MINING TELEMONITORING DATA FROM CONGESTIVE-HEART-FAILURE PATIENTS

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Abstract. The technology is providing us with increasingly more possibilities for telemonitoring patients, yet it is not clearly obvious how to utilize the obtained data. This paper describes the mining of telemonitoring data of congestive heart failure (CHF) patients, with the purpose to reveal potentially unknown relations between the monitored parameters and patient's overall feeling. The resulting models correlate monitored parameters with feeling of good or bad health, consistent with current medical knowledge, as well as confirming the opinion of some cardiologists, for which there has been less evidence.

1 Study overview

Many studies [1] researched the benefit of telemonitoring of patients, but the results of these studies seem to be contradictory. However, since the methods used in these trials were not particularly advanced, the use of intelligent computer methods on the gathered monitored data could help to reveal previously unknown relations in the data.

This paper describes the mining of telemonitoring data of congestive heart failure (CHF) patients. The data was collected in the Chiron[1] project with the purpose to reveal relations between the monitored parameters and patient's overall feeling of health. The research included 25 CHF patients, who produced a total of 1068 recording days. The 49 static parameters were measured at the beginning of the study (e.g. age, BMI, cholesterol, etc.). The 15 dynamic parameters [2] include environmental variables and measurements of vital signs, which were extensively monitored with on-body sensors (ECG and accelerometers). All dynamic parameters were further averaged (*avg*) for each day and changes (*chg*, relative change since the previous day) of values were calculated. The calculations were made for each type of activity in the day ('lying', 'sitting', 'moving' and 'all' activities) and the health risk of the patient was estimated [3]. A mobile application was used for daily reporting of patient's feeling (e.g. 'feeling better' than yesterday), the parameter which we aim to predict with generated models.

[1] http://www.chiron-project.eu/

2 Results

Feature and algorithm selection: We compared subsets of dynamic all_act features, finding that avg and avg + chg performed better than the rest. While the combination with per _act features reduced accuracy, the extension of the subset with static features performed best of all. We also tested various automatic feature selection methods from Weka[2]. The J48 algorithm was selected for its comprehensibility and at accuracy of 76.9% it was outperformed by the best algorithm for less than 5 percentage points.
Interesting models: Two examples are presented in Figure 1. They show that a high heart rate (HR_avg_all_activities), short QRS interval (QRS_avg_all_activities), high systolic blood pressure (SBP) and low diastolic blood pressure (DBP) are all associated with the feeling of good health, which coincides with existing medical knowledge. Increased weight (DRWChg) – signifying excessive fluid retention – and oxygen saturation below 97 % are associated with feeling of poor health as expected. Association of low humidity (HumA) and decrease in humidity (HumAChg) with good health confirms cardiologists' opinion that CHF patients poorly tolerate humid weather.

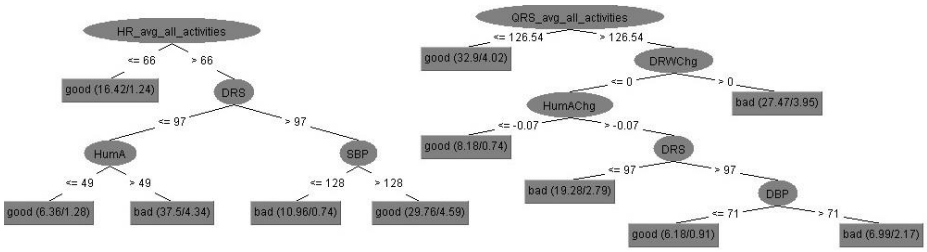

Fig. 1. J48 classification tree on the avg subset of all_act dynamic features (left) and J48 classification tree on the avg + chg subset of all_act dynamic features (right).

Conclusion: This paper presented analysis of the telemonitoring data of CHF patients. The derived models appear consistent with current medical knowledge. However, the models that contain new relations might be even more significant, since they might represent important discoveries, and must be further examined by cardiologists.

References

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