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INDUSTRIAL ROBOTS USING SINGLE VALUED NEUTROSOPHIC FUZZY NUMBERS

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ABSTRACT. Robotics deals with the study of robots and their related parts, design and functions. The domain requires versatility with knowledge in science, engineering and technology as an amalgamation to produce the required output. The need for robots can stem from various different sectors such as household needs, military action, industrial needs and much more. Robots have the capacity to reduce human effort and ensure that the efficiency of an action is greatly enhanced. This research model is applied towards decision-making for selection of industrial robots to find out the best robot for industrial work.

1. INTRODUCTION

The word “Robotics" was first used by Isaac Asimov, an author who also later framed the laws of Robotics. Robots are most commonly found in industries which involve human activities with an element of risk. The “service" sector is now slowly turning into a “hot-bed" for robot interaction which is considered more effective than human involvement. Even in our city, Chennai, we have two robot themed restaurants where the robots interact with the customers and serve as waiters. Robots involve the working of manipulator, sensors and controls as a combined unit to complete a specific action. The manipulator consists

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of joints, links and the gripper. The movement of joints and links leads to accurate positioning of the gripper along a planned trajectory. These movements are controlled by sensors based on the surrounding conditions or could be human-operated. Industrial Robots can be classified as direct driven arms and indirect driven arms. Most industrial robots used today are indirect-drive-geared mechanisms. However, this drive mechanism may suffer from poor dynamic response under heavy mechanical load, gear friction and backlash.

The functionality of the gripper varies based on the need and availability. For example, the transfer of metallic components would require a magnetic gripper to ensure better efficiency whereas a brittle porcelain dish would need a vacuum gripper. These grippers can be altered in a similar fashion to lathe fittings, used in industrial workshops. Actuators are important components of any robotic system. They assist in motion of the robot and its associated parts. They can be motors, pumps and even compressors. The use of electric signals determines the exact moment these actuators need to produce movement of the robot's parts. This paper organized as follows; the first gives the introduction about the robotics. Second derives with basic notions and definitions of single -valued Neutrosophic number. Further ends with a conclusion and suggestion.

2. Neutrosophic preliminaries

Definition 2.1 (Neutrosophic sets). *Let ϵ be a space of points with generic elements in ϵ denoted by x. Then a neutrosophic set α in ϵ is characterized by a truth membership function, $T_(\alpha)$ an indeterminacy membership function I_α and a falsity membership function F_α. The function $T_\alpha : \epsilon \to [0, 1^+]; I_\alpha : \epsilon \to [0, 1^+]; F_\alpha : \epsilon \to [0, 1^+]$.*

It is noted that there is no restriction on the sum of $T_\alpha(x), I_\alpha(x), F_\alpha(x)$, i.e., $0 \leq T_\alpha(x) + I_\alpha(x) + F_\alpha(x) \leq 3^+$.

Definition 2.2 (Single Valued Neutrosophic set). *Let ϵ be a universal space of points with a generic elements of ϵ denoted by x. A single valued neutrosophic set S is characterized by a truth membership function $T_s(x)$, an indeterminacy membership function $I_s(x)$, a falsity membership function $F_s(x)$ with $T_s(x), I_s(x), F_s(x) \in [0, 1]$ for all $x \in \epsilon$.*

When ϵ is continuous a SVNS can be written as: $S = \int < T_s(x), F_s(x), I_s(x) > x, \forall x \in \epsilon$.

When ϵ is discrete a SVNSs S can be written as: $S = \sum < T_s(x), F_s(x), I_s(x) > x, \forall x \in \epsilon$.

It is noted that for a SVNS S, $0 \leq \sup T_s(x) + \sup F_s(x) + \sup I_s(x) \leq 3, \forall x \in \epsilon$.

3. Algorithm

Step 1: Problem field selection.
Consider a multi-Parameter decision making problem with m_1 alternatives and n_1 attributes.

Table 1: single valued Neutrosophic set decision matrix.

$$D =< d_{ij} >_{m\times n}$$
$$\begin{Bmatrix} < d_{11} > & < d_{12} > \cdots & < d_{1n} > \\ < d_{21} > & < d_{22} > \cdots & < d_{2n} > \\ \vdots & \vdots & \vdots \end{Bmatrix}$$

Here, $d_ij(i = 1, 2, \ldots, mandj = 1, 2, \ldots, n)$ are all single valued Neutrosophic number.

Step 2: Single valued Neutrosophic Fuzzy number as edge weight.

Step 3: Convert Neutrosophic single valued Fuzzy number to crispy number using score function

$$\text{SVNFN}\,(A_i) = \frac{1}{m}\sum_{n=1}^{m}\left[\frac{2 + T_{rj} - I_{rj} - F_{rj}}{3}\right].$$

Step 4: Ranking of Alternatives.
According to the Single Valued Neutrosophic number, we can set up a panel of all alternatives in descending order and we can choose larger number of alternatives into the decision making process considering highly acceptable zone and tolerable acceptable zone.

Step 5: End

Example 1 (Numerical example).
Selection of industrial robot using single valued Neutrosophic fuzzy number.

Alternative Robot.
Robot -R_1,
Robot -R_2,
Robot -R_3,
Robot -R_4

Set of criteria
I_1*=Speediness,* I_2*-Payload capacity,* I_3*-Repeatability*
I_4*-purchase cost,* I_5*-extent of manipulator research,* I_6*-extent of reliability*
I_7*-programming flexibility,* I_8*-positioning accuracy,* I_9*-Man-Machine Interface*

	Robot-R_1	**Robot-**R_2	**Robot-**R_3	**Robot-**R_4
I_1	<0.5,0.2,0.3>	<0.6,0.2,0.1>	<0.8,0.3,0.3>	<0.7,0.2,0.1>
I_2	<0.5,0.1,0.2>	<0.6,0.3,0.3>	<0.8,0.1,0.2>	<0.7,0.2,0.3>
I_3	<0.5,0.3,0.1>	<0.6,0.4,0.3>	<0.8,0.2,0.3>	<0.7,0.3,0.2>
I_4	<0.5,0.3,0.4>	<0.6,0.4,0.0>	<0.8,0.3,0.1>	<0.7,0.3,0.2>
I_5	<0.5,0.4,0.1>	<0.6,0.5,0.3>	<0.8,0.3,0.2>	<0.7,0.5,0.4>
I_6	<0.5,0.5,0.4>	<0.6,0.5,0.4>	<0.8,0.3,0.1>	<0.7,0.4,0.3>
I_7	<0.5,0.6,0.4>	<0.6,0.1,0.0>	<0.8,0.4,0.3>	<0.7,0.4,0.3>
I_8	<0.5,0.2,0.1>	<0.6,0.2,0.2>	<0.8,0.2,0.1>	<0.7,0.3,0.2>
I_9	<0.5,0.3,0.5>	<0.6,0.3,0.4>	<0.8,0.1,0.0>	<0.7,0.2,0.1>

$$
\begin{aligned}
VNFN(I*_{11}) =& \frac{1}{9}[\frac{2+0.7-0.2-0.1}{3}+\frac{2+0.7-0.2-0.3}{3}+\frac{2+0.7-0.3-0.2}{3}\\
&+\frac{2+0.7-0.2-0.1}{3}+\frac{2+0.7-0.5-0.4}{3}+\frac{2+0.8-0.4-0.3}{3}\\
&+\frac{2+0.8-0.4-0.2}{3}+\frac{2+0.8-0.3-0.2}{3}+\frac{2+0.7-0.2-0.5}{3}]\\
=&0.7259
\end{aligned}
$$

Similarly,
SVNFN(Robot-1)=0.6333
SVNFN(Robot-2)=0.6852
SVNFN(Robot-3)=0.7926
SVNFN((Robot-4))=0.7259

Step 6: Ranking of the alternatives.

$$0.7926 >> 0.7259 >> 0.6852 >> 0.6333 >>$$

4. Conclusion

The Best Robot was analysed by Single Valued Neutrosophic Fuzzy set, Robot-3 is the best Robot for all the nine criteria. This method is useful for industries to identify the effective for dealing for management system.

References

[1] G.S. Schwening, A.M. Abdalla: *Selection of Agricultural Aircraft using AHP and TOPSIS methods in fuzzy environment* 29th Congress of the International Council of the Aeronautical Sciences, p. 0875, 2014.

[2] A. Rajkumar, M. Vivek, A.G. Narayanan: *Selection of Agricultural Aircraft using Dodecagonal Fuzzy Relational Mapping(DgFRM)*, International Journal of Pure and Applied Mathematics, **120**(6) (2018), 1813-1825.

[3] E. Albayrak, Y.C. Erensal: *Using analytic hierarchy process (AHP) to improve human performance. An application of multiple criteria decision making problem.* Journal of Intelligent Manufacturing, **15** (2004), 491-503.

[4] M. Dag deviren, S. Yvuz, M. Nevzat: *Weapon. Selection using AHP and TOPSIS methods in Fuzzy Environment*, Expert Systems with applications, **36**(4) (2009), 8143-8151.

[5] Z. Ayag, R.G. Ozdemir: *A fuzzy AHP approach to evaluating machine tool alternatives*, Journal of Intelligent Manufacturing, **17** (2006), 179-190.

[6] A. Victor Devadoss, N. Jose Parvin Praveena: *A Study of Decision Making Problems Using hexadecagonal FuzzyRelational Maps (HDFRMS)*, International Journal of Pure and Applied Mathematics, **113**(12) (2017), 89-97.

[7] H. Wang, F. Samarandache, Y.Q. Zhang, R. Sunderraman: *Single valued Neutrosophic sets, Multispace and multistructure*, **4** (2010), 410-413.

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