Leveraging Common-Sense in Human Activity Recognition

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***Abstract*—The purpose of this research proposal is mainly intended to justify the feasibility and potential benefits that could be obtained from a comprehensive approach to activity recognition, based on the combination of action descriptors, sensor values, and common-sense knowledge.**

***Keywords*-component; formatting; style; styling;**

I. INTRODUCTION

The main purpose of the proposal here outlined is to advocate the potential benefits that could be drawn from encompassing the theories of common-sense world to the activity recognition tasks. In this regard, a common-sense approach to action inferencing has already been successfully exploited in the field Ambient Intelligence. It seems therefore plausible that the same approach could be also extrapolated to the field of Human Activity Recognition. Basically, the only difference that distinguishes both fields of knowledge is the information sources. In the Ambient Intelligence case, information is coming from a wide variety of sources (basically sensors) while in the latter, information is coming from body sensors and action descriptors. In any case, this information can be contrasted to the knowledge about how the world works, or the so called common sense knowledge, in order to semantically drive the action inferencing.

Additionally, action inferencing can also benefits from the knowledge of the situation that is taking place in the surrounded context. This cognitive capability is therefore dependent on the ability to perform causal explanations of the facts, that come in the shape of sensor values and action descriptors. According to Davidson [1], the reason that motivates an action also rationalizes it, and therefore, this research proposal is also grounded in the working hypothesis that an appropriate philosophy of actions should be adopted so as to support the aforementioned cognitive and understanding demands.

This reference to cognitive and understanding capabilities basically alludes to the need to interpret the facts provided by sensors and video processing applications as constituent parts of an ongoing situation. The *situation* notion is used here, in the same way proposed by McCarthy [3], so as to model world changes as a result of actions and events taking place in it. The followed approach when it comes to model actions and events basically consists in describing the world before the action takes place and afterwards. It is possible to determine the set of possible actions by selecting those that drive the context, given the initial state, to the current situation.

To the best of my knowledge, some activities have already been undertaken in this regard, although from the perspective of indoor mobile robots [2][4]. The common-sense source of knowledge of existing approaches are either provided by OpenMind[1] or OpenCyc[2]. Although it is out of the scope of this research proposal draft to undertake a thorough comparison of existing systems for common sense, it can be noticed that the first system simply provides knowledge base capabilities. This means that OpenMind lacks of an inference and reasoning engine while OpenCyc, apart from being a restricted version of the commercial project, and it therefore provides a limited reasoning and inference capabilities, it also counts on inappropriate means to manage actions and events. On the contrary, the Scone systems[3] models the knowledge about events and actions in terms of the context state or world-model just before the action or the event takes place, and the context state immediately after the action.

In this sense, my research in Ambient Intelligence has been mainly devoted to context modeling and understanding, and to the implementation of behavioral responses. For this endeavour I have trusted Scone to hold the context domain knowledge, and to perform reasoning tasks.

II. AIMS AND OBJECTIVES

The main working hypothesis of this research proposal is grounded in the conviction that activity recognition tasks can be enhanced with common-sense knowledge and reasoning capabilities. Human poses and motion data can be combined with the conclusions yielded from the context understanding process in order to support a high level activity recognition task.

[1] http://openmind.hri-us.com/login.jsp
[2] http://www.opencyc.org/
[3] http://www.cs.cmu.edu/~sef/scone/

The aims and objectives of this research proposal can be summarized as follows:

1) To characterize and model the set of activities and actions that are being considered for the prototyped implementation. It has to be noticed that Scone, in contrast to OpenMind or OpenCyc, does not count on a large knowledge base of asserted knowledge.
2) To parameterize and model the context in which such activities are being considered. In order to support the activity recognition upon the conclusions drawn from the context understanding, it is necessary to previously describe the context in which those activities are being considered. For example, the same actions undertaken in different contexts might have different meaning. The action of lying down when performed in the room has a completely different meaning than when it is being performed in the kitchen. The last situation might be suggestive of a falling.
3) To design and implement a reverse action planning algorithm. It is a reverse planning algorithm since it starts from the set of action effects that have been captured from the context sensors. The action planning is intended to yield the action that might have caused the sensed effects. Additionally, the action might also suggest the primary reason that has motivated the action to take place. For example, from figuring out that a person is cooking it is possible to infer that the person is likely to be hungry.
4) To design a prototyped architecture to evaluate and validate the expected outcomes of the proposal. In order to compare the achieved results with existing approaches it is necessary to assess the solution responses by means of a prototyped implementation.
5) To devise a gateway mechanism to assert contextual facts into the Scone Knowledge-Base and to retrieve query responses from the Scone reasoning engine.

III. Conclusion

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Acknowledgment

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