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A PERVASIVE APPROACH FOR INTELLIGENT DECISION SUPPORT IN CRITICAL HEALTH CARE

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Health Care, ICU, INTCare, Pervasive, Real Time, Critical Environment, Data Mining, Online processing

ABSTRACT

Pervasiveness, real-time and online processing are important requirements included in the researchers' agenda for the development of future generation of Intelligent Decision Support Systems (IDSS). In particular, knowledge discovery based IDSS operating in critical environments such of intensive care medicine, should be adapted to those new requests. Solutions are proposed for the most important constraints. The new approaches implemented allow having all data online, in real time and obtain excellent results with the prevision.

INTRODUCTION

In the future, the decision-making process and the form how the people decdie should take into account new requirements like pervasiveness, real-time and online processing. This work is part of a major project, INTCare, an IDSS for intensive care units (ICU). ICUs are considered critical units where each decision needs to be performed very carefully. The existence of a high number of data sources difficult, the data dissemination and the decision making process. In the ICUs exists many platforms with patient information, however still exists much information in the paper format. The creation of intelligent agents (De Turck et al., 2007) allow, perform some automatic tasks, continuously and in real-time. However the process automation has some restrictions, due to problems that arise during tasks execution like incorrect values, missing identification and others. In order to resolve these problems was developed a platform for register, consult and validate the patient data electronically with a total control of values by the humans. At the same time the pervasive approach adopted by the systems, allow to have patient data access by the doctors anywhere and anytime.

BACKGROUND

INTCare is an IDSS that was developed to Intensive Medicine, with the main goal predicts the organ failure and outcome (Gago et al., 2006; Santos et al., 2011) in real time (Portela et al., 2010). The INTCare system is divided into four subsystems and uses intelligent agents (Santos, et al., 2011) to, for example, automate the collection, processing and transformation of data, and update the predictive models in real-time, without the need for human intervention. The base of the entire process was: the results obtained in the past (offline) (Silva, 2007; Silva, Cortez, Santos, Gomes, & Neves, 2008), the necessity of innovation, systems integration, dematerialization of processes, turn all information electronic and make it available online and in real-time eliminating the high number of errors present in the patients records. The system is being concluded and is been tested in the ICU of the Hospital Santo António (HSA) in Porto, Portugal.

OBJECTIVES

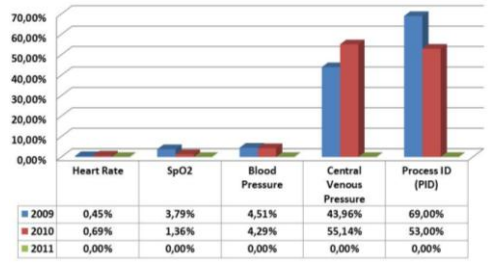
The results presented in this abstract were obtained after achieve these objectives:

a) Change the environment, creating a "smart environment" and make it pervasive;
b) Define a new information system architecture that will be able to work in real-time, online and pervasive mode;
c) Make a process dematerialization, making all process automatic and electronic as possible;
d) Develop prevision Data Mining (DM) models.

To obtain good results was necessary change the environment and information system architecture, using the Pervasive Health Care features and ICU needs, automatize the data acquisition process, define the Data Mining System and develop / test the models / technique with the best acuity.

RESULTS

The environment has changed (Portela, Santos, Silva, Machado, & Abelha, 2011) and now only some tasks are manual. For the best results, ENR, a web-based touchscreen platform, was been developed and, gives the possibility to monitor, store validate and consult, online, all data about the patient. Now, a new information system architecture (Portela et al., 2011) is been used by ICU, being the most important the data acquisition sub-system. After have all data in real-time and in electronic format the DM system was designed. With the modifications made in the Environment and in the Information System Architecture was possible verify an improvement in the data quality like figures 1 shows.



Figures 1 – Values out of range and nulls PID

These improvements also allow having a good result with the DM Models, where almost all have 100% in sensibility (table 1). For each target was developed a set of 4 scenarios for some DM techniques: Artificial Neural Network (AAN), Support Vector Machine (SVM) Decision Trees, Regression and Ensembles.

Table 1: Best results for each target

Target	Scenario	Sensibility	Technique
Cardiovascular	M1	93.4	ANN
Respiratory	M2	100.0	SVM
Renal	M4	100.0	SVM
Hepatic	M4	100.0	SVM
Coagulation	M2	99.8	SVM
Outcome	M1	100.0	SVM

CONCLUSIONS

With the modifications made the the system is more secure, robust, easily accessible and intelligent. Is expected the system will improve the patient outcome in the future due to some new facilities like the data availability in online, real-time and in electronic format. With the ICU pervasive access recast, is possible to accede to knowledge portions that can support the decision making process, anytime, anywhere.

FUTURE WORK

Define all processing and transforming task for all data collected, making it an autonomous process by the agents that execute the tasks and rules defined for each variable / source, refining the data quality. Improve the Data Mining Model and continuing the test of prevision models with real data collected in real-time and online mode. Improve the data mining scripts for critical events, ratios and medical scores automatic calculation.

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