

Making p-Health feasible: Automatic detection of personal behavioural changes through process mining analysis techniques

Carlos Fernández-Llatas¹, Eric Rojas², Jose Miguel Benedi³ and Vicente Traver¹

Abstract—In this paper, we analyze the eligibility of Process Mining technologies for inferring behavioral models based on the available results on IoT and AAL frameworks.

I. INTRODUCTION

With the arrival of Internet of Things (IoT) and Ambient Assisted Living frameworks(AAL), the amount of data available to analyze users in an individualized way is increasing dramatically. The big quantity of the available sensors allows the creation of holistic precise individualized models for explaining the user behavior, enabling the creation of better personalized treatments that can be adapted to user behavioral changes.

Pattern recognition and machine learning techniques can create automatically behavioral models. However, for allowing a complete understanding of the individual behavior of a user it is desirable to create human understandable models in an automatic way.

In that way, we propose Process Mining technologies. Process Mining [1] is a machine learning discipline that infer models from activity logs that provide human understandable models, usually, in form of workflows. Process Mining technologies [1], can support the individual analysis of the behavior not only for detecting the behavioral changes, but also to offer a human understandable view of which are the real changes of a user [2].

II. RESULTS

In order to explore the possibilities of Process Mining tools for detecting different human behaviors an experiment was designed. Using an Ambient Assisted Living (AAL) Simulator [3], we have created logs for three different behaviors that suppose three different stages that a human can evolve through his life. The objective of this experiment is to evaluate if Process Mining technologies can provide information about the inherent behavior that are present in the activity logs provided. In that way, we will analyze if the results represents the behavior that was initially simulated.

In the experiments, it is possible to see graphically how Process Mining techniques can show the differences in the behavior of an user based on the data collected by AAL and IoT scenarios. The results shows graphically the inherent differences of each corpus in an easy to understand view.

¹C.Fernandez-Llatas and V.Traver are with ITACA-Universitat Politècnica de Valencia cfllatas at itaca.upv.es

²E.Rojas is with Pontificia Universidad Católica of Chile eric.rojas at uc.cl

³J. Benedi are with PRHLT-Universitat Politècnica de Valencia

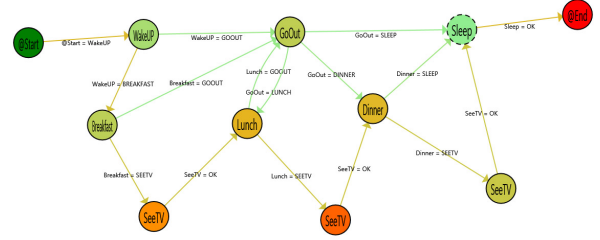


Fig. 1. Inferred Behavior of Log A

TABLE I
NUMERICAL VALUES OF AGGREGATED DURATION OF ACTIVITIES

	Log A	Log B	Log C
GoOut	0,08	0,26	0,48
SeeTv (Morning)	0,20	0,09	0,08
SeeTv (Evening)	0,25	0,19	0,05
SeeTv (Night)	0,09	0,17	0,11
Others	0,38	0,28	0,27

The application of Process Mining techniques for inferring individualized behavior models allows the creation of human understandable models that provide better support to experts in the understanding the real behavior of users. The use of Process Enhancement techniques to highlight some features using color gradients, like the aggregated duration of user in each stage, enables the experts in the quick understanding of the individualized behavior (See Figure 1).

As the models inferred by Process Mining technologies are formal, it is possible to take advantage of mathematical frameworks for verification and model checking of the inferred workflows. Table I shows the numerical values of the most interesting activities inferred by PALIA. Using these numbers it is possible to find correlations and, distance measures among behaviors for analyzing the concept drift not only in a qualitative, but also in a quantitative way.

REFERENCES

- [1] Wil van der Aalst. *Process Mining: Data Science in Action*. Springer, 2016.
- [2] Carlos Fernández-Llatas, José-Miguel Benedi, Juan M. García-Gómez, and Vicente Traver. Process mining for individualized behavior modeling using wireless tracking in nursing homes. *Sensors*, 13(11):15434–15451, 2013.
- [3] Carlos Fernández-Llatas, Juan Bautista Mocholí, Pilar Sala, Juan Carlos Naranjo, Salvatore F Pileggi, Sergio Guillén, and Vicente Traver. Ambient Assisted Living spaces validation by services and devices simulation. *Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, 2011:1785–1788, 2011.