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Genetic case-based reasoning for improved mobile phone faults diagnosis☆

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ABSTRACT

Different types of fault diagnostic applications that utilize case-based reasoning (CBR) are applied in the diagnosis process. However, CBR cannot provide solutions to unanticipated or unknown problems. Therefore, further investigation of the retrieval and revision mechanisms of CBR is essential in improving the diagnosis accuracy and precision of the method. This study proposes a hybrid scheme that combines the genetic algorithm and CBR (GCBR) to improve CBR diagnosis. CBR applies experience and knowledge on existing cases of fault diagnosis to newly provided cases. The genetic algorithm aggregates and revises relevant cases to provide solutions to unknown cases. GCBR is implemented in a mobile phone fault diagnosis application. This domain is a good testing environment because mobile phones are of various types and models. Test results show that GCBR can detect several mobile phone faults with average accuracy 98.7%.

1. Introduction

Numerous individuals strive to acquire personal mobile phones because the use of mobile phones has become rampant, thereby making automated means a priority. Outdated mobile phone technologies undergo alterations. Hence, novel techniques are proposed continually. Mobile phones have limitations, such as system failures that require device servicing [1]. Users can perform device repair on their own. However, people are not provided sufficient opportunities to learn from experts in these domains because the time allotted for learning is normally restricted. Therefore, the creation of expert systems is essential. Artificial intelligence (AI) is an

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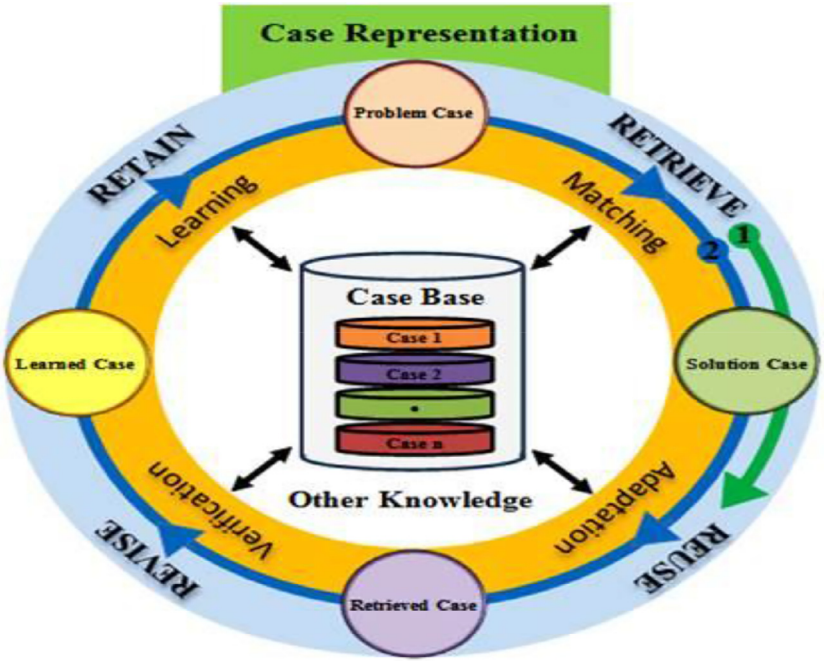

Fig. 1. CBR scheme.

intelligent methodology wherein information is a consequence of expertise. Mobile fault diagnosis (MFD), which requires domain expertise for detecting mobile phone failures, can be used to implement this prerequisite. The MFD scheme allows operators to submit queries and issues. Problem solving is directed toward users, who subsequently identify the real cause of the problem. Users are expected to recognize the reason for the problem and address it. The cost involved will decrease if this scheme is utilized. The proposed scheme is based on case-based reasoning (CBR) articulation, in which the solution to an issue is attained based on a case, and knowledge bases comprise definite cases.

CBR is an AI method that possesses cognitive capabilities, such as memorizing a formerly practiced case. In the mobile phone cognitive context, the CBR scheme involves four phases, namely, retrieve, reuse, revise, and retain. Each phase is used to regulate the information flow of CBR and produce consistent outcomes [2]. These phases register and document a specific case and examine a suitable case for determining the practicality of resolving a fresh case that is accessible to experts. When administrative achievement is a vital consideration, CBR is the best method for gaining knowledge and resolving problems on the basis of previous experiences. Previous experiences are deposited as resolved issues ("cases") at self-styled case bases. Fresh problems are resolved by familiarizing the system with the answers to recognized comparable issues (Fig. 1). CBR solves unacquainted issues on the basis of answers of comparable previous situations. The study conducted by Schank and Abelson in 1977 is considered the origin of CBR. The common understanding regarding circumstances is documented in the form of a script that offers reasoning aptitude for setting up prospects and performing implications (universal performance in normal human problematic resolving) [3]. A script is described as containing structures of theoretical reminiscence, unfolding data, and understanding conventional proceedings (e.g., moving toward a cafeteria or visiting doctors). This issue-resolving technique or intellectual structure is implemented in four phases, namely, retrieve, reuse, revise, and retain (Fig. 1). The descriptions of the four steps are shown below [1–3].

- **Step 1 —** Retrieve: Recover comparable cases or groups of cases.
- **Step 2 —** Reuse: Reprocess data and understand and explain cases to solve current problems when flawless matching occurs.
- **Step 3 —** Revise: Review and familiarize with identical cases or groups of cases for comparison with other cases when impeccable matches are not instituted.
- **Step 4 —** Retain: Preserve or protect fresh experiences or cases for upcoming recoveries and problem solving; thus, a case base is rationalized in protecting recently cultured cases.

These processes turn CBR toward learning and creating fresh solutions and fresh cases that are to be combined with the case base. Therefore, the retrieve procedure of CBR is expected to be dissimilar when compared with database procedures. When information has to be queried, databases generally recover little information through careful matching, but CBR retrieves information through estimated matching. CBR cycles begin from explaining fresh incidents that can be answered by recovering a previous case and reclaiming a resolved case. If possible, optional solutions are offered or reviewed, and mended cases are held and integrated into case bases. However, these cycles rarely occur because of the lack of manual interference, which frequently becomes convoluted with the retain phase. Many approaches and procedures for developing CBR systems have been deliberated [4,5]. The techniques used for case