

# Expert System for the Diagnosis of High Blood Pressure Diseases

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**Abstract: Background: High Blood Pressure:** is the force exerted by your blood as it flows through your body's arteries. Arteries are blood vessels that transport blood from the heart to the rest of the body. When your heart beats, blood is pushed through your arteries. As blood flows, it exerts pressure on the artery walls. This is referred to as blood pressure. When your blood flows through your arteries at a higher pressure than normal, you have high blood pressure. High blood pressure can be caused by a variety of factors. If your blood pressure becomes too high or remains too high for an extended period of time, it can lead to health problems. Uncontrolled high blood pressure increases your chances of having a stroke, heart disease, a heart attack, or kidney failure. **Objectives:** The main objective of this expert system is to assist medical professionals in detecting high blood pressure diseases and solutions. **Methods:** In this paper the design of the proposed Expert System which was produced to help medical professionals in diagnosing many of the high blood pressure. The proposed expert system presents an overview about high blood pressure diseases are given, the cause of diseases are outlined and the treatment of disease whenever possible is given out. E-clips Expert System language was used for designing and implementing the proposed expert system. **Results:** The proposed high blood pressure diseases diagnosis expert system was evaluated by group of medical professionals and they were satisfied with its performance. **Conclusions:** The Proposed expert system is very useful for medical professionals in diagnosing high blood pressure diseases and treatment it whenever possible is given.

**Keywords:** Expert System, CLIPS, Delphi, high blood pressure, Diseases

## 1. INTRODUCTION:

High blood pressure (HBP): indicates that the pressure in your arteries is higher than normal. Hypertension is another term for high blood pressure. High blood pressure raises the population's risk of disease and death. It is a major public health concern as a clinical risk factor, accounting for the third largest proportion of disability-adjusted life years lost globally after dietary factors and cigarette smoking. The heart circulates blood throughout the body, and its beating causes blood pressure to rise and fall.

The peaks are referred to as systolic, while the troughs are referred to as diastolic. Blood pressure is measured in systolic/diastolic units, such as 140/90 mmHg (pressure equivalent of millimeters of mercury). Blood pressure measurement is an important consideration because it necessitates a certain level of skill, an appropriate setting, and well-maintained and calibrated equipment. At least two readings should be used to make a measurement. When the force of the blood pushing on the blood vessel walls becomes excessive. When someone has high blood pressure, the heart has to work harder to pump blood. As blood flows away from the heart, the arteries (blood vessels that carry blood away from the heart) are put under greater strain.



**Fig 1:** Diagnosis of High Blood Pressure

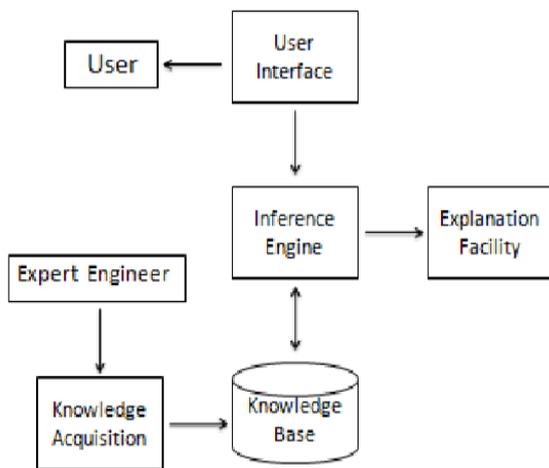
Blood pressure is determined by the amount of blood pumped out by the heart and by the level of resistance to blood flow in the arteries. The more blood the heart pumps and the narrower the arteries, the higher the blood pressure. To detect and treat hypertension, blood pressure is measured with a special device consisting of an inflatable bracelet that is wrapped around the arm (to reduce blood flow), a mechanical mercury pressure gauge, a bellows and a control design.

The measurement results shall be in units of millimeters of mercury (mm Hg), and these results include two values: The first, or highest, number - measures the pressure in the arteries when the heart muscle contracts while it is beating (systolic pressure). The second, or lower, number - measures the pressure in your arteries between beats (diastolic pressure).

Blood pressure is measured the normal systolic pressure for middle-aged adults ranges from 90 to 140 millimeters of mercury, the diastolic pressure ranges from 60 to 90 millimeters of mercury, and the average pressure is 120

millimeters of mercury. When the heart muscle contracts, it pushes blood into the aorta, which expands sideways to allow blood to pass through, and the blood pressure of the blood vessels through which it passes is known as systolic pressure in this condition. Globally, between 16 and 37 percent of the population suffers from high blood pressure. In 2010, it was estimated that hypertension was a factor in 18% of all deaths (9.4 million globally).

**2. EXPERT SYSTEMS IN HEALTH:** Expert systems have a wide range of applications. They are best suited in situations where an expert is unavailable. In order to create an expert system, Domain expert knowledge must be extracted. This information is then converted into a computer program. The Knowledge Engineer is in charge of extracting knowledge from domain experts. The most well-known type of knowledge-based system is rule-based expert systems. The knowledge is represented using IF-THEN rules. Figure 2 depicts various modules for a rule-based expert system.



**Fig 2:** Components of an expert system

The proposed expert system for of High Blood Pressure problems diagnosis was designed and implemented using CLIPS. CLIPS stands for C Language Integrated Production System. CLIPS public domain software tool for building expert systems. CLIPS is probably the most widely used expert system tool. CLIPS itself is written in C, extensions can be written in C, and CLIPS can be called from C. Its syntax resembles that of the programming language Lisp. CLIPS incorporates a complete object-oriented language for writing expert systems. COOL combines the programming paradigms of procedural, object oriented and logical (theorem proving) languages.

**3. Causes and types of blood pressure:**

Blood pressure is a measurement of the force of blood pushing against the walls of blood vessels. The heart pushes blood into blood vessels, which transport it throughout the body. High blood pressure, also known as hypertension, is dangerous because it causes the heart to work harder to pump blood out to the body and contributes to atherosclerosis, stroke, kidney disease, and heart failure A blood pressure reading is written like this: 120/80. It's read as "120 over 80."

The top number is called the systolic, and bottom number is called the diastolic. The ranges are:

Normal: Less than 120 over 80 (120/80)

Elevated: 120-129/less than 80

Stage 1: high blood pressure: 130-139/80-89

Stage :2high blood pressure: 140 and above/90 and above

Hypertension crisis: higher than 180/higher than 120 -- See a doctor right away

If your blood pressure is above the normal range, talk to your doctor about how to lower it.

**4. Blood pressure is a measurement:**

There are two types of blood pressure measurements: systolic blood pressure (the highest pressure on blood vessels when the heart pushes blood out) and diastolic blood pressure (the lowest pressure on blood vessels when the heart pushes blood out) (the lowest pressure on blood vessels when the heart relaxes between beats). Both are measured in millimetres of mercury (mmHg) and are frequently expressed as a systolic/diastolic ratio (e.g., 120/80 mmHg). In general, blood pressure should be between 90/60 mmHg and 120/80 mmHg. High blood pressure (also known as hypertension) is commonly defined as a reading of 140/90mmHg or higher and is a risk factor for many diseases, particularly heart disease

| Blood Pressure Category                | Systolic (mmHg) | Diastolic (mmHg) |
|--|-----------------|------------------|
| Low blood pressure                     | <90             | <60              |
| Optimal                                | 90-120          | 60-80            |
| Normal                                 | 120-129         | 80-84            |
| High normal (elevated/prehypertension) | 129-139         | 85-89            |
| High blood pressure (hypertension)     | ≥140            | ≥90              |

**Fig 3:** Blood Pressure Category

**5. MATERIALS AND METHODS**

The expert system can diagnose High Blood Pressure by displaying all symptoms in a list and selecting one to analyze the disease. The expert system will prompt the user to select from a list of human symptoms. Then, on the day of recognizing symptoms, click the analyze button to diagnose the day of survival and spread, favorable conditions, and a snapshot of the status. The expert system was created to allow you to change the theme of the user interface, such as font color, background color, font name, and font size. It may also have a form that displays a specific format. Figure 4 shows, for example, the expert system's basic data, such as name and image.

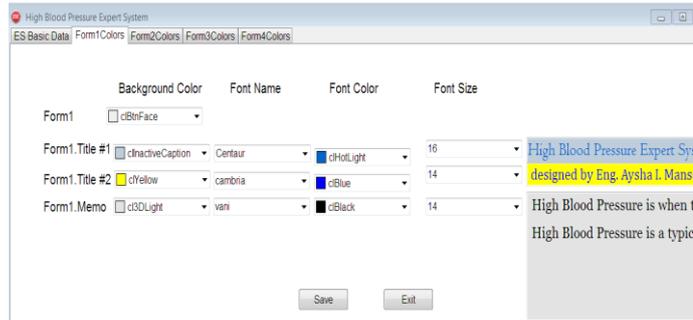


Figure 4: Display the basic data for expert system

Figure 5 shows the format of the first user interface, which includes the name of the expert system, who designed it, and some background information about the system.

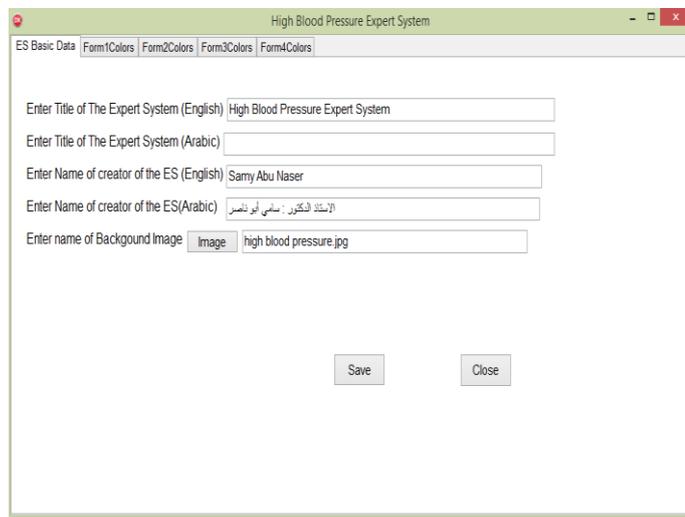


Figure 5: Display format of the main page in expert system

Figure 6 depicts the format of the symptoms screen, which displays all symptoms in the list.

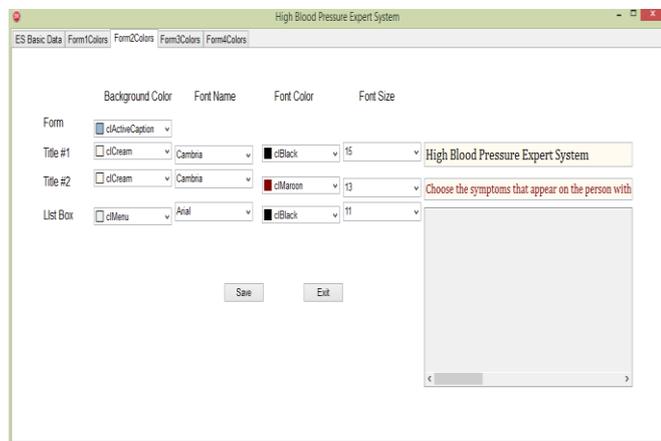


Figure 6: Display format of selection symptoms.

Figure 7 depicts the format of a result screen that includes all details about the disease's diagnosis.

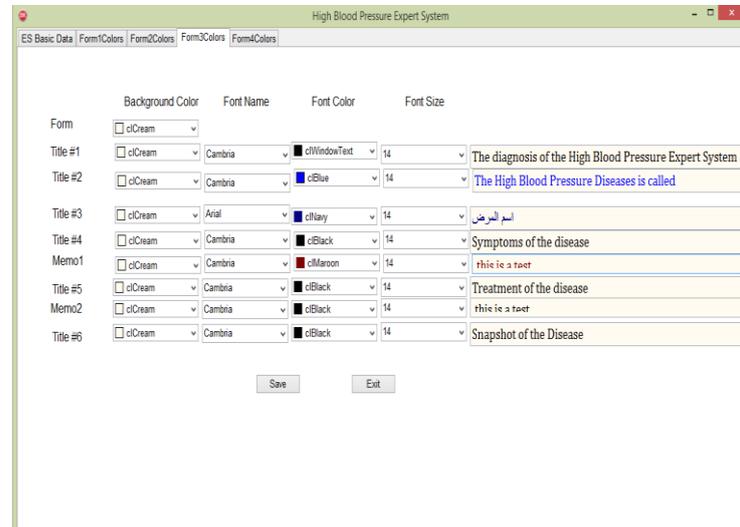


Figure 7: Display format of details screen of disease

Figure 8 depicts the format of a screen for entering disease information

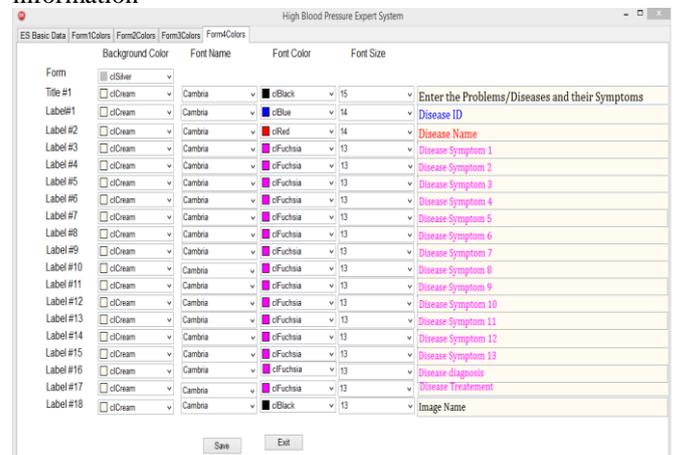
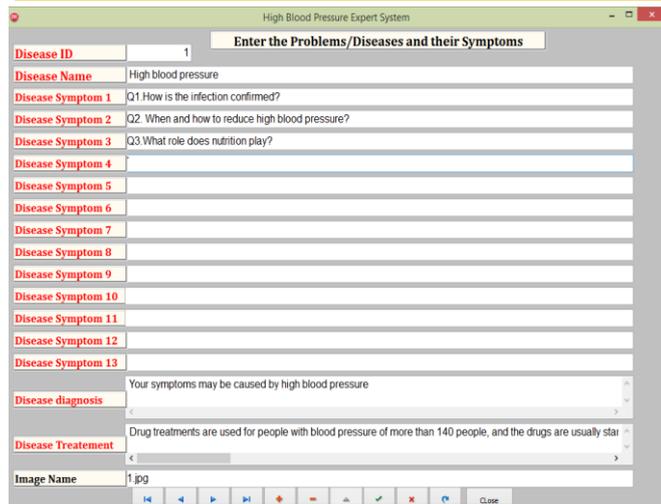


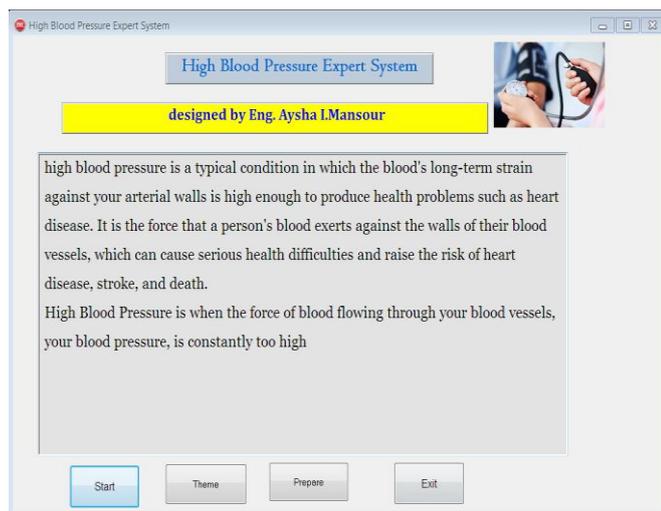
Figure 8: Display the format of entering diseases details

Figure 9 depicts the format of a screen for entering symptom details on each day of disease occurrence



**Figure 9:** Display the format of entering diseases and symptoms details

In the Figure 10 display the main page of the high blood pressure expert system include the details and the important of the high blood pressure expert system.



**Figure 10:** Main page of castor expert system

**6. LITERATURE REVIEW:**

There are numerous expert systems designed to diagnose health and other types of diseases. However, there is no free expert system for diagnosing high blood pressure diseases. despite the fact that many diseases have similar symptoms. The proposed expert system was created specifically to aid medical professionals in the diagnosis of high blood pressure diseases.

**7.KNOWLEDGE REPRESENTATION:**

The main sources of the knowledge for this expert system are medical and specializes websites for high blood pressure diseases. The captured knowledge has been converted into CLIPS Knowledge base. Symptoms of high blood pressure are:

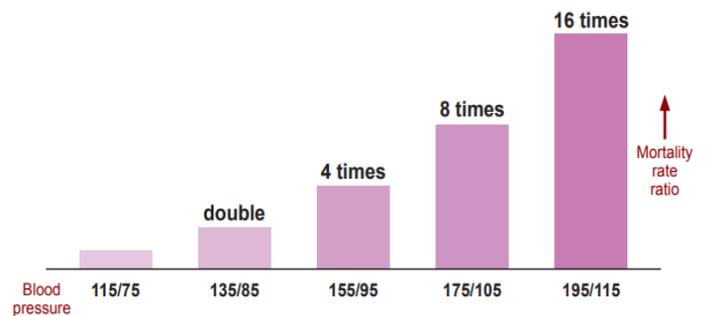
- Feeling severe headache, especially in the area at the back of the head from the neck.

- Feeling very dizzy and unsteady in movement.
- Severe neck pain.
- shortness of breath.
- Patients with high blood pressure may experience nosebleeds.

**A.Cardiovascular disease:**

As blood pressure rises, so does the risk of dying from cardiovascular disease.

- The graph below depicts blood pressure above 155/95 mmHg, which results in a fourfold increase in the risk of death from heart disease, an eightfold increase at 175/105, and a sixteen fold increase at 195/115.

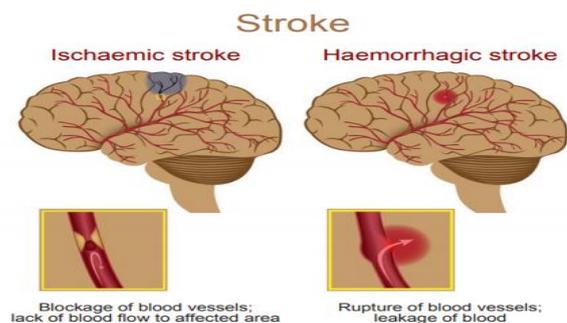


**Fig 11:** Cardiovascular disease

**B. Stroke:**

Stroke is a cerebrovascular disease that occurs when there is spontaneous vascular bleeding (cerebral haemorrhage) or when blood vessels become blocked.

- You are likely to lose consciousness, which could result in paralysis.



**Fig 12:** Stroke

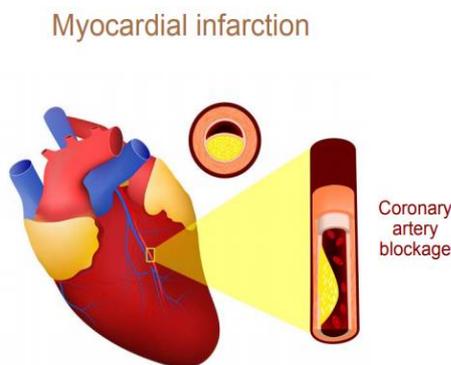
- When blood pressure exceeds 160/100 mmHg, the risk of cerebral haemorrhage increases 4.3-fold.
- If the patient exhibits any of the symptoms listed below, it is critical that a local emergency number be dialed or that the patient be taken to the hospital.
- Treatment is often critical within three hours of the onset of the following symptoms:

- Sudden weakness or numbness in the face, hand, legs, or any part of the body
- Sudden difficulty speaking or feeling confused.
- Sudden loss of vision.
- Difficulty walking, dizziness, or poor sense of direction.
- Sudden onset of severe headache without reason.

**c. Myocardial infarction:**

Myocardial infarction and heart failure are caused by hypertension.

A myocardial infarction, also known as a heart attack, occurs when the heart muscle fails to contract properly due to a blockage of the vessels that supply the heart muscle. Heart failure occurs when there is insufficient blood supply to the body as a result of deterioration in heart function.



**Fig 13:** Myocardial infarction

When blood pressure is not controlled, the risk of a myocardial infarction triples, and the risk of heart failure quadruples.

If a patient exhibits any of the following symptoms, they should seek immediate medical attention:

- Chest discomfort, pressure in the chest, or pain in the sternum that lasts several minutes.
- Pain radiating to the shoulder, neck, or arm.

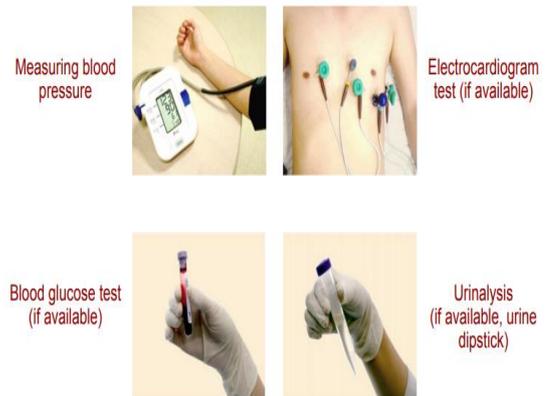
Dizziness, difficulty breathing, fever, or nausea, accompanied by chest pain.

**Regular check-ups for hypertension:**

To avoid complications, it is critical to maintain a healthy lifestyle, visit the hospital on a regular basis, and take medication on a consistent basis.

Regular check-ups are also required to avoid complications.

Annual blood and urine tests, as well as regular tests to detect any damage to the eyes, heart, or kidneys, should be performed.



**Fig 14:** Regular check-ups for hypertension

- Routine hypertension tests include: hemoglobin/hematocrit, sodium, potassium, glomerular filtration rate, and uric acid.
- Fasting blood glucose levels, as well as a fasting lipid profile
- Liver function test
- Urine analysis (proteinuria, hematuria, albumin/creatinine ratio)

**Possible causes of uncontrolled blood pressure:** Consult your doctor if your blood pressure does not remain below 140/90 mmHg.

Common causes include incorrect blood pressure measurement, lifestyle issues (obesity, excessive alcohol consumption, and sleep apnea), excessive body fluid due to high salt intake, poor adherence to prescribed medication, inappropriate prescription, and drug interaction (nonsteroidal anti-inflammatory drugs, steroids, and oral contraceptives).



- Non-adherence to prescribed medicine
- Taking other medicines that can interfere with your hypertension treatment (nonsteroidal anti-inflammatory drugs, steroids, oral contraceptives, etc.)
- Excessive salt intake
- Binge drinking or otherwise harmful use of alcohol
- Sudden weight gain and sleep apnoea

**Fig 15:** Possible causes of uncontrolled blood pressure

**Conclusion:**

In this paper, a proposed expert system was designed and developed using Clips expert systems language in order to help physicians and parents in diagnosing their high blood Pressure problems in an easier and more precise way than before. This expert system is simple, fast and easy to use.

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