

# Properties of an Intelligent Cardiovascular Monitoring System

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The group of cardiovascular diseases is considered as the leading cause of morbidity and mortality in most industrialized nations. The incidence of cardiovascular disease has an increasing importance even in the young age decades, especially in males. Remote monitoring provides a cost-effective and comfortable means of medical care. The basic motivation in our project was to ensure the quality requirements of the vital signal measurements (ECG, blood pressure, weight measuring, motion activity) performed at home. Furthermore a special attention was paid to the personalized analysis of significant and malignant changes in the parameters monitored. The architecture of the system ensures that the relevant information can reach all the participants of a distributed care. In this way all the costs and troubles such as travel from remote locations related to routine medical examinations can be significantly reduced.

There are differences between the hospital based medical care and telemedicine:

1. Measurement taker: The patients cannot be expected to have high-level technical and medical competence. We have to correct the electrode transposition failures and examine the influence of the wrong electrode placement.

2. Place of the measurement: The system has to transmit the information as soon as possible to the intelligent datacenter for evaluation and in case of alarm to the monitoring service for human evaluation. If necessary the ambulance has to be informed. It is also very important to use wireless technique so that our system could be flexible enough to fit different situations. The system has to notify the patients about the incoming measurements via SMS or e-mail.

3. Diagnoses: These measurements are not as precise as the hospital based ones, but they are suitable to detect the malignant changes compared to the starting status. To improve the diagnoses efficiency there is a need for estimating processes.

In our system the patient unit collects the ECG, blood-pressure, motion-activity and weight measuring results. These results are transmitted into the intelligent datacenter and are automatically evaluated by the system. This datacenter stores the Electronic Health Record (EHR). To achieve intelligent monitoring with alarms based on input parameters there is a need for integrated decision support, the aim of which is to provide a medical decisionmaking diagnostic support. These auto-diagnoses draw the attention of the doctor to the possible problems. If the incoming measurement is a reference measurement, the system makes the evaluation by the Minnesota coding system that includes rules for 12 lead ECG for the whole population. In this time 424 rules are defined. If the incoming measurement is follow-up measurement (3 lead ECG) the system makes the evaluation by the personal evaluation process that considers the daily variability and the electrode misplacements of the ECG. Besides the system can detect the electrode transposition and can correct it in several cases. With the help of the estimate process we would like estimate the precordial (V1-V6) leads from the measured I, II, V2 leads to improve the diagnoses efficiency.

In case of an emergency situation, information is sent directly for human evaluation to the Monitoring Service, available 24 hours a day. The medical doctor at the Service can contact the patient, the ambulance or the nearest competent hospital by phone.

The system stores not only the possible diagnoses, but also stores the Minnesota code and ECG parameters that are responsible for the diagnosis. This function will be very useful for doctors and students, because the crucial parameters can be highlighted from the several other parameters. Three types of user interfaces are implemented: a Web based interface, a WAP interface, and a special application with high representing and document generation. These applications can be used in the education. The students can search among the diagnoses, and they can find, not only the diagnose, but also the parameters and rules that are responsible for it.