# DESIGN OF AN AUTOMATIC SYSTEM FOR ARRHYTHMIA DETECTION USING UNSUPERVISED PATTERN RECOGNITION TECHNIQUES


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## INTRODUCCTION

An arrhythmia is an alteration of heart condition, which occurs due to the change of heart rate, mainly attributed to electric conduction system injury. Some arrhythmias, given its infrequent and transitory nature, are difficult to be detected with a 12-leads electrocardiography (ECG) test, and therefore ambulatory or Holter electrocardiography should take place, which allows for evaluating the patient for long periods of time without interfering with the patients' daily activities [1].

In order to classify the representative heartbeat of the Holter recordings, techniques from either supervised or unsupervised analysis can be used; being the latter the most recommended [2]. Since the prior knowledge or labelling of known beats is mostly unfeasible, unsupervised techniques result advisable for this classification problem. Despite the existence of techniques than have been very helpful, the design of a robust system to face problems such as signal noise, the large amount of heartbeats, the minority classes, and the morphological variability [3] is still an open issue.

The design of a complete system for the identification of arrhythmias is proposed using unsupervised techniques of representation and clustering, the system design involves stages for heartbeat segmentation, characterization, representation, evaluation of the sensibility of the number of clusters, clustering and evaluation of performance [4]. To characterize the heartbeats, morphological and spectral features that generate separability between cardiac arrhythmias are used and next the segment cluster is realized. The tests are made over recordings from MIT/BIH's arrhythmia database, which includes 48 records with the arrhythmias recommended by the AAMI (Association for the advanced medical of instrumentation) such as : Normal beats (N), premature atrial beats (A), Premature ventricular contractions (V), right bundle branch block (R) and left bundle branch block (L).

The number of features was reduced from 117 to number that depend of the record, to provide fair comparison among methods, the quality of grouping is measured by some unsupervised clustering quality indicators as accuracy, sensitivity and specificity. As average performance, including five types of arrhythmia, our system reaches 99,36%, 91,31,74% and 99,16% for accuracy, sensitivity and specificity, respectively.

## KMEANS

kmeans as clustering method is used. In this method, a start partition associated to an initial center set is chosen and their center reassignments changes, that are done to generate new partitions, are assessed per each iteration. Then, once a center is moved, all reassignments are done and the objective function change due to this movement is computed [5].

## EXPERIMENTAL SET UP

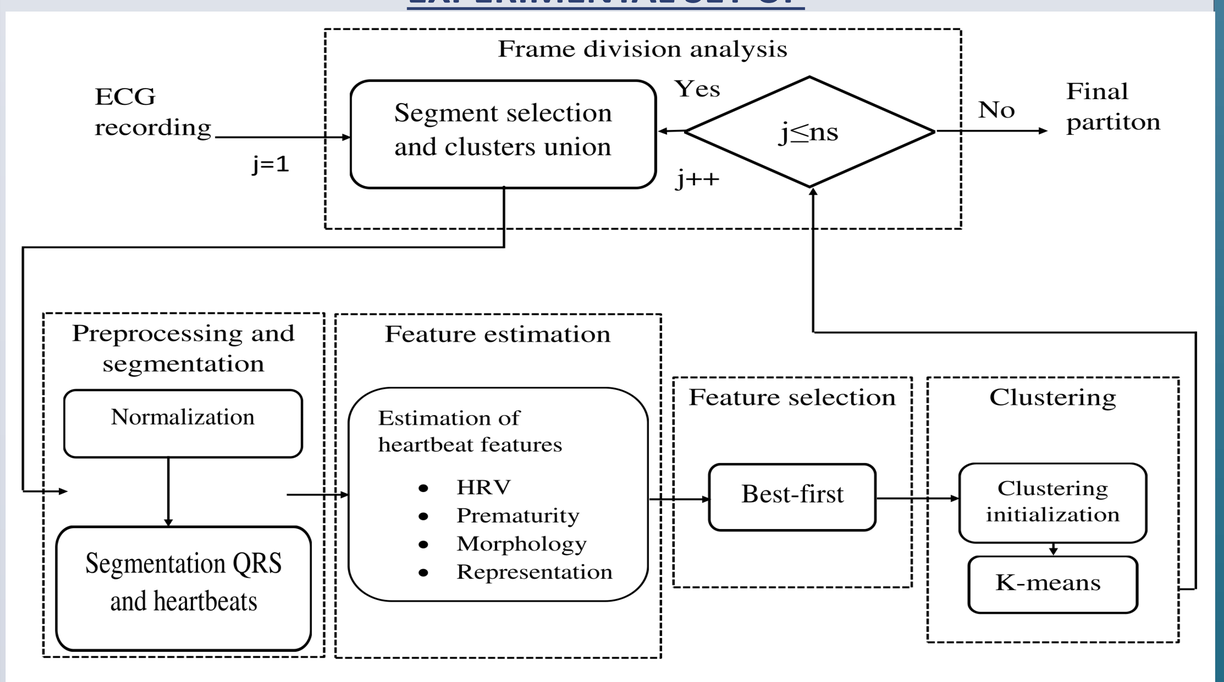


Figure 1. Block diagram of proposed unsupervised methodology for Holter monitoring of cardiac arrhythmias.

Clustering of cardiac arrhythmias is the assignment of a set of heartbeat observations into subsets or clusters so that observations in the same cluster are considered similar regarding certain descriptive patterns (features). The methods of clustering are commonly formed by the following stages: preprocessing and segmentation, feature estimation and selection, and clustering.

## RESULTS

In Figures 2, 3 and 4, how the performance measures vary regarding different values of number of groups (k) are depicted. Particularly, experiments with k = 5,8,10,12 are performed, the graphs of specificity and accuracy are maintained almost constant as k varying and the sensitivity graph grows as k increases. For random initialization can see that with a k=12 sensitivity has an approximate value of 76%. For kmeans with initialization Jmeans with k=12 has a sensitivity value of 87% and finally for kmeans with initialization maxmin with k=12 has a sensitivity value of 91%. Thus, maxmin initialization is the one with the best results in performance measures which improve with increasing number of groups. Additionally, performance measure (accuracy) value are displayed.

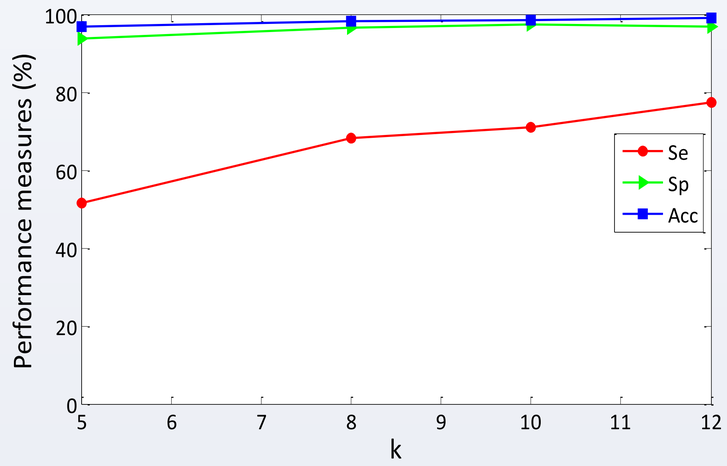


Figure 2. Performance measures of K-means with random initialization and different k

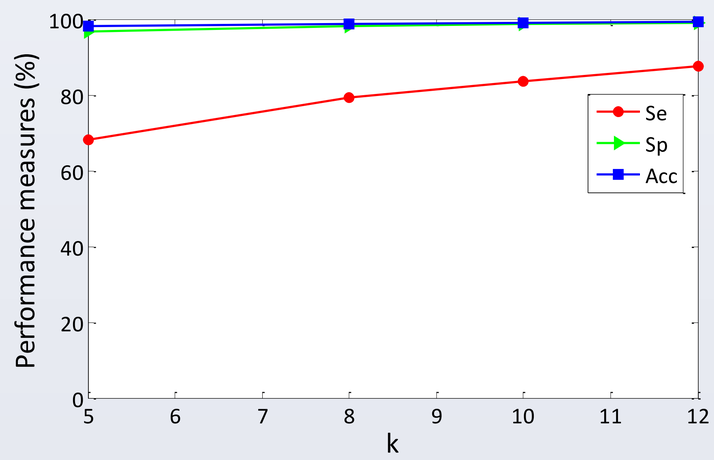


Figure 3. Performance measures of K-means with jmeans initialization and different k

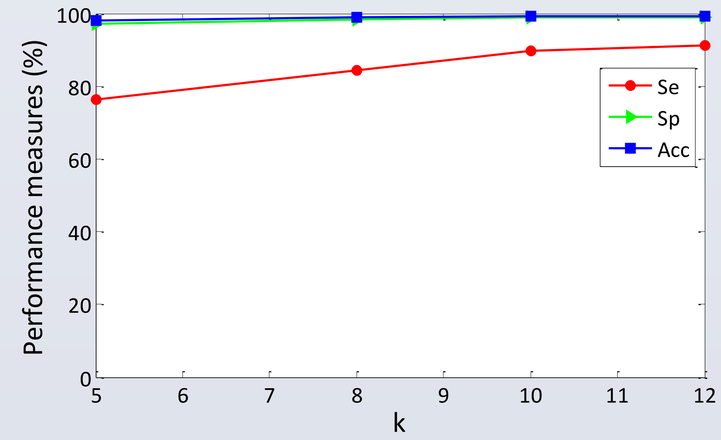


Figure 4. Performance measures of K-means with maxmin initialization and different k

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