An Insight Study of Hard Robotics to Soft Robotics Shift within the Medical Sector

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Abstract: - The following research is carried out to conduct a detailed study of the use of robotics and soft robotics in different sectors of the world. The increased demands for robots in the medical industry have made this technology evolve into different units depending on its requirements. The sections in this research include details about the study of robots and soft robots. The research highlights the evolution from robotics to soft robotics in the medical industry for lesser invasive surgeries and other useful applications. Robots have taken over the manufacturing industry in most countries and the future application for this technology is quite promising in the coming decades, these technologies can be used for space traveling, military, hazardous robots, etc. The research also aims to produce detailed information about the use of robotics and soft robotics in medical and industrial applications, the thesis also consists of conclusive evidence related to the importance of soft robotics in the medical industry. The study includes information gathered in support of the research which has been differentiated with thematic analysis to answer every research question raised in the investigation.

Key-Words: - Robotics, Manufacturing, Medical Sector, Hard and Soft Robotics, Industrial Application, Surgical, Drug Development, Industrial Automation, Artificial Intelligence.

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1 Introduction

Robotics is a fast-growing interdisciplinary field of science and engineering, which is rapidly growing in all sectors of the world, [1]. Robots are often used these days in the manufacturing and medical industry to reduce human effort and carryout tasks in a more efficient approach. Robots can be designed in many forms including humanoid robots can substitute human actions depending on the requirements of its user, [2], [3]. Robots can provide possibilities to change the lifestyle of humans both at work and home, these autonomous machines will have learning capabilities to interact seamlessly with the environment around them which can transverse the gap between the digital and physical world, [4].

Soft robotics is a division of robotics that deals with design that can replicate living organisms, [5], [6]. The use of soft robotics was mainly focused from 2008 on developing joints that are more flexible and adaptable in robots. This field of robotics helps to break the constraints of hard materials like metal and plastic in conventional robots which are usually hard and rigid in nature. During the course, this technology grew more sophisticated in the medical industry, helping doctors carry out preliminary examinations and surgeries on patients. Universities like Harvard have been developing and designing many technologies based on soft robotics for researchers to conduct studies on bio-organisms and surgical probes for medical applications, [7]. Manufacturers like Medtronic and Johnson & Johnson are currently trying to dominate the medical market around the world with robotic technology that can bring a breakthrough in MIS, [8]. Companies like da Vinci are putting effort into creating surgical robots that can carry out treatments for urological, bariatric, and gynaecological surgery whereas companies like Stryker have created robots called MAKO which specializes in orthopaedic surgery, [9]. The use of robots in the medical industry does not stop with just surgery and diagnosis but also can be used as care robots and hospital robots which can look after the patients and provide them with necessary services. In a recent study, analysis proves there has been an increased shortage of caretakers around the world to look after the aging population. In countries like America, the federal government is planning to increase the budget for senior citizens from 40 % to 50 % by the year 2029, [10].

Despite all the positives of soft robotics, there is still much hesitation in the utilisation of the technology. In recent years, the material, design, and functionality have drastically improved which

led to the market growing to $6.39 billion, however, 40% of patients with limb impairment still opt out of using soft robotics. The main issue reported was that it feels unnatural and is very heavy. The underlying core issue can be said to be that electronics are not considered to be an extension of the human body. Other shortcomings of the technology are the power supply, failure to autonomously respond, environmental feedback, and many more. However, the recent advancement in the form of electronic skin or e-skin has the potential to reduce some issues, [11].

1.1 Research Background and Purpose

The research aims "to identify the effect of shift from robotics to soft robotics in the medical industry. The study explores the key research objectives as:

1. To analyse the effect of the shift from robotics to soft robotics in the medical industry?,
2. To analyse the use of robotics and soft robotics in medical and industrial applications; and
3. To identify and suggest the positive aspects soft robotics could bring out in medical and research fields.

The robotics industry has grown significantly over the past few decades spreading its advanced technology in almost all commercial sectors to reduce manpower. The technology has also spread its wings in both industrial and medical grounds resulting in the evolution of many tasks that were considered impossible to complete. In the following research, we are trying to establish the different uses of robotics and soft robotics in the medical industry and the impact soft robotics can have in the medical industry. A conventional robot used in the medical industry has a limitation of providing flexibility and can harm or hurt the patients while conducting diagnosis due to the rigid body they possess; this disadvantage could be eliminated by bringing in soft robotics which consist of soft materials that can damage less tissues while conducting a study or surgery on patients. Soft robotics in the medical field has enabled professionals to be able to perform minimally invasive surgeries. One such technology is wearable robotic gloves or exoskeletons that helps in the process of conducting minimally invasive surgery. With these types of robot-assisted surgeries, doctors have been able to perform complex surgery very easily with more precision, control, and flexibility. Soft robotics are also being utilized for many prosthetics for individuals' mission extremities. Thus, conducting research on the extent to which soft robotics can help and how it will assist the medical industry to evolve is necessary. This research is carried out to find out the different technologies soft robotics can bring out in the present and future of the medical industry. The purpose of the study is to understand the use of robots and soft robots in different sectors around the world. Robots have taken over almost all major manufacturing industries like automobile, metal casting, and food processing, and autonomous robots have even taken over factories like Amazon and noon to arrange and sort packages. This fast-growing technology can in have a major impact in many sectors like the military, retail, entertainment, and medical industry in the present and future. This research consists of information related to robotics and the branch of robotics called soft robotics. This unique technology can change the face of the medical industry by providing a much more feasible and reliable healthcare service. The study focuses on highlighting the use of soft robotics and some of the benefits it can provide compared to the use of conventional robots.

2 Literature Review

2.1 Introduction

The motive of this section is to know in depth about robotics and soft robotics' possibility of revolutionizing its place in society and industry by reviewing the current existing literature about the practice of this technology in medical, industrial, and research applications. Soft robotics is an emerging technology that can make a major impact in the field of engineering. This technology has a wide opportunity in the medical and industrial sectors, promising to bring out an immense change in the world of science. The literature review includes information about the current and future market opportunities robotics could showcase in almost every sector of the world.

2.2 Robots and Soft Robots

A robot can be an integration of both electrical and mechanical systems in addition to some advanced methods of intelligence and computation. An ideal robot should be capable of handling a complex volume of tasks automatically. Through the combination of multiple existing and new technologies; researchers are trying to evolve robots into a better version for human needs, [12]. The interpretation of robots around the world is mostly humanoid, most people around the world believe robots are supposed to look like humans and should

function like them however this is a wrong perpetuation, it is not compulsory for a robot to look humanoid to accomplish a task, [12]. The first programmable robot was designed in 1954, named Unimate. The device was a based hydraulic-based manipulator arm that was mainly used by automobile manufacturers for metalworking and welding processes, [13].

Robotics is a division of engineering that involves the design, manufacturing, and operation of robots. Robots are created to reduce human effort and assist humans in diverse methods. The field of robotics has vastly grown over the 20th century, expanding its use from medical to industrial purposes. The word robot was first used by writer Karel Capek who used this in his play which took place in 1920, [1]. However, it was Isaac Asimov who was recognized to use this word in 1940 for the first time. Machine learning is an important factor for robots to learn the surrounding environment which would help them to identify and react to obstacles. This learning can be carried out by a self-exploration program or with the help of a human operator. For example, picking and placing objects, object detection, and path planning, [1].

Robots have many applications and variants, which include humanoid robots that resemble a human being and their nature, serial manipulator that are used in manufacturing units like the automobile industry, and nanorobots used in the medical industry to track down cancer cells to execute them. These robots are going to be a huge part of humans from housekeeping to helping colonize other planets in the future as these systems can be programmed according to our needs and can accomplish tasks that are not possible with human strength and ability making them ubiquitous in the future, [12]. Soft robotics has been offering possibilities that are much more advanced than conventional robots can offer. The rigid limitation in a normal robot can be solved by this technology offering human-friendly robots that looks and operate more like humans, [14]. This technology can also be used to replicate any organism. Researchers are trying to develop soft actuators and other soft material designs to create completely operating devices out in the market as it could open many possibilities for the medical and research field, [15], [16].

2.3 Robotics within the Medical Sector

2.3.1 Robot Assisted Medical Surgeries

The idea of robot-based surgeries started around 50 years back until 1980 the first orthopaedics image-guiding robot was developed by Han Paul and William Bargar for the replacement of hip surgeries, [17]. Robot-based surgeries reduce the recovery period, cause less pain and bleeding during the surgery, it also reduces the volume of scars on the body. The device is more capable of removing cancer cells which makes it more prominent and efficient in cancer-related treatment and surgeries, [18]. Robots assisting high-precision devices were recently developed by researchers from Maastricht University for the cure of cancer cells. This device is designed to be controlled by a surgeon using food pedals and forceps like a joystick for removing unwanted cells in a more precise method. The researchers further conducted a trial surgery on 20 women with lymphedema which is a condition developed due to breast cancer, they were further divided into 2 groups, in which group 1 went through manual surgery and group 2 underwent surgery with the help of a robot based high precision device called MUSA, which was developed by Microsure a Dutch based company. The result for Group 2 seems slightly better than Group 1, as the recovery rate was slightly quicker with proving robotic-based surgeries could be a feasible and reliable form of treatment, [19].

2.3.2 Robt Lab Assistants

A team led by PhD student Benjamin Burger from the University of Liverpool has created and designed a robot that can undertake all the lab activities and assist lab operators to carry out research 1000 times faster than humans can perform, [20]. The device can work 22 hours a day with 2 hour of charging period with the ability to perform intense time-consuming research which is difficult to tackle. The device was asked to find out the fastest chemical reaction to produce hydrogen from light and water, the robot was further programmed with the basic algorithm. The machine was able to carry out 688 experiments in 8 days. The technology took 3 years to develop its controlling software and the hardware which would price from $125,000 to $150,000. The machine uses LIDER (light detecting and ranging) technology to navigate through the lab, this technology is used in self-driving cars and can operate even in the dark. The manipulator arm attached to the machine is produced by a German-based company called Kuka, [21].

2.3.3 Service Robots for Medical Sectors

Service robots have been in demand since COVID-19, as they have been used in many hospitals and medical industries to disinfect patients' rooms and

many other autonomous activities that have helped distance doctors and nurses from patients to reduce the spread of covid. In the year 2019, a study proved that 47% of robots have been manufactured and programmed to work for the medical industry. Disinfection robots have been a breakthrough during COVID-19 to help sanitize rooms for patients preventing the infection from spreading. In 2014 UVD robots created their first autonomous disinfecting robot which can kill 99.9 % of any bacteria and viruses. The hospitals also concentrate on investing in robots that can interact with humans to provide comfort for young and old patients. A study has proven 24% of patients have turned happy and 34% have felt a reduction in stress with a robot companion. Delivery robots are also a part of service robots in the medical industry that can help substitute labour shortage and can help deliver food and medicine to patients along with other uses like hospital labs and pharmacies, this technology could solve many logistic problems and can help reduce cost in many segments of the hospital, [22].

2.4 Examples of Soft Robots in Research Studies

Jellyfish

Scientist around the world have dedicated their life to studying the ocean and marine life to find out medicines and other useful applications they can offer to both the human race and aquatic species for its betterment, this study must be carried out as early as possible due to the climate issues that have impacted the oxygen level in the oceans, the reason of oxygen being less could be attributed at the fact that the water temperature is getting higher yearly, it is therefore mandatory to study about the ocean at a faster pace, [23].

It is not always practical for a human diver to reach at the deepest level due to the high pressure at the bottom of the deep sea. This limitation has forced marine researchers to conduct their study with the help of automated or remotely operated vehicles (ROV) also known as robot probes which are sent inside the water for deep ocean studies. The conventional probes which are available in the market were built with the motive to carry out undersea constructions and oil pipeline installation. The marine researchers wanted to develop a device that could collect delicate samples and fragile biological specimens from under the sea. The constraint of breaking or damaging the delicate object using the manipulator arm of a conventional robot made this process more difficult for the researchers, Following this complication, engineers constructed a manipulator arm which is made of soft robotics and developed a probe with this technology that looks like marine species. This technology was further used for carrying out marine studies without disrupting the aquatic species, [24]. The jellyfish-based robots were created to capture jellyfish from under the sea as these creatures can be of remarkable promise for researchers. For instance, jellyfish can be used in developing medicine related to ending or reducing the aging process. However, they have been trying to catch these species unharmed for a while now, the new soft robotic-based device seems to give out a promising result of collecting the jellyfishes from under the ocean without possessing the risk of injuring or killing the species like the conventional grippers used to do. This could also be attributed to the fact that the soft robotic-based device exerts a pressure of just 0.045 kPa (kilopascal) while the most advanced conventional jellyfish capturing device available in the market exerts 1 kilopascal of pressure on the specimens, [25].

Octopus Inspired Robots

Octopus-inspired soft robotics arms have been developed by researchers from Beijing University and Harvard john A. Paulson school of engineering. Studies have shown that two-thirds of octopus neurons are in its arm, which means each arm can have its own mind. The octopus-inspired arms were developed to create a manipulator arm which has the same properties and structure as an octopus. The manipulator arm which acts as a tentacle is designed with immense flexibility and suction cups to increase friction on its surface. These suction cups help in lifting objects of different shapes and sizes, For example, eggs, phones, and exercise balls, [26]. The octopus-inspired arm is designed in a way that it could fit in tight places where a human arm can't reach or grab, it has 2 valves in its tentacle arm which one helps in bending the arm and the other hand helps in activating the suction cups attached to the tentacles. The suction cup in the tentacle can control the pressure; depending on the objects the arm is targeting to lift, [27].

Octobot is another example of octopus octopus-inspired robot created and designed by a group of researchers from Harvard University, this project was based on an attempt to create a complete soft robot-based device, which was designed and operated with soft materials as a proof of concept. This little device was created with the simple fabrication of three different methods (moulding, lithography, and 3D printing), the device works under pneumatic mode using gas under pressure as a source of energy. A phenomenon of reaction taking

place inside the bot exerts a large amount of gas resulting in the movement of the Octobot, this reaction is controlled by a microfluidic logic circuit, [28].

2.5 Soft Robot Application in the Medical Sector

Spider Shaped Soft Robots

Harvard researchers have developed a spider-shaped soft robot which can be a key aspect in the development of minimum invasive surgeries (MIS) and microsurgeries. The system was built inspiring the peacock spider which tends to be more rigid and metallic compared to the robot spider. The system is driven by the simple mechanics of a microfluidic system, the robot gets its ability to move, operate, and abilities from the microfluid. The spider infill is pumped with liquid which helps the robot move their limbs, change colour, and perform assigned tasks. This device can be altered to add more features depending on its requirement and can be used in surgeries that are hard for doctors to perform and rigid robots to reach. Since this research was further improvised, the limitation of the current model was that it could only provide one degree of freedom which means the device can only actuate in a single direction. The new soft robotic-based spider was developed with a hybrid technology that consists of three different methodologies which gave an output of 18 degrees of freedom which could create a change in their structure, movement, appearance, and micrometre range, [29]. This device was further called MORPH (Microfluidic Origami for Reconfigurable Pneumatic/Hydraulic). They used the micromachining technique to cut each layer for the body and further used the lithography technique to compile 12 layers of silicon to make the robot. The body was assembled to create a 3D structure of a spider, [30]. This current robot is not used for practical purposes but was an example for proof of the MORPH method, this approach brings in a lot of improvement in MIS and medical purposes, [29].

Soft Robotics in Endoscopic Surgeries

Endoscopic surgeries help doctors reach narrow tracts and parts of a patient more conveniently to carry out any form of surgery. In the past 40 years, there has been a significant improvement in the use of endoscopic surgeries as a procedure to look inside the human body to identify illnesses and disorders. This equipment was mainly used to perform surgeries like endoscopic mucosal resection (ESD) and endoscopic submucosal dissection (EMR), [31]. EMR is the process of removing cancer and pre-cancerous growth developed in the digestive tract whereas ESD is used in removing large tumours developed in the gastrointestinal tract, [32]. The robots used in this process are rigid and limit the doctors to perform surgeries in a more efficient manner giving them less dexterity and sensing. The engineers at Harvard University have developed a soft robotics-based device that is more flexible and rigid, which could give multiple degrees of freedom. Soft robotics are a promising aspect for the future of surgeries as they match the stiffness of a human resulting in very little chance of puncturing or a tissue tear. The limiting factor for this technology is the lesser amount of force exerted by the system due to the device being built with soft materials, the material doesn't rupture any tissue in the body but however it also cannot be relied on to remove tissues from the body. The researchers from Wyss Institute for Biologically Inspired Engineering at Harvard University developed a new hybrid model that consists of a rigid skeleton covered with soft materials, and integrated soft actuators in the device. Soft actuators are used in this equipment to reduce the chance of exposing the body or tissues to high voltage and temperature. The motive for combining soft robotics and origami-inspired structures was to bring out the best in both the technologies. The researchers made a soft design based on this technology which could reach the surgical area without damaging the tissues, which would further deploy soft systems that could effectively manipulate the targeted tissues. The soft actuators used in this technology are powered by water, the arm is also attached with a suction cup inspired by an octopus tentacle. The team further tested the device by performing surgery on a pig tissue which was a success. The researchers are further improvising the device to carry out endoscopic procedures that are even harder to execute, for example, lungs and the brain, [33].

Soft Robotics in Medical Amputees

Amputation is the process of removing the finger, toe, or limbs of a person due to medical reasons or condition. Amputations can be caused by accidents, cancer, combats, or burn injuries but about 54% of amputations are caused by diseases caused by vascular conditions like diabetics and peripheral arterial disease (PAD), [34]. Most of the amputees depend on prosthetics after going through an amputation, researchers around the world are trying to improvise and provide a much more reliable prosthetic devices for patients to feel like how they used to do when they had their limbs. The researchers have made much more improvement in

this field of study by adding programs that could make the patient feel the sensation of the objects they touch and control their arm using the electric signals stimulated by the brain. Soft robotics based prosthetic arms can be of great advantage due to their lightweight design which makes them easier to manufacture than a conventional prosthetic arm. However, the model is yet not completely applicable in the real world due to its lack of practical requirement with the conventional prosthetic arm in the current market, researchers have been trying to transverse this gap. The idea behind soft robotics-based prosthetics is to not just ensure lightweight and effortless manufacturing but also to create a prosthetic that can be easily affordable to patients around the world, conventional arms which is available in the market comes with a heavy price tag and cannot be easily affordable by some patients. The requirement of an ideal prosthetic arm is to have a proper design related to Kino dynamic, mechanical, and essential functionality, [35]. Canadian scientists have developed a microfluid-enabling soft robot prosthetic that can reduce skin ulceration and pain in patients who undergo an amputation. The idea was to develop a pneumatic actuator that will be controlled by a microfluid chip that has access to 10 integrated pneumatic. Medical researchers with years of experience in prosthetic development figured out a desired pressure value for the socket. This research was focused on patients who have lost their lower limbs due to diabetic foot ulcers, [36].

Soft Robotics Based Hand Gloves

Studies have shown patients who have suffered a stroke or been through a coma because of spinal cord injury can regain their ability to move their fingers and gain neurological strength back by repetitive hand gestures. This could also help in regaining strength, motion, and accuracy. Patients usually go for physiotherapy after such incidents which could be expensive and take time to improvement, but these portable gloves have increased accessibility and faster results. The device provides more degree of freedom and is designed to be comfortable with the use of fabric and elastomer materials. This device is portable and cost-efficient due to its low production cost and simple mechanism. Soft robotic gloves weigh less than 0.5 kg, it is designed to fit different sizes with the ease of putting them on and removing them after use, [37]. The gloves are further being modified by adding sensor components that can improve force and joint angle controls which could help in grasping objects and controlling the force. The device helps stroke patients with increased spasticity and flexor tone to regain their flexion, [38].

Soft Robotic Devices for Drug Delivery

Soft robotic based on microrobots are being used in medicinal applications, they are intended to deliver medicine to specific fragments of tissue for treatment purposes. This is a field of study as it has not been yet tested in humans and is still in its development stage and animal experimentation. The current microrobots are capable of locomotion on hard surfaces and not human bodies as humans are made of dense tissues, due to which researchers are in the phase of developing bots that can locomote on human tissue surfaces. Researchers have tested some alginate capsules on top of a rat cortex and spinal cord of a mouse, the test significantly delivered the medicines up to six locations with tissues which are of different types and spatial specificity with the help of microbat Development of this project can be helpful in clinical and pre-clinical applications like diagnosis and drug delivery, [39]. The technology can also be used in delivering drugs to the nervous system, consuming pills orally to treat diseases like cancer might affect areas of the body and nervous systems that are related hence this could reason for other complications in patients, searchers have developed a robot that can move upstream to blood flow and slopes which can travel to the targeted nerve in place to deliver drug, [40].

2.6 Future of Robotics and Soft Robotics

2.6.1 Future of Industrial Robotics

The robotic industry is set to hit 119 billion US dollars by the year 2030 due to the high demand for the technology from both Eastern and western consumers, this fast-expanding technology has taken over the market in the past few decades. The effect of COVID-19 have increased the demand for robots in the medical industry expecting to have a growth of 15% in CAGR (compound annual growth rate), [41]. The improved functionality of autonomous robots can increase productivity giving more profit and less production cost. The future could witness 6 advanced technological innovations that can improve the production line for manufacturers: the internet of things (IOT), autonomous devices, blockchain, intelligent robots, advanced materials, and artificial intelligence. Robots could be easily available in the future for an affordable price enabling their use in agriculture, manufacturing, and different services, [42].

2.6.2 Robots and Soft Robots for Military Application

Robots are now being developed around the world for global military and defence sectors, this technology will aid human soldiers on the battlefield and can be developed in multiple units for ground and air defences by the requirement of each sector. The governments around the world are investing money into robotics for military defence, according to the global military robot industry 30.83 billion US dollars will be raised by 2022 with a CAGR of 12.9%, [43]. Some of the main uses of military-based robots will include wearable robots, surveillance robots and combat robots.

Wearable robots will allow the soldier to carry extra ammo, space to carry more food, medicine, and gear like night vision goggles, etc. The advanced hydraulic technology possessed by wearable robots helps the soldiers sprint 10 miles an hour while carrying up to 200 pounds worth of stuffs with them, [44]. ***Surveillance robots*** are used on the battlefield to analyse the terrain, enemy movement, and resources before an attack. Guard Bot is a surveillance robot that was designed and manufactured to be sent to mars, this bot can travel through hard terrain, sand, and snow. The device can be controlled through satellite and remotely, the military services are planning on investing in this future technology to study their enemy movement before an attack however the technology is still not in the market and is under development, [45].

Combat robots have been a matter of discussion over the past few decades, this technology used to be the reason for a raging debate in the United Nations, as automated killer robots could be a potential threat to the world, debaters called the UN to ban the technology and its development as per the suggestions from a pioneer in robotics and artificial intelligence but the strong argument from both the sides made it difficult to take a decision on the discussion, [46]. This technology being developed by us military has claimed to build a machine learning integration that has facial recognition and decision-making skills to target and execute the kill, [47].

Researchers from Harvard University are trying to develop soft robotics-based prototypes for defence advanced research project agency. The institute is trying to develop an exoskeleton also known as a wearable robot with the help of rigid components that helps support the leg muscle making joint movement less stressful with a heavy load. Inspired by the study of biomechanism, the suits are designed to consist of soft actuators and sensors which will be fitted on the ankle, knee, and hip of the soldier, the suit will also contain a flexible power system and human intuitive algorithm. University of Harvard was awarded a 2.9-million-dollar grant by the defence advanced research project agency to continue working on this project and develop a promising result, [48].

2.6.3 Future of Robots in Medical Sector

Healthcare organizations around the world are searching for new means of efficiency by introducing robots and robot-based surgeries into their hospitals. Medical robots within the larger fields of computer assisted medicine has shown huge interests in medical and surgical activities by healthcare professionals. This enables doctors to address the human limitations through the use of technology, while improving the overall safety and quality of the surgical procedures. Studies have also highlighted towards further research in all aspects of technological and systems development with increased importance on clinical applications. Finally, it is important that while working on key problems that are aligned towards both clinical and technological goals, the key measures of success are measured upon through patient care [49].

There has been an increased demand for robots in the medical industry during COVID-19 which can be attributed to the fact that doctors could perform surgeries on patients during COVID-19 at a safer distance to avoid contact that can risk the patient or the doctor transmitting the virus. This could reduce the risk of complications for the patient after surgery, [50].

It is also inevitable that innovations in automation will make their way toward the medical field as the advantages related to robotics have been carefully observed. With the help of AI, many things can be done such as calculations for tumours at a granularity that can help towards the creation of a better treatment plan. This is cab help to improve the TNM organizing framework that is being used currently. However, the development is expected to begin in a very basic direction such as developing laparoscopic port position or aid to link preoperative imaging. Furthermore, it will also act as a "telephone a-companion" which can be used for the purpose of getting in touch with an expert for assistance. As the advancements keep happening, the innovations will develop into an intraoperative "GPS", managing the interactions with the experts through activity, little by little. Since all these innovations will be collecting data bit by bit and sharing it across many emergency clinics and nations, small medical issues will be possible to be treated very easily. In addition, in a much more

distant future, it is possible that robotics will be self-governing and implement treatment on their own, [51].

2.6.4 Future of Soft Robots

soft robotics is a fast-growing branch of robotics that consists of technology that can be found in the medical industry to space exploration and disaster relief. While this field of robotics is still a proof of concept for many developments, there are some technologies related to soft robotics that are available in the market. The soft robotic-based technology can however bring a great opportunity for creating medical equipment with high potential into the market from navigating catheters to endoscopes this technology could minimize the impact of damage on the tissues, [52]. NASA is researching and investing in soft robotics to build space exploration probes that can be used to explore other planets with the flexibility and pliability the technology offers, this technology can also be used during natural calamities like earthquakes or a fire to navigate through confined space, [53]. NASA has also invested in ventures like breeze to create soft robots which do not have a central drive shaft, the robot does not require a metal shaft for its joint the robots joint could be completed just by injecting mould or plastic pieces, [54]. Soft robotics technology mostly concentrates on introducing new chemically and electrically powered soft actuators to and improve its rigidity-tenable properties, [55].

Material science and engineering are required to find and produce new generation active materials that can provide better stress, strain, and speed for certain soft robotic-based applications. The traditional metallic connectors and electrodes can't be used in the production of soft actuators, [56], [57]. This technology could help robots for many applications like navigating over hard terrains, probe through confined spaces that are harder for humans to reach, drug delivery in humans, and angioplasty, [55], [57], [58]. The section identified the different types of technologies that can be developed with the help of soft robotics and robotics in the future. The main idea behind robots is to develop a technology that can work exactly like humans and in a more efficient method and carry out tasks that are difficult and dangerous for humans to execute. The section has also provided concise information on some technologies that are being used in the medical industry and research field to obtain results that cannot be possible with human skills and ability. The review also describes some future technologies that can showcase a great change in the military, medical, and industrial sectors.

3 Research Approach

The research approach and methods adopted in the research are presented with the reasons for selection. Research Onion proposed by [59] has been followed in this study to select the most appropriate methods. In this specific context, the justifications for selecting the specific philosophy, approach, strategies as well as data collection and analysis methods are explained in this section.

3.1 Research Background

The research onion helps the researcher develop and implement the most effective strategies for conducting research successfully as shown in Figure 1, [59]. From the outside part of the research onion, each layer explains the detailed ways of conducting the entire research.

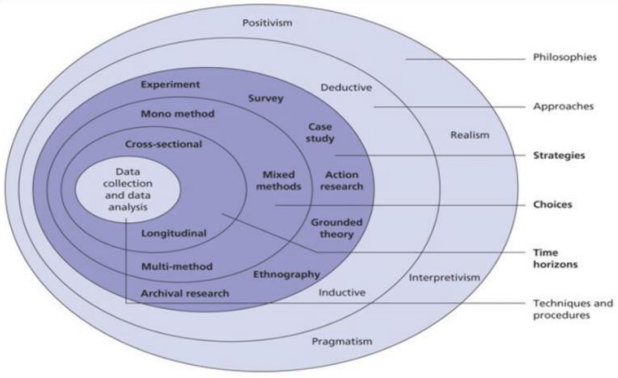

Fig. 1: Research Onion, [59]

This research onion helps the researchers to understand the stages through which the most appropriate methodology is designed for research. From right to left, this Research Onion shows the types of philosophy, approach, strategy, choice, time horizon, and techniques of research.

3.2 Research Philosophy

The above-mentioned research onion indicates that there are mainly four types of research philosophies used in business-related studies. These philosophies are positivism, realism, interpretivism, and pragmatism philosophies shown in Figure 2, [59]. Positivism philosophy helps researchers to gather factual data based on the specific research topic and objectives.

Following this philosophy, the researchers do not show any interference in the data collection process. In contrast, in the case of interpretive

philosophy-based studies, the researcher shows personal interest in the data collection process, [60]. On the other hand, pragmatism philosophy is generally followed to select the best-suited methods for the changing consequences of the research, [59].

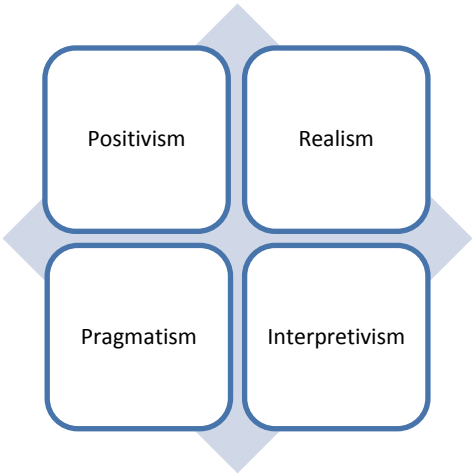

Fig. 2: Types of Research Philosophies, [59]

Realism philosophy allows the researcher to collect data based on the human mind's idea of independence. In this research, a positivist philosophy has been taken into consideration at the time of designing the research plan. This selected philosophy has helped to collect a range of relevant factual data for addressing the specific research questions. The use of robotics and soft robotics in the medical sector has been emphasized to collect relevant data for this research. To avoid bias from the collected data, the interpretivism and realism philosophies have not been selected. Moreover, to ensure certainty in the entire research design, the pragmatism philosophy has also not been considered in this research. Hence, it can be said that positivist philosophy is most appropriate in this present research context.

3.3 Research Approach and Strategies

The ***research approach*** helps to select the most appropriate data collection and analysis methods for research. As per the Research Onion, there are two main types of research approaches inductive and deductive research approaches as shown in Figure 3, [59]. Researchers mainly use inductive approaches when they aim to develop any completely new hypothesis, theory, or concept, [61]. Oppositely, the deductive approach is preferred when the researcher aims to justify, test, or prove any existing theory, concept, or hypothesis, [62].

Fig. 3: Types of Research Approaches, [59]

This present study aims to analyse the effects of shifting robotics to soft robotics in the medical industry. It indicates that the concepts of robotics and soft robotics already exist. However, the effects need to be known from the context of the medical industry. Hence, in this present context, there is no need to develop any new theory to answer the specific research questions. Taking all the above aspects into consideration, a deductive approach has been followed in this study to select the most appropriate research strategies and techniques. Following this approach, the researcher has been able to justify the previously found consequences of shifting robotics to soft robotics, particularly in the medical industry. Therefore, it can be said that the deductive approach is the most suitable approach for this present research.

Research strategy helps to perform an appropriate role in collecting data as well as information for managing those analytical interpretations of data and information in the research. Different research strategies can play a pivotal role in conducting research operations. These research strategies can be segregated into various parts; "Experiment, Survey", "Case Study", "Action research" and "Grounded theory" shown in Figure 4, [63]. As this research is based on secondary qualitative data analysis, archival information like journal articles have been searched considering the research requirements and then used here in this research so that proper findings can be mentioned. Data sources have been included here for making a justified research operation and development.

Fig. 4: Types of Research Strategies, [63]

One of the major reasons for choosing this research strategy is the large volume of research data and information that has been incorporated into

the journal articles, [63]. It is needed for the researcher to plan their database as per the strategic approach and hence a large volume of data sources has been included in this research for making a successful data collection operation.

3.4 Research Techniques and Procedures

The research method is helpful in managing the role of the data collection process which is helpful for researchers to make a significant analysis of their performance and research development plan, [64]. This research planning and execution are to be termed as one of the significant strategies for gaining a highly developed approach to their data collection as well as analysis operation with the help of their collected information evaluation process. These research choices are segregated into three types: "Mono Method", "Mixed Method" and "Multi-Method". This specific research has adopted the "Mono Method" for the analysis process as shown in Figure 5.

Fig. 5: Typologies for Research Choices, [59]

One of the prime reasons for following the Mono method is the nature of the data analysis process, which is to include a single type of data. As per the plan of action and data collection, secondary data, as well as information, is included in this data collection process for strategic analysis for gaining a wide analysis of the collected data and information, [65]. Data information management systems can be analysed for managing a proper data analysis method. This data analysis method has played a major role in the success of this research.

Time Horizon is a policy of data collection and research to make an analysis as per the nature of the information as shown in Figure 6.

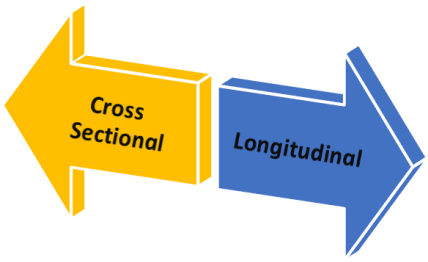

Fig. 6: Time Horizon, [66]

The researcher needs to develop data sources as per the need and hence, two types of time horizons have been chosen by the researcher, nowadays: "cross-sectional" and "longitudinal". It is commonly based on the type of data and information, which have been included in conducting this research analysis, [66]. This research has been based on secondary data and information; hence a longitudinal time horizon has been selected for this research. This time horizon is essential for the analyst to make a subsequent evaluation of the secondary information. This secondary information base has been chosen in this research for collecting specific data and information as per the need. The prime reason for this secondary data and information included is to include different data and information.

Secondary research and operation are needed here to make a justified analysis regarding data collection and analysis for gaining a major implementation regarding thematic implementation. This thematic analysis has been helpful for the researcher in making a successful analysis of the research and development objective, [67]. This objective achievement is needed for the research to make proper assimilation for understanding to develop objective linking and thematic discussion based on the identified articles. For managing the technique of the data collection process, different criteria like inclusion and exclusion criteria, have been chosen by the researcher. Furthermore, the information collection technique is to be included in the research operation for managing the proper growth with respect to managing the scopes of data inclusion.

This procedure of data analysis and collection techniques is significant, especially while conducting the secondary research operation. This secondary research operation is based on the journals and other sources, which have been included for making a proper objective linking and theme formulation process, [68]. To conduct secondary qualitative research, the selection of journals plays a major role, which can also be helpful in managing data collection techniques and operative sources. This research and development plan for the procedure and techniques to deal with keyword searching and focus on the research area. This research area needs to get developed as per the implications of data and information. In this research, relevant articles have been reviewed, and a thematic discussion has been made based on the findings from the articles.

3.5 Research Inclusion and Exclusion Criteria

As this research is based on robotics, especially soft robotics, it is needed for the researcher to include proper keywords for managing the inclusion and exclusion criteria. In the case of secondary information usage, this keyword searching plays a major value in the research. Both the inclusion as well as exclusion criteria have been adopted by the researcher as the aim and objective of the research as shown in Table 1, [69].

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
▪ Keywords like ***Robotics*** and ***Soft robotics.*** ▪ The research paper includes ***Robotics medical.*** ▪ The timeline has been selected from the last five years.	▪ Journals without these keywords have been excluded from this research. ▪ The inclusion of robotics in different sectors apart from medical has been excluded. ▪ Old journals out of the five years have been avoided in this data collection process.

These specific keywords and timeframe regarding inclusion as well as exclusion criteria have been implemented by the specific researcher to make their propositional approach which can be helpful to meet strategic aims and objectives, included in this research.

This research propositional and planning can help make a successful plan which is needed for developing the scope of research with high process analysis with the keywords, which can be included for making a highly developed analysis, and propositional approaches are to be developed accordingly. It is also needed for the researcher to follow the proper timeframe for conducting this research. One of the major reasons for choosing these criteria is to put the appropriate focus on the research topic. Additionally, it is needed for a researcher to make a proper plan of action based on information, from their data collection and analysis process. Furthermore, the respective researcher needs to deal with the proper data. As this research is based on a proper data collection process, it is needed for the research operators to make a proper analysis of the performance plan for managing a high growth scope and management. This growth scope management is necessary for the researcher to make a successful objective-linking policy. This objective linking policy is needed for the respective researcher to make a proper evaluation of specific data collection strategies as well as analysis.

This section deals with the strategy for conducting this research. Secondary data as well as information, which have been used has been used in this research. Positivism research philosophy has been used here for conducting this data collection process. Furthermore, it is needed for the researcher for making a proper deductive approach to gain a highly effective data collection process. Secondary research has been included in this data collection process to gain a proper degree of thematic analysis. This thematic analysis has helped the researcher to conclude. Objective planning and development are the main key sources of this methodology. The Mono method is used here to make a proper data collection and evaluation operation. Different information as well as exclusion criteria have been included in this research for selecting a proper data source for the management of that information.

4 Data Analysis

4.1 Background and Prisma Table

This data analysis part is based on 5 peer-reviewed journals, which are based on the influence of robotics and soft robotics in the healthcare sector. It is needed for the officials to make a subjective analysis and performance based on their influence. A PRISMA diagram has been included in this research according to the journal table as shown in Figure 7.

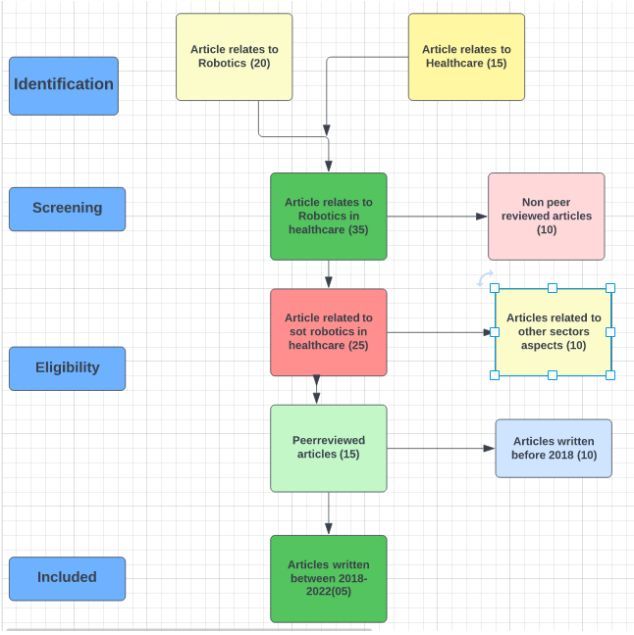

Fig. 7: Prisma Model Framework

The method of research and the findings have been discussed in this journal table along with the

detailed discussion. This discussion part includes a major discussion regarding the analysis and operative sources of data management and themes have been drawn accordingly. It is found that the discussion has included a concise analysis of the findings from the journal.

4.2 Key Research Source Review

The section presents the key research sources reviewed as part of the analysis the research questions and the framework shown in Table 2 (Appendix).

4.3 Discussion using Thematic Analysis

Theme 1: Soft robotics serves the purpose of better human-machine interaction, a simple gripping system as well as better adaptability to various wearable devices

Soft robotics can be implemented for managing better approaches to human-machine interaction [70]. It is needed for the direct communication process plan. This development plan can be commented on as one of the major strategies for gaining a scope of technical escalation and operation, [75]. This technical operation is needed for the authority to manage a diversified growth scope and operation. Adaptability can be commented as one of the major demands that can be taken into consideration while developing performance planning and operation for managing their sustainability quotient for better performance operation. This performance escalation is needed for the authority to manage the sources of the operation. An industrial or medical organization needs to focus on the adaptability of new technology for better service output, [76]. Along with that, continuous research and analysis are going on to gain an escalation of the robotics implementation.

According to [77], it is needed for the authority to develop their human-machine interaction policy, which can be helpful for them to gather a better adaptive approach. This is needed for the authority to manage their growth and sustainability operation with the help of their diversification quotient and performance. This performance balancing is needed for the authority to make a proper implementation of technology for managing growth, adaptability, and diversification.

Theme 2: Soft robotics is helpful for both the medical and industrial operation

Based on the above journal table, it is understood that soft robotics is the current demand in technology and healthcare. To gain success in more compact service delivery, dependency on the technology is increasing from the end of the operators. In the last couple of years, many hospitals in the UK and Singapore, are planning to make a subsequent development in their healthcare operation by delivering a special focus on the implementation of soft robotics, [78]. As per the above analysis, it is found that robotics implementation in the healthcare sector, especially at the time of operation has become a popular strategy. However, soft robotics can be committed as one of the significant tools, which can be applied at the time of operational activity in healthcare. Technical forces are to be managed for the authorities to gain a major success plan including success in the activity. The implementation of robotics can be taken into consideration while managing sustainable growth and accuracy in healthcare operations. To gain a major development in robotics implementation, is officials are needed for officials for manage accuracy, [79]. In developed countries, both private and public hospitals are focusing on attracting an effective patient base, [80]. Shifting towards soft robotics can play an effective role in attracting those customers into their operational plan.

Theme 3: Soft robotics is more effective in compared to conventional robotics

In the current era of technical planning and diversification, one of the major reasons for including soft robotics is its better productivity operation as compared to conventional robotics. It is evident for those developers to conduct research on robotics to gain better output, [81]. As per the findings of the journals, it is noticed that the roles of technical development can be managed with high growth in technical factors of robotics implementation. This technical task can be included in managing high growth and analysis of the need, [82]. Different research operations are still going on, which can implement a major success in the revenue generation and accuracy process in healthcare. Soft robotics have been used for the replacement of human tissues, and companies like Baymax, are currently developing their soft robotics for making its proper inclusion into the healthcare sector, especially for the replacement of organs, [83]. Big Hero 6 is a popular project of this company that can be used in medical healthcare operations, [84].

To gain major diversity, it is needed for the officials to shift their process toward soft robotics. There is a long debate about whether soft robotics is needed for the escalation process or not. To include this soft robotics protocol in medical operations. In

this healthcare operational role and responsibilities, soft robotics with high implementation planning, [85]. Propositional growth in technical spheres is to be analysed for managing the accuracy level. Different aspects of soft robotics can be influenced for gaining a high operational process for their strategic technology implementation, [78]. A Special research and development operation is going on to manage the soft robotics technology. Medical areas like orthopaedics and cardiac cure processes can be benefitted from the application of this soft robotics.

Theme 4: Different limitations and challenges, faced by the current robotics

According to [71], one of the major challenges of the current robotics system is the lack of utility in all the sectors in both the medical and industrial sectors. The Healthcare sector can be commented on as one of the major revenue-generating areas, in private entities. As per the examples of highly developed countries like the USA, Italy, and Denmark, it is found that all the implications are to be managed for gaining a productive and operational advantage. However, it is seen during the COVID-19 that the robotics implementation has faced a major challenge in the following areas.

- Mobility.
- Manipulation.
- Actuation.
- Control.
- Sensing.
- Human-Robot Interaction.
- Physical HRI.

Challenges have been faced by the organization in managing sustainable growth and diversity to deal with the issues of current operational management and development. It is needed for the officials to find out a solution to the planning. During the Covid-19 pandemic situation, it is seen that all the factors are to be developed for managing the need and sustainability practice by providing additional care to the patients for managing performance development and operation. This performance management planning and operations are based on the overall performance of the robotics implementation. Furthermore, technical errors can also be commented on as a strategic challenge, which can be produced in front of others, [86].

Theme 5: Soft robotics seems effective in future operations in the medical industry

Many healthcare officials are managing their distinctive focus on soft robotics implementation for gaining a sustainable hike into their policies and proclamations for gaining a developed accuracy during their practices. The application of AI technology is one of the major components that is to be followed by the officials for managing a sustainable growth plan, [81]. This growth planning operation is needed for the officials for a scope of performance management and operation. This performance management and operation can be improved with the proper application of robotics, especially soft robotics for providing accurate service. Medical development is needed for the organizers to gain a hike into their planned operation technique, [82]. This technical enforcement is also essential for the healthcare units, [87], [88].

This study is based on the observation and findings regarding the implementation of soft robotics in the healthcare sector. In the PRISMA diagram, the strategy of journal selection has been implemented. Five journals have been chosen for managing the data collection and analysis process. Themes have been chosen in this study as per the subject matters as well as the objectives of the research. Along with that, an in-depth discussion of the journal findings has been included in this section. Journals have also been chosen as per the objectives of this research.

5 Conclusions and Future Recommendations

From the overall discussion it can be concluded that in the study of robotics, soft robotics has made outstanding progress because of which overall the medical industry being benefitted. It has been found that in the medical industry, robots are being used in conducting surgery, as lab assistants whereas soft robots are being used in the research fields. Apart from that this study has helped in identifying how soft robotics is becoming part of the minimum invasive surgeries (MIS) and microsurgeries, endoscopic surgeries, and Amputation along with helping in drug deliveries as well. In the pandemic era as well, robots have been considered a great resource for helping the healthcare setting such as monitoring patient condition by checking the temperature, pulse rate, and breathing frequency. Other operational roles such as robots as food delivery persons and the military also use robotics in real life. From the overall process of the research, it is found that soft robotics is the current demand of industry and healthcare for managing their roles and responsibilities. It is found that different

modulations of soft robotics have been planned and developed for both industrial and medical roles. Along with the prime topic of this research, the focus has been prompted to the process to soft robotics from conventional robotics implementation in the healthcare sector.

5.1 Key Conclusions and Linking to Research Objectives

Linking Objective 1:

Soft robotics is needed for gaining major development in the industrial as well as the medical sector. By implementing this technology, docs and other healthcare operators can get an advantage in managing better operations. Prosthetic limbs and Origami muscle robots are prominent examples of soft robotics, which can be implemented in the healthcare sector. One of the major aims of this soft robotics operation is to deliver a successful approach to planning and implementation as per the need for formative development and process to deliver better service. In many developed countries like the USA and Japan, this software robotics technology has been implemented for managing better outcomes for operational development. This operational development is needed for the authority to manage growth and development for purposes of dealing with time-consuming operations. AI-powered interfaces are examples of soft robotics, which can be assigned to medical operations. It is needed for the officials to manage a successful implementation of robotics to manage the growth scope and adequate accuracy. The development of the human-machine interface can also be mentioned as a major purpose of soft robotics. This process can be helpful in the medical sector for managing substantial operations and potential outcomes.

Linking Objective 2:

Three types of soft robotics have been used for medical purposes: rehabilitation, surgical, and diagnostic soft robots. As per the above analysis, it is found that the process initiations are to be developed as per the aim of healthcare service and development. This process needs to be developed to reduce human pressure. Both soft robotics and origami muscle robots need to be included as with the aim of better observational outcomes. To manage substantial growth and development, it is needed for the authority to develop proper medical care. It is also needed for the authority to manage the accuracy of the healthcare operation. Therefore, different procurement strategies have been followed by medical caregivers to manage sustainable growth for their operational policy improvement. These policies are to be implemented for managing major accuracy during their healthcare operation. Matching the Physical properties with biological tissues is the prime motto for adopting technical development through soft robotics implementation. Therefore, it is needed for the authorities to make a substantial plan for including this technology on medical grounds.

Linking Objective 3:

Soft robotics possess high-level behavioural diversity which is absent in conventional robotics. It can be commented that the planned action and operational performances are to be followed by the authority for managing sustainability in operation. Tolerance of low accuracy can also be commented on as one of the major factors that can be implemented for managing substantial growth, analysis, and diversity management. This growth analysis and diversification are needed for the authority to manage development issues, which can be performed by officials of the operations. In all the above-mentioned aspects, it is seen that soft robotics is more useful as compared to the conventional robotics method. This conventional robotics method cannot deliver equal potential from the point of three major factors: flexibility, sensitivity, and malleability. However, in the case of soft robotics, these three components are to be delivered accordingly. From this point of discussion, it can be commented that soft robotics can deliver better productivity, compared to conventional robotics applications. Therefore, officials of the medical units are currently focusing on developing this technology for achieving better outcomes and performances.

Linking Objective 4:

One of the major limitations of conventional robots is the lack of multiprogramming and multitasking. It is found that conventional robotics are based on a single user interface and lack of human-machine interaction. As per the latest AI development, this interface development is needed for the authority to make a substantial growth and development plan for managing the workforce in both industrial and medical areas. During the COVID-19 pandemic situation, conventional robotics played a major role in the healthcare units of the USA, Italy, and Denmark. However, it is seen that multipurpose activities are not to be performed by these conventional models. Therefore, the operators need to search for a better replacement. AI-based behavioral technology is one of the significant parts of soft robotics, which can be helpful for better

performance in the medical and healthcare sector. Therefore, most of the officials are shifting their focus on achieving development in the aspect of planned activity and performances. To achieve successful operational objectives for managing growth and sustainability, robotics implementation is needed for the operation. To meet all the limitations, soft robotics is essential with their AI-based behavioral diversity technology. One of the major disadvantages of conventional robotics is the size of machines and their production cost. Furthermore, the maintenance cost can also be coined as a major disadvantage of conventional robotics.

Linking Objective 5:

Since 2014, soft robotics has been in increased demand, and it is needed for the authority to manage the scope and development of their planned technology operation and development. It is useful for the authorities to use nanotechnology and more user-friendly interfaces for managing soft robotics in their plan of action and development. These user-friendly interfaces are to be developed as per the needs of common operations in the healthcare industry. In the future, nanotechnology with robotics implementation can play a major role in this development planning and operation to deal with the notions of performance and development. Both the industrial and medical sectors need proper development to increase their skill development and operation. This potential development is needed for the authority to develop its growth scope and operation as per the aim of these institutions. It is also found in this research that the objectives are to be achieved for gaining substantial accuracy in the technical and medical fields. In this regard, the planned actions are to be taken into consideration and manage a major escalation after evaluating the research of current soft robotics practices. After implementing a better AI system, it is needed for the authority to manage the development process with the proper implementation of developed AI technology. It is also expected that different human organs can function by robotics for manage growth performance.

5.2 Future Recommendations

Hence, the recommendations are mainly based on implementing soft robotics in the system to solve the issues faced by different patients and normalize their lives by adding such technological advancements.

- One of the most important aspects is to recommend soft robotics so that better care is taken for several patients who are not able to walk or do any kind of physical activities because of which the barriers to those physically challenged patients can be decreased by 10% within the next 8 months.
- Artificial muscle development is needed to get infused into soft-robotics planning and development. This soft robotics planning should also include the process of technology and its influence over healthcare operations. It is also important for the operators to make a special evaluation of the conventional robotics needs and operations.
- Optics development is needed for the authority to include soft robotics in healthcare planning and operation. This healthcare planning can also be developed as per the sense of responsibility during the performance of medical infusions. Organs, which have been designed for future implementation, will also be based on AI technology and its operational data inclusion and performance.
- The recommendations also include the addition of the latest robotic technologies used in the medical field to cure patients without facing any difficulties so that the cure of the patients can be faster with a rate of 20% within the next 12 months. Medical services should include robotic systems so that they can simply do their work and save most of the physical labour. To keep a balance of the medical sense, AI technology needs to be included in this research as per the need for operational development and planning.
- One of the most important recommendations in delivering the ideas which will help in finding a better solution that is relevant. Implementing soft robotics will help the patients to regain their confidence by 15% within the next 6 months. They will find it better to undergo different challenges without facing any difficulties in terms of their physical abilities. Hence, medical fields must implement the latest enhancements to upgrade the quality of treatment provided to patients and to cure them immediately.

Soft robotics can be commented on as a significant tool for the industrial and medical sectors in future times. This research can be used for future evaluation to include findings for the larger area, where these findings are to be articulated. Along with that, the recommendations, which have been mentioned in this study, can play a pivotal role in increasing the service quality regarding soft

robotics. Medical fields like neurosurgery, cardiac and orthopaedic, can also get help from the soft robotics implementation. Dependence on journals and online articles reduced the scientific data and knowledge regarding technology. Technical knowledge plays a major role in soft robotics, especially at the time of its influence on the medical sector. It is needed for the authority to make a subsequent plan of action for making an adequate development. This is also essential for the researcher to shed light on the technical aspect of soft robotics, which can be further implemented into subjective analysis and performance planning for gaining a development plan of action and analysis. However, the lack of technical data can be commented on as a major gap in this study.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

The authors wrote, reviewed and edited the content as needed and they has/have not utilised artificial intelligence (AI) tools. The authors take full responsibility for the content of the publication.

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APPENDIX

Table 2. Research Question and Sources

Research Question (RQ1): What is the purpose of soft robotics?	
Authors	[70], [71]
Source	Soft robotics: A review of recent developments of pneumatic soft actuators. In Actuators
Method	A secondary quantitative method of data collection has been used here as a method. Different technical applications like semiconductors have been used here for managing the authenticity of the data collection process.
Findings	***Soft Pneumatic Actuators*** have been discussed in this journal for making a subsequent analysis for managing growth and diversity in robotics inclusion. This inclusion plan is needed for the medical sector to manage growth. This journal has also discussed the implementation of soft robotics in the medical sector.
RQ2 - What are the limitations of conventional robots?	
Authors	[72]
Source	Medical robots for infectious diseases: lessons and challenges from the COVID-19 pandemic. IEEE Robotics & Automation Magazine.
Method	Secondary data from countries like Denmark, the USA, China, and Italy have been taken here for discussion. A table has been included in this journal, which marks the area of challenges. Most of the observations of this journal have been included during the Covid-19 pandemic situation.
Findings	In Italy and China, Mobility of Robotics has not been found to be effective in Diagnostics, Treatment, and Homecare. Actuation of prevention, screening, diagnosis, and treatment are not sufficient in Denmark and the USA. Therefore, it can be commented on as one of the major challenges of robotics implementation. Along with that, technical errors and malfunctions during healthcare operations can be commented on as the significant challenge of robotics.
RQ3: How is soft robotics useful in medical and industrial applications?	
Authors	[73]
Source	Soft robotics with compliance and adaptation for biomedical applications and forthcoming challenges. International Journal of Robotics and Automation.
Method	This journal is based on secondary data and information regarding the literature on robotics and soft robotics implementation. Keyword-based searching has been included in this study for managing a vast literature source.
Findings	It is viewed in this journal that soft robotics has become the major diversification in robotics engineering. One of the prime reasons for implementing soft robotics is to gain growth in both the commercial and medical sectors. It is needed for the officials to make a substantial analysis of the implementation of this soft robotics in the medical sector.
RQ4: Why is soft robotics more reliable than conventional robots?	
Authors	[74]
Source	Flexible actuators for soft robotics. *Advanced Intelligent Systems*.
Method	This study is also based on secondary data and information. This study provides a major focus on the optical instruments that have been included for managing a high growth regarding the optical and ware-based technologies.
Findings	It is found that robotics is continuously going through the analysis process, and it is needed for the developers to include soft robotics technology based on the improvement for commercial and medical purposes. It is found that implementation of the robotics is commonly observed in the operation theatre for conducting complex operations and surgeries.
RQ5: How is soft robotics going to be the future of advanced technology?	
Authors	[75]
Source	An overview of novel actuators for soft robotics. In *Actuators*
Method	A systematic literature review has been conducted for managing the data collection process and analysis. This data collection process has been conducted by including several literature sources, which have been included in this research.
Findings	This study has provided details regarding the application of both robotics and soft robotics. All these technologies are planned to be developed with a proper implication for data collection and management operation. It is also evident that this technology can be included in medical purposes.