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A New Expert Toolbox System Based C # For Diagnosis Of Brain Diseases

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***Abstract*— The automatic diagnosis systems for many diseases in medical area have recently become important topic. Here, we present an expert toolbox system based C # programming language for diagnosis of brain diseases (BHUS). This expert toolbox system uses forward chaining artificial intelligence method for diagnosis decision procedure and C # programming language. The correct diagnosis rates of this expert toolbox system are tested by using real brain diseases database. The test results demonstrated that this expert diagnosis system can be used to facilitate the work of specialist doctor.**

***Keywords*— Expert system; diagnosis; toolbox; forward chaining method; artificial intelligence; automatic system; C # programming language**

I. INTRODUCTION (*Heading 1*)

In literature, [1] there are many brain diseases. Some of the major types of diseases are neurogenetic diseases, muscular dystrophy, cerebral palsy, Parkinson's disease and Alzheimer's disease, Gaucher's disease, cerebrovascular diseases, eg. stroke and vascular dementia, trauma, eg. spinal cord and head injury, convulsive disorders, eg. epilepsy, infectious diseases, eg. AIDS dementia, and brain tumors.

A low power view of cerebral cortex stained with the Bodian silver method to bring out the senile plaques of Alzheimer's disease [2]. The cause of Alzheimer's disease is unknown. May be due to deposition of amyloid in the parenchyma of the brain which is toxic to neurons and oligodendroglia. An alternative hypothesis is that deposition of amyloid is a secondary effect. The amyloid deposition is thought to be due to an abnormality in the amyloid precursor protein.

A low power photomicrograph of an abscess with a central region filled with neutrophils, macrophages and dead edema [3]. This is surrounded by an area of less severe inflammation with proliferation of fibroblasts and reactive astrocytes trying to wall off the abscess from the rest of the brain. An abscess arises from septic emboli or direct exposure of the brain to outside organisms through head trauma or erosion of an infection through the bone as in sinusitis and mastoiditis. Both bacteria and fungi can cause abscesses.

A coronal section of the brain through the level of the midbrain showing agenesis or lack of development of the corpus callosum during intrauterine life [4]. Can be associated with mental retardation or seizures depending on other accompanying malformations. Patients can be of normal intelligence but lack ability to transfer information from one hemisphere to the other. Both genetic and sporadic.

Infant missing skull and cerebral hemispheres - anencephaly

Also note the cleft lip and palate and scoliosis [5]. Anencephaly is due to failure of the anterior neural tube to close properly during very early intrauterine life.

Mothers with infants having neural tube defects have high levels of alpha feto-protein.

Normal artery wall with slightly thickened intima, internal elastic lamina (arrows) and well organized smooth muscle in the media with a thin adventitia [6]. The berry aneurysm is a small, saclike structure at the branchpoints of arteries with a wall which does not contain a media or internal elastic lamina and therefore can easily rupture during periods of hypertension or stress. Most commonly ruptures when the patient is 40-60 yrs.

A low power photomicrograph of the cerebral cortex, showing shrunken, reddish neurons typical of neuronal ischemic change [7]. These changes may be seen after prolonged cardiac arrest before resuscitation. To see this change, patients must have lived 6 - 12 hours after the arrest. Anoxia is due to lack of oxygen transport to the brain

It may be due to exposure to CO or CN which bind with hemoglobin to form compounds which do not allow oxygen to be transported, pulmonary disease, cardiac disease or cardiac and/or respiratory arrest. Severe blood loss can also lead to anoxia of the brain.

This is the back of an infant with the spinal canal open to show the cerebellar tonsils herniating through the foramen magnum- a characteristic of Arnold-Chiari malformation [8]. This may be due to a small posterior fossa and is usually seen in infants with meningomyelocoele. Both Chiari type I and II may be due to a malformed posterior fossa.

A low power view of a cerebellar astrocytoma, showing a mildly hypercellular white matter [9]. This is the most common posterior fossa tumor of children. The other two posterior fossa tumors of childhood are medulloblastoma and ependymoma.

One half of a coronal section of the brain at the level of the lenticular nucleus and internal capsule, resting on its side [10]. Note the marked widening of the sulci and narrowing of the gyri and markedly enlarged lateral ventricle. This is a case of severe atrophy due to Battens disease, a ceroid-lipofuscinosis which produces what is known as hydrocepholus ex vacuo; that is, enlarged ventricles due to loss of parenchymal tissue. Cerebral atrophy, that is, widening of the sulci and narrowing of the gyri, can be seen after many types of damage to the brain such as chronic HIV infection, ischemic infarcts, and old trauma. It can also be seen with aging, degenerative diseases such as Alzheimer's disease and multiple sclerosis and chronic disease. Dilatation of the ventricles accompany the gyral changes.

Part of a coronal section through the foramina of Monro showing a colloid cyst of the third ventricle [11]. Colloid cysts can intermittently obstruct the foramina causing severe headaches or can become impacted in the third ventricle causing acute hydrocephalus and herniation. Colloid cysts are said to arise from Rathke's pouch.

The coronal sections above show a defect in the inferior temporal lobe and occipital lobe, probably due to a traumatic contusion [12]. Contusions are usually due to movement of the brain in the skull during the trauma. Such injuries result in a scraping of the inferior aspect of the brain over the petrous temporal and orbital surface of the frontal bones.

A low power view of a loose "spongy" or vacuolated white matter which can be around a tumor, infarct or be due to a metabolic disease [13]. May be due to tumor, trauma, infection, metabolic disease, vascular disease or toxins.

An infant with a portion of brain protruding out from his occipital region in a skin covered sac [14]. This is called an encephalocele. An encephalocele is a neural tube defect of lesser severity then anencephaly. Failure of the anterior neural tube to close for genetic, toxic or infectious reasons.

A high power photograph of a very cellular, pleomophic brain tumor known as the glioblastoma multiforme [15]. This tumor makes up 50% of gliomas and is highly malignant.

The survival time is 6 months to a year after diagnosis, even with radiation and chemotherapy. The exact etiology is not known but has to do with several mutations in protooncogenes and tumor suppressor genes. Some appear as a part of several hereditary syndromes such as neurofibromatosis or Turcot's syndrome.

A coronal section through the cerebellum and pons [16]. The hemorrhagic areas represent partly the tumor - a hemangioblastoma - as well an attempt to resect the tumor. Note the swelling of the cerebellum and distortion of the pons. The hemangioblastoma is made up of numerous capillaries and larger abnormal blood vessels as well as characteristic small foamy cells. Can occur sporadically or in Von Hippel-Lindau's disease where they are multiple.

The leptomeninges [17] represents subarachnoid hemorrhage from a ruptured berry aneurysm. Most common cause of subarachnoid hemorrhage outside of trauma is a ruptured berry aneurysm. The berry aneurysm is a small, saclike structure at the branchpoints of arteries with a wall which does not contain a media or internal elastic lamina and therefore can easily rupture during periods of hypertension or stress. Most commonly ruptures when the patient is in his 40's or 50's. Low power view of a small old cystic cerebral infarct containing glial and vessel remnants [18]. Near the borders of the infarct, there are reactive astrocytes (arrows) and macrophages. Infarcts are due to the occlusion of an artery of the Circle of Willis or one of its branches or a vein by a thrombus or embolus.

Low power photomicrograph of a high grade large cell lymphoma of the brain, probably of B cell origin [19]. The neoplastic cells loosely infiltrate the brain. Lymphomas of the brain are seen most often in AIDS but are also seen as the cause of 1-2% of brain tumors. The etiology of lymphoma is unknown in normal people. It appears to be related to the to the Epstein Barr virus in immunosuppressed patients such as those with AIDS.

Coronal section through this brain shows the cortex to be thrown into numerous small gyri characteristic of polymicrogyria [20]. Note the enlarged ventricles and small size of the white matter. These patients are usually retarded and may have seizures or other neurologic findings. In literature, there are many studies of brain diseases diagnosis. In these studies, some artificial intelligence methods such as neural network were used [21-23].

In this study, a promising diagnosis toolbox system based C # for brain diseases (BHUS) is introduced. Here eight different brain diseases are diagnosed. These disorders are prolaktinoma, akromegali, gigantizm, TSH oma, pituitary adenoma, non functional pituitary adenoma, astrositoma, and adenoma with ACTH secretion. The symptoms of these disorders are shown in Table 1:

TABLE I. THE USED BRAIN DISORDERS AND SYMPTOMS OF THESE DISORDERS.

Disorders	Symptom 1	Symptom 2	Symptom 3	Symptom4	Symptom 5	Symptom6	Symptom 7
Prolaktinoma	galaktore	amenore	Infertilite	Headache	visual disorder	gybecomastia	
Akromegali	Hand and foot growth in	Age>18	Teeth in the range of opens	hypertension	headache	gybecomastia	visual disorder
Gigantizm	Hand and foot growth in	Age<18	Headache	gybecomastia	visual disorder		
TSH oma	Goitre	palpitation	visual disorder	Headache	Too much sweating		
Pituitary adenoma	visual disorder	Headache	Amenore	infertility	To the answer trh stimulation		
Non functional pituitary adenoma	Headache	visual disorder	nausea	infertility			
Astrositoma	nausea	Morning headache	visual disorder	Loss of consciousness	Early death	Respiratory depression	
Adenoma with ACTH secretion	Plenty of acne	Of brown	weight gain	Headache	visual disorder	nausea	

II. FORWARD CHAINING METHOD

In this study, used forward chaining is one of the two main methods of reasoning when using inference rules in artificial intelligence. The forward chaining is referred in philosophical circle as modus ponens. The opposite of forward chaining is backward chaining [24].

Used forward chaining starts with the available data. Then, it uses inference rules to extract more data until a goal is reached. Generally, an inference engine using forward chaining searches the inference rules until it finds one where the antecedent (If clause) is known to be true. When found forward chaining method can conclude, or infer, the consequent (Then clause), resulting in the addition of new information to its data.

This inference engines will iterate through this process until a goal is reached. For instance, suppose that the goal is to conclude the color of a pet named Ezgi, given that he croaks and eats flies, and that the rule base contains the following four rules:

1. If X croaks and eats flies - Then X is a frog
2. If X chirps and sings - Then X is a canary
3. If X is a frog - Then X is green
4. If X is a canary - Then X is yellow

This rule base would be searched and the first rule would be selected, because its antecedent (If Ezgi croaks and eats flies) matches our data. Now the consequents (Then X is a frog) is added to the data. The rule base is again searched and this time the third rule is selected, because its antecedent (If Ezgi is a frog) matches our data that was just confirmed. Now the new consequent (Then Ezgi is green) is added to our data. Nothing more can be inferred from this information, but we have now accomplished our goal of determining the color of Ezgi.

The data determines which rules are selected and used; this method is called data-driven, in contrast to goal-driven backward chaining inference. The forward chaining approach is often employed by expert systems. The reception of new data can trigger new inferences, which is one of the advantages of forward-chaining over backward-chaining. It makes the engine better suited to dynamic situations in which conditions are likely to change.

III. THE PRESENTATION OF DEVELOPED EXPERT INTERFACE SYSTEM

In this study, the presented expert toolbox system based C # programming language for diagnosis of brain diseases (BHUS) has three stages. These stages are identity information, symptoms (symptoms-1 and symptoms-2), and query (searching). In below, these stages of BHUS are explained respectively:

Stage-1: Identity Information

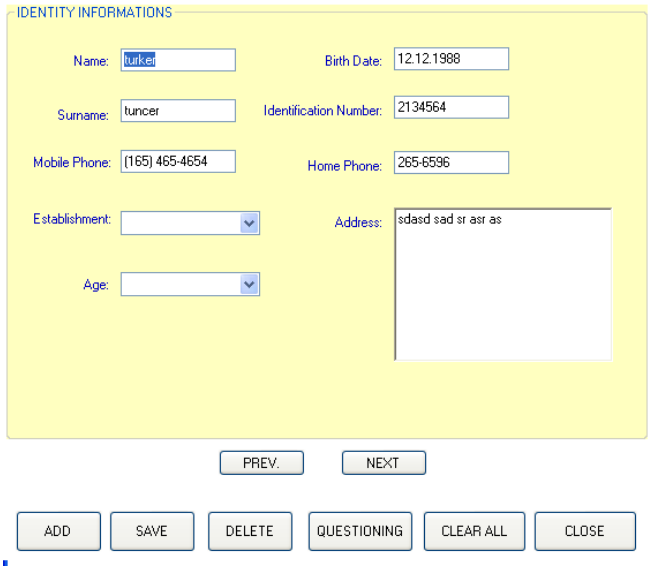

Fig. 1. *The identity information window of BHUS.*

In this stage, identity information of patient is entered into database of BHUS. As shown in Fig.1, this identity information of patient are name, surename, birth date, identification number, mobile phone, home phone, establishment, address, age, etc.

Stage-2: Symptoms (Symptoms-1 and Symptoms-2)

In this stage, symptoms values of prolaktinoma, akromegali, gigantizm, TSH oma, pituitary adenoma, non functional pituitary adenoma, astrositoma, and

adenoma with ACTH secretion disorders are entered into database of BHUS. These symptoms are given in Table-1 and in Figs.2-3. The symptoms of each of these disorders are different from others. In symptoms windows (symptom-1 and symptom-2), there are many buttons. These buttons are delete, save, questioning, clear all, close, prev., and next. The task of these buttons can be explained in below:

- Delete Button: This button deletes previously kept records and information.
- Save Button: This button saves new records and information.
- Questioning Button: This button gives the result of diagnosis according to the entered information.
- Clear all Button: This button deletes all filled information area.
- Close Button: This button closes all windows of this BHUS program.
- Prev. Button: This button opens previous window of BHUS program.
- Next Button: This button opens next window of BHUS program.

The top menu allows to you changing the background color and opacity of the form.

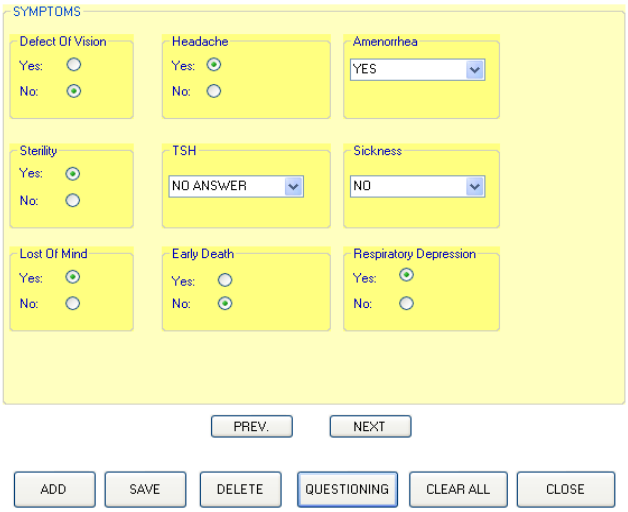

Fig. 2. *Symptom-1 window of BHUS.*

This BHUS expert diagnosis program provides very important benefits to specialist doctor for diagnosis of brain diseases. You can receive as a result output from the printer by using this BHUS program. Moreover you can store results of diagnosis into database of BHUS expert program.

Fig. 3. *Symptom-2 window of BHUS.*

Stage-3: Query (Searching)

After all values of information and symptoms are entered to database of BHUS expert system for each of patients, the query process is realized by pressing the questioning button. Thus, the results of diagnosis for these entered information and symptoms of any patient and the result of diagnosis, which has most high percentage, are seen in search area and diagnostic area respectively.

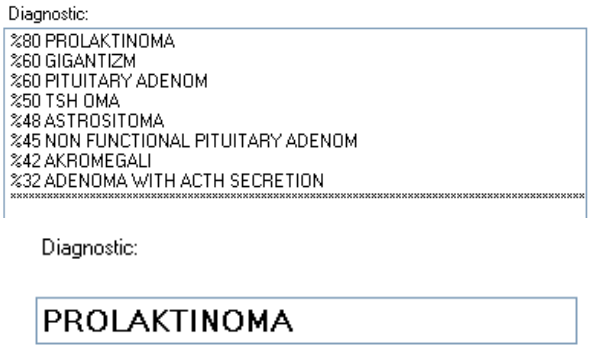

Fig. 4. *Query window of BHUS.*

IV. Experimental Studies

The correct diagnosis rates of this expert toolbox system based C # programming language (BHUS) are tested by using real brain diseases database. The real information and symptom of total 100 patients were used. The obtained correct diagnosis rates of this expert interface system (BHUS) are given in Table 2.

TABLE II. The obtained correct diagnosis rates of this expert interface system (BHUS).

Disorders	The number of correct diagnosis	The number of fault diagnosis	The percentage of correct diagnosis (%)
Prolaktinoma	10	4	71.42
Akromegali	12	3	80
Gigantizm	11	2	84.61
TSH oma	9	3	75
Pituitary adenoma	8	3	72.72
Non functional pituitary adenoma	10	2	83.33
Astrositoma	8	3	72.72
Adenoma with ACTH secretion	10	2	83.33
TOTAL	**78**	**22**	**77.89**

The test results demonstrated that this expert diagnosis system can be used to facilitating the work of specialist doctor.

V. CONCLUSIONS AND RESULTS

In this study, BHUS expert toolbox system based C # programming language for brain diseases was used. Then, performance evaluation techniques [25-29] were applied to obtained correct diagnosis rates of this expert toolbox system based C # programming language (BHUS). This expert toolbox system uses forward chaining artificial intelligence method for diagnosis decision procedure and C # programming language. The correct diagnosis rates of this expert toolbox system are tested by using real brain diseases database. As shown from these results, the BHUS expert diagnosis system for brain diseases obtains very promising results in diagnosis the possible brain patients. Therefore, the developed BHUS system can be very helpful to the specialist doctors for their final decision on their patients. The specialist doctors can perform very accurate decisions by using such an efficient tool.

The results show that BHUS based forward chaining artificial intelligence method can assist in the diagnosis of brain diseases. In future studies of brain diseases diagnostic, different brain disease types and artificial intelligence methods will be used for increasing of correct diagnosis rate.

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