Developed a module towards evaluating design of industrial robot

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Abstract: Design evaluation of industrial robot for any industrial application is difficult tasks in real time manufacturing. Multi criteria Decision Making dealt with a set of techniques involving multiple evaluation criteria facilitating in managerial decision making. Many robot design evaluation problems are considered in the context of Multi Criteria Decision Making (MCDM) in present era. In the presented research work, the authors has designed an Multi Criteria Decision Making (MCDM) appraisement module, which undertook pertinent objective and subjective dimensions, corresponding to numerical data and fuzzy data against objective and subjective dimensions, respectively, is valid for design evaluation. Proposed module can be solved by multi objective optimization design evaluation approach, which must handle mixed information.

Key words: Robot, Module, Objective and Subjective Information (O/SI), Multi-criteria group decision making process (MCGDMP)

I. INTRODUCTION:

A robot is a machine designed to execute one or more tasks automatically with speed and precision. There are as many different types of robots as there are tasks for them to perform. Robots that resemble humans are known as androids; however, many robots aren't built on the human model. Industrial robots, for example, are often designed to perform repetitive tasks that aren't facilitated by a human-like construction. A robot can be remotely controlled by a human operator, sometimes from a great distance. Design always necessitates considering the aesthetic, functional, economic, and sociopolitical dimensions of both these requires objective and subjective design process.

Decision-making is extremely intuitive while considering single criterion problems, since we only need to choose the alternative with the highest preference rating. However, when decision-makers (DMs) evaluate alternatives with multiple criteria, many problems, such as criterion weight, preference dependence, and conflicts among criteria, seem to complicate the problems and need to be overcome by more sophisticated tools and techniques.

In order to deal with Multi-Criteria Decision Making (MCDM) problems, the first step is to figure out criteria/attribute listing. Next, we need to collect appropriate data or information in which the preferences of DMs can be correctly reflected upon and considered (i.e., constructing the preferences). Further work builds a set of possible alternatives or strategies in order to guarantee that the goal will be reached (i.e., evaluating the alternatives). Through these efforts, the next step is to select an appropriate method to facilitate us to evaluate and outrank or improve the possible alternatives or strategies (i.e., finding and determining the best alternative)

Fig: 1 Design of robot

II. LITERATURE SURVEY:

Few literature related to robots are given here, Tansel et al. (2013) developed a two-phase robot selection decision support system, namely ROBSEL, to help the decision makers in their robot selection decisions.

Karsak (2008) introduced a decision model for robot selection based on quality function deployment (QFD) and fuzzy linear regression. Chakraborty (2011) explored the application of an almost new multi-objective optimization method based on ratio analysis (MOORA) to solve different decision making problems as frequently encountered in the real-time manufacturing environment. Bipradas et al. (2012) investigated the robot selection dilemma with employing the newly proposed Multiplicative Model of Multiple Criteria Analysis (MMMCA) approach.

Athawale and Chakraborty (2011) considered ten most popular MCDM methods and compared their relative performance with respect to the rankings of the alternative robots as engaged in some industrial pick-n-place operation and observed that all the ten methods give almost the same rankings of the alternative robots, although the performance of WPM, TOPSIS and GRA methods are slightly better than the others.

Wu and Lee (2004) proposed a vision-based soccer robot system in which vision identified the position and heading angle of each robot, and the position of the ball. With those imaging data, values for the defense factor, the competition factor, and the angle factor, were obtained. Experimental results of a robot soccer game have been used to illustrate the feasibility of the proposed method.

III. GROUP DECISION MAKING:

It is a type of participatory process in which multiple individuals acting collectively analyze problems or situations, consider and evaluate alternative courses of action, and select from among the alternatives a solution or solutions. The number of people involved in group decision-making varies greatly, but often ranges from two to seven. The individuals in a group may be demographically similar or quite diverse. Decision-making groups may be relatively informal in nature, or formally designated and charged with a specific goal. The process used to arrive at decisions may be unstructured or structured. The nature and composition of groups, their size, demographic makeup, structure, and purpose, all affect their functioning to some degree. The external contingencies faced by groups (time pressure and conflicting goals) impact the development and effectiveness of decision-making groups.

IV. INFORMATION AGAINST PARAMETERS

Qualitative measurement: The qualitative measurement dealt with vagueness, incompleteness, and impreciseness; associates the partial or linguistic information (Sahu et al., 2012; Sahu et al., 2014; Sahu et al., 2015a,b; Sahu et al., 2016a,b,c,d; Sahu et al., 2016a,b,c,d,e,f; Sahu et al., 2017a,b,c,d,e,f,g).

Qualitative measurement delivers the inaccurate result, as appropriateness ratings and importance weights are assigned in the form of non crisp value against criterions. It determined that in MODM problem, measures play a very dominant role during for undertaking numerical data against robot design parameters.

V. RESEARCH OBJECTIVES:

It is found after conveying the momentous literature survey, there is need to design / construct a general robot appraisement module, which could consider both, objective and subjective dimensions corresponding to numerical and fuzzy data, respectively, for evaluating design of robot. Proposed module can be solved by multi objective optimization design evaluation approach, which must handle mixed information (Karsak (2008), Chakraborty (2011), Bairagi et al., (2012), Wu (1990), Athawale and Chakraborty (2011), Wu and Lee (2004), Tansel et al., (2013).

VI. DESIGNED MODULE:

General robot appraisement module is module proposed in Table. 1. This module is consist of general design parameters in order to evaluate the design of alternatives.

VII. CONCLUSION:

Robot appraisement module (for evaluating designed of general robot), which could consider both, objective and subjective dimensions, corresponding to numerical data and fuzzy data, respectively, for evaluating design of robot. Proposed module can be solved by multi objective optimization design evaluation approach, which must handle mixed information i.e. TOPSIS, Grey relational analysis (GRA), Inner product of vectors (IPV), Measuring Attractiveness by a categorical Based Evaluation Technique (MACBETH), Multi-Attribute Global Inference of Quality (MAGIQ), Multi-attribute utility theory (MAUT), Multi-attribute value theory (MAVT), New Approach to Appraisal (NATA). Presented module might assist the mangers of manufacturing firms towards electing the best design of industrial robot under multiple subjective or objective dimensions in extent of subjective or objective information. The outcomes of research work might help each manufacturing firm to improve their firm further profit.

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Table.1 Robot design evaluation module

Goal (G)	**Robot designing parameters**	
Evaluation of design of robot	OI	Cost, INR, (C_1)
		Speed, m/s, (C_2)
		Load carrying capacity, kg, (C_3)
		Space Requirement, (C_4)
		Cost, INR/Year, (C_5)
		Degree of Freedom, No, (C_6)
		Energy Consumption, Unit/Hrs (C_7)
	SI	Effectiveness, (C_8)
		Worker intention, (C_9)
		Flexibility against change in goods design , (C_{10})
		Chances of failure, (C_{11})
		Simplicity, (C_{12})

