Situation awareness in the speech therapy domain: A systematic mapping study[☆]

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Abstract

Situation Awareness (SA) involves the correct interpretation of a situation, allowing a system to respond to the observed environment and providing support for decision making in many systems domains. Speech therapy is an example of domain where situation awareness can provide benefits, since practitioners should monitor the patient in order to perform therapeutic actions. However, there are a few studies in the area that address reasoning about a situation to improve these tasks. For this reason, this systematic mapping study aims to identify and compare different proposals in the speech therapy domain in order to verify which aspects related to obtaining and maintaining SA are supported. Our analyzes provide useful insights on whats aspects of SA are best integrated in the speech domain - such as knowledge bases and adaptation - and other aspects that remain to be improved - like the action support and projection abilities. Also, this paper includes statistics, methodologies used by different authors and other issues involving research processes. As main contributions, this work presents an overview of the SA integration in the speech therapy domain, discussing challenges in the area and providing directions for further research.
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1. Introduction

Situation-Awareness (SA) has been recognized as an important and yet unsolved issue in many different domains, including physical cyber-security systems, epidemic monitoring and control, intelligent transportation systems, among others (Kokar and Endsley, 2012). The term has been developed simultaneously with the growth of problems **Q3** interconnected to human factors, since they require skills of perception and decision making. According to Endsley (1995), "*practitioners must deal with human performance in tasks that are primarily physical or perceptual, as well*

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7   *as consider human behavior involving highly complex cognitive tasks"*. So it is evident the need for evaluating dif-
8   ferent context information and conducting actions according to such information.

9   The implementation of SA in systems is a complex task, which involves a high level of dynamics: it is necessary
10 to collect contextual information about the environment (usually from different sources), make decisions based on
11 this collection, act according to decisions, gather feedback from the environment to complement existing knowledge
12 and thus, make better decisions in the future (Kokar and Endsley, 2012). A variety of situation-aware systems have
13 been presented in the health area, concerning risk prevention and patient monitoring. We can mention, for example,
14 the use of Assistive Technology Devices (ATDs), which are responsible for observing the individual through sensors
15 and provide, if necessary, suitable measures according to the analysis of his/her behavior. However, in the speech
16 therapy domain, there are few studies that use knowledge modeling and interpretation of situations to improve tasks
17 such as diagnosis, therapy planning and therapeutic intervention (Chuchuca-Méndez et al., 2016).

18   In terms of speech therapy, situation-aware systems represent powerful tools that can provide benefits for both
19 patient and clinician. Firstly, it allows the patient to extend the sessions of face-to-face therapy, performing exercises
20 in any environment. In these cases, a situation-aware system is able to capture data about the patient's speech, under-
21 stand the current situation and execute actions without any intervention (the system can exhibit, for example, cus-
22 tomized exercises according to the last calculated performances). On the side of the therapist, situation-aware
23 systems can monitor the health status of the patient and predict future situations. Through this prediction, the clini-
24 cian can make better informed decisions, since it is possible to achieve a good level of comprehension about the
25 patient's condition and actions that need to be taken (Frost and Gabrielli, 2013).

26   Considering the great improvements that situation awareness can bring to speech therapy, the insufficient number
27 of studies in the area that use SA is the main research problem addressed in this paper. It is necessary to understand
28 which barriers prevent the effective SA integration in existing methodologies, so that future researches can identify
29 measures to be taken in the development of situation-aware speech therapy systems. In addition, if speech therapy
30 systems can be aware of the situations that involve them, these systems can become more efficient and intelligent in
31 the provision of services to users (patients or therapists), representing a great advance for the area in general.

32   From the issues mentioned and the wide scope of the topic, this systematic mapping study (SMS) aims to identify
33 characteristics of situation awareness that remain a challenge for the construction of speech therapy systems. More
34 specifically, this SMS address studies in the speech therapy domain that cover aspects of SA, assessing what has
35 been done so far with regard to situation awareness. Based on the approach presented by Salfinger et al. (2013), we
36 assess whether the selected papers are able to gain and maintain SA, according to the criteria pointed by the authors.
37 As results and main contributions, this SMS (1) exposes research problems encountered by different authors and
38 how they proposed effective solutions, (2) analyzes the proposals based on SA criteria in order to identify relevant
39 characteristics, (3) presents techniques and methodologies in the speech therapy domain and (4) discusses the chal-
40 lenges and open research possibilities in the area.

41   The structure of the paper is presented as follows. In the next section we present the dimensions of research. In
42 Section 3 we present the method used to select the papers of the systematic mapping. In Section 4 we present criteria
43 for obtaining and maintaining SA. The Section 5 presents the papers selected in this study. In Section 6 we present
44 the analyzes and discuss the results obtained. We conclude with our remarks in Section 7.

2. Dimensions of research

46   This section presents concepts related to knowledge areas involved in this SMS, including context-awareness, SA
47 and situation-aware systems in health and speech-language domain.

2.1. Context-awareness

49   Context can be interpreted as a set of aspects about the state of entities in an environment, which allow the model-
50 ing of adaptive systems. The classic definition of the term is given by Dey (2001), who defines context as *"any infor-
51 mation that can be used to characterize the situation of an entity (person, place or object) that is considered relevant
52 to the interaction between the user and an application, including the user and application themselves"*.

53   Acquiring context awareness is the first step in a hierarchy to acquire SA (Fig. 1). From contextual information
54 captured by sensors, it is possible to abstract one or more situations of interest and obtain knowledge of the events