Abstract

A software development review is a method to improve the quality of deliverables, and it contributes to quality improvement. In software development, the waterfall development model is often used, and the process takes place from the upstream to downstream. Therefore, the quality of the requirement definition document (RDD), which is a deliverable of the upstream process, is very important. Although many review methods have been developed to improve the quality of deliverables, there is no single best method for all situations, and individual differences are more important than differences in review methods. Furthermore, existing indices, such as defect detection rate and review efficiency, cannot sufficiently evaluate the review quality. In addition, the process of the review is a black box, and it is difficult to determine how the review was conducted.

This study was performed to develop tasks to evaluate the review performance of the RDD in the upstream process of software development and characterise factors affecting review performance by using gaze patterns. The review process consists of the following three parts: reading, understanding the structure, and detecting and fixing defects. Understanding the structure, detecting and fixing defects are specific processes in the review, the gaze patterns that affect these two processes were characterised.

In Chapter 2, the sensitivity of defect detection was defined as an index of review quality to replace the defect detection rate, and the relationship between sensitivity and gaze patterns was discussed. In the experiment, RDDs used in actual software developments introduced defects absent in the original RDDs, and the sensitivity to detect those defects was calculated using signal detection theory. As a result, there was a significant correlation between the sensitivity to detect defects and the blink rate, indicating that blink was a major feature of characterising a review performance. Related to the review process, it was suggested that reviewers with a low defect-detection sensitivity may remain in the reading process.

In Chapter 3, the software was symbolised by geometric patterns, and an experiment was conducted to create a pair of client requirements and RDD. In the review, the reviewer matches the deliverables from the previous and current processes. However, client requirements are not explicitly defined in the RDD review. Therefore, the client requirements were described as geometric patterns by symbolising the software with geometric patterns. By using these pairs of client requirements and RDD, it is possible to evaluate the review performance to determine whether a RDD is necessary and sufficient to meet client requirements. In Chapter 4, the relationship between review performance and gaze patterns was analysed. As a result, the reviewer with a high correct rate tended to have mydriasis in their pupils, it was likely that they had greater cognitive effort and better concentration on the task. Furthermore, the fixation tended to be focussed on a certain part of the sentences when the review was successful. This result indicated that the reviewer with good review performance may strategically allocate cognitive resources according to the amount of information in each sentence.

In summary, it was suggested that the blink rate could be used to determine whether the reviewer remained in the reading process, and the distribution of pupil diameter and the fixation for each sentence could be used to evaluate review performance in processes specific to the review (understanding the structure, detecting and fixing defects). Therefore, gaze patterns are appropriate for characterising review performance, and review quality can be predicted in real time using these findings.

Keywords

gaze, software review, requirement definition document, review performance, machine learning