Restoration of a Heritage Buildings by Using Artificial Neural Network

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Abstract-Now days the decaying of consolidation materials of heritage buildings is huge problem of all countries. A cultural heritage protection needs restoration actions for increasing the life of heritage buildings. Actually the life span of heritage buildings is more than the RCC buildings. Because of that the monuments restoration action is very essential. The factors which responsible for degradation of building are environmental degradation agents, quality of material, protective treatment, design of buildings, quality of work and maintenance. The aim of the paper is to study the different consolidation materials which are used in restoration actions of heritage buildingsand automatic material selection system. For avoiding improper conservation strategy we use the artificial intelligence. By using artificial neural network we get most suitable material. It is a decision support system and also takes less time than the other methods which are used for the restoration of heritage building

Keywords-Heritage Building, conservation, restoration, decision support system, artificial neural network.
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I. INTRODUCTION

The peoples and nations are identified by heritage. The conservation of heritage building means requisite actions taken to prevent deterioration by adopting approaches that extend the life and basic functions. The maintenance of heritage means continuous care and protection involving minor repair works in order to increasing the life of building. The heritage buildings are highly valuable assets due to their historical values and tourism potentials. Now days there is no any maintenance free building either heritage or RCC. Artificial Intelligence (AI) is a very versatile and potential technology in the field of computer technology, which enables computer users in various fields to solve problems for which algorithmic approach cannot be formulated and which normally requires human intelligence and expertise. Cultural heritage protection demands targeted restoration actions in order to increase monuments' lifetime. Artificial neural networks are biologically inspired in the sense that neural network configurations and algorithms are usually constructed with the natural counterpart in mind. The tremendous processing power of human brain is basically the result of the massively parallel processing units called neurons. Every neuron consists of a cell body, axon and dendrites. On the basis of restoration the automatic material selection system was developed by various authors. For avoiding improper conservation strategy and selecting proper materials, these systems are very useful.

II.   OBJECTIVES

1. To study of Artificial intelligence for heritage buildings restoration.
2. To select the proper consolidation materials by using Artificial Neural Network.
3. To study of conservation materials.
4. To study how to use conservation materials with the help of artificial neural network

III.   RELATED STUDIES

3.1 Definitions

1 "Conservation" means all the processes of looking after a place so as to retain its historical and/or architectural and/or aesthetic and/or cultural significance and includes maintenance, preservation, restoration, reconstruction and adoption or a combination of more than one of these.
2 "Preservation" means and includes maintaining the fabric of a place in its existing state and retarding deterioration.
3 "Restoration" means and includes returning the existing fabric of a place to a known earlier state by removing accretions or by reassembling existing components without introducing new materials.
4 "Authority" means National Monuments Authority.
5 "Competent Authority" means an officer not below the rank of Director of archaeology or Commissioner of archaeology of Central or State government or equivalent rank.
6 "Construction" means any erection or a building, including any addition or extension thereto either vertically or horizontally.
7 "Prohibited Area" means area of the protected monuments declared as of national importance and extending to a distance of 100 meters in all direction.

3.2 Restoration tools

From the literature, two toolswidely used in restoration of heritage building are mentioned below:
1) A combined fuzzy C-means and neural network system is adopted to automatically suggest the most suitable material.
2) The sustainability, data collection, and potential applications of an analysis using artificial neural network.

Also new techniques like simulation, fuzzy logic, expert systems are used in the restoration tools of heritage building.

3.3. Types of stones in the Heritage Buildings

C. Thomas, et al studied the types of stones which are used in preservation of heritage building. According to this paper in a visual on-site inspection of the building structure, four types of stone were identified.The dominant stone in terms of presence is a white limestone (WL) used as masonry in the construction. Another is sandstone, used as ashlars in the construction, more affected by weathering phenomena, with two distinct qualities: one is white sandstone (WS) with a grayish hue, and the other red sandstone (RS). Finally, with only a slight presence, a fourth type of stone is marly limestone (ML).

3.4 Neural Network Functions

A.K.L. Srivastav describes the details of artificial neural network. The author said that the use of computers started almost four decades but it is not fully used in structural design and planning.

Artificial intelligence is a very versatile and potential technology in computer technology field, which enables the computer users in various fields to solve problems for which algorithmic approach cannot be formulated and which normally requires human intelligence and expertise. There are two main types of Artificial Intelligence i.e. expert systems and artificial neural network. The artificial neural network is a biological inspired technology. Its process behaves like a natural counterpart in mind. In the brain there are hundreds of thousands of neurons. These are structural and functional unit of brain, processing parallel to each other.Every neuron consists of a cell body, axon and dendrites. Artificial Neural Networks consist of small processing units called nodes, which operate in parallel, and these nodes are densely interconnected by elements called weights. The information to be stored is fed at the input and small values are assigned to the weights. The weights are modified until the output of the network is satisfactory. Author said that the artificial neural network is a purely nondestructive test hence it is useful than the Schmidt test hammer method and ultrasonic pulse velocity method.
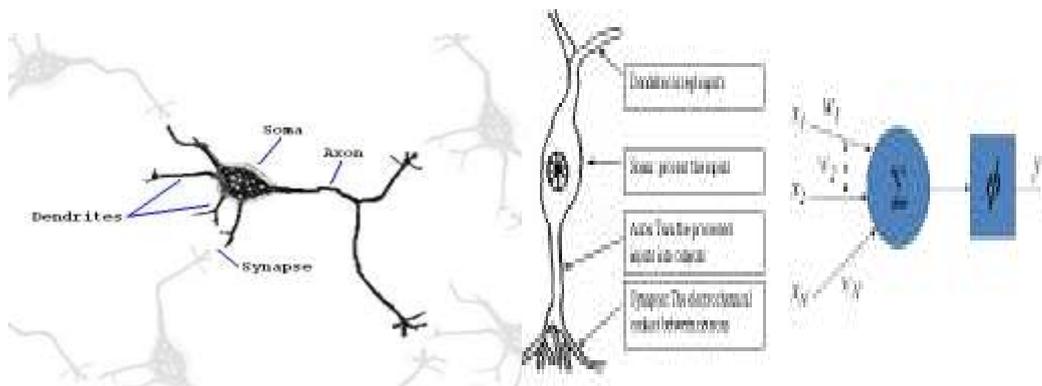
***Figure.1 Basic Neural Network   Figure. 2 Neural Network Activities***

IV.   MODEL DEVELOPMENT FOR ARTIFICIAL NEURAL NETWORK

J.M. Yatim, et al studied on degradation of heritage building by reasons like environmental degradation agents, quality of material, protective treatment, design of buildings, quality of work and maintenance. This paper shows the global issue of sustainability, data collection and potential applications of an analysis using artificial neural network. By using this application at University Technology Malaysia author predicting the service life of affordable quality housing. Artificial neural network used for asses and predict the service life of building and its component. In this process author used input variables like environment load factors, workmanship, building materials, usage and level of maintenance.

Sustainability is defined as balancing and safeguarding of the future's social, economy, and environment to meet the today's needs without compromising the ability of future generations to meet their own needs. The quality and reliability of building materials are decrease with time. The components are affected by factors like exposure to the environment, workmanship, building materials, usage and level of maintenance. Service life equation is derived,

ESL=RSL*A*B*C*D*E*F*G

ESL= Estimated service life.

RSL= Reference service life.

A= quality of component,

B= design level,

C= work execution level,

D= Indoor environment,

E= outdoor environment,
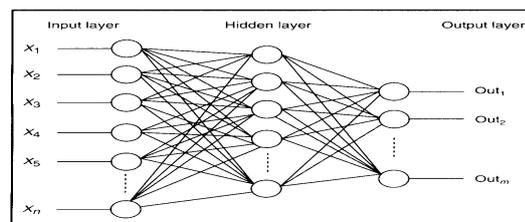
Figure.3 Neural Network Model (One hidden layer)

F= in use condition,
G= maintenance level.

In this paper author collected data from various areas of Malaysia. The total area divides into six zones: Rural, Urban, Industrial, Coastal, Highland and Island. By using this data author develop a model which has 11 inputs and one output. He decided to use only one hidden layer. The input layer includes environment, exposure, work quality, usage, maintenance, rating, SO2, rain, temperature. The author collected data from 294 timbers. From all of these timbers, ANN chooses the perfect timber for specific environment of specific area.

The equation bellow is used to for estimating the number of neuron in hidden layer;

Nhid=0.5*(Nin+ Nout) +√Ntpatt

Nhid= number of neuron in hidden layer, Nin =number of input parameter,

Nout=number of output pattern, Ntpatt= number of training pattern.

At last author compared the scatter plot of neural network output and the training target data. The coefficient of correlation r, for the training process of 0.8939 was achieved. However the network model cannot achieve a high level of accuracy.

V. DECISION SUPPORT SYSTEM

AnastasiosDoulamiset al evaluate the system which automatically suggests to the experts the most suitable consolidation material product, among the available ones in the market. The author also describe the decaying factors like aging, environmental conditions like humidity, salty environment, natural phenomena, previous incorrect restoration treatment, change of use of building like residential to hospital or college. He used the consolidation technique. This technique have main goal of restoring the strength of a decayed stone. The author said that the consolidation treatments are most risky methods because of their irreversibility and having side effects on stone after their application.In this paper the author introduce generic decision support systemable to assist users in monitoring, inspecting and finally inventing protection procedures on cultural assets. There are great variety of existing available information about building and its possible solutions of conservation materials because of that preservation of heritage building being a difficult and complicated process. The author, cultural heritage preservation application is divided into three parts;
1) Macro scale: Generic aspect of a building.
2) Meso scale: Decay and damages of building.
3) Micro scale: kinetics and thermodynamics of the decay phenomenon.
   The developed decision support system is running on the parts visual/ signal analysis, contextual and knowledge construction, decision making and expert systems and finally adaptation strategies and users feedback. The analysis can be improved through the use of usual data by using photographic scanning of a building surface. In this expert system author included three modules;
1) Artificial intelligence module:
   In this module cultural content applying different learning algorithms like supervised, unsupervised and semi supervised.
2) Recommendation system module:
   It suggests the potential solutions. The recommendation system is a type of information filtering system.
3) Decision support system:

By proper combining of artificial intelligence tools and recommendation system output, the process gets the final decision.

The inorganic materials, Nano-limes, organic materials, and alkoxysilanes are the types of consolidation materials. A combined fuzzy C-means and neural network system is adopted to automatically suggest the most suitable consolidation material to be used
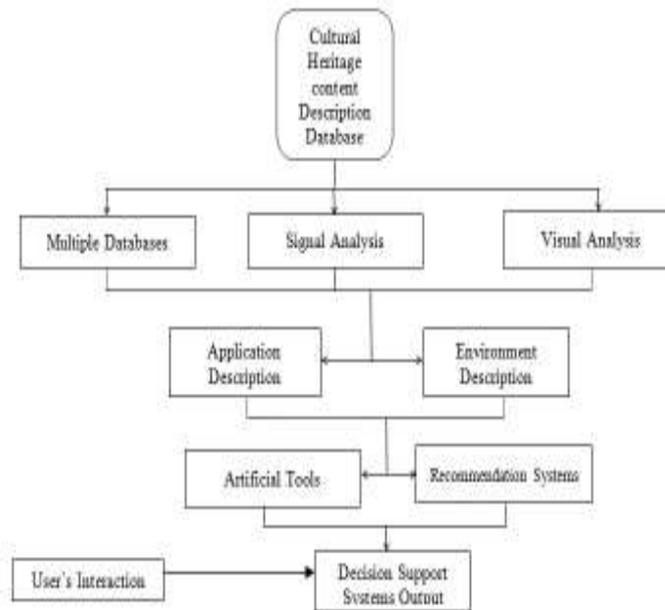
Figure.4 Decision Support System

VI.   CONCLUSION

After reviewing the literature it is concluded that conservation and restoration of heritage buildings is major problem in all the countries because of improper strategy of material selection. Also the paper is to discuss various methods used for proper selection of suitable consolidation materials. These decision support systems has modern tool called Artificial Neural Network

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