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Survey Article

Role of Software Engineering Processes to Develop Environmental Model

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Abstract. The recently found systemic errors in atmospheric environmental model are evident in the malfunctioning of measuring instruments in West Africa. The software development in the past had been compromised; hence the need to embark on new software development is eminent to avoid future environmental accident. The architectural structures of the new model, as well as the financial importance were examined. Therefore, there is the need for writing of detachable source codes to assist the collective software development of environmental models. The architectural structures of the new model, as well as the financial importance were examined. Therefore, there is the need for writing detachable source codes to assist the collective software development of environmental models.

Keywords. Software engineering; Environmental model; Formal method; Aerosols

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1. Introduction

The dynamism of environmental models especially translating mathematical codes to easy use software may be quite difficult. Mathematical techniques used in design, implementation and testing of computer systems are known as Formal Methods [1]. Generally, in the development and verification of software, it is more effective to have an understanding of what the vital components of the software are. Studies of these parts are done in details by creating mathematical models of these sections and verifying them. However, creating mathematical

models for environmental situation is somewhat challenging due to changing parameters that are dependent on geographical locations [2–6].

There are different techniques in mathematical modelling as regards to environmental studies. The first is to take a definite transition system and according to that system check whether all the important properties hold for every part of the system. For example, the analysis of the aerosol size distribution requires a modest check on salient parameters that are mostly ignored. Emetere et al. [7] proposed that the malfunctioning of measuring instruments in West Africa is more systemic than design error. The systemic errors are embedded into the software formulation and may not be corrected unless a holistic process is initiated. Hence environmental model is not limited to minute varieties of the system under investigation. Since our world depends largely on technology and this technology is rapidly advancing, it is important that mistakes which may have dire consequences be avoided. To avoid such terrible mistakes, the Formal Methods can be used in achieving this safety measure. Mathematical method is a systematic, logical and procedural way of displaying mathematical processes. In computing, it is represented as a function or procedure that is used as an interface with an object-oriented programming language. It is frequently used by hardware vendors, such as IBM, Intel and AMD to programme. Mathematical techniques that is used in design, implementation and testing of computer systems are known as Formal Methods [1]. For example, hardware vendors adopts the formal method (FM) to undertake parameterized verification of cache coherent protocol, processor execution engine validation, optimization of system functionality, verification of high performance dual-port gigabit Ethernet controller, verification of power gates probing the Cadence technology and troubleshooting hardware protocols.

Software engineering for environmental models begins with the mathematical structures forming the semantic conceptual model associated with a system; system of descriptive characters given by the syntax, graphics or tables used in the document of a software system; and connecting real life aspects of applications by using software description techniques.

Software engineering makes use of principles in mathematics as well as computer science for the maintenance and developing process of software systems which depends on logical protocols from mathematical principles. Recently, software engineers have argued that mathematics is not so needed in software engineering [12]. The role of natural occurrences like climate change and the role of software systems as ordered by academics and specialists would definitely promote standard generalized role of discrete mathematics in software engineering.

Software engineering makes use of techniques which includes; analyzing the process, designing the process, writing codes during the process, testing the process and maintaining the process. There are various processes of environmental models [3–5] which must be understood before choosing the technique to elaborate upon.

The natural disasters around the globe are tied to negligence of environmental models which is expressed using mathematical principles. The world is gradually becoming too large and busy for meteorological centers and media houses to be solely saddled with the

responsibility of creating awareness of impending environmental dangers. It makes a lot of sense if environmental source codes are written in portable mobile devices to trigger alarm via an internally built sensors system. The fruition of this proposal requires a strong synergy between environmental experts and software engineers. In this paper, the importance of a corroborative alliance between the environmentalist and software engineer was emphasized to work out an integrated sensory system for modern mobile devices.

Incorporating the software engineering into solving environmental challenges is the aim of this paper. Section 2 of this research relates the importance of software development to environmental field. Section 3 illustrates specific environmental processes. Section 4 illustrates the incorporation of systems.

2. Environmental Model: Architectural Structure

The concept of accurate aerosol estimation is salient to many aspect of living. For example, it could initiate significant climate change; it determines the pattern and volume of rainfall; it initiates wind recirculation in some region; it determines the thermal comfort over a region; and has significant effect on daily solar radiance. Most meteorological centers utilize a mono aerosols retrieval technique. The mono aerosols retrieval technique entails the direct measurement of aerosols from sun photometer or sondes. One of the disadvantages of the mono aerosols retrieval technique is the sudden change of climate which alters the readings emanating from the aforementioned measuring devices. Hence, it leads to loss of large data set (Figure 1) or sudden spikes within a set of stable measurement (Figure 2).

The technical suggestion to avoid danger of negligence is to repackage the operating software in the measuring instruments to run on four models i.e. two main models and two supportive model (Figure 3). The main model is the end-results expected from the measuring devices. The supportive model is used to determine the possibility of engaging the main model per time. For example, the supportive model determines if the weather condition is expected to be harsh to guide the choice of the 'command line' to vary the tuning parameters of the main models.

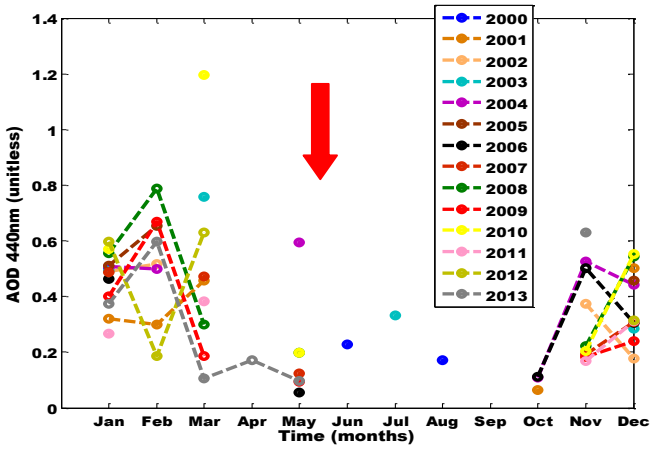

Figure 1. Very scanty data set from over 14 years

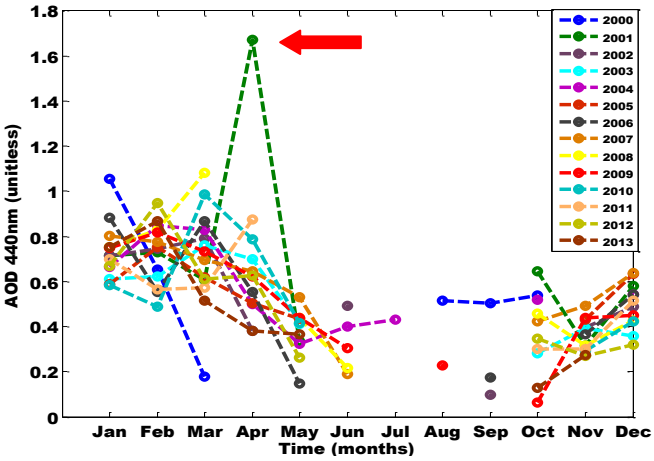

Figure 2. Sudden spike in data set over 14 years

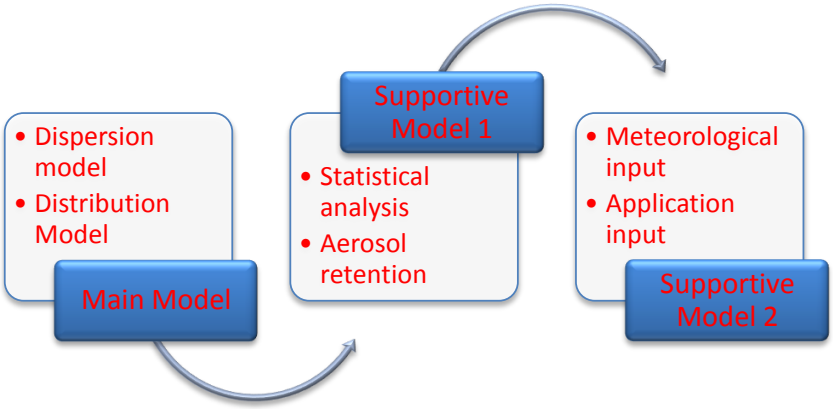

Figure 3. Proposed software description of environmental software

3. Software Development

There are important steps to be considered in software development as it relates to environment research. In the previous section, we established the steps required for a successful completion of the environmental model. Beyond the need to understand the task in preparing list of algorithms or architectural structure of the environmental model, it is important to examine the financial bottlenecks like demands for shorter investment periods, faster time-to-market, and increased operational agility [8]. For developing nation, this is a herculean task because of its undefined market parameters [9]. How important is the proposed environmental model? All the funded projects such as like AErosol RObotic NETwork (AERONET), African Monsoon Multidisciplinary Analyses (AMMA), Dynamics-aerosol-chemistry-cloud interactions in West Africa (DACCIWA), West Africa Climate DRandD Project, Saharan West African Monsoon Multiscale Analysis (SWAMMA), and West African Science Service Center on Climate Change and Adapted Land Use (WASCAL) depends on the outcome of the research to improve on the accuracy of its exploration programme in West Africa. Hence, the urgency of the relevance of the environmental model to the teeming population in West Africa requires a radical approach to its software development.

The environmental model expressed in the last session requires a group of software developmental methodologies that form their grounds based on development gotten by the repetition of certain procedures both supporting models to ascertain the adequate application of the main models. The main model requires an iterative kind of development and a continuous feedback to ascertain that the software systems are efficient to perform the given task. How has past software fared in calculating environmental model? The ISC3, CTDMPLUS, BLP, OCD, CMAQ and REMSAD software [10] had shown that it occupies disk space and requires large free disk space to operate. The large processes and the expected high turn-around time are the basic properties needed for developing the software that must be compactable with environmental model in Figure 3. Therefore, there is the need for the writing of detachable source codes that can be individually transformed by a compiler program into low-level machine code that is understood by the computer. This would facilitate the comprehensive software development of recent environmental models.

4. Roles of Mathematical Methods in Developing Environmental Software

Since software and systems engineering deals with the design of large and often complex information processing systems, it is essential to note that the most environmental models may be more complex due to high degrees of uncertainty. Here are various roles mathematical methods play in the formation of environmental models.

a. *Basis for Computing*: they are like the basis for computing. When it comes to environmental modelling, mathematical methods play a vital role as it were. Also, it is a strong foundation and anchor for the design, structuring, development, accuracy and display of various finding in environmental exploration.

b. *Accuracy and Precision*: Environmental models sometimes require the auto piloting system which needs a lot of programming and mathematical accuracy in controlling the re-ordering of reiterative protocols. Here, principles in vector analysis, probability and some part of calculus come into full play.

c. *Error Analysis and Reduction*: Numerical analyses in mathematical methods take credit for this role. Here, the round-off and round-down processes in calculations help to check errors and then reduce it to an insignificant deficit with 100% accuracy which occurs in rare cases.

d. *Calibration of Industrial Equipments*: Several findings have shown that recent environmental hazard was caused by inadequate calibration of measuring instruments [3–6]. This may be due to external factors such as factory errors or environmental agents. Ultimately, the measuring equipment loses their accuracy and precision, and ultimately these errors lead to in accurate results which on a large scale would cause a lot of damage to scientists. In this case, a well developed mathematical methods such as numerical analysis and complex function analysis can be employed to rectify such errors.

e. *Web Designing*: From the word “web” having various links to software. In the creation of web application and designs, there is a great deal of mathematical functions required both in programming the armature and running the processes on it.

5. Mobile Device and Its Embedded Mathematical Reality

Mobile devices work on the applications used by technological devices and social apps (such as twitter and Facebook), gaming apps (such as subway surfers) which are direct influences of compiled codes that are mathematical oriented. Some codes used by game apps use complex codes that require the use of numbers, analytical and logical thinking or reasoning to arrive at. There is not one software ever created that was not produced based on analytic thinking and logical reasoning. It takes a lot of time and calculations to come up with this source codes [12,13]. Since, environmental model are quite complex and comprehensive, it is essential for software developer to have a good background in the mathematical field since this aids logical and analytical reasoning [14]. Recent mobile devices are designed using the QR codes which are made-up of matrix or two-dimensional barcode. QR code uses four standardized encoding modes i.e. numeric, alphanumeric, byte/binary, and kanji to efficiently store data. The efficiency of the QR codes in mobile device qualifies it to host regional meteorological data to ease the running of environmental models like any other apps on the mobile device. The mobile device would be the best medium to create environmental awareness to the teeming population. Some of the causalities from sudden natural disaster could have been averted if this concept exists.

The cost of development of this proposed product is dependent on the amount of errors made in the object code. In order for the errors made to be reduced to the minimum level, the codes used are checked severally. We recognize that huge thinking should be incorporated into this proposed product because errors made during software systems development could have grave consequences. Huge loss in terms of money could occur; also client may be endangered by false alarm due to such errors. However, its success could be very lucrative and informative.

6. Environmental Source Codes: The Errors and Possibilities

Formal methods have been proven to help achieve the required level of safety [1]. Therefore mathematical environmental model could be incorporated for design, implementation of protocols, testing and control of software systems. The application of this mathematical methods or techniques to the creation and verification of software systems, as well as its importance to environmental information or prediction are labour intensive. Therefore it is not advisable to check all the desired properties and functions of a software program in a detailed manner. It is more cost and time effective to first of all determine the important properties of the software before choosing the type of environmental model to embark upon.

It is important to note that the size of the codes is very important to curb error. Environmental models may be intensive with lots of iterative procedure [3–6]. The size of these developed codes should be reduced to its minimum, for greater compatibility and faster compilation. This risk can be reduced using the JSZap. It transforms source codes into three streams: AST production rules, identifiers, and literals, each of which is compressed independently. Another way of writing sizeable codes is familiarizing oneself with different mathematical methods to help in understanding, thinking and working method. Also, originality, authenticity, and efficiency in problem solving are important when it comes to the use of codes. These days it is observed that a lot of physics methods and analysis is put into the development

of efficient codes. This physical methods no doubt have their roots deep down in mathematics.

Therefore one of the sensitive functions of mathematical methods includes error management, estimation and rounding off, softcopies of mathematical representation and easy learning [13, 14].

7. Conclusion

In conclusion, the development of software for environmental model and the incorporation of it to portable mobile devices to ease the dissemination of environmental alerts are lucrative and informative if all mentioned procedures are carefully executed.

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Competing Interests

The author declares that he has no competing interests.

Authors' Contributions

Author write, read and approved the final manuscript.

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