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INTERFACING OF ROBOTS FOR MANUFACTURING AUTOMATION

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***Abstract:* This article outlines the various stages of operations involved in pick and place operation by the interfacing of 2 robots. The interfacing involves sending the input signals to the second robot from the first robot to perform the task. What coded by the user set of instructions. While performing any robot operation, a robot may interact with other robot in various 4 degrees ranging in between 2 extremes. Now-a-days, various advanced robots are used in industries, but still controlling is done manually or using processors likewise Arduino, microcontroller. Here the programmable logic and Controller is used for controlling and operating robotic arm. All the various problems of this process have been analyzed properly, and have been taken into consideration while programming and designing the pick and place robotic arm. Kinematics have been defined in DMU module of CATIA and Robot joints are simulated to validate the real time movements of physical robots (Igus Robotic control) of vacuum gripper and magnetic gripper igus robots present in the ARC Lab of Mechanical branch, Aditya Institute of Technology And Management. Initially, the whole layout of the manufacturing automation should be placed at correct coordinates i.e., assigning the robots, material handling and storage retrieval system to their respective coordinates. Designing of two different robots' parts in CATIA V5 software and assembling the parts to form the vacuum and magnetic robots. The kinematics motions of robots are assigned in CATIA V5 software that gives the revolute motions of each joint and had made the simulations of two robots.**

***Keywords:* CATIA V5, Interfacing, Robots, Code, Kinematic Motion.**

I. INTRODUCTION

Industrial robots are advanced automation systems, mainly controlled by a computer. Automation can generally be defined as the process of following a predetermined sequence of operations with little or no human labour, using specialized equipment and devices that perform and control manufacturing processes. Automation in its full sense, is achieved through the use of a variety of devices, sensors, actuators, techniques, and equipment that are capable of observing the manufacturing process, making decisions concerning the changes that need to be made in the operation, and controlling all aspects of it. The components of Industrial robot (shown in figure 1) systems consist of four major subsystems Mechanical unit, Drive, Control system and Tooling.

Fig.1 Igus Robot

In this chapter literature study is carried out on the researches of Automated Robot in various fields:
Based on the researches of [2], the development of literature review is carried out on the Automating Industrial Robotics task through mechatronics systems. Pressing requirements of improved and enhanced productivity in industrial applications has necessitated deployment of robot to automate tasks. Manipulator based articulated robots for today's industrial applications vary widely in terms of number of Degree of Freedom (DOF), payload capacity, Range of Motion (ROM), control implementation and mountable configurations. This review represents a comprehensive and systematic review of industrial robots [12] with a focus on their application areas. The study of manipulators for diversified applications has highlighted the need of sophisticated algorithms for their control and trajectory planning. Both of these key concepts are discussed in the paper. The control of industrial manipulator

is important for accomplishing tasks requiring high precision, repeatability and reliability by mitigating the effects of disturbances. The trajectory planning is vital for time optimization, energy optimization and collision avoidance to ensure most appropriate trajectory for a given task in an environment. The application-oriented review offers readers opportunities to generate ideas applicable to their operations and to confirm feasibility of their ideas. A detailed survey of existing industrial manipulators categorized in applications is presented with notes on the manipulator's control and trajectory planning. It is a myth that the area of industrial robotics is already saturated. We can expect much more developments in future. Sophisticated control algorithms together with fusion of sensors and learning capabilities will offer intuitive and user-friendly installation, maintenance and programming of industrial manipulators [14]. The productivity can be further increased by employing hybrid vision-based and force-based control. Enriching the capabilities of robots by using wireless communication is already under investigation. Moreover, it is anticipated that future industrial robots will be much safer. In addition to industrial sector, manipulator-based robots may find applications outside industrial plants in banks, restaurants or even at homes. This research contributes to the ongoing discussions and debates about AI, automation, machine learning, and robotics. This article looks at the promises, challenges, and future research directions of these transformative technologies. According to [10], Missouri University of Science and Technology, USA had given the relationships between the artificial intelligence and automated robots. The exponential advancement in artificial intelligence (AI), Machine learning, robotics, and automation are rapidly transforming industries and societies across the world. The way we work, the way we live, and the way we interact with others are expected to be transformed at a speed and scale beyond anything we have observed in human history. This new industrial revolution is expected, on one hand, to enhance and improve our lives and societies. On the other hand, it has the potential to cause major upheavals in our way of life and our societal norms. The window of opportunity to understand the impact of these technologies [13] and to preempt their negative effects is closing rapidly. Humanity needs to be proactive, rather than reactive, in managing this new industrial revolution. Not only are the technological aspects investigated, but behavioral, societal, policy, and governance issues are reviewed as well. It is hoped that this article will heighten awareness of the importance of understanding these disruptive technologies as a basis for formulating policies and regulations that can maximize the benefits of these advancements for humanity and, at the same time, curtail potential dangers and negative impacts. Distilling a generally-accepted definition of what qualifies as artificial intelligence (AI) has been attempted for many decades. One reason why a definition is hard to get is that AI is not a single technology, but a consolidation of many disciplines. From machine learning to robotics[10], to natural language processing and the Internet of Things, AI plays an important role in the modern technology world and has merged into our daily life. Consequently, many problems should be considered in conducting research on AI. The research agenda proposed in this paper list some potential directions for future study. Although the technical aspects of AI, such as reinforcement learning and generative models, deserve much attention, the research agenda also focuses on the impact of AI and on topics that are closely related to human work, society, and humanity. The future of work and the future of humanity are at least as important, if not more important, than the technical aspects of AI. Koen De Backer and Timothy DeStefano, said that the growing investment in robotics is an important aspect of the increasing digitalization of economy. Economic research has begun to consider the role of robotics in modern economies, but the empirical analysis remains overall limited. The empirical evidence of effects of robotics on employment is mixed, as shown in the review in this chapter [1]. The effects of robots on economies go further than employment effects, as there are impacts for the organization of production in global value chains. These change the division of labour between richer and poorer economies. Robotics may reduce off shoring of activities from developed economies towards emerging economies. Global spreading of automation with robotics can lead to faster de-industrialization in the development process. Low-cost jobs in manufacturing may increasingly be conducted by robots such that fewer jobs than expected may be on offer for humans even if industries were to grow in emerging economies. The analyses in this paper demonstrate that robotics may impact the location of production within GVCs. The most important finding is the negative effect that robotics may have on the off shoring of activities from developed economies i.e., robotics seems to decrease the need for relocating activities away from developed economies. Yet, while robotics may thus keep production activities in developed economies, these same investments in robots do not seem strong or large enough to bring back activities that have been off shored in the past. In addition [4], there is mixed evidence about robotics being a major factor in attracting international investment, when analyzing the effect of robotics on the international reallocation of resources within MNEs. There are a number of reasons that may help explain the rather limited evidence found in this paper. First and foremost, it may be too premature to observe the potentially disruptive effects of robotics on the location of production. Investments in robots have grown significantly indeed but may have done so only recently and it can be expected that potential impacts will take some to materialize. If a robotics revolution is about to happen like some are arguing, one response this paper calls for is the need for further and follow up research in the coming years. Second, while information on robotics has become increasingly available across industries and countries including emerging economies, it should be taken into account that the available data only include information on the number (i.e., a count) of robots. Regretfully, no information is available on the size and especially the growing quality of robots one can easily assume that new vintages of robot investments have a higher performance but this is not reflected in the data. Third, robots are only one part of the wider digital revolution that is currently taking place. Other developments including the Internet of Things, artificial intelligence, etc. will additionally contribute to the digital revolution and, consequently, it can be expected that companies will need to invest in complementary assets to fully benefit from their investment in robotics. The data in this paper do not include information on these other components of the digitalization of manufacturing, which may mean that the effects of robots are somewhat underestimated. The negative effect of robotics on off shoring that is found in this paper seems to be in line with the distinction made by Baldwin [3] (2016), who argued about the differential effects of respectively communication and information technologies on the international fragmentation. The rapid progress in communication technologies has been one factor behind the rapid growth of GVCs in the past as these technologies allow for the monitoring and coordination of production activities across large distances. Information technologies, including robots' investment, instead may curb the further international dispersion of activities and may make developed economies more attractive (again) for manufacturing activities. One reason is that information technologies reduce the share of labour costs in total production costs. A second reason is that information technologies allow companies to customize their products better and much faster, which is increasingly becoming important in a number of industries. The effect of robotics on off shoring in developed economies, based on historical data, also supports the results of De Backer and Flaig [1] (2017), who simulated the future of GVCs based on a number of scenarios for the future. They reported that one specific scenario, namely the rapid progress in information technologies including robotics, will increase the attractiveness of OECD economies for manufacturing activities. This would be reflected in a decreased sourcing of intermediates from abroad, lower levels of off shoring and a stronger export position of OECD manufacturing in global markets. Jamshed Iqbal Zeashan Hameed Khan and Azfar Khalid, said that Robots essentially have the potential to transform the processes in food processing and handling, palletizing and packing and food serving. Therefore, recent years witnessed tremendously increased trend of robot's deployment in food sector. According to Jamshed Iqbal Zeashan Hameed Khan and Azfar Khalid [2] expressed about usage of automated robots in food serving comparatively to human interference using sensor fusion, CPS design, HMI, robot learning and training software solutions, vision systems, robot structural re-configurability and operation of robots during maintenance. Technological advancements in various domains have broadened the application horizon of robotics to an incredible extent. Highlighting a very recent application area, this paper presents a comprehensive review of robotics application in food industry. Consequently, the aspects related with robot kinematics, dynamics, hygiene, economic efficiency, human-robot interaction, safety and protection and operation and maintenance are of critical importance and are discussed in the present review. A comparison of actual robots being used in the industry is also presented. The review reveals that the food serving sector is the new potential area in which ample research opportunities exist by integrating advancements from various technology domains. It is anticipated that wider dissemination of research developments in 'robot-food' will stimulate more collaborations among the research community and contribute to further developments. The comprehensive state-of-the-art reveals that the domain of robotics has incredibly increased the productivity as compared to the manual production systems [6]. It is highlighted that the food serving sector has the largest potential of research and development. The new ideas are emerging based on the enabling technologies that were unavailable. The urgent requirement is to integrate various sorts of technology areas to realize competitive and novel solutions. M.Pellicciari, G. Berselli, F. Leali, A.Vergnano [8] said that this interest in novel methods and tools for optimizing the energy consumption in robotic systems is currently increasing. From an industrial point of view, it is desirable to develop energy saving strategies also applicable to established manufacturing systems with no need for either hardware substitution or further investments. Within this scenario, the present point reports a method for reducing the total energy consumption of pick-and-place manipulators for given TCP position profiles. Firstly, electromechanical models of both serial and parallel manipulators are deriving. Then, the energy-optimal trajectories are calculated, by means of constant time scaling, starting from pre-scheduled trajectories compatible with the actuation limits. In this manner, the robot work cycle can be energetically optimized also when the TCP position profiles have been already defined on the basis of technological constraints and/or design choices aimed at guaranteeing manufacturing process efficacy/robustness. The effectiveness of the proposed procedure is finally evaluated on two simulation case studies. A method for the energy consumption optimization of robotic systems has been presented. Differently from other optimization routines, the proposed strategy does not rely on either equipment replacement, plant modification or path re-planning. After the presentation of preliminary experimental results and background theory, the different contribution of inertial, gravitational and dissipative energy terms is highlighted with respect to reference and scaled trajectories. Then, the approach has been tested on common parallel and serial robots performing cyclic pick-and -place operations. The results allow the operator to parameterize and adjust the manipulator operations in order to reduce the EC, whenever allowed by other scheduling constraints (e.g., during the homing motions). In particular [15], it has been recalled that slowing down an operation as much as possible is not always beneficial. In addition, it has been highlighted that the EC of a given operation as a function of the task execution time can be described by a fifth order power series. Regardless the robot topology, this information turns useful also when programming real industrial robots whose instantaneous powers can be derived by means of black-box proprietary software (e.g., where the robot inertial parameters are unavailable to the end-user). Future work includes a further improvement of the motor model, an experimental campaign to evaluate the method accuracy and efficacy on multi-robot cells, the development of on-line programming g algorithms, and the implementation of dedicated simulation tools to be integrated on proprietary soft and study of automated storage and retrieval systems [16].

II. METHODOLOGY

In this current work set out the need of an automated material handling system which could work on its own with minimum human interventions also a conveyor belt system for transmission and pick and place objects and sorting and segregating of objects like ideas were proposed by different experts in their researches made the team curious to go in more depth of the concept so our team decided to design one such model which can pick and place objects from conveyor belt which itself is made automated which can start and stop on its own for that we collected data we sensed that different sensors and micro controllers will be required like ultrasonic sensors to stop conveyor belt as soon as a product encounters it and then a robotic arm will come to pick an object and place it in a pre-determined position. We analyzed different methods and different perspective of authors of robotics and considering the workspace we decided the manipulators attributes and robotic arm configuration like link length and joint values and connection between computer system and robot. Mainly to operate the interfacing between the robots requires the mechanical dimension of the robot workspace and material (product) location from operating robot and selection shown in figure 2. The major steps are written below for Interfacing of Robots, are: Set up and Connections: In the first step, there will be the connection between the control system (computer), control cabinet (Modular Robot Controller) and the robot.

- Switch on the Robot
- Connect and move the robot
- There are two basic system configurations available:
- Preparation using the embedded computer
- Preparation using the USB-CAN adapter
- Controlling through iRC or CProg software

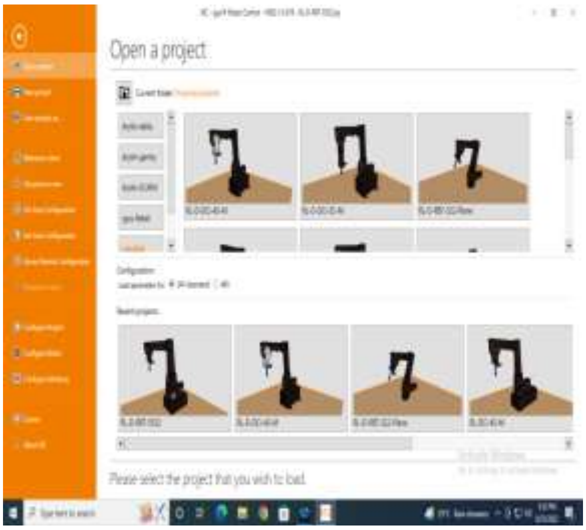

Fig. 2 Selection of a Specific Robot

- **Connect**-Establish connection to the hardware.
- **Reset**-Reset the errors.
- **Enable**-Activation of the motors.
- **Referencing** shown in figure 4 is mandatory prior to moving in Cartesian coordinates or executing a program.

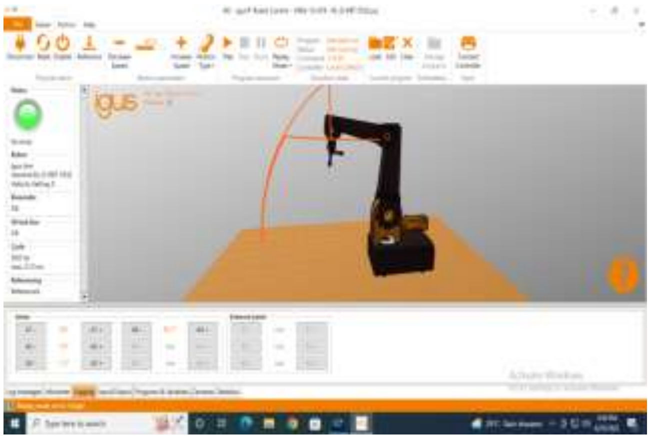

Fig. 3 Reference Position of robot

The joints can be moved of the robot using the buttons in the "Jog" tab. In this Part Design, we are used to design Magnetic gripper robot and Vacuum gripper robot. So, we have to design all the parts of both robots. The parts are designed individually one another. The parts are designed by the help of the tools in-built in the Software. The parts are designed according their dimensions and are depending on the type of robot and its specifications. The below shown parts are belongs to Vacuum gripper robot, which were

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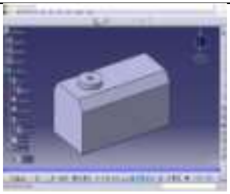
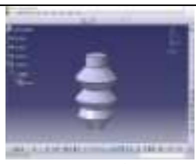
designed in CATIA V5 Software using all the tools and commands. This robot also contains the same parts instead of gripper. Here the gripper is operated by Vacuum also called air or pneumatic. Here the new part design is only Gripper remaining parts (Base, Manipulator, Arm, End-effector, Gripper (pneumatic) are same as like the Magnetic Gripper Robot shown in table 1.

Table 1 Parts of A Vacuum Gripper Robot

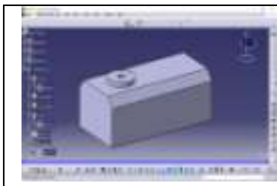
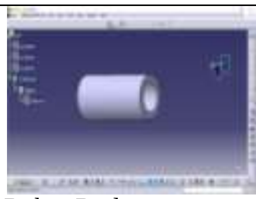
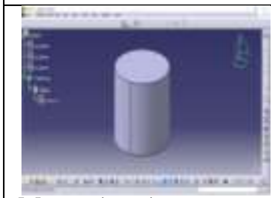
 Robot Base 1	 Robot Base 2
 Robot Arm	 Robot Rod
 Robot End Effector	 Vacuum gripper

In assembly, the parts are assembled after completion of the design. Already designed parts are taken into a single Workbench and some assembly commands are used to drag and move the parts to assemble or attach to our requirement or in proper way. After assembly of all the parts, these are the final robots in figure 4.

Fig. 4 Design of Vacuum Gripper Robot

The below shown Robot parts are designed in CATIA Software, the parts are designed as per its dimensions. The Magnetic gripper robot allows magnetism to hold the objects of ferrous materials only. The parts of the Magnetic Robot are designed as by step by step process and the parts are as follows in table 2.

Table 2 Parts of A Magnetic Gripper Robot

 Robot Base 1	 Robot Base 2
 Robot Arm	 Robot Rod
 Magnetic gripper	 Robot End Effector

In assembly, the parts are assembled after completion of the design. Already designed parts are taken into a single Workbench and some assembly commands are used to drag and move the parts to assemble or attach to our requirement or in proper way. After assembly of all the parts, these are the final robots in figure 5.

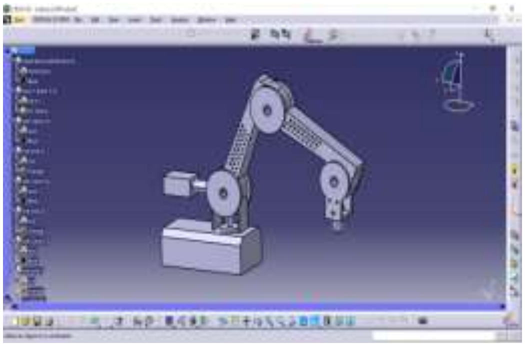


Fig. 5 Design of Magnetic Gripper Robot

Kinematics motions have been defined in CATIA which is an independent CAD product dedicated to simulating assembly motions. It addresses the design review environment of digital mock-ups (DMU) and can handle a wide range of products from consumer goods to very large automotive or aerospace projects as well as plants, ships and heavy machinery. The DMU Kinematics workbench lets you add kinematic mechanisms to your assemblies. Use these mechanisms to simulate your assembly's motion. You

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can then use the simulation to evaluate your design. The DMU Kinematics course gives you the tools to get your assembly designs moving. Simulation is the imitation of the operation of a real-world process or system over time. Simulation requires the use of models, the models represent the key characteristics or behaviors of the selected system or process, whereas the simulation represents the evolution of the model over time. Often, computers are used to execute the simulation. In this DMU Kinematics, simulation is applied for both the Magnetic and Vacuum gripper Robots.

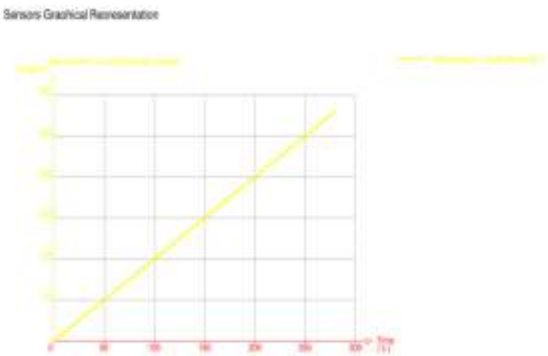
III. RESULTS AND DISCUSSIONS

The interfacing of two robots for pick and place operations are done about the plan and process of coded instructions. This paper focuses on handling the materials on conveyor and arranging the handling materials in predetermined locations with a precise time. This picks and place operation results the following;

- Accuracy and high precise tooling
- High level of movement Flexibility
- Increase Consistency
- Maximize Safety
- Faster Delivery

The results are obtained by user guided coded instructions which is stored in the computer memory. The code that sends information's by decoding into robot language to start the task. After completion of material handling, then robot picks the material and placing those materials in a storage system. For all joints of robot, the results of speed and acceleration graphs are obtained according to the motion of the robot. The graphs from figure 6 to 13 show that the motion of various robot joints moving with its capable speed and acceleration. With help of theses graphs, we can manage to operate the robot configurations as per our geometric coordinates. These results indicate the pick and place operation with different speeds and accelerations to complete the

JOINT 1:



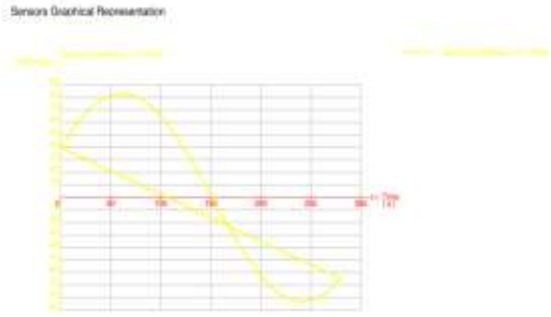
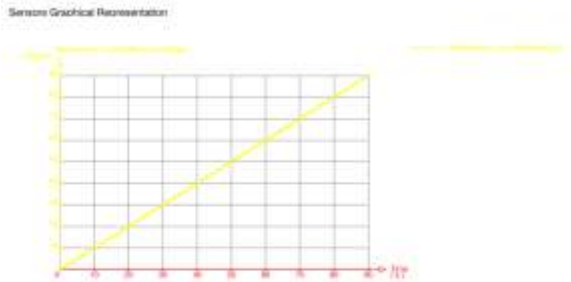


Fig. 6 and 7 Joint 1 Motion

JOINT 2:



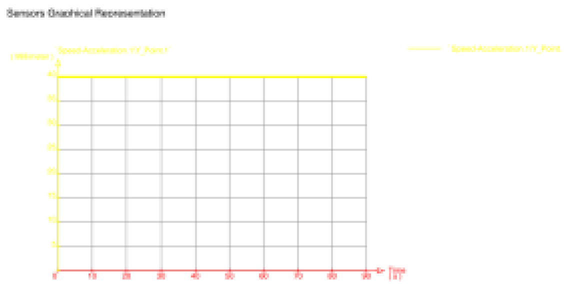
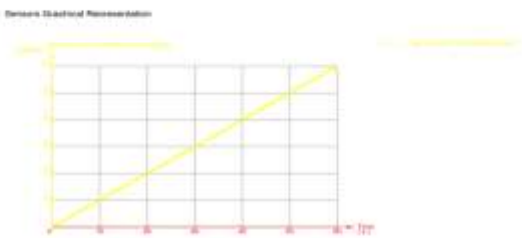


Fig. 8 and 9 Joint 2 Motions

JOINT 3:



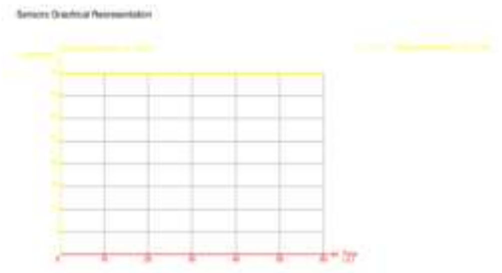


Fig. 10 and 11 Joint 3 Motions

JOINT 4:

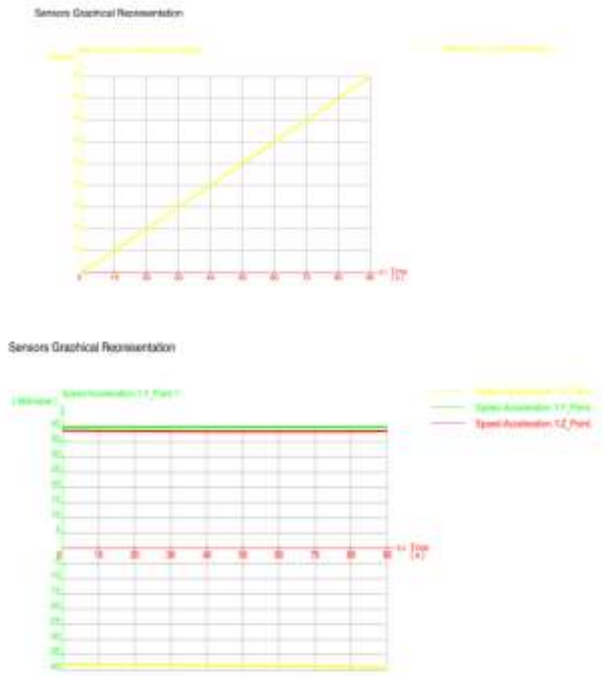


Fig. 12 and 13 Joint 4 Motions

IV. CONCLUSIONS AND FUTURE SCOPE

This article helps to find solution for difficulties coming in Industrial automation. The robotic arm is used for material handling, object, pick and place the objects in a desired locations, automatic storage and retrieval system purposes. A successful model of pick and place robots' interface could be done by connecting one robot to another robot with some signaling devices called wires, these signals give the information about the material how much time it will take to reach its second extreme position known as second robot.

The objective of the gripper assembly design was to satisfy these functions while picking and placing of objects or any materials. The automatic Pick and Place Robot Manipulation using a Microcontroller and was tested successfully and was capable of picking objects and migrating them across a 250mm horizontal, with accuracy, precision and efficiency, repeatability and speed of operation was high making the robot suitable for dexterous tasks. The industry is moving from current state of automation to Robotization, to increase productivity and to deliver uniform quality. The industrial robots of today may not look the least hit like a human being although all the research directed to provide more and more anthropomorphic and humanlike features and super-human capabilities. Automation can generally be defined as the process of following a predetermined sequence of operations with little or no human labour, using specialized equipment and devices that perform and control manufacturing processes. Interfacing between the robots i.e., coordinating between the robots with the robotic programmable software's like igus robotic control and CPRog software. The interfacing goes through a chain of devices that on one side convert human intelligible commands into robot commands and on the other side convert robot feedback in human understandable information. The robots talk wirelessly, using a common domain language to convey events as they occur, and, crucially, they also provide feedback to each other, which allows them to work together even when things don't go exactly as planned. After completion of the model, the pick and place robot and selection of programming language both should be interfaced. The interfacing of robot and computer using the software is the most important thing in this work.

V. REFERENCES

[1]. K De Backer, Robotics, AI, and Humanity, 07 Issue: 06 | June 2021 -Automation Industry library.oapen.org

[2]. J Iqbal - Food Science and Technology and "Design and Fabrication of Automatic Material Handling System for Engraving Machine", 2017, - SciELO Brasil

[3]. Baldwin, Tehnicki vjesnik/Technical Gazette 23 (3), 2016

[4]. T DeStefano - Robotics, AI, and Humanity, 2021 - Automation Industry library.oapen.org

[5]. T Grift - Journal of Bio mechatronics 2008, Vol. 3 Issue 12, December 2008 ISSN (Online) 2348 – 7968 - bio mechatronicsjournal.tibm.org.tw

[6]. A Khalid - Food Science and Technology, 2017 - International Journal of Research In Computer Applications And Robotics, ISSN 2320- 7345, Vol.5 Issue 5, Pg.: 32-37 May 2017 and SciELO Brasil

[7]. KC Ting - Journal of Bio mechatronics 2008 - journal.tibm.org.tw

[8]. M Pellicciari, G Berselli - Mechatronics, 2013 International Journal Of Research In Computer Applications And Robotics, ISSN 2320- 7345, Vol.5 Issue 5, Pg.: 32-37 May 2017 – Elsevier

[9]. N Kondo- Journal of Bio mechatronics 2008 bio mechatronicsjournal.tibm.org.tw

[10]. K Siau - Journal of Database Management (JDM), 2019 ISSN: 2455-6211 Volume 10, Issue 1, January-2022, Impact Factor: 7.429, available online at-automation Industry igi-global.com

[11]. Q Zhang - Journal of Bio mechatronics 2008 - journal.tibm.org.tw

[12]. Raza Ul Islam- Food Science and Technology, 2017 "Automation of Material Handling with Bucket Elevator and Belt Conveyor", Department of Industrial Engineering and Management Khulna University of Engineering & Technology. - SciELO Brasil

[13]. W Wang - Journal of Database Management (JDM), 2019 - igi-global.com

[14]. Syed Zain Abbas- Food Science and Technology, 2017 - SciELO Brasil

[15]. F. Leali, A. Vergnano - Mechatronics, 2013 – Elsevier

[16]. K.Murali Krishna, D.Bhujanga Rao, I.Sravan Kumar, S. Sai Manoj, Roopsandeep Bammidi, D Raghuveer, "Development of Automated Storage and Retrieval System for Small Scale Industries", International Journal of Engineering Research and Applications, Vol. 12, Issue 7, (Series-I) July 2022, pp. 67-72