

A Study on Challenges of Testing Robotic Systems

Afsoon Afzal, Claire Le Goues, Michael Hilton and Christopher Steven Timperley

Carnegie Mellon University
Email: afsoona@cs.cmu.edu, clegoues@cs.cmu.edu, mhilton@cmu.edu, ctimperley@cmu.edu

Cite this paper:

```
@inproceedings{afzal20icst,  
  title={A Study on Challenges of Testing Robotic Systems},  
  author={Afzal, Afsoon and {Le~Goues}, Claire and Hilton, Michael and  
Timperley, Christopher Steven},  
  booktitle={International Conference on Software Testing, Verification and  
Validation},  
  series = {ICST'20},  
  year={2020},  
  organization={IEEE}  
}
```

The interview script

The purpose of this research study is to study how developers in robotics do testing and verification. For that reason, we will be interviewing developers who work with robotics. We anticipate the interviews will take between 45 minutes and 1 hour. All participants must be 18 years of age or older.

There are no foreseeable risks associated with this project, nor are there any direct benefits to you.

Anything you share with us in this interview will remain confidential. Identifiable data will not be circulated beyond the study team. All data will be anonymized to the best of our ability. All reports and publications based on this data will be carefully written to avoid indirect identification of the identities of those involved. Readers who are qualified to double-check the quality of the anonymization will review reports and articles.

If you do not want your work and views to be the subject of study, you should choose not to be part of this project. If at any time in the future you no longer want your work and views to be the

subject of such recording and study, you can opt out at that point. If you opt out after initial participation, every effort will be made to remove information you have contributed to the study. However, because anonymization is a high priority of the project, it may not be possible to identify all data you have provided to that point. Your participation is voluntary, and you may stop completing the survey at any time.

Demographic Questions

IQ1: What is your background?

- a) What area of robotics have you worked with and for how long?
- b) Education background
- c) Years in industry

Interview Questions

IQ2: What do you currently do in your job?

IQ3: Tell me about the last time you found a problem by testing your code?

- a) How do you define these types of testing?
- b) Is the testing done by your team? Another team?
- c) What are all the different types of testing you do? (HW vs SW, etc)
- d) Can you describe your test running process?
- e) How often do you run your tests?
- f) How do you decide which tests to run?
- g) How much of your testing is done for certification and such, or as a part of the process to deliver quality?
- h) How do you know if your tests are good? (code coverage? Other ways?)
- i) How do you decide when to stop testing?

IQ4: How often do your tests fail as you were describing? In other ways?

- a) How often do your tests find problems?
- b) Which types of tests find the most problems?
- c) Why do you think some types of tests are more successful in preventing problems than others?

IQ5: Do you write your own tests?

If yes:

Can you describe your test writing process?

IQ6: What is difficult about writing tests?

- a) what was the type of test, for which module/part?
 - b) why was it difficult to write?
 - c) Have these difficulties ever made you giving up on writing the tests at all?
- Is there any part of writing tests that is not difficult?

IQ7: What types of tests are the most difficult to write? For what reasons?

- a) Is there a difference in difficulty in writing unit tests vs integration tests?
- b) When writing a test, how do you decide if it is a manual test or an automated tests?
- c) For your tests that are not fully automated, why are they not?

IQ8: How do you think the difficulties of running/automating tests in robotics differ from your other experiences in other software development domains? (if they have worked outside of robotics)

IQ9: Tell me what is difficult about running tests

- a) What types of tests do you have the most difficulty running?
- b) Unit testing vs. integration testing
- c) What makes them difficult to run?
- d) What steps have you taken to overcome these problems?
- e) In your experience, is there anything that helps with making it easier to run tests?
- d) What tools/frameworks/techniques do you use to simplify running tests? (custom or not?) (explicitly ask about simulation?)

IQ10: How often do you maintain the tests?

- a) Refactor
- b) Have you ever deleted tests? -> Tell me about a time you deleted tests....
- c) Do you have problems with false positives?

IQ11: Have you ever made any changes to your testing practices?

If so

In what ways and why?

If not

Why haven't you revisited your testing practices? (Are they sufficient or the costs are too high?)

IQ12: Overall, do you believe testing is beneficial for robotics?

If so

In what ways?

What do you think is the most important bottleneck in the way of writing/running/automating tests in robotics?