Predicting Safety Hazards among Construction Workers Using HAAR Cascade Method

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Abstract: The construction industry plays a significant role in the social and economic development in our country. Safety in the construction industry is considered as the major issue in the development and developing countries. The construction sector suffers recently from poor safety and health condition. As safety rules do not exists and work hazards at the workplace are not perceived. By implementing safety management is to promote working conditions and work practices that will assure all employees of a safe and healthful work environment for all construction activities. The construction industry has always been considered as one of the most dangerous industrial sectors the construction industry is one of the most hazardous industries suffering from high on-site accident rate. A lot of safety hazards result from the activities of construction workers . The major objective of the project is to identify various factors affecting safety management at construction industry. A literature review and factors recommended by experts in different areas of interest were considered to categorize the factors. 10 different factors were identified. Identifying the danger zones using Haar- cascade algorithm. Based on the detection workers are identified from the danger zones.

Keywords; *Construction Industry, Relative Importance Index, Safety Management, Influencing Index*

I. INTRODUCTION

Construction and safety management process is essential to protect employees from safety hazards, protect the public in the surroundings and keep the job on track and schedule. Promoting safety cultures on construction sites protects everybody related to the project. In order to promote site safety, the safety manager must build a strong relationship with the employees so that they follow the safety manager. The workers must realize the importance of process safety management for their respective tasks and that the safety regulations have been enforced upon them to make them safe. The safety manager must take steps as and when necessary to promote and direct safe practices and safe working conditions. The best companies in the world prioritize employee health and safety to make it a shared responsibility for all. These companies do so in a strategic way that enables them to effectively practice prevention, while also equipping them to effectively handle any incident that may occur. According to the Industrial Accident Prevention Association a safety program is a systematic combination of activities, procedures , and facilitates designed to ensure and maintain a safe and healthy work place. It is the responsibility of the construction team, including the client, architect/engineer, contractor construction manager, subcontractor and suppliers, to ensure that each project is completed without injuries or recorded accidents thus it is the responsibility of the construction team to implement safety programs. The importance of a well-

designed safety management program is known by most, but unfortunately not implemented by all. An organization's ability to keep its employees safe depends on its ability to design, implement, and improve upon safety management processes and programs within their company. It's also a good idea to remind employees often that safety takes priority over productivity.

II. METHODOLOGY
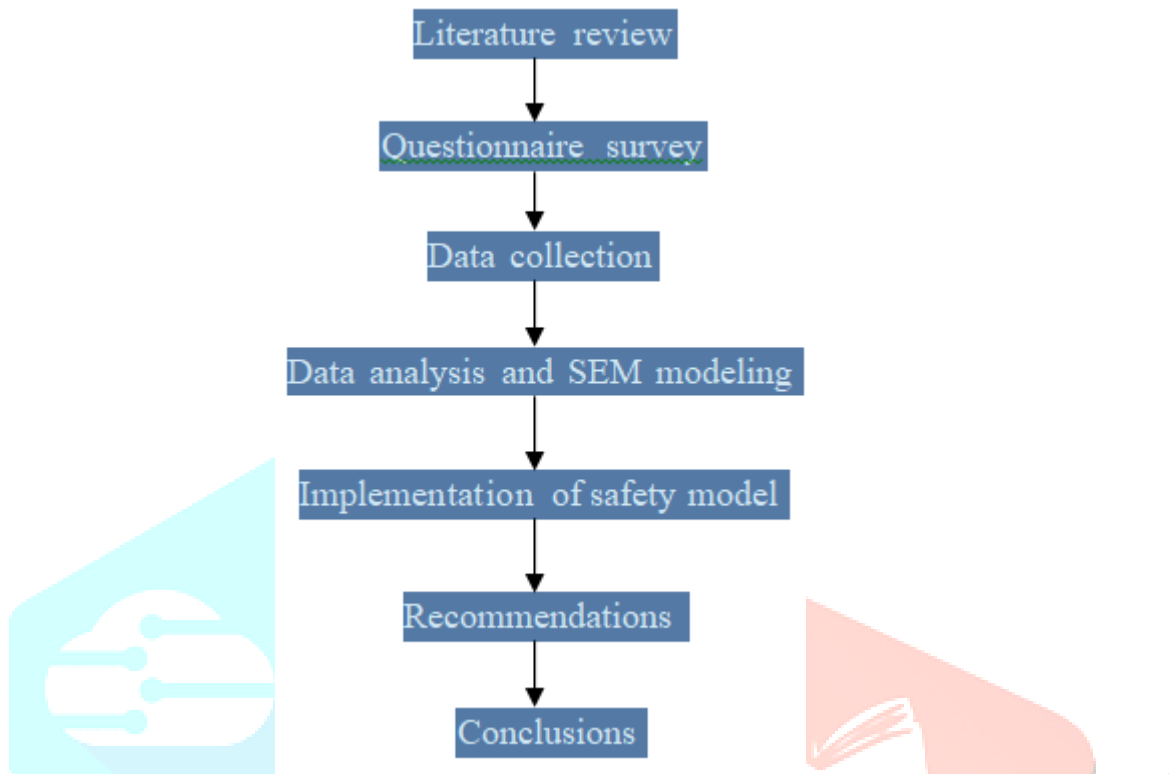
III. LITERATURE REVIEW

Tixier, Antoine J-P., et al. (2016) Provides model that predict injury type. This opens the gate to a new research field, where construction safety is considered an empirically grounded quantitative science. Finally, the absence of predictive skill for the output variable injury severity suggests that unlike other safety outcomes, injury severity is mainly random, or that extra layers of predictive information should be used in making predictions, like the energy level in the environment. In the context of construction safety analysis, this study makes important strides in that the results provide reliable probabilistic forecasts of likely outcomes should an accident occur and show great potential for integration with building information modeling and work packaging due to the binary and physical nature of the input variables.

Phuc,LeTranHuu,et. al. (2019) Provides model by creating a safety warning system for the working site. The machine- learning algorithm Haar-cascade was used to build four different classes for safety equipment recognition. Then proposed algorithm was applied to calculate a score to determine the safety of the current working environment. For checking the efficiency of this project, three different situations were installed with this system. With the advantages of the Haar-cascade algorithm, this system can be used as a real-time safety tracking system.

Marques, Paulo H., et al. (2014) The study aims at establishing the impression of laborers at the buildingdestinations in regard to illegal medication use and liquor abuse. The investigation is situated in building destinations situated in two local areas. The investigation has revealed insight into the requirement for customers to advance components for guaranteeing liquor use and medication abuse is controlled at building locales.

Mushi, Frank V., and Sylvester L. Manege. (2018) Study mainly focused on the various impact that would effect the workers .Questionnaires were prepared for survey .The substance abuse causes are generally grouped in to seven categories: Demographic Factors, Socio Economic Factors, Individual Factors, Health Factors, Work Related Factors and other factors. Around 180 responses were collected The responses was analyzed using RII method. They concluded that workers are less productivity

IV ELEMENTS FOR EFFECTIVE SAFETY MANAGEMENT

JOBSITE SAFETY

A poorly planned and untidy site is the underlying cause of many accidents. This results from fall of materials and conflict between workers and plant or equipment and affects the safety and health of workers and the cost & productivity. A safety management is essential at every site and it provides a systematic way to identify hazards and control risks while maintaining the declaration that these risk controls are effective. Jobsite safety management refers to the cyclic process of planning, organizing, implementing and reviewing, control of work and manpower to reduce accidents. Safety is an aspect of construction related activities concerned with protecting construction site workers and others from death, injury, diseases or other health related risks. The leading causes of site fatalities are falls, electrocutions.

SAFETY PROMOTION PROGRAMS

The objective of safety program is to develop and maintain awareness among all personnel of the organization's commitment to safety and health and individual persons' responsibility to support that commitment. Safety program is to promote working environment and work practices that will assure all employees of a safe and healthful work environment for all construction activities. Thus, the company makes full effort to establish a clear and positive safety culture on each construction site. They require very suspicious thinking and consideration if the greatest profit is to be obtained. The proprietor or contractor should develop, as part of a safety promotion program , a procedure to recognize and acknowledge good safety performance either by individuals, teams, departments or the organization.

SAFETY MEETINGS

A meeting can provide a good opportunity for promoting safety. Meetings suitable for promoting safety include orientation meetings for new comers, training meetings, and tool-box meetings. Safety and health films/videos can be shown during these meetings with time allowed for discussion after the viewing. The line managers can promote safety directly to all subordinates during the normal course of work. Through the day-to-day contacts, they can get the safety messages across and make workers accept safety as a way of life. Safety seminars, conferences and campaigns are the most high-profile way to promote safety. They can be used to raise safety awareness and promote good practices and safety standards. Safety campaigns usually involve the mobilization of people at different levels for a cause and can thus focus minds on safety issues and spread the safety messages across the entire workforce.

TRAINING OF WORKERS

The safety officer should ensure that all workers fully understand the safety and health hazards of the processes they work with for the protection of both themselves and their fellow workers. Also, additional training in subjects such as operating procedure and safe work practices, emergency evacuation and response, safety procedures and other subjects pertinent to process safety and health should be included in the training program. Hands-on training where workers are able to use their senses beyond merely listening will enhance learning and should be provided. Other training techniques using videos or on-the-job training should also be considered. The proprietor or contractor of the relevant industrial undertaking should periodically evaluate the training program to see if the necessary skills and knowledge are being properly applied by their trained workers. The training should

include a general description of the training plan and an overview of what plan will include. Training should not be one-time experience during the on boarding process.

PERSONAL PROTECTIVE EQUIPMENT

Construction sites are having many types of hazards as explained earlier due to complexity of the work environment. For a good safety culture all workers should be ensuring to use the required PPE Use of Personal Protective Equipment (PPE) to decrease employee contact to hazards when engineering and administrative controls are not feasible or effective in reducing these exposures to adequate levels. Broadly these are Safety helmets, Face shield, Safety belts, Safety shoes, hand gloves, goggles, Safety glasses or goggles, Earplugs or sound mufflers, Back supporter, Particle respirator, Vapor respirator, fall arrester etc. Personal protective equipment should be made available near the work spot for ease of use by workers. Workers may feel some inconvenience in using the PPE, but management should conscientiously enforce the use of PPE right from day one and each worker realized the importance of PPE and it should be made to believe these as last defenses indepth to save their life.

SAFETY SIGNS AND SIGNALS

Employees will notice that business provides the best conditions for increased employees health and safety. Because they won't be experiencing fatigue and discomfort, then there will be an increase in employee's involvement. Their motivation will increase the more they feel taken care of by the company. This can reduce the turnover rate and make business others want to work with. Labels, posters and signs are shows hazard information to employees and can be useful in providing additional information and making you aware of a probable safety or health hazard. Posters must locate in the area of hazard communication, confined space and pathogens. The employer must make sure that each sign or label posted can be understood by all workers. The safety signs include illuminated signs, hand and acoustic signals, traditional signboards, such as exclusion and warning signs, signs for fire exits, fire drills and fire-fighting equipment. Signs, posters and signals more helpful to understand easily about the dangerous occur.

IDENTIFICATION OF HAZARDS

Identify hazards and assess their associated risks, the safety officer of a relevant industry undertaking should in the first place prepare a list of items covering premises, plant, people and procedures, and gather information about them. After the identification of the hazardous exposure or the risk of such exposure to the workers of a relevant industrial undertaking, the proprietor or contractor should find out whether planned or existing safety precautions are sufficient to keep the risk under control and meet legal requirements. If the conclusion is negative, he should take steps to manage the risk so that they are reduced to the lowest level that is logically practicable, using engineering methods.

RII ANALYSIS AND RANKING OF INFLUENCING FACTORS

Relative Importance Index (RII) is used to determine the relative importance of quality factors involved. Survey responses were analyzed using SPSS software and then various factors was ranked using RII method. The various factors are ranked using RII methods to reach at a conclusion regarding most and least contributing factors affecting substance abuse. The factors are ranked by following equation.

$$RII = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{A \; x \; N}$$

RII= Relative Importance Index

n_5 = no of respondents for strongly agree

n_4 = no of respondents for agree

n_3 = no of respondents for no comment / neutral

n_2 = no of respondents for disagree

n_1 = no of respondents for strongly disagree

A = highest weight

N = total number of respondents

V. RESULT AND DISCUSSION

Safety Management factors

Problem Statement	Code	RII	RANK
Ensure regular safety meetings	A	0.441	5
Adopt emergency planning	B	0.531	4
Promote safety motivation	C	0.556	3
Focusing on accident investigation	D	0.579	1
Ensure work place safety	E	0.567	2

Signs, signals and barriers

Problem Statement	Code	RII	RANK
Obey safety signs	A	0.571	3
Exits properly marked	B	0.629	1
Chemical containers labeled	c	0.581	2

Safety training

Problem Statement	Code	RH	RANK
Workers receive safety training	A	0.605	3
Time allotted for training are sufficient	B	0.629	2
Trainer was knowledgeable	c	0.660	L

Safety inspection

Problem Statement	Code	RII	RANK
Safety inspection held periodically	A	0.705	6
Inspect each area	B	0.753	2
Checking maintenance record	c	0.729	5
Asking questions and making notes	D	0.744	3
Identify deficiencies and recommend	E	0.738	4
Information reported in a systematic manner	F	0.758	1

Safety value and reward system factor

Problem Statement	Code	RH	RANK
Safety awards and recognition	A	0.650	4
Promote safety suggestions	B	0.66	2
Incentivize safe behavior	c	0.671	1
Encourage safety tips	D	0.659	3

Safety culture

Problem Statement	Code	RII	RANK
Focus on prevention	A	0.338	3
Work together to improve safety	B	0.414	2
Safety risks are quickly corrected	c	0.452	1
Comfortable in reporting problems	D	0.411	4

Safety resources

Problem Statement	Code	RII	RANK
Always wear PPE	A	0.620	3
Safety products quality maintained	B	0.607	4
Rest breaks are provided	c	0.629	2
Providing medical allowances	D	0.633	1

Knowledge

Problem Statement	Code	RII	RANK
Awareness classes provided	A	0.595	3
Promote safety education	B	0.611	2
Focus on safety communication	c	0.632	1

Safety Environment

Problem Statement	Code	RII	RANK
Provide safe drinking water	A	0.600	3
Sufficient lighting provided	B	0.640	1
Adequate ventilation maintained	C	0.619	2
Always keep work areas tidy	**D**	0.595	4

Safety Rules

Problem Statement	Code	RII	RANK
Action against drug abuse	A	0.604	2
Always follow work protocol	B	0.612	1
Obey safety rules	c	0.595	4
No unauthorized entry	D	0.599	3

Most Contributing Factors

Contributing factors	Code	RII	RANK
Safety management	A	0.535	10
Signs, signals and barriers	B	0.594	8
Safety training	c	0.631	3
Safety inspection	D	0.738	1
Safety value and reward system	E	0.660	2
Safety culture	F	0.575	9
Safety resources	G	0.622	4
Safety knowledge	H	0.612	6
Safety environment	I	0.614	5
Safety rules	J	0.602	7

SEMMODELLING
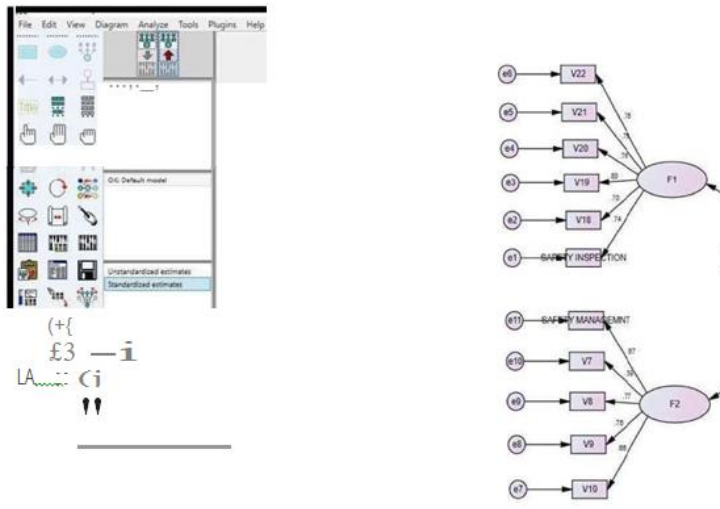
Haar Cascade approach

Haar Cascades are one of the algorithms that are currently being used for object detection. The major objective of this model is dangerous area detection. The detected dangerous area can be set up as shown in figure.
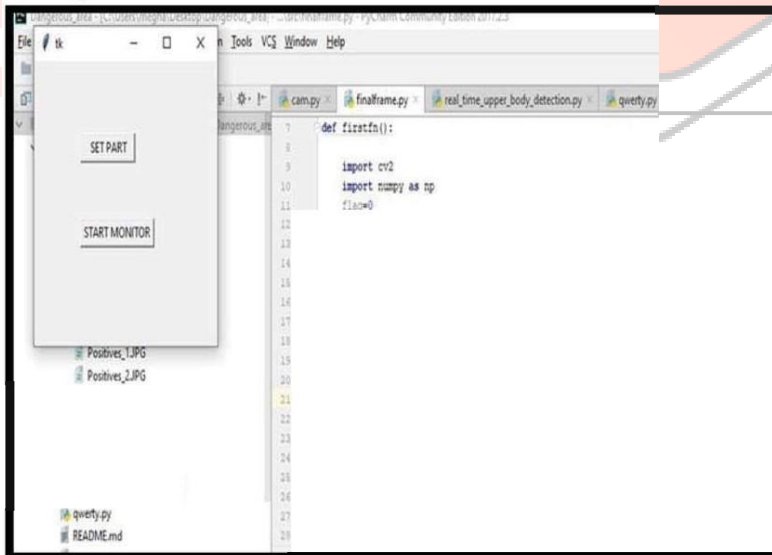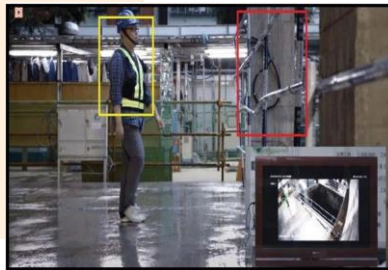
This is how the dangerous area detection will be set up by the manager. Once dangerous area is detected it is to be marked. we can see that the manager has already detected the dangerous area which is marked in red and brought to the notice of workers. When the careless workers pass the red box the alarm system get activated and then start to peep. The workers will be able to detect the dangerous area and prevent accidents

VI CONCLUSIONS

1. Regular Audits need to be conducted to identify the unsafe conditions and repairs prioritized and then implemented.

2. Worker health and well-being is an important aspect of workers motivation and job satisfaction which influences the productivity.

3. Visible commitment is a key factor in providing a safe and healthy work environment.

4. If the company implements effective disciplinary procedures it will help the company to go with their policies and also to maintain safety in the organization.

5. Suggesting suitable ideas will avoid accidents and improve the safety measures.

6. Safety and health tend to be the most important thing in a management of a company.

7. Most and least contributing factors are safety inspection and safety management.

8. Positive relation is obtained when SEM modeling carried out.

9. Suggestive safety model using Haar Cascade method.

10. Safety model can be used for identifying the danger zones.

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