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"AUTOMATION FOR INSERTING WPF"

AUTOMATION FOR INSERTING WPF

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ABSTRACT

Manufaturing of an front housing of MO2 and MO1 is done on moulding machine and all dimention are found to be ok if curing time of the product will incressed upto 3 min but 3 min for one single product manufaturing was to much time and we wiil not able to achive our daily production target due to this we have reduce the cycle time and curing time of the product to 1.75 min. but we have not able to achive all dimentions of the products to be ok one dimention which was very important for whole product which is not ok and due to this movement of bridgre is not happening and due to this whole product goes under rejection it will cost to much for the plant around 12000/product. For reducing the cost of rejection we have decided to inset an WPF (warpage preventive fixture) in the product it will prevent the warpage of the product and will improve the productivity and reduce the rejection of the product. but after implementation of inserting WPF in MO1 and MO2 one human worker was daily requred for inserting them for all shifts if any cause happen we have to stop the production of the product and it will cause an production loss to the plant. To over come this problem we have decided to implement and automation for inserting an WPF. Which will help to improve the production and productivity of the product and plant. Automantion will eliminate all the human activity for the insering WPF and reduce the cost of production permanetly and it will save monthly 21000 rs, of three shift of one person. This will going to help for cost saving of plant and production.

CHAPTER 1: INTRODUCTION

1.1. World Wide Scenario

Industrial automation is defined as the controlling and processing of heavy industrial machines, equipment, and devices with the help of advanced systems, and software. These systems and software are backed up by advanced technologies such as machine learning, cloud, robotics, and others. Several companies in the manufacturing industry are focused on adopting and implementing industrial automation solutions to increase the overall productivity, educate their employees and reduce high cost while accomplishing precision and flexibility. Automation in industries helps stakeholders and manufacturers to achieve growth in productivity, enhanced quality and minimizes error. Also, usage of automation solutions such as computer software and advanced sensors in the industrial process helps to ensure the collection of reliable data, facts, and figures which can be used to make informed decisions, resulting in significant cost savings.

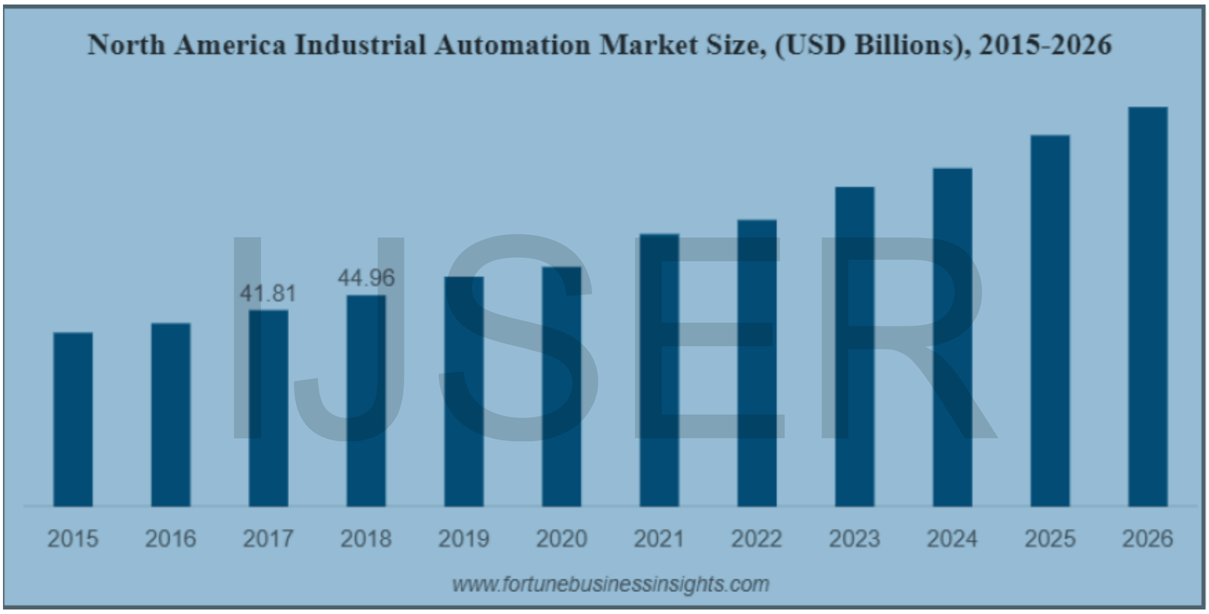

Fig 1.1. future market of automation industry

Smart automation will help to power the Industry 4.0 revolution, as advancement in process and discrete industry processes will support to drive manufacturing productivity in the upcoming future. Further, industries have understood the potential efficiency and productivity that can be accomplished through the applications of Industry 4.0, including the Industrial Internet of Things (IIoT) and cloud computing. The growing adoption of smart grid technology to provide new opportunities for SCADA systems and PLC software is one of the key drivers compelling the market's growth in the forecast period. For instance, key members of industrial internet consortium (IIC) such as Robert Bosch GmbH, National Instruments Corporation, Cisco System, and Tech Mahindra Limited, deployed smart factory solutions such as IoT and smart grid technology, in their business processes. These smart factory solutions offer applications such as advanced supply chain management, streamlined human resources, and increased profitability.

Various industrial automation systems, such as automated PI, automated warehouse, automated staff, and among others, are an essential component of maintaining and promoting the functioning of innovative manufacturing. These industrial automated systems are deployed to offer a factory-level solution to severe manufacturing concerns. Further, key companies in this process to automate the business and increase the profitability in terms of revenue. For instance, in August 2018, ABB Ltd deployed a software-as-a-service cloud-based model in their Ability Electrical Distribution Control Business System. This deployment will help customers to browse, select and leverage the potential and capabilities of a company's products more precisely. Similarly, in July 2018, Siemens AG partnered with Alibaba to deploy Cloud solutions to develop and provide Industrial Internet of Things (IIoT) in Asian countries.

1.2. Market Drivers

"Increasing adoption of Industry 4.0 trend and IoT enabled smart devices, will drive the market in near future."

The increasing adoption of technologies such as industrial 4.0, artificial intelligence (AI) based smart robots, IoT, and others, helps to reduce the manufacturing cost and offer enhanced quality and reliability to the product. These factors are very important for companies to withstand a leading position in the competitive market. Key players are focused on mergers and collaboration to discover new opportunities by adopting IoT technologies. For instance, in May 2018, Rockwell Automation collaborated with Plug and Play, an innovation platform. This collaboration helps Rockwell Automation to and new opportunities to leverage disruptive industrial IoT technologies. Moreover, advancement in computer-aided systems, industrial internet of things (IioT), and upcoming engineering 5G technology will boost the market growth in the coming years. Ongoing developments in the field of Industrial IoT also help to drive progress in the automation industry and creating opportunities for disruptive industry models. For instance, in June 2019, Red Lion launched a new Signal Conditioner product line up. Signal Conditioner is powered by IioT and can be used in the industries, where the precise data is required to be transmitted over a certain distance without external noises.

1.2.1. By Component Analysis

Under the scope of the study, the component segment is divided into hardware and software. The industrial automation software segment is expected to grow with a decent CAGR during the forecasted period. This growth is due to the fast adoption of software solutions including human machine interface (HMI), supervisory control and data acquisition (SCADA), manufacturing operations management (MOM) software and others, among the industry. The rising adoption of automated software helps organizations to monitor and control the overall manufacturing process and offer superior quality products. During 2016-2018, industrial automation market witnessed several software launches, research & development activities from software providers. For instance, in July 2018, Rockwell Automation launched Connected Components Workbench software, an industrial automation software. This automated software provides a familiar design environment and helps to reduce programming time. Further, based on the hardware segment is bifurcated into Sensors, Programmable Logic Controllers, Human-

Machine Interface, Servo, Laser Markers, Safety Light Curtain and Robots. In the hardware segment, sensors are expected to reach a market value of USD 27.71 Billion by the end of 2026 at a CAGR of 9.5% during the forecast period (2019-2026). Under the hardware segment, sensors hold a substantial share in terms of revenue, in the overall industrial automation market during the forecast period. In industry, sensors help to monitor, control (temperature, flow, pressure, etc.) and collect data. Further, in industries, more than 20 different types of sensors are deployed due to their monitoring capabilities and remote sensing application. Robots will have high demand in the market, as a result of increasing demand for AI-based industrial collaborative robots in various applications such as part transfer, pick and place, packaging, semiconductor manufacturing, and others. Also, in the discrete automation industry, robots are used for self-optimization of the production lines and customized product solutions. Major players in this market are focused on mergers and acquisitions for developing industrial robotics solutions. For instance, in April 2018, Schneider Electric, France based company, collaborated with Stäubli Robotics to integrate robotics solutions into Eco Struxure smart machines by combining products and software into a complete automated solution.

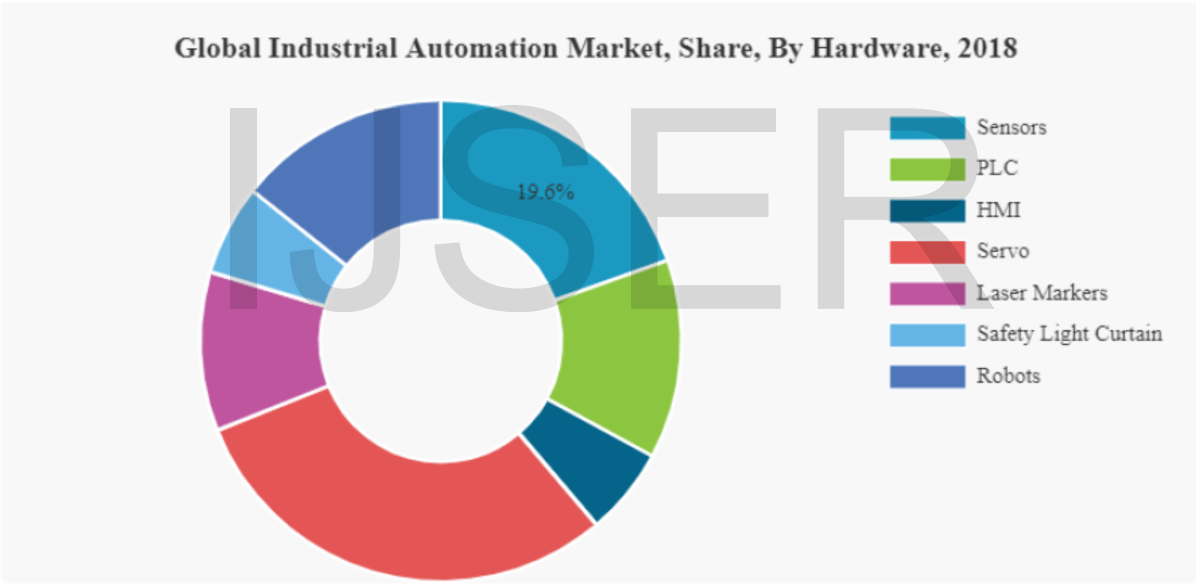

Fig 1.2. pie chart

1.2.2. By Industry Analysis

Based on industry, under the scope of the study segmented the market into discrete and process. Discrete industry is expected to hold the maximum market revenue share during the forecasted period. Under the discrete industry, we have included automotive, electronics, heavy manufacturing, packaging, and others. The automotive industry holds a major share in terms of revenue and is forecasted to grow with an exceptional CAGR during the forecast period. The demand for industrial automation products in discrete automation will be mostly driven from automotive, heavy manufacturing, and electronics, industry to ease the manufacturing process. Referring to multiple secondary sources, Indian automotive sales were valued at around 4 Million in 2017, growing with a CAGR of 9.5%. India is the 7th largest manufacturer of commercial vehicles in 2018.

1.2.3. List of Key Companies Covered:

ABB Ltd.
Emerson Electric Co.
General Electric Company
Honeywell International Inc.
Mitsubishi Electric Corporation
Omron Corporation
Rockwell Automation Inc.
Schneider Electric SE
Siemens AG
Yokogawa Electric Corporation

1.3. Report Coverage

The report provides an elaborative analysis of the global industrial automation market dynamics and competitive landscape. Various key insights presented in the report are the price trend analysis, recent industry developments in the global market, such as mergers & acquisitions, the regulatory scenario in crucial countries, macro, and microeconomic factors, SWOT analysis, and key industry trends, competitive landscape and company profiles.

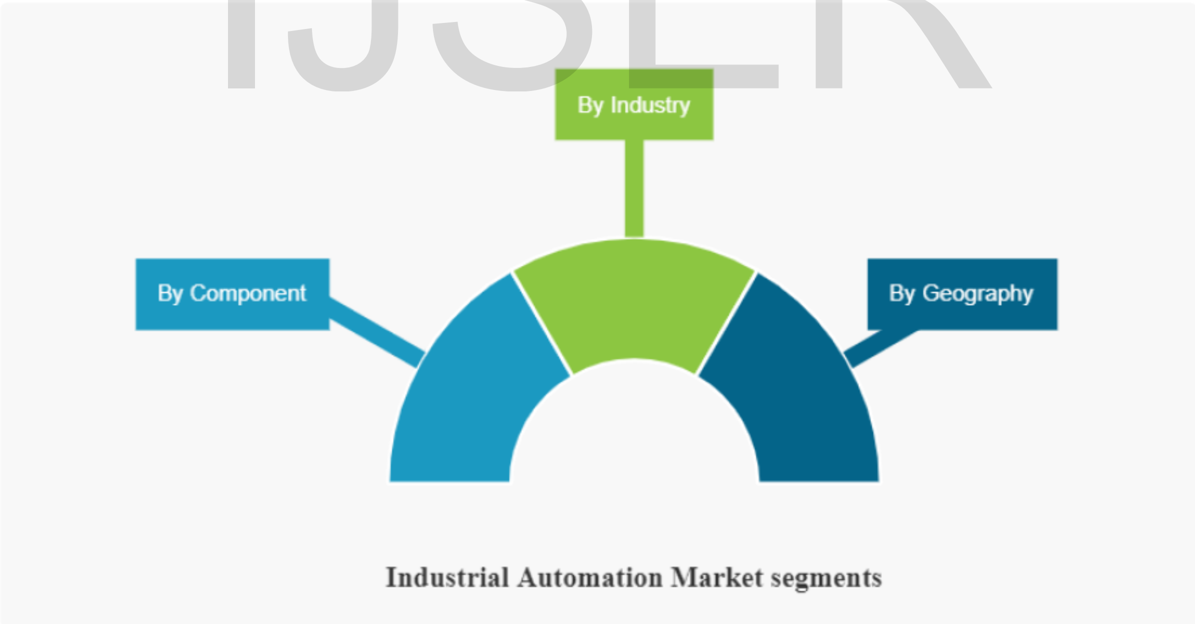

Fig 1.3. market segments

1.4. Introduction To Exiting Process

When the moulding machine get started and the moulding of the product is in process it takes about 2 min to get out from the mould. After that a person setting at outlet of the machine took the product in his hand and remove the unwanted material from it like flash, chips etc. and remove the runner of the product which was an extra part on it due to mould gate structure and after that he insert an WPF in it to prevent the warpage of the product. that's how the whole process is carried out.

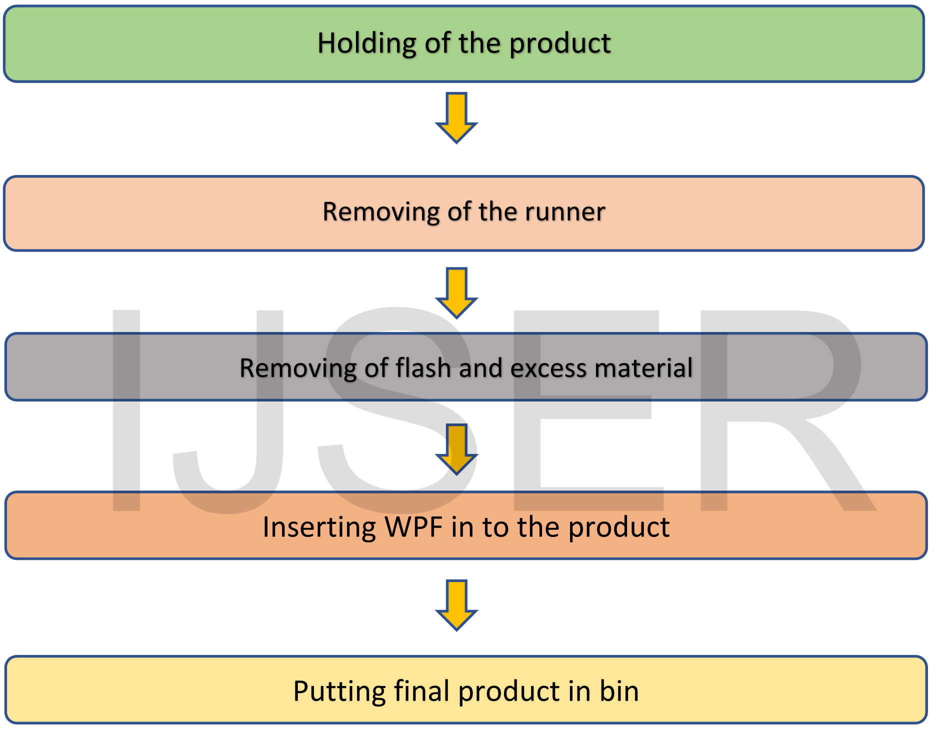

Fig 1.4. process flow of existing process

Fig. runner removing

fig. Inserting WPF

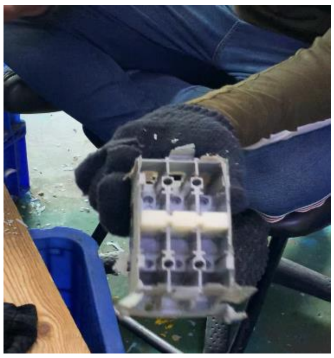

Fig. Final product

1.5. Problem Statement

we are the largest manufaturer of an contory of electrical standartd products and one of the finest with authorised all quality standard certified ferm of electrical product in india. And we have more than 300 products manufaturing curently but mainly MO 1 and MO2 are bigger in size that's why when they came out of the mould of the machine due to the hotness of the product then get shrink as its temprature goes down to the atmospheric temprature due to shrinkage of the product it is been imposible to achive the standard dimention. To avoid this shrinkage of the product we have decieded to insert a fixture inside it to avoid the shrikage we named that fixture Warpage Preventive Fixture. But to insert that fixture one person is always required to do this job and machine is cotinuously runing for 24 hr it is not posible to sit a person there for doing that job because it was an hectick work. To run the machine countinuously with loss of production and time we have decided to implement an automation for achive maximum efficiency of production and plant.

warpage of the product causing improper dimention achivement to overcome this problem we have decided to insert an WPF in the product but for inserting WPF in housing one person is continuously required for it. And it was an hectic job for continuous inserting WPF. so continuous production is very difficult to achive, we have to produce this product in one shift only due to low number of available work force.we have to implement an automation to achive maximum production of three shift.

1.6. Cause and Effect Diagram

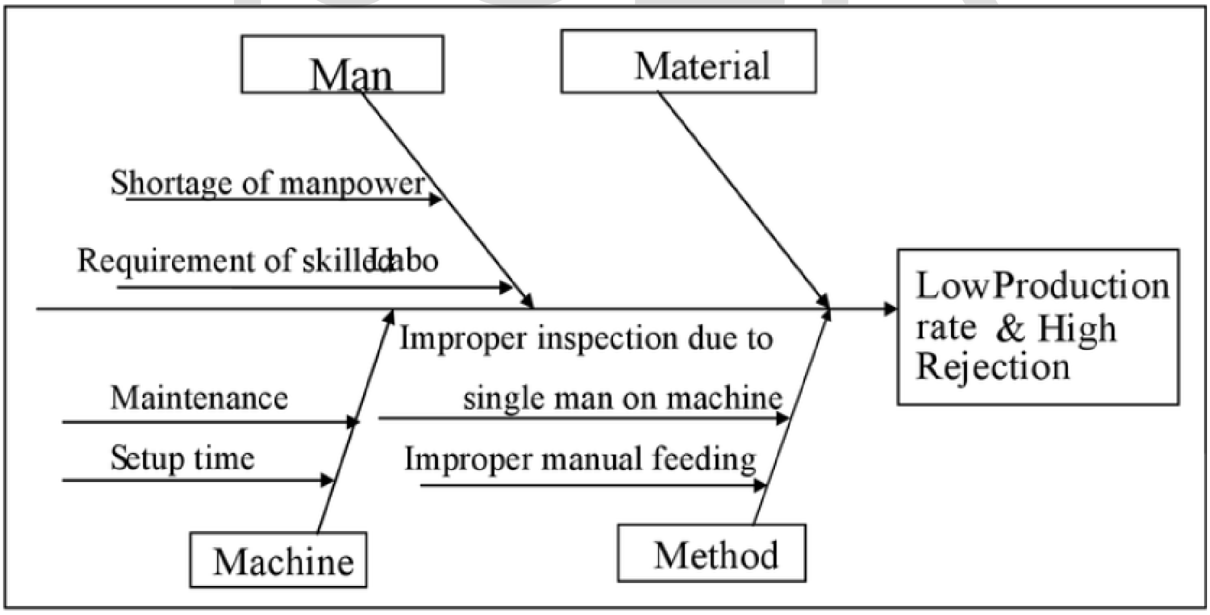

Fig 1.5. Cause and Effect Diagram

1.7. Need Of Project

2. Reduce Worker Fatigue and Effort or Labour-Intensive Operation – Typically, humans dislike banal, repetitive tasks. However, computer systems perform them without complaint. Tasks that lack variability provide a place for automated systems to shine, but this also holds true for systems utilizing advanced sensors and integration. If the task requires conditions not suited to human comfort or focus, consider automation.

3. Industrial Automation Services Prevent Products or Materials from Being Damaged or Destroyed – Humans make mistakes when they fatigue. This embodies the sentiment of the "human condition." Mistakes using tools mean damaging raw materials, components, assemblies, and end products.

4. Prevent Non-conforming Product from Shipping – Computers controlling robots do not forget steps. Neglecting to put in a screw requires a human touch. A machine not doing it yields an error to be addressed. Does the process require doing something in a specific order to improve yield? Automated systems will not violate the instruction set. Moreover, automated systems may employ inspection capabilities. Tune the system and allow the data to roll in without preference or bias.

5. Increase Efficiency – Improving processes for efficiency makes a company more competitive, but do people always do the same thing, in the same way, every time they do it? No, human variation exists. Automated systems allow for improvements that benefit from consistent execution. Perfect planning and training do not defend against the human touch.

6. Collect Better Data – Remove the accidental data entry or missed data point from logging. Make the method of collecting sensor and process data regulated.

7. Improve Metrics – Sending reliable data directly to a database provides an ongoing resource. Does the process improve with changes? Why do I see more failures now than in the past? Leveraging data can provide these answers beyond a simple list of pass/fail statistics from the past. Correlation of associated process data with pass/fail records provides insight rather than guessing "what is causing this?".

8. Devise the Right Process Improvements – Automated systems now collect reliable data. The database provides a searchable forum. What comes next? Equipped with copious amounts of reliable data, engineers make the most of this information.

9. Save Money – Why instrument that test stand? Why log that data? Why spend the money now? Simply, inventing in industrial automation yields cost savings through making processes more regular and collecting data for making confident decisions.

CHAPTER 2: LITRATURE REVIEW

2.1 INDUSTRIAL AUTOMATION

Context: A systematic literature review(SLR) is a methodology used to find and aggregate all relevant studies about a specific research question or topic of interest. Most of the SLR processes are manually conducted. Automating these processes can reduce the workload and time consumed by human. Method: we use SLR as a methodology to survey the literature about the technologies used to automate SLR processes.

Result: from the collected data we found many work done to automate the study selection process but there is no evidence about automation of the planning and reporting process. Most of the authors use machine learning classifiers to automate the study selection process. From our survey, there are processes that are similar to the SLR process for which there are automatic techniques to perform them.

Conclusion: Because of these results, we concluded that there should be more research done on the planning, reporting, data extraction and synthesizing processes of SLR.

Keywords: SLR, Automation, Planning, Reporting, Data Extraction, Synthesizing

A systematic literature review or a systematic review is a means of identifying, evaluating and interpreting all available research relevant to a particular research question, or topic area, or phenomenon of interest.[1]

The systematic literature review methodology has a well-defined methodological steps or protocol. The methodological steps , search strategy and research question are explicitly defined so that other researchers can reproduce the same protocol.[2]

There are many reasons for undertaking a systematic review. The most common reasons are: to summarize the existing evidence concerning a treatment or technology, to identify any gaps in current research in order to suggest areas for further investigation and to provide a framework/background in order to appropriately position new research activities.[3].

2.2 ROBOT IN INDUSTRY 4.0

Robots play an important role in modern manufacturing industry. The number of multipurpose industrial robots developed by players in the Industry 4.0 in Europe alone has almost doubled since 2004 [4].

An essential face of Industry 4.0 is autonomous production methods powered by robots that can complete tasks intelligently, with the focus on safety, flexibility, versatility, and collaborative. Without the need to isolate its working area, its integration into human workspaces becomes more economical and productive, and opens up many possible applications in industries. More industrial robots are evolving with the latest technological innovation to facilitate the industrial revolution. Smart robots will not only replace humans in simply structured workflows within closed areas. In Industry 4.0, robots and humans will work hand in hand, so to speak, on interlinking tasks and using smart sensor human-machine interfaces. The use of robots is widening to include various functions: production, logistics, and office management (to distribute documents) and they can be controlled remotely. If a problem occurs, the worker will receive a message on his mobile phone, which is linked to a webcam, so he can see the problems and give instructions to let the production continue until he comes back the next day. Thus, the plant is operating 24 hours/day while workers are only there during the day [5].

Several robots have been introduced with the latest technology to be the pioneer in Industry 4.0. Kuka LBR iiwa is a lightweight robot for industrial applications that is designed for safe close cooperation between human and robot on highly sensitive tasks. Iiwa which stands for intelligent industrial work assistant can learn from its human colleagues and can independently check, optimize, and document the results of its own work while connected to the cloud [6].

Bosch also introduces the APAS family robot system which includes APAS assistant, APAS inspector, and APAS base for an agile and flexible production concepts based on quickly and easily retooled production systems [7].

The robot features mobile, intrinsically safe, networked and configurable process modules which can be adjusted to new tasks by using the dialog-controlled user interface. The advanced collision avoidance system makes it safe for working together with humans. Nextage robots from Kawada Industries are an evolution from mere equipment to becoming a partner in parts assembly lines. Its overall design includes a “head” with two cameras, a torso, two 6-axis arms, and a mobile base, a flexible software GUI. Its advance stereo vision with image recognition system allows it to ascertain object distance and attain 3D coordinates with high precision. The accompanying open source software provides superb visibility and usability, making the operation and instruction of Nextage easy and flexible. There are two versions of the robot, one for the industry and the other for research. The dual-arm YuMi robot is the first collaborative robot from ABB. It features an advanced vision system, flexible hands, parts feeding systems, sensitive force control feedback, and state-of-the-art robot control software that allows for programming through teaching. Along with the built-in Safety function, it is designed to work side-by-side with humans. Several other robot models developed by various companies in keeping up with the trend is listed in Table 1 below.

2.2.1. Review Process Adopted

A literature review is necessary to know about the research area and what problem in that area has been solved and need to be solved in future. This review process approach was divided into five stages in order to make the process simple and adaptable. The stages were:-

Stage 0: Get a “feel”

This stage provides the details to be checked while starting literature survey with a broader domain and classifying them according to requirements.

Stage 1: Get the “big picture”

The groups of research papers are prepared according to common issues & application sub areas. It is necessary to find out the answers to certain questions by reading the Title, Abstract, introduction, conclusion and section and sub section headings.

Stage 2: Get the "details"

Stage 2 deals with going in depth of each research paper and understand the details of methodology used to justify the problem, justification to significance & novelty of the solution approach, precise question addressed, major contribution, scope & limitations of the work presented

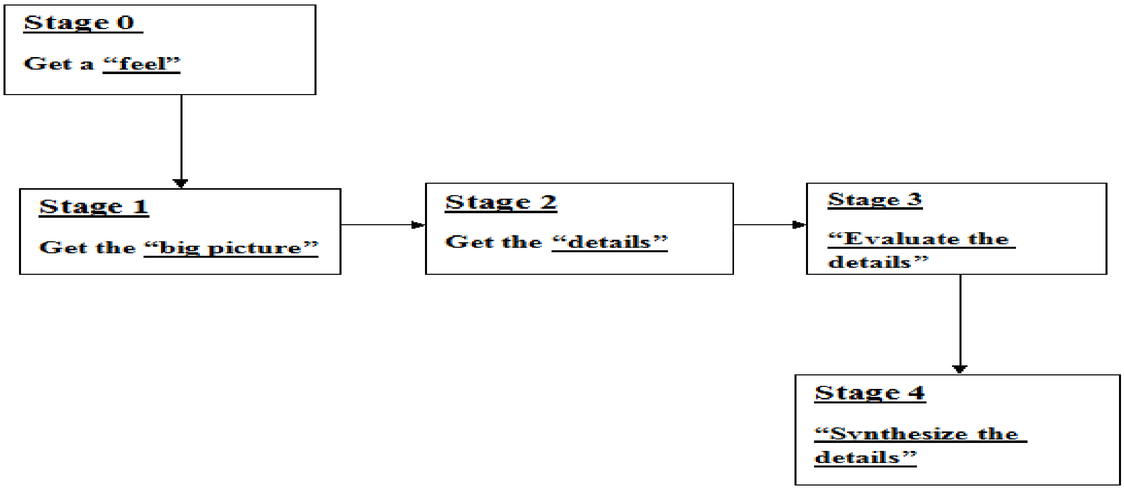

Fig: 2.1 Review Process Adopted

Stage 3: "Evaluate the details"

This stage evaluates the details in relation to significance of the problem, Novelty of the problem, significance of the solution, novelty in approach, validity of claims etc.

Stage 3+: "Synthesize the detail"

Stage 3+ deals with evaluation of the details presented and generalization to some extent. This stage deals with synthesis of the data, concept & the results presented by the authors.

2.2.2. Various Issues In The Area

After reviewing 15 research papers on Controlling Parameters of Injection Molding Machine we have found following issues, which has to be addressed, while the designing and implementation of the Injection Molding Machine these issues are:

1) **Controlling method of injection molding machine for new technologies**
2) **New trends in industrial Automation**
3) **Energy Storage in co-generation power plant**
4) **Wireless Data Transmission**

2.2.3. Issue Wise Discussion

Issue 1: - Controlling method of injection molding machine for new technologies

Controlling method of injection molding machine for new technologies is one of the issue, some approaches were used for this issue which is injection molding machine controlling process very hard with relay logic, so embedded system controlling process (logic) used for injection molding machine, this process is better than the relay logic & it provides an effective & easy way to control the hydraulic system. The increasing complexity of automation applications needs new framework architecture to development automation control system. By using automation components like that component oriented design, reusability & picture structure is better way for reduces increasing complexity of automation. This approach reduces valuable development time because the component can be tested with their internal test functionality. By using hardware structure, system software architecture & experimental plate form give a better approach to development of a distributed control system for PLC based applications. PLC based applications & technology is very effective and useful technique to improve product quantity & quality.

Issue 2: - New trends in industrial Automation

New trends in industrial Automation is second issue, some approaches were used for this issue which is simulation approach for speed control of Induction motor using Lab view software. Lab view software is one of the most significant software & with the help of LABVIEW, today's industries control applications are done by remote processes only, user normally sits somewhere safe place away from the working environment from there he/she has to control the plant and also make sure that the system parameters should be optimized so here simulation Software plays a vital role in Industrial Monitoring and Control system. Actually the main issue in the designing field is that most of the problems occur while using large no. of control circuits, since increase in no. of control circuits lead to superfluous no. of wires. To reduce the no of hardwire circuits and to see things moving or happening graphically can be easily seen so we can implement these circuits on simulation level using Simulation software. Even it is not possible to design control of distant systems as this would involve large no hard wire circuits, Simulation programs have made engineering design easy and with lesser amount of material requirement. It claims that choosing Lab View as the human machine interface for the implementation is a proper decision as it has various types of application s and functions that are easy to understand and use, secondly this approach is more economical as the objectives and system defects can be identified without the implementation of the circuit. To be precise, this paper falls under the area of controlling an induction motor and its variable like speed and direction with the help of LAB VIEW, but there is again a problem occurs with this simulation software as this is not sufficient because it couldn't fetch the desired result and even in controlling the speed there are only3 multilevel references in the VDF, so we need to improve this for the better controlling and simulation.

Issue 3:- Energy Storage in co-generation power plant

Energy Storage in co-generation power plant is third issue, some approaches were used for this issue which is comparison of two methods of electrical power storage.One of them is conventional method on other side another is modern system. In conventional power storage method has taken the battery storage method and in modern method has taken capacitor bank method for electrical storage. It's not sufficient because new installation of capacitor bank storage contain many difficulties and connection complex-city. By some of the way tried to solve the problem of conventional storage of electricity by giving a better alternative for electrical storage. Limitation of the given alternative is so much similar to the conventional method al-thought this is only suggested method of the electrical power storage. With the less complexity of the circuitry and the less economical investment this will become a better alternative for electrical storage in solar plants**.**

Issue 4:- Wireless Data Transmission

Wireless Data Transmission is fourth issue, some approaches were used for this issue which is Engineering Approach for Secure and Safe Wireless Sensor and Actuator Networks for Industrial Automation Systems which includes the security concept in context of industrial automation and It gives an introduction of a holistic networks but still easy to implement approach for automation networks. Justification of problem illustrated through the holistic approaches including security protocols and also works on VEST (Virginia Embedded Systems Toolkit) focuses on the development of effective composition. But a gap is that a security solution must ensure that the cost of an attacker to break the security solution is higher than his/her potential benefit. Solution approach obtained through an engineering methodology to cope with security requirements in context with industrial automation. Data collected and analyzed through the three stages of solution - the development flow, inputs of the selection process, mapping from requirements to practical solutions. The proposed development flow promises a reliable objective engineering of proper system solutions. Key concepts of the flow are a holistic goal description and an iterative composition algorithm that inherently applies and extends existing knowledge. This Holistic approach is reliable, safe and secure. Applications of Short-Range Wireless Technologies to Industrial Automation: A ZigBee Approach. Bluetooth, ultra-wideband (UWB), ZigBee, and Wi-Fi are four popular wireless standards for short-range communications. Specifically, ZigBee network is an emerging technology designed for low cost, low power consumption and low-rate wireless personal area networks with a focus on the device-level communication for enabling the wireless sensor networks. ZIGBEE develops a wireless network which should be low power consumptive with low cost. Hence, it has been becoming widely used in many applications, such as home automation, industrial control, location and position, telecommunication, and wireless sensor networks.

2.3. AUTOMATION-

2.3.1. Advanced robotics: -

Robotics is any kind of mechanical device that can perform tasks and interact without human assistance. Some examples of advanced digital robotics include: soft robotics (non-rigid robots built with soft and deformable materials that can manipulate items of varying size, shape and weight with a single device); swarm robotics (coordinated multi-robot systems which often involve large numbers of mostly robots performing physical tasks); tactile/touch robotics (robotic body parts, for example biologically inspired hands, with capability to sense, touch, exhibit dexterity, and perform a variety of tasks); and humanoid robots (robots physically similar to human beings; they integrate a range of Artificial Intelligence (AI) and robotics technologies and are able to perform a variety of human tasks) (Manyika et al, 2017).

2.3.2. Machine learning: -

Machine learning can refer to supervised or unsupervised learning techniques. Supervised learning trains an algorithm to correctly classify a new batch of data; it is used, for example, for spam detection. Unsupervised learning is instead a method that implies the use of algorithms for pattern (rules) discovery without a direct input from the researcher, its used for example for customer purchases analysis (that is, which products are usually bought together) (Hahsler et al, 2005).

2.3.3. Scale, scope, and sectors: -

automation technologies The Gartner Hype Cycle for emerging technologies5 , a forecasting tool for technological developments, places AI, machine learning and smart robots at the peak of the hype cycle (that is, maximum level of inflated expectations) with predictions of widespread adoption in the industry or in services between 5 and 10 years (cognitive computing). This means that the perceived potential of these technologies is very high but that implementation will actually take longer than the current narrative suggests. Possible causes of the delay between expectation and implementation could be Technology Readiness Levels6 , that is the level of applicability of the technology, and the investment required to acquire these new technologies or products thereof (Eurofound, 2017). At global level, data from the World Robotics 2016 report (International Federation of Robotics, 2016) show that most industrial robots are present in the automotive industry, which is the sector with the highest density of robots worldwide; other sectors that intensively use robots are electrical and electronics, metal, and chemicals. A European Commission report (2016) discussing the use of industrial robots in manufacturing industries in Europe finds that while almost half of manufacturers of rubber and plastic products and manufacturers of transport equipment already use industrial robots in their production processes, robots are only used by one out of five companies in the textile industry. The countries with the highest number of industrial robots per 10,000 employees in manufacturing (in the sample considered) in 2012 are Germany, Sweden, Italy, Spain and France. This should not be a surprise since all these countries had a strong automotive industry where robots are widely used. The highest percentage of companies using robots in Europe is in Spain, France and Switzerland (note the 'at least one robot'): '47% of Spanish firms, 42% of French firms and 39% of Swiss firms used at least one industrial robot in their factories in 2012 followed by Sweden (35%) and Austria (32%). The lowest rate of industrial robot deployment is reported in the Netherlands (24%)' (European Commission, 2016, p. 3). In terms of expected growth in the annual supply of industrial robots in different geographical regions the biggest increase, by 2018, is meant to happen in Asia/Australia7 . Essentially, automation is more likely to happen in countries where workers enjoy higher wages (EU big 5, US, Japan) and/or in countries with a large population (India, China). For Asia this forecast is in line with the argument that low levels of workers' organisation could favour automation due to a low level of social dialogue interaction while for Western economies the argument of replacement of high wages can be applied.

2.4. Implications for the labour market: -

The threads of the technological debate of the past, the extent of technological impact on work and employment and solutions for mass unemployment which might result from the widespread adoption of automation of work technologies, have been picked up again in the current debate on automation. Several recent studies examine the effects of technological changes on the labour market. Two main aspects are being discussed: first, the substitutability of human labour by robots and machines, which also involves the discussion of changes in task structures and work activities as well as employment shifts in sectors; second, growing inequalities, involving labour market polarisation and upgrading, and the need for new skills that are required for humans to compete against their potential replacements or to perform jobs which complement those of machines. Where possible, the impact of technology on different demographic groups including gender will be differentiated in the following discussions.

2.4.1. Intrinsic quality of work: -

Intrinsic quality of work (skills, autonomy and social support) could change due to human robot interaction (HRI). Depending on how it is implemented, it could make job quality better in terms of more interesting tasks or, on the contrary, make tasks boring and repetitive, provoking workers' autonomy loss. The literature presents arguments for both scenarios, briefly illustrated below. Manyika et al (2017) write that more integration with technology will free up time for human workers allowing them to focus more on activities to which they bring skills that machines have yet to master. This could make work harder to organise, more complex, and would require spending more time on coaching (Manyika et al, 2017, p. 114). A broad debate on the challenges and features of the collaboration between humans and robots is discussed under the term human-robot-interaction (HRI) (for an overview of this debate see Moniz and Krings, 2016; Sheridan, 2016). Collaborative robots raise new questions and challenges entailing an adaptation of workplace design and organisational models, mostly in terms of increased complexity of decision-making. Robotic systems in manufacturing, for example, raise the question of how to integrate the organisation of complex tasks with several workers in different workstations. The chance that an existing production model will continue to be used after the introduction of robots is very high, since system developers often only provide technical solutions, but no organisational solutions.

2.5.Electric System For Automation

Gilberto P. Azevedo [1] et al explains in the software development area, as in most fields of the computer industry, new technologies are trumpeted as revolutionary solutions almost daily, just to disappear silently some time later. This was not the case with open-architecture energy management systems (EMS). About 10 years after their conception, they have proven to be a successful technological approach. But this does not mean that all problems have been solved; in fact, this is a dynamic research area, in continuous evolution and still raising challenges for the near future.

G. L. Kusic et al describes the Transmission line equivalent circuit parameters are often 25% to 30% in error compared to values measured by the SCADA system. These errors cause the economic dispatch to be wrong, and lead to increased costs or incorrect billing. The parameter errors also affect contingency analysis, short circuit analysis; distance relaying, machine stability calculations, transmission planning, and State Estimator Analysis. An economic example is used to demonstrate the affect of transmission line errors. SCADA measurements from several utilities are used to compute the 'real world' value of the transmission line parameters. State Estimation with the estimated parameters is compared to the computations using the theoretical values.

Zhihong Liu et al describes To sump up, the power distribution automatic system in the Yangjiaping Power Supply Bureau builds a "digital network" by utilizing advanced computer technology. It can be used for realtime and direct mastery of the information of power network system and assisting personnel in service management and decision, for the purpose of performing effective and scientific management for power network, improving management quality and operating efficiency, reducing operation cost and ensuring the reliability of power supply. Stanley. A. Klein explains addresses development of an opensource toolkit for constructing secure, next generation (based on IEC-61850 and related standards), and SCADA systems for control of electric power transmission, distribution, and distributed generation. The toolkit will include basic SCADA and control center components. It can be used in a variety of ways such as building a starter SCADA for small utilities, providing local control at a distributed generation facility, and others.

S. M. Dragojlovic et al describes the Very minor number of the information system for power distribution on south-east Europe and underdeveloped countries has technical information system, business information system; geographic information system, billing system and accounting system unite into unique information system. Working on developing into this power distribution system is very hard; they have small information for their system. Our information system can be solution for many power distribution systems.

Amit Aggarwal describes need for a Smart Grid if we were to deliver on the requirements of electric generation, distribution, and usage in the future. We have shown that Smart Grids build on the technologies of sensing, communication, and control. We have postulated a medium size distribution network and computed the bandwidth requirements of the communication facilities in the grid. Based on the assumptions we have used, we can already foresee needs for communicating at 100Mbps and above even for a moderate size distribution system.

Zhaoxia Xie explains the Analysis of 162 disturbances from 1979 to 1995 reported by the North American Electric Reliability Council (NERC) indicates the importance of information systems under the regulated and competitive environment. This paper points out the major deficiencies in current communication and information systems and proposes new power system information architecture aimed at correcting these deficiencies. The proposed architecture includes automation and control systems at all levels, from substation control system to independent system operator (ISO) operating center, taking into account the requirements of real-time data, security, availability, scalability, and appropriate Quality of Service (QoS). It uses multiple communication channels employing a wide variety of technologies to transmit real-time operating data and control signals.

2.5.1. Sensors used in automation:-

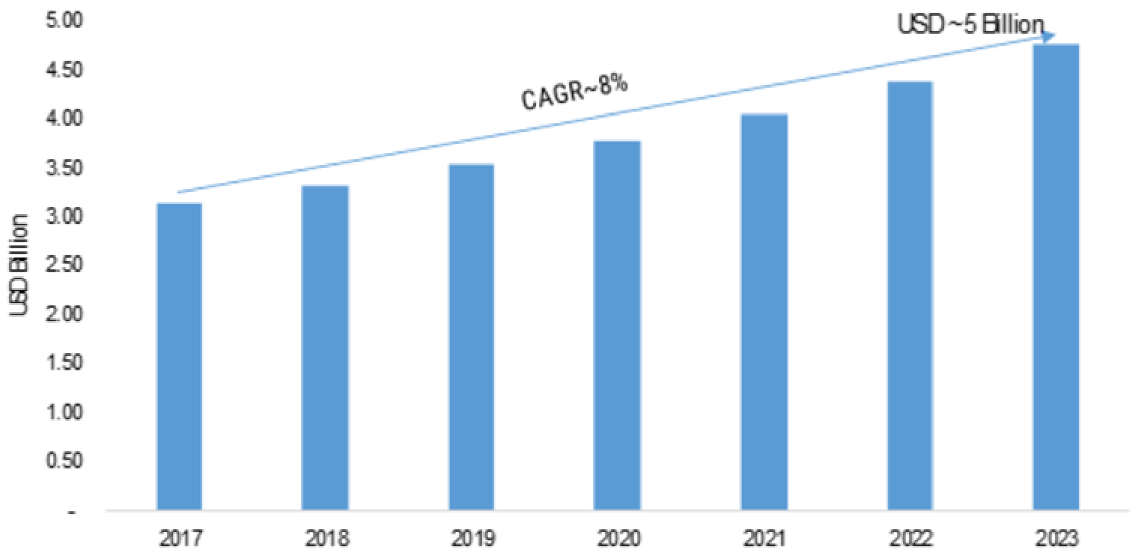

Fig. 2.2. Adoption of pneumatic system

2.5.2. Intelligent Systems and Wireless Sensor Networks –

In Bhavana Narain, Vinod Patle et al., described the use of wireless sensor networks which are widely seen in the fields of target detection and tracking, environmental monitoring, industrial process monitoring, and tactical systems. In wireless sensor network nodes works with an incomplete power source, energy efficient operations in an important factor of the nodes in wireless sensor network. Energy conservation plays an important role in different layers of the TCP/IP protocol suit, and for MAC layer it is the effective part. Therefore, to work in wireless communicating sensors network, they used MAC protocol which improved energy efficiency by increasing sleep duration, decreasing idle listening and overhearing, and eliminating hidden terminal problem or collision of packets. In this paper in the first section they described the accessible energy– efficient MAC protocols for sensor networks their energy saving method. In Second section they discussed the architecture of same protocols and then compared the same protocols depending on their advantages and disadvantages.

2.5.3. Based Sensor Network-

IEEE 802.15.4 is a standard which enables low-rate wireless personal area networks. It allows devices to communicate within short range without expecting any infrastructure. The devices interact with each other within simple wireless network. When this network concept is compared with standard OSI layer, it can be defined as lower layers of OSI protocol. It is interacted with upper layer through IEEE 802.2 logical link control. IEEE 802.15.4 consists of two layers MAC and physical layer. The physical layer is the first layer in standard OSI reference model. It provides data transformation service, maintains the databases and allows access to all layers management function. MAC layer allows transmission of MAC frames through physical channel. Apart from this, it provides access control to the physical channel and network beaconing.

2.5.4. Pressure Sensors-

In Alan Branzel, Patrick Baudisch et al.,explored how to track people and furniture based on a high-resolution pressure-sensitive floor. Gravity pushes people and objects against the floor, causing them to leave imprints of pressure distributions across the surface. While the sensor is limited to sensing direct contact with the surface, they sometimes concluded what takes place above the surface, such as users' poses or collisions with virtual objects. They demonstrated how to extend the range of this approach by sensing through passive furniture that propagates pressure to the floor. To explore their approach, they created an 8 m2 back-projected floor prototype, termed Gravity Space, a set of passive touch-sensitive furniture, as well as algorithms for identifying users, furniture, and poses. Pressure-based sensing on the floor offers four potential benefits over camera based solutions: (1) it provides consistent coverage of rooms wall-to-wall, (2) is less susceptible to occlusion between users, (3) allows for the use of simpler recognition algorithms, and (4) intrudes less on users' privacy. please purchase.

2.5.5. Motion / Proximity Sensor

In Chien-Hui, Charles H.P. Wen et al., discussed the recent, fall detection has become a popular research topic to take care of the increasing aging population. Many previous works used cameras, accelerometers and gyroscopes as sensor devices to collect motion data of human beings and then to distinguish falls from other normal behaviours of human beings. However, these techniques encountered some challenges such as privacy, accuracy, convenience and data-processing time. In this paper, a motion sensor which is compressed motion data is split into skeleton points effectively meanwhile providing privacy and convenience are chosen as the sensor devices for detecting falls. Furthermore, to achieve high accuracy of fall detection, support vector machine (SVM) is employed in the proposed cloud system. Experimental results showed that, under the best setting, the accuracy of our fall-detection SVM model can be greater than 99.90 %. In addition, the detection time of falls only takes less than 10^{-3} s. Therefore, the proposed SVM-based cloud system with motion sensors successfully enables fall detection at real time with high accuracy.

2.5.6. Radio Frequency Identification Sensors

In Manasee Patil and S.R.N. Reddy, states the Wireless Sensor Network (WSN) is most widely used wireless technology in different applications. Home automation makes day to day life of people easier .WSN provides flexible management of lighting, heating, cooling and security from anywhere in the home/office [20]. In this paper, they proposed the use of both wired and wireless technology for home/office automation. RFID technology is used for automatic door opening & closing. They also proposed the use of wireless sensor network for temperature, lighting, smoke detection and automatic door opening & closing. GSM technology is used in this project to monitor and control various devices from outside the home/office.

2.5.7. Vibration Sensors

In Jasodha J, Natarajan A et al., discussed a wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to cooperatively pass their data through the network to a main location. There is a growing interest in the wireless sensor network technology in the home automation field, but as the number of sensor nodes in the home increases and as the data traffic generated by such nodes grows, the network becomes more congested. Due to resource constraints, a congestion control scheme for wireless sensor network is designed with simplicity and energy efficiently. In the existing system, ADCC(Adaptive Duty-cycle Based Congestion Control), a lightweight congestion control scheme using duty-cycle adjustment for wireless sensor networks was used. This scheme uses both the resource control and traffic control approaches according to the amount of network traffic for the congestion avoidance. In this proposed work, improved energy efficiency with congestion control scheme is implemented for Home Automation Network (HAN) with wireless sensor network (WSN). The Improvement is made on Adaptive Duty-cycle Based Congestion Control (ADCC) scheme. The deployment of Improved ADCC involves the aggregation of incoming traffic and node's channel capacity variation.

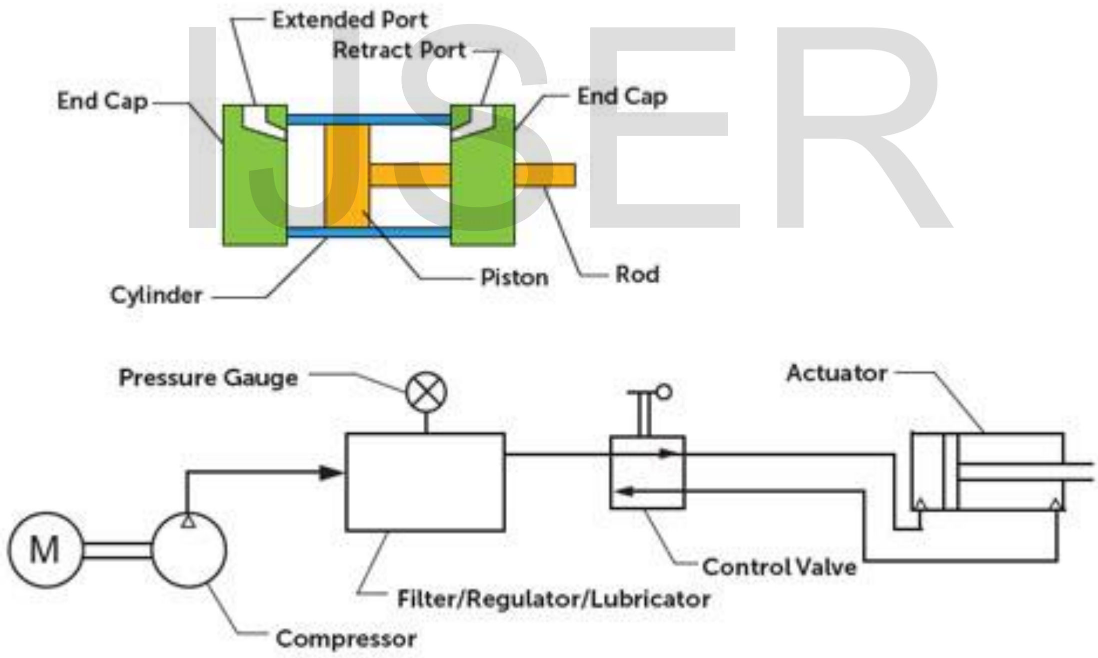

Fig.2.3. working principle of pneumatics system

CHAPTER 3: DESIGN OF AUTOMATION

3.1. Components of Automation

3.1.1. Mechanical components-

1)GRIPER-

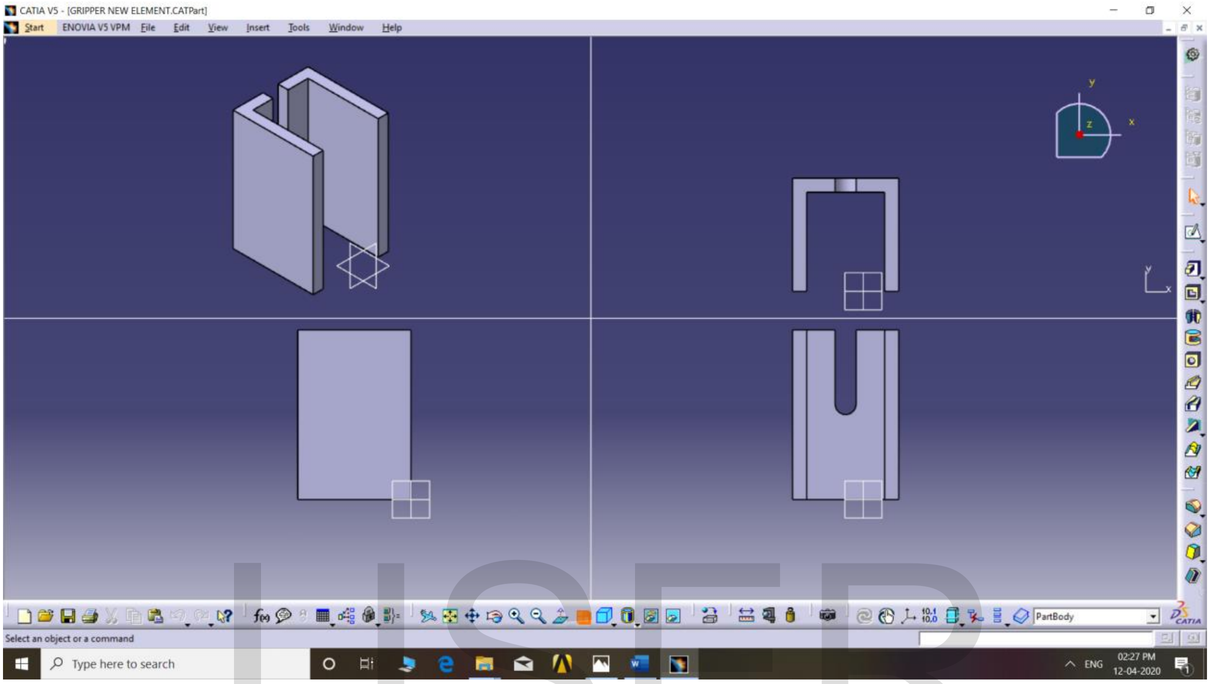

Fig. 3.1. Gripper

Function-

1) Griper is the First component of our automation which is been used for picking of the product from the mould of the moulding machine.

2) holding it to put on the WPF inserting table.

3) This component is made from aluminium to be lightweight in construction and a vertical slot is provided on the back side of the Griper.

4)for holding the component in the griper there is provision of a pneumatic actuator for holding the component gently.

Construction-

1)This component is made up of Aluminium.

2)The basic dimensions Are 80X75X120 mm according to size of component.

3)The dept of cut of the gripper to adjust the runner of the product is 60 mm from the top.

4)Internal size is 55mm to hold the component

5)Pneumatic actuator is attached from left side of the gripper.

2)GRIPER HOLDING ARM –

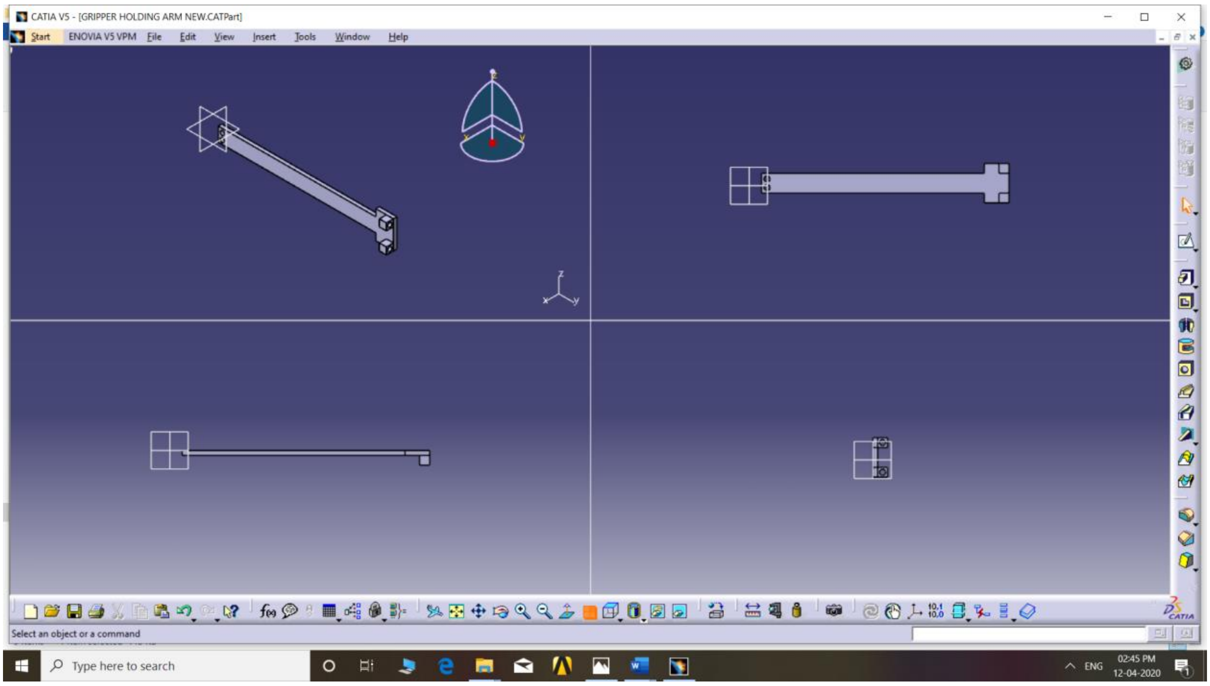

Fig.3.2. Gripper holding arm

Function-

1)the main function of the holding is to hold the griper and to extend from the safety window of the machine up to the mould of the machine.

2) And to came bake to the original position.

3)Next function is to remove the runner of the of the product by moving down the runner is get removed by the cutter.

4) Then to bring the product to the magazine to insert WPF.

Construction-

1)The component is made up of aluminium for better operation and lightweight property of it.

2)The total length of the product is 1000mm. and the maximum height of the product is product from rear end is 160mm and from the front end is 80mm.

3)to hold this product in vertical and horizontal arm properly there where hinge holes are provided at rear end of it.

4) To hold the griper the front end is drilled with 4 holes.

3) HORIZONTAL RESTING ARM-

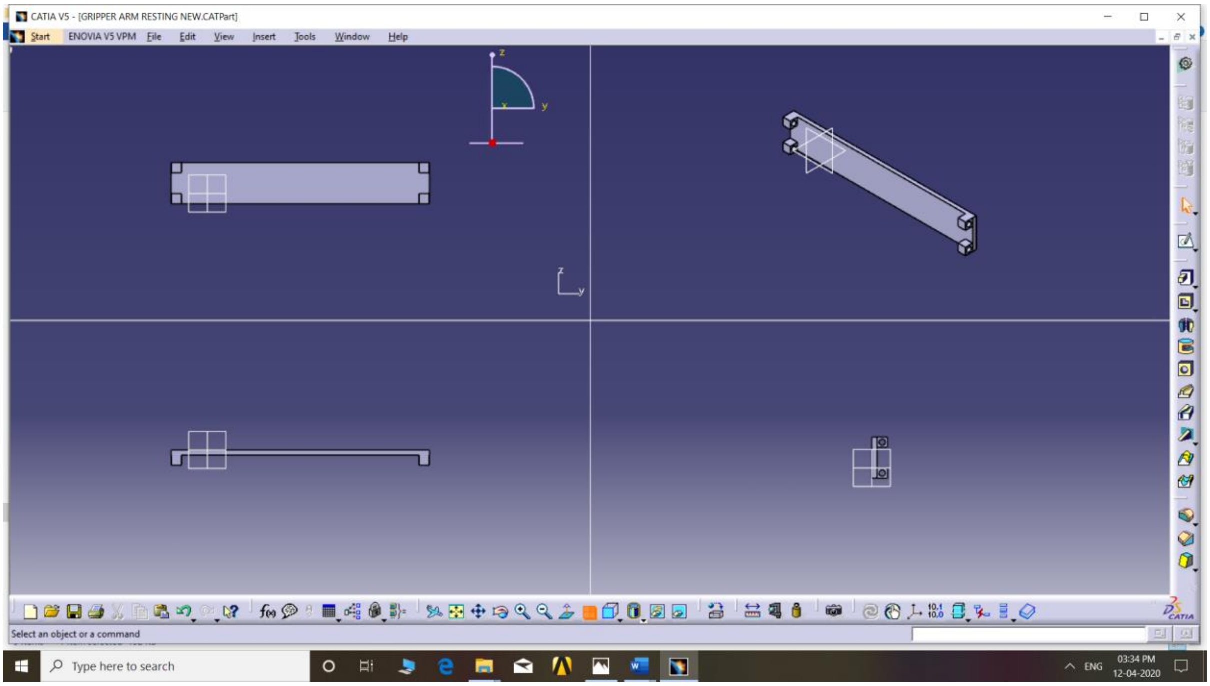

Fig.3.3. Horizontal Resting Arm

Function-

1)The main function of the griper resting arm is to provide resting for holding arm and transfer the motion of forward and backward direction to the gripper to complete the work.

2)There is a one servo motor is provided for movement of the griper in forward and backward direction.

3)But whole assembly of griper, griper arm and griper resting arm is moved downward and upward by another servo motor which is attached to the vertical resting arm.

Construction-

1)This component is made up of steel for better life and heavy function of the movements and load caring capacity.

2)The total length of the component is 1000mm. and height of it is 160mm.

3)there are 4 hinged to hold the rod from front side. And 4 hinges to hold the rod from the rare side.

4) VERTICAL RESTING ARM-

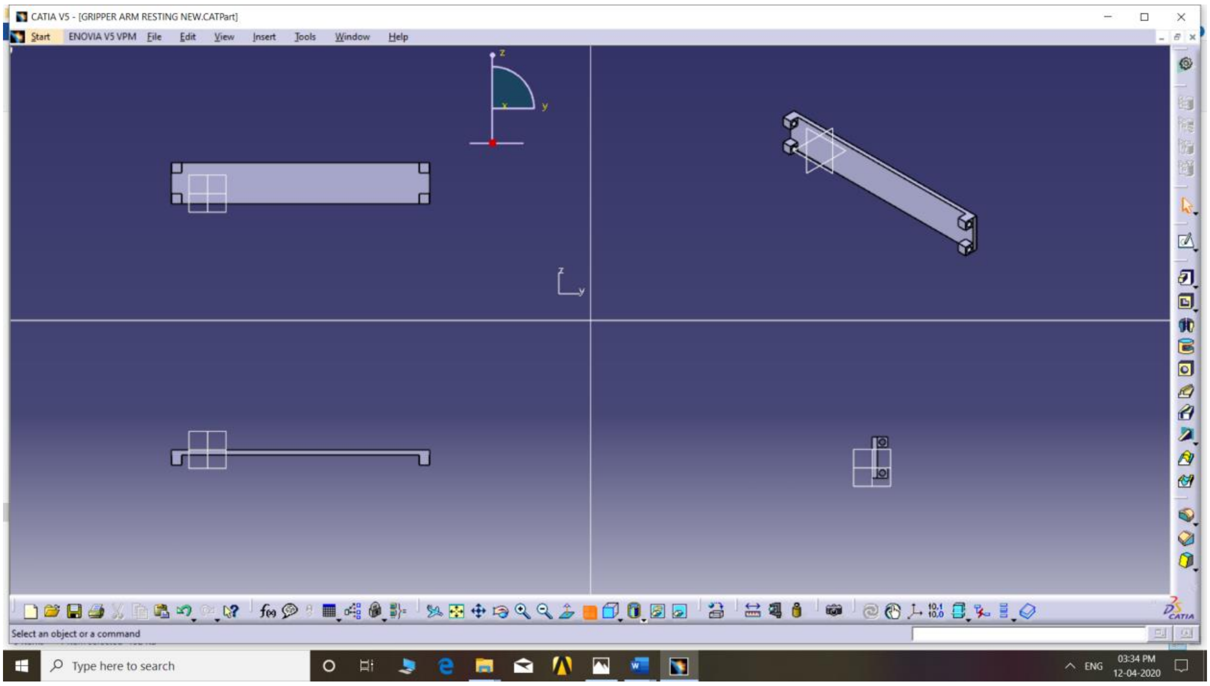

Fig.3.4. Vertical Resting Arm

Function-

1)The main function of this component to support the horizontal resting arm and whole assembly of the horizontal resting arm.

2)The next function of the component to provide the upward and downward movement to horizontal resting arm.

3)Whole load of the all components with horizontal resting arm is on this component hence this was made stronger.

Construction-

1)The component is made up of steel to provide an strong support to the automation.

2)The dimension of the product are 1000mm in length. 160mm in height and 10mm in thickness.

5) MAGZINE-

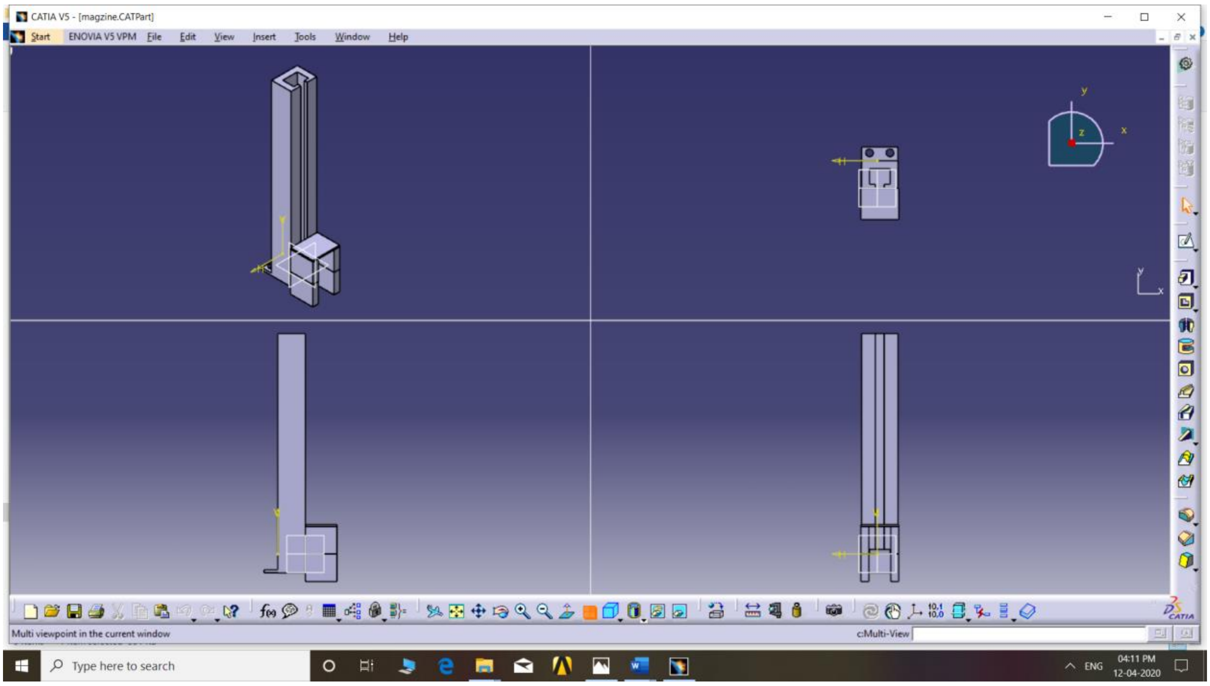

Fig.3.5. Magazine

Function-

1)The main function of the component is to hold the WPF and insert them into the CS53697 product of the moulding machine.

2)This component was resting on the base of the automation. The magazine holds 50 WPF at one time installation.

3)There is one pneumatic actuator attached to push the WPF in to machine product.

Construction-

The magazine was made up of aluminium due the low weight. And attached to the base bed of the automation unit.

The total height of the magazine is 565mm and width is 70 mm and breath is 60 mm.

there is an attachment of pneumatic actuator to the magazine for inserting the WPF into the machine component.

3.2. Pneumatic components

- **Actuators-**

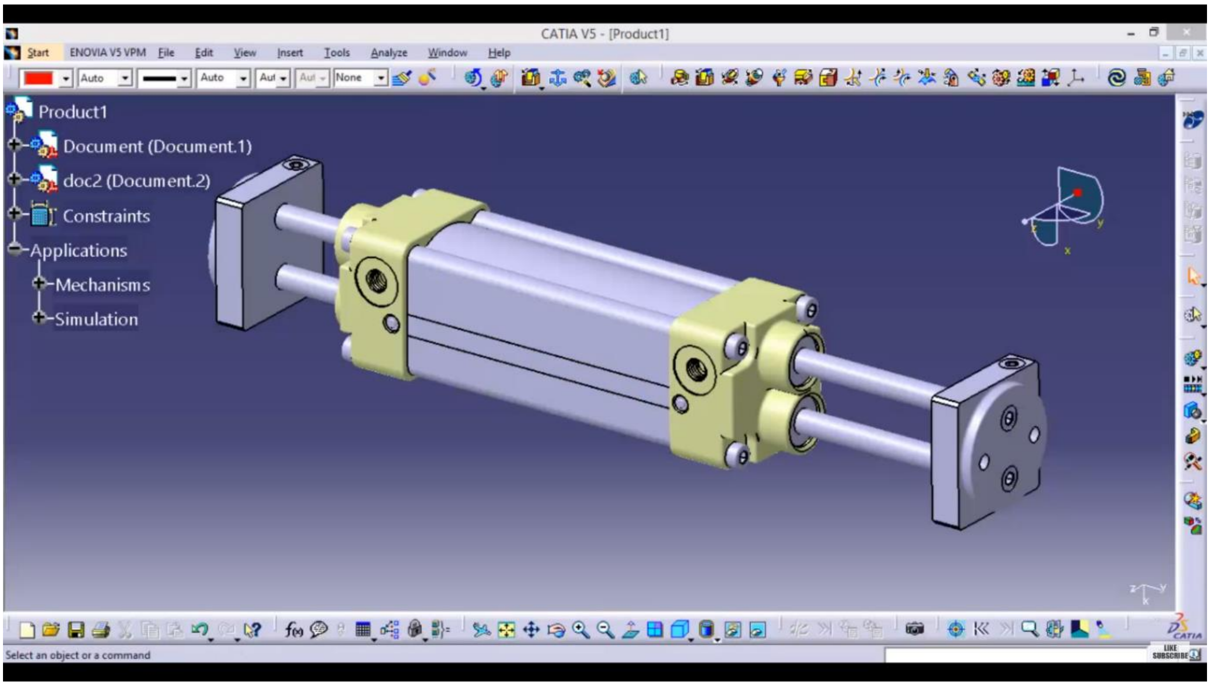

Fig.3.6. Actuators

Function-

1) There are 3 pneumatic actuators used in this project and all these three actuators have different working application they are as following-

   - First actuator (diaphragm type)- this actuator was used in the griper to hold the component which was taken from the mould the main reason behind using diaphragm type of actuator is that it is small in size and it apply very small pressure on the component that why this type of actuators was used to avoid the damage to the component.

   - Second actuator (double acting cylinder)- this actuator was installed to the magazine at the bottom side to insert the WPF into the component. This was a little large in size than the diaphragm type. And more intensive than the first one because to insert WPF it requires more pressure.

   - Third actuator (double acting cylinder)-this actuator was used for pushing the component on the conveyor belt after completion of inserting WPF into the machine component.

   - All this three actuator are operated with solenoid controlled valves which are connected to the microprocessor.

Construction-

- Actuator consist of 2 ports one is inlet port and another is outlet port when injection from one port is in process at the same time another port is act an open valve.
- In our automation the diaphragm type of actuator which was use to grip the component was the smallest in construction and have low intensive pressure.
- Other two actuators are same in design and construction because they are the double acting cylinders.

❖ **Hoses-**

Fig.3.7. Hoses

Function-

- The main function of pneumatic hose is to supply the compressed air the all pneumatic components of the system.
- Fitting elements of pneumatic system are leak prof which helps to maintain a suitable pressure inside the system and help to improve the efficiency of the system.

Construction-

- These hoses are made from a rubber which was of high grade to sustain long life and the fitting components are made from the stainless steel.

3.3. Electric components

❖ Microcontroller-

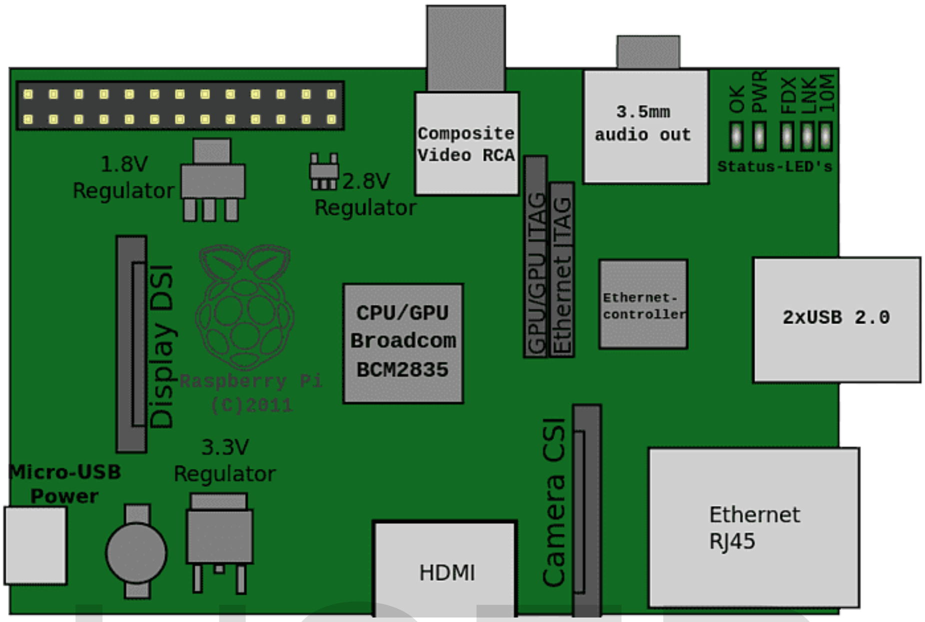

Fig. 3.8. Raspberry pi Microcontroller

Function-

This is a microcontroller which was named a Raspberry pi. Which is most efficient microcontroller with all the latest function compared to all old microcontrollers. The main function of the pi is to control all electrical sensors and electrical equipment's like servomotors, add on, conveyor unit motors, pneumatic solenoids etc. This will act like a brain to the all components of automation all components are get operated by the microcontroller.

All connections of sensors and actuator solenoid are connected by wires to the microcontroller in different pins. Controller have its own memory to store the program due to which all the functions are get operated the language of this controller was python language which is most advance language in computer languages.

The principle in which the project is based is fairly simple. First, the sent SMS is stored and polled from the receiver mobile station and then the required control signal is generated and sent to the intermediate hardware that we have designed according to the command received in form of the sent message. A microcontroller-based system has been proposed for our project. The proposed approach for designing this system is to implement a microcontroller-based control module that receives its instructions and command from a cellular phone over the GSM network. The microcontroller then will carry out the issued commands and then communicate the status of a given appliance or device back to the cellular phone.

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Sensors-

Linear Position Sensor:

This plays an important role in the automation control, where accurate (precision) positioning is required. It measures the linear position of a device. A very good example of this type of sensor is the Linear variable differential transformer (also known as LVDT). It is a type of transformer that is used to sense and measure linear displacement.

Fig. 3.9. Linear Position Sensor

Angular Position Sensor:

This sensor often referred to as a rotary sensor calculates the orientation of an object with respect to a specific reference position as has been expressed by the amount of rotation necessary to change from one rotation to the other about a specific axis. It measures the relation established by any position with respect to any other position. These are used, where long term reliability is required.

Fig.3.10. Angular Position Sensor

Whereas based on the sensing principles used, the position sensors can be classified into different categories.

Potentiometric position sensors:

These use resistive effect as the sensing principle. It is wear-free as these do not have any contacting parts. In these types of sensors, the position marker is attached to the moving part of the application, whose position needs to be measured. The sensing element is a resistive or a conductive track, where a wiper (for example) is attached to the part of the device, whose displacement has to be measured. The wiper remains in contact with the track. As the device moves, the wiper also moves and the resistance between one end point of the track and the wiper changes. This makes resistance a function of the wiper position. In this, the change in resistance per unit change in wiper position is linear. The ease to use these sensors makes them advantageous.

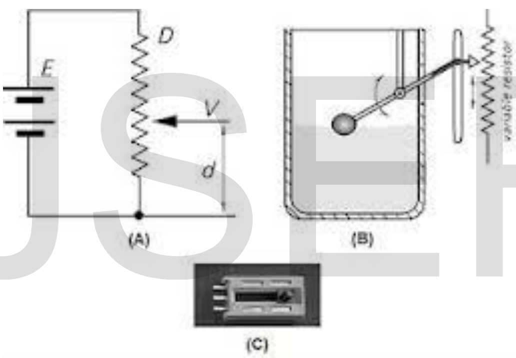


Fig. 1. (A) Potentiometer as a position sensor; (B) gravitational fluid level sensor with a float; (C) linear potentiometer.

Fig.3.11. Potentiometric position sensors

Capacitive displacement sensors:

These are based on the principle of ideal plate type capacitors, where the moving object is attached to the dielectric or to the plates of the capacitor to generate the changes in the capacitance. These are the devices that are capable of high-resolution measurement of the position or the change of position of any conductive target. These can also measure the density or the thickness of non-conductive material. These types of sensors are found in manufacturing and machining facilities all around the world. It is used in the precision positioning of objects at the nano meter level and in the measurement of precision thickness of disk drives, assembly line testing and machine tool metrology. It is widely used in machining.

Servomotor-

Fig. 3.12. Servomotor

The function of the servo motor is to receive a control signal that represents a desired output position of the servo shaft and apply power to its DC motor until its shaft turns to that position.

It uses the position sensing device to figure out the rotational position of the shaft, so it knows which way the motor must turn to move the shaft to the instructed position. The shaft commonly does not rotate freely around similar to a DC motor, however rather can just turn 200 degrees. From the position of the rotor, a rotating magnetic field is created to efficiently generate toque. Current flows in the winding to create a rotating magnetic field. The shaft transmits the motor output power. The load is driven through the transfer mechanism. A high-function rare earth or other permanent magnet is positioned externally to the shaft. The optical encoder always watches the number of rotations and the position of the shaft.

Working of a Servo Motor

The Servo Motor basically consists of a DC Motor, a Gear system, a position sensor and a control circuit. The DC motors get powered from a battery and run at high speed and low torque. The Gear and shaft assembly connected to the DC motors lower this speed into sufficient speed and higher torque. The position sensor senses the position of the shaft from its definite position and feeds the information to the control circuit. The control circuit accordingly decodes the signals from the position sensor and compares the actual position of the motors with the desired position and accordingly controls the direction of rotation of the DC motor to get the required position. The Servo Motor generally requires DC supply of 4.8V to 6 V.

3.4. Calculations

- Magazine cylinder-

1. Stroke length and distance to which load has to moved
2. Magazine cylinder=50mm
3. Pressure=0.4bar
4. Cylinder time=2sec.

- Design
    1. Stroke length(S)=20mm
    2. Cycle time(t)=2sec
    3. Pressure(P)=0.4bar

    Velocity(v)=$\frac{stroke\ length}{time\ required}$ =$\frac{120}{2}$=$\frac{mm}{sec}$

    =10mm/sec.

- Acceleration

S=(μ×t)+($\frac{1}{2}$×a×t^2)

20=(0×2)+($\frac{1}{2}$×a×2^2)

=0.5×a×4

20=2a

a=$\frac{20}{2}$

a=10mm/sec^2

a=0.001mm/sec^2.

- Total force required(F)

1.To move the load.

2.To overcome the friction.

F=ma+μ×w

=0×0.010+0.15×9.81×a^3

F=0.44445N.

Pressure=$\frac{force}{area}$

pressure=0.4bar =0.4×$10^{-5}m^2$

- Weight of job =300gram

  =$\frac{300}{1000}$ =0.3kg

  F=0.44445N

  Pressure=$\frac{Force}{Area}$

  0.4×10^{-5}=$\frac{0.44445}{\frac{\pi}{4}\times d^2}$

  d^2=$\frac{0.44445\times4}{\pi\times0.4\times10^5}$

  d=$\frac{\sqrt{0.44445\times4}}{\pi\times0.4\times10^5}$

  =$\sqrt{33953.266}$

d=184.26m

d=20mm

- Vertical arm cylinder=50×10=500mm

  1.Stroke length(S)=500mm

  2.Cycle time=18sec

  3.pressure=0.4bar

  Acceleration(a):-

  S={(μ×t)+($\frac{1}{2}$×a×t^2)]

  500=0×18{($\frac{1}{2}$×9×18^2)}

  500=1629

  A=$\frac{500}{162}$ =81000mm/sec^2

a=81m/sec^2

For=gripper arm=400m×10=400mm

(s)=400m

t=15

p=0.4bar=0.4×10^5

Acceleration=

S=μ×t+$\frac{1}{2}$×a×t^2

400=0×15+$\frac{1}{2}$×9×15^2

400=112.59

$\frac{400}{112.5}$=a

a=3.56mm/sec^2

a=0.00356m/sec^2

- Force required

F=ma+μw

=0.3×0.00356+0.15×0.3×9.81

F=0.4425N

3.5. Description of the Pneumatic Circuit:

- The fig 4.1 shows the hydraulic circuit for the automatic feeding mechanism.
- The circuit of two cylinders namely feeder and magazine cylinder.
- The two-solenoid operated direction control valves DCV-1 and DCV-2 are used for feeder and magazine cylinders respectively.
- The flow control valves FCV-1 and FCV-2 are connected on the return line of feeder cylinder and on forward line of magazine cylinder.
- The three limit switches LS-1, LS-2, LS-3 are located as shown. They are used to limit the movement of cylinders.
- The pressure relief valve which is set at 0.4 bar pressure, a 1.5 HP electric motor, hydraulic pump which is a fixed displacement type internal gear pump and filter are positioned as shown in the circuit.

3.5.1. Sequence of Operations:

1. compressor starts.
2. cylinder extends.
3. Pusher touches LS2.
4. LS 2 sends signal to solenoid x.
5. Direction of DCV 1 changes.
6. magazine cylinder retracts.
7. Pusher touches LS1.
8. LS 1 sends signal to timer.
9. Timer starts and spring operated DCV changes its direction.
10. push cylinder extends.
11. After a set time interval DCV 2 changes its direction.
12. Push cylinder retracts and touches LS3.
13. LS3 sends signal to solenoid-y.
14. Cycle continued.

3.5.2. Working of the pneumatic Circuit:

- Initially when the auto cycle is not started, the position of both the cylinders and direction control valves are shown in fig.
- Now when the compressor is started fluid from the compressor to the system. Note that unless the auto cycle is not started the fluid cannot entered in to the system.

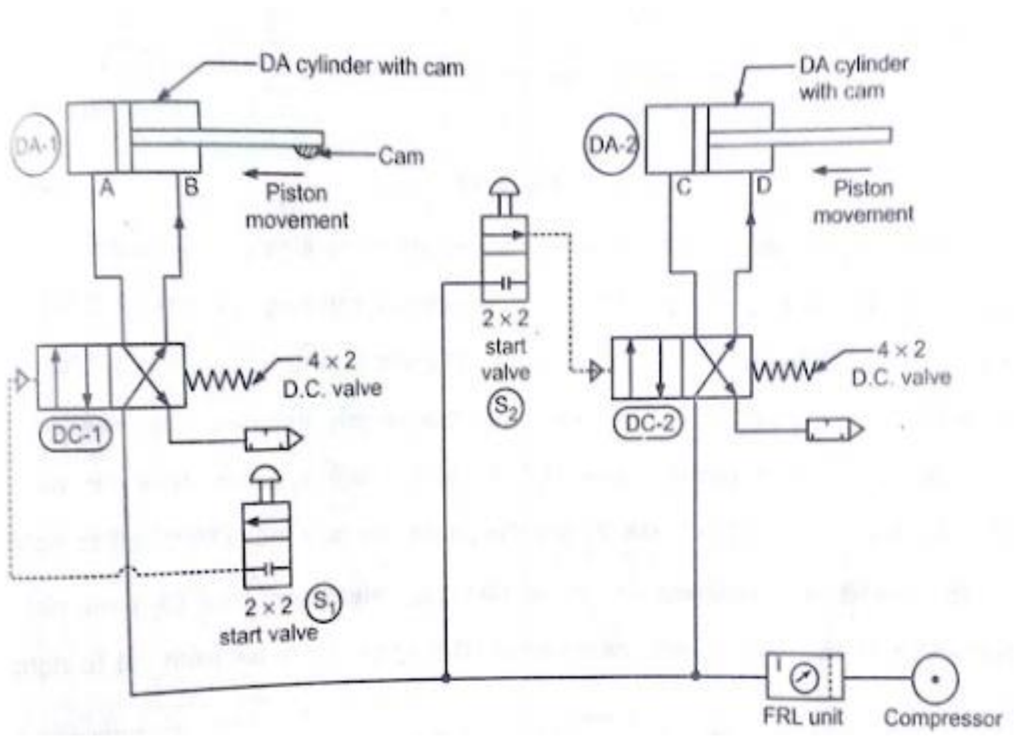
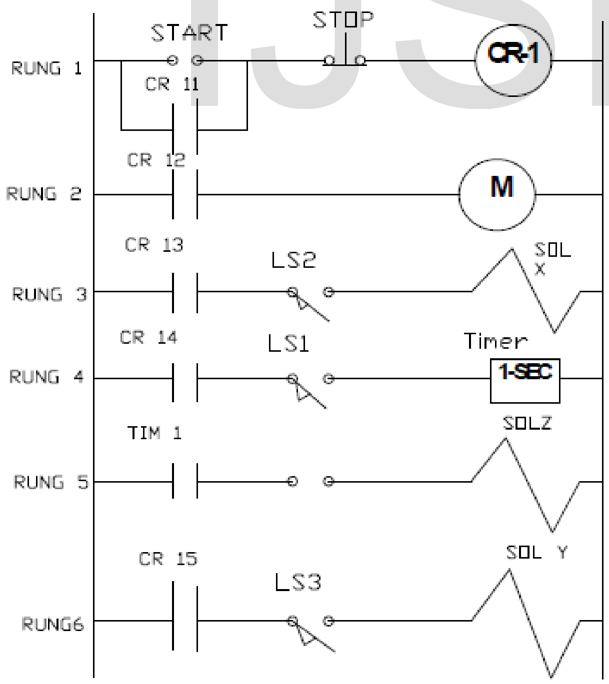


Fig.3.13. Pneumatic Circuit for Automatic Mechanism.

- When the auto cycle is run the fluid from compressor goes toward cylinders through the direction control valves. The fluid flows from DCV-1 to full bore side of magazine cylinder causes the cylinder to extend, and also flows from DCV-2 to annulus side of magazine cylinder which causes the cylinder to remain in retracted position. The fluid at annulus side of feeder cylinder flows through flow control valve FCV-1 to control the speed of extension.
- When magazine cylinder's piston rod reaches to limit switch LS-2 it send the signal to solenoid operated DCV-1 and causes to change its direction. At the same time magazine cylinder remain in the same position.
- Now the fluid from compressor goes to annulus side of magazine cylinder causing it to retract. When fluid flow toward annulus side of feeder cylinder it flows through silencer because of which the quick return of feeder can be achieved.
- When feeder cylinder retracts fully it reaches limit switch LS-1, that sends signal to timer and timer resets for the push cylinder control valve DCV2.
- The solenoid operated direction control valve DCV-2 change its direction for the time set in the timer and return back. Thus magazine cylinder extends and retracts within the time set in timer.
- When magazine retracts it reaches to limit switch LS-3, it sends signal again to direction control valve DCV-1 and cycle will continue.
- When feeder cylinder extends it push a work piece into machine and when magazine cylinder extends and retracts it drops a work piece at the guide way.

3.5.3. Working of the Ladder Circuit:

- As shown in the ladder circuit, in rung 1 start button is normally open and stop button is normally closed. When start button is pushed, contact is closed and coil relay will get energized.
- After CR 1 gets energized contact relays CR11, CR12, CR13, CR14, CR15 are energized.
- When start button is released due to CR11energized flow is continues and CE1 is energized until stop button is not pressed.
- Now in rung 2 CR 12 is energized which causes motor to start and due to this pump flow starts and feeder cylinder extends.
- In rung 3 CR 13 is energized closes LS 2, as LS2 closes solenoid x will get energized and position of DCV changes which causes retraction of feeder cylinder.
- In rung 4 CR 14 gets energized which closes LS1 and signal is sent to timer.
- For the set time DCV 2 changes its position and magazine cylinder extends. After a set time spring operated DCV 2 came to its initial position which causes to retract the cylinder.
- In rung 6, after full retraction of magazine cylinder CR 15 gets energized to closes LS 3. Due to closing of LS 3, solenoid y will get energized which causes DCV to come to its initial position and continues.



Notations:
PB 1-2: Push button.
CR11-15: Control Relay.
SOL: Solenoid.
Tim 1: Timer.

CR1: Coil Relay 1.
M: Motor.
LS 1-3: Limit Switch.

Fig.3.14. Ladder circuit diagram

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CHAPTER 4: MECHANICAL STUCTURE

4.1. MECHANICAL STRUCTURE

The mechanical structure is basically a fixture which is attached directly to the grinding machine. It is made in order to match the centre height. It acts as the man feeding the jobs into the machine.

4.2. AUTOMATION STUCTURE

It is mainly made up of many parts like base, holding table, runner tray, vertical arm, horizontal arm, magazine for WPF, extending arm, gripper holding for gripper. gripper is attached to the extending arm. And the extending arm is attached to the horizontal supporting arm with an servo motor for extending and retracting of the gripper holding arm, supporting horizontal arm is attached to the vertical supporting arm with an servo motor for upward and downward direction and attached to the base bed of the automation. On the other side of the bed magazine was installed for inserting an WPF into the moulded component with help of the pneumatic actuator , beside the magazine a runner tray was installed for collecting the runner and from front side a another actuator is attached for pushing the component on the conveyor belt which was installed Infront of the actuator.

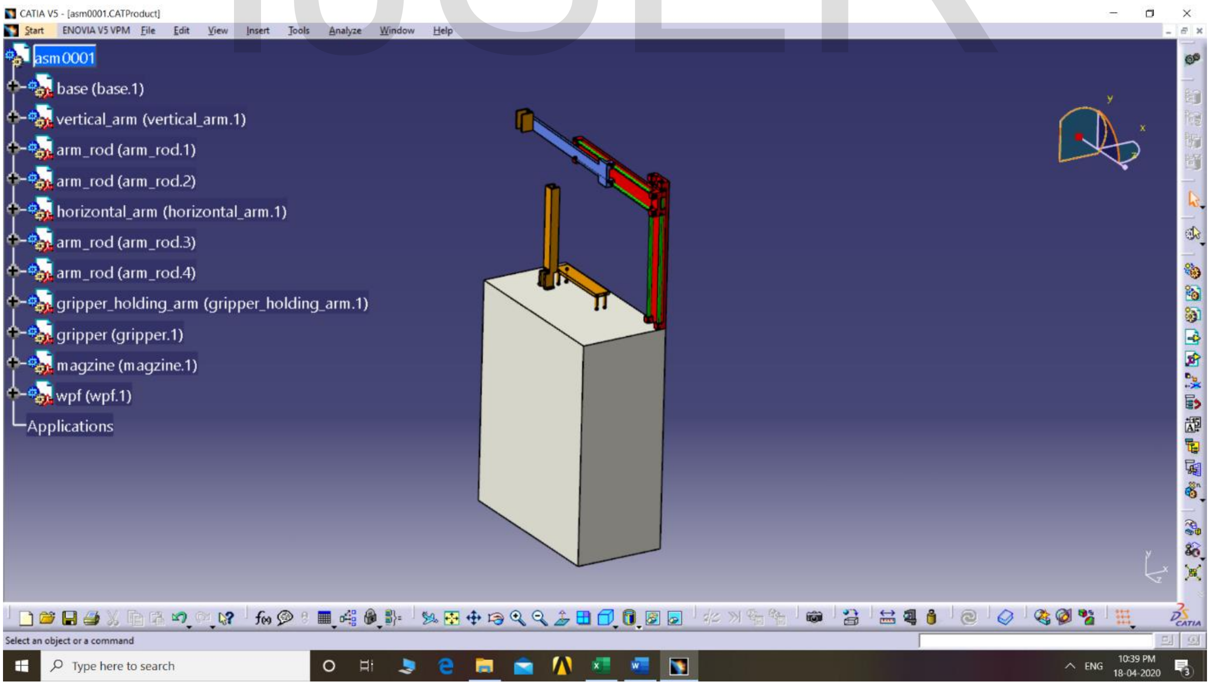

Fig. Automation Structure

4.3. Schematic View

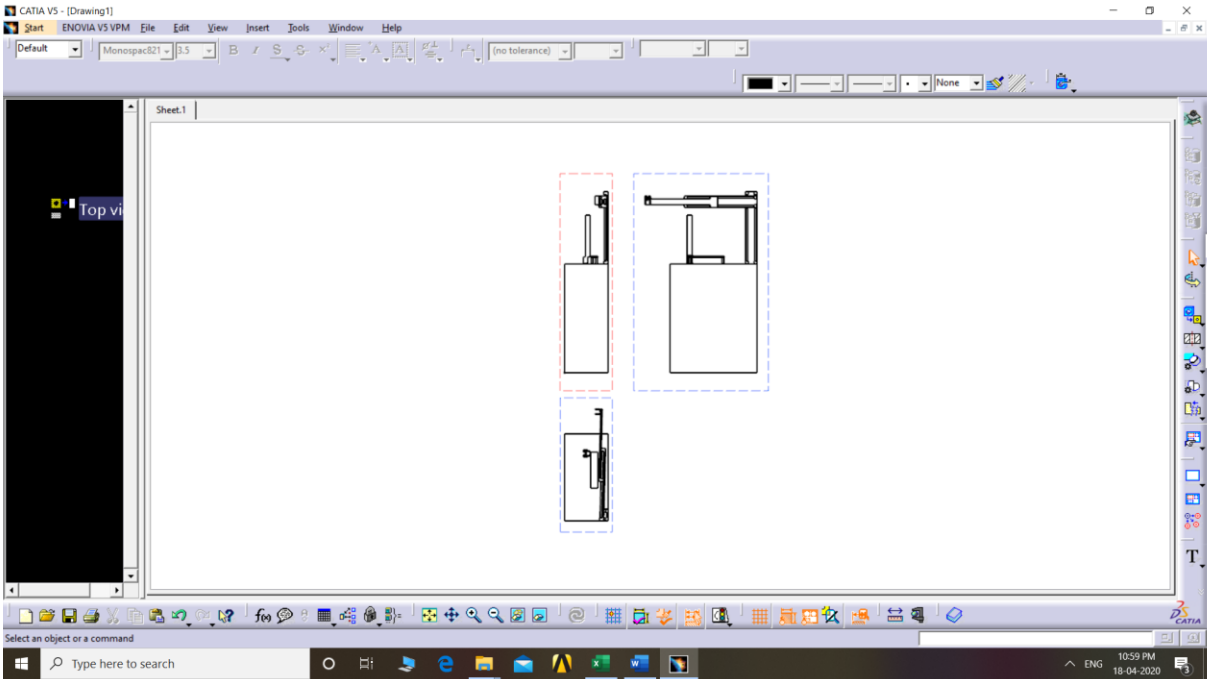

Fig. Schematic Diagram

Above Fig Shows Schematic View Of Assembly In 3 Views like Front view , top View and side view of the automation assembly To Construct the Structure we have used Catia V5 for designing and assembly of the Product we have Followed following Steps to Create an Assembly of Automation:-

1. Open Catia v5 and start to draw an object one by one.
2. Draw all the components one by one in part design.
3. Then save them all.
4. Close the Catia and open again the go to product design.
5. Product design is used to create an assembly of the products.
6. Call parts which we have created and fix them one by one by their position.
7. After fixing colour them by different position.
8. And save the product.

4.4. PROCESS SHEET

GRIPPER

Sr. No	Operation	Machine	Cutting tool	Holding Device	Inspection required
1	Cutting	Power hack-saw	Hack-saw blade	Machine vice	Vernier caliper
2	Milling	Milling machine	End mill cutter(HSS)	Machine vice	Vernier calliper, height gauge
3	Drilling	Drilling machine	Twist drill	Machine vice	Vernier calliper, bore gauge
4	Grinding	Surface grinding.	Grinding wheel	Magnetic chuck	Spirit level, dial gauge
5	Tapping	-	Taps	Bench vice, tap wrench	Thread gauge

Table .4.1 Process Sheet for Gripper

GRIPPER EXTENDING ARM

Sr. No	Operation	Machine	Cutting tool	Holding Device	Inspection required
1	Cutting	Power hack-saw	Hack-saw blade	Machine vice	Vernier calliper
2	Milling	Milling machine	End mill cutter(HSS)	Machine vice	Vernier calliper, height gauge
3	Drilling	Drilling machine	Twist drill	Machine vice	Vernier calliper, bore gauge
4	Grinding	Surface grinding.	Grinding wheel	Magnetic chuck	Spirit level, dial gauge
5	Tapping	-	Taps	Bench vice, tap wrench	Thread gauge

Table.4.2. Process Sheet for gripper extending arm

HORIZONTAL RESTING ARM

Sr. No	Operation	Machine	Cutting tool	Holding Device	Inspection required
1	Cutting	Power hack-saw	Hack-saw blade	Machine vice	Vernier calliper

2	Milling	Milling machine	End mill cutter(HSS)	Machine vice	Vernier calliper, height gauge
3	Drilling	Drilling machine	Twist drill	Machine vice	Vernier calliper, bore gauge
4	Grinding	Surface grinding.	Grinding wheel	Magnetic chuck	Spirit level, dial gauge
5	Tapping	-	Taps	Bench vice, tap wrench	Thread gauge

Table4.3. Process Sheet for horizontal resting arm

VERTICAL SUPPORTING ARM

Sr. No	Operation	Machine	Cutting tool	Holding Device	Inspection required
1	Cutting	Power hack-saw	Hack-saw blade	Machine vice	Vernier calliper
2	Milling	Milling machine	End mill cutter(HSS)	Machine vice	Vernier calliper, height gauge
3	Drilling	Drilling machine	Twist drill	Machine vice	Vernier calliper, bore gauge
4	Grinding	Surface grinding.	Grinding wheel	Magnetic chuck	Spirit level, dial gauge
5	Tapping	-	Taps	Bench vice, tap wrench	Thread gauge

Table4.4. Process Sheet for Vertical Resting Arm

MAGAZINE

Sr. No	Operation	Machine	Cutting tool	Holding Device	Inspection required
1	Cutting	Power hack-saw	Hack-saw blade	Machine vice	Vernier calliper
2	Milling	Milling machine	End mill cutter(HSS)	Machine vice	Vernier calliper, height gauge
3	Drilling	Drilling machine	Twist drill	Machine vice	Vernier calliper, bore gauge
4	Grinding	Surface grinding.	Grinding wheel	Magnetic chuck	Spirit level, dial gauge
5	Tapping	-	Taps	Bench vice, tap wrench	Thread gauge

Table 4.5. Process Sheet for Magazine

CONVAYOR BELT

Sr. No	Operation	Machine	Cutting tool	Holding Device	Inspection required
1	Cutting	Power hack-saw	Hack-saw blade	Machine vice	Vernier calliper
2	Milling	Milling machine	End mill cutter(HSS)	Machine vice	Vernier calliper, height gauge
3	Drilling	Drilling machine	Twist drill	Machine vice	Vernier calliper, bore gauge
4	Grinding	Surface grinding.	Grinding wheel	Magnetic chuck	Spirit level, dial gauge
5	Tapping	-	Taps	Bench vice, tap wrench	Thread gauge

Table 4.6. Process Sheet for Conveyor Belt

CHAPTER 5: IMPLIMENTATION OF AUTOMATION

5.1. IMPLIMENTATION OF AUTOMATION

Effective automation is as much about good business process design as is it is about the robotics. There are multiple factors to consider, including systems use, business impact, Return of investment of labour, and investment. Key factors driving the automation are cost benefits and improved efficiency over manual process handling, Automation results like reduced processing time by about 75% in the processes. Additionally it improved areas like quality to meet standards of more than 99 % .

Automation results in the following benefits: -

Reduced Average Handle Time (Speed).

Quality of the product

Decreased training timeline of operator for inserting WPF

Increased process compliance

Enhanced efficiency

Higher CSAT scores through faster resolution of the cases

5.1.2. There is a total of 5 Steps to Implementing Automation for the WPF

Identify opportunities to automate. First, we visited L&T and studied about the machine the construction and working of the moulding machine and the work of the operator of inserting the WPF to prevent the shrinkage and Identified to what extent we can automate it

Validate the opportunity. Check how adaptable the process is to being automated. Automation can be designed to achieve some quick wins over the manual part which is the more time-consuming repetitive task. In the process that we automated, we noticed that most of the effort of inserting WPF is on the operator that can be completely automated,

Select a Design Model. Select the best model for your requirement. You may need to redesign the process to maximize the scope for automation. In some cases this yields additional benefits. Design the automation plan that suits the business structure. Customize the automation model to suit the process needs. We split the process into three distinct subprocesses: capturing the input, building the right codes, and then updating the systems. While building the right codes is where we need the product build experts, a lot of time was also spent on capturing the input and on updating the systems. In this case, we redesigned the process using automation to capture the inputs. Then our experts-built codes, and automation was used to update the systems. This result was more than a 75% increase in efficiency for this particular process.

Develop the automation plan. It is important to deep dive into the process and identify all exception scenarios. It is best to automate the time-consuming part of the process and then build additional incremental automation. Develop the automation implementation process in phases, keeping in mind all level 3 exception scenarios. Often, it may not be prudent to automate all scenarios, and it is best to try and automate over 75% of the Observe how your plan works and performs in each phase and then start on the next phase.

Deploy the pilot phase. When you develop an automation plan and are ready to implement it, run a pilot project first sow first we ran an animation of our project. This allows you to observe the effectiveness and overall performance of your automation plan with an actual process in real-time. Take the results of the pilot project and make improvements accordingly. Look at the results of the pilot and then include those scenarios that need to be automated and those that can remain an exception. It is good to understand the long-term plan. Sometimes there is a difference in testing and live environment, and so we presented a Power point presentation of for project and explained the measures to take in case of a roll out

Before implementation of automation the process of removing runner, flash removing, inserting WPF, and placing it into tray was done manually which was very time-consuming process each piece would take around 30 seconds and always needed a skilled operator to do.

Fig.6.1. before process

5.3. The following graph compares no of WPF units inserted per shift before and after the implementation of Automation

Method of operation	No. of WPF units inserted per shift
Manually	400
Automation	500

Table.6.1.WPF Insert Per Shift

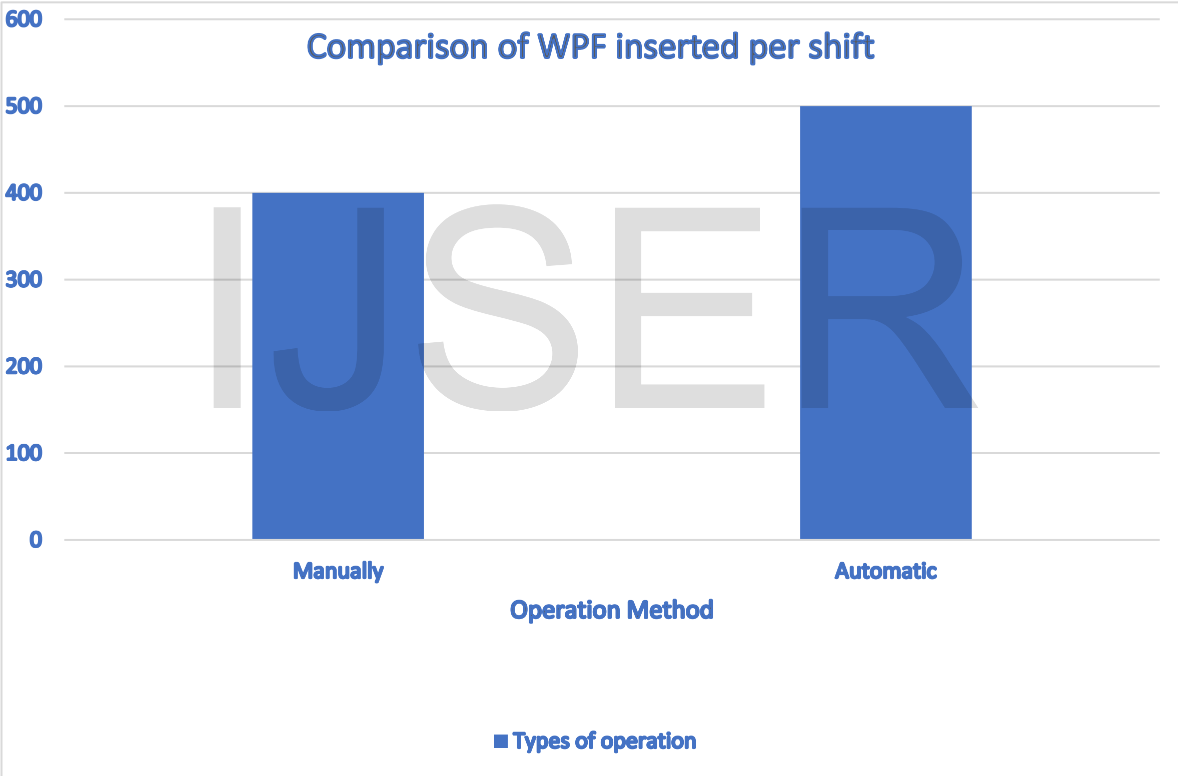

Fig.6.2. graph of operating method

Before implementing the automation, it was a time-consuming process of removing the flash and inserting the WPF which by manual method would take a lot of time and effort by implementing the automation we can totally save time and also increase the production.

5.4. For comparison of no of working hours per day before and after implementation of the Automation

Method of operation	Working hours
Manually	16hrs
Automatic	24 hrs

Table.6.2 Working Hours

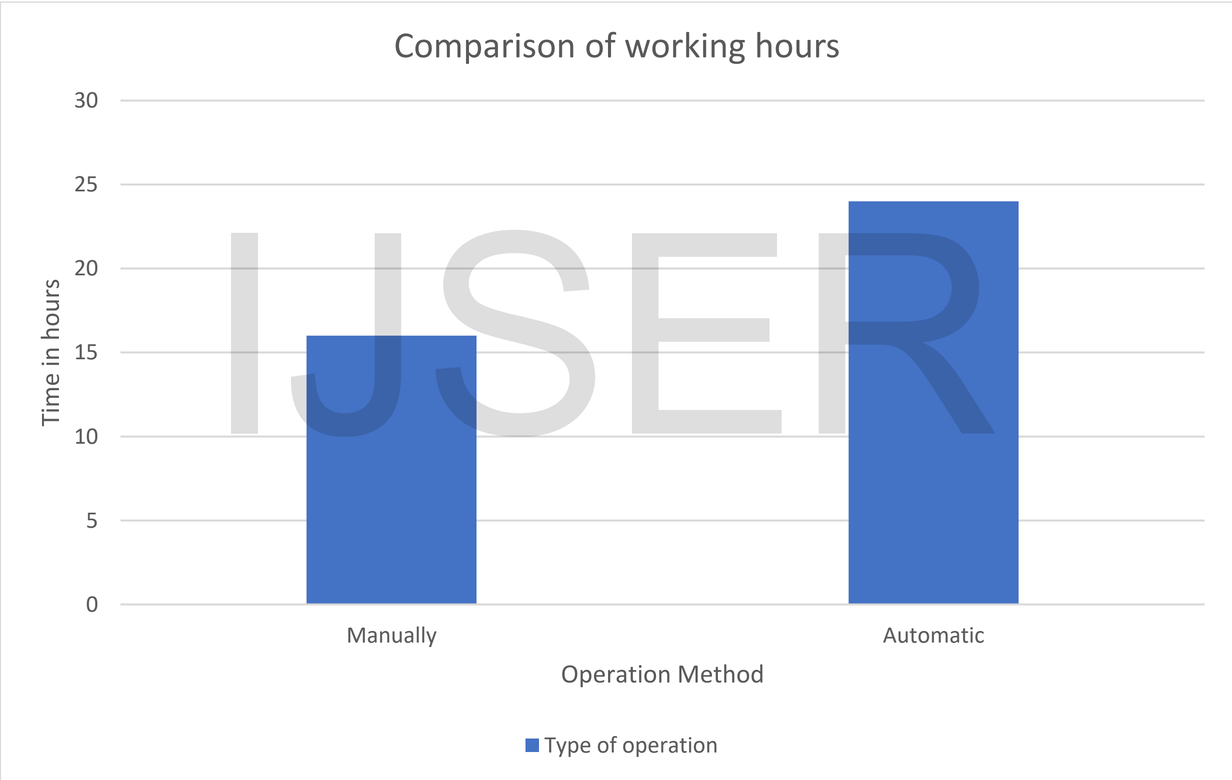

Fig.6.3. graph of operating hours

Before Automation the working hours were 16 i.e. 2 shifts of 8 hours each so two operators were required for the working, So after implementation of the automation the machine can work continuously for 24 hours with proper maintenance thus by implementing the automation we can totally cut off the workers and the labour charges for the workers

5.5. For the comparison of number of defective pieces per 100 pieces before and after the implementation of the automation

Method of operation	No. of parts rejected per 200 pieces
Manually	7
Auto feeding	3

Table.6.3. Defective Pieces

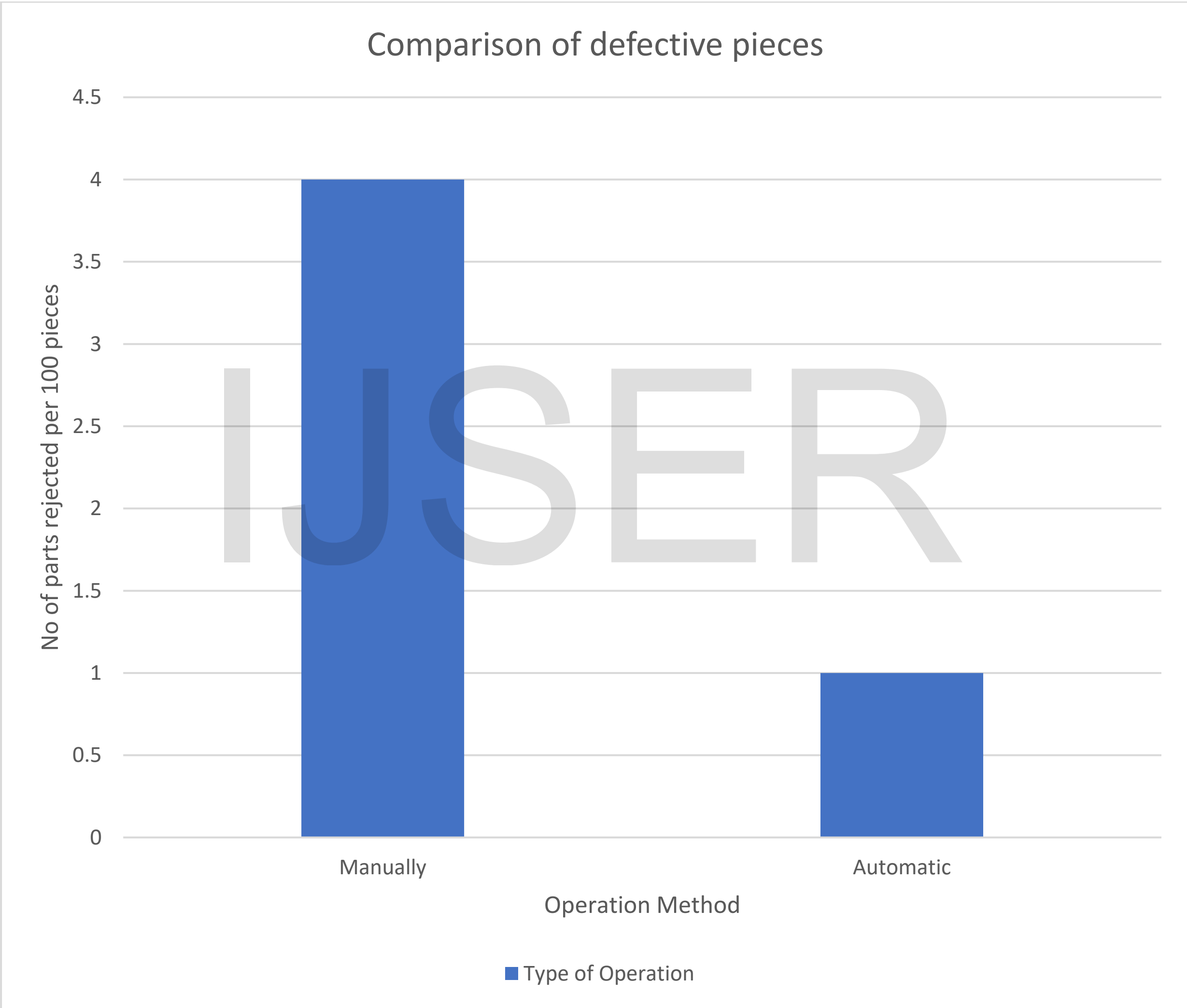

Fig.6.4. graph of Defective pieces

CHAPTER 7: COST ESTIMETION

6.1. Raw material cost:

- Material: M.S., Aluminum
- Mild steel cost: 50 Rs/kg
- Aluminium Cost: 220 Rs/kg
- Total Raw material required: 200 kg
- Total Raw material cost =220X50+50X150

=18500 Rs.

6.2. Labor cost:

6.2.1. Labor cost = machining time X salary of worker per hour X no of workers

= 44 X 50 X 5

= 11000 Rs.

6.3. Machining cost Estimation:

Sr. No.	Process Name	No. Of hours	Rate/hr.	Machining cost
1	Cutting	14	40	560/-
2	Milling	10	80	800/-
3	Drilling	10	40	400/-
4	Grinding	10	60	600/-
Total machining cost				2360/-

Table 7.1: Machining Cost Estimation.

6.4. Components cost

SR, NO,	DESCRIPTION	QTY	UNIT	RATE	AMOUNT
	Rotating Conveyer Assly 1 Mtr :-				
1	Al. sections 40 x 80, 40 x 40, Hardware, & accessories	1	set	42850	42850
2	Gear box & motor 0.5 hp, Buonfiglio make	1	Nos	30000	30000
3	Rubber roller	2	Nos	4200	8400
4	Tensioning Arrangement	1	set	5000	5000
5	SS Plate, MS Plate, & other	1	set	8000	8000
6	Conveyer Belt	1	Nos	4000	4000
7	Assembly charges	1	Nos	15000	15000
	Fix Conveyer Assly 2 Mtr :-				
1	Al. sections 40 x 80, 40 x 40, Hardware, & accessories	1	set	19500	19500
2	Conveyer S.S. Plate & hardware	1	set	8000	8000
3	Assembly charges	1	set	5000	5000
	Air cylinder & Valve				
1	Air cylinder with magnetic & read s/w SMC Make	7	Nos	5200	36400
2	Photo sensors	10	Nos	3000	30000
3	Valve Bank manifold 10 way	1	Nos	10000	10000
4	solenoid coil 24 vdc	10	Nos	3000	30000
5	Air cylinder accessary	1	set	12000	12000
	Electrical Panel				
1	Panel box 400 x 500 x 250	1	Nos	2800	2800
2	PLC FX3U-64MR/ DS, 32DI, 32DO, MITSUBHSHI MAKE	1	Nos	38500	38500

3	SMPS, RELAY CARD, Control transformer, contactors, p.b. etc	1	Nos	23500	23500
4	Control Cable ,power cable, lugs , ferrols, Led push button ,Connectors, tray etc .	1	set	20000	20000
5	PLC programming charges	1	Nos	30000	30000
6	Labour Charges for wiring	1	set	18500	18500
7	Servo Motor	3	Nos	1500	4500
	Total				**401950**

Table.7.2. Component Cost

Total project cost:

Total project cost = Raw material cost + Labour cost + Machining cost + Cost of Components used

= 18500 + 11000 + 2360 + 401950

= 433310 /-

Total project cost = 433310 /-

CHAPTER 7: FUTURE SCOPE

7.1. Cloud Manufacturing

Due to digitalization, virtualization and Industry 4.0, the structure of the manufacturing industry is changing. One result of this development is cloud manufacturing, a new manufacturing paradigm. The number of new literatures related to this topic is increasing tremendously. Therefore, cloud manufacturing degenerates into a collective term, with a wide variety of definitions and research areas emerging. On the one hand, this paper deals with an automated statistical evaluation of the literature on cloud manufacturing. On the other hand, the main research areas of cloud manufacturing are identified by a statistical evaluation of the literature keywords from three selected databases. By means of natural language processing and machine learning methods, the keywords are automatically evaluated and grouped into clusters to obtain the main research areas.

7.2. Industrial Artificial Intelligence for industry

Artificial Intelligence (AI) is a cognitive science with rich research activities in the areas of image processing, natural language processing, robotics, machine learning etc. Historically, Machine Learning and AI have been perceived as black-art techniques and there is often a lack of compelling evidence to convince industry that these techniques will work repeatedly and consistently with a return on investment. At the same time, the performance of machine learning algorithms is highly dependent on a developer's experience and preferences. Hence, the success of AI in industrial applications has been limited. On the contrary, Indus- trial AI is a systematic discipline, which focuses on developing, validating and deploying various machine learning algorithms for industrial applications with sustainable performance. It acts as a systematic methodology and discipline to provide solutions for industrial applications and function as a bridge connecting academic research outcomes in AI to industry practitioners.AI-driven automation has yet to have a quantitatively major impact on productivity growth. Besides present-day industries are facing new challenges in terms of market demand and competition. They are in need of a radical change known as Industry 4.0. Integration of AI with recent emerging technologies such as Indus- trial Internet of Things (IIoT), big data analytics, cloud computing and cyber physical systems will enable operation of industries in a flexible, efficient, and green way. Since Industrial AI is in infancy stage, it is essential to clearly define its structure, methodologies and challenges as a framework for its implementation in industry. To this end, we designed an Industrial AI ecosystem, which covers the essential elements in this space and provides a guideline for better understanding and implementing it. Furthermore, the enabling technologies that an Industrial AI system can be built upon are described. a provides a schematic comparison of the desired system performance of Industrial AI with other learning systems over time.

7.3. Basics of future modification -

- We can add a feedback system so that it can work smoothly according to the output achieved any variation in the output can be sensed and accordingly input will be given
- By adding IIOT we can operate the system by using smartphones or laptops from anywhere and also secure it with a password to prevent unauthorized users from operating it
- Further we can use PLC (Programmable Logic Controller). It will have a program which will select optimum speed to give desired quality within tolerance limit and feed rate for variable size of WPF.

CHAPTER 8: SAFTY AND ENVOIRMENT

8.1. Safety and Health

- Factor-oriented activities to eliminate factors thoroughly and Results-oriented activities with analyzing what has happened
- Eliminate of Unsafe Condition and Unsafe Behavior
- The experience of Close Calls (Near Accident) to eliminate potential risks
- KYT (Kiken Yochi Training/ Risk forecast Training) and KYK (Kiken Yochi Katudou)
- Inherent Safety: Fail safe and Fool proof (Poka-yoke)
- Objectives and Types of Safety Inspection: Regular Inspection based on laws, Daily inspection done by the work manager or by a person instructed to do so, Special Inspection
- Work Safety: Warring protective gear, Managing protective gear, Scaffolding for work at a height, Safety on non-stationary production-related work
- General Safety Measures in Using Machine tools
- Safety Items regarding work on Electrical Equipment; Electric Shock, SAC Arc Welding Machines
- Safety Regarding Carrying Equipment; Cranes, Slinging, Hoists
- Safety Patrol

8.2. The safety Program-

No company can survive and prosper without Health and Safety in the workplace

People work to pursue happiness, and they must never be allowed to suffer the greatest misfortune of their lives while doing so.

- **Health and Safety and their relationship with productivity and economy**

A effective safety management plan can be created based on the following key safety policies:

1) Safety is the bedrock of all business operations

2) Safety and higher productivity go together

3) Safety improvements mean more efficient production

4) Safety improves communication

5) Safety prevents equipment losses

- **Workplace incidents, and problems to be solved in creating a safety workplace**

The Heinrich Principle：Serious accident (Lost-Time Accident) 1, Minor accident (Non-Loss-Time accidents) 29, Harmless incidents (Actual near-misses, Hypothetical near-miss Concerns) 300- invisible, Many unsafe situation (hazards) and unsafe behaviors

- **Why do people fail to observe rules properly?**

If we want rules to be followed, we must:

1） Create a working environment that allows the rules to be observed

2） Ensure that people who have to observe the rules understand why they have to observe them, and let them work out their own way of doing so.

However, as many case studies attest, knowing that is not in itself enough to build a safe and secure workplace- it is also necessary to know the right way to proceed.

- **The two basic approaches to safety**

1) The reactive approach stat by analyzing something that has already happened.

2) The proactive approach tries to eliminate potential causes while they are still relatively insignificant, before they causes an actual incident.

- **Involving Everyone in Creating Safe Workplaces- Roles at Different levels**

The proactive approach is designed to detect problems at the 'suspect' stage, and is used to identify potential causes while they are still minor issues. The reactive approach, necessitates various kinds of investigation and analysis; and carefully assessing the results of the proactive approach is an important part of it.This process should be led by management, who should analyze any accident that have occurred and periodically patrol the workplace to evaluate the safety situation.

- **Creating a companywide safety management structure**

1） Establishing statutory systems; appointing health and safety committee, health and safety officials, etc.

2) Deciding on and approving safety; safety decisions should not be left up to individuals.

3) Evaluating safety; safety conditions in the workplace must be assessed by managers and shop floor operators

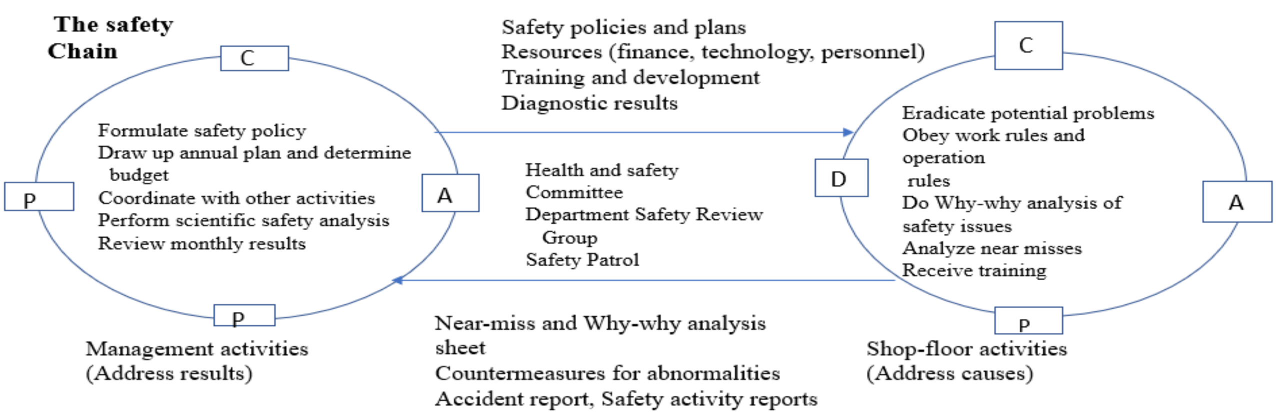

Fig. 8.1 Safety Chain

- **Safety activities integrating management with shop floor**

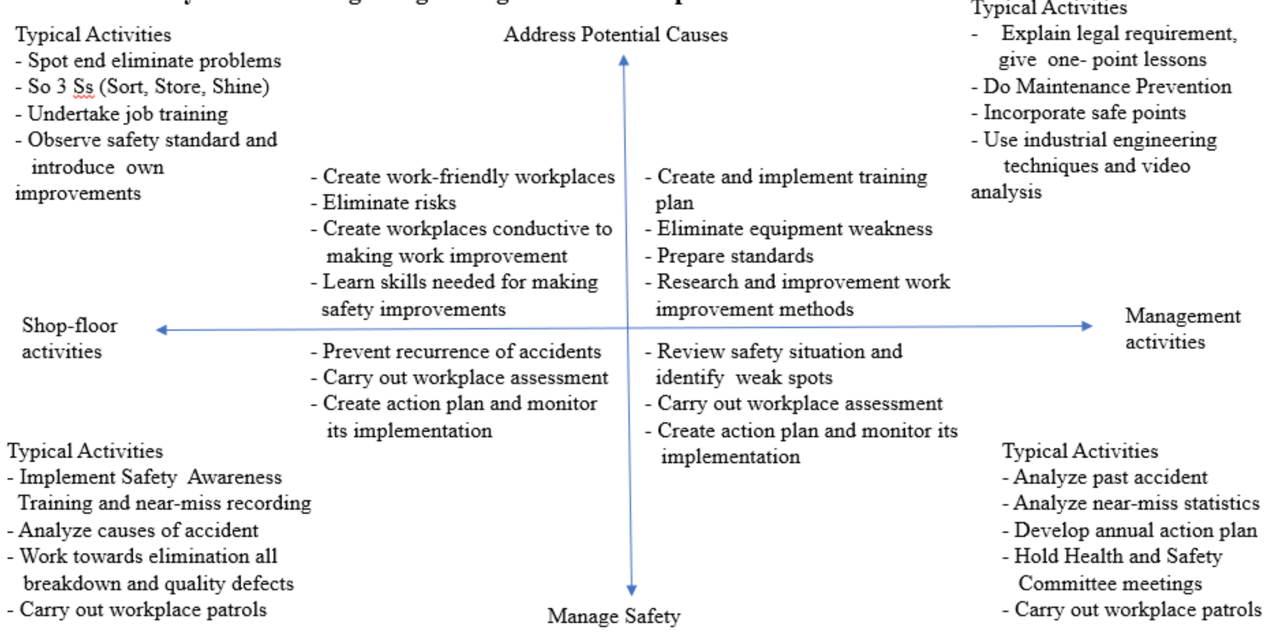

Fig. 8.2. Safety Activity Manegment.

8.3.Overview of step-by-step program for achieving zero behavioral accidents

Step 1. Analysis current situation

Step 2. Perform General Inspection for hazards

Step 3. Create hazard chart

Step 4. Eliminate hazards

Step 5. Establish zero accident condition

Step 6. Create inspection standards and conduct training

Step 7. Perform safety view

- **Using safety tags and maps**

(1) Safety tags; often colored yellow

(2) Maps and boards

(3) Tag lists

1) Categorize past scenarios and define their titles and contents

2) Define the perspectives from which accidents will be analyzed, and sort the data into the relevant categories

3) Record the locations of past accidents and near misses on a map pf the workplace

8.4. Developing Worker-Friendly Workplaces

It is essential for avoiding problems arising from human error at the interfaces between operators and equipment/production systems, as well as abilities or become alienated from their work.

- **Evaluating and improving the working environment**

To establish standards for working environment and create pleasant and hospitable workplaces;

① Maintain a pleasant working environment

② Change the work so that workers' movements and operations are rhythmical

③ Provide equipment and facilities to remove stress and fatigues

- **The five basic conditions for being 'people-friendly'**

1. Work that does not cause fatigue to build up

2. Comfortable, safe, healthy working environment

3. Safe workplace where human errors are not liable to occur

4. Workplace that are also welcoming to older employees

5. Workplaces that allow employees to enjoy creativity, zest for life, and satisfaction in their work

8.5. A list of references

[1] TPM Award committee (2017), Total Productive Maintenance Training Text book- Appendix Total Productive Maintenance for Process Industries, Japan Institute of Plant Maintenance (JIPM)

[2] JIPM(2016), Monodzykuri Text book- Learning Textbook, JIPM

[3] JIPM(2017), TPM Glossary, JIPM

[4] Seiichi Nakashima & Kunio Shirase editorial supervision, JIPM ed. (1992), New TPM Deployment programs for an evolution- Process and Assembly (in Japanese), JIPM

[5] Hiroshi Kubota(2018), *On Concepts & Methodologies in TPM Activities & TQM Activities: Toward Intelligent Production*, 2017 Seminar Next-stage manufacturing, JIPM, pp.85-143

[6] TQM Committee ed. (1998), Total 'Quality' Management in the 21th Century, JUSE

Introduction of brief profile of Hiroshi Kubota

Date of birth: 17th Apr. 1943, Nationality: Japan, Doctor degree(Engineering): Tokyo Institute of Technology

Professional Career: 1988 professor & 2012 Professor Emeritus in Hiroshima Institute of Technology 2016 Advisor in Japanese Standards Association

Main Official Positions in Academic Society:

A vice-president/ a director/ editorial committee chair and a honorary member in JSQC(Quality Control), A member of the standing director committee/research project committee chair in JSIM (Information & Management)

Main official Positions in Professional Society

A lead Examiner of the Deming Application Prize Subcommittee, An organizer in the Head Office for Quality Circle The chairman and an examiner of TPM Excellent Award committee