Available online at http://www.ijirr.com

ISSN: 2349-9141

International Journal of Information Research and Review
Vol. 2, Issue, 04, pp. 589-592, April, 2015

OPEN ACCESS JOURNAL

Full Length Research Paper

A FORMAL SYSTEM APPROACH FOR CEREBRAL MALARIA

Ejiofor, C.I and *Okengwu, U.A.

Department of Computer Science, University of Port-Harcourt, Port-Harcourt, Nigeria

***Corresponding Author**

Received 28th March 2015; Accepted 30th April 2015

Abstract

Cerebral Malaria is a neurological complication caused by the plasmodium falciparum malaria. Therefore quality and prompt treatment in addition to fault tolerance is necessary due to critical safety. The use of formal specification creates a formal approach for specifying the underlying functions and properties of the cerebral malaria system. This paper has attempted to give a formal description of the activities cerebral malaria system Using Zed notations. The interaction within the system is visualized using Unified Modelling Language (UML) sequence diagrams.

Keywords: Cerebral, Z-Notation, UML.

To cite this paper: *Ejiofor, C.I and Okengwu, U.A. 2015. A Formal System Approach for Cerebral Malaria. International Journal of Information Research and Review. Vol. 2, Issue, 04, pp. 589-592.*

INTRODUCTION

Cerebral Malaria is a neurological complication caused by the plasmodium falciparum malaria. It is usually associated with coma and asexual forms of the parasites on peripheral blood smears (Healthline, 2014, Mycoclinic, 2014, and Right Diagnosis, 2014). Cerebral malaria (CM) forms part of the spectrum of severe malaria, with a case fatality rate ranging from 15% in adults in south-east Asia (Dondrop *et al*., 2005) to 8.5% in children in Africa (Dondrop *et al*., 2010). Clinical signs of acidosis carry a higher risk of death but nevertheless CM accounts for a significant proportion of malaria mortality, as well as the potential for neurological deficits in survivors.
The standard clinical definition of CM centres on a state of un-arousable coma partnered with the presence of malaria infected red blood cells in the peripheral circulation and a lack of other potential causes of coma such as other infections or hypoglycemia (Idro, *et al*., 2005 and WHO, 2010). More recently, ophthalmic observations of retinopathy have been added to this definition in both adults and children to increase the specificity of the clinical diagnosis (Beare *et al*., 2011 and Maude *et al*., 2009). Most observations of the pathophysiology of disease come from postmortem observations of Plasmodium falciparum (Pf) infections, which are thought to account for the vast majority of CM cases, and show a common feature of vascular sequestration of infected erythrocytes (IE) in the brain (MacPherson *et al*., 1985). There are also some differences, particularly between CM in adults and children, broadly separable into a 'pure' sequestration pattern and IE sequestration with variable (and moderate) vascular pathology. The latter varies from the accumulation of pro inflammatory cells such as leukocytes and platelets to localized vascular damage (Dorovini-Zis, *et al*., 2011). With the hallmark of IE sequestration for CM (albeit based on post-mortem studies), investigations into the pathology of disease have looked at the adhesive interactions between IE and host cells, including endothelium, but have also ranged from host genetic studies to clinical measurements of a wide range of systemic and local effectors. So, while we do not fully understand the pathology of CM and suspect that it may have multiple etiologist, we do know that it has some differences to, and some overlaps with, other brain inflammatory diseases and we have information about some of the potential contributions from the parasite and the host that could lead to CM (Medicine Net, 2014 and Right Diagnosis, 2014). The symptoms of cerebral malaria includes, Fever, Altered state of consciousness, Seizures, Abdominal cramps, Muscle pain, Low blood pressure, headache, Persistent chill, convulsion and coma.

The focal point of this research paper is geared toward formalizing Cerebral Malaria system.

MATERIALS AND METHOS

Materials

Z-notation uses mathematical notation to describe in a precise way the properties a software system must possess, without unduly constraining the way in which these properties are achieved (Spivey 1998, Sannella, 1998 and Spivey, 1992). Formal specification (Mathematical notation or Z) uses mathematical data types to model data in a system and achieve it underlining objectives. These data types are not oriented towards computer representation, but they obey a rich collection of mathematical laws which make it possible to reason effectively about the way a specified system will behave. We use the notation of *predicate logic* to describe abstractly the effect of each operation of our system, again in a way that enables us to reason about their behaviour. The other main ingredient in Z is a way of decomposing a specification into small pieces called *Schemas*. By splitting the specification into schemas, we can present it piece by piece. Each piece can be linked with a commentary which explains informally the significance of the formal mathematics. In Z, schemas are used to describe both static and dynamic aspects of a system (Spivey 1998). The static aspects includes

- the state it can occupy;
- the invariant (quantity that is unchanged by a set of mathematical operation) relationship that are maintained as the system moves from states to state.

The dynamic aspect Includes:

- the operation aspect that are possible;
- the relationship between their input and outputs;
- the changes of state that happen.

The schema presented in this presented paper provided an avenue wherein our formal specification could be presented in fragment enabling us to associate commentaries; explaining informal the significance of the formal mathematical notation representation.

Methodology

The following are some of the basic types in Z {CHAR, STRING, CURRENCY, QUERY, OBJECT, COMPONENTS, BOOLEAN:: = TRUE/FALSE, DATA and OBJECT} The Cerebral System (CS); authentic each user using his username/ID and password on the system

```
—— System User ——
System User_name/ID: seq CHAR
System User_password: seq CHAR
System User:   ℙ System User
Access! : Boolean User
————————
System ∈system. access! = accepted) ᵛ (system ∉system. access ≠ accepted)
```

Schema 1. System User Schema

There is no frontier to the number of registered system user the Cerebral System can ascertain and each system user can have only one authentication and authorization privilege. Logging on, each system user must register it's his user ID.

```
—— System List ——
System:  ℙ SYSTEM: ℙCEREBRAL FUNCTIONALITIES
System List:  SYSTEM → CEREBRAL FUNCTIONALITIES
————————
Systems = dom list
```

Schema 2. System List

The *Systemlist* provide the cerebral functionalities provide by the system.

```
—— Register Cerebral Functionalities ——
Λ System List
System? : SYSTEM
Cerebral Functionalities: cerebral Functionalities
report! : REPORT
————————
(system?  ∉system^System List' = System List U {system?  → Functionalities?}^ report! = ok) ᵛ(system?
∉system^systemlist' = systemlist^ Report! = already_known)
```

Schema 3. Register cerebral Functionalities Schema

The list braces the facility in registering cerebral functionalities given that the system process does not exist previously. If the process exists previously, a report of 'already known' is returned or vice versa as the case may be.

```
—— Locate Cerebral System Process ——
Ξ SystemList
Processes? : HOTEL PROCESSESS
Systemlist?ℙ HOTEL PROCESSES
————————
(systemlist! = {system: systems / list (system) = Process?} ᵛ(system ∉ systems ^ report! = not  known)
```

Schema 4. Locate cerebral process Schema

The *Locate cerebral Process* function obtains a process type as an argument and returns a result responds.

```
—— Already Existing Cerebral Process ——
Ξ System List
system? : SYSTEM
result! : REPORT
process? ∈ Processes
————————
result! = already_known
```

Schema 5. Already Existing cerebral Process Schema

The *Already Existing cerebral Process Schema* determines if a change to the system list in terms of new input process already. If it the result, will reply already_knowm otherwise not known.

```
—— Cerebral Process Not Available ——
Ξ Process list
process: ℙCEREBRAL PROCESS
report! : REPORT
request? : CEREBRAL PROCESS
∀process ∈system. list (process) ≠ Reliability
————————
report! = not_known
```

Shema6. Cerebral Process Not Available Schema

The schema 6, shows the error which occurs when a system user requests for a process which has not been registered in the system list. An error report of 'not known' is returned. The list is initialized at the beginning with no process or cerebral process in Schema 7.

```
—— Cerebral L Initialize_List ——
System List
PROCESS: ℙCEREBRAL PROCESSES
 System list = Ø
————————
Cerebral process = Ø
```

Schema 7. Initialize_List Schema

System Design and Unified Modeling Language (UML)

Software design immediately follows the requirements engineering phase in a software process. Software design is the translation of the requirement specification into useful patterns for implementation. Unified Modelling Language (UML) is a standard modelling language used for modelling software systems. We use UML for design of the hotel system process because UML focuses on creating simple, well documented and easy to understand software models. UML sequence diagram shows the interaction between classes (or object) in the system for each use case. The interaction represents the order of messages that are exchanged between classes to accomplish a purpose. For the system we specify the utilizing several sequence diagram specified on Figure 1.

environment**.** Enter a statement, press the carriage return ("ENTER") and the statement is immediately execute Given the power that can be packed into one MATLAB statement, this is no small accomplishment.

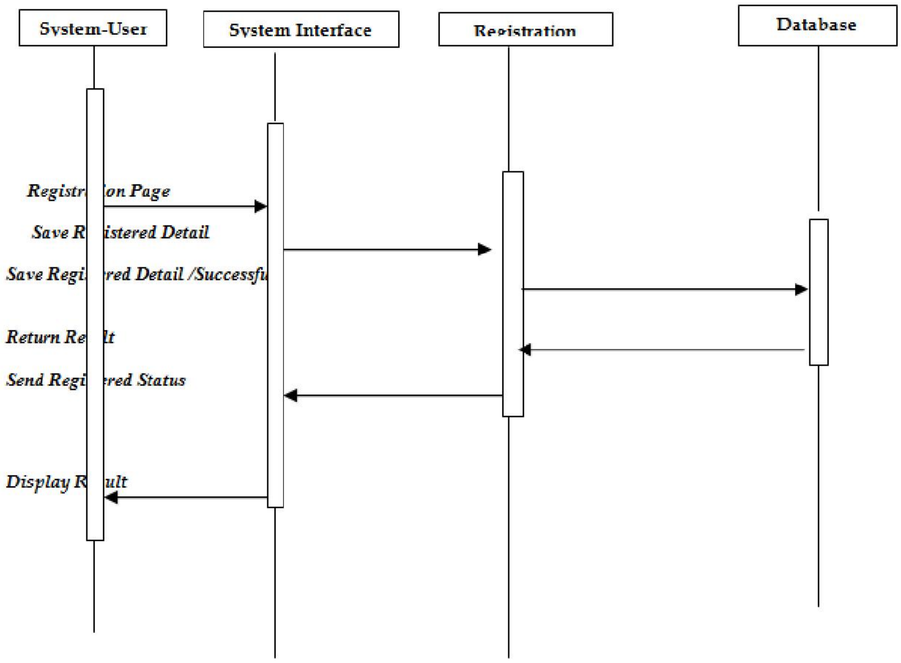

Figure 1: *Registration User Sequence Diagram*

Figure 1, models the sequence of steps involved in the registration of a system user. The order of appearance of the arrows indicates the order of the actions while the arrow direction indicates the direction of flow of events / results.

Implementation

The implementation of the system was handled utilizing MATLAB, for several reasons:

- It also manipulation across varied numerical data and
- It integrates with numerous user interfaces.
- Since formal specification are specified utilizing mathematical notation, MATLAB was at the frontier of all available implementation tools available to us due to it available mathematical ingredients.
- It open source
- Most importantly, it has a large active community base

Utilizing several MATLAB tools such:

- *Assignment Statements*: Assignment statement as a MATLAB tool was used in overriding Predecessor variable while the successor variable took over. The assignment statement were used in the system to override previous entries which have be saved to the system database
- *Case Sensitivity:* The variable name within are system were case sensitive acceding to Matric laboratory rules. The case sensitive rules in MatLab helped us in distinctively separating our variables name
- *Immediate and Deferred Execution:* When MATLAB is invoked; the user is presented with an interactive

Findings

Based on the ease at which the users get information through this new system, the following are revealed:

- Provide cerebral process thereby eliminating wastage of unusual time
- Eliminate and ratify unknown errors
- Support multiple system processes
- Provide user-friendliness interface

Conclusion

Formal specification is the bedrock of safety critical system which uncovers ambiguities and unwanted error from system requirement. In Nigeria and African as a whole this approach has not be implemented for most safety critical system opening the avenue for system failure with huge implication such as financial loss and untimely death. This research paper focuses on providing a sample representation of formal specification utilizing cerebral processes as a case base. The system design was specified utilizing UML while implementation was handled exploring MATLAB. The results of the finding were listed assiduously. Formal specification is an avenue, which must be explored in as much safety is involved.

REFERENCES

Beare, N.A., Lewallen, S. Taylor, T.E., Molyneux, M.E. 2011, "Redefining cerebral malaria by including malaria retinopathy", *Future Microbiology***,** Vol. 6, Pp.349– 355.

Dorovini-Zis, K., Schmidt, K., Huynh, H. 2011, “The neuropathology of fatal cerebral Malaria in Malawian children. Journal of Pathology, Vol.178, Pp. 2146–2158.

Garibaldi J. M. and Ifeachor E. C. 1999, IEEE Transactions on Fuzzy Systems, Vol.7(1) Pp. 72-84.

Healthline 2014, “Cerebral Malaria”, retrieved online from healthline.com, September, 2014

Idro, R., Jenkins, N.E., Newton, C. R. 2005, Pathogenesis, clinical features, and neurological outcome of cerebral malaria, Lancet Neurol. Vol., 4, Pp. 827–840

MacPherson, G.G., Warrell, M.J., White, N.J. 1985, “Looareesuwan S, Warrell DA 1985, “Human cerebral malaria” A quantitative ultra-structural analysis of parasitized erythrocyte sequestration”, *Journal of Pathology*, Vol.119, Pp.385-401

Maude, R.J., Beare, N.A., Abu, S.A. 2009. The spectrum of retinopathy in adults with Plasmodium falciparum malaria. Trans. R. Soc. Trop. Med. Hyg**.**, Vol. 103, Pp.665–671.

Mycoclinic 2014, “Cerebral Malaria, Diagnosis and Treatment, retrieved online from http://www. mycoclinic.com, January, 2014

RightDiagnosis 2014, Cerebral Treatment, retrieved online http:// RightDiagnosis.com

Sannella D., 1988, “A Survey of formal software development methods”, appeared in Software Engineering: A European Perspective, A. McGettrick and R. Thayer (eds.), IEEE Computer Society Press, Pp. 281-297, 1993.

Spivey J. M. 1992, “The Z Notation: A Reference Manual, 2nd Edition”, Prentice Hall International (UK) limited, United Kingdom.

Spivey J. M. 1992, “The Z Notation: A Reference Manual, 2nd Edition”, Prentice Hall International (UK) limited, United Kingdom.

Spivey J. M. 1998, “The Z Notation: A Reference Manual”, Oxford, United Kingdom.

Spivey J. M. 1998, “The Z Notation: A Reference Manual”, Oxford, United Kingdom.

WHO 2010, “Guidelines for the Treatment of Malaria (2nd Edition)**”**, the WHO, Geneva, Switzerland

****