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# A Novel Multi Attribute Decision Making Approach for Selection of Modular Self Reconfigurable Field Robots

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**ABSTRACT:** In this research work we are working on the MSRR that is modular self reconfigurable robots that can work in fields for the purpose of digging, dragging. Field robots can work as Modular Self Reconfigurable Robots and all the methodological comparisons will be done. How MSRR mark authenticity for CRITIC and AHP.

Robotics is a field which has gained lot of enhancement and advancement in past few decades. Every other company is designing new robots. New features are been polished in these robots. These robots can be used in many particular applications.

New series of robots have come into existence, which are called as self reconfigurable robots. M-TRAN, SMORES, CBOT and many other robots are examples and new researching topics. Modular self reconfigurable robots can be used in space exploration, rescue operation and search operation.

## I. INTRODUCTION

### ROBOT :

Is an automatic machine which does all work without human efforts. It does not look like humans although but has ability to work in every field. Moreover, Robots work in engineering fields up to a long extent. Constructions, designs and operations in engineering are also handled by robots. Robots can change its shape with the help of actuator that are thin (2.5 cm) and high extendable (upto 20 cm) in both vertical and horizontal directions. Robots have good and wide variety of uses which make them best for technology. In future we will be seeing robotic system ruling the entire world. [1]

### ROBOTICS :

Is a system which is intermingled with science, engineering and technology to give a life to machines called robots. R2 – D2, optimus prime, wall – E are some of the examples. These created structures by humans seem like real humans. Robotics is progressing in terms of technology. [2]

### SELF RECONFIGURABLE ROBOTS :

Are automatic kinematic machines with variable analysis. They have ability to change their shape by rearranging the connectivity of their parts. They have ability to adapt in new adaptations, circumstances perform task and even recovery from damage. For example, a robot assume that is of the shape of worm to move through a pipe, to cross terrain which is uneven. [3]

### FIELD ROBOTS :

Are similar to other robots but the difference is these robots work in open air environment which includes underwater, in forests, in mines and in farms. The advanced technology of robots has helped the engineering field a lot. These robots work in harsh lands also. Field robotics is making economic and social contribution to many different areas of applications. [4]

### MODULARITY :

Modularity is a property of a system which measures the degree of connected compartments which lie within a system and then after measuring can be separated into individual communities. It is assembling to a large configuration by joining together standardize units. These modules can be reconnected also through the reconfiguration of inventory of



modules. The joints used in modules are revolute joints, universal joints etc. This modularity depends upon the independence of components used in the product .

#### CATEGORIES OF MODULARITY

Slot Architecture Bus Architecture Sectional Architecture Slot Architecture : There is no interchanging of modules in the product . These modules possess different interfaces. We have many examples of this type. [5]

Bus Architecture : We have a common module in this type and not many. To this single module other modules connect through same interface.

Sectional Architecture : Slot and bus architecture together give life to sectional architecture . The phases between all modules are identical and linkage is also allowed.

#### APPLICATION OF MODULAR SELF RECONFIGURABLE ROBOTS

Modular self reconfigurable robots are different from fixed robots.

1.Space Exploration : One application that highlights the advantages of self reconfigurable robots is space. The tasks which take place in space are highly mass constrained , need space and have high volume . MSRR here works as a victory for work as a single robot system can perform so many tasks.

2 .Search and rescue : Here we can talk about earthquakes which are sudden and unfortunate .During these mishaps many organisms unidentified get buried under collapsed debris. MSRR can turn into snake topology to find victims . These snake robots are used in fields also like agriculture.

3.Bucket of stuff : This term “BUCKET STUFF” was coined by David Duff at Palo Alto Research centre which meant the modules can do house hold jobs too. For cleaning purpose as in gutters and folding clothes etc.

#### DOCKING OF MODULAR SELF RECONFIGURABLE ROBOTS

Docking is the most important process we see in MSR because it allows all the modules to connect with each other .so that it form certain type of configuration which suits our task. The methods we use for docking purpose magnets, electromagnets, electromechanical magnets.

**Chen li , Kevin lewis ( 2022 ) :** In this research the need for feasibility of alternative ground robots to traverse sandy and rocky extraterrestrial terrain was studied. Researchers were hoping for feasibility such as digging as they dint calculated the integrated weights.

**SenNin , ling et al . (2022) :** This research happened in 2022 and was about novel modular self reconfigurable and self assembling robots known as Ant3DBot . This robot has many configurations . This robot has very fine , précised locomotion performance and versatility . These robots had multiple configurations which helped in versatile work and cooperative motion .

**Shubhdildeep et al. (2022) :** Two degree freedom MSRR (modular self reconfigurable robots) with active docking mechanism was presented in this paper. Active docking system achieves structural benefits of large systems. The dual mobility is seen here, one for longitudinal locomotion and one for lateral locomotion.

**SM Bhagya et al. (2022) :** Study was about reconfigurable robots should be able to walk or more through narrow spaces with shape changing performance. Study was about proposing a method for navigation process of reconfigurable robots through narrow spaces.

**Dmitry Blinov et al. (2021) :** Here we study about kinematic structure of a modular robotic system with the help of deep reinforcement learning . Q – learning algorithm is used. This is the method because of which forming vector can be analysed for effectiveness of this discussed method , a computer simulation of a robotic system consisting of 5,10&15 modules was created.



**BaudouinDafflon et al. (2021)** : On cyber physical system work is done . How CPS works in the upcoming era of industry 4.0. Out of 626 primarily extracted relevant articles 78 were scrutinized on CPS for manufacturing.

**ErcanOztemel And SametGursev (2020)** ; This was study as it was an initiative for 4.0 industry .This initiative received good applause . The study was not new and was in talks for many years. The name 4.0 industry is being accepted now .The effect on social life because of 4.0 industries going to be markable. There will be some transformation also. Robots would be more dominant in manufacturing and other technologies , such as agricultural productions.

**EXPLANATION :**

Snake robots are type of self reconfigurable robots as they can change their shape and configuration. As snake shaped robots can dig into fields , can search dumped items and can help in rescue operations. As the fields are concerned the self reconfigurable robots can work in agriculture with the help of the property of changing their shape into snake like robots.

Table 1.1

Intensity of attributes	Definition	Explanation
1	Equal importance	Two contributions are seen by objectives
2	Intermediate values between the two adjacent particles.	When compromise is needed
3	Moderate importance of one over another	Experience strongly favor one activity over another
4	Strong importance	judgment strongly favour one activity over another
5	Intermediate values between the two adjacent judgments	When compromise is needed
6	Intermediate values between the two adjacent judgments	When compromise is needed
7	Very strong importance	An activity is strongly favoured a
8	Intermediate values between the two adjacent judgments	When compromise is needed
9	Extreme importance	The evidence favouring one activity over another .



Table 1.2

Compared weights		C1	C2	C3	C4
Importance of objective weights	Importance of subjective weights				
1	0	0.22038	0.23818	0.25792	0.28247
0.8	0.2	0.23228	0.27228	0.22817	0.26641
0.6	0.3	0.21619	0.26551	0.18751	0.23014
0.5	0.4	0.22215	0.28257	0.17264	0.22211
0.4	0.5	0.22810	0.29962	0.15776	0.21408
0.3	0.6	0.23405	0.31667	0.14289	0.20606
0.2	0.8	0.26799	0.37459	0.13894	0.21825
0	1	0.27990	0.40870	0.10920	0.20220

All the evaluated values are less than 1 which initiates to the authenticity of CRITIC and AHP.

## II. CONCLUSION

The main goal of modular self reconfigurable robots and modular self reconfigurable field robots evaluation and selection is to choose appropriate robot that suits the environment and system.

In this research work we finally get to the point where it is justified that modular self reconfigurable field robots can do rescue operations and digging

With this study we can also conclude that modular self reconfigurable robots can also work in fields like agriculture and farm fields..

Methods discussed in this study are accurate and mostly précised.so, if we have to undergo the main part of reshaping and regaining of shape then these methods are best of knowledge.

## III. FUTURE SCOPE

In my study , the future work can be improvised in terms of searching modular self reconfigurable robots working on field robots doing ploughing in the fields. self reconfigurable field robots would be comparing the subjective and objective weights with methods such as spider diagram.

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