REVIEW PROTOCOL

1. SLR'S OBJECTIVE

The objective of this systematic literature review is to summarise the state-of-the-art use of robotics in test automation of mobile devices.

2. RESEARCH QUESTIONS

This study aims to answer the following research questions (RQ):

- What are the motivations for using robotics in test automation of mobile devices? (RQ1)
- What types of tests tend to be automated by using robotics? (RQ2)
- How effective/efficient is the use of robotics in test automation of mobile devices? (RQ3)

3. SEARCH STRATEGY

The search strategy consists in determining what databases, keywords and inclusion/exclusion criteria will be used to find and filter studies. The elaborated strategy is later used during the selection procedure.

3.1. DATA SOURCES

- ACM Digital Library;
- IEEE Xplore;
- Science Direct;
- SpringerLink.

3.2. SEARCH TERMS

The following keywords were extracted from this study goal: robotics, test, automation, mobile, leading to the following possible variations:

- robotics: robot, robots;
- test: tests, testing;
- automation: automatic, automated;
- mobile: mobiles.

Therefore, this study will consider the following search string: *("automatic testing" OR "test automation" OR "automated tests" OR "automated testing") AND ("robotic" OR "robot" OR "robots") AND ("mobile" OR "mobiles")*. Considering the characteristics of each data source, the search string is going to be applied as follows.

- ACM Digital Library: The search string is applied by using the advanced search tool with the following delimitations: the items searched are contained in the ACM Guide to Computing Literature, the search considers all fields (Search Within: Anywhere), the search term used is the string previously defined and the publication date range is from 2000 to 2020. The From/To months are automatically selected to the January and December, respectively. No filters are considered. The full query syntax is shown below:
  - "query": { AllField:(("automatic testing" OR "test automation" OR "automated tests" OR "automated testing") AND ("robotic" OR "robot" OR "robots") AND ("mobile" OR "mobiles")) } "filter": { Publication Date: (01/01/2000 TO 12/31/2020) }
  - Researched in 01/06/2021.
  - The search yielded 154 results.
  - [Query link](#)

- IEEE Xplore: In the advanced search, we click on "Command Search" and provide the search string as it was defined before. Then, we add the term ""Full Text .AND. Metadata":" to each keyword in our search string. The search yields initially 600 papers, but then we filter the publication period to 2000--2020. In the end, we have 535 papers. The full query syntax is shown below:
  - (("Full Text & Metadata":"automatic testing" OR "Full Text & Metadata":"test automation" OR "Full Text & Metadata":"automated tests" OR "Full Text & Metadata":"automated testing") AND ("Full Text & Metadata":"robotic" OR

"Full Text & Metadata":"robot" OR "Full Text & Metadata":"robots") AND ("Full Text & Metadata":"mobile" OR "Full Text & Metadata":"mobiles"))
- The search yielded 596 results.
- Researched in 01/06/2021.
- [Query link](#)

- Science Direct: The search string can be applied without modifications to the advanced search tool, fully supports the formatting of terms and operators in the string; by default, terms are searched in the full text and in the entire database. In the advanced search options, filling in the additional fields restricts the search without modifying the main string, in these fields it was defined that the date range from 2000 to 2020. When accessing the site using some institutional account, it is possible to export all results (authors, title, abstract, and a direct link to the paper).
  - The search yielded 190 results.
  - Researched in 01/06/2021.
  - [Query link](#)

- SpringerLink: the search string can be used as it is in the Simple Search field. Then, the results can be filtered by the publication year (click on "Date Published"). All results can be downloaded as a CSV file by clicking on "Download search results (CSV)".
  - The search yielded 412 results.
  - Researched in 01/06/2021.
  - [Query link](#)

- **INCLUSION AND EXCLUSION CRITERIA**

  This review will consider the following criteria for identifying studies of interest.

- Inclusion criteria
  - Only individual papers are considered.
  - Studies regarding the use of robotics in test automation of mobile devices;
  - Studies published from 2000 to 2020;
  - Studies written in English;
  - Studies that we are able to get access to the full text.

- Exclusion criteria
  - Proceedings, indexes and similar documents are not considered;
  - Small papers (with <= 2 pages) are not considered.
  - Studies not aligned to this study goal;
  - Studies published before 2000;
  - Studies written in other languages than English.

4. SELECTION PROCEDURE

The selection's objective is to identify relevant articles to be reviewed. The following selection procedure developed, making possible to collect and filter the studies in an organised manner. Considering six researchers, the selection procedure is made up by the following steps:

A. The search string will be applied to the selected databases, and each researcher should take a note on the date the search was carried out;
   a. ACM Digital Library will be assigned to researcher #1.
   b. IEEE Xplore will be assigned to researcher #2.
   c. ScienceDirect will be assigned to researcher #3.
   d. SpringerLink will be assigned to researcher #4.
B. The results obtained from each database will be combined into a single document, and duplicates are going to be removed;
C. Based on the Title and the Abstract, the inclusion/exclusion criteria will be applied;
   a. For each paper, the criteria is going to be applied by two researchers.
   b. The papers are going to be randomly assigned to the following groups.
      i.   Group 1: researcher #1 and researcher #2.
      ii.   Group 2: researcher #1 and researcher #3.
      iii. Group 3: researcher #1 and researcher #4.
      iv.   Group 4: researcher #2 and researcher #3.
      v.   Group 5: researcher #2 and researcher #4.
      vi.   Group 6: researcher #3 and researcher #4.
   c. The assignment was performed with the aid of a Java program. The assignment was validated by an independent researcher (i.e., not the one who has written the code).

d. If a consensus is not reached when evaluating each paper (both researchers agree on including/excluding the paper), a consensus is going to be reached with the aid of two other researchers (researcher #5 and researcher #6).

D. Based on the Introduction and Conclusion, the inclusion/exclusion criteria will be further applied.

a. The same procedure described in step C applies here.

E. Each selected study will be randomly assigned to a single researcher, among researchers #1 to #4.

F. After reading the whole paper, new studies will be identified from the references of the selected ones (snowballing).

a. The results obtained from the snowballing process (as suggested by each researcher considering the studies assigned to him/her) will be combined into a single document, and duplicates are going to be removed.

b. Steps D and E will be repeated considering the new studies identified during the snowballing process.

5. DATA EXTRACTION

When reading the studies, the information relevant to this review is going to be registered according to the following data extraction table. Later, this information will be used to answer the defined research questions.

Table 2 - Data extraction table

ID	DATA	INFORMATION
D01	Researcher responsible for the data extraction	
D02	DOI	
D03	Title	
D04	Publication year	
D05	Author(s)	
D06	Organization and country	
D07	What are the reasons for using robots?	
D08	What types of tests are automated with robots?	
D09	What device/software is tested with robots?	

D10	Robots' details (e.g. brand, model)	
D11	How robots are used to promote test automation?	
D12	What frameworks are used to promote automation?	
D13	Were the results compared with other testing strategies?	
D14	If so, were the results successful?	
D15	What are the identified limitations?	
D16	What is planned as future work?	
D17	List any referenced work that is also worth reading.	
D18	Other relevant information.	

During the full text evaluation, the data extraction table may be modified, in the case there is important information which is not being covered by the table questions. In such a situation, the already read studies will need to be revisited in order to update the corresponding tables. After the extraction process is completed, these tables shall be used as means of comparison between the researchers' achievements, making the data synthesis possible.

6. SYNTHESIS OF EXTRACTED DATA

In this step, the data obtained by each researcher will be initially compared, to verify if there is any discrepancy between the extracions. Thus, the differences are going to be discussed between the researchers and the accomplishments, mutually accorded, shall be synthesised.

Then, the data will be analysed, observing similarities, differences and patterns. The synthesis has, as its objective, to reach a conclusion and answer each research question. In what follows, we identify which data information is directly related to each research question.

- RQ1 relates to the following data information: D07;
- RQ2 relates to the following data information: D08 and D09;
- RQ3 relates to the following data information: D13, D14 and D15.