Towards A Multimedia-Based Educational System for Children

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ABSTRACT
In this paper, we propose an educational system for children with special needs. The system is based on multimedia technology to teach the children in an interactive and innovative way. It uses formal concepts analysis and a simple ontology to extract the keywords from texts related to the animals and foods domains. We link these keywords with multimedia elements which are fetched from Google database using Google APIs. These keywords represent the main entities of the texts that include the named entities, the main characters, period and actions. We discuss also the FCA extraction algorithms and we propose some improvement. The system is divided into different modules with a simple interface allowing the instructors to input the text and get the corresponding multimedia elements. They can browse easily through these elements and select what is suitable for the children.

Keywords
Multimedia, Algorithms for Keywords Extraction, Formal Concepts Analysis, Ontology.

1. INTRODUCTION
Teaching children with intellectual disability requires a lot of efforts and resources. Teachers should always repeat the same lessons several times due to lack of memorization and recognition of objects and concepts by these children. In previous work [1,3,18] we have developed an Arabic-based tutorial system that teaches the children with mild and moderate intellectual challenges using multimedia technology. Every tutorial is followed by a set of animated puzzles and games of different difficulty levels. The system helped the instructors to repeat easily the computerized lessons at any time. Parents also were able to use the system to review the lessons with their children at home and strengthen their learning skills. In addition, the children were able to interact with the system through the multimedia games. In fact, these games had tangible user interfaces where the children can use them to play the games and be more proactive in the classroom [2,13,14,15]. The main problem with the proposed multimedia lessons is the content development. In fact, every lesson needs few weeks to be completed properly. The special education instructor sets the script of the lesson, the designer proposes the corresponding scenes and the multimedia animator adds the movement to the characters and the objects. Once established, the lesson will be tested with the children in the classroom. In many cases, the content can be suitable for some children only but not for the whole group of students in the classroom even though they have been classified to have the same intellectual disability [3]. The instructors needs always different multimedia contents that can suit every child. Finding these elements with the current used techniques is not possible. Developing an intelligent system that can get as input the script of the lesson and generates the corresponding multimedia elements will be of great importance for both teachers and children as well as for their parents. In fact, children can understand better the lesson, teachers can improve the learning process as they have a collection of multimedia elements related to the lesson; and the parents can use the system at home to help their children to review the lesson. They can select different elements that can be found more suitable to their children.

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their actions (e.g., bark, attack, eat, howl, fly, swim) are selected using formal concepts techniques along with a simple animal and food ontology which consists of a number of terms representing the entities and their relations.

In our previous work [4], we have developed some algorithms to map texts into sentences, then sentences to list of words using FCA and Galois connection. These algorithms are mainly used in this proposed system with some improvement that we discuss briefly in this paper. We used an open source stemmer to extract the roots of the keywords which will be matched against the ontology and linked with the multimedia elements. We have set so far two domains for the lessons which are foods and animals. As a matter of fact, animals and foods are amongst the best attractive domains for children. Our approach for keywords extraction is totally different from the techniques proposed in [7] who used natural language processing to extract the keywords from text. These techniques are language-dependent while ours are totally language-independent. This means that we can apply our techniques on texts in different languages like English, French, German and Arabic, by simply translating the used ontology and apply the same FCA algorithms to get the same results. Other works focus on text segmentation and named entities extraction with visualization of the associated metadata [16].

2. MATHEMATICAL BACKGROUND

In this section we discuss briefly the formal concept analysis FCA that are used to extract significant segments of text from a lesson script in preparation for linguistic analysis and multimedia mapping. The notion of formal concept has been introduced by different researchers under the name of maximal rectangular [8], and in graph theory as a maximal bipartite graph [10]. In FCA terms, a space of information can be modeled as a formal context which is a triple \((G, M, I)\) where \(G\) is the set of objects in that information space, \(M\) is the set of properties owned by some objects and \(I \subseteq G \times M; i.e. I\) is the binary relation that is a subset of the product of the set of objects and the set of properties in that information space. Let \(O\) be the following set of objects \(O = \{\text{Leech, Bream, Frog, Dog, Spike-weed, Reed, Bean, Maize}\}\), and let \(P\) be the set of properties \(P = \{a, b, c, d, e, f, g, h, i\}\) where \(O\) is a set of some animals, and \(P\) is a set of the following properties: “\(a\) = needs water”, “\(b\) = lives in water”, “\(c\) = lives on land”, “\(d\) = needs chlorophyll to produce food”, “\(e\) = is two seed leaves”, “\(f\) = one seed leaf”, “\(g\) = can move around”, “\(h\) = has limbs”, “\(i\) = suckles its offspring”. The binary context \(R\) is given in the following table 1 below.

Table 1. Binary context \(R\) relating objects and attributes

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
<th>i</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leech</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bream</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Frog</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dog</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Spike-Weed</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Reed</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bean</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maize</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Leech</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

A concept of a binary context is a binary relation that can be defined in terms of its objects (intents) and their shared attributes (extensions) to be the collection of the maximum number of objects (set \(O\)) sharing the collection of the maximum number of attributes (set \(P\)).

More formally, let \(f\) be a function from the powerset of the set of objects \(O\) (i.e., \(2^O\)) to the powerset of the set of properties \(P\) (i.e., \(2^P\)) in the binary context, such that: \(f(A) = \{m \mid \forall g \in A \Rightarrow (g, m) \in R\}\); \(f(A)\) is the set of all properties shared by all objects of \(A\) (subset of \(O\)) with respect to the context \(R\). Let \(g\) be a function from \(2^P\) to \(2^O\) such that: \(g(B) = \{g \mid \forall m \in B \Rightarrow (g, m) \in R\}\); \(g(B)\) is the set of objects sharing all the properties \(B\) (subset of \(P\)) with respect to the binary context \(R\). The closure function is defined as follows: \(\text{closure}(A) = g(f(A)) = A'\), and \(\text{closure}(B) = f(g(B)) = B'\).

The formal context is formally the pair \((A, B)\), such that \(f(A) = B\), and \(g(B) = A\). We call \(A\) the extent and \(B\) the intent of the concept \((A, B)\). If \((A_1, B_1)\) and \((A_2, B_2)\) are two concepts, \((A_1, B_1)\) is called a sub-concept of \((A_2, B_2)\), provided that \(A_1 \subseteq A_2\) and \(B_2 \subseteq B_1\). In this case, \((A_2, B_2)\) is a super-concept \((A_1, B_1)\) and it is written as follows:

\[(A_1, B_1) < (A_2, B_2).\]

The relation “<” is called the hierarchical order relation of the concepts. The set of all concepts of \((G, M, I)\) ordered in this way is called the concept lattice of the context \((G, M, I)\). A formal context can be represented as a hieratical concept lattice structure. Such structures have the tendency to grow exponentially in terms of the number of concepts they include.

This problem is known to be NP complete [8,12] for which there have been a number of approximations to find the minimum number of concepts that can represent the maximum knowledge in a lattice with the minimal redundancy to save processing power and resource consumption. For that purpose, we have adopted in the proposed system a greedy approach for finding the minimal number of concepts entirely covering a binary relation based on a space optimization criterion described in details in [12]. In this method, the notion of optimal minimal contextual coverage refers to the decomposition of a binary relation \(R\) in a minimal set of optimal rectangles (or optimal concepts). Let \(R\) be a binary relation defined from \(G\) to \(M\). A rectangle of \(R\) is a pair of sets \((A, B)\) such that \(A \subseteq G\), \(B \subseteq M\) and \(A \times B \subseteq R\).

A rectangle is called maximal or none enlargeable if and only if it is a concept. Since a binary relation can be represented by a relatively large number of concepts, optimization in space becomes an important scalability factor. A trade-off between storage saving and knowledge acquisition has to be made to address this optimization need.

The gain function \(W(R)\) is defined as: \(W(R) = (r/dc)(r - (d + c))\); where \(r\) is the cardinality or number of pairs in \(R, d\) is the cardinality of the domain (objects set) of \(R, \text{and } c\) is the cardinality of the range can be utilized to support the selection of a minimal significant set of concepts representing the relation. One key to optimizing information representation is to study the concepts pertaining to a pair in the binary relation and decide on the most optimally significant rectangle to include in a conceptual coverage. We can call a rectangle \(RE \subseteq R\) containing an element \((x, y)\) to be optimal if it produces a maximal gain \(W(RE (x, y))\) with respect to other concepts containing \((x, y)\).

3. THE SYSTEM COMPONENTS AND ARCHITECTURE

The proposed system consists of a number of components laid out into modular layers. The core application components handle the processing of textual manuscripts of stories and converts extracted entities of animals into multimedia elements supporting the
These components cover mainly four areas of the core processes which are detailed in the following subsections.

### 3.1 The Text Processing Component

One of the most important components is the initial text processing component which handles the stemming process and conversion of the text into a binary relation mapping keywords in a story to the sentences they appear in. This means that the sentences in the story will constitute the set of objects O and words will represent the set of attributes P. Two words will be considered identical if they share the same lexical stem. An open source stemmer has been used in this component. This component generates the input to the FCA extraction component. The **Stemmer Service** and the **Part of Speech Service** shown in Figure 2 represents the text processing component.

### 3.2 The FCA Extraction Component

This component handles the conceptual analysis part of the system. It extracts the minimal number of optimal concepts entirely covering the binary relation corresponding to the original story text. The optimality of a concept is calculated using space optimization factor called concept weigh. The output of this component is considered as a short intermediary representation of the significant ideas and concepts in the story. The **Content Service** in Figure 2 represents the FCA extraction component.

### 3.3 The Learning Component

The learning component comprises the usage of the animal and food ontology to aid the named entity extraction and the part of speech tagging processes. The input to this component is the sentences contained in the extracted concepts generated by the FCA extraction component. The **Ontology Service** given in Figure 2 represents the learning component. Details about the animal and food ontology is given in section 4.

### 3.4 The Multimedia Mapping Component

The multimedia mapping component is responsible for mapping the short representation of the text generated by the FCA extraction component into reusable multimedia elements to aid the learning process for children with special needs. The multimedia elements that match the extracted keywords are retrieved from Google using Google APIs which allow to query the Google database that contains billions of web pages with multimedia elements and constantly refreshed by Google’s automated crawlers. In that way our multimedia database (i.e., data repository) can be expanded and enriched by new multimedia elements related to the animal and food domains. Note that Google APIs (Ilan.Google.API) usage is freely accessible for researchers but with some limitations on the number of queries per day. A good and free downloadable application to fetch images from Google is accessible from this link [5]. It allows to query Google search image database by providing the keywords. The following figure 1 shows how we can use this tool to retrieve images from Google.

### 3.5 The Architecture

The proposed system architecture is based mainly on service oriented architecture or SOA [17]. Using external component such as Google APIs services or Yahoo! SDK, our target is to utilize SOA to consume available multimedia search solution that will translate concepts and actions expressed in representative text segments into multimedia elements. We can retrieve easily thousands of images and clips that should be validated by the instructors who can browse through these multimedia elements and store what is suitable into the children’s databases. The below figure shows the components of the proposed system distributed into modular layers. This gives some flexibility when any modification is required. Modifying one layer doesn’t affect necessarily the others layers.
4. ANIMALS AND FOODS ONTOLOGY

The ontology is one of the most significant parts of the learning component of our system. An ontology represents usually the concept which is separately identified by the users domains, and used in a self-contained way to communicate information. An ontology defines the terms used to describe and represent an area of knowledge. The term definition gives detailed information about the relations in which it may belong. The ontology describes then basic concepts in a domain and defines relations among them. Basic building blocks of ontology design include: classes or concepts, properties of each concept describing various features and attributes of the concept, restrictions on slots [11,19].

The animal ontology helps us to identify the objects belonging to the animal and domains and to discover the relations between these objects.

A simple animal and food ontology can group the names of animals with eventually their images and the relations between other objects belonging to the domain like “meat” and “herbs”. We can discover or infer from the ontology that the monkey and the camel eat herbs while the lion and the dog eat meat. Ontology development needs expert in the domains. For the time being, we build a simple ontology that groups some animals and foods, their images and their actions. This ontology will be enriched in the next step of this project by adding other terms like animals habitats (i.e., a camel lives in desert, a lion lives in the forest, a fish lives in the sea or river, etc.), behavior (i.e., attack, climb, crawl), locomotion (i.e., how an animal gets around -by swimming, flying or climbing). The extension will be based on the stories used by the instructors in the Shafallah center for children with special needs. These instructors can contribute to the enrichment of the ontology. The following figure 3 shows a simple instance of the animal ontology with their names, actions and images.

![Figure 3. Entities representing animals’ names and behaviors belonging to the animals and foods ontology with the relations between them.](image)

We mention that an important ontology for animals is proposed by the US (NRSP-9 animal traits ontology project) and Europe (EADGENE and SABRE) [11]. It includes trait information for animals and species and group scientific and industrial terminologies. In addition, it describes the relations and characteristics of objects. The teams have also developed a thesaurus called “Wikisaurus” accessible only to the SABRE members. Another animal ontology is the “Wildlife ontology” [21] which consists of a set of simple vocabulary for describing biological species and related taxa. The vocabulary defines terms for describing the names and ranking of taxa, as well as providing support for describing their habitats, conservation status, and behavioral characteristics. Others ontology related to the animal domains is the animal behavior ontology [6]. We are studying these ontologies in the objectives to use them in our system.

In the context of the current application, children mostly read Arabic stories. After having built a corpus of stories, an ontology of the animals and foods’ domains is generated manually. The ontology is structured around different basic named entities. These entities include animals, actions, time period, objects, foods, places, and countries. Using some basic entities, we defined different events related to children stories about animals. Some of the defined events include: eating, playing, hunting, attacking etc. An event is structured by means of basic entities, for example: event “eating” is composed of named entities: “animal”, “food”, and “location”, meaning that some animal is eating some food somewhere. The application will thus assist the teacher to create the needed domain based on the following structure.

Event: “eating”.

Entities: “animal”, “location”, “food”, “time”.

Ontology: event and entities.

Multimedia: images and clips representing the event.

4.1 Concepts Extraction Based on Ontology

Starting from the named entities, a set of single or composed terms are given a priority during automatic concept recognition, as for example the “dog” is recognized as an instance of the entity animal, and the date “10-02-2012” is considered as an instance of the entity date. During the conceptual analysis phase, starting from a text, a binary context R relating each sentence to any word belonging to it is built. Starting from the binary context R, a conceptual clustering is realized as described in the following algorithm:

for each pair (sentence(s), word(w)), we associate a weight as the product of the number of sentences sharing word w by the number of words belonging to sentence s. By starting with the pair of the highest weight, a pre-restriction of relation R by the antecedents of w and post-restriction by the set of the image of s, should either correspond to a concept (i.e., a complete bipartite graph), or a union of several concepts. In the first case, the concept is selected and an adequate label (or name) of the concept is generated. This name is used to communicate the main concept of the text that later we map to an image. In the second case, the algorithm is repeated in the sub-graph. The algorithm ends as soon as the coverage of the relation R by the concepts is obtained. During the process of labeling a priority is given to words belonging to instances of the named entities.

Example 3. “Four cats are waiting for their lunch every day in the morning, the mother and its three children. The cats jumped on the table in the garden all together, looking to me with insistence asking for their regular lunch. As soon I open the door of the kitchen, they come to me trying to cross the door. Finally, I give them some fish or meat in their room in the garden. Other cats in the neighborhood come at the regular time and try to get something to eat. The number of cats is increasing year per year in the garden”.

We can algorithmically express the steps for generating the multimedia mapping algorithm as follows:

```
Algorithm: map_story
```

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...
The Research Bulletin of Jordan ACM, Volume II(II)

Input: Story textual manuscript Doc.
Output: Story Multimedia manuscript Mult.

1. BR = text_proc(Doc); //convert Doc to Binary Relation
   BR: [Sentences]x[words]
2. Cov[C_1, C_2, ..., C_n] = extract_coverage(BR); //Cov: Ordered concepts list by weight
3. for each concept C_i in Cov
   for each sentence S_j in C_i
      temp = pos(S_j) //Apply part of speech POS tagging to sentences, extract events and generate named entities
      Mult += get_multimedia(temp);
4. Return Mult;

As can be seen in the previous algorithm, step 3 concerning the generation of representative keywords for the original story text is highly dependent on the maturity of the linguistic tools and thus on the quality of the natural language processing output. To reduce this factor, we can replace this step with a step dependent in majority on the conceptual structuring of the text. In the alternative method, the extracted formal concepts in the coverage set will be labeled based on the best weighted term in the concept. The set of labels of these concepts would then be used as the extracted keywords list to map to multimedia elements. The update algorithm would be then as follows:

Algorithm: map_story

Input: Story textual manuscript Doc.
Output: Story Multimedia manuscript Mult.

1. BR = text_proc(Doc); //convert Doc to Binary Relation
   BR: [Sentences]x[words]
2. Cov[C_1, C_2, ..., C_n] = extract_coverage(BR); //Cov: Ordered concepts list by weight
3. for each concept C_i in Cov
   temp = maximum_weight(S_j) //Give a name concept C_i as the word with the maximum frequency in the range of words in the concept
   Mult += get_multimedia(temp);
4. Return Mult;

In the above technique two variances of the map_story algorithm, the exact_coverage method handles the critical conceptual analysis part that transforms the binary relation representing the original text into a minimal coverage set of formal concepts. This method operates as per the following steps.

Algorithm: extract_coverage

Input: Binary relation representing the story text BR:[Sentences]x[words]
Output: Minimal coverage set of concepts Cov[C_1, C_2, ..., C_n]

1. For each pair (x,y) in BR
   1.1. Calculate ER(x,y) = I(y,R^{-1}) o R o I(x,R)
       // Calculating the elementary relation for the pair (x,y)
   1.2. Calculate W(ER(x,y)) = (r/dcr)
       // Calculate the weight of each elementary relation ER(x,y)
       Weighted_ER += W(ER(x,y))
2. While BR not entirely covered
   2.1. For each elementary relation ER_i in Weighted_ER
       Rectangles[i] +=
       Find_Optimal(ER_i)/Find all optimal rectangles containing an element in ER_i
   2.2. For each elementary relation ER_i in Weighted_ER
       COV +=
       min_optimal(Rectangles[i])/find the minimum number of rectangles among the optimal that entirely cover ER_i

Using the developed algorithm map_story, the system gives the following words in the following decreasing order:
cats(4), garden(3), lunch(2),
door(2), come(2), waiting(1),
regular(1).

Starting from the selected words, the system shows only sentences related to the corresponding concepts. The multimedia tool mapped the sentences to an image representation, to help for communicating the ideas of the story to children with mental difficulties, by adding sounds and text to help a better knowledge of the vocabulary. For each of the identified concepts, the corresponding set of sentences are passed to the part of speech tagger and the named entity extractor. The resulting sentences are then passed to the Google service for retrieving the
corresponding multimedia elements. The steps of the proposed system can be summarized as follows:

<table>
<thead>
<tr>
<th>Text of the story</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part of speech Tagger</td>
</tr>
<tr>
<td>Identify main actors of the story</td>
</tr>
<tr>
<td>Identify primary events (main actions)</td>
</tr>
<tr>
<td>Identify secondary events (secondary actions)</td>
</tr>
<tr>
<td>Identify Temporary Information (like time)</td>
</tr>
<tr>
<td>Generate the multimedia elements (images, clips and pictures)</td>
</tr>
</tbody>
</table>

We make the keywords extraction based on the ontology related to the domain of animals and foods. Other ontologies can be built to cover other domains.

Example 4. Assuming that the story text is the following: “Monkey is one of the animals which lives in the forest. The Monkey is a vegetarian animal. Its favorite food is banana.”.

Using FCA, the stemmer and the ontology we can extract the binary representation of the text breaking into sentences and corresponding keywords that are then mapped to the relevant multimedia elements. We extract then automatically the main keywords of the story text. Table 2 below shows the details.

Table 2. Binary representation of the words and sentences.

<table>
<thead>
<tr>
<th>Keyword</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>Stop Word</th>
<th>Stem</th>
<th>Ontology</th>
<th>Retrieved Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monkey</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>false</td>
<td>monkey</td>
<td>true</td>
<td>![Image 259x313 to 296x351]</td>
</tr>
<tr>
<td>is</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>true</td>
<td>Is</td>
<td>false</td>
<td>![Image 523x700 to 560x737]</td>
</tr>
<tr>
<td>one</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>false</td>
<td>one</td>
<td>false</td>
<td></td>
</tr>
<tr>
<td>of</td>
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<td>true</td>
<td>of</td>
<td>false</td>
<td></td>
</tr>
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</tr>
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<td>which</td>
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<td></td>
</tr>
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<td>1</td>
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<td>false</td>
<td></td>
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<td>1</td>
<td>false</td>
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<td></td>
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<td>favorite</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>false</td>
<td>favorite</td>
<td>false</td>
<td></td>
</tr>
<tr>
<td>food</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>false</td>
<td>food</td>
<td>false</td>
<td></td>
</tr>
</tbody>
</table>

5. CONCLUSION

A new assistive multimedia-based educational system for children with intellectually challenges is proposed and being tested. Formal concepts analysis and ontology techniques have been used to extract keywords from stories texts related to the animals domain and link them with the multimedia elements. Google APIs have been used to retrieve the images and clips related to the extracted keywords from the web. We have improved the FCA-based algorithms to extract the keywords. In the next phase of this project, we will work on annotating manually and automatically the extracted keywords and use a text to speech tool like text-to-speech engine of Microsoft or Shakhr to read them. In addition, we plan to create a repository of clips and sounds associated with keywords in the animals domain so we can first retrieve these elements rather than searching directly for them through the web. As the instructors can fetch automatically the multimedia elements from the web, a filtering algorithm can be added to the system to avoid getting offensive or harmful contents. We will add also some characters from the local environment like the well-known characters Haboob and Noof to act as avatars to read the keywords and make some movement while displaying the related multimedia elements. The existence of avatars let the children feel interacting directly with those avatars rather than the computer. We plan to use a translation tool like Google translations APIs or Shakhr system to translate into Arabic the tagged images retrieved from the Web. We will improve the system interface so that the instructors can display the images retrieved from the Internet or from the repository. They should be able also to browse through the keywords labeling the multimedia elements. We will build lists of synonym words (i.e., different words that mean the same thing) associated with the keywords so that the search and retrieval of images can be easier. For instance the animal lions which means Assad in Arabic has the following synonyms: “Shebel”, “Layss”, “Drgha’m”, “Sabeh”, “Malek Al Ghabah”, “Malek Al Al Hayawana’t”. Once one of these words occurs in the text the multimedia elements associated with the animal lion will be displayed. We plan also to use Yahoo! SDK API for images retrieval as it may give sometimes better results than Google API as stated in [3].

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7. REFERENCES


