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ANN BASED CONSTRUCTION SITE RESOURCE ALLOCATION AND PREDICTION USING AI

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Abstract – *This is an ANN based artificial neural network for allocation and prediction of construction site resources. By using this data our smart algorithms and AI system we are going to predict and allocate construction site resources. We are going to provide user interface to each and stack holder at construction site. Using this UI every stack holder will update the information about site like material and resources on cloud. Using this data we will create data set and will apply our smart algorithms and programs on this dataset to prediction and allocation system. Each and every registered user will have access to own profile to CRUD the dataset on cloud. This system is accessible from different devices like desktop, mobile and wearables.*

Key Words: Algorithm, civil, AI, Network, Construction, Apps, Dataset, ANN

1. INTRODUCTION

Applications of ANN (Artificial Neural Network) in construction management in general go back to the early 1980's. These applications cover a very wide area of construction issues. Neural network models have been developed internationally to assist the managers or contractors in many crucial construction decisions. Some of these models were designed for cost estimation, decision making, predicting the percentage of mark up, predicting production rate …etc. The objective of this research is to develop a neural network (NN) model to assess the percentage of site overhead costs for building projects in Egypt. This can assist the decision makers during the tender analysis process. Cost Estimating is one of the most significant aspects for proper functioning of any construction company. It is the lifeblood of the firm and can be defined as the determination of quantity and the prediction or forecasting, within a defined scope, of the costs required to construct and equip a facility. The significance of construction cost estimating is highlighted by the fact that each individual entity or party involved in the construction process have to make momentous financial contribution that largely affects the accuracy of a relevant estimate. The importance and influence of cost estimating is supported by scores of researches. Carty (1995) and Winslow (1980), for example, have documented the importance of cost estimating, mentioning it as a key function for acquiring new contracts at right price and hence providing gateway for long survival in the business. According to Larry, D. (2002) cost estimating is of paramount importance to the success of a project. Alkanes (1988), articulated that, estimating departments is responsible for the preparation of all estimates, estimating procedures, pricing information, check lists and applicable computerized programs. He also insists on the fact that accurate cost categorization, cost reporting, and profit calculation are the heart of the construction business.

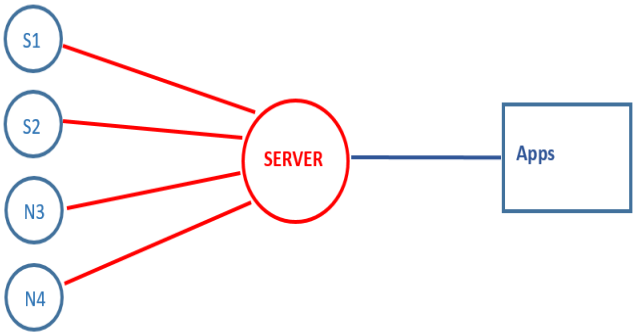

Fig -1: ANN Architecture

In order to achieve a financial engineered estimating methodology, it is imperative that different techniques should be evaluated. Hegazi and Moselhi (1995), conducted several surveys studies in Canada and the United States to determine the elements of costs estimation. The survey was carried out with the participation of 78 Canadian and U.S.A building construction contractors in order to elicit current practices IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 3, No. 1, May 2011 ISSN (Online): 1694-0814 www.IJCSI.org 274 with respect to the cost elements used to compile a bid proposal and to identify the types of methods used for estimating these elements. Their results indicated that direct cost and project overhead costs are estimated by contractors primarily in a detailed manner, which is contrary to the estimation of the general overhead costs and the markup. Assar, S. A. et al. (2001), investigated the overhead cost practices of construction companies in Saudi Arabia. They show how the unstable construction market makes it difficult for construction companies to decide on the optimum level of overhead costs that enables them to win and efficiently administer large projects. Cost estimating models and techniques provides a well-defined

engineered calculation methods for the evaluation and assessment of all items of office overhead, project overhead, profit anticipation, total project cost estimation, and the assessment of overhead costs for construction projects that leads to competitive bidding in the construction industry. This paper presents the steps followed to develop a proposed model for site overhead cost estimating. The necessary information and the required projects data were collected on two successive yet dependent stages: I. Comparison between the lists of site overhead factors collected from previous studies and the applied Egyptian site overhead list of factors that is adapted by the first and second categories of construction firms in Egypt; and II. Collection of all required site overhead cost data for a sample of projects in Egypt to be used during the analysis phase and site overhead cost assessment model development.

2 Literature Survey

Construction industry is highly competitive and faces challenges in the areas of costs of projects, delays in construction activities, labor productivity, disputes, tenders, bidding prices, safety aspects, rate of materials, maintenance costs, risk analysis etc. which are highly complicated in nature. To deal with these challenges, Artificial Intelligence (AI) techniques like fuzzy logic, case-based reasoning, probabilistic methods for uncertain reasoning, classifiers and learning methods, Artificial Neural Networks (ANN), Genetic Algorithms and hybrid techniques are widely used in the field of Construction Management (CM). In the last two decades of twentieth century, there was a surge in publications dealing with Artificial Intelligent techniques and especially ANN in various aspects of CM. In 2001, Adele and Yen provided a comprehensive review of such applications made before the turn of the century. The current work presents a review of about 70 papers published in the area of CM. The objective of the paper is to highlight the applications of ANN in the following fields of CM: Cost, Productivity, Risk Analysis, Safety, Duration, Dispute, Unit rate and Hybrid Models. Further critical review of the findings will help the readers to focus on important areas for potential use and development of ANN in the said areas of CM. The future scope will facilitate continued research efforts. The paper is further synthesized as follows: Initially a brief introduction on ANN is presented and is followed by the assessment of their recent applications in the areas of Cost, Productivity, Risk Analysis, Safety, Duration, Dispute, Unit rate and Hybrid Models. Discussion and critical review is done in the preceding section followed by author's comments on the findings and future scope. ANN is a soft computing tool, mimicking the ability of human mind to effectively employ modes of reasoning and/or pattern recognition. ANN as a concept was existing for a long time; however its application in civil engineering started in late 1980's primarily in construction activities. ANN's were found to learn from the relationships between input and output provided through training data and could generalize the output, making it suitable for non-linear problems where judgment, experience and surrounding conditions are the key features. ANNs typically comprise of 3 layers viz. input layer with input neurons, hidden layer(s) with hidden neurons and output layers with output neurons. Each neuron in the input layer is connected to each neuron in the hidden layer and each neuron in hidden layer is connected to each neuron in the output layer. The number of hidden layers and number of neurons in each hidden layer can be one or more than one. The number of input neurons, hidden neurons and output neurons constitute the network architecture. Before its application the network is trained, i.e., the connection weights and bias values are fixed, with the help of a mathematical optimization algorithm and using part of the data set until a very low value of error is attained. The network is then tested with an unseen data set to judge the accuracy of the developed model. The network is trained using various training algorithms which aim at minimizing the error between the observed and network predicted values. The networks are classified according passage of flow of information either in the forward direction (feed forward) or in reverse or lateral directions (recurrent network). Generally three-layer feed-forward or recurrent networks are found to be sufficient in civil engineering practices. Other types of networks include the counter-propagation ANN, Hamming's network and the radial basis function network. Risk Analysis and Safety are important aspects in CM in for identification of potential risk in the projects and safety indices are carried out. ANN based procedures had been developed to predict the likelihood of contractor default in Saudi Arabia [44], and to estimate the risk index for an expressway construction stage using the principles of system theory, operability, independence and comparability. ANNs were developed to estimate percentage variation between the forecasted and actual costs of floats at 30, 50, 70 and 100% completion stages based on 11 significant risk factors. In 2014, Mehdi assessed the risk value for 10 risk factors as mechanical failure, electrical failure, wrong vendor selection etc. in cement industries in Bangladesh. In 2007, Ella and Wang compared techniques of ANN and regression analysis to estimate the risk score and risk category for bridge maintenance projects. Liu and Gao in 2014 proposed a risk assessment method using rough sets to reduce uncertainties and ANNs. An ANN system was developed so as to identify the cost deviations that occur, due to the political risk involved in a construction project. The project manager can incorporate the risk consequences into a bidding decision, and generate revised and updated risk estimates systematically and easily during the progress of the project. A rating in the form of a percentage change in cost from the baseline cost forms the output vector for the neural network model. An ANN model was developed to predict safety climate of a construction project and evaluation of construction employees' safe work behavior. ANN-based model was developed for predicting workers' fatigue in hot and humid environment. In a study ANN and Logistic Regression were utilized to model the occupational safety and health of construction workers and performance

of the models were assessed by calculating the log-likelihood (LL) ratio. In 2015, Chen and Liu developed model based on Bayesian network for performance assessment of the subway construction safety in China. Mohammad am et.al. in 2015, used chain analytical approach which included rough set theory and ANN modeling, and modeled the factors affecting health of workforce and predicting severity of occupational injuries. In 2013, Goh and Chua used neural network to study relationship between elements of safety management and accident severity and discussed on proactive management of accidents.

3. PROPOSED SYSTEM

We are going to provide user interface to each and stack holder at construction site. Using this UI every stack holder will update the information about site like material and resources on cloud. Using this data we will create data set and will apply our smart algorithms and programs on this dataset to prediction and allocation system. Each and every registered user will have access to own profile to CRUD the dataset on cloud. This system is accessible from different devices like desktop, mobile and wearables. Data collection is done at backend once data is collected our program will create dataset ae per user query also our system auto generate the reports and states to analyze the results and predict the session.

4. SYSTEM ARCHITECTURE

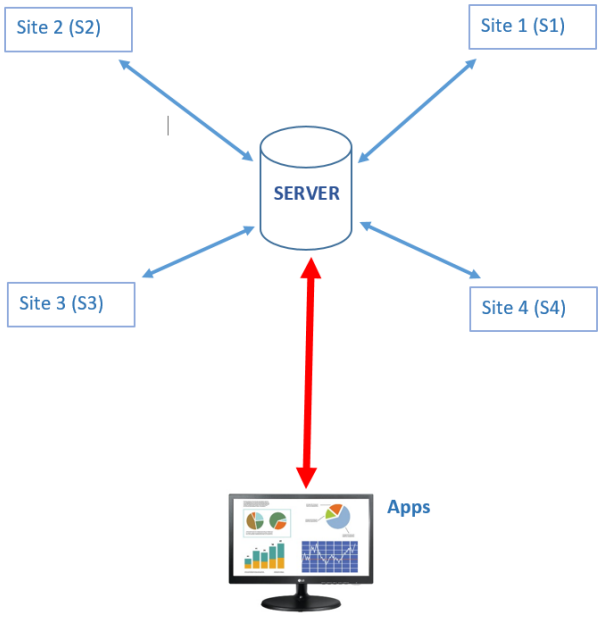

Fig -2: System Architecture

As shown in above system architecture S1, S2, S3, S4 are the construction sites where all users will store the data centrally at server and then at user end our program will generate the results like charts, reports, and predictions of allocation of resources. Also user interface to each and stack holder at construction site. Using this UI every stack holder will update the information about site like material and resources on cloud. Using this data we will create data set and will apply our smart algorithms and programs on this dataset to prediction and allocation system. Each and every registered user will have access to own profile to CRUD the dataset on cloud. This system is accessible from different devices like desktop, mobile and wearables.

5. REQUIREMENTS

- OS : Android, Windows
- Internet : Required
- Server : Apache Tomcat
- RAM : 512 MB
- Platform : WEB, Cloud, Mobile

6. CONCLUSIONS

This system is very useful for construction site management as well as resource allocation and resource prediction. Also very helpful for resource tracking and accounting purpose. Highly secured cloud based system for dataset management. Each stack holder have own profile and security credentials to access profile and insert data related to particular related construction to cloud.

Central information of all site of particular vendor at on click to manage and allocate resources. Trace account of resources like human manpower, row material, transportation and expenditures. Highly secure data on cloud to access anywhere.

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