ISSN:0975-9646



# Human Robotics Interaction (HRI) based Analysis – using DMT

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**Abstract-The paper presents analysis of methodology proposed for mutual interaction among human and robotics following a master-slave relationship utilizing data mining techniques. The collaboration between human and robotics leads to achieve joint actions for its utilization in manufacturing industry, service industry and other daily life work. The technique designed in this paper helps human to handle the queries and tasks using human robotics in such a way that robotics acts as an interface with server-systems for the flow of communication data. The use of human-robotics interface helps to manage queries following a sequential system such as; input device used to collect data and server system used to process data such that in the absence of interface, interactions between human and the server system will not be possible. The proposed procedure describes that how humans interact with robotics and shows the complete communication flow among them by using three different types of data mining techniques viz. classification, regression analysis and time series such that each technique using a separate type of data to perform mining task. In this paper, theoretical as well as experimental based analysis has been investigated.**

**Keywords:** Data mining, human robotics, time series analysis, regression analysis, classification.

## 1. INTRODUCTION

HRI (Human Robotics Interaction) is the most emerging technology to design and develop robotics for the welfare society for shaping the future of coming generations. The HCI (Human Computer Interaction) is a field that has made great strides towards understanding and improving our interactions with computer based technologies. The goal of developing robotics is to provide communication similar to natural communication among humans [11].Interaction of robotics with the human can only be possible by using interface that is based on HCI. Interface shows the social interaction with the robotics and provides assistance to people through physical contact or by using sensors that may helps to entertain human through social interactions [1] and the interface acts as an "Agent" between the human and robotics [6]. HCI acts like an autonomous robotics and helps to provide interactions under HRI [4] and automated analysis helps to judge the behavior under such interaction. Generally, the HRI concepts can be categorized as "remote interactions" and "proximate interactions". In this paper, an analysis has been conducted using "Proximate interaction" based on various parameters for designing and implementation of robotics systems capable of accomplishing interactive tasks in different environments. The fundamental goal of HRI is to develop the principles and algorithms for robotics systems that are more capable to direct safe and effective interaction with humans [7]. The initial use of robotics was repetitive task and the priority was given to a human in which activities that includes interaction with people required to complete those tasks [9].The robotics solutions are increasingly applied to real world problems such as aging society, climate control and responses in case of emergencies etc. The design and development of robotics must meet the human needs in addition to address technical challenge [5]. A variety of states can be considered by using different data mining techniques [3] that are used to process large amount of data and searching the data and also build relationship within the data by using "regression analysis data mining technique". The technique is required to retrieve the information quickly, improving the quality and effectiveness of the decisions utilizing the time series databases. Human-robotics behaves artificially and has distinct advantage of their capability of secure private information of any organization without any information loss. The secured information can be maintained by the robotics designer that always act as a "MASTER" and other team members like normal user or virtual users act as "SLAVES" that performs joint action. In daily life, assistive robotics is being used that helps to identify different moods of humans by using some visual appearance effects [2]. A system based approach is adopted rather than isolated components [10]. In future, the behavior of human towards work can be predicted by applying "predictive data mining technique" by designing new sensor nodes [8]. This paper proposes a procedure named as "HRI analysis-Using Data Mining Techniques" and perform analysis using theoretical as well as experimental consideration and is shown with the help of graphical representations.

## 2. DESIGNING METHODOLOGY

For providing communication between human and robotics in a natural way, this paper proposes a new procedure/Mechanism named as "HRI analysis-using data mining techniques". Figure1 shows the schematic diagram of human-robotics for performing the tasks such that without using human-robotics interface, interaction would not be possible.

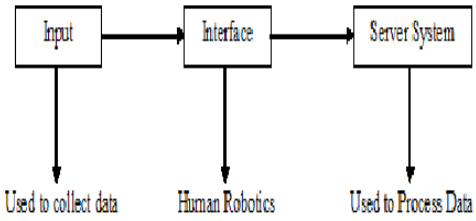



Figure 1: Interaction with the server system.

## 3. PROPOSED PROCEDURE

***Step 1.*** When User Send Request: =Robot Mode Is ACTIVE.
{Using classification technique, the active mode or de-active mode of the robot can be analyzed}.
MODE VALUE: = ACTIVE (indicates value 1).
MODE VALUE: = DE-ACTIVE (indicates value 0).

***Step 2.*** IF INPUT FORMAT CORRECT: =REQUEST PROCEDDING!
{Using "Regression analysis technique" the relation between the previous tasks with the current task to be performed can easily be identified. It also gives the information between the independent and inter-related tasks that will be performed by the robot}.

***Step 3.*** SET SESSION: = REQUEST COMPLETION!
{Using "Time series Analysis technique" the completion time of task can be checked such that whether the task will be completed before the session expires}.

***Step 4.*** THEN REPEAT STEP 3 even "N" Number of tasks included.

## 4. WORKING

The interface as shown in Figure 1 is a sandwich between human and robot for maintaining master-slave relationship where human act as a master and is responsible for performing number of tasks by Robot that acts like a slave and perform task as per instructions given by his master. At first, check the ROBOT is in ACTIVE MODE or DE-ACTIVE MODE. If the robot is in ACTIVE MODE then current will pass and shows value 1 otherwise signal disables and shows value 0. After checking the status, in the second step, check the format of the input applied by the HUMAN (MASTER), whether it is in correct format or not. If input is in correct format, then REQUEST PROCEED otherwise generates a warning message. In the third step, in the request processing human set session, the task must be completed before session expires and if in case session expires, then request would be in pending mode and displays a warning message of request failure and THEN REPEAT step 3 even "N" number of tasks are to be performed.

## 5. ANALYSIS BASED ON THEORATICAL CONSIDERATION

The analysis has been conducted using three types of data mining techniques as follows:

### 5.1 Regression based analysis

This technique used to find out the best parameter values for any function and also helps to reduce error. The specific function must be best fit for data set that will be provided by the user. Regression analysis uses various mathematical equations that show the relation between the dependent or independent variable. Linear regression analysis is used here which is based on the single predictor and shows the relation between X and Y. The mathematical equation used in linear regression analysis is given as follows.

$Y=A+BX.$ (1)

Where Y is dependent and X is Independent variable. A and B are constants.
The equation (1) can be solved by considering two cases.

| LRA Parameters | Value for X-Coordinate | Value for Y-Coordinate |
|---|---|---|
| CASE 1(X,Y) | 0 | 1 |
| CASE 2(X,Y) | 1 | 0 |

Table 1: Parameters consideration for linear regression analysis

In case-1: (X, Y) → (0, 1)
Put values of X and Y coordinates in Eq. 1. For Independent Variable

$$Y=A+BX.$$
$$1=A+B\ (0).$$
$$\boxed{A=1}$$

In case-2: (X, Y) → (1, 0)
Put values of X and Y coordinates in Eq. 1. For dependent Variable

$$Y=A+BX.$$
$$0=A+B\ (1).$$

$0=A+B$ (2)

Substitute value of A = 1 in Eq. 2.

$$0=1+B$$
$$\boxed{B=1}$$

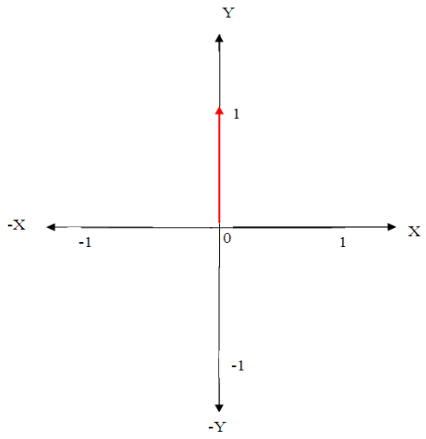



Figure 2: Graphical Representation for Case-1(X, Y) →(0, 1)

Figure 2 shows that the task is dependent on previous task.

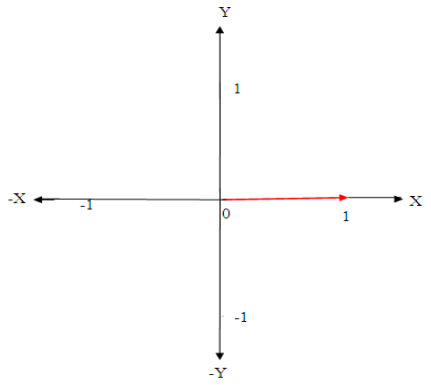



Figure 3: Graphical Representation for Case-1(X, Y) →(1, 0).

Figure 3 shows that the task is Independent from the previous task.

**5.2 Classification based analysis**

This technique helps to specify each category in more accurate form. The paper presents three different categories of users named as Robot Designer acting like a Master, Virtual User (Slave 1) which is basically a software program or service that executed iteratively and generate traffic from location to target server and Normal User (Slave 2) as shown in Figure 4.

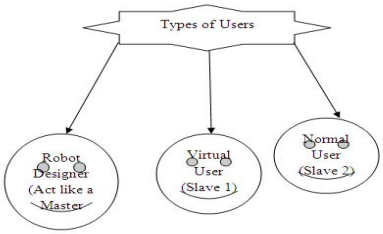



Figure 4: Diagrammatical representation of types of users in Classification.

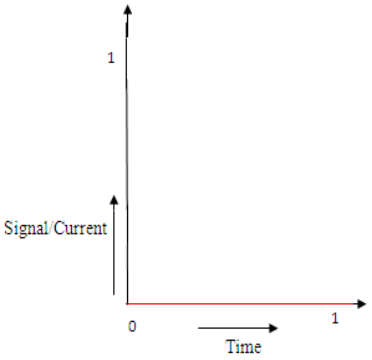



Figure 5: Graphical representation for Mode VALUE=DE-ACTIVE (Logic 0).

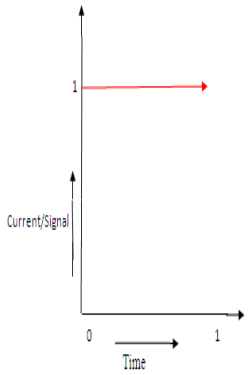



Figure 6: Graphical representation for Mode VALUE=ACTIVE (Logic 1).

Figure 5 and Figure6 shows graphical representation for mode value corresponding to logic 0 and logic1.The preference is given to digital signal that shows values at specific intervals according to the proposed procedure. However, the analysis can be conducted using analog signal. The two mode values that show ROBOT will either be in ACTIVE MODE (logic 1) or in DE-ACTIVE MODE (logic 0) are used.

***5.3* Time Series based analysis**

This technique uses a "time series database". It stores data at regular intervals. It consists of sequence of values or events those changes with changing request status. Request must be completed before session expires and if in case session expires before completion of the desired task then user has to submit request again until the task is completed.

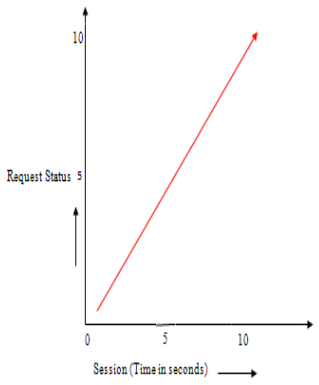



Figure 7: Graphical representation: Before SESSION Expires.
Request Status: = Complete AND THEN SESSION: = Expires

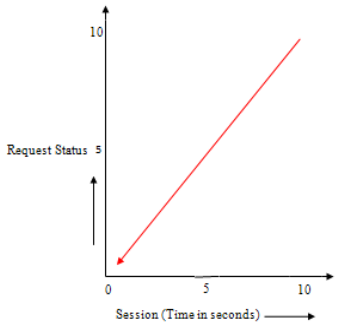
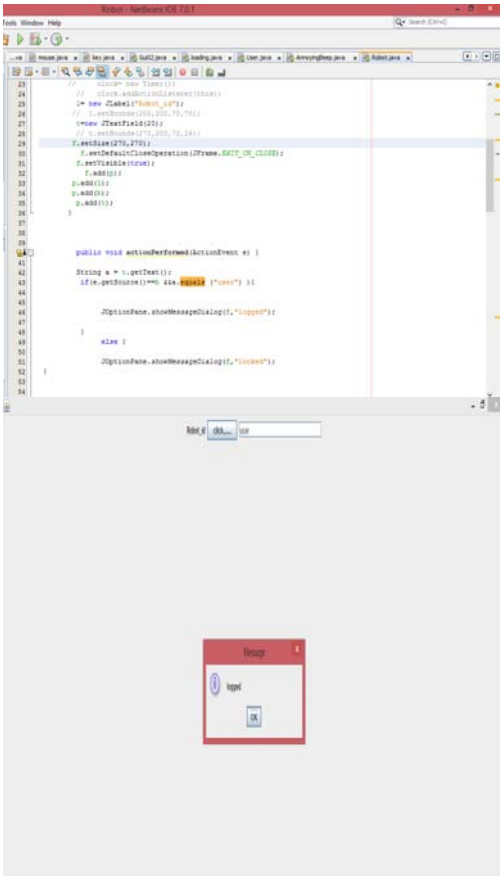


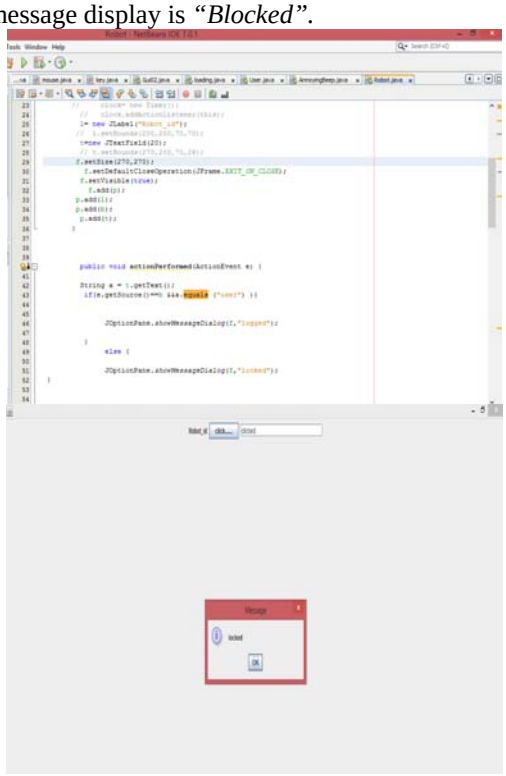

Figure 8: Graphical representation: After SESSION Expires.
Request Status: = Pending AND SESSION: = Expires.

## 6. Experimental Based Analysis

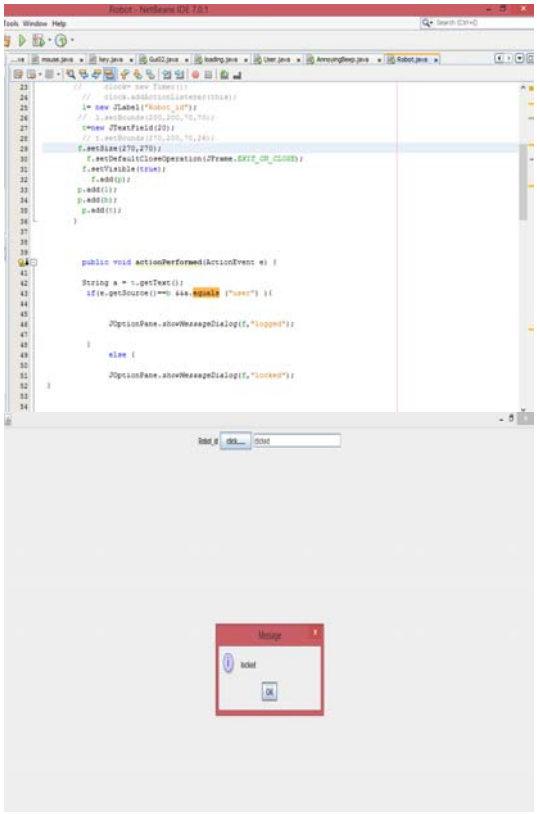
***Step-1 A)*** Screenshot for when Robotics is in ACTIVE MODE and when any user enters ROBOTICS_ID then message display is *"Logged In"*.



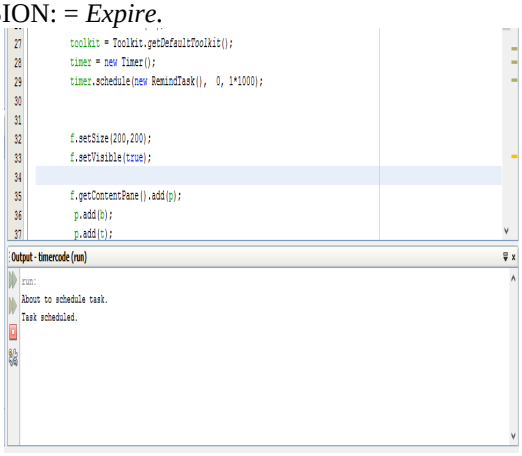
***Step-1 B)*** Screenshot for when Robotics is in DE-ACTIVE MODE and when any user enters wrong ROBOTICS_ID then message display is *"Blocked"*.



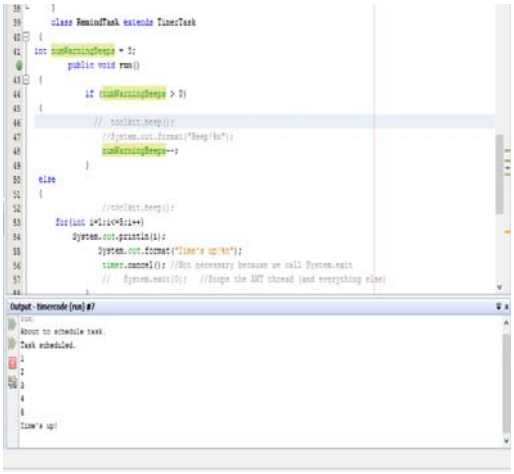
**Step 2)**Screenshot for when Input is in *Incorrect format* i.e. use of special characters then that displays a message as *"Blocked"* and the request will not proceed further.



***Step 3-A)*** Request Status: = *Complete* AND THEN SESSION: = *Expire*.




***Step 3-B)*** Request Status: = *Pending* BEFORE SESSION: = *Expire.*




## 7. CONCLUSION

In this paper, the human-robotics interaction analysis on the basis of theoretical as well as experimental considerations has been conducted and represented by graphs using proposed "HRI analysis-using Data Mining Techniques" with an interface. The Master-Slave relationship during human-robotics interaction has been analyzed using data mining techniques. The procedure helps to provide the complete information about the communication flow between the human and robotics. The procedure /mechanism as developed in this article provide natural way of communication methodology where communication will not be possible in the absence of human-robotics interface. With the help of data mining techniques human queries can easily be managed by the robotics. A variety of algorithms, scientific tools and techniques can be used for human-robotics interactions.

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