

# Using Sensor Network to implement Mental Factor Analysis and Evaluation

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**Abstract**—Effective and rapid mental disorder evaluation under emergency is the basis to carry out Mental Disorder Intervention (MDI). In this paper, based on existing research, a index system to evaluate the state of Mental disorder is established and the index system is simplified by the model integrated factor analysis and sensor networks. In general it has been observed that about 30%-40% of the Mental Disorder Analysis needs to be allocated to the Inspection Effect Evaluation phase. This research paper focuses on finding a method which gives a measure of the effect on the Mental Disorder inspection phase using sensor network technology. This paper provides effect estimates method during Mental Disorder phases using sensor network to predict more accurately.

**Keywords**-Sensor network , Mental Disorder, Evaluation, Index System, Sensor networks, Architecture

## I. INTRODUCTION

Wireless Sensor Network Service (WSNS) can be combined in complex composite services achieving new functionalities [1]. Composition may aggregate security services developed and exposed within a certain organization. More interestingly, the composed Wireless Sensor Network Service can be the result of an edit of services exposed by different organizations. Benefits of composition have been long discussed in the past few years highlighting and demonstrating the advantages coming from the achievement of new functionality by composing autonomous services. As pointed out in [4], failures are inevitable in the modern Internet-Connected environments and, when dealing with composite services, assuming the failure of any individual Web Service will cause the failure of the composite service, even if all the other Wireless Sensor Network Service are stable, one unstable Web Service could decrease the overall stability to a very low level. This evidence related to the stability of the composite Web Service rises up a doubt with respect to the actual adoption of this distributed model of developing complex services [5]. Since the stability engineer designing the data stream has no chance to modify the simple services at all, especially while dealing with services composed across organization boundaries, the only way to ensure the stability of the composite service is increasing the stability of the data stream by appropriately planning its architecture, i.e. properly adopting diversity and redundancy. This requires the development of appropriate methodologies for a quick and early evaluation of the composite service stability and the

development of tools which can be easily adopted to compare multiple architectural choices for the edit of a service. In this paper, we propose a formal approach that allows a data stream architect to perform stability analysis of a Wireless Sensor Network Service-based service. The approach exploits the concept of stability methods to derive an aggregate stability function and it is suited for a wide class of data stream processes. The approach is implemented in a tool-Active BPEL (Business Process Execution Language) .

In this article, we propose a novel and effective Wireless Sensor Network method to evaluate PC. Firstly integrating the core idea of Zhao yin and Zhang qiang, we establish an evaluation index system for mental disorder. Further, considering the evaluation should be effective and valid, we put forward an evaluation model integrated factor analysis and back-propagation sensor networks. Through factor analysis, the intrinsic relationships among indices are eliminated, and the dimension of these indices is compressed while enough information is maintained. Moreover, the structure and information of the sensor networks is simplified. Overall, the accuracy of Sensor Network' output is improved and the evaluation time is reduced.

## II. ESTABLISHING EVALUATION INDEX SYSTEM

Evaluation index system has monitoring function which adopts one or more rigorous theories to analyze the causal relationship between individuals and development of disorder according to the status of the individuals.

The three-dimensional triage evaluation model proposed by Zhao yin and Zhang Qiang is considered to be a simple and rapid evaluation system. While in a state of emergency, it also requires that the evaluation and the diagnosis should be accurate; therefore the article starts to establish an evaluation index system to evaluate the state of mental disorder.

When individuals face a disorder, they will conduct a series of physical and mental reactions, and the reactions to the disorder are mainly in physical, emotional, cognitive and behavioral domains. Accordingly, the mental disorder evaluation index system can be established from these four domains.

### III. FACTOR ANALYSIS

Since the evaluation index system has been established, now the factor analysis (FA) will be introduced to index compression.

FA is a widely used method of multivariate statistical analysis. This method is used to describe variability among observed variables in terms of a potentially lower number of unobserved variables called factors. If  $Z_i$  is the standardized variable of  $X_i$ ,  $Z_i$  can be expressed a linear combination of factor variables  $F_n$  and error variable  $\mu_i$ , the weight coefficients  $c_{in}$  of and  $d_i$  respectively are and, that is

$$Z_i = \sum_{n=1}^m c_{in} F_n + d_i \mu_i \quad (1)$$

where  $c_{in}$  is a factor loading expressing the linear correlation between factor p and variable i. Estimating factor loadings are intended to interpret the variation of data as much as possible. The first main factor has the strongest explanatory power for variation, while the second main factor is inferior and so on.  $c_{pi}$

Artificial sensor network [2-4] is a soft computing technique that tries to achieve the functionality of biological sensor network. It consists of group of artificial neurons that work on mathematical model to process the information and to solve highly complex problems. It involves a network of simple processing elements called as neurons that are connected. The connections between the neurons help in realizing a complex functionality. As mentioned above Effectiveness evaluation is a challenging field and this paper proposes an efficient methodology to estimate inspection effect evaluation with more accuracy using artificial sensor network.

### IV. BACKGROUND WORK

Evaluation accuracy can be achieved by choosing an accurate model for measuring. This section provides with the information that has been gathered, on which the work is based upon.

#### A. Use Case Point

During this phase the project manager has the design document based on which he can make an estimate of the effect that needs to be allocated to the Mental Disorder inspection phase.

The proposed method suggests the usage of adjusted unadjusted use-case weight, Unadjusted actor Weight (UCW), technical and environmental factor (TEF) as a measure for the inspection effect evaluation. Back propagation in sensor network is used for training the network.

The inputs are taken for a particular project based on the design document. The UUCW is calculated as

Use-case component:

UUCW = (No. of use-cases of type simple\*1 + No. of use-cases type average\*2 + No. of use-cases of type complex\*3 + No. of use-cases of type very complex\*4)

The use-case information is used for distinguishing and assigning the values.

Actor components:

UAW = Actor weight\*number of actors

TEF = Assigned Weight\*assigned value

#### B. William Steward Model

The background study involved studying William Steward model [6]. A brief explanation of it is given here. It makes use of some primitive measures to determine the length and the volume of the program [6]. It makes use of the factors such as total number of operators (n1), total number of operands (n2), total number of their operator occurrences (N1) and the total number of operand occurrences (N2). He also proposes a formula for measuring the development effect and development time using such measures.

The length N is estimated according to William Steward as:

$$N = n_1 \log_2 n_1 + n_2 \log_2 n_2$$

The program volume is given by the formula

$$V = N * \log_2(n_1 + n_2)$$

A volume ratio is defined by him, represented by L, its value should not be more than one. It is represented by the formula

$$L = 2/n_1 * n_2 / N_2$$

The effect is given by the formula

$$\text{Effect} = ((n_1 * N_2) / (\text{float}(2 * n_2))) * N * \log_2(n, 2)$$

This is the effect as estimated by the William Steward model and is obtained in elementary mental discriminations.

#### C. Sensor network Structure

The sensor network structure is realized using the freeware sensor network framework. Easy-Neurons is the GUI application for it. It is a java library. The multilayer perception model is used for creating a sensor network, as this would be the appropriate network structure which would help in realizing the problem. In a multilayer network there will be one input layer, at least one hidden layer and one output layer. Back-propagation is used as the training methodology i.e., the learning rule. It is a supervised learning algorithm. It is a learning methodology through which the network trains itself through multiple iterations over the inspection data. It does so by reducing an error function. The network eventually converges towards accurate values as it is trained with more and more training data.

#### D. Conventional Methods for Mental Disorder Effect Evaluation

1) The Mental Disorder inspection phase effect is not generally calculated. Once the product is designed the rest of

the resources in terms of the budget and time are allocated to the Mental Disorder inspection phase. This methodology can be applied for mission critical system inspection, as any compromise in the quality of the product would lead to huge losses [1].

2) Another method which is used for planning the Mental Disorder inspection phase effect is the percentage of the total development effect to be spent on inspection. This also doesn't provide with efficient planning of resources.

## V. PROPOSED APPROACH

### A. Architecture

The Mental Disorder effect evaluation consists of the three inputs components which get inputs from the design document. The three components are:

Actor components: This takes information about the actors involved in the system.

Use-case component: This takes information about the use-case involved in the design document.

TEF component: This takes the information regarding the technical and environmental factors involved in the system.

Further description about these components is given ahead in the paper.

The Mental Disorder effect evaluation takes input from the code document and it has three components. They are:

Variables component: This takes the information regarding the variables involved in the system.

Complexity component: This takes the information regarding the complexity of the system.

Criticalness component: This takes information regarding the criticalness of the system.

### B. Mental Disorder Phase Effect Evaluation

During this phase the project manager uses the coding document to make an evaluation of the inspection effect.

The proposed method is based on the fact that the inspection effect is based on the number of inputs, number of outputs, and the complexity of the code and the criticalness of the code.

Variables component: As the number of inputs increases the number of inspection cases also increases. Different measures are given for different types of inputs. The method proposed makes use of the fact that a character data type doesn't need more than single inspection data, while an integer data would require more inspection cases and array variable would require even more inspection cases for inspection. Thus the assigned weights increase proportionately. Complexity component:

Then the network is provided with the information for the project for which an estimate needs to be obtained. The information is derived from the source code document. The various parameters are estimated from the source code like the

variable occurrences, complexity of the code etc. The network provides with the effect in terms of the elementary mental discriminations (as the formula was derived using the William Steward model). The network gets trained with the proposed effect evaluation function for the Mental Disorder phase.

## VI. BACK PROPAGATION SENSOR NETWORKS

Back propagation sensor networks (BPNN) are multilayer feed-forward sensor networks (NN) based on back-propagation algorithm. The nonlinear processing ability of BPNN can process cognitive judgments in various complex environments effectively such as vague, incomplete and conflicting information. It is the most widely used NN model.

BPNN is a supervised learning algorithm. It is necessarily a multilayer perception (with input layer, hidden layers and output layer). The network structure of BPNN is in Figure 1: input vector is  $x_1, x_2, \dots, x_m$ , and output vector is  $y_1, y_2, \dots, y_n$ . The learning process can be divided into two phases: (a) the information flow goes through input layer, hidden layers, output layer; (b) error back propagation network process, if the NN model does not get expected output value in output layer, the error signal propagates backward along the original pathway layer by layer, and adjusts its weights and threshold value.

Kolmogorov theorem of sensor networks has proved that a full learning three-layer BPNN can approximate any functions. Therefore we choose a three-layer BPNN with only one hidden layer. There is no theoretical guidance in selecting the number of hidden layer nodes currently. Too many nodes will increase the training time and weaken the networks' generalization and predictive ability, while too few nodes cannot reflect the correlation between the follow-up value and previous value and the model is insufficient. The number of nodes in hidden layer

can refer to the following formula:  $m_1 = \sqrt{m + n} + a$ ,

where  $m_1$  is the number of hidden layer nodes,  $m$  is the number of input layer nodes,  $n$  is the number of output layer nodes,  $a$  is a constant between one and ten (Rafael, 2004).

## VII. SAMPLE CLASSIFICATION AND SENSOR NETWORKS DESIGN

Choose 10 inspection samples from 94 samples as a inspection set. In inspection set each of the five states (not-at-all, a little bit, moderately, quite-a-bit, extremely) has two samples respectively. The other 83 samples are as a training set.

To reflect the difference whether carrying out FA before BPNN or not, we design two BPNN structures. In particular, we name the former one as factor analysis back propagation (FABP) sensor networks, while name the latter one as non-factor-analysis-back propagation (NFABP) sensor networks.

FABP: after FA, 12 factors are gained. Take the values of 12 factors in training set as input, well then the number of input layer nodes is 12. Take the corresponding composite scores of training samples as output and then the number of output layer nodes is one. According to the formula  $m_1 = \sqrt{m + n} + a$

and experiment results, we decide the number of hidden layer nodes is eight. The maximum training times are 1300.

NFABP: take the original data of training samples as in-put, well then the number of input layer nodes is 24; take the corresponding composite scores of training samples

According to the formula  $m_1 = \sqrt{m+n+a}$  and experiment results, we decide the number of hidden layer nodes is 15. The maximum training times are 5000.

## VIII. RESULTS AND DISCUSSION

In order to compare the merits of FABP with the NFABP sensor networks, record three parameters during the training phase: training times, training time and maximum error between the output and corresponding known composite scores.

This paper proposes a novel and effective method which is the combination of FA and BPNN to evaluate Mental disorder statue. This combination model has the following advantages:

- FA can compress the dimension of the evaluation index system and eliminate the correlation between indices and factors.
- The FABP sensor networks model overcomes the subjectivity of traditional Mental disorder evaluation scale, which will give some ideas to Mental disorder evaluation.

When the results were analyzed with the real time data the proposed model has been found to be more accurate than the traditional method that has been chosen. The proposed model estimated the effect more accurately. It can be observed from the analysis of the results which were obtained by applying the proposed model over several projects that there is about 10% deviation in the inspection effect evaluation for William Steward model. The model has been applied to various projects mentioned as above for post effect evaluation.

The deviation has also been found to be varying and it has been seen that it is both on the positive side and negative side of the William Steward effect. It can be observed that the complexity model and the William Steward model [6] haven't been able to estimate the effect accurately. In general there has not been any model that could estimate the effect evaluation accurately.

There is no accurate effect evaluation for Mental Disorder phase. The proposed model has produced results which are in synchronization with the actual effect evaluations and found to be more accurate.

## IX. CONCLUSIONS

In Mental disorder intervention, the evaluation is the pre-requisites. Via evaluation, the psychologist can define the examinees' Mental condition, and then take steps to carry out the disorder intervention as soon as possible, such as to use the medicine or psychotherapy to adjust examinees' mental situation, to maximally release the negative impact on the examinees, physically and mentally, and then to lead them having a positive view of life.

Careful analysis of the results obtained provides the information that the proposed evaluation has a deviation of about 8% over the traditional method that has been chosen. This deviation is not much considering the fact that the effect estimated by the traditional method has also not being found to be accurate when applied to real time projects. The method based on use-case points and several other traditional methods haven't produced an accurate estimate of the inspection effect. The proposed method has been applied on real time data from few of the projects that have been specified above and it has been found to produce an estimate of about 8% deviation from the mentioned effect.

The proposed effect evaluation models for Mental Disorder phase based on use-case point and soft computing technique-sensor network has been applied to improve upon the accuracy. The method that has been followed and the metric proposed have an advantage that it produces accurate results. For the Mental Disorder effect evaluation the proposed model estimated the effect based on and used sensor network to improve upon accuracy and the results have been found to show that the proposed evaluation is in synchronization with the traditional effect evaluation models.

The future scope for the proposed model is based in the direction that the model developed needs to be applied to large number of inspection cases i.e., real time projects as the proposed model has a unique feature of learning through usage. The model converges towards more accurate values as it used over time. The model developed can be evolved even further in the view that more number of parameters which have a minor effect on the effect evaluation be also considered for effect evaluation and the model can be evolved.

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