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Article

Construction Cost Estimation and Employee Tracking Management System

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A B S T R A C T

The aim of this proposed system is to highlight the importance of material management as materials make considerable percentage of total construction costs and also employee tracking. Construction material and equipment constitute more than 70% of the total cost for a construction project. Considering different employee management needs, our systems come with remote access features for builders, which will allow you to manage your workforce anytime. As Android applications are increasingly gaining popularity these days, we are developing an Android based application for location tracking and conferencing which can be used by employees working on site, outside office. One of the main features in employee management system is distance tracking for employees and report generation for particular site. This effective location tracking mechanism saves both time and money of construction industry. As adequate construction cost estimation is main factor in any type of construction project and also material management is beneficial towards the material savings, combining this both facts together, we are developing Web Application for prediction of material requirement and cost. For cost estimation and prediction we are using neural network algorithm to predict accurate cost and also two techniques of neural network namely feed-forward neural network architecture and back-propagation learning technique are included in this system. For secure data transfer we are using AES algorithm.

Keywords: Global System for mobile, Back-Propagation, Neural Network, Cost Estimation, Material Prediction, Global Positioning System, Firebase

Introduction

Construction Cost Estimation and Employee Tracking Management System are based on material prediction, cost estimation, and employee tracking. Prediction is the basis of decision-making. Prediction and estimation are done by using BP Neural Network (back propagation).[1] Prediction method will be applied to process according to the mastered historical dataset in order to reveal a relationship between variables so as to predict future development. Back propagation method which is a type of neural network model is proposed to forecast future cost of construction projects. Back propagation method can be used to produce the best solution and performs well when the dataset is large.[2,8] Material management is beneficial towards the material savings. Combining this both facts together, we are developing Web Application for prediction of material requirement and cost. Considering different employee management needs, our systems come with remote access features for builders, which will allow you to manage your workforce anytime. As Android

applications are increasingly gaining popularity these days, we are developing an Android-based application for location tracking and conferencing which can be used by employees working on site, outside once.[3] One of the main features in the employee management system is distance tracking for employees and report generation for a particular site. This effective location tracking mechanism saves both time and money of the construction industry.

Related Work

Zeyan Du, Binyong Li[1] performed a study on scientific determination of investment and cost estimation and also simplified the investment estimating preparation based on the learning process of standard BP neural network. An improved BP neural network estimation model with GA optimization was also proposed by him. The estimation model was applied to practical projects and applicability and reliability of improved BP neural network was verified.

Smita K. Magdum, Amol C. Adamuthe[2] developed a neural network and multilayer perceptron-based model for construction cost prediction. Four NN models and twelve MLP models were tested based on varying number of hidden layers and hidden nodes. Performance of NN on training and testing dataset varied significantly with different hidden nodes while MLP models on training dataset were not significant. This research concludes that MLP models gave the best training results with ten and eight hidden nodes but gave better results with 8 hidden nodes on testing dataset as compared to NN. Also, RMSE values of NN and MLP models were consistently low for training dataset.

Sphurti S. Arage and Nagaraj V. Dharwadkar[3] have also conducted studies on estimation of construction cost. Ordinary Least Square Method which is a type of simple regression model was proposed to forecast future cost of the construction project. As OLS method produced the best solution and performed well when a dataset is small, experiments were performed with 12 years of district schedule rates of Pune region to find out the accuracy of the model. Researchers noted that the proposed model gave 91 percent to 97 percent prediction accuracy.

Punam Toke, Abhishek Gole et al.[11] designed employee management system which was adopted to our managerial requirements. The system was developed to provide easy online access to employees that are currently at work, to allocate jobs to employees and to manage workforce anytime. Also, better management of resources was done via this system. The system provided quick and reliable access to the running of the business and saved both time and money for the construction industry.

MY. Cheng, H.C. Tsai and E. Sudjono,[8] Cost Estimates using Evolutionary Fuzzy Hybrid Neural Network for Projects in Construction Industry", International Journal on Expert Systems with Application, 2010; 37(6): 4224-4231. This study proposes an artificial intelligence approach, the Evolutionary Fuzzy Hybrid Neural Network (EFHNN), to improve conceptual cost estimate precision. This approach first integrates Neural Networks (NN) and High Order Neural Networks (HONN) into a Hybrid Neural Network (HNN), which operates with alternating linear and non-linear neuron layer connectors.

R. Yadav, M. Vyas, V. Vyas, and S. Agrawal,[5] Estimation Model for Residential Building using Artificial Neural Network", International Journal of Engineering Research and Technology, 2016; 5(2): 312-314. The average error of test dataset for the adapted model was largely acceptable and can perform as a good indicator regarding the ability of the proposed model to predict the total construction cost of any future construction project at an appreciated degree of accuracy. This paper gives a clear review of implementing the ANN tool in the prediction of the total cost of building construction projects and the relevant factors affecting it.

Huawang Shi and Wanqing Li,[10] Integrated Methodology of Rough Set Theory and Artificial Neural-Network for Construction Project Cost Prediction", Proceedings of 2nd International Symposium on Intelligent Information Technology Application, 2008; 16-21. The rules developed by rough set analysis show the best prediction accuracy if a case does match any of the rules. The rationale of our hybrid system is using rules developed by rough sets for an object that matches any of the rules and neural network for one that does not match any of them. These effects of our methodology were varied by experiments comparing traditional discriminant analysis and neural network approach with our hybrid approach.

Proposed System

Introduction

Observing the trends in construction technology presents a very mixed and ambiguous picture. On the one hand, many of the techniques and materials used for construction are essentially unchanged. Construction cost estimation of construction project and also material management is beneficial towards the material savings.Good project management in construction must vigorously pursue the efficient management of employees, material and equipment. Material handling, which includes procurement, inventory, shop fabrication requires special attention for cost prediction. Thus there is need of system which includes management of employees, tracking of employees, cost prediction and material estimation together.

The objectives of this system include:

- Design of a Android application for employee management and tracking.

- Web based application to estimate the cost required and material prediction.
- Database to store historical datasets of materials cost year wise and maintain data of employees.
- A user friendly front-end for the user to interact with the system.

System Architecture

The problem which is occurred due to manual cost prediction of required material on construction sites and also task management that are overcome in proposed system. The proposed system consist of four modules.

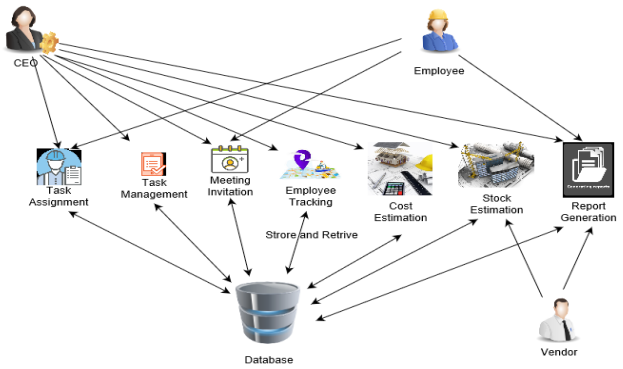

Figure 1.System Architecture

Employee Tracking

Using Android application real time location of an employee visiting different construction site is tracked by using GPS and Firebase database.[3] It is introduced for tracking the employee visit to a site, company needs to give allowance for employee visit. So this tracker functionality will keep record of source and destination address of every visit. The employee will be able to attach proofs in the form of photos of current construction site with its exact location using longitude and latitude values.

Task Management

Task management is very important in organization to keep track of all employee, their training, meeting planning, task assessment and many more which helps to produce more effective productivity. In this proposed system, it allows user to make internal planning for future work like budget, skill level of employee, productivity, compliance. A user can broadcast message as well conduct online meetings. The vendors and employer can communicate with each other for the selling and buying purpose. It will take the note of all the sailed raw material which is used in construction.

Material Prediction

In construction environment, an organization maintained a balance between critical stock-outs and reduced inventory costs. This analysis helped in managing the materials well for both raw materials and for finished goods.[7] It would help to understand the problems occurred in purchasing and safety stock. Based on per square feet area of construction building amount of material required is predicted.

Cost Estimation and Prediction

Considering prior knowledge of material prediction cost estimation and prediction is carried out. The construction cost is calculated by using historical dataset including different parameters like Year, Ground Floor Area, Duration, Earthwork etc.[1,9] The BP neural network is used to predict the cost of construction. During shortage of material required for square area, accordingly cost is calculated and supplied by vendor.

Construction Cost Prediction Model

Artificial neural network algorithms simulate the learning process of human brain. The artificial neurons are interconnected and communicate with each other.[1] Each connection is weighted by previous learning events and with each new input of data more learning takes place. The Back Propagation (BP) neural network algorithm is a multi-layer feed-forward network trained according to error back propagation algorithm. The back-propagation algorithm is used to find a local minimum of the error function. The network is initialized with randomly chosen weights. The standard BP network is composed of three kinds of neurons layer. The lowest layer is called the input layer.[4] The middle one is named as the hidden layer and the top one is called the output layer.

- Forward pass
- Backward pass

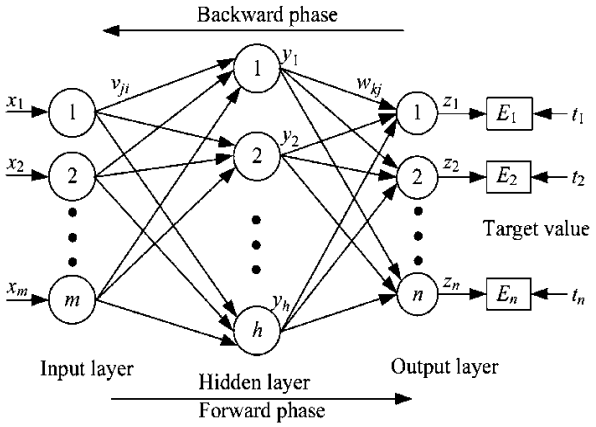

Figure 2.BP neural network[1]

Forward Pass

Forward pass traverse through all the neurons from first to last layers. There are two steps, in first step we get the values of hidden layer nodes and in second step these values are further used to compute the values of output layer node. A set of weights is applied to the input data and calculate an output, the set of weights is selected randomly in first

pass. The output of first pass is compared with the target value if the actual output varies from targeted output then in backward pass the weights are changed.

Backward Pass

Similar to forward pass, in backward pass calculations occur at each layer. We begin by changing the weights between the hidden layer and the output layer. Our aim with backward pass is to update each of the weights in the network so that they cause the actual output to be closer the target output after each step thereby minimizing the error for each output neuron and the network as a whole. In this way forward and backward pass together make one whole iteration.

Algorithm BPN

1. Give input dataset.
2. Decide number of node and Initialize weight.
3. Apply forward pass:

For every node in the layer

- Calculate the weight sum of the inputs to the node.
- Add the threshold to the sum.
- Calculate the activation for the node.

4. Apply backward pass:

For every node in the output layer Calculate the error signal.

For all hidden layers

For every node in the layer

- Calculate the node signal error.
- Update each node's weight in the network.
- Calculate the Error Function.

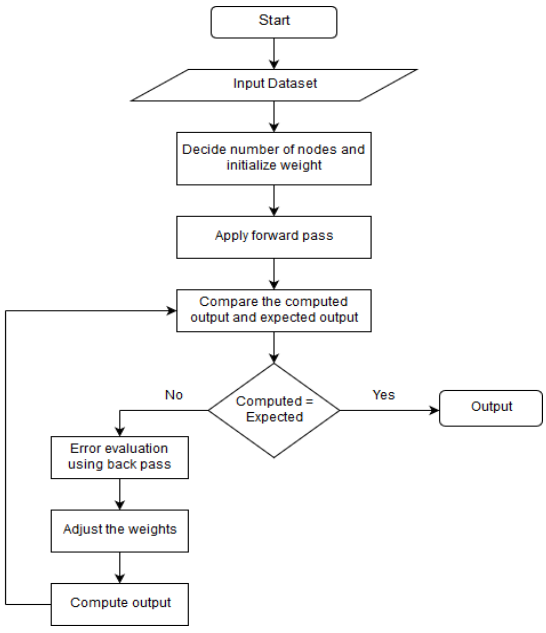

Figure 3.Flowchart of BP Neural Network

Conclusion

The proposed system will provide an overall solution for the employer to manage its employee and task assignment for each employee. This helps in proper reimbursement for travel allowances. Provides ease of sending a message as well as the broadcast message for emergency announcements this application will help to reduce the efforts of employer and employee, quickly analyse data and share this data when they need to. The proposed system is based on the intranet service by using this organization will work efficiently; it helps to manage data under a network. The neural network has got more and more attention in the economy owing to its non-linear mapping ability and approaching ability for any function. This project uses the artificial neural network to extract the relation between the project features and the estimation of fabrication cost from a large number of past estimation materials and sets up the estimation neural network model.

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