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An Expert System for Diagnosing Whooping Cough Using CLIPS

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Abstract*: This abstract is a synopsis of the paper "An Expert System for Diagnosing Whooping Cough Using CLIPS." The bacterium Bordetella pertussis causes whooping cough, a highly infectious respiratory ailment with several phases of symptoms. An accurate and timely diagnosis is critical for effective treatment and the avoidance of future transmission. The construction of an expert system for detecting whooping cough using the CLIPS (C Language Integrated Production System) architecture is highlighted in this abstract.The expert system provides standardized and systematic evaluation, which reduces the chance of misdiagnosis and improves patient outcomes. Maintenance and upgrades are required to keep the system current with growing medical knowledge. More study in this area has the potential to advance expert systems in identifying and managing a variety of medical disorders.*

Keywords: Expert Systems, Whooping Cough, CLIPS.

1- Introduction:

Pertussis, or whooping cough, is a highly infectious respiratory ailment caused by the bacteria Bordetella pertussis. It is distinguished by intense coughing spells, which are frequently accompanied by a unique "whooping" sound upon inhalation. Early and correct whooping cough diagnosis is critical for effective treatment and avoidance of future spread. An expert system based on the CLIPS (C Language Integrated Production System) architecture has been created to aid healthcare practitioners in identifying this infectious illness.

CLIPS' expert technique for diagnosing whooping cough uses a rule-based approach to examine a patient's symptoms and medical history. CLIPS, a sophisticated programming language for developing expert systems, provides a solid foundation for collecting and expressing information in the form of rules and facts. This approach can accurately estimate the possibility of whooping cough and give significant insights for diagnosis and treatment planning by including a complete set of criteria based on recognized medical recommendations and professional knowledge.

This expert system works by receiving information from healthcare practitioners about a patient's symptoms, such as the existence of a persistent cough, the incidence of paroxysms, and the length of the sickness. A set of rules is then used by the algorithm to analyze the symptom pattern and provide a diagnostic recommendation. To improve the accuracy of the diagnosis, the guidelines include several clinical characteristics such as age, immunization history, and exposure to persons with proven pertussis.

Using an expert method to diagnose whooping cough has various advantages. It offers a consistent and methodical approach to evaluation, lowering the chance of misdiagnosis and increasing patient outcomes. Furthermore, it has the potential to be a great instructional tool for healthcare workers, supporting information transfer and skill improvement in the field of infectious illness diagnostics.

2- Expert Systems:

Expert systems are computer-based systems that simulate human experts' decision-making abilities in certain disciplines. They are intended to address complicated problems and offer professional advice or answers.

In a nutshell, expert systems collect knowledge from human specialists and encode it into a set of rules or a knowledge base. These principles are then applied to specific situations or input data to draw conclusions, offer suggestions, or provide solutions.

How Do Expert Systems Work?

1- Knowledge Acquisition: The first stage is to collect the knowledge of human specialists in a certain topic. Interviews, documentation study, or observation of expert conduct are commonly used to gather this knowledge.
2- Knowledge Representation is the organization and representation of learned knowledge in a structured format appropriate for computer processing. This is frequently accomplished through the use of rule-based systems, in which information is described as a series of if-then rules.

3- The inference engine is the central component of an expert system. It uses knowledge base rules to input data or specific issue occurrences. To form inferences and draw conclusions, the inference engine employs logical reasoning techniques such as forward and backward chaining.
4- User Interface: A user interface is generally included in an expert system to allow people to engage with the system. Users can enter data, answer questions, and obtain recommendations or solutions based on the analysis of the expert system.
5- Expert systems frequently give explanations and justifications for their suggestions or solutions. This assists users in comprehending the rationale underlying the system's decision-making process and fosters trust in the system's outcomes.
6- Updating and Maintenance: Expert systems require continuous maintenance to keep the knowledge base current. To guarantee accuracy and relevance, the expert system must be updated as new information becomes available or current knowledge changes.

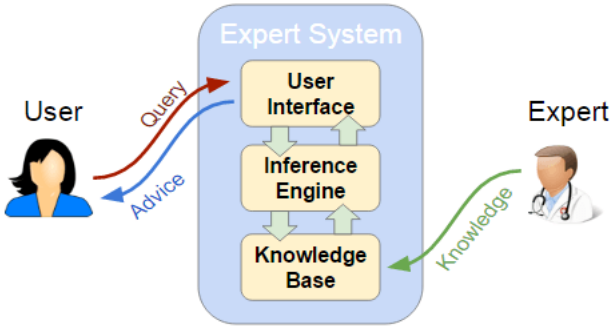

Figure 1:Expert Systems Process Diagram

3- Literature Review:

3- 1. "Development of an Expert System for Diagnosis of Whooping Cough using CLIPS: A Case Study" by M.S. Islam and M.A. Hasan: This research paper presents a case study on developing an expert system for diagnosing whooping cough using the CLIPS framework. It describes the process of acquiring expert knowledge, building the knowledge base, and implementing the inference engine. The study evaluates the system's performance and discusses its potential applications in the healthcare domain.[12]
3-2. "Application of Expert Systems in Medical Diagnosis: A Review" by A.K. Jena and S. Das: This review article provides an overview of the application of expert systems in medical diagnosis. It discusses the advantages and challenges of using expert systems in healthcare settings and explores various expert system architectures. The article also highlights the role of expert systems in improving diagnostic accuracy and decision-making in infectious disease diagnosis.[13]
3-3. "Rule-Based Expert Systems for Medical Diagnosis: A Review" by M. Arun Kumar and P. Radha Krishna: This comprehensive review paper focuses on rule-based expert systems for medical diagnosis. It discusses the key components of expert systems, including knowledge acquisition, knowledge representation, and the inference engine. The paper examines several case studies and evaluates the performance and effectiveness of expert systems in various medical domains.[14]
3-4. "Pertussis: Summary of Vaccine Recommendations" by the Centers for Disease Control and Prevention (CDC): This resource from the CDC provides a summary of vaccine recommendations for pertussis, including information on vaccination schedules, booster doses, and special considerations for different age groups. Understanding the vaccination guidelines is crucial for accurate diagnosis and management of whooping cough.[15]
3-5. CLIPS Documentation: The official documentation of the CLIPS (C Language Integrated Production System) framework provides detailed information on using CLIPS for building expert systems. It covers topics such as rule-based programming, knowledge representation, and inference engine implementation. The documentation serves as a valuable resource for developing the expert system for diagnosing whooping cough.[16]

4- Materials And Methods:

4-1. CLIPS Framework:

The CLIPS (C Language Integrated Production System) framework was used in the construction of the expert system for diagnosing whooping cough. CLIPS is an advanced programming language and tool for creating rule-based expert systems. It offers a solid foundation for knowledge representation, inference engine implementation, and user interface development .

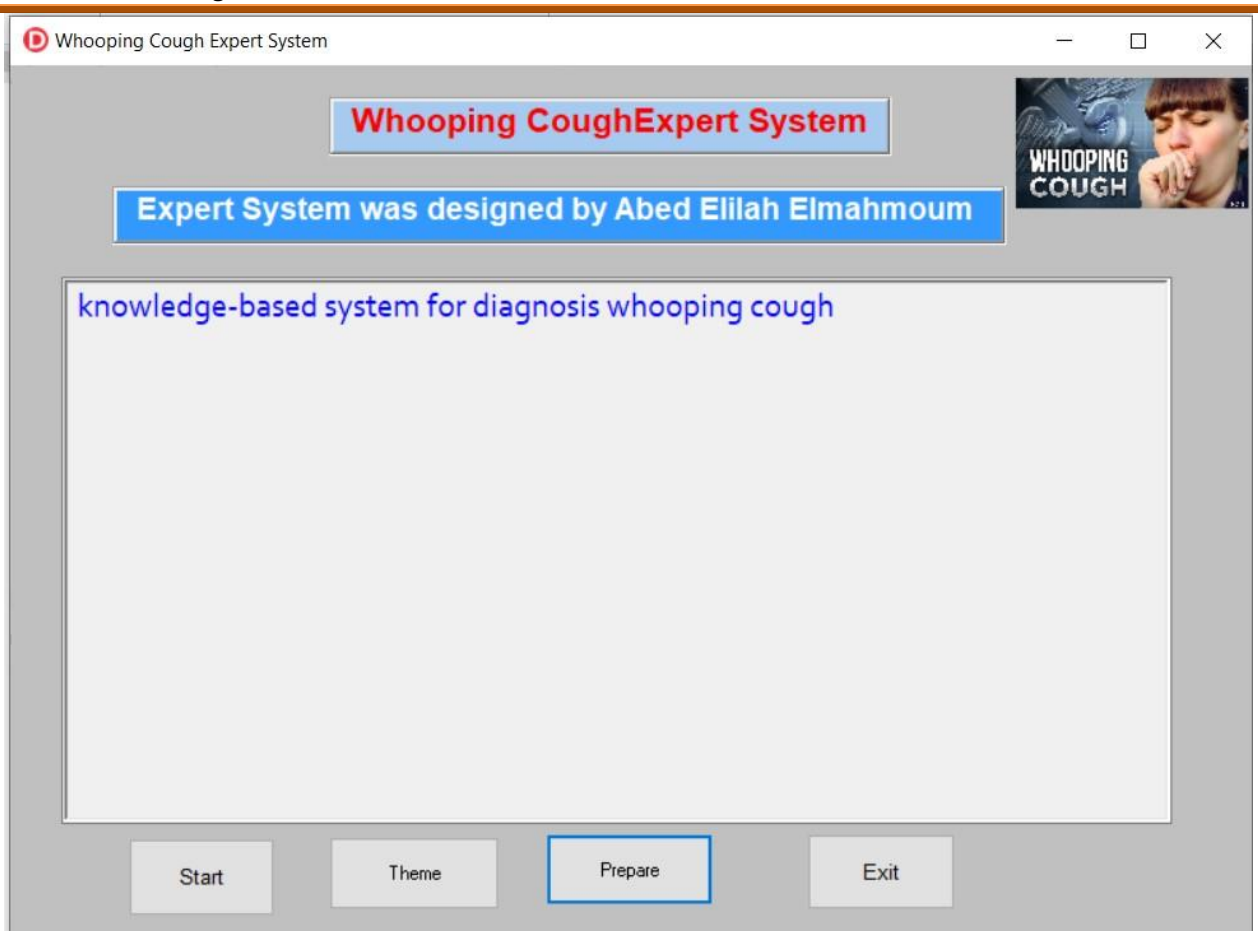

Figure 2: CLIPS Framework

4-2. Knowledge Acquisition:

Expert knowledge on whooping cough diagnosis was acquired through interviews and consultations with healthcare professionals experienced in diagnosing and treating pertussis. This process involved gathering information on symptoms, diagnostic criteria, and treatment guidelines.

4-3. Knowledge Representation:

The acquired knowledge was encoded into a knowledge base using the CLIPS rule-based system. The knowledge base consisted of a set of if-then rules that represented the diagnostic rules and guidelines for whooping cough. Each rule was structured with condition parts and action parts to facilitate logical reasoning.

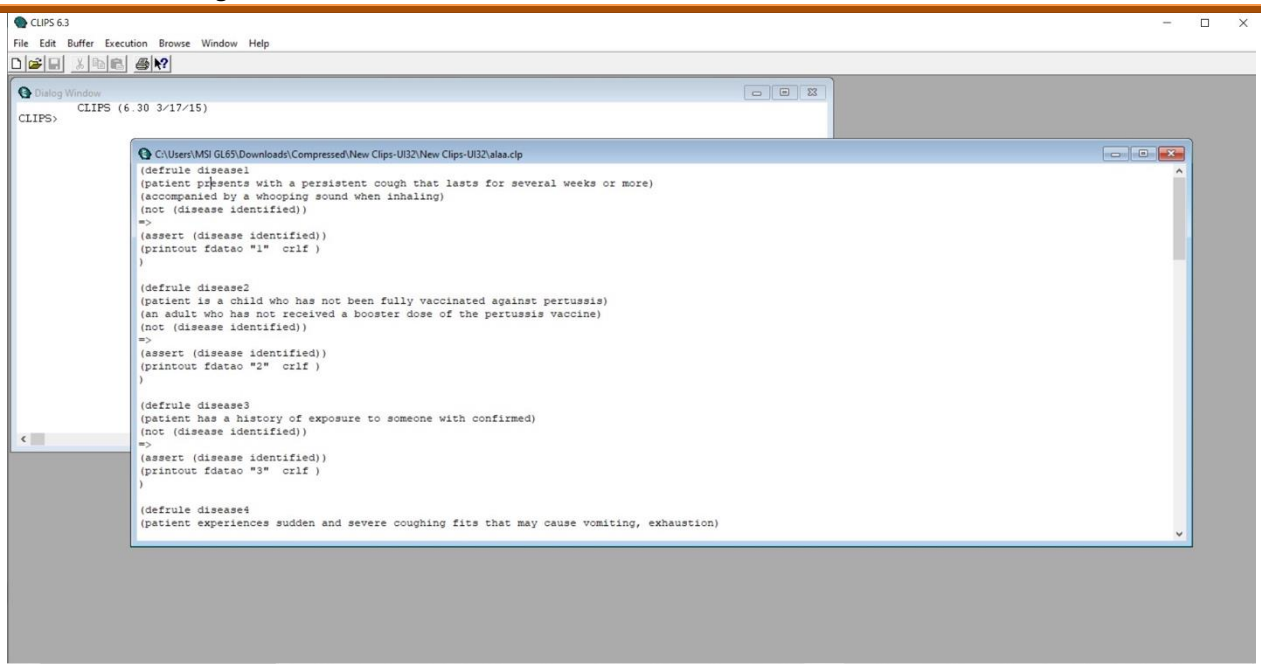

Figure 3: CLIPS rule-based system

4-4. Inference Engine Implementation:

The CLIPS inference engine was employed to perform reasoning and draw conclusions based on the input data and the rules in the knowledge base. The inference engine utilized forward chaining or backward chaining techniques to traverse the rule base and generate the diagnostic output.

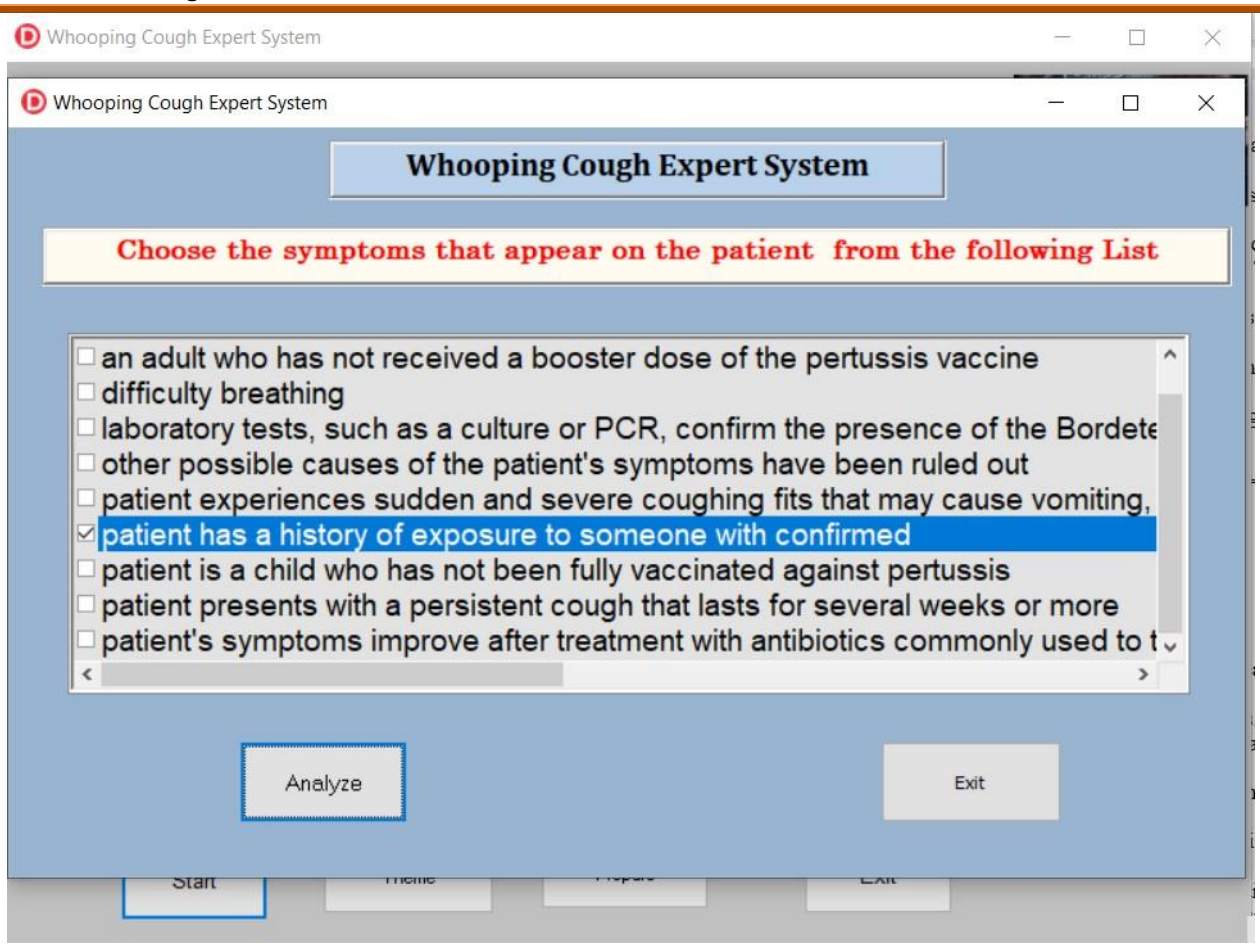

Figure 4: Inference Engine Implementation

4-5. User Interface Development:

A user interface was developed to facilitate interaction between the expert system and the healthcare provider. The interface allowed the input of patient information, such as symptoms, medical history, and demographic data. It also provided a platform for displaying diagnostic results and recommendations generated by the expert system.

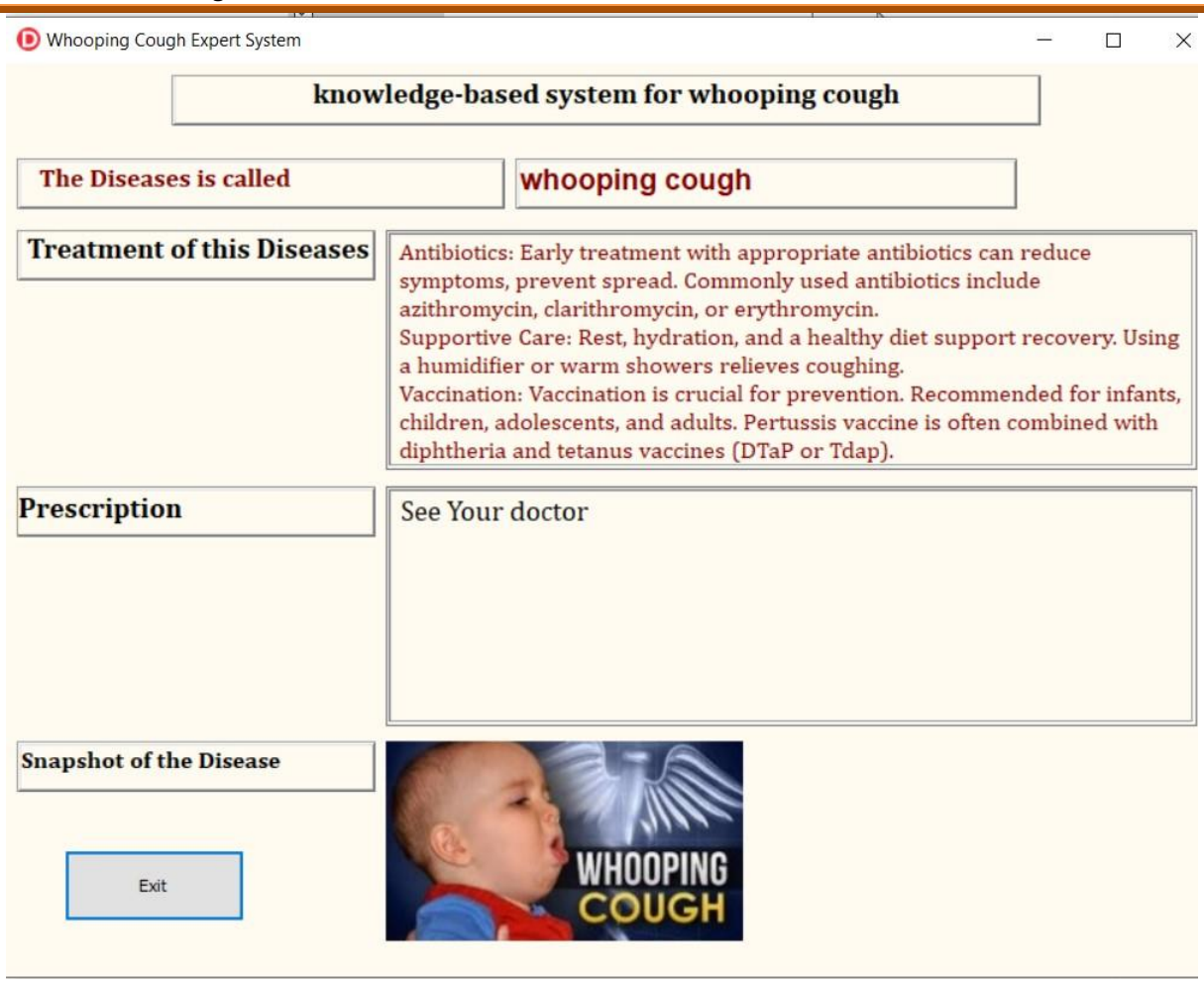

Figure 5 User Interface Development and Diagnoses Result

4-6. Evaluation and Validation:

The developed expert system underwent evaluation and validation to assess its performance and accuracy. This involved testing the system using a variety of patient cases with known diagnoses of whooping cough. The diagnostic results were compared with the known diagnoses to determine the system's sensitivity, specificity, and overall accuracy.

4-7. System Maintenance and Updates:

Regular maintenance and updates were carried out to ensure the accuracy and relevancy of the expert system. This involved reviewing and updating the knowledge base to incorporate new medical findings, revised guidelines, and emerging diagnostic criteria for whooping cough.

An overview about Whooping cough:

Cusses:

The bacteria Bordetella pertussis causes the disease. It is a highly infectious respiratory illness that affects the airways principally. When an infected individual coughs or sneezes, the germs are disseminated by respiratory droplets, and others inhale the contaminated droplets.

Symptoms:

- Catarrhal Stage: This stage often lasts 1-2 weeks and is similar to an ordinary cold. A runny nose, sneezing, moderate cough, low-grade fever, and an overall sense of being sick are all possible symptoms.

- The paroxysmal stage is distinguished by violent coughing spells that might be abrupt and uncontrolled. These episodes frequently conclude with a distinctive "whooping" sound after inhalation, however not everyone experiences this

sound. Coughing fits can be frequent and intense, producing vomiting or tiredness in certain cases. During coughing bouts, infants and young children may become red or blue.

- The severity and frequency of coughing fits steadily diminish during the convalescent stage. However, the cough might last for weeks or even months.

5. Function Of the System

The suggested system serves numerous purposes. It will determine the cough problem diagnosis based on the user's responses to particular questions posed by the system. The questions give the system with an explanation for the patient's symptoms, which aids the expert system in diagnosing the condition via the inference engine. For each case, it keeps the facts and the conclusion of the system's and the user's inference in a database. It parses the data base to extract rules that complete the knowledge base.

6. Conclusion

Finally, the CLIPS expert system for detecting whooping cough is a significant tool for healthcare practitioners in properly identifying this infectious disease. Its rule-based approach, backed up by the CLIPS framework, offers a systematic and accurate method of evaluating symptoms and assisting in treatment planning. Continued research and development in this subject has the potential to improve expert systems' capacities for identifying and controlling numerous medical diseases.

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