究针对多类型信息的内容摘要技术.例如:可将关键帧提取技术应用到测试过程截屏录像中,提取本次测试过程中最具有代表性的帧或错误发现帧;从图片中提取关键错误信息块的技术,则可以帮助审核人员快速地从大量截图信息中确认最有效的错误截图.

### 4.5 测试行为的自动化回放

测试行为的自动回放对程序员定位错误和修订错误具有重大的意义.在众包测试领域,目前使用最为广泛的回放方法包括:要求众包工人使用录屏或者拍摄工具对操作过程进行全程录制,然后提交所录制的数据;通过客户端记录工具记录众包工人的操作行为并生成相应的脚本,然后将脚本提交至服务器端.然而,上述两种方式都在不同程度上降低了众包任务的执行效率.同时,由于软硬件环境存在着差异,这两种方式都可能会遗漏实际执行过程中的关键信息.研发自动记录后台系统日志的工具,将有效解决测试行为自动回放的难题[112].一方面,日志信息的记录相对于现有的两种主流录制方式,可以获得更加丰富的数据信息;另一方面,日志信息的记录过程更加轻量,对待测对象的行为和执行效率的影响更小.尽管日志记录工具的研究已较为成熟,但是如何从日志中实现测试行为的自动回放,这方面的研究还处于较为初步的阶段.

## 5 总 结

本文从学术研究现状和工业研究进展两个方面,对众包软件测试技术做出了比较全面的概述.我们收集并最终汇总了众包软件测试领域的 52 篇文献,并简要描述了这些文献的技术、策略和实验验证情况.此外,我们分析对比了当前应用最广泛的 20 个众包测试平台,并从多个角度讨论了众包测试平台的特性.在此基础上,详细讨论了众包软件测试技术的未来研究方向.众包软件测试技术有着良好的应用前景,但仍然存在着大量的研究问题尚待解决,它必将成为软件工程领域的一个新兴研究热点.

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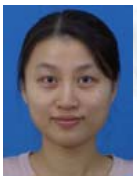

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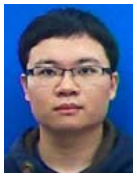

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