was downloaded, example Attribute Table of Halls Layer (illustrated in Figure 1), and with this the data (attributes data) and the map (spatial data) were linked in Arc Map 10.3.
The map was adjusted by the coordinates taken with navigator device (illustrated in Table 13) by spatial adjustment. Thus, the final adjusted map containing all layers is as shown in (see Figure 2). Pictures of some features of the Technology College were taken and added to the map by hyperlink command in Arc Map 10.3, for example, the picture of the mosque of college (illustrated in Figure 3).
By completing all these processes, a geographical database for the College of Technology was be obtained.
The analysis process was conducted to inquire about things whose data are difficult to manually analyze. For example, to find out the total number of students that all halls of the College of Technology can contain, the attribute table for the halls layer has been opened and the field representing broadness has been selected, and from it, statistics is chosen. It was obtained (see Figure 4): Count: 5 is the number of halls in college 5. The minimum halls capacity is 45. The maximum halls capacity is 350. Total capacity of the halls is 1090. The average capacity for halls is 218. Finally, the standard deviation is 99.929975.

HALLS

OBJECTID *	SHAPE *	SHAPE_Length	SHAPE_Area	NAME	BROADNESS	FANS	AIR CONDITIONERS	LIGHTING
1	Polygon	66.530644	272.98776	Hall of the late Professor Abdel Moneim Ahmed	350	13	12	Good
2	Polygon	65.253527	261.373227	New Deanship Hall	195	9	7	Good
3	Polygon	64.368948	253.97262	Western Deanship Hall	250	13	7	Good
4	Polygon	63.165155	243.675723	East Deanship Hall	250	13	13	Medium
6	Polygon	29.597756	54.345831	Meeting Hall	45	6	5	Good

Figure 1: Attribute Table of Halls Layer

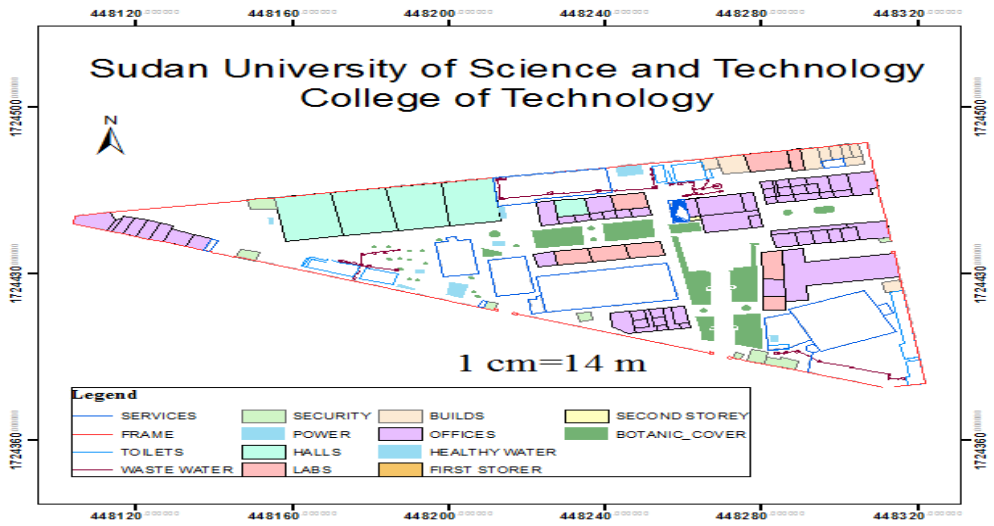

Figure 2: College of Technology Map

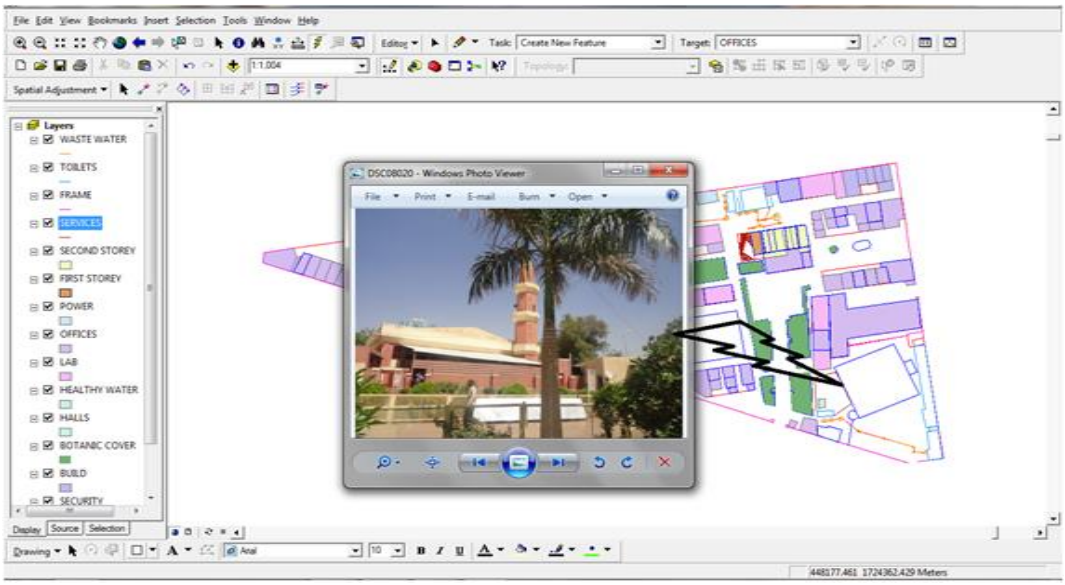

Figure 3: Add Picture by Hyperlink Tool

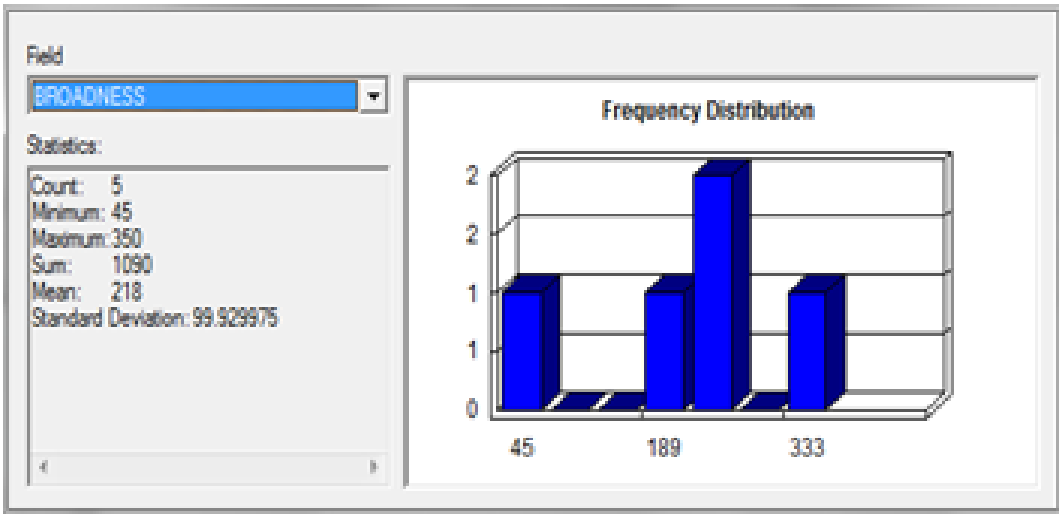

Figure 4: Analysis Process of Halls Capacity

In the same way, we can get the largest capacity in the offices for employers, which was found equal to fifteen employers in the registration office, and in this way, it is possible to compare all the data in the fields in all layers.

Also, it is possible to inquire about the data by writing the equations from the select by attributes option. For example, you want to know the offices that contain 8 chairs or more, this is done by writing the equation "chairs"> = 8, and then the map appears specified in it all offices that have 8 or more chairs, as shown in (Figure 5), this analysis is useful, for example, in employee distribution in offices.

Also, the analysis can be done by locations by select by location, for example to choose the botanic cover that is located within 15 meters from the labs, this is done with the option are within a distance of (and there is other
options) and then the map appears specified in it the botanic cover in the distance of 15 meters from labs (illustrated in Figure 6). This analysis is useful, for example, for students to find the closest vegetation location to take a break between working in the labs.

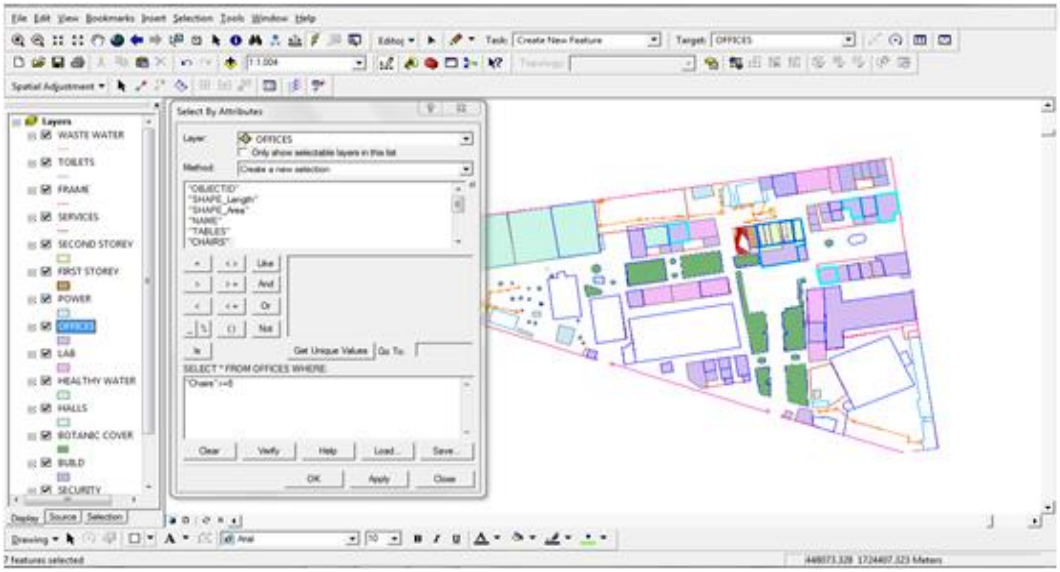

Figure 5: Analysis Process by Attributes

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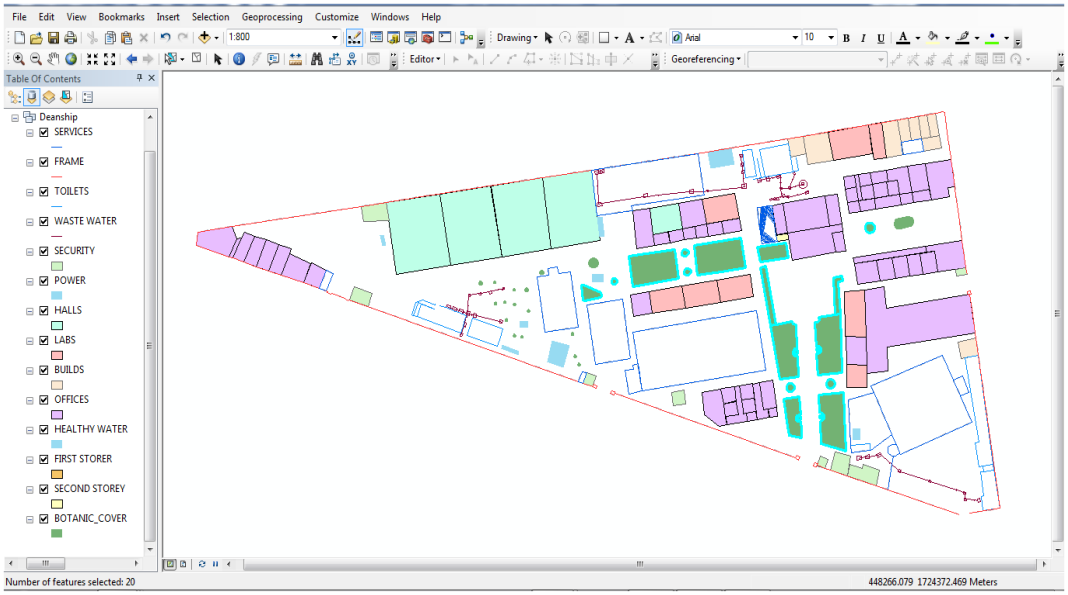

Figure 6: Analysis Process by Locations

Many other analyzes can be made in the framework of making the most of the capabilities of geographic information systems in the field of geographical databases in terms of speed, ease and decision-making support.

CONCLUSIONS

A complete digital map of the study area was obtained. The study area was classified into several layers, and these layers contain all the features on the digital map of the College of Technology. All data related to these features were collected and downloaded in the database of digital map in the attribute tables for all the layers, a digital map was adjusted by spatial adjustment. Pictures of some features were added and some inquiries were made about some features. The study concluded:

- The possibility of creating a geographical database with the attributes data for it.
- The features within the college through the geographical database can be easily identified.
- Features can be classified into multiple layers, and each layer appears with different settings from the other layer.

- Ease and flexibility in dealing with the system interface.
- Ease of data analysis.
- Knowing the total capacity of the halls and then setting the appropriate study schedules, and other analyzes.

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TABLE 1: TOILETS LAYER DATA

Object	Number
1	10
2	6
3	15
4	10
5	27
6	4

TABLE 2: SERVICE LAYER DATA

Object	Name	Tables	Chairs	Fans	Air Conditions	Lamps	Cupboards	Computers	Employers	Broadness	Type of Services
1	College Mosque	0	0	15	10	46	1	0	0	640	-
2	Girls Lounge	0	10	2	0	4	0	0	0	0	-
3	Cafeteria	35	250	13	6	60	0	0	12	250	-
4	Technology Library 2	2	1	2	0	2	1	0	1	2	Photography - Office Tools - Credit
5	Girls Lounge	0	186	0	0	0	0	0	0	186	-
6	Engineering Deanship Library	1	1	1	0	2	2	0	1	1	Balance Transfer - Photography
7	Boys Lounge	0	105	0	0	0	0	0	0	105	-
8	Student Services Center	1	1	1	0	2	1	0	1	2	Photography - Office Tools - Communications
9	Workers Lounge	0	9	1	1	2	0	0	22	9	-
10	Technology Library	56	314	20	17	58	72	17	12	314	Acquaintance
11	Stairs	0	0	0	0	0	0	0	0	0	-

TABLE 3: POWER LAYER DATA

Object	Name	Type	Volt
1	Electricity Generator	SDMO 5450	160/400 A
2	Electricity Illiteracy	-	HV:11000 / LV:433
3	Electricity Meters Room	-	-

TABLE 4: OFFICES LAYER DATA

Object	Name	Tables	Chairs	Fans	Air Conditions	Lamps	Cupboards	Computers	Coolers	Employers
1	Electricity Maintenance Office	1	4	1	1	2	1	0	1	3
2	Computer Workshop	2	6	1	1	2	1	1	1	1
3	Head of Computer Division	1	8	2	1	3	1	1	1	2
4	Computer Professors Office	2	4	0	1	2	1	0	0	12
5	Social Welfare Office	3	2	3	1	2	3	1	0	3
6	Website Office	3	7	0	1	3	1	4	1	4
7	Alumni Affairs	2	4	1	1	2	1	0	0	2
8	Public Relations and Media Office	1	4	1	1	2	0	1	0	2
9	Male and Female Dormitory	0	2	2	1	4	1	0	0	0
10	Medical Assistant	2	4	1	1	2	0	0	0	1
11	Doctor's Room	1	2	1	1	2	0	0	0	1
12	Reception	0	0	0	0	0	0	0	0	0
13	Lab	2	2	0	1	1	0	0	0	2
14	Revenues	6	10	2	2	6	8	3	0	8
15	Certificates and Alumni	10	17	6	3	8	17	7	0	9
16	Head of Accounting Department	2	5	1	1	2	3	1	0	1
17	Head of the Commercial Studies Department	2	5	1	2	2	3	1	0	2
18	Economics and Social Sciences Division	2	5	1	1	2	2	1	0	1
19	Division of Management Information Systems	2	5	1	1	2	3	1	0	1
20	Supply Unit	1	2	1	3	4	0	0	0	1
21	Online Education	0	0	0	0	0	0	0	0	0
22	Office of the Deputy Dean of Student Affairs	2	7	1	1	5	1	1	0	1
23	Office of the Head of Accounts Department	1	5	1	1	2	2	1	1	1
24	Store	0	0	0	0	0	0	0	0	0
25	Store	0	0	0	0	0	0	0	0	0

26	Store	0	0	0	0	0	0	0	0	0
27	Store	0	0	0	0	0	0	0	0	0
28	Reception	1	2	1	0	1	0	0	0	1
29	Financial Receipt Entry Office	0	0	0	0	0	0	0	0	0
30	Office of Internal Audit	4	11	2	2	7	1	1	0	6
31	Payments	3	4	1	1	4	2	2	0	2
32	Division of Applied Sciences	1	4	1	1	2	2	1	0	2
33	Human Studies	2	5	1	1	3	1	2	0	2
34	Engineering Studies	2	2	1	1	3	1	0	0	1
35	Students Affairs	2	5	1	1	2	1	1	0	1
36	Worker Affairs	1	5	1	1	1	1	0	0	1
37	Health Insurance Office	1	5	1	1	3	3	1	0	1
38	Registration Office	5	15	4	4	6	0	13	0	15
39	Registrar's Office	3	8	2	1	2	2	2	0	1
40	Technical Support and Networks	4	7	1	1	4	3	7	0	6
41	Registrar Assistant for Admission and Registration	4	5	1	1	4	3	2	0	2
42	Registration Lounge	0	87	4	2	14	0	0	0	-
43	Photography Office	1	2	1	1	2	0	0	0	1
44	Examination Sort Office	1	7	1	1	2	3	0	0	1
45	Examination Sort Office	1	7	1	1	2	3	0	0	1
46	Secretarial Office	2	4	1	1	2	2	2	0	1
47	Department of Training and Continuing Studies	3	7	2	2	4	4	2	1	3

TABLE 5: LABS LAYER DATA

Object	Name	Tables	Chairs	Fans	Air Conditions	Lamps	Cupboards	Computers	Coolers	Employers
1	Computer Lab No. 4	35	35	2	3	6	1	35	0	1
2	Computer Lab No. 1	39	39	3	3	4	0	36	0	1
3	Computer Lab No. 2	35	35	3	3	8	0	32	0	1
4	Computer Lab No. 3	35	37	3	3	6	0	33	0	1
5	Computer Lab No. 5	32	33	4	1	5	0	32	0	1
6	Glass Forming Workshop	0	0	0	0	0	0	0	0	0
7	Computer Lab No. 6	22	24	1	2	8	0	21	0	1
8	Computer Lab No. 7	23	22	1	3	7	1	20	0	1

TABLE 6: HEALTHY WATER LAYER DATA

Object	Name
1	Thermal Bricks
2	Thermal Bricks
3	Washbasin
4	Tank
5	Washbasin

TABLE 7: BOTANIC COVER LAYER DATA

Object	Type
1	Garden
2	Garden
3	Garden
4	Tree
5	Tree
6	Garden
7	Tree
8	Tree
9	Tree
10	Tree
11	Garden
12	Garden
13	Garden
14	Garden
15	Garden
16	Garden
17	Garden
18	Garden
19	Garden
20	Garden
21	Garden
22	Garden
23	Tree
24	Tree
25	Tree
26	Tree
27	Tree
28	Tree
29	Tree
30	Tree
31	Tree
32	Tree
33	Tree
34	Tree
35	Garden
36	Tree
37	Tree

TABLE 8: HALLS LAYER DATA

Object	Name	Broadness	Fans	Air Conditions	Lighting
1	Hall of the late Professor Abdel Moneim Ahmed Saleh	350	13	12	Good
2	New Deanship Hall	195	9	7	Good
3	Western Deanship Hall	250	13	7	Good
4	East Deanship Hall	250	13	13	Medium
5	Meeting Hall	45	6	5	Good

TABLE 9: BUILDS LAYER DATA

Object	Name
1	Shop
2	University Pharmacy
3	SUST Travel and Tourism Agency
4	Market
5	Market
6	Market
7	Market
8	Store
9	Youth Microfinance Foundation

TABLE 10: SECURITY LAYER DATA

Object	Name	Tables	Chairs	Fans	Air Conditions	Lamps	Computers	Coolers	Employers	Cupboards
1	University Guard Lounge	1	2	1	1	2	0	0	7	7
2	Boys Reception	2	2	2	0	2	0	0	2	0
3	Girls Reception	1	2	2	0	2	0	0	2	0
4	Security and Safety Office	1	4	1	1	2	0	0	4	2
5	Security and Safety Office	2	7	2	1	2	1	1	1	2
6	Staff Reception	1	2	1	0	1	0	0	1	0
7	Reception	1	2	1	0	1	0	0	1	0

TABLE 11: FIRST STOREY LAYER DATA

Object	Departmental Task	Tables	Fans	Air Conditions	Lamps	Cupboards	Computers	Coolers	Employers
1	Department of Languages and Translation	2	1	1	2	2	2	0	2
2	Division of Communication Sciences and Division of Education, Arts and Society	2	1	1	2	2	2	0	2
3	Department of Scientific Studies	2	1	1	2	1	2	0	3
4	Department of Human Studies	2	1	1	2	3	2	1	6
5	College Secretary's Office	2	1	1	2	5	1	0	2

TABLE 12: SECOND STOREY LAYER DATA

Object	Name	Tables	Chairs	Fans	Air Conditions	Lamps	Cupboards	Computers	Coolers	Employers
1	Results Office	2	16	3	1	2	2	7	1	2
2	Vice Dean's Office	1	5	1	1	2	2	1	1	1
3	Deputy Dean's Secretariat	2	8	1	1	2	1	1	0	2
4	Dean's office	7	19	2	2	4	6	1	1	1
5	Dean's Secretariat	5	5	2	1	2	1	2	0	2
6	Vice Dean's Guard	1	7	1	0	3	0	0	1	1

TABLE 13: COORDINATES BY NAVIGATOR DEVICE

Point No	East (meter)	North (meter)
1	448103.980	1724454.339
2	448103.506	1724451.003
3	448306.789	1724485.22
4	448322.117	1724383.762