Looking for the Lost Follis

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Abstract

This paper describes the application of a new technique of error tolerant image retrieval to the classification and study of late Roman Empire coins. To a query, in form of a given coin, the technique answers proposing a set of coins from the database whose similarity distance is not greater than a user selected threshold. A pair of interesting results are reported and discussed.

Keywords: Visual Database, Approximate Search, Ancient coins.

1. Introduction

The traditional way of sharing information about ancient coins or other precious old items between archaeological Institutes and Museums is through collections of photographs. Typically whenever a new coin is found an expert uses his previous knowledge and all the information known about the object, to find its origin and its classification. In this difficult task accessing to catalogues of coins as described above is an invaluable tool to validate or reject hypotheses. However, the size and number of catalogues available to an expert for consultation are, necessarily, limited. Computers are changing this traditional framework in several ways. First fast and cheap scanning techniques are greatly increasing the volume of available pictures. Second "intelligent" methods provide valuable support to the expert's task. As the size of image databases grows the traditional methods of finding an image are useless. In this context, algorithms to analyze and compare efficiently thousands of pictures provide a significant break-through. In literature there are different strategies to resolve this problem: keyword-based querying or content-based querying like "query by content" [6], "query by example" [2], "similarity retrieval" [5] and "sketch retrieval" [3]. Recently [1] a new technique, tolerant to error and noise, to retrieve a structured object from a large database has been introduced. In this work we intend to demonstrate the suitability of such new approach to the field of ancient coins studies. In particular we report preliminary experiments relative to a small collection of late Roman Empire coins [4]. In this short paper we first quickly review the technique of [1] for error tolerant retrieval and describe a possible partial structure to file coins information. We conclude the paper with a report of the first encouraging results obtained.

2. The Technique

A coin semantically is as a complex object with a precise syntax and structure. An expert defines the syntax and the structure of a coin locating the most important features that are helpful in assessing its identity. These features can be organized in a tree and the distance between two trees (expressed as the cost to change one tree in another [7]) provides a heuristic way to estimate the "distance" between the corresponding coins. The organization of such a tree largely depends on a thoughtful analysis that an information technologist carries out together with an expert Archeologist. A general rule is that the nodes of a tree in the higher levels are associated with the features more selective. This rule may be overridden whenever it would create inefficiency in dealing with the resulting tree structure.
A partial features tree associated with a generic coin is shown in Fig. 1.

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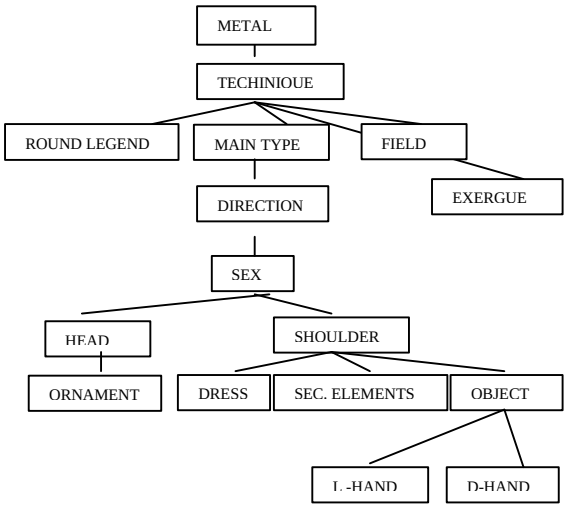

Figure 1: *General tree of a coin.* ***METAL:*** *{ Gold, Silver, Bronze, Brass, Copper},* ***TECHINIQUE*** *{ Cast, Struck},* ***DIRECTION****: { Left, Right, Facing},* ***SEX****: { Male, Female},* ***HEAD****: { Bare, Radiate, Crowned, Laureate, Veiled, Helmeted},* ***ORNAMENT:*** *{Diadem, Bare, Laureate, Feather},* ***DRESS:*** *{ Draped, with a Cuirass, Draped and with a Cuirass},* ***SEC.ELEMENTS****: {Shield, Crescent}.*

The database of all the coin trees is organized into a trie. The trie is used to retrieve all image-coins in the database that mach a query up to some degree of approximation, i.e. such that the distance between the query-coin and the candidate-coin is less than a threshold t. To describe the detailed way to perform such search within efficient time bounds is outside the scope of the present paper and it is reported in [1] and [7].

3. Results

In this section we report some results obtained using the algorithm proposed.
At the moment only few coins have been inserted in the database, but searching among them, without the help of an expert is already a quite difficult task. It should also be noted that we are not taking advantage of all the available information but only of one side of the coin (literally!)
For demonstrative purposes we report about the answers obtained relatively to two different queries. Distances among the items in the database range from 0 to about 16.
A first query is a coin whose type shows the profile of a veiled man, fig.2 (a).
The coin bears a Latin inscription. A low threshold (t = 3) for similarity, gave as answers the same coin together with the coin in Fig. 2 (b). In particular, both coins have similarity distance equal to 2. All the other coins in the database have distances of about 10 from the query: for example the distance between the query and the coin in Fig.2 (c) is 14.
Although a more extensive experimentation on a larger set of coins is needed to asses with precision the robustness of the proposed method, this is an encouraging evidence on the discriminatory power of the algorithm. It should be noted, however, that the quality of the performance observed in this case has been observed in most of the cases.

(a) *(b)* *(c)*

Figure 2: *(a) Divus Maximianus. (b) Divus Maxentius. (c) Valentinianus I*

(a) *(b)*

Figure 3: *(a) Helena. (b) Fausta.*

An interesting counterexample is the following. When the database is queried with the coin in Fig. 3 (a), with the profile of a woman, the closest coin with a female representation (shown in Fig.3 (b)) has similarity distance 12. Although this could be interpreted as a bad performance of the proposed algorithm, there is a simple and instructive lesson to be learned from it. As a matter of fact the sex of the person represented in the tree describing a coin is locate below the direction toward a profile is looking. This arbitrary choice has been suggested by the archeologist, because direction, especially for badly preserved coins, is generally easier to check than the identity of the person represented on a coin. It seems, in any case, that there is a large room for improvements in order to obtain a closer match between the computed distance and the distance perceived by an expert.

4. Conclusion

We have reported an application of an error tolerant retrieval technique to the field of archeological items. The results obtained, although the development of the database is not yet complete are good. Few discrepancies have been observed, and most of them have been easily explained. The construction of the database, at this point, requires the intervention of an expert, a large development of such a database, hence, will require the use of more sophisticated pattern recognition techniques.

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