

## A Formal Specification for the Game Ailo-Akada

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### Abstract

Ailo-Akada is an educational board game portraying undergraduate study in higher institutions. It is played by throwing a die and moving seeds, representing students, from one cell to another. A cell represents an activity, obstacle, a distraction or a difficult situation that students frequently encounter in the course of their study. To graduate, a seed must move through cells from the first cell (Cell 1) to the last cell (Cell 77). Currently the game is very popular amongst students in Nigeria and it is played by hand. A detailed study of the game was carried out leading to a formal specification for the game using a system analysis and design approach to enable players have a quick way of understanding the game using the specification. The specification also provides a good mechanism for the computerization of the game using VB 6.0. Preliminary results indicated the computer version of the game ran well.

**Keywords:** Ailo-Akada, Seeds, Cells, Pitfalls, Game, Computerization.

### I. Introduction

Ailo-Akada is a game intended to guide students through College or University education. It was designed by John Igoli in 1987. The game can be played by two to four players simultaneously. It is played by throwing a die and moving seeds many places as stipulated by the rules of the game or instructions on the board. Each player in the game struggles to graduate his seeds (students) first and in the highest possible class of degree thereby scoring more points and avoiding pitfalls which are issues like students protest, fighting, cheating in examinations etc. The game comes to an end when a player graduates all his/her set of seeds. The player with the highest score (total sum of points), wins the game irrespective of whether all his seeds graduated or not. The player(s) left with un-graduated seeds have their scores reduced by the number of un-graduated seeds. For a seed to graduate, it must pass through all the phases of the game from Cell 1 (year one registration) to Cell 77 (Graduation and Convocation). The Ailo-Akada game involves both elements of luck and strategy.

Ailo-Akada board looks like that of Scrabble but it is played like Ludo. The Ailo-Akada board is as seen in Appendix A. Its seeds are sixteen in total: four Red, four Green, four Blue and four Yellow. All the seeds are flat in nature. The significance of the game stems from the fact that it guides undergraduates through their study levels and reminds them to be aware of the problems they may encounter and how to avoid them in real settings. The main goal of this study is to provide a formal specification for the game which can easily be transformed into a software for playing the game. The computerized version can easily be installed and played on computers and mobile phones without a physical hard board version of the game as is the current practice.

### II. Review of Education Games

Revenscroft(2007) reviewed a design based research conducted over the last ten years that modelled and promoted student reasoning, conceptual change and argumentative dialogue process and practices through designing a number of digital dialogue games. Hong *et al.*(2009) developed an assessment tool to examine the educational values of digital games. They sorted the evaluation into seven categories: mental change, emotional fulfillment, knowledge enhancement, thinking skill development, interpersonal skill development and bodily coordination. Their research provided a preliminary framework for future game designers, parents and teachers in assessing the educational values of digital games. Seewald(2010) presented a constrained object recognition task that solved simple machine learning methods using a small corpus of about 1000 images taken under a variety of lighting conditions. The task was to analyze images from a mobile phone camera showing an endgame position of a Japanese board game called *Go*. The system worked with cheap low-quality cameras and was resistant to changes in board or camera position without the need for any manual calibration. Kalles and Fykouras(2010) presented an experiment in human-computer interaction. In their experiments, interaction took place when humans accepted to teach a computer to play a strategy board game. Their experimental sessions consisted of two distinct stages. In the first stage data was collected based on human-computer interaction sessions. In the second phase the learned policies were paired on computer-computer interaction rounds of various types of elimination tournaments to obtain insight as to whether some individuals attained a clearly good training of its computer players. It also examined whether the composition of players delivered a better player simply by self-play. Hanwu *et al.* (2010)

presented a general architecture of the stereo educational game based on computer vision marker localization and identification interaction. The computer vision marker localization approach provided the ability to calculate the position and poses of the marker in real time and can be used to develop an intuitive human-computer interface for an educational game. It allowed players to pick up, move and put down virtual objects. Kaufman *et al.*(2011) examined the impact of an online educational game called "Asthma: 1, 2, 3... Breath!" on cognitive learning. Their research examined whether there was an improvement in secondary school students' cognitive skills as a result of playing the game. They also studied the differences between males and females in cognitive skills developed by the game. Their results showed significant improvements in a variety of cognitive skills after students played the game on laptops in their classrooms for 40-60 minutes and no differences were found between males and females.

Spires *et al.*(2011) reported that middle age grade students achieved significant learning from game play interactions that required solving a science mystery based on microbiology. Malempati and Mogalla(2011) introduced the most popular ancient Indian board game called Snakes and Ladders as a tool to enhance memorability and security of passwords. The game was used to select lengthy and memorable passwords. The board of the game consisted of 100 grid cells that is 10x10 and consisted of snakes and ladders. Users made their favourite moves between the grid cells and selected each cell number in the move as part of the password. By this there was no need to remember the password; users just had to remember their favourite moves. Mwamngi et al. (2011) examined the design processes that promoted the development of an educational computer game that supported teaching and learning process. They specifically examined the design of an educational computer game for teaching and learning functions in mathematics. Their design was based on Craw Ford's computer game design sequence model. Their game was used for the teaching of Discrete Mathematics to first year students at JKUATs' Taita/Taveta Campus in Kenya.

### III. System analysis and design

A system analysis and design method was used in this study. This method was broken into two main phases: analysis and design. In the analysis phase the existing system is decomposed and studied with the view of finding out what its current problems were. In the design phase a new system is built that overcomes the existing problems.

#### System analysis

In the analysis phase the game was studied in detail and observations were also made on how the game is played. The following were observed about

the game. The game was broken down into five phases.

Start Phase is a phase that signals the beginning of the game. Once the game is initialized every player is at this phase. To leave this phase for the Study Levels phase a player throws a die and obtains six as an outcome. If any other value is obtained the player loops and tries again. The Study Levels Phase covers the period when a student registers and undergoes studies for a course. It has forty four cells, eleven cells for each of the levels for a four year degree programme. Activities in this phase include registration, matriculation, studies, examination, seminars and project writing. In this phase a seed can enter the Absolution Phase or the Pitfalls Phase.

The Absolution Phase covers cells from A, B to Q. Square A stands for disciplinary Committee which a student may face in the course of his studies for an offence committed. Square C in the phase stands for suspension. A student may be suspended from school for an offence committed. Square Q in this phase stands for clearance. A student will be cleared after completing his studies. Once a student (seed) finds itself in any of the cells, a die is thrown and depending on the outcome it may leave the phase or still remain in the phase.

The next phase of the game is termed the Pitfalls. This covers problems a student may encounter in the course of studies. It is made up of 24 cells. For example cell 12 stands for Re-sit. If a seed enters this cell it means the student has a re-sit examination to write. The student will have to go back to the Study-levels phase where he will retake the affected course(s). Cell 13 stands for Failure. Here again the student is referred back to the Study-levels phase to register and pass the affected course(s). A student can also enter the Absolution phase from the Pitfalls phase.

Another phase in the game is the Results-Release phase. If a seed enters this phase it means the student has completed his studies. It is entered from the Pitfall phase cell 68. Once you are in this phase you must be in cell 69. A die is thrown and if a 1 is the outcome of the throw it means you have to repeat final year and go back to the Study-Levels phase and register the affected courses. If a two is thrown you enter the Unapproved Result cell. If a 3 is the outcome you graduate with a Pass Degree. If a 4 is the outcome your class of degree is 3<sup>rd</sup> Class. If a 5 is the outcome your class of degree is 2<sup>nd</sup> Class Lower. If on the other hand a 6 is thrown the seed lands on cell 75 which indicates 2<sup>nd</sup> Class Upper tentatively; a die is further thrown and if a 1 or 2 is obtained you go to cell 76 which indicates that you graduated with a 1<sup>st</sup> Class. Otherwise you graduated with a 2<sup>nd</sup> Class Upper. After obtaining your class of degree you enter cell Q in the Absolution phase which stands for Clearance. A throw of 1 or 5 in cell Q takes you to cell 77 of the Release-

Result phase which stands for Graduation and Convocation.

### Design

An algorithm provides a specification in a form that can easily be simulated by a computer program. In the design of the algorithm the following parameters were defined and used.

Arrays B, Y, R and G were defined to represent Blue, Yellow, Red and Green seeds respectively. Each of the arrays had four positive integer values corresponding to the number of seeds of a given colour. Initially the values of the arrays were set to zero. The maximum value each element of an array was allowed to have is 77 corresponding to the end of the game. At each move of a seed its corresponding value was incremented by the amount of the throw obtained from the die except from the START cell where it was simply moved to cell 1 if a 6 was thrown. Another exception was made when a seed jumps from one phase to another. If a jump occurs there was no increment to the values of the seed. For example from cell 1 if an  $n(n \leq 6)$  was thrown by a

player whose seeds are represented by Green seeds and he moved the first Green seed, the value of the first array element in G was updated as  $G(1) = G(1) + n$ .

Since  $G(1)$ ,  $G(2)$ ,  $G(3)$  and  $G(4)$  were initially zero this made the value of  $G(1)$  to have a value of  $n$ . Phases were defined as a set  $S_i$ ,  $i = 0, 1, \dots, 4$  in which the game can be in at any given time.  $S_0$  was the START phase,  $S_1$  the Study Level Phase,  $S_2$  the Pitfalls phase,  $S_3$  the Absolution phase and  $S_4$  the Result-Graduation phase. The input alphabet, U, to the game was taken to be the unsigned integers with values ranging from 1 to 6 corresponding to all possible outcomes of throwing a die. The transformation function T, was defined to be  $U \times S_i \rightarrow S_i$  which defined the movement from one phase to another or to the same phase using the input alphabet U. The Ailo-Akada game, A, was defined formally as  $A = (U, S_i, T, P)$ , where  $U$ ,  $S_i$ ,  $i = 0, 1, \dots, 4$ , T were as previously defined. P was defined to represent a player. The algorithm for playing the Ailo-Akadagame was formulated as in Fig1



#### IV. Results and Discussions

In Fig 1  $n (1 \leq 6)$  was used to represent the outcome of throwing a die. The outcome is very important in the game because it determines at any point in time the phase in which the game will be in. For example from the Start phase a value of six must be obtained for a seed to move to the Study level phase, otherwise the seed loops and tries again. Also in Fig 1, C stood for clearance which a seed must undergo after completing studies.  $S_0$  represented the Start phase in which the game must initially be.  $S_1$  represented the Study Level phase,  $S_2$  the Pitfalls phase,  $S_3$  the Absolution phase and  $S_4$  the Result-Graduation phase. The preliminary computerization of the game using the above specification was carried out using VB 6.0. Command and label controls were extensively used. The random number generator, RND, was used to generate the values of the die which were used in the game. Results showed that the game was playable using the computer. This version of the game is recommended for use by undergraduates because of its portability.

#### V. Acknowledgement

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## APPENDIX A: AILO-AKADA GAME BOARD

### AILO-AKADA (R)

<b>GRADUATION and CONVOCATION</b> 77 Throw a two or four 77				
<b>FIRST CLASS (Hons).</b> Five points go to Q 76				
<b>SECOND CLASS (Hons), UPPER DIVISION</b> Throw a one or two, go to 76 else four points go to Q 75				
<b>SECOND CLASS (Hons) LOWER DIVISION</b> Three Points, go to Q 74				
<b>THIRD CLASS (Hons)</b> Two Points, go to Q 73				
<b>PASS</b> One Points, go to Q 72				
<b>UNAPPROVED RESULT</b> Write to Senate, go to Q 71				
<b>FAILED</b> Repeat final, go back to 52 70				
<b>RELEASE OF RESULTS</b> Go up as many places as thrown 69				
<b>CLEARANCE</b> Throw a one or five Go to 77 Q	<b>PASSED</b> 1 Promoted Go to 18	<b>PASSED</b> 34 Promoted Go to 35	<b>PASSED</b> 51 Promoted Go to K	<b>COMPLETED</b> 68 Awaiting result, Go to 69
<b>SENATE MEETING</b> Throw a six Go back to 69 P	<b>CHEATED</b> 16 Copied in examination go to C	<b>CHANGE OF COURSE</b> 33 Go to F. Probation, go to G	<b>RIOTED</b> 50 Under Detention Go to J	<b>OVER DUE BOOKS</b> 67 Surcharged, Go to N
<b>PROTEST</b> O Throw a two or five Go P	<b>FINED</b> 15 For Damaged apparatus Go to B	<b>SCREENING</b> 32 Credentials Required Go to E	<b>EXCESS CREDIT LOAD</b> Seek Approval Go to I 49	<b>SQUATTING</b> 66 Illegal accommodation, Go to M
<b>LIBRARY</b> N Throw a one or Three Go 69	<b>FOUGHT</b> 14 In the refectory Go to A	<b>OWING</b> 31 School Fees Go to D	<b>SICK</b> 48 Brain Fog Go to H	<b>PROJECT</b> 65 Incomplete write up Go to L
<b>STUDENTS' AFFAIRS</b> M Throw a Three or four Go 69	<b>FAILED</b> 13 Repeat year one Go back to 1	<b>FAILED</b> 30 Repeat second year Go back to 18	<b>FAILED</b> 47 Repeat third year Go back to 35	<b>FAILED</b> 64 A carried over course, Repeat final year Go back to 52
<b>PROJECT DEFENCE AND SUBMISSION</b> L Throw a Two or four Go to 69	<b>RESIT(S)</b> 12 Go back to the next course below	<b>RESIT(S)</b> 29 Go back to the next course below	<b>RESIT(S)</b> 46 Go back to the next course below	<b>RESIT(S)</b> 63 Go back to the next course below
<b>ALLOCATION OF PROJECT</b> K Throw any number Go to 62	SECOND SEMESTER EXAMINATIONS AND HOLIDAY 11	SECOND SEMESTER EXAMINATIONS AND HOLIDAY 28	SECOND SEMESTER EXAMINATIONS AND HOLIDAY 45	SEMINAR AND PROJECT WRITE UP 62
<b>POLICE STATION</b> J Throw a six Go to K	GENERAL STUDIES 10	COURSE 252 27	COURSE 353 44	COURSE 454 61
<b>SENATE'S APPROVAL</b> I Throw a one or five Go to K	COURSE 151 9	ELECTIVE/CARRY OVER COURSE(S) 26	COURSE 313 43	COURSE 444 60
<b>HOSPITAL</b> H Throw a one or four Go to K	COURSE 141 8	COURSE 242 25	ELECTIVE/CARRY OVER COURSE(S) 42	COURSE 434 59
<b>APPLICATION AND RE-ADMISSION</b> G Throw a six Go to 18	COURSE 131 7	COURSE 232 24	COURSE 343 41	ELECTIVE/CARRY OVER COURSE(S) 58
<b>APPLICATION AND APPROVAL</b> F Throw a one or five Go back 1	FIRST SEMESTER EXAMINATIONS AND HOLIDAY 6	FIRST SEMESTER EXAMINATIONS AND HOLIDAY 23	FIRST SEMESTER EXAMINATIONS AND HOLIDAY 40	FIRST SEMESTER EXAMINATIONS AND HOLIDAY 57
<b>SCREENING PANEL</b> E Throw a one or two Go to 35	COURSE 121 5	COURSE 222 22	COURSE 333 39	COURSE 424 56
<b>BURSARY DEPARTMENT</b> D Throw a two or three Go to 35	COURSE 111 4	ELECTIVE/CARRY OVER COURSE(S) 21	COURSE 323 38	COURSE 414 55
<b>SUSPENSION</b> C Throw a six Go to 18	COURSE 101 3	COURSE 212 20	ELECTIVE/CARRY OVER COURSE(S) 37	COURSE 404 54
<b>LABORATORIES</b> B Throw a three or five Go to 18	MATRICULATION 2	COURSE 202 19	COURSE 303 36	ELECTIVE/CARRY OVER COURSE(S) 53
<b>DISCIPLINARY COMMITTEE</b> A Throw a four or five Go to 18	REGISTRATION YEAR ONE 1	REGISTRATION YEAR TWO 18	REGISTRATION YEAR THREE 35	REGISTRATION FINAL YEAR 52
START ENTRANCE EXAMINATION. Throw a six Go to 1				

### AILO AKADA (R)