Towards an Approach for Generating iStar Goal Models from Journey Maps

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***Abstract*—In contemporary software engineering practices, understanding user requirements and translating them into models is essential for effective system design and development. User journey maps offer a holistic view of user interactions with a system, while iStar goal models provide a structured representation of system goals and dependencies. This paper presents an ongoing effort to design an approach for generating iStar goal models from user journey maps. We propose a mapping between journey maps elements and iStar elements. Generating goal models from journey maps proves to be a non-trivial undertaking. Throughout this paper, we delve into various challenges encountered in this process and propose potential solutions to address them.**

***Index Terms*—Goal models, Journey maps, iStar**

I. Introduction

Companies are increasingly interested in providing positive customer experiences. They aim to offer a smooth and pleasant experiences with their consumer facing applications [1]. Journey maps, also known as experience maps or customer experience maps, have been growing in popularity in the design fields such as user experience (UX) design, customer experience and interaction design, over the last decade [1]. As the name suggests, journey maps provide a graphical visualization of a user's experience with a product, a service or a system. It aims to discover the journey, as it is experienced by users themselves [2]. It is designed in a collaborative manner with the participation of real users. Thus, Journey maps offer valuable insights into user interactions focusing on achieving specific goals such as buying a car, health monitoring, getting in a better shape, and others. However, their informal descriptions make them challenging to use directly in requirements analysis.

To address this limitation, we advocate for the transformation of journey maps into goal models. Such transformation has many advantages for requirements analysis. First, goal models provide a more systematic approach to incorporate user-centered requirements derived from journey maps, by allowing the traceability between goals and requirements. Second, this transformation will facilitate analyzing the resulting goals for consistency and correctness, potentially revealing conflicts between user objectives and system requirements. For instance, in a health app, *users* may prioritize detailed nutritional information for food tracking, whereas the *system* may prioritize minimizing data storage for optimal app performance [3]. Third, goal models enable the identification of requirements trade-offs, since goals are usually related to system requirements where sacrificing or compromising one requirement is necessary to achieve a balance between conflicting objectives. Finally, goal models can be evaluated to compute satisfaction scores that assess the degree to which goals are satisfied within a journey map [3].

To tackle this challenge, we are currently working on a model transformation approach to transform user journey maps into iStar goal models. We chose iStar, among other goal modelling frameworks, because it includes social interaction elements, which are crucial for capturing the dynamic relationships and dependencies between users, systems, and other stakeholders [4].

The remainder of the paper is organised as follows. Section II describes the background of journey maps and goal models, and discusses related work. Section III presents the mapping between journey map elements and iStar elements. Section IV discusses the challenges behind the generation of goal models from journey maps. We conclude the paper in Section V.

II. Background and Related Work

A. Journey Maps

Journey maps add a third dimension to traditional personas by focusing on a diachronic outline of a user's experience with a product over time [5]. Journey maps provide a graphical visualization or a map of a customer's or user's experience with the product and the business or organization which produced it. It maps significant changes in the user's needs, and degrees of satisfaction with the product [2]. Journey mapping combines two powerful instruments: storytelling and visualization, which are effective mechanisms for conveying information in a way that is memorable, concise and that creates a shared vision.

Typically, journey maps display the major phases of a user's experience along a horizontal axis of the visual to show the progression of time, as shown in the example of Table I. Along the vertical axis, designers will then add categories or metrics of particular interest [1], [2], [5]:

- Stages: represent the key phases that users go through when engaging with a product or service. They may vary depending on the specific context and nature of the user journey. For example, in the context of a purchase, we generally find three phases: pre-purchase, purchase and post-purchase.
- Channel: represents the medium or platform through which users interact with a product, service or the system.
- Actions: represent the tasks that users performs as they progress through various stages of their experience.
- Goals: represent the objectives that users aim to achieve while interacting with a product, service or system. The goals drive the user's actions and decisions throughout their journey.
- Thinking: represents the cognitive process and mental activities that users engage in as they interact with a product, service or a system.
- Feeling and emotions: represent the emotional responses, attitudes and reactions that users experience at different stages of their interactions during the experience.
- Pain points: represent specific problems, frustrations, or challenges that users encounter during their experience. They represent areas in the experience where users experience difficulty in achieving their goals or completing their tasks effectively.
- Touchpoints: refer to specific moments or interactions where users come into contact with a product, service, or system.

Journey mapping techniques serve different domains, purposes and audiences. We distinguish three techniques of journey mapping according to the application domain: User Journey map, Customer journey map and patient journey map. User journey maps are used primarily in the fields of product design, user experience design and software development, to understand how users engage with digital products or platforms [1]. Customer journey maps are used in marketing, sales, and customer experience design to understand and improve the overall customer experience [6]. Patient journey mapping is used in healthcare and patient experience improvement initiatives to understand and optimize the patient experience, care delivery processes and clinical pathways [7].

B. Journey maps and requirements engineering

Journey mapping is rarely explored from the point of view of requirements engineering. According to [1], journey mapping has its roots in story mapping, a well-known and proven method in agile development. Although the methods of story mapping and user journey mapping sound similar, they are nevertheless quite different in purpose, setup and outcome. User story mapping is rooted in agile software development. It aims for a minimal viable product and serves to understand the functionality of the system under development. A story map might be performed by a single person. It requires neither collaboration nor the involvement of users, or any documentation of reported usage problems: it relies on the knowledge of the person or team performing the mapping [1]. User journey mapping, on the other hand, is done at the beginning of a UX project in order to ease the learning about relevant user processes. It aims to discover needs for user research, as well as the journey, as it is experienced by users themselves. It is performed in a decidedly collaborative manner and best done with the participation of real users. Therefore, the main difference between story mapping and user journey mapping is their views regarding requirements [1].

In [8], the authors used customer journey mapping for requirements elicitation. They proposed a multidisciplinary workshop for well-being applications based on a design thinking methodology, to build empathy with users by understanding their functional and emotional needs using customer journey maps (CJM). Authors proposed to embed online and offline customer journeys because this offers a whole story that the users can become part of and help them manage their emotional needs through small intervention. They argue that such a combination has the potential to create an application where users become attached to and engaged with, and eventually improve their well being.

C. Journey maps modelling languages

Some research efforts proposed modelling languages for journey maps. However, these approaches lacks some elements of journey maps. In [9], the authors introduced a modeling language called *Customer Journey Mapping*. The modeling language focuses on the conceptualization of touchpoints rather than the entire journey.

Similarly, in [10], users were involved in developing a modeling language for customer journeys (CJML). In [11], an approach was presented to map customer journey maps and BPMN. In past work [12], we modeled customer journeys using the Case Management Model and Notation (CMMN) language, an OMG standard for modeling case management/flexible processes. However, these notations lack many elements of journey maps.

D. Goal models : iStar

Goal models are representations used in requirements engineering to capture, analyse and communicate the goals that a system aims to achieve.

There are several approaches for creating goal models, each with its own techniques and notations, like iStar, Kaos, GRL, and Tropos. Among these approaches, iStar was used with socio-technical systems, and systems that involve human-centered aspects. The iStar is a framework and a language for modeling and reasoning about social (who?), intentional (why?) and strategic aspects (how?) of software systems. iStar was applied in various domains, such as healthcare systems, eCommerce, business modeling, security analysis and others [5].

The iStar language represents the social characteristics of systems in terms of actors, their intentions, and relationships. *Actors* can be of type *Role* or *Agent*. Actors aim to achieve their goals in collaboration with other actors and are graphically represented as circles.

Stage	Initial Diagnosis and Onboarding	Daily Monitoring and Management	Ongoing Support and Education
Channel	· Primary Care Clinic	· Monitoring application	· Monitoring application
Actions	· Receive diabetes diagnosis. · Download diabetes management app. · Connect IoT devices.	· Measure blood glucose levels using IoT glucometer. · Log meals, activity, and medication. · Receive real-time feedback from app.	· Access app resources for meal planning and exercise. · Connect with peers in app's online community.
Goals	· Understand diagnosis and implications of diabetes.	· Maintain target glucose levels.	· Connect with peers and professionals for advice.
Thinking	· Curious about technology's role in diabetes management. · Integrating new technology into routine.	· Reflecting on daily habits' impact on glucose levels. · Planning adjustments based on monitoring results.	· Seeking information to improve management skills. · Strategies for overcoming challenges and staying motivated.
Feeling	· Anxious about chronic condition. · Hopeful about digital tools' benefits.	· Empowered by real-time data and insights. · Frustrated by occasional tech issues.	· Supported by community. · Frustrated by management setbacks.
Emotions	· Fear, Curiosity, Hope.	· Empowerment, Frustration.	· Support, Frustration
Pain points	· Overwhelmed by technology setup.	· Technical glitches with devices or app. · Overwhelmed by data interpretation.	· Conflicting advice from different sources.
Touchpoints	· Interaction with doctor for diagnosis and recommendation. · Onboarding support from app customer service.	· Customer support for device issues. · Telemedicine check-ins with healthcare provider. · Enter logs in the application.	· Participation in app's education sessions. · Engagement with app's online community for support and advice.

TABLE I
EXAMPLE OF PATIENT JOURNEY FOR DIABETES MONITORING.

Actors are considered to have intentions that are modelled as *goals* to be achieved, *tasks* to be performed, *resources* to be used or *quality, also called softgoal* to be satisfied. These intentions are respectively modelled by: Goals, Tasks, Resources and Softgoals. *Goals* are usually related to functional requirements, whereas *softgoals* are related to non-functional requirements. Graphically, goals are represented as ovals, softgoals as curved shapes, tasks as hexagons, and resources as rectangles.

There are four types of links between intentional elements: refinement, needed-by, contribution, and qualification. There are also dependencies or associations between actors that represent the social aspect, such as part-of, plays, covers, occupies, instantiates, etc. [4]. Goal models are used for modelling and analysing social systems [3]. Some extensions were proposed in the literature to complement iStar with elements like emotions [13], [14].

III. MAPPING JOURNEY MAPS TO ISTAR MODELS

As a first step, we tried to map journey maps elements to iStar elements, based on their definition, and using the example of the IoT diabetes monitoring application for illustration (see Table I). We first discuss the input format of journey maps. Second, we propose a preliminary mapping between the elements of journey maps and iStar elements. Finally, we discuss validation strategies for the mapping and the generation process.

A. Journey maps input format

Designers use different templates with different elements. In this paper, we tried to capture the most used elements in the literature (section II-A). We will formalise journey maps by extending the metamodel proposed by [10] with journey map elements defined in II-A, such as emotions, pain points, etc. Based on this metamodel, we plan to build an editor to assist the designers and software engineers to specify the journey maps. Such tool will also guide the transformation of the journey maps to iStar goal models.

B. A preliminary mapping

In the following, we discuss a preliminary mapping between journey map elements and iStar elements.

Stages represent the various phases of an experience. iStar lacks a dedicated element to systematically represent these stages. Stages will be conceptualized as high-level goals. For instance, consider IoT diabetes monitoring, where the stage Daily *monitoring and management* can be defined as a high-level goal, as depicted in table I.

Channels are the mediums or platforms through which actors interact, such as *the diabetes monitoring application*. If a channel acts independently to achieve its goals, collaborating with other actors, it may be represented as an actor in the goal model. However, if the channel is not autonomous, like a *chatbot*, interacting with users, within an e-commerce website, it may be represented as a resource in the goal model.

Actions in journey maps represent the tasks that the user performs as they progress through the various stages. Tasks in goal modelling are defined as actions that an actor wants to execute to achieve a goal [4]. Actions and tasks have the same definition. Consequently, actions in journey maps are transformed to tasks in goal models.

Goals in journey maps and goal models have the same definition. In both models, goals represent objectives that users aim to achieve. iStar definition of the goal emphasises that it has clear-cut criteria of achievement [4].

Thinking in journey maps refers the user thoughts, perceptions and decision-making processes throughout their journey. These can be correlated with the *belief* element in iStar, which represents the user's perceptions about the world that he or she assumes to be true [15]. Note that the *belief* element was removed from iStar 2.0 [4].

Feeling and emotions represent the emotional responses, attitudes and reactions that users experience at different stages of the journey. Many research efforts tried to represent emotions in goal models. In [5], human aspects were presented as quality goals (softgoals), where the quality goal represented the level of achievement the actor desires. However, in [14], the author argued that softgoals and emotions ”*are not actually the same, in the sense that quality requirements are nonfunctional requirements at the system level (i.e., such as reliability, effectiveness, usability, etc.), whereas emotion-oriented requirements are user-centric requirements that describe the user’s perceptions, feelings, and emotions generated from users’ experience with the system.*”. At this preliminary stage, we will map emotions to softgoals. Negative emotions can *hurt* some tasks or softgoals and positive emotions can help to *make* tasks or goals. We express this relations using contribution links. In future iterations, we plan to expand our mapping with the use of other works that extended goal models with emotions [13].

Pain points indicate the areas within an experience where users encounter obstacles when performing tasks effectively. Currently, iStar does not propose an element to represent pain points. To address this gap, we propose to add a new element, called ”pain point” or ”obstacle,” linked negatively to iStar *tasks* through a contribution link. The latter denotes the obstructive impact of the ”pain point” element.

Touchpoints are the points of contact between the user and the system, product, or service [16]. Touchpoints are important in journey maps because they alter the way the user perceives the experience. In [17], authors identified three constructs for touch points: the Stimulus, Interface, and the Encounter. The *Stimulus* is a perceptible element offering a potential encounter with a specific *function* or *objective* to the customer. The Interface carries a collection of touchpoints, mediates Stimuli, and facilitates Encounters. The Encounter is the actual moment or an interval of contact of a customer with a touchpoint at a point in time. The Stimuli and Interfaces are the elements to be designed in the system that the user interacts with. For example, for the touchpoint *”Engagement with app’s online community for support and advice”*. *The app’s online community* is the *interface* and *support and advice* is the *stimuli*. According to this example : *Interface* is mapped to a *resource* and *stimuli* is mapped to a *goal*.

We applied these transformation to the goal *maintain target glucose levels* in accordance with the transformation of the patient journey map depicted in table I to iStar elements. Table 1 shows the result of the transformation.

C. Validation strategies

This mapping needs to be improved by establishing clear rules that consider the semantics and characteristics of both representations. We plan to conduct experimental studies to validate the proposed transformations with domain experts from the design fields (user experience, customer experience and interaction design) and goal-oriented RE field to review the proposed mapping rules. Experts can provide valuable insights and identify potential inconsistencies or ambiguities. We also consider user feedback to evaluate the usability and effectiveness of the mapping. We will iterate to improve the mapping based on feedback and insights gained from the validation process. This may involve refining mapping rules, revising mappings based on empirical findings, and addressing any identified issues or concerns.

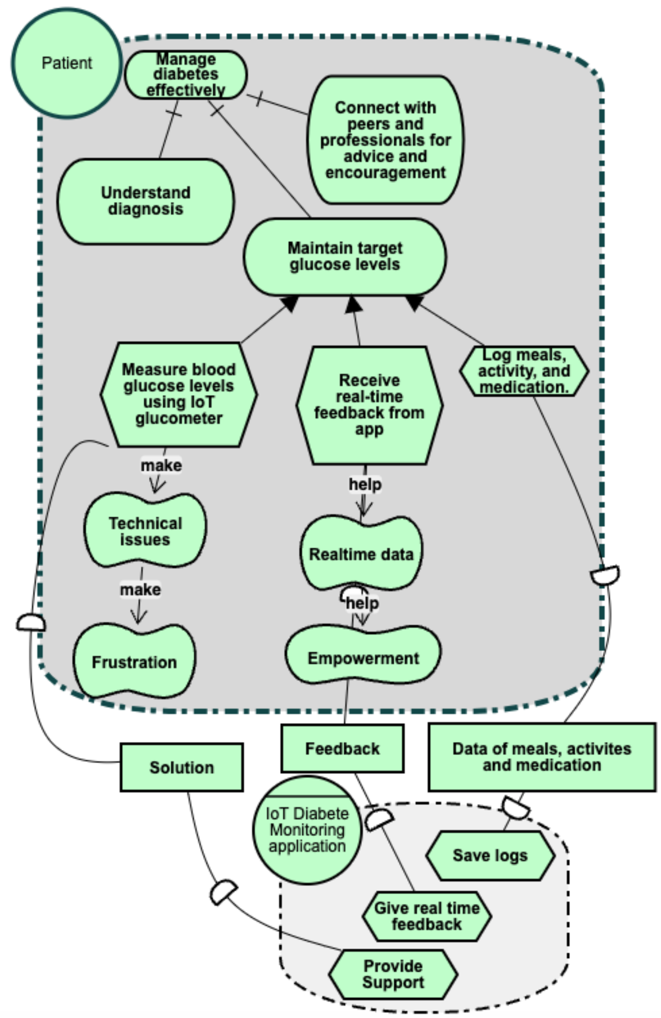

Fig. 1. Refining the Goal *maintain target glucose levels* in accordance with the transformation of the patient journey map depicted in Table I to iStar elements.

IV. Generating iStar Models from Journey Maps : Challenges

Generating goal models from journey maps is not a trivial task. In the following, we explain the different challenges that we faced when trying to generate iStar models from journey maps.

The first challenge, *the user journey primarily reflects the user’s perspective*, offering numerous advantages such as heightened empathy and insight into user experiences. However, it may neglect to emphasize the roles and perspectives of other actors involved in the process. In this paper, we argue that information about touchpoints provides us with insights into the actors that assist the users in achieving their goals. However, descriptions of touchpoints may be vague. From this perspective, we aim to employ natural language processing techniques to analyze touchpoints and other elements of journey maps, in order to map them to elements in goal models.

Second, *complexity escalates as the scope and level of detail in both journey maps and goal models expand*. Complex user journeys with multiple interactions and potential goals involve meticulous analysis and mapping to construct comprehensive goal models. Journeys involving numerous actors, systems, touchpoints, and channels (e.g., omnichannel and multichannel marketing) further increasing this complexity. Additionally, journeys may vary based on user categories, represented by personas, i.e. stereotyped user profiles [5]. To address these challenges, we adopt an iterative approach, beginning with simple examples and gradually increasing complexity.

V. Conclusion

User journey maps offer a holistic view of user interactions with a system, while iStar goal models provide a structured representation of system goals and dependencies. In this paper, we presented an ongoing effort to develop an approach for generating iStar goal models from user journey maps. We proposed a mapping between journey maps elements and iStar elements. Finally, we delved into various challenges encountered in this process and propose potential solutions to address them.

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