



# Reusable Virtual Coach for Smoking Cessation and Physical Activity Coaching

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## ABSTRACT

Smoking tobacco and physical inactivity are key preventable behavioural risk factors of cardiovascular disease (CVD). Computerised coaching systems can help individuals to modify risky behaviours, thereby preventing CVD. However, most reported eHealth or computerized coaching systems are hard to reuse in slightly different settings. To provide an open-source, reusable computer coaching system, we developed Perfect Fit. The reusability is manifested by building around the open-source text- and voice-based contextual assistant framework Rasa. Rasa provides a simple, standard interface to many popular messaging and voice channels, and custom connectors are easily implemented. A set of algorithms have been developed and connected to Rasa to drive and personalize the conversation flow and the coaching process. Such algorithms make use of data stored in a devoted database. Furthermore, Perfect Fit adheres to best practices and standards in software engineering. The modular design of Perfect Fit will allow researchers to connect the virtual coach to any messaging or voice channel with only modest modification. Perfect Fit is available under open-source license in GitHub and is currently in prototype-phase. Concluding, Perfect Fit will deliver a virtual coach that can easily be adapted and reused in different settings. The coach helps individuals to achieve and maintain abstinence from smoking and sufficient physical activity (PA).

## CCS CONCEPTS

• Applied computing • Life and medical sciences • Healthcare information systems

## KEYWORDS

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Contextual assistant, conversational agent, eHealth, open-source, Rasa, software reusability, virtual coach

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## 1 Introduction

Smoking tobacco and physical inactivity are major risk factors of cardiovascular disease (CVD) [22]. Smoking causes mortality related to coronary heart disease, stroke and heart failure; exposure to second-hand smoke increases risk of stroke by 20-30% [11]. Insufficient physical activity (PA) causes ischaemic heart disease and coronary heart disease, respectively. Interventions that target multiple health-risk behaviours such as smoking and physical inactivity can create synergy in prevention of CVD.

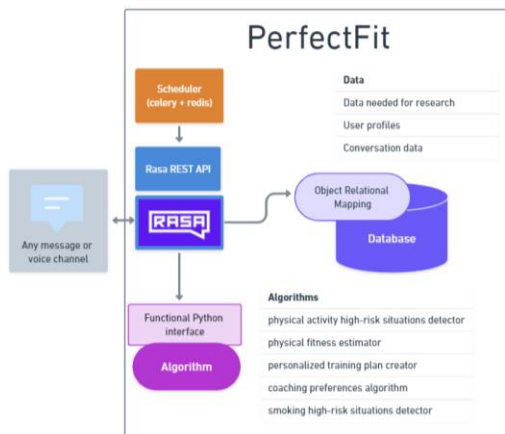
Support to behaviour changes has to be provided in order to help individuals in avoiding health-risk life styles and reducing the risk of CVD. Recent studies show how Virtual Coaches (VCs) can be deployed to provide 24/7 support for behaviour change [18, 20] with good results in smoking cessation [15] as well as in other domains such as treatment of depression [8], PA [21], insomnia [12]; and nutrition combined with PA [3]. The VC's activities result in maximal outcome when VCs provide personalized data-based advice to users, since every individual has a preferred persuasive style for becoming motivated to change behaviour [13]. In particular, the use of personalized motivational messages resulted in a positive impact for behavioural changes towards more PA [22], and likewise it has been shown to improve smoking cessation rates when delivered through text messaging [10].

While several eHealth or computerized coaching systems have been implemented, one of their limitation is that they are hard to reuse in slightly different settings [17, 19]. Often the code is not publicly available under a permissive license, limiting the application and the impact of such solutions. Conversely, the

system is not designed to be reused: documentation is inadequate, components are not modular, or software engineering standards are not used. In this context, we have developed Perfect Fit. It is an open-source system that implements a text-based VC that combines big-data science, sensor technology, and personalized real-time feedback for individuals to achieve and maintain abstinence from smoking and sufficient physical activity, preventing CVD, facilitating wellbeing and reducing healthcare costs.

## 2 Perfect Fit system

Perfect Fit is a modular open-source and reusable system, where different components work synergistically, as shown in Figure 1.



**Figure 1: Perfect Fit components. The core modules, the connections among them and with external services are shown.**

The core of the system is the open-source text- and voice-based contextual assistant Rasa<sup>1</sup> [4]. Rasa is a machine learning framework, that provides automated conversations based on personalized contexts, that can be connected to messaging and voice services through standard interfaces. Perfect Fit leverages the Rasa framework, for the development of custom conversation flows. Such logics are used to guide the VC behaviour leveraging the Self-regulation Theory (SRT [5, 6, 9, 14]) and the Relapse Prevention Model (RPM [16]), and are nested into the conversation flow to provide an evidence-based coaching approach. To this aim, a combination of conversation rules set in the Rasa framework and devoted algorithms developed to personalize the coaching activities (e.g., personalizing a PA plan, providing coping strategies) are used to drive the conversation [1, 2]. The algorithms are connected to Rasa through a Python interface. The VC intervention effect shall be maximized using a personalized data-driven approach. Thus, meaningful information on the users have to be collected, stored and processed to be used during the conversations. To this aim an SQL database has been developed and connected to the system. The database stores information about the user profile (e.g., age, gender.) as well as conversation data (e.g., answers to specific questions, preferences). To allow the VC to asynchronously initiate

the conversation, a scheduler has been created using the open-source Celery system<sup>2</sup> for tasks queuing. The scheduler can be used to ask questions for collecting information in predefined timepoints used to check and track the status of the user. In the configuration described, Perfect Fit is designed as an intelligent conversational agent for smoking cessation, that can be integrated with different messaging channels using standard or custom interfaces. This approach makes Perfect Fit a solution easily adaptable to a large set of configurations and purposes. For example, Perfect Fit can be used to conduct research on VCs adoption or it can be used as an add on to existing widespread messaging services for the provision of virtual coaching. To guarantee the system reusability and accessibility, Perfect Fit [4] is publicly available under open-source license in GitHub<sup>3</sup>. Perfect Fit aims at delivering a robust system to obtain high quality, reproducible results from the research conducted using the system. For this reason, the best practice and standards in software engineering have been adopted [7] and documented in the design and development phases. Currently, Perfect Fit is in a prototype phase, and the development must be finalized. The evaluation of the Perfect Fit approach in real-life will be conducted through a trial. The group of involved subjects will be using Perfect Fit for smoking cessation and abstinence maintenance, and for PA planning and stimulation. To this aim, the conversational engine has been connected to the NiceDay App<sup>4</sup>, an application that provides the possibility to chat with a therapist to be supported in mental health care. In this configuration, the therapist is substituted by the VC, with which the users can interact through the chat. The two systems have been integrated using connectors developed *ad hoc*. Moreover, in this configuration, Perfect Fit has been equipped with additional connectors to allow the use of data acquired through movement sensors in free-living conditions. Such data can be used to obtain a quantitative evaluation of the PA of the user and, thus, produce personalized suggestions.

## 3 Conclusions

A new VC system for the administration of conversational coaching for smoking cessation and PA has been described. The Perfect Fit approach is based on scientifically grounded evidences on life-style changes strategies and virtual coaching applied to health. From the technical point of view, Perfect Fit has been developed according to the principles of reusability and open-sourcing. This approach makes Perfect Fit a solution readily available for conducting further research, enhancing its potential impact on the reduction of CVD risk factors. The development phase has to be completed in order to enable the conduction of a trial to validate the approach on a group of real users.

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<sup>1</sup> <https://github.com/RasaHQ/rasa>

<sup>2</sup> <https://github.com/celery/celery>

<sup>3</sup> <https://github.com/PerfectFit-project/virtual-coach-main>

<sup>4</sup> <https://niceday.app/en/home/>

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