

Table 5 Realism of the evaluations

表 5 评估的现实性

M	EC	Subjects	S	#	P_n
CS	I	Practitioners	S1	6	p1,p4,p20,p31,p34,p52
CS	A	Researchers	S2	30	p2,p7,p8,p9,p11,p12,p15,p17,p22,p23,p24,p26,p33,p38,p40,p41,p43,p50,p53,p59,p60,p67,p78,p80,p81,p85,p87,p88,p90,p91
CS	I	Researchers	S2	2	p18,p47
CS	A	Researchers	S3	2	p19,p28
CS	I	Students	S3	1	p25
CS	A	Practitioners	S2	1	p30
CS	I	Practitioners	S2	1	p48
CS	A	Researchers	S1	1	p57
CS	A	Practitioners	S1	1	p58
CS	I	Practitioners	S3	1	p64
CS	A	Students	S1	1	p61
FS	I	Practitioners	S3	1	p45
LH	I	Researchers	S3	2	p16,p29
LH	A	Researchers	S2	4	p27,p51,p69,p82
LH	A	Practitioners	S2	1	p62
LH	A	Students	S3	1	p63
LH	I	Practitioners	S1	3	p42,p49,p73
LH	A	Researchers	S3	2	p46,p84
LH	A	Practitioners	S3	3	p3,p5,p54
LH	A	Researchers	S1	2	p39,p66
LH	I	Researchers	S1	1	p68
LS	A	Researchers	S2	10	p10,p32,p55,p70,p71,p75,p83,p86,p89,p92
LS	I	Practitioners	S1	2	p14,p56
LS	A	Researchers	S3	5	p21,p35,p37,p44,p76
LS	A	Researchers	S1	3	p36,p74,p77
LS	I	Researchers	S1	2	p72,p79
LL	A	Researchers	S2	2	p6,p13
LL	I	Practitioners	S1	1	p65

注:M:评估方法;EC:评估上下文;S:评估规模;#:论文数量;P_n:文章编号;CS:案例研究;FS:实地考察;
 LH:以人为主的实验;LS:以软件为主的实验;LL:经验总结;I:工业界;A:学术界;S1:工业级评估;
 S2:简单示例;S3:中小规模真实案例

从表 5 中我们可以发现:

- (1) 研究中对作者提出的方法进行验证最常用的情景是在学术界由研究者用案例研究的方法以一个简单示例进行验证;
- (2) 只有 11 篇论文是在工业界由实践者以工业级进行评估的(表中以阴影形式表示).

以上分析可知:在情景敏感的需求获取与建模的经验型研究中,技术转移的成熟度是不高的.

3.5 问题5:技术在工业中实际采用的程度

为了验证研究文献中实验的质量,我们将实验上下文、实验设计和实验验证分别分为强、中、弱这 3 个等级^[46].强是指描述详细且有组织性,中是指有简单的说明,弱是指没有提及.详细数据见表 6.

从表 6 中我们可以发现:

- (1) 实验设计在所有的文献中均有描述,即被标记为“中”以上,这是因为在经验型研究中,实验设计是必要的部分.而实验上下文和实验验证部分经常被大家所忽视.只有 7 篇论文在 3 个属性上得分均为强,当每个属性均为强时,实验结果是最令人信服的.因此,为了提高技术转移的可信度,对实验上下文和实验验证的描述应该加强.
- (2) 与其他方法相比,由软件为主的实验在 3 个属性上评级为强和中的最多.这是合理的,因为实验的上下文更容易描述且很多统计分析的方法可以对实验结果进行验证.

Table 6 Evaluation of the state of the actual adoption of technologies in the industrial**表 6** 技术在工业中实际采用的程度评估

M.	CD	SD	VD	#	P_n
CS	强	强	强	2	p1,p52
CS	弱	中	中	4	p2,p9,p12,p50
CS	强	强	中	2	p4,p48
CS	中	强	弱	4	p7,p30,p34,p57
CS	弱	中	弱	20	p8,p11,p15,p23,p28,p43,p47,p53,p59,p60,p64,p67,p78,p80,p81,p85,p87,p88,p90,p91
CS	弱	强	弱	8	p17,p22,p24,p26,p33,p38,p40,p41
CS	强	中	弱	2	p18,p25
CS	中	强	强	3	p19,p31,p61
CS	弱	强	强	1	p20
CS	中	强	中	1	p58
FS	中	强	弱	1	p45
LH	中	强	中	1	p16
LH	中	中	强	1	p27
LH	强	强	弱	1	p29
LH	中	强	强	4	p42,p49,p68,p84
LH	中	中	中	2	p46,p82
LH	弱	中	中	1	p51
LH	强	强	强	1	p54
LH	弱	中	强	1	p39
LH	弱	中	弱	3	p3,p62,p69
LH	强	中	弱	1	p5
LH	强	中	中	1	p63
LH	中	中	弱	2	p66,p73
LS	弱	强	强	3	p44,p10,p32
LS	强	强	强	4	p14,p35,p36,p77
LS	中	强	强	2	p21,p37
LS	弱	中	中	2	p55,p92
LS	弱	强	中	1	p76
LS	弱	中	弱	7	p70,p71,p74,p75,p83,p86,p89
LS	中	强	弱	2	p56,p72
LS	中	强	中	1	p79
LL	弱	中	弱	1	p6
LL	中	中	弱	1	p13
LL	中	强	弱	1	p65

注:M:评估方法;CD:实验上下文;SD:实验设计;VD:实验验证;#、P_n、CS、FS、LH、LS、LL 同表 5

4 效度威胁

尽管我们严格按照系统文献综述的过程来实施综述,但效度威胁是不可完全避免的,以下效度威胁仍然可能会存在.

- 遗漏相关文献

尽管我们根据软件工程中常用的数据库选择了搜索库,但遗漏相关文献的可能性仍然存在.因此,我们进行了“滚雪球”的过程,并找到了 5 篇相关文献,从而降低了相关的效度威胁.文中选择和分析了用英文和中文书写的文章,英文是学术论文中常用的语言,又加入了中文文献扩大了调研的范围,因此这个效度威胁是可以接受的.

- 实验与方法的能力差异

文中在总结各方法对情景维度的支持情况时,主要是根据方法描述、实验或案例来统计分析的,可能导致分析结果与方法本身能力存在差异.但由于作者总是选择最适合体现自己方法能力和特色的视角描述,因此这个差异是可以接受的,分析结果是合理的.

- 潜在个人偏见

研究者的个人偏见可能会对分析结果产生影响,为了消除这种偏见,文献过滤和数据抽取的过程由第一作

者和第三作者各自独立完成,并对结果进行交叉,结果不一致时由两人进行讨论达成统一意见.当两人意见不能统一时,将不一致内容及各自理由提交到仲裁小组,由仲裁小组决定.仲裁小组由 1 名博士生导师、3 名博士和 3 名硕士组成.

5 相关工作

近年来,有研究者对相关研究进行了一定的总结,并发表相关研究文献.详细情况见表 7,其中,Sreethar 等人主要关注于从服务目录、中间件基础设施和情景发现协议等方面发现情景感知服务的最新研究进展^[73]; Bencomo 等人主要讨论了在自适应系统中不确定性所扮演的角色,并讨论了相关的研究挑战和已有的解决方案^[74]; Wiesner 阐述了在物联网系统中需求工程面临的挑战^[75]; Almaliki 等人使用专家调研的方式来识别社会适应性的核心优势和面临的挑战^[76]; Yang 等人主要关注于自适应系统的需求建模和分析研究^[15]; Hong 等人提出了一个情景感知系统的分类框架,该框架包括概念与研究层、网络层、中间件层、应用层和用户基础层,可指导情景感知系统的开发^[77]; Alegre 等人分析了情景感知系统的开发方法及其没有广泛采用的原因,并分析了情景感知系统开发过程中面临的挑战和应用的技术^[78].尽管在这些文章中也涉及了情景敏感的需求相关的内容,但其研究问题和关注点与本文差异很大.在本文中,我们研究情景维度对于需求获取与建模的支持情况,总结情景感知的需求获取与建模的方法,并分析了在本领域中经验研究方法的技术转移成熟度.

Table 7 Related works

表 7 相关研究

文献	方法	主题
[73]	调查研究	普适计算环境下情景感知的服务发现
[74]	综述	自适应系统中的需求现状与挑战
[75]	综述	物联网系统中需求工程的挑战
[76]	综述	需求驱动的社会适应性研究
[15]	系统文献综述	自适应系统中需求的建模与分析研究
[77]	系统文献综述	情景感知系统的分类框架
[78]	综述	情景感知系统工程化的开发方法
本文	系统文献综述	情景维度对于需求获取与建模的支持;情景感知的需求获取与建模的常用方法与应用;本领域中研究方法的技术转移成熟度

6 结论与展望

6.1 结论

情景感知的需求获取与建模研究得到了包括软件工程、人机交互与普适计算、人工智能等领域研究者的广泛关注,具体进展情况如下.

- 情景感知的需求获取方法
 - 基于群组调查的方法:该类方法的成功实施往往依赖于需求工程师丰富的需求获取经验、对目标领域的深入了解和相关涉众的积极参与,本方法由于交互性不强,通常用来获取静态的情景需求.
 - 基于观察的方法:该类方法通过对用户行为、神态等的观察分析实现情景感知的需求获取.由于观察法只能观察被观察者的行为而无法获知被观察者的意图,因此,当前基于观察的方法往往会将观察法和访谈法、问卷调查法、群组讨论法等方法配合使用,以便将观察法推断的用户意图和行为轨迹与真实的用户意图进行比对,通过情景和行为偏离分析,以获取情景感知的需求.
 - 基于场景的方法:该类方法以其便于描述交互和“一事一例”的特征,使其成为获取情景感知需求最常用的方法.为了增加基于场景的方法对于情景要素的获取与描述能力以及场景获取能力,研究者们主要通过扩展场景描述方法的情景建模能力和提供易操作的过程来指导情景需求的获取.另外,利用工具减轻情景建模的工作量,也是本方面的一个新兴研究方向.

- 基于数据挖掘的方法:该类方法侧重于通过数据分析,更好地理解系统的运行环境、用户偏好和用户行为,从而支持情景需求的抽取,是一类新兴的需求获取方法.该类方法不仅能够解决用户参与需求获取意愿不高、需求描述难以准确完整的问题,对于在无法观测的系统和无法重现的系统过程中获取情景感知的需求也是非常重要的.目前,该类方法在普适计算领域已有广泛应用,但仍然需要大量的手工操作.自动化程度不高、普适性不强是其主要问题.
- 情景感知的需求建模方法
 - 基于模型的方法:该类方法侧重于以提出的情景需求模型为核心描述、组织与分析情景需求.其中,基于通用情景模型描述语言的需求建模方法抽象程度最高、适用范围最广.
 - 基于目标的方法:该类方法侧重于利用目标建模方法中的已有元素(目标、软目标、约束等)对情景需求进行建模;当建模能力不足时,增加新的建模元素,如情景变化点,以支持情景感知的需求建模.
 - 基于问题框架的方法:该类方法侧重于丰富问题框架的类型或形式化定义的描述能力,使其能够满足情景感知的需求建模的需要.
 - 基于逻辑的方法:为了能够更好地建模情景变换引起的系统行为或状态变化,引入了 Petri 网、马尔可夫链等逻辑方法,从而支持情景模型的各种行为分析.
 - 基于图的方法:该类方法通过对常用的 UML 图形如用例图、活动图进行扩展,加入描述情景的元素,从而满足情景感知需求建模的需要;
- 情景感知需求获取与建模方法的技术转移成熟度

对评估方法、评估上下文、评估主体和评估规模对综述中涉及的情景感知的需求获取与建模方法的技术转移成熟度进行分析,结果表明:本领域的研究在论证其提出的方法技术的有效性时,大部分采用的是案例展示,表明本领域研究提出的方法和技术还需要在工业环境中进一步接受检验.

6.2 展 望

综上所述,情景感知的需求获取与建模问题虽然得到了各领域研究人员的广泛关注,但随着移动计算、普适计算、泛在计算的蓬勃发展,构建具有情景感知能力的个性化、智能化应用的需求日益强烈,其获取与建模方法面临的情景需求多样化、动态性和不确定性挑战将成为推动研究向纵深发展的动力.未来的研究方向主要包括以下几个方面.

- 经典需求获取与建模方法的有效利用与改造

访谈法、观察法、场景法、目标法等经典需求获取与建模方法不仅具有简单、高效、易于掌握和被充分检验的特点,而且彼此之间存在优势互补,因而成为构造情景感知的需求获取与建模方法的重要组成成分.在对经典需求获取与建模方法的扩展、选择和组合过程中,充分考虑情景需求来源的多元化、情景需求形式的多样性、情景需求的动态性和不确定性,是本方面未来研究开展的一个重要途径.

- 数据分析方法的有效利用及其与经典方法的融合

数据挖掘与分析是一种被证明行之有效的从情景数据中发现情景需求的重要手段.一方面,如何利用数据挖掘、人工智能领域的最新成果提高情景需求发现的能力,是未来的一个重要研究方向;另一方面,如何将数据分析方法与经典需求获取与建模方法结合起来,使通过数据分析方法获得的情景需求能够得到确认与验证,真正成为可用的情景需求至关重要.

- 自动化的情景需求获取与建模方法

现有的情景感知的需求获取与建模方法大部分是劳动密集型的,情景的获取和建模工作大部分是通过人工分析和记录完成的,工作量大、规范性差、效率低下.在情景感知应用中植入用户友好的情景及情景需求收集模块或单独开发辅助工具辅助情景需求获取与建模,将是未来的发展方向.

- 实证研究的进一步加强

当前,情景感知的需求获取与建模方法普遍存在实验规模较小、验证较弱的现象,这不利于方法被工业界

采纳.因此,开展更多的经验研究来扩大实验的规模、加强实验的验证、提高方法的成熟度,是情景感知需求获取与建模未来的研究方向之一.

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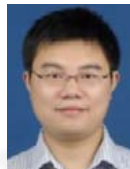
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