Computational System Analysis and Detection of Diabetes Mellitus

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Abstract. *Diabetes mellitus type 2 (DM2) is the leading cause of death in Mexico and is characterized by hyperglycemia (high glucose levels in the blood). Due to the high cost means to control DM2 in patients containing the disease, is created a computer system for early detection, which uses a pattern recognition method (KNN) to make a diagnosis on admission of a new data patient. The computer system can determine a diagnosis of a new patient with a faster way, plus it helps keep a more organized and easy access to information of each individual.*

Keywords: Pattern analysis, Pattern classification, KNN, Diabetes Mellitus TII

1 Introduction

The quality of health care defined by Donabedian as "the degree to which the most desirable means used to achieve the highest possible improvements in health." To ensure quality, there must be two inseparable elements, namely the system design and performance monitoring. Preventive medicine units should consider using a computer system, the result is to help in the capture and retrieval of patient information [1].

Measure and report the health of a population is crucial for anyone concerned about providing quality services to the population. A surveillance system allowing for timely information that facilitates making decisions or make recommendations for short, medium or long term, objective and scientific bases for the purpose of preventing or controlling health problems like diabetes mellitus type 2 (DM2), known for its high impact on health services utilization.

DM2, particularly when not controlled, can represent a heavy economic burden for the individual and society. Thus, depending on the country, estimates suggest that diabetes may represent between 5 and 14 % of health care expenditure to control the disease. [1] In Mexico, the DM2 is the leading cause of death in Fig. 1 can display the global position he occupied Mexico in the years studied. This is because people do not have a previous diagnosis or information sufficient to prevent it. The Guanajuato state ranks third in prevalence to diabetes at the national level (Fig. 2). [3]

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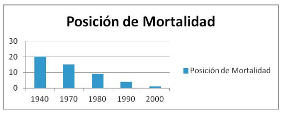

Fig. 1. Position of Diabetes Mortality in Mexico. [2]

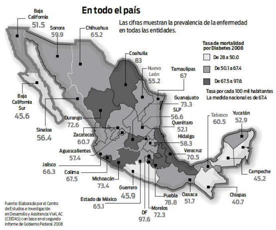

Fig. 2. Prevalence of Diabetes in Mexico. [5]

We developed a computer system capable of making a timely diagnosis of type 2 diabetes using an artificial intelligence technique (KNN) on databases of diabetic and nondiabetic patients. With the implementation of KNN, we can determine whether a new patient has diabetes mellitus or not.

The epidemic of diabetes mellitus, is the leading cause of death in Mexico, with an upward trend for three years to add more than 60 000 deaths and 400 000 new cases annually, with a greater number of deaths among women.

Significantly, the World Health Organization (WHO) has recognized this disease as a global threat, since it is estimated that more than 180 million people with diabetes worldwide, with the likelihood that this figure will increase to more double by 2030. [3]

2 Methodology

The new patient data are captured, including: File No., age, sex, body mass index, waist circumference, history of hypertension and diabetes mellitus, fasting glucose, systolic and diastolic blood pressure. The captured data representing the points of a vector. The system takes the values of 4 records in the database, two records of diabetic patients and two non-diabetic patients. Taking into account the physiological and biological characteristics of man and woman are different, if the new patient is female will be drawn only records of female patients and male otherwise. These data also represent the points of a vector. The system then calculates the distance between the new vector and the other 4 vectors by KNN. The shortest distance is chosen, if it is closest to the vector with DM2 positive, then the system concludes that the new patient is diabetic, otherwise it is not diabetic.

The KNN is described in the following steps:

1. First, each pattern in the training set is classified using k neighbors of the other training patterns set.
2. If the classification obtained is different from the original, the model is excluded from the training set. Thus, a new, smaller set of training is obtained.
3. The test patterns are classified using the 1-NN rule and the new training set derived in step 2. [4]

The criteria for defining whether a subject has diabetes are:

1. Fasting capillary glucose $>$ 126 mg / ml or blood glucose levels at any time of day $>$ 200 mg / ml.
2. Systolic blood pressure $>$ 140mmHg or diastolic pressure $>$ 90mmHg.
3. Body mass index $>$ 30 kg/m2, obese, (25 to 29.9 kg/m2 overweight), ($\leqslant$ 24.9 kg/m2, normal weight).
4. The abdominal obesity was identified as the waist circumference of men was greater than 102 cm and women greater than 88 cm. [2]

3 Results

In Tables 1, 2 and 3 use the following nomenclature to describe the characteristics used in the system to determine if a new patient is diabetic or not.

- Sex (1 for women, 2 men's) 1 female Indeed, 2 male
- dm = (history of diabetes mellitus 1 = yes, 2 = no
- ht = (A history of hypertension, 1 = yes, 2 = no)
- gld = (blood glucose
- sis = systolic pressure
- dias = diastolic pressure
- imc = body mass index
- abd = waist circumference

The system resulted in the same diagnosis that the doctor previously performed, so that we can say that the system is effective. The databases used by the KNN are shown in Table 1 and 2.

Table 1 and 2 shows the databases previously assessed by the doctor that were used by the KNN to determine the diagnosis of diabetes in new patients.

Table 3 shows the database with information of new clients with which the system was tested, which were also previously evaluated by the doctor to perform the comparison of results, both the doctor and the system.

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Table 1. Database nondiabetic

Nº	Edad	sexo	dm	ht	imc	abd	sis	dias	gld
1	17	1	2	2	22.5	75	100	65	84
2	18	1	2	1	20	75	97	60	85
3	19	2	2	2	20	84	110	64	80
4	18	2	2	2	24	85	117	95	91
5	19	1	2	2	22	70	94	64	111
6	18	2	2	2	30.5	98	136	80	120
7	19	1	2	2	19.6	77	107	58	81
8	19	2	1	2	23	87	111	72	96
9	18	1	2	2	17.6	102	64	71	94
10	18	1	2	2	19.5	75	93	60	85
11	18	2	1	2	24.1	89	108	58	106
12	19	1	1	1	23.2	84	101	69	91
13	19	2	1	1	21.2	93	102	56	80
14	18	1	1	1	18	71	97	55	117
15	18	2	1	1	22	83	117	57	80
16	18	2	2	2	24	90	107	60	92
19	19	2	2	2	24.3	85	124	60	95
20	18	2	1	2	23	89	124	69	101

Table 2. Database diabetic patients

Edad	sexo	imc	abd	dm	ht	sis	dias	gld
51	1	42.18	95	2	2	120	80	170
36	1	32	90	2	1	110	70	140
36	1	30.11	80	2	2	130	90	135
42	2	31.2	96	2	2	120	70	146
77	2	28	85	2	2	140	80	154

Table 3. Database Tests and results

N°	Age	sex	dm	ht	imc	abd	sis	dias	gld	Medical Diagnosis	Diagnosis System
1	18	1	2	2	19	67	116	86	91	No diabético	No diabético
2	19	1	2	2	21	76	102	68	76	No diabético	No diabético
3	19	1	2	2	29	91	83	60	86	No diabético	No diabético
4	19	1	2	2	22	70	93	54	80	No diabético	No diabético
5	17	2	2	2	27	91	110	69	80	No diabético	No diabético
6	17	1	2	2	26	87	100	71	78	No diabético	No diabético
7	19	2	2	2	22	74	106	53	81	No diabético	No diabético
8	18	2	2	2	26	87	116	62	79	No diabético	No diabético
9	18	1	2	2	23	76	96	63	89	No diabético	No diabético
10	18	1	2	2	24	87	110	70	93	No diabético	No diabético
11	19	1	2	2	22	81	112	63	87	No diabético	No diabético
12	19	1	1	2	26	88	101	57	81	No diabético	No diabético
13	19	2	2	1	27	89	107	65	75	No diabético	No diabético
14	19	2	2	2	19	73	106	57	86	No diabético	No diabético
15	18	1	2	2	19	73	99	59	97	No diabético	No diabético
16	18	1	2	1	25	93	108	68	83	No diabético	No diabético
17	18	1	1	2	20	71	107	84	106	No diabético	No diabético
18	18	1	2	2	21	71	83	48	114	No diabético	No diabético
19	17	1	2	2	21.5	73	103	64	80	No diabético	No diabético
20	18	2	1	1	27	90	128	61	84	No diabético	No diabético
21	32	2	1	2	40.7	82	123	79	324	Diabético	Diabético
22	45	1	2	2	30.2	77	89	80	234	Diabético	Diabético
23	24	1	1	1	38	103	113	93	200	Diabético	Diabético
24	29	1	2	1	37.2	81	117	90	115	Diabético	Diabético
25	18	1	2	2	29	87	111	80	194	Diabético	Diabético
26	34	1	1	2	46	82	99	94	113	Diabético	Diabético
27	56	2	1	2	33.3	87	101	88	187	Diabético	Diabético
28	89	2	1	1	41.9	83	91	99	169	Diabético	Diabético
29	34	1	2	2	35	78	87	87	192	Diabético	Diabético
30	23	1	1	2	41	74	116	74	178	Diabético	Diabético
31	67	1	1	2	50	93	149	75	182	Diabético	Diabético
32	45	1	2	2	32.5	70	137	86	128	Diabético	Diabético
33	67	1	1	2	47	85	154	91	190	Diabético	Diabético
34	56	1	2	1	35	84	132	96	120	Diabético	Diabético
35	37	1	1	2	49	98	109	84	177	Diabético	Diabético

4 Conclusion

The proposed computer system allow the availability of reliable and permanent, and to store the data of each patient and have quick access to them. The system helps the different characters of institutional health care team providing information useful to have a positive impact on the pharmacological control of the disease, prevent acute complications and late complications delay. 35 tests were made which had a result equal to diagnosis by the doctor, so you can say that the AI technique (KNN) used is very efficient. In the medical field rules established are used for diagnosis. AI can help facilitate the work to create programs that are fed by these rules, to make faster diagnoses. We plan to continue forward with this project. Once the first phase will collect more patient data to bring the system to test a larger population.

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