Noise Pollution Monitoring and Modelling based on Nuerofuzzy Techniques at Mining Site

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Abstract— Mining industry is one the most polluting industry especially noise pollution. This is because of use of heavy machineries and blasting techniques. Following project work concentrates on monition of noise pollution in mining site and formation of a nuerofuzzy model to assess the workers work efficiency in the noisy environment as a function of level of noise, task type and time of exposure. The construction of model is done in the MATLAB software using ANFIS toolbox as well as fuzzy logic of IF-THEN rules. In high noisy environment with difficult task a worker cannot work efficiently on the other hand if noise levels are minimized and time of exposure reduced a worker can work efficiently.

Key words: Noise pollution, Nuerofuuzy modeling, Industrial workers, Work efficiency

I. INTRODUCTION

The word noise is derived from the Latin word nausea. Noise means wrong sound in the wrong place at the wrong time. "Noise pollution defined as sound, which is undesired by recipient, which gets damped into the atmosphere without regarding to the adverse effects it may have". Human ear are known to be sensitive to an extremely wide range of intensity varied from 20 Hz to 20000 Hz [1]. Sources of noise pollutions includes vehicular traffic, neighborhood, electrical appliances, railway and air traffic and electricity generating sets, heavy machineries, various oscillating and vibrating devices, gridding and crushing machineries, blasting operations on mining sites etc. Music concerts, festival celebration or rallies are example of less frequent noise pollution sources [2]. The Studies based on specific data collection and analyzing to make mathematical model for prediction of noise pollution effects on workers has started. To state reduction in work efficiency deterioration, one of the tools used is neuro-fuzzy logic. It has been established that a neuro-fuzzy computing system helps in identification and analysis of fuzzy models [3].

II. LITERATURE REVIEW

Number of studies has been done by many scientists on effect of noise pollution in surrounding on work efficiency of a worker or employee. To establish a fuzzy model between noise pollution and work efficiency of workers. Emphasis is given to identify the main parameters that affect work efficiency, needs to be consider in model making. Type of task has been identified as important parameter and linked with other parameters such as level of noise and duration of exposure [1]. The accurate prediction of noise level caused by machinery. Main objective of prediction model is to accuracy in measurement of 'sound pressure levels (SPL), as instruments used in measuring SPL, might not give accurate results due to errors caused by various reasons[2]. The primary goal of this study was to test the examination address that human execution in assembling situations relies on upon the psychological requests of the administrator and the apparent nature of work life characteristics. The second research question was that this relationship is identified with the administrator's particular assignment and time introduction. Two producing organizations, with a consolidated populace of seventy-four multi-gifted, broadly educated specialists who created and gathered mechanical and electrical hardware, partaken in an eight month, four-wave pseudo board study. Basic comparison displaying and invariance examination methods were directed on the information gathered amid subjective assignment examination and the organization of polls [3].

III. METHODOLOGY

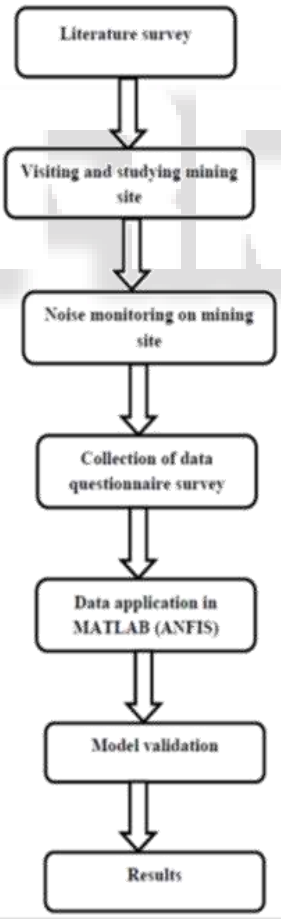

Fig. 1: Flow Diagram of Methodology

A. Noise Monitoring

The study for noise level in the study area has been carried out by selecting a noise monitoring station based on the following criteria.

- Source of the noise.
- Proximity of the noise generating source to the human settlements.
- Exposure time.
- Time- scaled dose-response ratio of the individual receptor.

B. Questionnaire Survey

Questions asked for survey

1) Name?
2) Age?
3) Type of work?
4) How many years you have been working here?
5) Do you use hearing Protection Devices (PPE)?
6) Does speech causes speech interferences?
7) Are you aware about effects of excessive noise exposure?
8) Are you annoyed by noise in the working environment?
9) Do you frequently have headache during working hours?
10) When you did your last health checkup?

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Siddhappa T	33	Truck Driver	7 years	No	No	No	Yes	No	Each 2 years
Rajesh J	37	Truck Driver	10years	No	No	No	Yes	No	Each 2 years
Manjunath A	22	Truck Driver	1year	No	No	No	Yes	No	Each 2 years
Pravina	25	Truck Driver	3years	No	No	No	Yes	No	Each 2 years
Sandip P	38	Truck Driver	10years	No	Yes	No	Yes	Yes	Each 2 years
Ashok	36	Truck Driver	10years	No	No	No	Yes	No	Each 2 years

Table 1: Answers of questions from questionnaire

C. Data Application in MATLAB (ANFIS Toolbox)

The methodology used in the construction of the present nuero-fuzzy model includes: Identification of the model parameters. To set the ranges of input and output parameters. Choosing of the membership functions for different inputs and the output. Formation of the fuzzy logic rules required.

IV. EXPERIMENTAL RESULTS

Workers or employees performance i.e. his/her work efficiency in the present model is obtained by inputs as level of noise, type of task, and time of exposure. Model is based on both neural and fuzzy logic. The inputs and outputs are given in table 2.

Sr no	Model inputs	Input parameter	Value	Fuzzy intervals
1	Inputs	Noise level	Low	50-65 dB(A)
			Medium	66-85 dB(A)
			High	86-105 dB(A)
		Type of task	Simple	0-3 point scale
			Moderate	4-7 point scale
			Complex	8-10 point scale
		Exposure time	short	0-3 hours
			Medium	4-7 hours
			Long	7-10 hours
2	Output	Reduction in work efficiency	Negligible	0-20 %
			Slight	21-40 %
			Moderate	41-60 %
			High	61-80 %
			Very high	81-100 %

Table 2: Inputs and Output Description of the Model

The implementation and results obtained by model are shown in following screenshots with respective explanation.

In figure 2 addition of inputs to the model is shown. The three inputs i.e. Level of noise, Type of task and Time of exposure respectively are supposed to feed here in the form of numerical values. After inputting these three parameters in the model, system considers these values for neurofuzzy computation i.e. logic as well if then rules formed in the model.

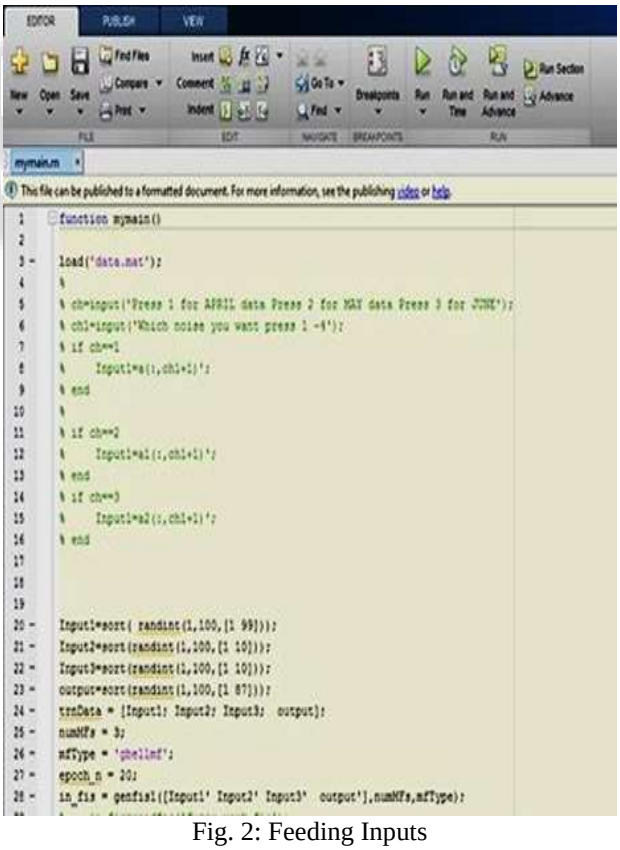

Fig. 2: Feeding Inputs

Model gives output in the form of graphs which are presented in two cases-

1) Output in the form of graphs shows noise level vs reduction in work efficiency containing three types of exposure times (short time, medium time and long time) where type of task is constant for three

graphs which are simple, moderate and complex respectively as shown in figure 4.4.2.

2) Output in the form of graphs shows noise level vs reduction in work efficiency containing three types of tasks (simple task, moderate task and complex task) where exposure times are constant for three graphs which are short time, medium time and long time respectively as shown in figure 4.

Figure 3 shows case one output in which three graphs are represented where type of task is constant i.e. simple task, moderate task and complex task. It is observed that reduction in work efficiency is less when exposure time is less when type of task is simple. Work efficiency reduces slightly as exposure time increases when type of task is moderate. And work efficiency considerably reduces when exposure time is high when type of task is complicated. Although it is clearly seen that as noise level increases work efficiency decreases. In other words work efficiency is good when noise level is less and exposure time to that noise is less. On the other hand work efficiency is get reduced when noise levels are high as well as exposure time is also high.

Figure 4 shows case two output in which three graphs are represented where exposure time is constant i.e. short time exposure, medium time exposure and long time exposure. It is observed that reduction in work efficiency is less when type of task is simple as well as exposure time is short. Work efficiency reduces slightly as type of task becomes moderate and where exposure time increases to medium. And work efficiency considerably reduces when type of task is complicated and exposure time is high. Although it is clearly seen that as noise level increases work efficiency decreases. In other words work efficiency is good when noise level is less and type of task is simple. On the other hand work efficiency is get reduced when noise levels are high as well as type of task is complicated.

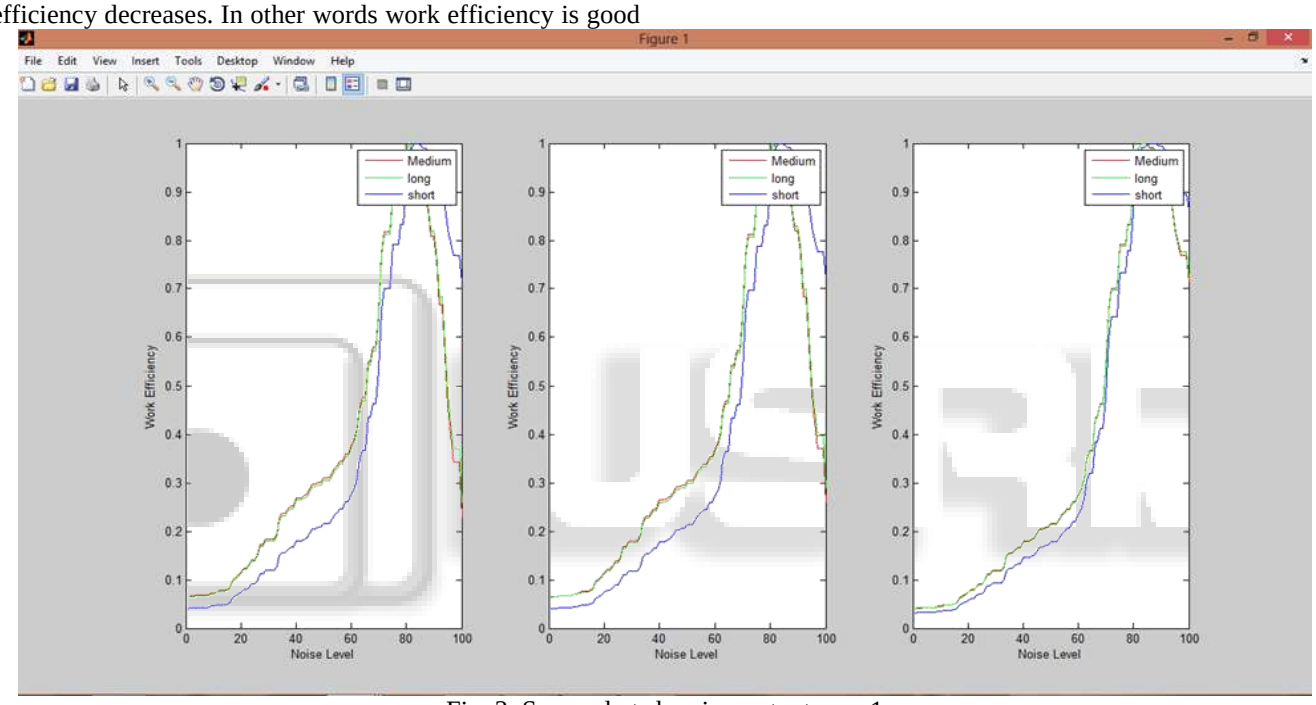

Fig. 3: Screenshot showing output case 1

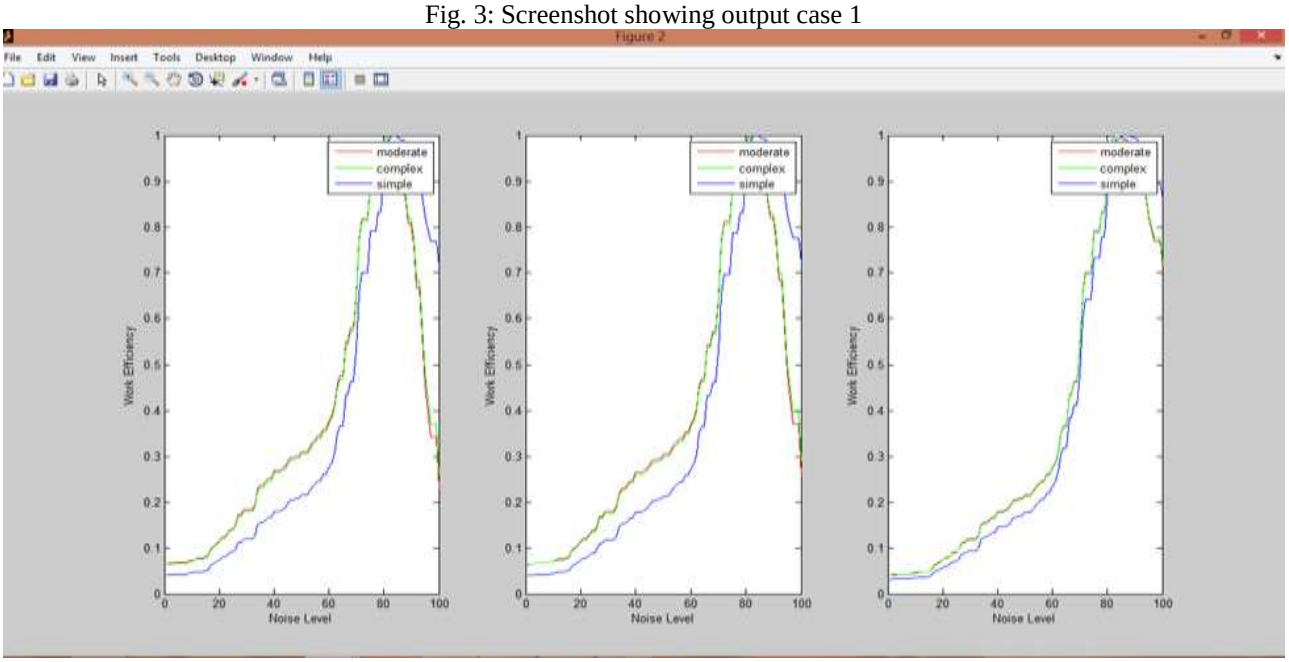

Fig. 4: Screenshot showing output case 2

V. CONCLUSION

The model was run on nuerofuzzy Toolbox of MATLAB software using both Mamdani and TSK inference. The outcomes found in both the cases are nearly similar. From the current nuerofuzzy model, it can be concluded that the workers work efficiency depends on the nature of the task, time of exposure and level of noise. The model is working as to achieve required objectives. This has dictated to adopt a hypothesized association between the workers work performance and sound dose based on Recommended Exposure Limit (REL) for workers involved in industries. With reduction of work performance another adverse effects of noise pollution are also present like sleep disturbance, vision distraction, headache etc. These effects can be minimized by following guidelines given by safety authorities of India.

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