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# Expert System for Testing the harmony of Arabic poetry

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## Abstract

Testing the harmony and identification of bahr for Arabic poetry is a complicated task. This task needs a human expert level to identify the poetry bahr.

In this paper a prototype, expert system harmony test (ESHT), has been developed to provide expert-level-solutions for testing the harmony correction and to identify the bahr of the arabic poetry. ESHT helps the inexperienced user to detect the failed position in the Arabic poetry text. This expert system has features of being flexible enough to edit, update knowledge base, it has a forward chaining inference engine. This tool is capable of creating different forms of Arabic poetry such as Arud writing and binary form representation of the poetry. It provides the identication of the bahr

## 1. Introduction

Expert system (ES) is a computer program that represents and reasons with knowledge of some specialist subject with a view to solving problems or giving advice [1]. These systems have been successfully used in a number of problem domains that require the kind of intelligence possessed by a human expert.

ES have been used in various applications. In the field of medicine, ES have been used for the diagnosis of diseases and recommendation of specific medicine [7]. Also, ES have been used in diagnosis of faults for reactor control system, fossil power plant and electric motors [3,4,10].

Defining the harmony of Arabic poetry is a complex task. Testing the harmony of poetry based on the Arud science defined by Ahmed El farahedy [18]. Arud science defines the harmony of Arabic poetry based on repeating the syllable phonetic by a certain pattern. The syllable phonetic called "Tafhela". Arud science defines 16 patterns, each called Baher, and the Arabic poetry must follow one of these to be correct. Each one of these 16 patterns, baher, has many forms due to different forms of tafella for each bahr. So, there are about 17292 different forms represent 16 Bahr for Arud science.

Throughout this paper we propose an expert system developed for testing the harmony of Arabic poetry. The expert system developed "Expert System Harmony Testing" (ESHT) is a consultation system designed to provide expert-level solution for testing the harmony of poetry. Our motivation for the development of this system is that the process of testing the harmony of Arabic poetry depends on human experts and heuristics knowledge posses by human experts in this area. This

system tests if the harmony of the poetry is correct or not. If the harmony of the poetry is correct the system infer which baher the poetry is follows. Also, it defines where the incorrect position of the poetry if it does not follow any baher.

The paper is organized as follows: Section 2 introduces an overview about the main modules of the expert system. Section 3, presents a detailed overview about the knowledge of the domain and how its representation. Also, it gives an overview about the inference and search techniques used. Section 4 presents the experimental results of applying the developed tool to some Arabic poetry. It shows the interaction with the developed tool. Fnally, section5 presents the conclusion.

## 2. Expert System Structure

Expert systems manipulate knowledge bases and take decisions by automated reasoning. These systems have widely used in application domains, which require human expertise. Expert system harmony test (ESHT) comprises three main modules: Consultation, Editor, and knowledge base as shown in fig(1).

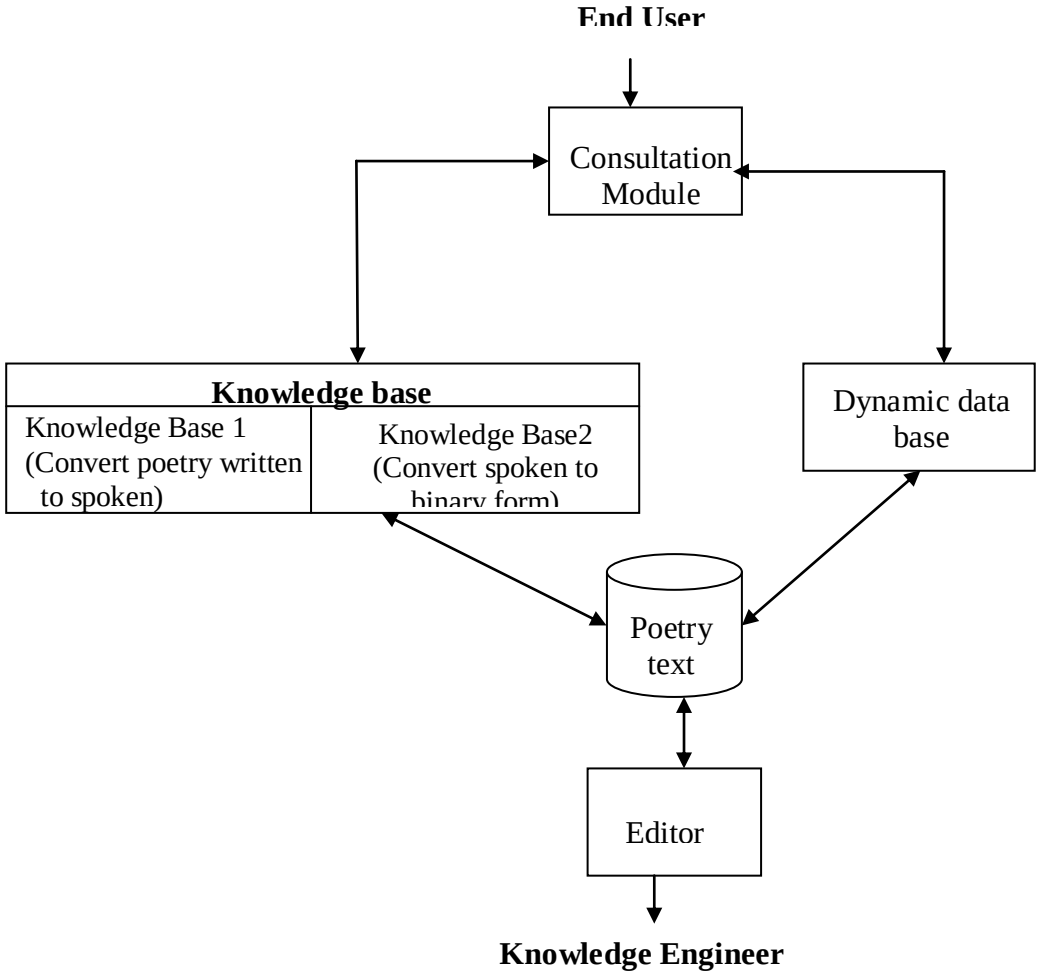


Figure (1):Organization of ESHT system & the major modules

**2.1 Editor Module.**

This module provides an interface to enter new Arabic poetry text. The main function of the editor is to create a new poetry text as well as to edit a previously entered one. This editor is a user-friendly interface. This module has a menu selection interface to enter new poetry text, edit, open and save a file contains a poetry text.

**2.2 Knowledge base**

Knowledge base is part of ES that contains knowledge about the domain area of interest. Representation of knowledge is defined as a combination of data structure and interpretive procedures that if used in the right way in a program will lead to "knowledgable" behavior [2]. There are many different ways for representing knowledge in an ES. The most widely used schemes are *rule-based System (RBS), semantic networks*, *logic* and *frames* representation [8].

RBS is one of the most poplar approaches for representing domain knowledge needed for an expert system. In RBS the knowledge consists of an unordered collection of basic units called rules [1,9]. Each rule has a condition (antecedent), sometimes called the 'left-hand side' part, usually indicated by the keyword 'IF. Also, each rule has an action (consequent) part, sometimes called the 'right-hand side' of the rule, indicated by the keyword 'THEN'. The condition and action of the rule is usually a boolean 'and' combination of clauses. A clause may be expressed as 'attribute-value' pair or 'object attribute value' triple. Thus rules always express a conditional with antecedent and consequent components. For example: IF $C_1$, $C_2$, $C_3$, …… $C_n$ THEN $Q_1$, $Q_2$, $Q_3$, ..... $Q_n$

There are two methods in which rules can be used in a rule-based system: the *forward chaining and the backward* chaining methods. The forward chaining systems progress from the given facts to the goal. While the backward chaining system begins with a goal and successively examines with matching consequent components. For more details about the RBS inference mechanisms see [1,6].

As shown in fig 1 the ESHT system has two modules for the knowledge base. The first module, *knowledge base 1,* contains a heuristic knowledge to convert the Arabic poetry text to spoken (Arud form). ESHT system reasons about its domain knowledge encoded as production rules. The second module, knowledge base 2, contains a deterministic knowledge to convert from arud form to binary form. The conversion of Arud writing to a binary form is done by representing the vowel by "1", and the consonant by "0".

**2.3 Consultation Module**

The consultation module is the core of the system; it interacts with the poertry text entered by end users through the editor module. It generates the identification of the poetry bahr using the human experts knowledge stored in knowledge base. This module uses both the heuristic knowledge in knowledge base1 and deterministic knowledge in knowledge base2.

Fig2 shows the steps the consultation module follow to test the harmony of the poem. As shown in the figure, the orthogonal writing must be converted into the Arud writing (nuncupative writing). There are two essential rules to do this:

1- Write only spoken characters.

2- Do not write what did not speaken.

This step has been done using the heuristic rules extracted from domain expert and stored in knowledge base1. Dynamic database contains intermediate information derived during the consultation. Also, it contains a record of the consultation session. This record contains information about the fired rules.

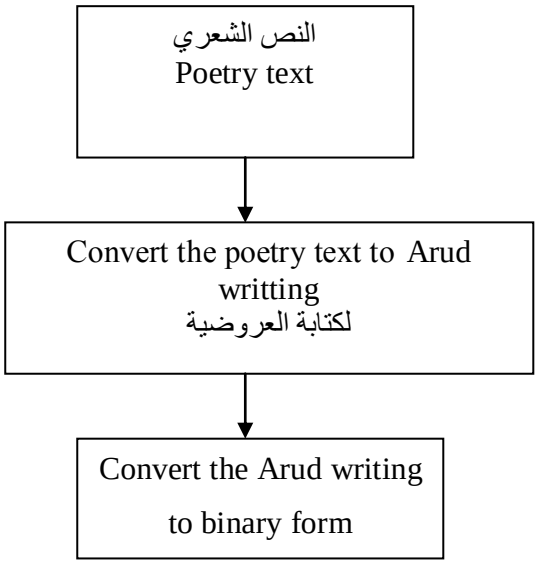


Fig (2): Steps to convert the written text to binary form

Example: the following example shows in details the steps applied to convert the Arabic text poetry to binary form.

1 The text :

2 The Arud writing:

3 The binary form

0111 0110101 01101 011011 0111 0110101 01101 011011

The tafhelat

متفعلن فاعلن مستفعلن فعلن متفعلن فاعلن مستفعلن فعلن

## 3. Domain knowledge in details

The formation is found in Arabic Language as in Hebrew. The formation done by adding special symbols to help in spoken langage. Some of these special symbols put above normal arabic characters. Others of these special symbols put under the normal characters. The formation in the Arabic language is done by putting the short vowels "ِ " (Kasra), " ُ " (Damma), "َ " (Fatha) and "ْ" (Sokoon) over a spoken letter. This formation is important to explain the meaning of the word, as in the following example: "أكلتُ" aklto (I eat), the short vowel " ُ " here over the letter "ت"(t) give the pronoun “I”, so the meaning of word (I eat), but if I said "أكلتُ" aklta (he eat ), the short vowel "َ" here over the letter "ت"(t) give the pronoun “you”, so the meaning of word (you punch), also "أكلتِ" (aklte) (she eat),the short vowel here over the letter "ت"(t) give the pronoun “she”, so the meaning of word (she punch).

The definition of these special symbols used for the formation of arabic language done using heuristic rules. The following are some of heuristic rules used to change from arabic poetry form, written form, to spoken (Arud writing):

":
"ُ Short Vowel named " ضمه damma" like O in "مُحمد Mohammed" we read "مُـ", as "MO"

"
"َ Short Vowel named " فتحه Fatha" like "a" in " عمَر Omar" we read "مَـ", as "Ma"

" :
"ِ Short Vowel named " كسره Kasra" like "e" in عامِر Amer" we read "مِـ", as "Me"

" :
"ٌ Noonation named " تنوين Tanween" like "n" in "محمدٌ Mohammedon"; adding n after damma.

" " :
"ً Noonation named " تنوين Tanween" like "n" in "عمرةً Omraton"; adding n after fatha.

" :
"ٍ Noonation named " تنوين Tanween" like "n" in "منالٍ Manalen"; adding n after kasra.

" :
"ّ Duplication ; " شده Shadda" mean we duplicate the letter under it. Like " "محمّدٌ Mohammed"

"ال": Definition article " ال al" like the " the dream alholm الحلم".

1- If the Noonation "ٌ " exists then replace it with "نْ noon"

As follows: "مٌ " (M) becomes "منْ" (Mn)

2- If the Noonation "ً " exists then replace it by "نْ noon "

As follows: "مً" (M) becomes "منْ" (Mn)

3- If the Noonation " ٍ " exists then replace it by "نْ noon "

As follows: "مٍ" (M) becomes "منْ" (Mn)
"كٍ" (K) becomes "كنْ" (Kn)

4– If the short vowel " ُ " exists at the end of a line then, replace it by " waw وْ",i.e, (w).

As follows: "مُ" (M) becomes "مو" (Mo), only when it is at the end of the line

5- If the short vowel " ً " exists at the end of a line then, replace it by "ا" (A).

As follows: "مَ" (M) becomes "ما" (Ma), only when it is at the end of the line.

6- If the short vowel " ِ " exists at the end of a line then, replace it by "ىْ" (E).

As follows: "مِ" (M) becomes "مى" (Me), only when it is at the end of the line.

7- If the Duplication "ّ" exists above a letter, then Delete the Duplication "ّ" and repeat the letter.

As follows: "محمَّد" becomes "محْمَمَد", We read The word "محمّد" (Mohammed) with a double "م" (M) so, we duplicate all letters that have the duplication "ّ" over it.

8- If the Definition Article "ال" (the) exists after a letter of the following string [س(S), ش(Sh), ط(T), ظ(Th), ن(N), ذ(Th), ص(S), د(D),ت (T), ن(N), ث(Th), ر (R), ز (Z) and ض (D)] then, delete the long vowel " ل " (L) from the Definition Article "ال" (the).

As follows: "الشَّمس" (the sun) becomes "اشْشمس".

9- If the Definition Article "الْ" (the) exists after a letter of the following string [أ(A), ب(B), ك(k), و(o), خ(kh), ق(k), هـ(H)ح (H), و(w), ع(A), غ(GH), ف(Ph), ج(G) and م(M)] and it's not the beginning of the line then, delete the long vowel "ا" (A) from Definition Article "الْ" (the). As follows: "منَ القمر" (From the moon) becomes "منَلْقمر".

10- If one of the following specified words exist it will be replaced as follows:

a- the word " لكن " (but) replace it by "لاكن".

b- the word "أولئك" (these) replace it by "أولائك".

c- the word "هذا" (This) replace it by "هاذا".

d- the word "هؤلاء" (This) replace it by "هاؤلاء".

e- the word "داود" (Dawood) replace it by "داوود".

f- the word "الرحمن" (Alrahman) replace it by "الرحمان".

g- the word "الله" (Allah) replace it by "اللاه".

h- the word "هذه" (This) replace it by "هاذه".

l- the word "هذان" (both) replace it by "هاذان".

14- If any of the symbols "؟", "!" and () exists, then delete it

Ex:

"ما هذا ؟" (what is this ?) becomes "ما هاذا ".

15 If any of the short vowel exists over the letter (ـه), then replace it by its corresponding long vowel.

Ex:

* (ـهُ)Becomes (ـهوْ), The short vowel "ُ" replaced by the long vowel "وْ".

* (ـهِ)Becomes (ـهى), The short vowel "ِ" replaced by the long vowel "ىْ".

16- If this exists "اً" which is a Noonation over "ا"(A) then, Replace it by the long vowel "نْ" (N).

Ex:

"محمَّداً" (Mohammed) becomes "محْمَمَدنْ".

17- If the Noon latter "ىً" which is a Noonation over "ى" (E) exists it is Replace by the long vowel "نْ" (N) As follows: "مدَىً" (extent) becomes "مدَنْ".

## 4. Experimental Results

The expert system has been implemented using prolog language. The developed expert system has been tested on 20 poems. The 20 poems chosen for testing from Farook Shoshaa book [18]. Table 1 shows the result of applying our developed expert system to the poems published in [18]. Figures (3) to (6) show some screen shots used during developing and running the ESHT system and its recommendation of the chosen poems for testing. Fig3 illustrate the main screen of the expert system. The system has six menus named file, arud, edit, testing, window and help. The tool also have five option buttons, named, text, Arud writing, Binary form, the afhela, and the bahr. Clicking the text option button results that the text of the Arabic poetry will appear in the right frame in main window. Fig4 shows when the user click the Arud option button the right frame will contain the Arud equivalent of the Arabic poetry text. Fig 5 shows the binary form of the poetry,

which appears by clicking the binary option button. Finally fig 6 shows the bahr identification of the arabic poetry.

| The name of poet | The name of poem | Baher of poem (Human expert) | Baher of poem (ESHT) |
|---|---|---|---|
| Monakhal El-eashkry | Fatat el khedr | Magthoo kamel | Magthoo kamel |
| Amer Ebn Rabehaa | Nohm | Taweel | Taweel |
| keass(Mgnoon laila) | Al-Mohnesaa | Taweel | Tawel |
| gameal Ebn Amer | Boyhena | Taweel | Taweel |
| keass Ebn Thareah | lobna | Taweel | Taweel |
| kasear Azza | Azza | Taweel | Taweel |
| yazead Ebn Mohya | Amtarat lohloh | Baset | Baset |
| Abo Abas | foz | Taweel | Taweel |
| Ebn El-Roomy | Waheada | Khafef | Khafef |
| Al-hamadany | Arak Assy El-Damh | Taweel | Taweel |
| El-shareaf El-raddy | Zebiat Alban | Baset | Baset |
| Doklaa Mangely | Al-yateama | Magzo kamel | Magzo kamel |
| Ebn zarek Baghdady | Kamer Phy Bghdad | Baset | Baset |
| Saphy El-Dean | Magless Alhabeab | Wafer | Wafer |
| Ebn Zydoon | Adhaa El-tanahy | Baset | Baset |
| Al-hosary Kairwany | Ya Lail Assab | Motdark | Motdark |
| Abo Kasem Shaby | Salwat phy Hykalhob | Khafef | Khafef |
| Aly Mahmood Taha | Al-Kamer al Hashek | Hazag | Hazag |
| Ebraham Nagy | Al-Atlal | Ramal | Ramal |
| Mahmood Esmahel | Akbly Ksalah | Kafef | Kafef |

Table 1 results of applying the ESHT system to test 20 poems

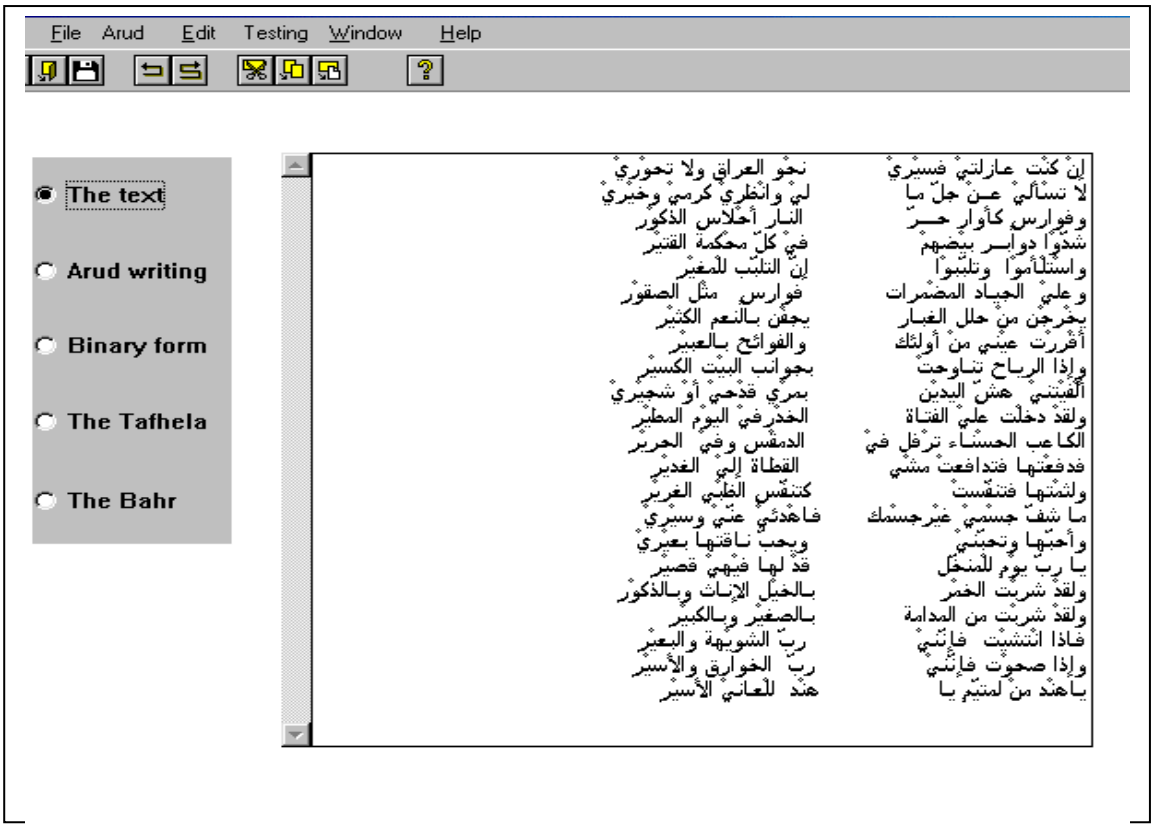


Fig (3) Screen of the system showing the text option chosen


Fig (4) Screen of the system showing the Arud writting option chosen

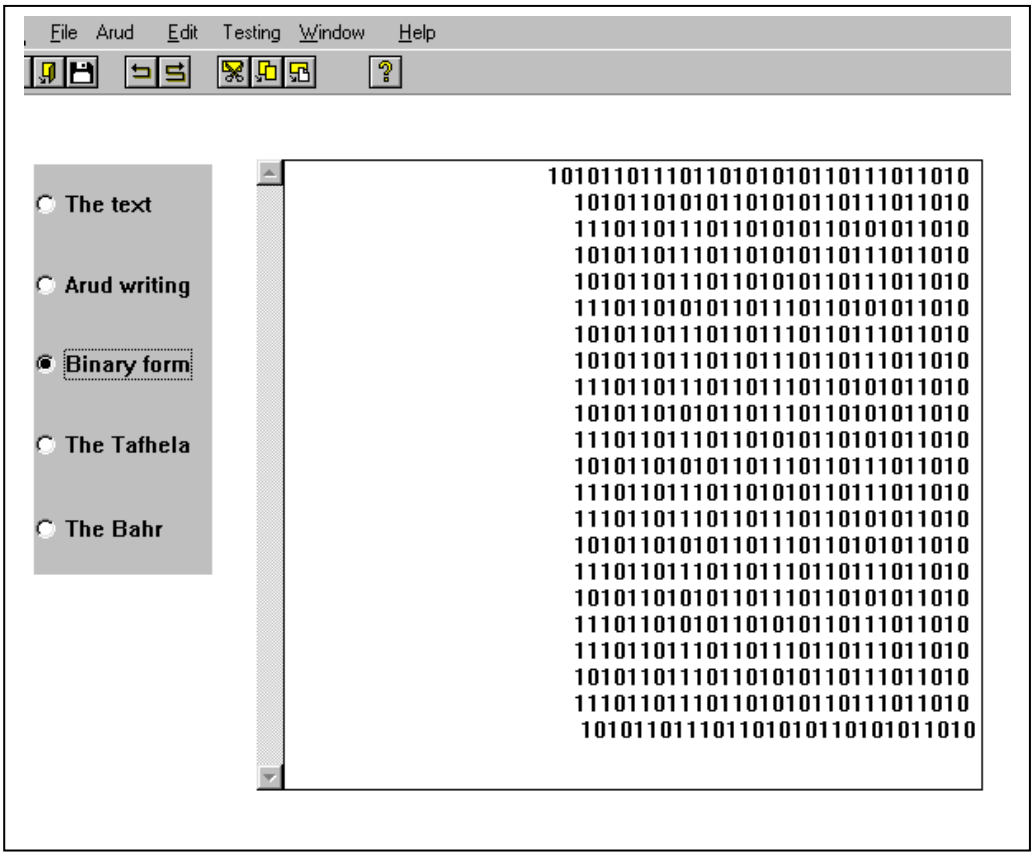


Fig 5 Screen of the system showing the binary form option chosen


Fig (6) Screen of the system showing the baher identification option chosen

## 5. Conclusion

Throughout this paper the ESHT has been designed and implemented. The ESHT tool has been tested under many test conditions and we get an excellent results. Using this tool Arabic poetry text can be edited, saved and update. The tool is capable of checking the harmony of Arabic poetry. Also, the tool illustrates the steps taken to check the harmony of the poetry. It shows in details the conversion of the written text of the poetry to spoken language. It create the spoken form of the written texe. The tool also gives the binary representation of the poetry text. At the end the tool shows the "tafela" pattern of the poetry text. Finally, the paper proposes a sample of case study for the systems have been implemented using the ESHT tool.

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