Social-space development, with the design of a smart card system for health services, based on GIS

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Abstract

In spite of the advancements made in science and technology, the world is still facing the perils of prevalence and epidemic of different diseases from one side and problems such as inappropriate distribution of treatment giving services in a large number of countries.In such a condition there remains a need for the design of a comprehensive health system using the GIS based smart cards. This can facilitate having all common health, treatment services, such as issuing and receiving prescriptions, insurance services, having access to medical records which can accompany every individual. This will facilitate the development of social and spacial.Considering the fact that the data becomes regional and transferable (knowing they should stay confidential, and have permitted access) , predicated data banks in the health and hygiene net work management, such as offices and treatment giving insurance institutions could have all kinds of possibilities for planning, organizing, controlling and utmost management, in both individual and common health of the society.Although some developed countries are at the moment using smart cards in theirs health systems, but in this suggested system, the objective is to utilize the advantages of GIS smart cards being regional.In this scheme a smart card is intended for each individual, and often loading the necessary information on it. This is used instead of his health service notebook and clinical record. In addition identification card used to access the patient's medical record and prescription card is designed for doctors. Also the service offering identification card is designed for health centres and pharmacies.Predications should be made of the regional information in every visit to the physician or a clinic, upon which all the following possibilities can be obtained; all statistical reports based on GIS, research activities, supervising over the health and treatment distribution, number and reason for visiting the health care centers, defining the start of an epidemic and factors offering it, checking the nutritional diseases, analysing the concentration and spreading of different disease and their causes according to region or country. All these data can help provide health maps, satellite pictures and defining various layers of information.Finally by the use of these cases optimum managing and development of a smart health and healing network can be made possible.

Keywords: health system, smart cards, GIS, health maps, smart GIS based health card, smart health service card.

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1. Introduction:

Nowadays societies are progressing towards making and developing electronic towns. In addition presenting health services to citizens is essential and everyone is somehow involved with it and therefore needs correct planning. As a result and bearing in mind the complications of today's societies, using modern technology for ease and speed in this field, is unavoidable.

Smart cards can be used for providing health services for all citizens. If this system is based on a suitable GIS basis, it will provide different ways of getting reports and observing, using data systems of the area. The possibility of planning and better guidance in the sectors of health, treatment and medical education is also provided.

In this system, four major sectors are predicted:

1) Setup of a suitable program and the GIS software and dedicating required hardware by the insurance and managing office with the two major purposes of issuing and extending smart cards for citizens, doctors and health centers ex. pharmacies, laboratories, etc. and also the ability of receiving and analyzing various data.

2) Smart health service cards and medical records that are given to all citizens and are used when receiving health services.

3) Doctors' smart card that when ran, connects the doctor to the program in the patient's card and he/she can write the patient's prescription. In this condition, using a computer and one of the statuses of ONLINE or OFFLINE appropriately will be necessary.

4) Health centers' service offering card that are given to centers such as pharmacies, laboratories etc. and when ran, also connects to the program in the patient's card and service is given.
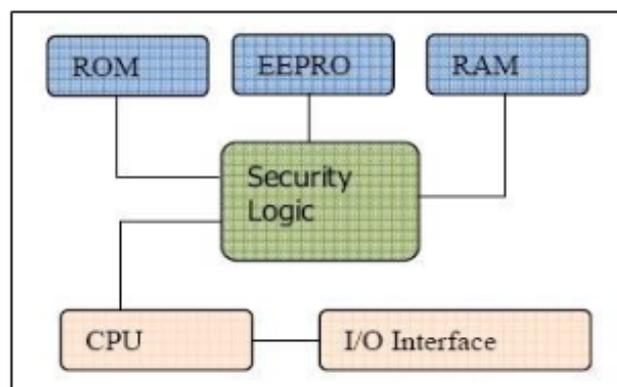
2. History of Smart Cards:

Smart cards when first invented in 1968 by German missile science scientist "Helmut Grotrop" and his colleague "Burgan Detholf" and finally registered in 1982. The first public and widespread usage of smart cards was in 1983 for electronically paying the French credit telephones. A smart card is a plastic card in the size of a credit card that one or more chips are used in it as aggregated circuits. There can also be one or more technologies such as magnetic strips, barcodes, biometric information and image recognition, which can be done by a machine, used in it. The combination of a common plastic card and a microprocessor, allows a large amount of information to be stored, processed and accessible, online or offline.

3. Types of Smart Cards:

There are two types of smart cards: 1- memory cards that only include nonoverflowable memory and some processes in order to provide security and 2- CPU cards which include a CPU and overflowable too.

The structure of smart cards is shown in the figure below.

4. Amount of Data Stored on Smart Cards:

Smart cards can store more data than normal cards (magnetic strips) and by storing encoding algorithms, they can also improve the security of transfers. The data stored on an IC chip is transferred by means of an electronic module that is connected to a terminal or a card reader device or by a magnetic field. Smart cards can have up to 8 kilo bytes RAM (Random Access Memory), 364 kilo bytes ROM (Read Only Memory), 256 PROM (Programmable Read Only Memory) and a 16 bit CPU.

5. Information Security in Smart Cards:

The information available on common magnetic cards can be easily read, rewritten on, deleted or edited. Therefore use of such cards requires complicated computer networking systems to receive and process data and to also insure the data being correct. This is why magnetic cards are not a suitable location for storing data. In conflict, because of their security systems, smart cards store data in themselves to be used when required without the need of connecting to a network.

The state of being ONLINE or OFFLINE in systems designed for smart and magnetic cards is demonstrated here. Therefore the smart cards' system is designed so that data is stored on it and because the CPU in it has control over access to the card's data, it has the essential security. However in common magnetic cards, owing to the lack of information security, data is stored on the network and the card only includes an identification code. Consequently access to the network is needed for using magnetic cards and therefore cannot be used if the data network is off at the time. On the contrary, using smart cards, needs no network and can therefore be used even if the network is not accessible at the time.

6. Functionality of Smart Cards

6.1 Operating System

The new pattern and programming in the operating system of smart cards is CardJava. This operating system was developed by the Sun Microsystem Company and afterwards extended in the form of JavaCard. This operating system is very popular because it provides independence and freedom in architecting for designers and programmers. Furthermore practical programs based on the Java operating system can also be used for any smart card that supports JavaCard. Nowadays most smart cards use their own specific operating system for communicating and performing planned actions. However for real support of practical programs, the operating system of smart cards, are based on the operations provided by international standard ISO7816.

Other operating systems that can be named as developed for smart cards are MULTIOS (Multi-Application Operating System) and Smart Card for Windows.

6.2 Programming Language

Many practical programming languages (Application Programming Interface) have been developed for smart cards. Some of them are:
GlobalPlatform/ OpenCard/ SC-PC/ CT-API

7. Advantages and Capabilities of Using Smart Cards:

Smart cards have many advantages and capabilities and this fact has caused their usages to extend in many ways. Of the most important advantages of their usage the following can be mentioned:

1) Size: This small card eliminates the need of carrying around large amounts of documents.

2) Security: Because of security systems on these cards, such as encoding abilities, the data on them is kept safe.

3) Data Capacity: Smart cards are capable of storing bigger amounts of information compared to magnetic cards.

8. Usages of Smart Cards:

Today, in many countries, smart cards are used in various tasks. These usages are generally put into

three groups:

1)   Identification Usages: These cards are used for identifying people and their owners, such as parking cards, traffic cards, etc.

2)   Financial Usages: Banks offer smart cards to their customers as their electronic identity in the bank they were issued in. By presenting this card to ATM machines, the customer can benefit from banking services.

3)   Storing Data Usages: An identification code and some personal information are stored on smart cards. This data can be accessed using a card reader device. Cards such as smart license cards, smart health cards, national identification cards and student cards are in this group.

9. Smart Health Cards:

These days, in most developed countries, particularly European countries, smart cards have a special position in health systems.

Performing projects related to health cards in the world started about two decades ago and has been extending ever since. Countries such as America, France and Germany have been pioneers in this area. Activities that can be mentioned in this topic are SesamVitale in France, QUEENS Health Network in America and Electronische and Gesundheistkarte in Germany. The Social Security Organisation and the Health Service Organisation in Iran have also been designing smart health cards for special diseases. The use of these cards eases managing services and accessing patients' medical records at any time. Two types of data are stored on smart cards, personal data and medical data. This data includes the patient's personal information, complete up-to-date medical records, insurance data, emergency data, prescriptions, the patient's personal code for communicating between the card and card reader devices.

Therefore using this card, the patient will be carrying the main part of his/her medical information and can use them when visiting a doctor. Also the doctor can use the patient's latest information for better diagnosing and prescription.

Using smart cards in the doctors' office is made possible by card reader devices. Doctors can use a card reader device to issue prescriptions electronically and benefit from advantages such as information security, being sure of accuracy in the performance of prescriptions, access to professional data sources in medical care, access to the patient's medical records, etc. Doctors also have a special card that is inserted into the card reader along with the patient's.

10. GIS Technology and Its Usage in the Health section:

Geographical Information System is a tool for storing, combining, analyzing and demonstrating geographical data. GIS is a combination of a computer, a database, software and a professional user who can process and illustrate categorized data in a geographical frame.

In the past years GIS has made undeniable evolution in geographical sciences. It has also developed organisation and management in location data. This science and technology has abilities such as receiving and transferring data between different sources, organising data, timely receiving and showing, processing and merging various data and the ability of offering multipurpose services. These abilities have opened new doors to researchers in the last decade. It has been used for many purposes and its usage are extending. With the improvement in technology, users discover new abilities of GIS everyday and are drawn towards it.

Using GIS, firstly we can discover what the health problems are and where they occur and secondly what qualities the locations have. By answering these questions, we can help prevent and solve the problems.

GIS usage in the health territory has a large history in the world.

The first health map was developed by Jhon Snow in 1965.

In the health section, the data gained from observing

the source location is merged with illustrated data and maps that include different layers of health and

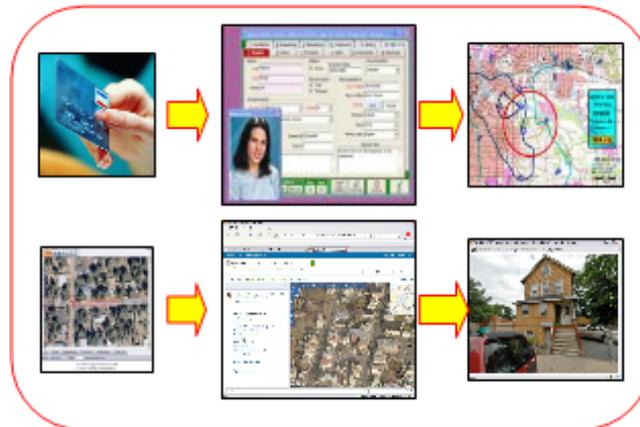hygiene data are made and given to professionals for use.

Fig. 2 sample of the progress of accessing people's location information using smart cards

Scientifically and with concern for public health, Health-GIS has scientific and practical usages. These usages are based on the two bases of presenting and surveying public health managing services and also on acknowledging the scattering of effective factors in improving health, such as diet treating, amplitude of diseases and dying, etc. Primary and fundamental indicators of improving the level of health and resisting diseases in society and also improving public hygiene, are measuring the amount of accession and effective factors on health or illness. Not only is accuracy in measuring these indicators, accuracy in assessment on presenting health and medical services but also it is a way to identify and evaluate effective factors on decreasing the level of health and increase in number of diseases, and the norms that are effective on health and profusion of illnesses. Health-GIS is undoubtedly a multi-dimensioned string that is generally made of three groups: 1) GIS and evaluation from a distant, 2) epidemiology and statistics, 3) computer and database.

11. Smart Health Card Based on Geographical Information System (GIS):

As mentioned in the smart health card section, the basis of smart cards is collecting data and keeping this data up-to-date so it can be used efficiently anytime and anywhere. GIS's usage is analysing events based on geographical data. According to the definition of GIS, a database can be achieved by combining and connecting people's location information (address, postal code, geographical longitude and attitude) and the data stored on each person's smart health card and also the location information of health centers (address, postal code, geographical longitude and attitude) with the following goals:

1) Designing GeodataBase for different subgroups of the health section such as hospitals and health centers' databases, doctors' databases, different diseases database, insured members' database along with the patients' medical records

2) Developing epidemiology maps of disease distribution in various comparisons and measures.

3) Creating maps of distribution of the locations of medical and health services like hospitals, emergency centers, pharmacies etc. or even creating a map of distribution of doctors and specialists.

4) Analysing the patient's health data according to time and place.

5) Using Mobile GIS and the technology of Geographical Positioning System for collecting data fields from health data and sending them to GIS database.

6) Transferring GIS technology to health managing and servicing systems nationwide.

7) Monitoring unusual aggregation of diseases in specific locations and their breadth.

8) Offering help and instructions for correct registration of health information nationwide with the aim of giving them placement in future.

9) Optimum managing of the distribution of health and medical services appropriate with the needs of the citizens.

10) Ease of planning and offering services to particular patients.

11) An effective managing tool in crisis handling bearing in mind the ability of recognition and correct, speedy and real understanding of the extents of crisis.

12. Practical instances of data analysis of the referent location in the use of GIS smart cards.

A. special diseases

The case of special diseases in a particular region, professional area, or even busy location of the afflicted, can help us investigate the probable relationship between the environmental factors such as soil, green mantle and so on with that special disease. Consequently considering all probabilities and facts obtained, causes can then be defined, preventive and controlling measures taken and restrictions of those factors developing these diseases made. Prevalence of M.S (Multiple Sclerosis) for instance has been observed alongside a river in Iran. Experts believe it is probably due to water being industrially polluted or poisonous fertilizers used for the green belt along the river.

B. nutrition and dieting

The same method can be utilized concerning nutritional diseases. By processing the data obtained from the data banks using GIS smart cards regarding numbers and abundance of the malnutrition cases in special locations, provision of prevention and appropriate treatment can then be managed.

For instance, Goiter, a disease caused by lack of iodine is a micronutrient observed in a special geographical area, can be easily prevented and cured. Likewise by improvement of local awareness regarding appropriate lifestyles, such as methods of cooking and keeping food, compensation policies for environmental factors concerning nutrition (like iodine salt) preventive and controlling measures can be taken.

This is also true about restricting other malnutrition disease, like Anemia caused by lack of iron. By analysing its prevalence in a special area, we can check it with the GIS geographical maps of cities, then consider the environmental factors such as economical and cultural factors and plan for them accordingly.

C. Service giving management

Superior management and smart and rational development of health and hygiene network are important advances of a GIS based health system.

Analysing the abundance and variety of the diseases, the distribution of health and treatment giving centers in different areas of towns, cities, provinces or countries using GIS, we can then check the strong and weak points of the networks in service giving centers, creating new centers, strengthening the existing centers in the required areas and avoiding developing centers in non-essentional regions are of utmost necessity. As example of which are dialysis center for patients with kidney disease, service giving centers to physical and mental handicapped or variety of other specialized treatment services given to areas with the abundance of the disease.

Conclusion:

According to the mentioned issues, it can be concluded that GIS based smart cards can be a suitable replacement for health service notebooks and patients' medical records. In addition to saving on expenses and human force, they provide better managing of distribution, control and guidance in health and medical services whether in the medical section or in facilities, equipment and service offering centers. Furthermore it provides the ability

of recognition, definition and good performance in the health section such as fatness, malnutrition, congenital and identifying their causes. It also makes on time predicting and better resistance in accession of diseases and handling unpredicted crisis (such as the prevalence of Swine flu) possible. Generally it is considered as a ideal managing tool in keeping the desirable conditions for society.

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