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ROBOTICS: AN APPROACH TO INCREASE EFFICIENCY OF AI IN THE WORKPLACE

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ABSTRACT

The convergence of robotics and artificial intelligence in revolutionizing efficiency in the workplace, optimizing processes and enhancing innovation in industries cannot be overstated. Today, ideas in robotics that were just science fiction in years gone by have become a reality in many industries, with robots enabled with AI technology greeting customers in stores and offering them personalized information and directions. This study aims to analyze the symbiotic relationship between robots and AI, with specific reference to how robots can assist in AI processes in different industries as this study has created a programmed collaborative robot (cobot) to help in enhancing Artificial Intelligence in different industries by creating a unique robotic model to assist in AI processes and also to enable it to function independently without human intervention like cobots do in order to move slower in order to enhance human safety. Additionally, the role of collaborative robots in manufacturing, healthcare, and logistics industries was explored, with their potential for enhancing productivity, safety, and cost reduction highlighted. This is to enable the robot to think like a human as a machine and learn from data or make decisions automatically. With a review of the mixed approach of using case studies and examples from industries as Methodology, we are able to prove that with the use of robots that are artificially intelligent, it is possible to streamline workflow, improve decision-making, and increase efficiency. For training, a Recurrent Neural Network (RNN) Algorithm was used, while Python Jupyter was used for programming, with the result indicating that the average productivity gain across all industries was found to be 27.5%, whereas the average error reduction was 25%. The maximum productivity gain was found in the logistics industry, which reached 35%, whereas in the manufacturing sector, the maximum error reduction was found to be 40%. We also present the challenges and limitations in implementing robots and AI systems, which include job displacement, ethical issues, and integration complexities.

INTRODUCTION

The fast-paced changes in artificial intelligence and robotics are changing the face of industries across the globe. In the pursuit of efficiency, the combination of AI and robotics is a key area of focus for many businesses. In the modern fast-paced business environment, efficiency is the key to innovation. The reason for this is the fact that the term "intelligent machine" evokes the word "robots" and Robotics (Nwozor, 2022). It could be argued that not all machines are robots, and for sure Artificial Intelligence is not only concerned with robots but also with virtual agents (i.e., agents that do not have any physical machine embodiment). On the other hand, many technical issues and solutions that must be addressed in order to design robots are not treated within Artificial Intelligence research (Anthonio, 2024). The clear separation between the two areas can be noticed in the '70, when Robotics is more focused on industrial automation, whereas Artificial Intelligence employs robots to show that machines are able to act in the environment too. Afterwards, the problems faced during the design of robotic systems able to act in unconstrained environments caused the dismissal of Robotics as a test-bed for Artificial Intelligence. (Luigi et al 2022) On the other hand, the research in Robotics gave rise to the creation of ever more sophisticated industrial robots. However, this status quo was altered in the '90s when robots started to repopulate AI laboratories, and Robotics specifically dealt with less controlled environments. Indeed, the following events occurred: Indeed, they played a main role in re-establishing a strict relationship between AI and Robotics that is nowadays one of the most promising developments of research even in the national context and at the European level. Nowadays, the term AI embraces the entire conceptualization of a machine that is intelligent in terms of its operational and social consequences. A practical definition is the following, which was provided by Russell and Norvig:"Artificial Intelligence is the study of human intelligence and actions replicated artificially, such that the results bears to its design a reasonable level of rationality". Such a definition could be further particularized by stating that the level of rationality could be beyond the level of humans, at least for particular and well-defined tasks. The current AI technologies are applied in online advertising, driving, aviation, medicine, and assistance image recognition (Robinson et al, 2023)

The recent achievements in AI have caught the attention of both the scientific community and the general public. A good example of this is a vehicle equipped with an "automatic steering system," also referred to as an "autonomous car." However, currently, AI technologies are only applicable in very specific situations. For example, one of the weaknesses of AI technology is the absence of "common sense," which allows a person to judge information beyond what he or she knows (Alexander et al 2023). A recent case of an AI robot, Tay, developed by Microsoft Corporation to assist in making conversations on social networks, was shut down shortly after it was connected due to an inability to differentiate between positive and negative interactions.

2.0 Conceptual Framework

2.1 Robotics

Robotics is an interdisciplinary branch of engineering and science, which encompasses mechanical engineering, electronic engineering, information engineering, computer science, and other fields. (James 2022) Robotics involves the design, construction, operation, and use of robots, as well as computer systems for their control, sensory feedback, and information processing. These technologies are used to make machines that can replace humans and mimic their actions. Robots can be applied in many situations for many purposes, but the present day finds many robots applied in dangerous situations, bomb detection, bomb deactivation, in the manufacture of products, and in areas where humans cannot survive, including in space, under water, in extreme heat, and for clean-up situations involving hazardous materials.

The robot can be of any shape but is designed to look similar to a human. This helps in accepting a robot in some replicative functions normally performed by a human. This robot tries to replicate functions such as walking, lifting, speech, cognition, or any other functions of a human. Today's robots are inspired by nature, which forms a branch of bio-inspired robotics. (Ayako 2024) The idea of creating machines that can operate independently dates back to ancient times, but research into the functionality and possible applications of robots has not significantly increased since the 20th century. Throughout history, it has been believed by different scholars, inventors, engineers, and technicians that robots will one day be able to mimic human behavior and operate independently in a human-like manner. Today, robotics is a growing field, and as technology advances, researching, designing, and making new robots serve a number of purposes, whether used domestically, commercially, or militarily. Some robots are designed to perform functions that are hazardous to humans, such as disarming bombs, searching for survivors in unstable structures, or investigating mines and shipwrecks. Robotics can also be used in teaching aids in STEM studies. Nanorobots, microscopic robots injected into the human body, could be a breakthrough in medical science.

2.2 Robots and the Workplace of the Future

Automation is changing the way we work, and to a larger extent, the way we live. Automation increases productivity, which allows companies and nations to remain competitive. Automation allows for new business models to emerge, which focus on delivering new products and services. It allows companies to increase the efficiency and flexibility in delivering products and services. Economists across the field agree that increased productivity is the answer to increasing the Gross Domestic Product, which is the value of goods and services produced within a country, and subsequently jobs and salaries. Society has been mechanizing the production and provision of goods and services for centuries, from the invention of the plough through the printing press and steam engine, and this has helped increase per capita earnings, living standards1 and life expectancy. With every new wave of automation technologies, there are apprehensions that a large number of professions are on the verge of extinction with employees unable to find work. There have been instances where a profession has become extinct. There have also been instances where the job profile changes, as was seen with switchboard operators and typists, where the skills were incorporated into a single job profile of a personal assistant. There have also been instances where automation technologies have led to a higher demand for a particular job profile. For instance, cash machines led to a higher demand for bank tellers, and automation of 98% of labor in weaving cloth led to a four-fold increase in the number of factory weavers over 70 years. (Bessen 2025).

However, there are no historical records of technology having a negative impact on aggregate employment levels. Yet again, with each round of technological change comes the concern that maybe this time it will be different. Will automation lead to a loss of jobs in excess of those created? We see such fears reflected in the current discussion in many of the Western economies about automation and robots. This time around, it is not just a concern that robots may replace workers, but that they could actually be smarter than us and end up controlling us. It is interesting to note that, unlike in the case of developing economies, in developed economies, there is a divergence in the attitude towards robots and automation, not only between developed and developing economies but also within developed economies. In Japan and China, which are considered to be developed economies, there is a positive attitude towards robots. Some of this is cultural in nature, for example, in Japan, it is explained that this is because of their heritage of animism, which is based on the idea that everything in this world is spiritual in essence. However, a significant part is also economic in nature (Johnson & Lee 2021). There is a growing concern in various nations across the world with regards to income inequality, political polarization, and social unrest in society. Automation is a convenient

scapegoat for concerns about job displacement income security. In addition, robots are a literal manifestation of our fears regarding our precarious position as overlords of planet Earth. Nobody knows for sure where technology is going to take us in 50 or 100 years. What we do know for sure is how technology, in general, and robots, in particular, are used today. We know for sure how the increasing use of robots is going to influence various industries, businesses, jobs, and workers in the next 10 years.

It is a picture of a positive future, in which the quality of work and the level of remuneration for work will be enhanced, in which new forms of jobs will emerge, and in which many types of work will be available to those who, because of their physical disability or because of their declining physical strength in old age, have been unable to gain access to the job market. It is a picture of a future in which small-to-medium-sized companies (SMEs), which comprise more than 90% of businesses in most countries, will be able to compete and play new roles in the supply chains of the world. It is a picture of a future for which most of our societies are not prepared. The shrinking workforces in developed countries, because of an aging population, are exacerbated by skills shortages in existing workforces in many industry sectors.

2.3 Robots in Manufacturing

The demand for product variety from customers has led to a rise in low-volume, high-mix manufacturing. Robots play a key role in increasing productivity in such a challenging environment. There will be a rise in adaptive factories, where production facilities can be easily changed. There will also be a rise in smart factories, where robots are connected through a digital network. This can lead to faster product development, fewer product defects, and lower machine downtime. There are advancements in collaborative robots and assistive technologies such as exoskeletons. This allows robots to perform a variety of tasks to increase worker productivity. There is a trend called ‘cloud robotics’ that aggregates data from robots for optimization purposes. Digitally connected robots have a variety of uses. Robots are increasingly being used in warehouses for faster product movement. There are advancements in autonomous mobile robots. There are advancements in robotic sensing technologies. There are advancements in robotics software. There are advancements in human-robot collaboration. There are advancements in service robots. There are advancements in assistive robots. There are business models such as ‘Robots as a Service’. Robots are getting cheaper, easier to repurpose, and easier to re-program. All these factors are expected to drive the adoption of robots in SMEs. The adoption of robots in the manufacturing industry has seen an average increase of 12% annually from 2021 to 2024 globally. The robots were mainly adopted in the automotive industry and electrical/electronic manufacturing industries, which together accounted for more than 66% of new sales in 2016 and close to 60% of total global operational stock (IFR 2024).

Only large organizations have been able to afford robots so far, because of the high cost of investing in a robot and the time and expertise needed to programme these robots for specific tasks. These factors have led to a low adoption rate of robots by SME manufacturers, who form almost 70% of the manufacturers worldwide (Tobe 2023). This is now changing with the decreasing cost of investing in an industrial robot, which includes hardware, peripherals, and systems integration, due to decreasing costs of components, advances in vision, gripping, and mobility technologies, and advances in robot hardware itself. with the advancement in artificial intelligence, a market for collaborative robots6 that work alongside humans instead of in cages is increasing. These collaborative robots are provided with sensors that are able to sense unexpected forces. There are some collaborative robots that, although not caged, are stationary. There are also mobile ones, most of which are provided with omni-directional wheels that allow them to move in all directions without having to turn. In case a worker bumps into a

collaborative robot by mistake, the robot could stop completely or move its actuator (a robot arm, or gripper, for example) out of the way. A mobile robot, for example, might be used to patrol a factory floor or a warehouse. It could be programmed to stop when a moving object is within a certain radius. Crucially for SMEs, such a mobile robot could be programmed easily, for example, by manually guiding the robot through a required action. The dual trend of declining costs for robots and increasing flexibility means that SMEs are able to realize productivity improvements without losing flexibility on working in small production runs.

Factories are becoming very flexible, with the ability to switch production lines very quickly, which allows manufacturers to meet customer needs for more variety and specialization in products. The factory can also be large, such as the "multi-modal" factory that GE opened in 2024 in India. The factory can switch from producing products for GE's oil and gas, aviation, transportation, and distributed power businesses, as well as building products for various industries. On the other hand, experts have predicted the dis-aggregation of manufacturing plants into smaller and highly versatile manufacturing units that could easily be deployed near the point of demand. Manufacturing equipment is expected to be modular in the form of containers, with each container comprising a smart internet-connected manufacturing equipment, assembly robots, and test equipment. The equipment is capable of assembly of various product orders from different customers through the transfer of product designs to licensed partners. The move towards smaller manufacturing units is likely to have a significant impact on the manufacturing market. For example, in Europe, the larger the firm, the larger the share of the total output or foreign sales they control, with only 1% of the total internationalized, high-performing manufacturing firms in Europe producing more than 75%, thus a shift to smaller units could create a significant opportunity for SMEs. The factory could potentially run on multiple products, or the focus could be on a single raw material, with designers, sales staff, and a small team of production planners, programmers, and maintenance technicians who run the factory in near-real-time for different orders based on the raw material (Bruggel, 2024).

2.4 Overview of Artificial Intelligence (AI)

Artificial intelligence is the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. Artificial intelligence can also be used to refer to any machine that has characteristics of a human mind, which includes learning and thinking. The best characteristic of artificial intelligence is that it can rationalize and make actions that will best attain a given goal. When most people are asked what artificial intelligence means, the first thing that comes to mind is robots. This is because big-budget films and novels have been written around stories of robots that destroy the Earth. However, nothing could be further from the truth. Artificial intelligence is based on the principle that human intelligence can be defined in a way that a machine can easily mimic it and execute tasks, from the simplest to those that are even more complex. The aims of artificial intelligence are to learn, reason, and perceive. As technology is evolving, past standards that were used to measure artificial intelligence are no longer applicable. For instance, a machine that is used to calculate basic functions or perceive written text through optimum character recognition is no longer considered to have artificial intelligence, as this is taken for granted as a function of a computer benefit many different industries (Tobe 2023). The wiring of a machine occurs through a cross-disciplinary approach that includes mathematics, computer science, linguistics, psychology, etc. The uses of artificial intelligence are limitless. The field of artificial intelligence can be applied to a wide variety of sectors or industries. Artificial intelligence is currently being used or tested in the healthcare industry for dosing drugs or different treatment in a patient, as well as for surgical procedures in the operating room. Additional examples of machines with artificial intelligence include a computer that plays chess or a self-driving car. All of these

machines must weigh the consequences of any action that they are performing, as it will affect the outcome.

The end result of a chess game is winning the game. For a self-driving vehicle, the computer would need to factor in all outside information and calculate it so that it behaves in a manner that would avoid an accident. Artificial intelligence can be applied to the financial industry, where it helps detect and flag banking and finance activity such as unusual use of a debit card and large deposits into an account, all of this information helps a bank's fraud department. Applications of artificial intelligence are also being implemented to help streamline and make trading easier (Anthonio 2024). This is done by making it easier to estimate the supply, demand, and price of securities. Artificial intelligence can be separated into two different categories: weak and strong. Weak artificial intelligence is the embodiment of a system that is designed to perform a particular task. Weak artificial intelligence includes video games, for example, the chess game discussed above. It includes artificial intelligence like Amazon Alexa and Apple Siri. You ask the assistant a question, and the assistant will answer the question for you. Strong artificial intelligence is a system that carries on the task that is considered to be a human task. Strong artificial intelligence is a complex and complicated system. It is designed to perform a task where the system may be required to solve a problem without a human intervention. Such a system is required for a car that drives itself or in a hospital operating room.

2.5 Related Works on AI & Robotics

Anthonio (2024) conducted research on Artificial Intelligence and Robotics. In this research, the author discussed the design, development, and application of artificial intelligence and robotics for the betterment of human lives. The author has done a great job, but could not implement the discussed issue on a model.

In their research, Robinson et al (2023) discussed a technological review on Artificial Intelligence and Robotics. In their discussion, the authors showed that as technology improves, tasks that are thought to require "intelligence" are often removed from the definition of AI, a phenomenon known as the AI effect. The authors have done a great job, but could not implement the construction process of a robot.

In their research, Luigi et al (2022) discussed the future of robotics technology. In their discussion, they showed that robotics is a subject that deals with the design, construction, operation, and use of robots, as well as computer systems for controlling them. their control, feedback, and information processing. The purpose of these technologies is to create machines that can replace humans. The authors have done a good job, but they could not apply the survey with a program for further clarification and understanding of the discussed issues.

The issue discussed in the research by Alexander et al. (2023) is the issues in the role of robotics in problem-solving. The main tools for the problem-solving part, along with two problem-solving methods, are the application of tasks using Mindstorm LEGO, Denmark, robot kits. This is done as a basic step before the syntax of a language is applied for the emulation of a Graphical User Interface (GUI) for a previous problem with a robot. There was no comparative analysis done on the developed interface with the existing one.

Bessen (2025) focused on learning by doing: the real connection between innovation, wages, and wealth. The author emphasized the need to drive innovation in robotics by making improvements in basic manufacturing technologies, which involve compact, efficient, and precision technologies, as well as sensing and smart technologies. The author did a good job but failed to implement the issue under discussion in a model.

Tobe (2023) conducted research on an enhanced survey of advanced robotics for the future. According to the author, robotics is a fun way to bring STEM to life. This is important because STEM is the key to a successful future for students who have the interest and motivation to do so. The author did a good job but failed to adopt a practical approach on how to improve the performance of advanced robotics.

Brugel (2024) focused on Materials and Methods for programmed robotics. From the work done by the author, the three major ways of programming: teach, lead, and offline, which they can prepare for the introduction of any type of robotics technology. The teach method is the most common method used for programming robots, with more than 90 percent of industrial robots programmed using the teach method. The author was able to do a good job but failed to implement the adopted method to a model.

James et al (2022) focused on new tools for predicting economic growth using machine learning: a guide for theory and policy. The authors were able to develop a machine learning framework for predicting growth and solving economic problems. From the work done by the authors, the result showed that the developed model will complement the prediction of growth for better planning. However, the authors failed to interpret the generated charts from the developed model.

The article written by Nwozor (2022) focused on the prediction of the behavior of the customers using the recurrent neural network. The author created an "Enhanced Customer Behavioural" model for the prediction of the behavior of the customers using the recurrent neural network. However, the author was not able to implement the robotic technique for the model.

The article written by Johnson & Lee (2021) on the integration of AI and robotics technology provides insights on the benefits of integrating AI and robotics technology in various industries. The collaborative robots or cobots have become a major focus area for the industry because it provides a platform for humans and robots to work together. According to the studies, cobots have the potential to increase productivity by 30% in a manufacturing environment.

Table 2.1 Industry Applications and Benefits

S/N	Industry	Application	Benefits
1	Manufacturing	Assembly, welding, material handling	Increased precision, reduced errors
2	Healthcare	Surgery, patient care, rehabilitation	Improved outcomes, enhanced care
3	Logistics	Warehousing, packaging, delivery	Faster processing, reduced labor costs

Challenges include job displacement concerns and integration complexities (Davis 2021). Despite these, the potential for AI-powered robotics to drive innovation is clear.

3.0 Methodology

The methodology for this research is a mixed-methods approach, which includes conducting case studies along with literature reviews to assess the effect of robotics on AI-based processes. We have specifically focused on the following industry-specific studies on the implementation of cobots:

1. Manufacturing industry
   a. Automotive industry
   b. Electronics industry
2. Healthcare industry
   a. Surgical robots
   b. Rehabilitation robots
3. Logistics industry
   a. Warehouse management
   b. Delivery system

Data Collection:

-Literature Review: We have analyzed various research papers, industry reports, whitepapers related to the present industry trends. (Total papers collected: N=13)

-Case Studies: We have collected various case studies on the successful implementation of cobots in the industry. We have focused on the following parameters for the case studies:

a. Productivity
b. Cost reduction
c. ROI

We have collected a total of n=10 case studies for the research.

- Expert Interviews: We have interviewed experts from the industry, where a total of n=5 from manufacturing, healthcare, and logistics to gather insights on challenges and best practices.

Where N=13 implies 13 research papers were used in reports in literature review, n=10 implies 10 case studies were used and n=5 implies 5 experts interviewed especially as we discussed challenges and limitations in implementing robotics and AI, such as job displacement. The unique robotic model (figure 3.1) will be able to automatically enhance the artificial intelligence of the pre-existing model and make it function without human intervention.

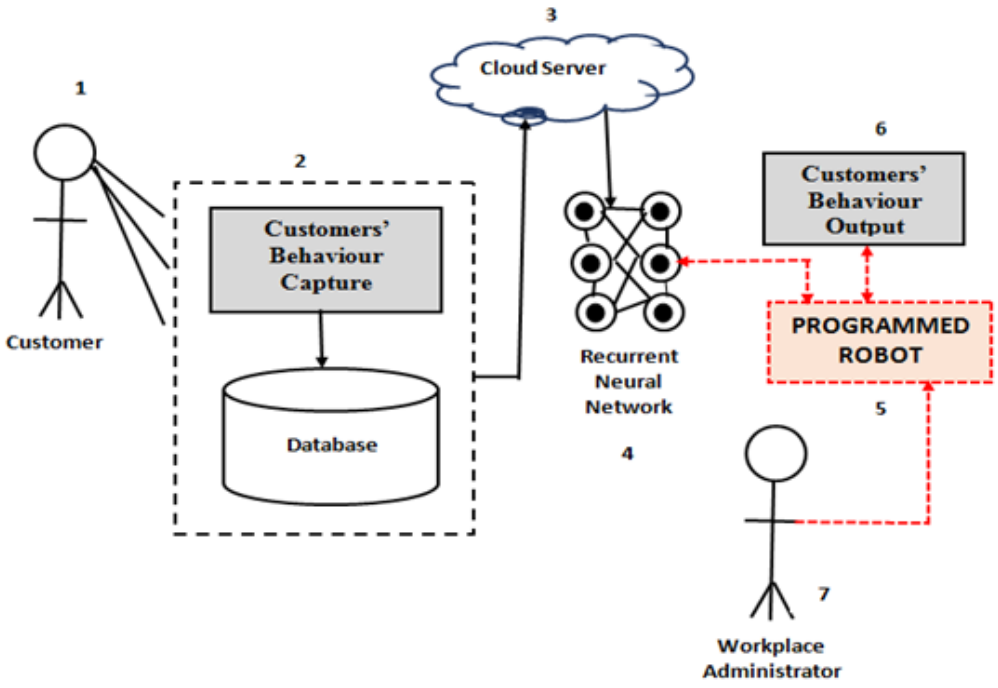

Figure 3.1: Architecture of the Proposed Model

3.1 Explanation of the Proposed System's Components

i) Customer:

This is a component that represents an individual who buys goods and services from a shop or business entity.

ii) Customers' behaviour capture:

This is a component that represents an interface which automatically captures the customer's reaction or emotion towards the services offered to him or her.

iii) Database:

This is a component that represents an organized collection of related files which is normally in digital form. It receives the customer behaviour.

iv) Cloud Server:

This is a component that is a logical server which is built, delivered, and hosted using a cloud computing platform over the Internet. Cloud servers possess and display similar capabilities or functionalities to a regular server.

v**) Recurrent Neural Network:**

This component will represent a class of artificial neural networks where the interconnections between the nodes will be in the form of a directed graph along a sequence. Unlike feed-forward neural networks, in RNNs, a neural network can use internal states to process sequences of varying length.

vi) **Output of Customers' Behaviour:**

This component will automatically show the processed information of the customers' behaviour to the workplace administrator.

vii) **Workplace Administrator:**

This component will represent an entity who will query the system for information on the behaviour of a particular customer.

vii) **The programmed Robot:**

This component will represent a robot where sensors and mechanical components are connected and controlled by electronic boards or CPUs. They will process information and make changes in the real world. They are independent and replace or assist humans in everything from mundane activities to very dangerous ones.

4.0 Results

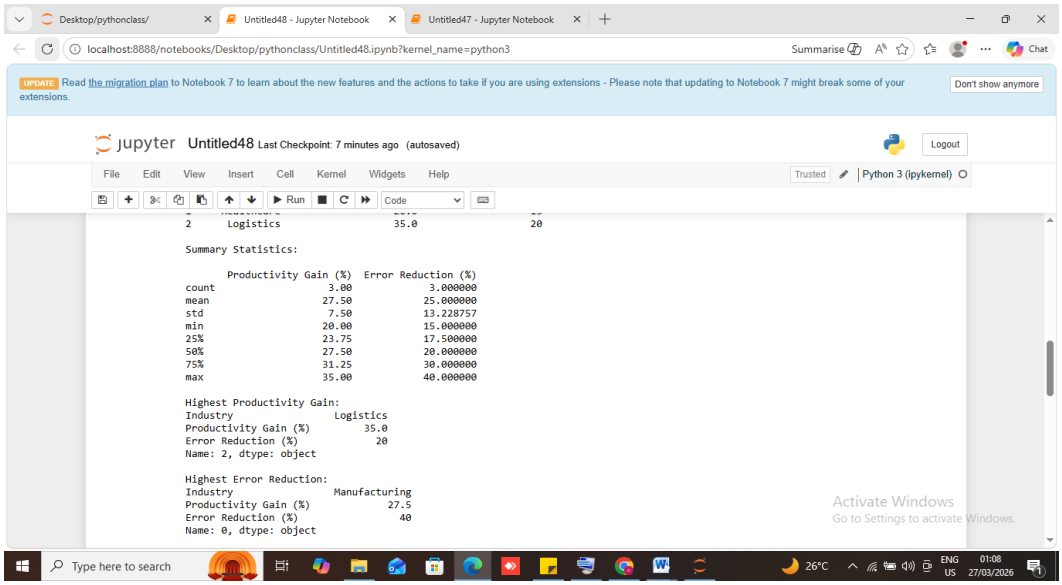

Figure 4.1: Descriptive statistics generated from the dataset

The bar chart showing the gain in productivity clearly indicated that logistics had the highest value at 35%, manufacturing at 27.5%, and then came healthcare at 20%. This clearly indicated that logistics had gained most in terms of speed, whereas healthcare, because of the complexities involved in medical procedures, showed a lower gain, but still a gain there was, as indicated in Fig4.2.

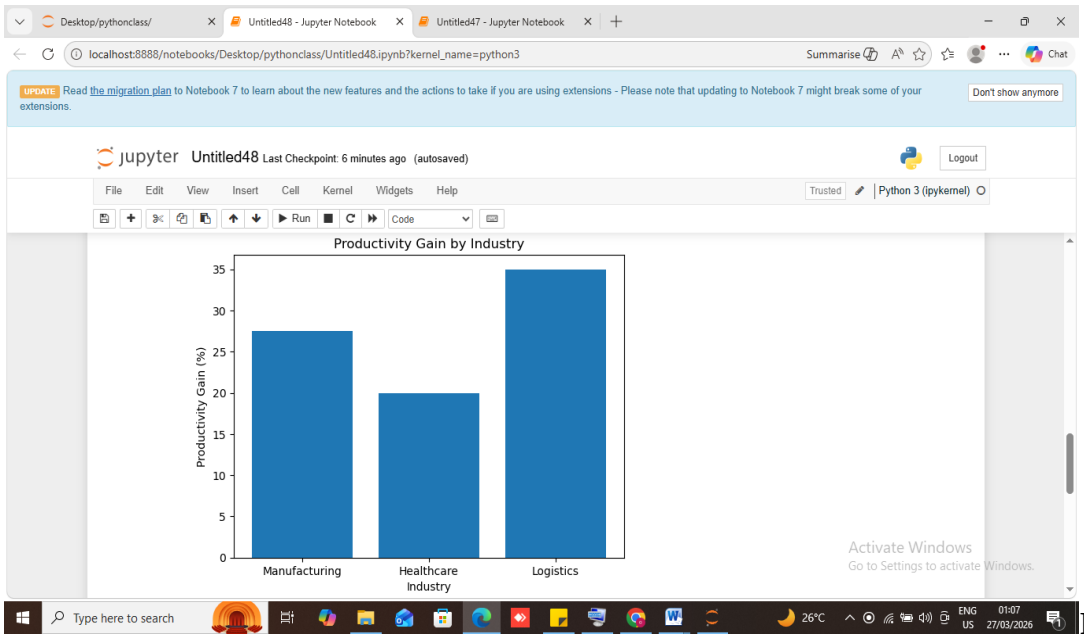

Figure 4.2: Productivity Gain by Industry

Likewise, in the case of error reduction, the bar chart indicated that manufacturing stood out as the highest in value, 40%, followed by logistics, 20%, and then healthcare, 15%. This further illustrated the importance of robotics in error reduction. In terms of improvements in product quality, accuracy in sorting and order fulfilment in logistics, and precision in surgeries and lab work in healthcare, as illustrated in Fig 4. 3.

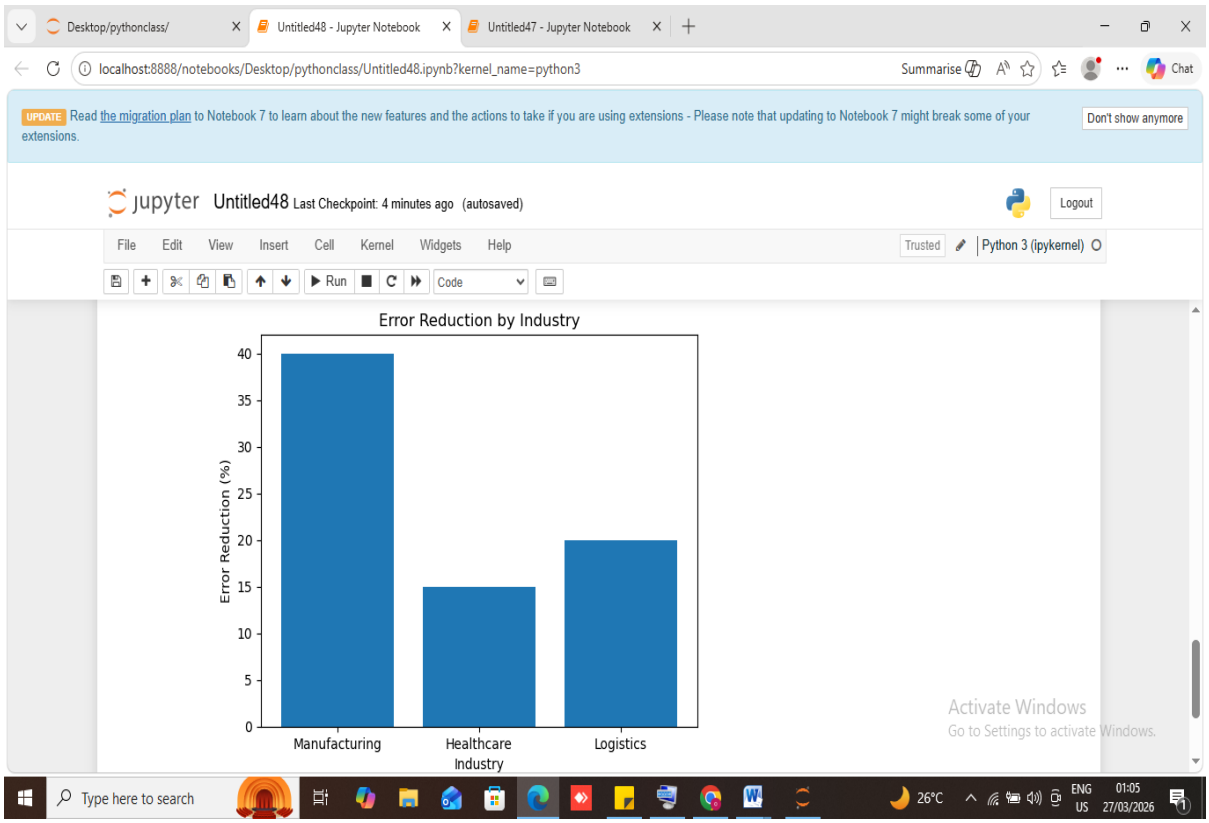

Figure 4.3: Error Reduction by Industry

Table 4.1: Industry Performance Metrics

Industry	Productivity Gain	Error Reduction
Manufacturing	25-30%	40%
Healthcare	20%	15%
Logistics	35%	20%

From the table above, it can be seen that the highest productivity gain was recorded in logistics at 35%, indicating that the implementation of robotics in logistics activities such as warehouse management and order fulfillment had a positive impact on productivity. Manufacturing was found to have the highest error reduction at 40%, indicating that collaborative robots (cobots) used in manufacturing activities such as assembly have reduced errors, minimized waste, and ensured high-quality products. In healthcare, a 20% productivity gain was recorded, along with a 15% error reduction.

4.1 Discussion

The descriptive statistics obtained from the dataset revealed that, on average, all industries realized a productivity gain of around 27.5%, while the average error reduction was 25%. The maximum productivity gain was realized in the logistics industry, which stood at 35%, while the manufacturing industry realized the maximum error reduction of 40%. This revealed that some industries focused on speed, while others focused on accuracy.

5.0 CONCLUSION

In this study, we have proposed a Robotic Model for Artificial Intelligence enhancement in the work environment. The Proposed Artificial Intelligence Robot has demonstrated significant prospects for improving productivity and efficiency in the work environment in manufacturing,

healthcare, and other industries. Despite the challenges associated with the use of robots in the work environment, such as cost and training, the advantages of using robots for improving accuracy and speed make it an emerging trend for organizations that wish to remain competitive in the market. As technology advances, there is a high possibility that the use of AI robotics will be adopted in the future since technology is continually evolving.

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