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STRUCTURAL DESIGN AND ANALYSIS OF PICK-AND-PLACE ROBOTICS COMPONENTS USING ANSYS SOFTWARE FOR AGRICULTURAL APPLICATIONS

J PRUDHVIRAJU[*1], K. HUSSAI BABU[*2], G. V. V. NAGARAJU[*3]
*[*1, 2, 3]Assistant Professor, Dept. of Agricultural Engineering.*
A.M Reddy Memorial College of Engineering and Technology, Andhra Pradesh.

Abstract: *A system designed to record and report on discrete activities within a process is called as Tracking System. In the same procedure we have developed a methodology of robot direction system for robotics to control and achieve accurate direction for a class of non-linear systems in the presence of disturbances and parameter variations by using wireless communication technique. In our project we track the robot by using wireless communication i.e. from Control section (acts as transmitter) we are ejecting the control signals, then the robot receives (acts as receiver) the signals, according to the signals it will change the direction in different paths. This project is designed is being designed by the modeling software like Catia V5; it is being done analysis by using Aluminum and steel material in Ansys or Hyper mesh Workbench. Around a Microcontroller which forms the control unit of the project. According to this project, a transmitter is used to transmit the control signals, which controls the direction of the robot. In the same way, receiver is placed on the robot which receives the signals according to which the direction of the robot is controlled. The microcontroller plays important role in controlling the direction according to signals being received at the Receiver side in Robot section. This project finds its place in places where one wants to control the direction of any automated device using wireless point to point communication.*

I- INTRODUCTION

Automation or automatic control is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching in telephone networks, steering and stabilization of ships, aircraft and other applications with minimal or reduced human intervention. Some processes have been completely automated.

A Pick and Place robot is a deployed for many purposes. The main area of application of Pick and Place robots is designed to replace human labor. The industry is behind other complementary industries in using robots because the sort of jobs involved is not straightforward, and many repetitive tasks are not exactly the same every time. In most cases, a lot of factors have to be considered (e.g., the size and color them to be picked) before the commencement of a task. Robots can be used for other horticultural tasks such as pruning, weeding, spraying and monitoring.

The biggest benefit of automation is that it saves labor; however, it is also used to save energy and materials and to improve quality, accuracy and precision. The term automation, inspired by the earlier word automatic (coming from automaton), was not widely used before 1947, when General Motors established the automation department.

It was during this time that industry was rapidly adopting feedback controllers, which were introduced in the 1930s. Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, and electronic and computers, usually in combination. Complicated systems, such as modern factories, airplanes and ships typically use all these combined techniques.

Fig: 1.1: Navigation System of the Autonomous Robot BoniRob

II - LITERATURE REVIEW

The aim of this chapter is to present the status of the current trends and implementation of Pick and Place robots and autonomous systems and outline the potential for future applications. Different applications of autonomous vehicles have been examined and compared with conventional systems, where three main groups of field operations have been identified to be the first potential practical applications: crop establishment, plant care and selective harvesting.

Moreover we will give examples of the economic potential of applying autonomous robotic vehicles compared to conventional systems in different applications. The comparison was based on a systems analysis and an individual economic feasibility study for each of the applications. Focus will be put on potential labor cost savings, farm structure implications and sizes for operation, daily working hours, potential environmental impact, energy costs and safety issues.

2.1 Types of automation

Two common types of automation are feedback control, which is usually continuous and involves taking measurements using a sensor and making calculated adjustments to keep the measured variable within a set range, and sequence control, in which a programmed sequence of discrete operations is performed, often based on system logic. Cruise control is an example of the former while an elevator or an automated teller machine (ATM) is an example of the latter.

The theoretical basis of feedback control is control theory, which also covers servomechanisms, which are often part of an automated system. Feedback control is called "closed loop" while non-feedback control is called "open loop."

III - WORKING DESCRIPTION OF THE PROJECT

3.1 Robots Designed for solution

Engineers and researchers works to increase the level of autonomous machinery in the best solution is to design and build robots capable to work continuously without human guidance. Robots deployed for agricultural purposes can deliver high accuracy and low costs while we can have in real-time a situation of tasks already completed.

Robots could be designed to include many techniques using a limited set of tools and replacing the human laborers. A fully autonomous robot should have the ability to understand the environment, work for an unlimited time without any operator intervention, capable for environment adaptation when changes occur, and to ensure the security for humans.

The number of commercial robots is still limited for a moment, but there is the assumption that in the near future their number will increase significantly.

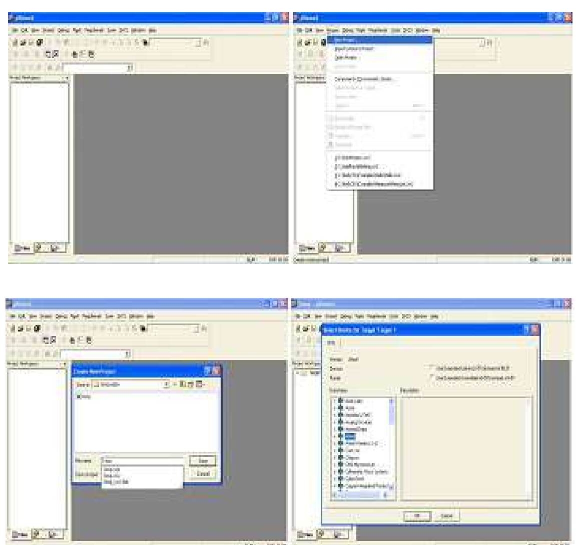
The aim is to build a robot able for a wide range of maneuvers and working the ground with high accuracy. They pass the problems with uneven and inconsistent terrain that can change the direction.

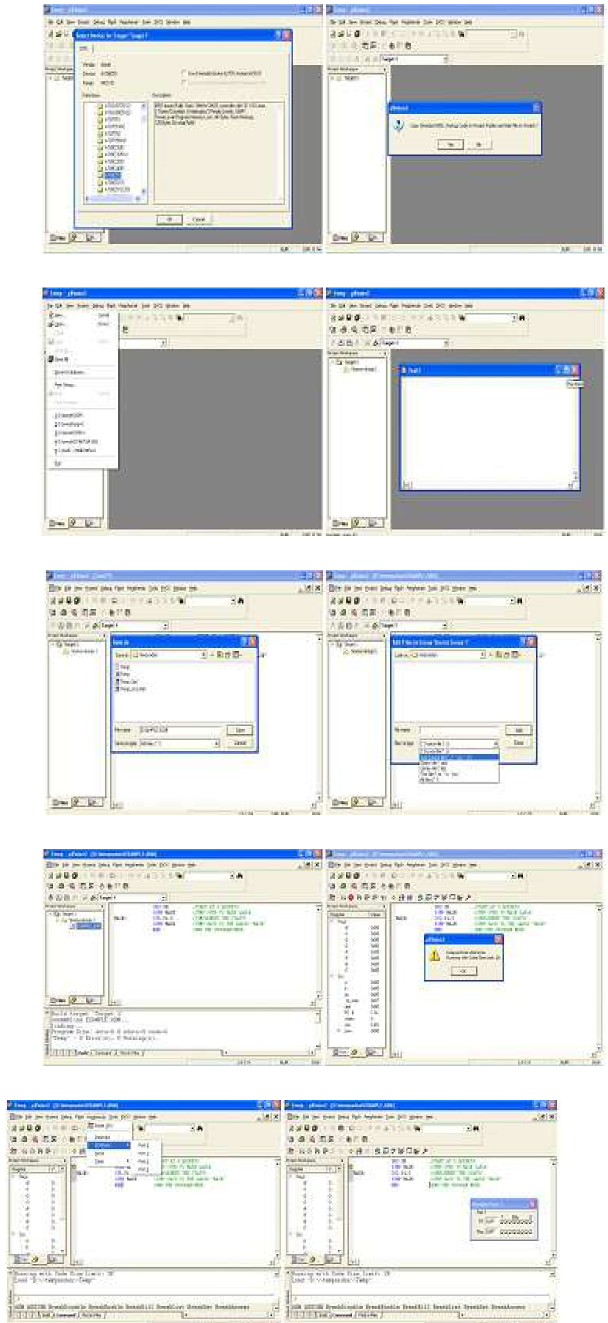
The autonomous system component includes a system to act the acceleration and steer, processing unit, and sensors to locate the position including GPS system. Sensors and a powerful computer is not enough to keep the tractor on the right path. The development team creates an application where the user calibrates the robot according to each terrain type.

This application is in the area of embedded systems. An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is specifically designed for a particular function. Since the embedded system is dedicated to specific tasks, design engineers can optimize it reducing the size and cost of the product and increasing the reliability and performance. Embedded systems are controlled by one or more main processing cores that are typically either a microcontroller or a digital signal processor. Embedded systems control many devices in common use today.

The Keil C51 C Compiler for the 8051 microcontroller is the most popular 8051 C compiler in the world. It provides more features than any other 8051 C compiler available today. The C51 Compiler allows you to write 8051 microcontroller applications in C that, once compiled, have the efficiency and speed of assembly language. Language extensions in the C51 Compiler give you full access to all resources of the 8051.

IV - SOFTWARE DESCRIPTION OF PICK & PLACE ROBOT





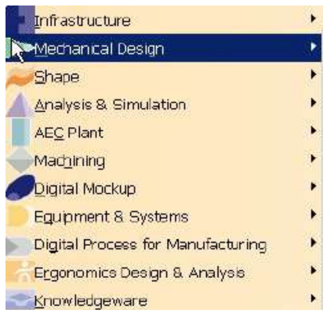
V - DESIGN METHODLOGY OF PICK & PLACE ROBOT

5.1 Introduction to CATIA

CATIA (Computer Aided Three-dimensional Interactive Application) is a multi-platform CAD/CAM/CAE commercial software suite developed by the French company Dassault Systems. Written in the C++ programming language, CATIA is the cornerstone of the Dassault Systems product lifecycle management software suite. CATIA competes in the high-end CAD/CAM/CAE market with Cero Elements/Pro and NX (Unigraphics).

The 3D CAD system CATIA V5 was introduced in 1999 by Dassault Systems. Replacing CATIA V4, it represented a completely new design tool showing fundamental differences to its predecessor. The user interface, now featuring MS Windows layout, allows for the easy integration of common software packages such as MS Office, several graphic programs or SAPR3 products (depending on the IT environment).

The concept of CATIA V5 is to digitally include the complete process of product development, comprising the first draft, the Design, the layout and at last the production and the assembly. The workbench Mechanical Design is to be addressed in the Context of this CAE training course.



CATIA can be applied to a wide variety of industries, from aerospace and defense, automotive, and industrial equipment, to high tech, shipbuilding, consumer goods, plant design, consumer packaged goods, life sciences, architecture and construction, process power and petroleum, and services. CATIA V4, CATIA V5, Pro/ENGINEER, NX (formerly Unigraphics), and Solid Works are the dominant systems.

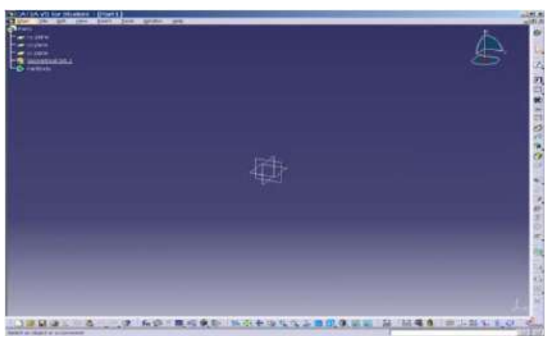


Fig: 5.1: Home Page of CatiaV5

This **PICK & PLACE ROBOT** is designed using CATIA V5 software. This software used in automobile, aerospace, consumer goods, heavy engineering etc. it is very powerful software for designing complicated 3d models, applications of CATIA Version 5 like part design, assembly design.

The same CATIA V5 R20 3d model and 2d drawing model is shown below for reference. Dimensions are taken from. The design of 3d model is done in CATIA V5 software, and then to do test we are using below mentioned software's.

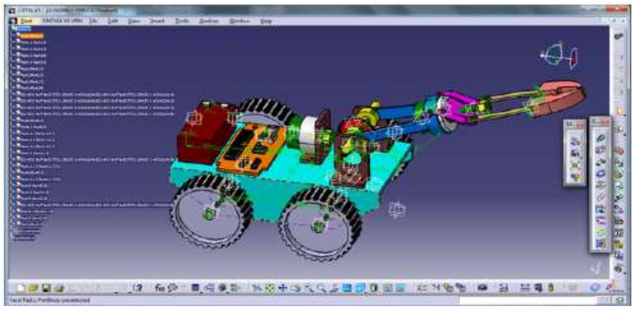


Fig: 5.2: Model design of PPR in CATIA-V5

VI - ANALYSIS OF PICK & PLACE ROBOT

6.1 Procedure for FE Analysis Using ANSYS:

The analysis of the components of pick and place robot are done using ANSYS. For compete assembly is not required, motor and attached system is to carried out by applying moments at the rotation location along which axis we need to mention.

6.2 Preprocessor

In this stage the following steps were executed:

- **Import file in ANSYS window**
  File Menu > Import> STEP > Click ok for the popped up dialog box > Click Browse" and choose the file saved from CATIAV5R20 > Click ok to import the file

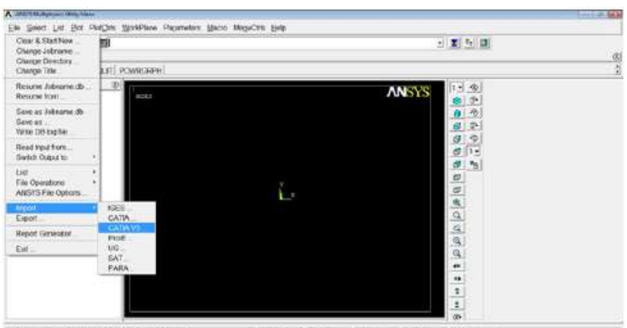


Fig.6.1: Import panel in Ansys.

6.2.1 Meshing:

Mesh generation is the practice of generating a polygonal or polyhedral mesh that approximates a geometric domain. The term "grid generation" is often used interchangeably. Typical uses are for rendering to a computer screen as finite element analysis or computational fluid dynamics. The input model form can vary greatly but common sources are CAD, NURBS, B-rep and STL (file format). The field is highly interdisciplinary, with contributions found in mathematics, computer science, and engineering.

Three-dimensional meshes created for finite element analysis need to consist of tetrahedral, pyramids, prisms or hexahedra. Those used for the finite volume method can consist of arbitrary polyhedral. Those used for finite difference methods usually need to consist of piecewise structured arrays of hexahedra known as multi-block structured meshes.

Meshing is an integral part of the computer-aided engineering (CAE) simulation process. The mesh influences the accuracy, convergence and speed of the solution. Furthermore, the time it takes to create a mesh model is often a significant portion of the time it takes to get results from a CAE solution. Therefore, the better and more automated the meshing tools, the better the solution. From easy, automatic meshing to a highly crafted mesh, ANSYS provides the ultimate solution. Powerful automation capabilities ease the initial meshing of a new geometry by keying off physics preferences and using smart defaults so that a mesh can be obtained upon first try. Additionally, users are able to update immediately to a parameter change, making the handoff from CAD to CAE seamless and aiding in up-front design. Once the best design is found, meshing technologies from, ANSYS provide the flexibility to produce meshes that range in complexity from pure hex meshes to highly detailed Hybrid meshes.

VII - DISCUSSION ON ANALYSIS RESULT

7.1 Results of Displacement analysis:

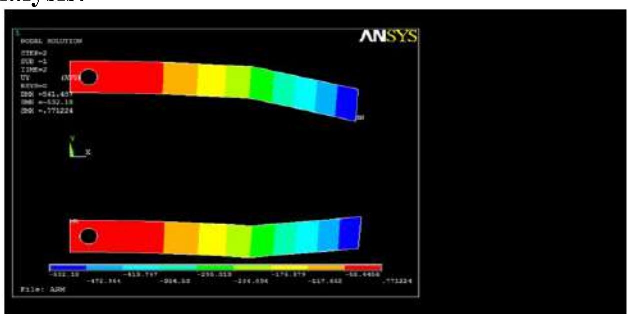


Fig: 7.1: Displacement of Arm

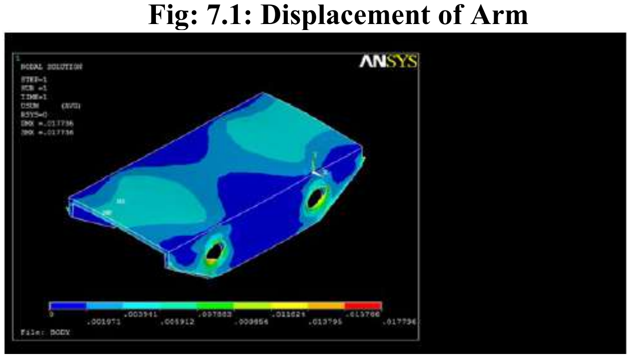


Fig: 7.2: Displacement of Body

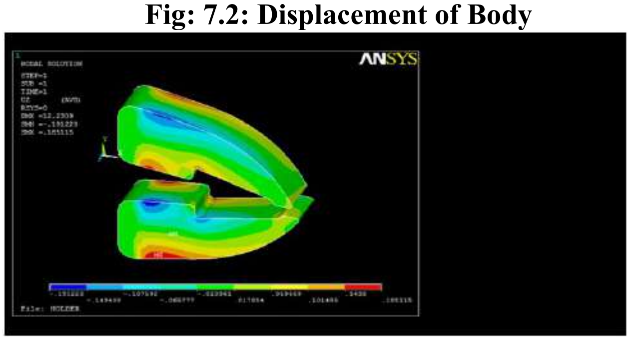


Fig: 7.3: Displacement of Holder

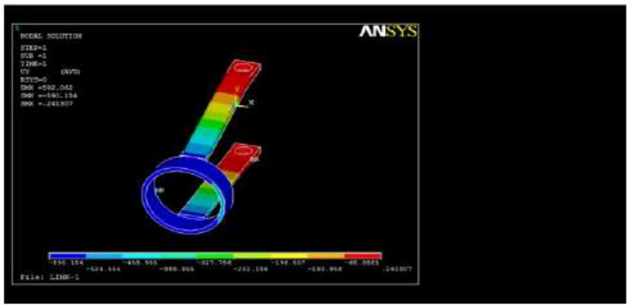


Fig: 7.4: Displacement of Link-1

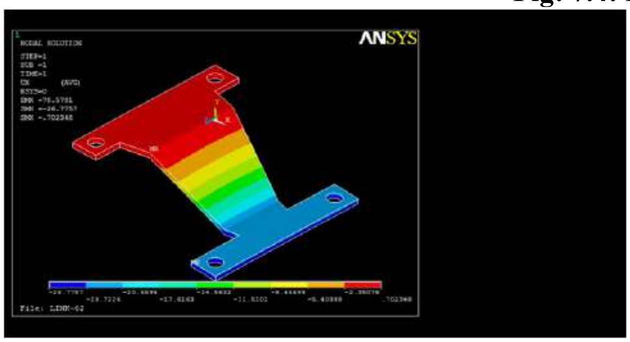


Fig: 7.5: Displacement of Link-2

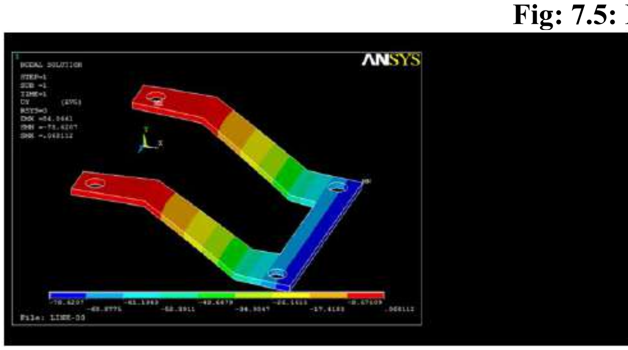


Fig: 7.6: Displacement of Link-3

7.2 Results of Stress analysis:

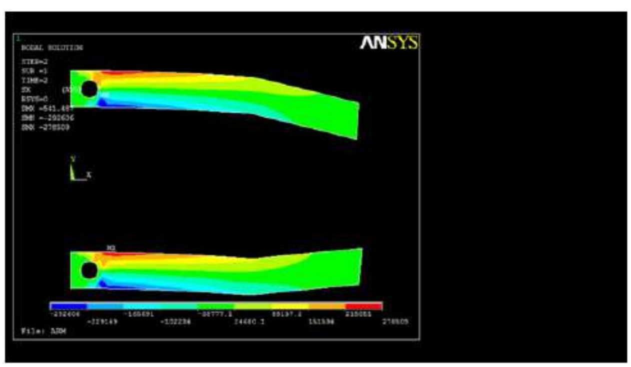


Fig: 7.7: Stress Analysis of Arm

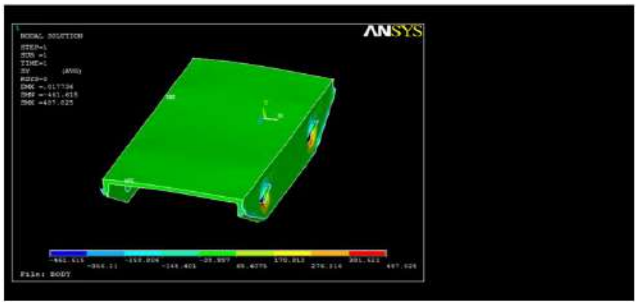


Fig: 7.8: Stress Analysis of Body

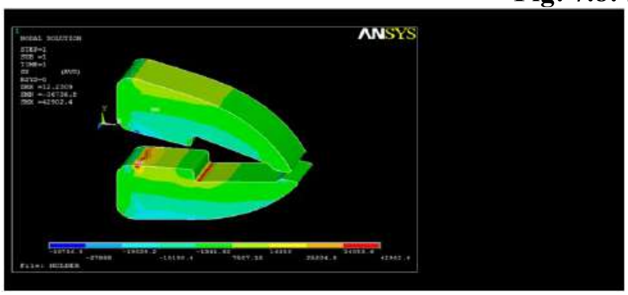


Fig: 7.9: Stress Analysis of Holder

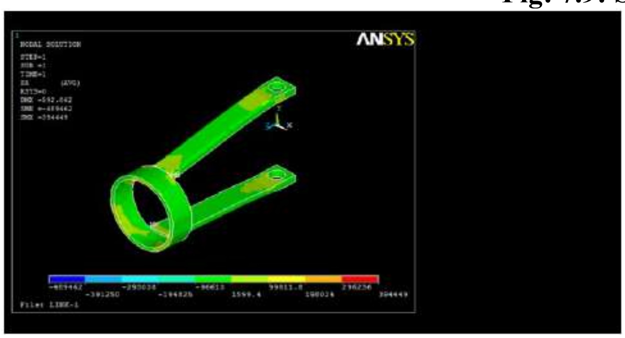


Fig: 7.10: Stress Analysis of Link-1

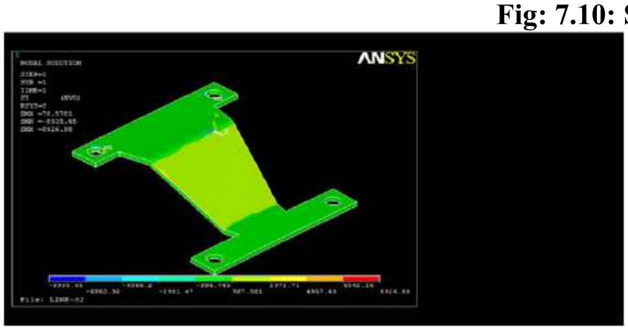


Fig: 7.11: Stress Analysis of Link-2

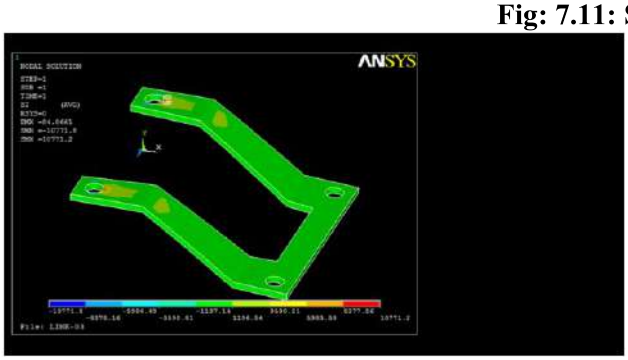


Fig: 7.12: Stress Analysis of Link-3

7.3 Results of Strain analysis:

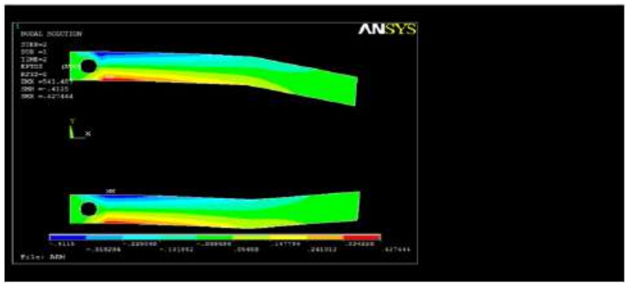


Fig: 7.13: Strain Analysis of Arm

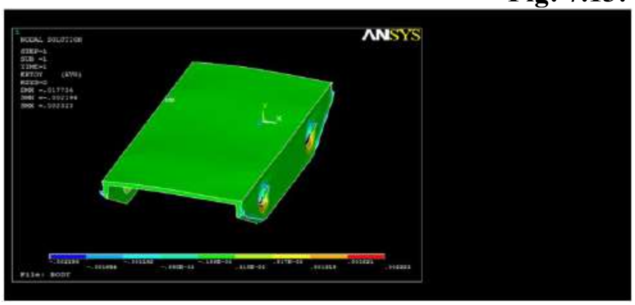


Fig: 7.14: Strain Analysis of Body

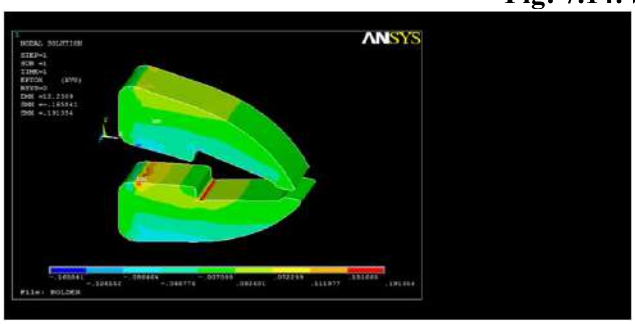


Fig: 7.15: Strain Analysis of Holder

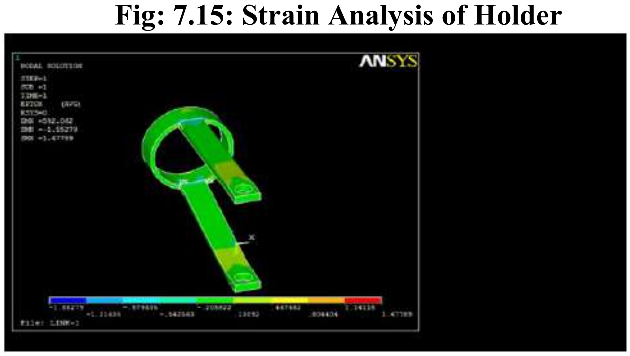


Fig: 7.16: Strain Analysis of Link-1

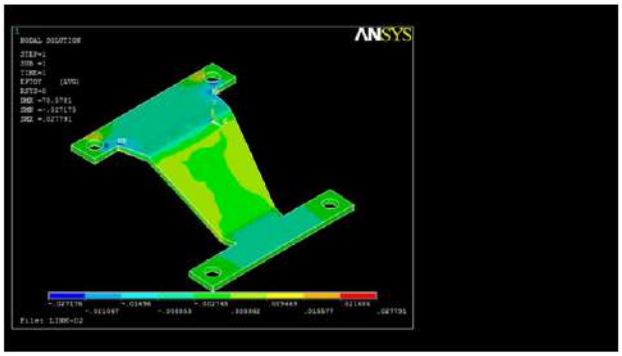


Fig: 7.17: Strain Analysis of Link-2

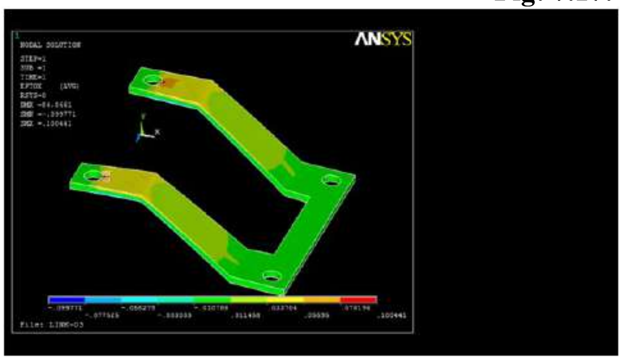


Fig: 7.18: Strain Analysis of Link-3

VIII - CONCLUSION

As shown above figures, the displacement of the design is meshed and solved using Ansys and displacement is very less. This is showing us that clearly each component in robot components is having minor displacement.

Stress is at the fixing location (Minimum Stress which is acceptable); stress value is very less compared to yield value of Aluminum & steel; this is below the yield point. The maximum stress is coming, this solution solving with the help of Ansys software so that the maximum stress is less. So we can conclude our design parameters are approximately correct.

The development process may be incremental but the overall concept requires a paradigm shift in the way we think about mechanization for autonomous machines that is based more on needs and novel ways of meeting them rather than modifying existing techniques.

FUTURE ENHANCEMENT

In the present project our main aim is to monitor different data between two micro controllers, which are not, connected any wire. The data will be transferred through module HT12E encoder that acts like a Transmitter. When the data is subjected to transfer the emitter collects it and sends it into the air, which will then be collected by the receiver situated at the other end. As we talk about the advancements in this module, the data can be transferred to a particular controller when in a group of them, which we technically call as Routing.

There is a huge scope for improvement in design techniques and solution solving in mechanization for autonomous machines and their systems.

One of the highly hyped advancement is in Wireless. For example the data can be transmitted between different by using simple coding technique and that too very efficiently.

Wireless communication is finding a huge development in Satellite Communications. The Bluetooth signals are sensed and reflected back to the earth stations. These signals contain information about weather forecasting, geological surveys and other cosmic developments.

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