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User's Guide for the Design and Testing System YEROTH_QVGE (YR_QVGE)

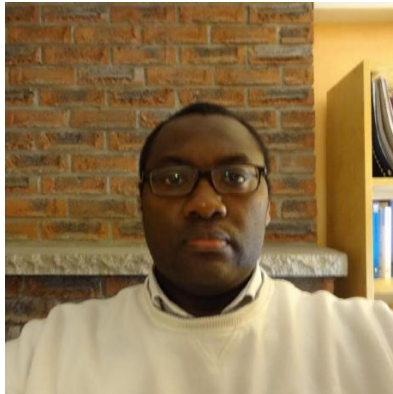


Figure 1: Portrait of PROF. DR.-ING. DIPL.-INF. XAVIER NOUMBISSI NOUNDOU .
Contact: yeroth.d@gmail.com

Table 1: STATE DIAGRAM MEALY MACHINE SPECIFICATION KEYWORDS in YEROTH_QVGE

| scientific keywords | engineering keywords |
|---------------------|----------------------|
| STATE | STATE |
| START_STATE | BEGIN_STATE |
| FINAL_STATE | ERROR_STATE |
| IN_PRE | IN_BEFORE |
| IN_POST | IN_AFTER |
| IN_SET_TRACE | IN_SQL_EVENT_LOG |
| NOT_IN_PRE | NOT_IN_BEFORE |
| NOT_IN_POST | NOT_IN_AFTER |
| NOT_IN_SET_TRACE | NOT_IN_SQL_EVENT_LOG |

Figure 2: **A SAMPLE state diagram mealy machine file.**

```

1. yr_sd_mealy_automaton_spec yr_missing_department_NO_DELETE
2. {
3.   START_STATE(d):NOT_IN_BEFORE(YR_ASSET,department.department_name)
4.   ->[in_sql_event_log('DELETE.departement.YR_ASSET',STATE(d))]/'SELECT.department'->
5.     ERROR_STATE(e):IN_AFTER(YR_ASSET,stocks.department_name).
6. }
```

Figure 3: A SCREENSHOT OF YEROTH_QVGE.

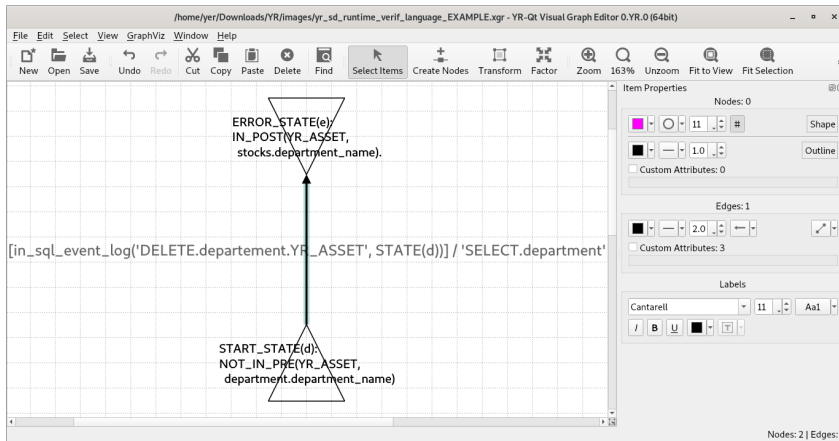


Figure 4: A SCREENSHOT OF YR-DB-RUNTIME-VERIF SQL EVENT LOG.

| time stamp | sql query | source | target | changed state |
|--------------|--|--------|---------------------|---------------|
| 09:46:12:951 | 'SELECT.departments_products' | SUT | YR-DB-RUNTIME-VERIF | 1 |
| 09:46:13:687 | 'DELETE.departments_products.YR_ASSET' | SUT | YR-DB-RUNTIME-VERIF | 1 |
| 09:46:13:700 | 'DELETE.marchandises.YR_ASSET' | SUT | YR-DB-RUNTIME-VERIF | 1 |
| 09:46:14:354 | 'SELECT.departments_products' | SUT | YR-DB-RUNTIME-VERIF | 1 |
| 09:46:14:380 | 'SELECT.departments_products' | SUT | YR-DB-RUNTIME-VERIF | 1 |
| 09:46:14:393 | 'SELECT.departments_products' | SUT | YR-DB-RUNTIME-VERIF | 1 |

| source file | line number |
|----------------------------|-------------|
| src/yeroth-erp-windows.cpp | 992 |

| before pre-condition on source state | after post-condition on target state |
|--|--------------------------------------|
| not_in_before(YR_ASSET, departments_products.nom_department_product) in_after(YR_ASSET, stocks.nom_department_product) | |

| evaluated guarded condition expression | value |
|--|-------|
| in_sql_event_log('DELETE.departments_products.YR_ASSET', STATE(d)) | True |

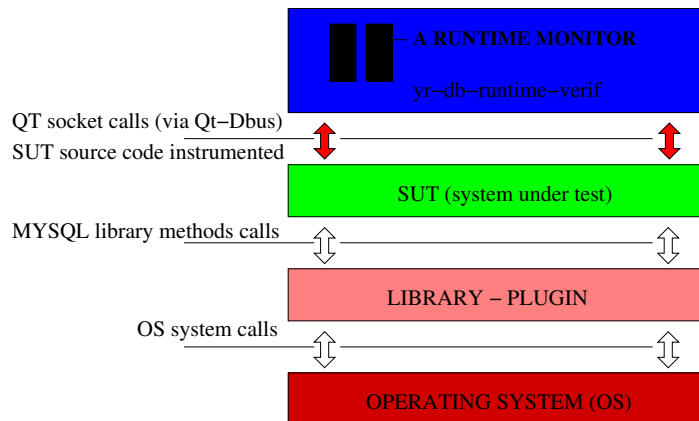
| runtime monitor name | previous state | accepting state | is error state | is recovered |
|-------------------------------------|----------------|-----------------|----------------|--------------|
| time_verif_language_EXAMPLE_release | d | e | True | |

1 Introduction

This user's guide helps briefly and concisely how to create a binary executable of the runtime monitoring testing tool YR-DB-RUNTIME-VERIF having user defined runtime monitors. The guide also specifies keywords allowed within runtime monitor specifications as State Diagram Mealy Machines.

2 YEROTH_QVGE (YR_QVGE) Short Overview

Figure 5: SOFTWARE ARCHITECTURE OF YR-DB-RUNTIME-VERIF.



YEROTH_QVGE is a CASE (Computer-Aided Software Engineering) design tool to generate "domain-specific language (DSL) YR_SB_RUNTIME_VERIF_LANG ¹" files, to be inputted into the "compiler YR_SB_RUNTIME_VERIF_LANG_COMP", so to generate C++ files for the "runtime verifier tester YR-DB-RUNTIME-VERIF ²" that allows for manual verification of SQL correctness properties of Graphical User Interface (GUI) software.

YR-DB-RUNTIME-VERIF inputs SQL correctness properties expressed using the formalism "state diagram mealy ma-

¹https://github.com/yerothd/yr_sd_runtime_verif_lang

²<https://github.com/yerothd/yr-db-runtime-verif>

³Scientific: fail (forbidden) trace.

⁴Structure Query Language.

chine (YR_SD_RUNTIME_VERIF)". Figure 5 illustrates a software system architecture of YR-DB-RUNTIME-VERIF, together with the monitored program under analysis. The Free Open Source Code Software (FOSS) tool-chain of development testing is located as follows for free, EXCEPT for "YEROTH_QVGE" that is a Closed Source Code Software (CSCS):

- COMPILER YR_SB_RUNTIME_VERIF_LANG_COMP (i.e.: YR_SB_RUNTIME_VERIF_LANG):
https://github.com/yerothd/yr_sd_runtime_verif_lang
- RUNTIME VERIFIER TESTER YR-DB-RUNTIME-VERIF:
<https://github.com/yerothd/yr-db-runtime-verif>
- state diagram mealy machine UNIT TESTS CODE (i.e.: YR_SD_RUNTIME_VERIF):
https://github.com/yerothd/yr_sd_runtime_verif_UNIT_TESTS
- state diagram mealy machine (i.e.: YR_SD_RUNTIME_VERIF):
https://github.com/yerothd/yr_sd_runtime_verif

3 State Diagram Mealy Machine Specification Keywords

Figure 6: A motivating example, as current bug in YEROTH-ERP-3.0.

$Q_0 := \text{NOT_IN_BEFORE}(\text{YR_ASSET}, \text{department.department_name}).$
 $Q_1 := \text{IN_AFTER}(\text{YR_ASSET}, \text{stocks.department_name}).$



TABLE 1 depicts scientific keywords and their engineering counterpart that can be used in describing NOT DESIRABLE ³ SQL ⁴ call sequence state diagram mealy machine in YEROTH_QVGE Design and Testing System.

A STATE DIAGRAM mealy machine specification is compiled into C++ code that describes a runtime monitor to be executed in the runtime monitoring tester YR-DB-RUNTIME-VERIF. Figure 2 depicts a sample State Diagram Mealy Machine specification on a NOT DESIRABLE SQL call sequence. Figure 6 shows a finite automaton representation of the mealy machine description in Figure 2.

4 Custom User Project

Table 2: YR-DB-RUNTIME-VERIF Directories

| Variable for illustration purposes | Meaning |
|------------------------------------|---------------------------------------|
| YR-DB-RUNTIME-VERIF | root directory of YR-DB-RUNTIME-VERIF |
| YR-DB-RUNTIME-VERIF/YR-PROJECT_DIR | root directory of user project |

Table 2 illustrates directories that will be used to describe a process to generate a single binary executable for a user’s custom project with several runtime monitor specifications.

Creating a binary executable for State Diagram Mealy Machine (SDMM) specifications consists of the following elements:

- **Property configuration file:** this file defines environment variables necessary for building a bi-

nary executable for the user; it is located in path: `YR-PROJECT_DIR/bin/configuration-properties.sh`.

- **YR-PROJECT_DIR/sd-mealy-machine-specs:** this directory contains user defined State Diagram Mealy Machine (SDMM) specifications to generate Corresponding runtime monitors within a single binary executable.
- **Generate an executable for a user defined runtime monitor:**

a) execute following command in directory `YR-PROJECT_DIR`:

```
./YR-create-executable-for-user-SDMM.sh -d YR-PROJECT_DIR
```

The generated binary executable (`yr-db-runtime-verif`) appears in directory `YR-DB-RUNTIME-VERIF/bin`.

5 Formal Scientific and Engineering Project Description

Detailed formal scientific and engineering contributions of design and testing system YEROTH_QVGE can be found at:

Information Brochure of the Design and Testing System YEROTH_QVGE (YR_QVGE)

PROF. DR.–ING. DIPL.–INF. XAVIER NOUMBISSI NOUNDOU
CONTACT: yeroth.d@gmail.com

Table 1: EQUIVALENCES

| scientific literature | engineering acronym |
|-----------------------|---------------------|
| PRE | BEFORE |
| POST | AFTER |
| A TRACE | AN EVENT LOG |
| A FINAL STATE | AN ERROR STATE |

Figure 1: A SAMPLE state diagram mealy machine file.

```

1. yr_sd_mealy_automaton_spec yr_missing_department_NO_DELETE
2. {
3.   START_STATE(d) : NOT_IN_BEFORE(YR_ASSET, department.department_name)
4.   -> [in_sql_event_log('DELETE.departement.YR_ASSET', STATE(d))] / 'SELECT.department' ->
5.     ERROR_STATE(e) : IN_AFTER(YR_ASSET, stocks.department_name).
6. }

```

Figure 2: A SCREENSHOT OF YEROTH_QVGE.

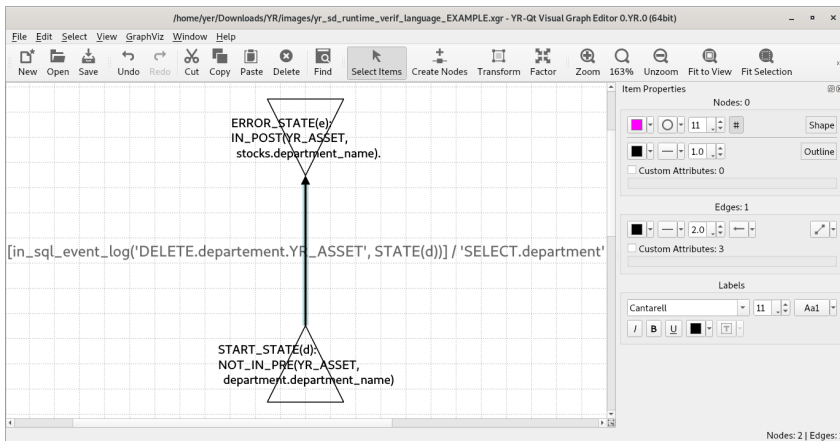


Figure 3: A SCREENSHOT OF YR-DB-RUNTIME-VERIF SQL EVENT LOG.

| timestamp | statement | source | target | changed qty |
|--------------|---|--------|---------------------|-------------|
| 09:46:12:951 | 'SELECT.departements_products' | SUT | YR-DB-RUNTIME-VERIF | 1 |
| 09:46:13:687 | 'DELETE.departements_products.YR_ASSET' | SUT | YR-DB-RUNTIME-VERIF | 1 |
| 09:46:13:700 | 'DELETE.marchandises.YR_ASSET' | SUT | YR-DB-RUNTIME-VERIF | 1 |
| 09:46:14:330 | 'SELECT.departements_products' | SUT | YR-DB-RUNTIME-VERIF | 1 |
| 09:46:14:380 | 'SELECT.departements_products' | SUT | YR-DB-RUNTIME-VERIF | 1 |
| 09:46:14:393 | 'SELECT.departements_products' | SUT | YR-DB-RUNTIME-VERIF | 1 |

| evaluated guarded condition expression | value |
|---|-------|
| in_sql_event_log('DELETE.departements_products.YR_ASSET', STATE(d)) | True |

| runtime module names | previous state | accepting state | is error state | is recovered |
|--------------------------------------|----------------|-----------------|----------------|--------------|
| time_verif_language_EXAMPLE_realcase | d | e | True | |

1 Developer Biography



Figure 4: Portrait of XAVIER.

PROF. DR.-ING. DIPL.-INF. XAVIER NOUMBISSI NOUNDOU is a CHRISTIAN BY FAITH, Cameroonian, born on September 16 1983 in DOUALA (LITTORAL region, CAMEROON). Xavier has a "Diplom-Informatiker (Dipl.-Inf.)" qualification from the **University of Bremen, Bremen, GERMANY** (May 25, 2007). XAVIER NOUMBISSI NOUNDOU IS A **PHILOSOPHIAE DOCTOR (PH.D.)** from **THE UNIVERSITY OF WATERLOO (ON, CANADA); DECEMBER 20, 2011!**

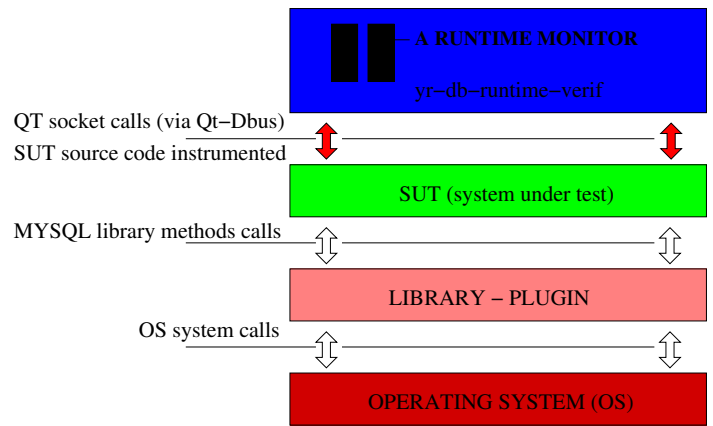
PROF. DR.-ING. DIPL.-INF. XAVIER NOUMBISSI NOUNDOU has worked together with **PROF. DR. RER. NAT. HABIL. jan peleska**, at AGBS-University of Bremen, GERMANY; and 2 years later at WatForm (Waterloo Formal Methods, ON, Canada) with **PATRICK LAM, P.Eng (Ontario, CANADA), PH.D. (MIT, BOSTON, MA, USA)**.

Xavier has following academic and professional engineering research contributions:

1. 'Context-Sensitive Staged Static Taint Analysis For C using LLVM'
 1. source code in C++:
<https://github.com/sazzad114/saint>
 2. full text: <https://zenodo.org/record/8051293>
2. 'YEROTH-ERP-3.0':
 1. source code in C++:
 - a. YEROTH-ERP-3.0:
<https://github.com/yerothd/yeroth-erp-3-0>
 - b. YEROTH-ERP-3.0 SYSTEM DAEMON:
<https://github.com/yerothd/yeroth-erp-3-0-system-daemon>
 2. full text (ongoing publication):
<https://zenodo.org/record/8052724>
3. 'Statistical test case generation for reactive systems' at RTT-MBT at (<https://www.verified.de>) Verified Systems International GmbH.

2 Introduction

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YR-DB-RUNTIME-VERIF inputs SQL correctness properties expressed using the formalism "state diagram mealy machine (YR_SD_RUNTIME_VERIF)". Figure 5 illustrates a software system architecture of YR-DB-RUNTIME-VERIF, together with the monitored program under analysis. The Free Open Source Code Software (FOSS) tool-chain of development testing is located as follows for free, EXCEPT for "YEROTH_QVGE" that is a Closed Source Code Software (CSCS):

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https://github.com/yerothd/yr_sd_runtime_verif

3 Advantages of YEROTH_QVGE

A sample state diagram mealy machine is shown in Figure 1.

WITH manual drawing of SQL CORRECTNESS PROPERTY MODEL, you are freed from manually writing "state diagram mealy machine text files" that could be tedious and lengthy. Also, editing state diagram mealy machine files manually could be more error-prone than letting a compiler (YR_SB_RUNTIME_VERIF_LANG_COMP) do it for you.

4 Conclusion

YEROTH_QVGE costs only 3,000 EUROS. WE ONLY SUPPORT **DEBIAN-LINUX** (<https://www.debian.org>).

¹https://github.com/yerothd/yr_sd_runtime_verif_lang

²<https://github.com/yerothd/yr-db-runtime-verif>