International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-4, November 2019

Cost Estimate Model for Software Projects using GREYWOLF Algorithm and COCOMO Model

Krishna Mohan G, J. Satish Babu, Venkata Naresh Mandhala, Gayatri V, Chaitanya Gupta G, Krishna Vamsi N

Abstract*: Cost estimation analysis for the software system project is the foremost difficult tasks in software organizations. In this paper, a comparison between an estimate and actual effort was done by applying the grey wolf's algorithm to predict the effort and time of this software system for a given archive. The intermediate semi-detached COCOMO model was used with the grey wolf's algorithm by taking the KLOC of the dataset as input, additionally to fifteen cost drivers and giving effort and time as output. The recommended model of the cost estimation helps the project manager by offering a fast and truly estimates the hassle and time of software system project which is nearer to the actual cost.

***Keywords*: Grey Wolf Algorithm, COCOMO Model, Cost Estimation, Effort Estimation, Time Estimation.**

I. INTRODUCTION

Pressman defines the estimation as a developer conceives to verify the quantity of cost, effort, sources and time needed to make each program or output system. Estimating the effort, size, schedule, and energy of computer code outcomes could be a vital method in program management and coming up with. Project effort cannot be a static science, however a combination of historical knowledge and advanced techniques that may prove the accuracy of the estimate. The computer code cost consists of:

Manuscript published on November 30, 2019.
* Correspondence Author
Krishna Mohan G*, Department of Computer Science and Engineering,Koneru Lakshmaiah , Education Foundation, Guntur, Vaddeswaram, A.P., India.
J Satish Babu, Department of Computer Science and Engineering,Koneru Lakshmaiah Education Foundation, Guntur, Vaddeswaram, A.P., India.
Venkata Naresh Mandhala, Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Guntur, Vaddeswaram, A.P., India.
Gayatri V, Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Guntur, Vaddeswaram, A.P., India.
Chaitanya Gupta G, Department of Computer Science and Engineering,Koneru Lakshmaiah Education Foundation, Guntur, Vaddeswaram, A.P., India.
Krishna Vamsi N, Department of Computer Science and Engineering,Koneru Lakshmaiah Education Foundation, Guntur, Vaddeswaram, A.P., India.

- Size i.e. The range of management and engineering employees allotted to the project.
- Interval signifies the quantity concerning your time needed to finish the design.
- Effort anticipates the personnel industry needed to finish a design sometimes weighed in person-months.

Cost estimation sometimes busts to precisely prophesy the particular expenses conversely the time required to generate the project. Computer code cost evaluation standards have two issues. It becomes tough to predict the prices and energy at the start of the project.

The data used for the COCOMO model distinct between the estimated and the actual effort.

II. LITERATURE SURVEY

Dr. Krishna Mohan,et al.., and (2016) the performance of SRGM is judged by its ability to suit the software system failure data. How sensible will a mathematical model fit the information and reliableness of the software system is bestowed [4].

Kaushik, et al., (2013) investigate the employment of Back-Propagation neural networks for software system cost estimation. That design has intended in such a process that it helps this wide practiced COCOMO model furthermore updates its fulfillment [2].

Srinivasa, et al., (2011) suggested a replacement model structure supported Alaa F. Sheta by using formal logic for the uncertainty of dominant prediction and tuned the parameters of the cost model by using swarm intelligence-Particle Swarm improvement. The verification of projected model results and comparison with the prevailing models was through with the National Aeronautics and Space Administration software package dataset [5].

Reddy, et al., (2010) proposed software system effort estimation principles supported artificial neural networks. The figures intended to enhance the fulfilling of the network that suits to the COCOMO Model [3].

Sehra, et al., (2017)use evolutionary computing procedures effort adjusting factors (eaf) that including fifteen cost drivers that has six positions of evaluation: very low, low, nominal , high very high, extra high. Bee colony optimization particle swarm optimization to use special theme of the COCOMO model parameters[6].

III. GREY WOLFALGORITHM OVERVIEW (GWO)

Meta heuristic optimization algorithms have become additional acquainted in engineering applications as a result of these

- Deem rather simple ideas and being outspoken to implement.
- Don't need gradient erudition.
- Will detour native optima.
- Do typically employ within a large variety of problems comprising completely varied systems.

Large aggregates of algorithms are presented for various combinatorial optimization issues. Grey Wolf optimization is an example of the distinct algorithms planned by Mirjalili et al., in 2016. This rule stands galvanized by the group action of grey wolves and it operates on the guidance hierarchy looking strategy. Grey wolves are thought about the commanding predators; they rest in a pack scope of 5–12 wolves. Supported the looking strategy the grey wolves are classified into four classes like alpha, beta, delta, and omega.

This algorithm could be a classic example of an extremely criticizable line of searches that crystal rectifier within the 1st decades of our millennia to the event of a complete zoological garden of metaphors ennobling optimization heuristics. In our opinion they, as is that the case for the Grey wolf optimizer, are typically however little variations of already existing heuristics rebranded with unnecessary and convoluted biological metaphors. Within the case of GWO, this is often significantly evident because the position update rule is shockingly trivial and might even be simply seen as a product of an organic process image or a particle swarm one.

The initial component that they explored as best fit to the explication is alpha (α), beta (β) and delta (ð). The balance of the component is considered as omega (ω). Here, the hunting (optimization) is commanded by α, β and ð. The ω wolves follow these three wolves.

A. THE SOCIAL HIERARCHY CONSISTS OF FOUR POSITIONS AS FOLLOW

ALPHA

Fundamental position is termed alpha. The alpha wolves signify sole rulers of the pack and that they comprise a male and a feminine.

They are to blame for creating selections regarding searching, moment to run, and a relaxing place so on. The pack members have to be constrained to decree the alpha excerpts and that they acknowledge the alpha by owning their cues underneath.

BETA

The betas are submissive killers that expedite the alpha in a higher cognitive process.

The beta wolf can be both male and feminine moreover that thinks about that simplest bidder to denote the alpha once the alpha passes away or enhances the recent.

The beta strengthens the alpha's grasps everywhere individual pack also provides the feedback over alpha.

DELTA

The delta wolves aren't beta or alpha wolves moreover assigned to as subordinates.

Delta wolves ought to be compelled to labor under the alpha and beta however they overlook the omega (the most inferior position in wolf's social hierarchy).

B. THE CLASSIFICATIONS OF DELTA IS AS FOLLOWS

Scouts- This following is for accountability for patrolling the limits of the township and threatening the pack in the event of any emergency.

Sentinels- This sect is for liable for the protection of the pack.

Elders- This assortment signifies the intimate wolves accustomed to being alpha or beta.

Hunters- This collection is liable for agreeing to the alpha and beta wolves in looking and procuring feed for the pack.

Caretakers- These are liable for heeding for the sick, frail and scraped wolves within every pack.

OMEGA

The omega wolves signify the whipping boy within the pack; all need to labor under all the opposite aggressive wolves.

They will appear don't seem to be vital people within the pack furthermore that they are the lowest conceded wolves to eat. The entire pack is competing just in case of losing the omega.

In the grey wolf optimizer (GWO), we estimate the most beneficial explication as the alpha, and the secondary and the part fittest solutions are named beta and delta respectively.

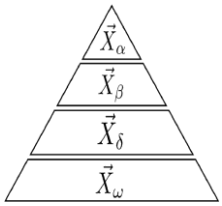

Fig. 1 Indicates Social Hierarchy

C. CLASPING THE PREY

As quoted above, grey wolves encompass victims during the hunt. To mathematically model encircling behaviour the following equations are suggested:

$$\overrightarrow{Di} = \left|\overrightarrow{Ci}.\overrightarrow{Xi}\left(t_p\right) - \overrightarrow{Xi}(t)\right| \quad (1)$$

$$\overrightarrow{Xi}(t+1) = \vec{X}_{ip}(t) + \overrightarrow{Ai}.\overrightarrow{Di} \quad (2)$$

$$\vec{A}i = 2\vec{a}\vec{r} - \vec{a} \quad (3)$$

$$\overrightarrow{Ci} = 2\vec{r}_2 \quad (4)$$

Where

$\overrightarrow{Xi}_p(t)$-the space vector of the victim.

$\overrightarrow{Xi}(t)$ - the space vector of the grey wolf

$\overrightarrow{Ai}$And$\overrightarrow{Ci}$ are the coefficient vectors that alternate to concede the wolf to regulate their site in the space encompassing the victim.

$\vec{r}, \vec{r}_2$Are selected random vectors in the domain of [0, 1].

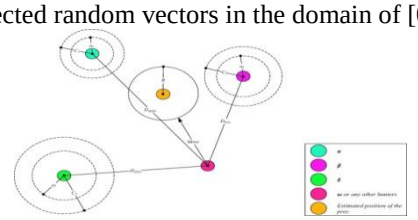

Fig. 2 Encircling Prey

Retrieval Number: D5395118419/2019©BEIESP
DOI:10.35940/ijrte.D5395.118419
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

D. HUNTING

Wolves ought the flexibility to acknowledge individual placement of victims and encompass them. Hunt transpires seldom radio-controlled via this alpha. The beta and delta may further sometimes partake in searching. In the exploration area, we've neither plan regarding the placement of the optimum (victim) to mathematically affect the searching function of grey wolves; we tend to suppose that the alpha (best candidate solution) beta and delta ought higher information regarding the potential state of the victim.

We tend to save the primary 3 most high-grade explications obtained to this point and oblige the opposite search agents (including the omegas) to update their positions in keeping with the status of the most effective search agent. The subsequent formulas are projected during this regard.

The subsequent equations are to calculate the gap between α, β, δ

$$\overrightarrow{D\iota_\alpha} = \left|\overrightarrow{C\iota_1}.\overrightarrow{X\iota_\alpha} - \vec{X}\right| \quad (5)$$

$$\overrightarrow{D\iota_\beta} = \left|\vec{C}\iota_2.\overrightarrow{X\iota_\beta} - \overrightarrow{X\iota}\right| \quad (6)$$

$$\overrightarrow{D\iota_\delta} = \left|\overrightarrow{C\iota_3}.\overrightarrow{X\iota_\delta} - \overrightarrow{X\iota}\right| \quad (7)$$

$$\overrightarrow{X\iota_1} = \overrightarrow{X\iota_\alpha} + \overrightarrow{A\iota_1}.\overrightarrow{D\iota_\alpha} \quad (8)$$

$$\overrightarrow{X\iota_2} = \overrightarrow{X\iota_\beta} + \overrightarrow{A\iota_2}.\overrightarrow{D\iota_\beta} \quad (9)$$

$$\overrightarrow{X\iota_3} = \overrightarrow{X\iota_\delta} + \overrightarrow{A\iota_3}.\overrightarrow{D\iota_\delta} \quad (10)$$

$$\overrightarrow{X\iota}(t+1) = \frac{\overrightarrow{X\iota_1}+\overrightarrow{X\iota_2}+\overrightarrow{X\iota_3}}{3} \quad (11)$$

By using certain equalizations a hunting agent modernizes its status as per alpha beta and delta in a passing m-dimensional search space. To boot every last point would transpire by passing random place at intervals a circle that is printed by the positions of alpha-beta and delta inside

the search space totally different time intervals. In numerous words, alpha, beta and delta estimate the position of the prey and totally different wolves updates their positions with reference to prey's position every which way round the prey as they begin searching.

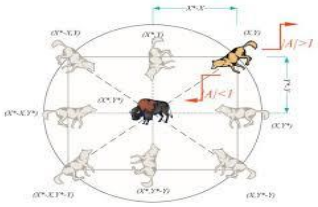

Fig. 3 Hunting Prey

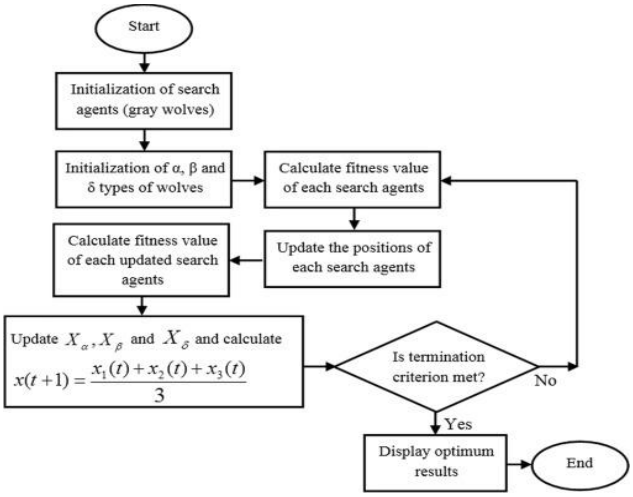

Fig. 4 Flow Chart of Grey Wolf Optimization

E. COCOMO MODEL

It is a cost assessment prototype for computer code outcomes moreover infrequently used as a method of prognosticating specific varied parameters related to creating an outline like extent, effort, cost, time also quality. It relies on the investigation of sixty-three outcomes that create it one in all these valid documented standards. Principal parameters that outline every standard of any computer code merchandise, the outcome concerning the COCOMO signify fundamentally Effort and Schedule.

Effort: quantity concerning the undertakings that may do needed to finish a task. It is rated in person-months units.

Schedule: merely suggests that a particular quantity of your interval needed for the achievement concerning a particular task, which implies, about development, equivalent to the hassle place. It's measured within the units of your time like weeks, months.

Diverse prototypes of COCOMO are planned to prophesy this cost estimation to completely different positions, supported an individual number of exactitude also decorum needed. A total of those standards is applied to a range of outcomes, whose properties verify these worth of constant to be employed in succeeding predictions. Those components referring to completely diverse practice varieties exist introduced underneath.

Organic: Each software package design signifies associate degree organic sort if unique crew extent needed is sufficiently little, the matter is well experienced and has worked with in particular yore additionally, the organization divisions have formal expertise concerning the quandary.

Semi-detached: Each software package outline is alleged to transpire a Semi-detached sort if particular important aspects like crew intensity, expertise, information of specific varied programming settings belong amid such as embedded and organic. Here outcomes rated essentially Semi-Detached mean comparatively limited acquainted plus troublesome to improve balanced facing this systemic entirety including necessitating plenty concerning expertise plus steering moreover creativeness.

Embedded : Each software package scheme claiming particular very best position regarding quality, creativity, moreover skill demand constitute this class. Such a software package needs a bigger crew extent than particular opposite 2 standards moreover additionally, those developers have to be compelled to signify amply old including inventive to acquire before-mentioned complicated designs. Group-specific higher than custom varieties employ completely several costs like unique constants employed in Effort Calculations

F. PROTOTYPES OFCOCOMO

COCOMO has 3 progressive schemes. The 3 forms will denote in keeping with our necessities. These comprise the Basic, Intermediate and Detailed.

Basic COCOMO Model:

The first model, Basic COCOMO will denote fast furthermore insignificantly estimated forecasts regarding software mode. Its exactitude moderately bound

Intermediate COCOMO Model:

Intermediate COCOMO receives certain cost drivers within deliberation, besides accounts during this influence of unique plan conditions, i.e. accounts for certain cost drivers including additionally, prognoses are offered part wise henceforward manufacturing every portion of correct results. These two models doused in our design.

This basic COCOMO model feigns that this hassle denotes barely a one perform concerning every quantity of lines of code and a few constants judged consistent with some various computer code. Nonetheless, in existence, neither system's effort plus schedule is often entirely cast covering every premise regarding Lines of Code. Towards the varied alternative constituents like dependability, endurance, Inclination. Certain representatives stand referred to essentially cost drivers plus also the COCOMO Intermediate Model employs fifteen so operators concerning cost estimation.

Each design supervisor does rate these fifteen completely diverse parameters concerning some selected project datasets preceding some computation from 1 to 3. Next, upon certain ratings, acceptable cost driver costs mean accepted of significantly higher. Those fifteen costs stay next increased to evaluate the Effort Adjustment Factor.

$$Ei = ai * kloc^{bi} * EAF \quad (12)$$

Ei indicates Effort estimation.

EAF is an Effort Adjustment Factor.

ai and bi is constants.

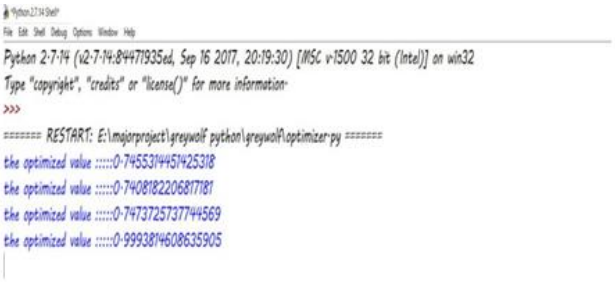

Fig. 5 Optimized COCOMO Values

NO	Cost Drivers	Ratings					
		Very Low	Low	Nominal	High	Very High	Extra High
	Product Attributes						
1	Required S/w Reliability (RELY)	0.75	0.88	1	1.15	1.4	-
2	Size of Application Database (DATA)	-	0.94	1	1.08	1.16	-
3	Complexity of the Product (CPLX)	0.7	0.85	1	1.15	1.3	1.65
	Computer Attributes						
4	Run Time Performance Constraints	-	-	1	1.11	1.3	
5	Memory Constraints (STOR)	-	-	1	1.06	1.21	
6	Virtual Machine Volatility (VIRT)	-	0.87	1	1.15	1.3	-
7	Turnaround Time (TURN)	-	0.87	1	1.07	1.15	-
	Personal Attributes						
8	Analyst Capability (ACAP)	1.46	1.19	1	0.86	0.71	-
9	Application Experience (AEXP)	1.29	1.13	1	0.91	0.82	-
10	Programmer Capability (PCAP)	1.42	1.17	1	0.86	0.7	-
11	Virtual M/c Experience (VEXP)	1.21	1.1	1	0.9	-	-
12	Programming Language Experience	1.14	1.07	1	0.95	-	-
	Project Attributes						
13	Modern Programming Practices	1.24	1.1	1	0.91	0.82	-
14	Use of Software Tools (TOOL)	1.24	1.1	1	0.91	0.83	-
15	Required Development Schedule	1.23	1.08	1	1.04	1.1	-

Fig. 6 15 Cost Drivers

Detailed Model :

detailed model detailed COCOMO consolidates total concerning the characteristic features regarding each intermediate redaction regarding COCOMO with each associate appraisal concerning each cost drivers influence proceeding every move about every software system engineering method. The prototype uses completely offbeat effort multipliers for every price driver attribute. In careful COCOMO an inclusive software system is split within several modules later we tend to apply COCOMO in several modules to estimate effort including later adding hassle.

IV. CONCLUSION

In this research paper, we investigated and scrutinized the unique software system cost estimation model exploits the COCOMO model supported the calculation of your effort required and time needed. Output costs are calculated by variable costs starting from very low to very high. Here within the analysis work, we've got reviewed the elaborated cost estimation models that were promoted former. A close correspondence within the estimated effort and also the actual effort was provided by applying input costs gained from national aeronautics and space administration outcomes. The work performed shows the calculable effort quantity completely different from the actual effort supported the actual costs obtained. We've got projected a model employing a Grey Wolf algorithmic rule that takes the input costs obtained through the COCOMO model and offers effort and time development. The projected model might facilitate the project manager to offer a lot of realistic estimates of the project effort and development time that features the cost of the programs. These estimates can be used for assessing software reliability based on SPC (STATISTICAL PROCESS CONTROL). [4] and SPRT (SEQUENTIAL PROBABILITY RATIO TEST) [5].

REFERENCES

1. AL-Saati, Dr, Najla Akram, and Marwa Abd-AlKareem. "The use of cuckoo search in estimating the parameters of software reliability growth models." arXiv preprint arXiv:1307.6023 (2013)
2. Kaushik, Anupama, A. K. Soni, and Rachna Soni. "A simple neural network approach to software cost estimation." Global Journal of Computer Science and Technology (1969).
3. Reddy, P. V. G. D., K. R. Sudha, P. Rama Sree, and S. N. S. V. S. C. Ramesh. "Software effort estimation using radial basis and generalized regression neural networks." arXiv preprint arXiv:1005.4021 (2010).
4. Satyaprasad, R., G. Bharathi, and G. Krishna Mohan. "SPC-Based Software Reliability Using Modified Genetic Algorithm: Inflection S-Shaped Model." IUP Journal of Computer Sciences 11, no. 4 (2017).
5. Prasad, R. Satya, V. Surya Narayana, and G. Krishna Mohan. "Software Reliability Estimation: Gompertz." (2016).
6. PVGD, Prasad Reddy, and Hari Ch VMK. "Fuzzy and Swarm Intelligence for Software Cost Estimation." Global Journal of Computer Science and Technology 11, no. 22 (2012).
7. Sehra, Sumeet Kaur, Yadwinder Singh Brar, and Navdeep Kaur. "EVOLUTIONARY COMPUTING TECHNIQUES FOR SOFTWARE EFFORT ESTIMATION." IJCSIT
8. Alaa, F. Sheta, and Alaa Al-Afeef. "A GP effort estimation model utilizing line of code and methodology for NASA software projects." In 2010 10th International Conference on Intelligent Systems Design and Applications, pp. 290-295. IEEE, 2010.

AUTHORS PROFILE

J.Satish Babu, working as Assistant Profesor in the Department of Computer Science and Engineering,KoneruLakshmaiah Education Foundation, Vaddeswaram, A.P.,India. His area of interests are Data Mining, Software Engineering. Email:jampanisatishbabu@kluniversity.in.