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Applications of Robotic in Industry – A Review

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Abstract

As the time passed the population increased to such an extent that it felt short of everything from food grain to cloths, from needles to automobiles. At that point Industry 3.0 came into existence, where primary importance was given to automation, including robotics. Robots were used in every aspect of industry, including manufacturing line, painting, loading, material handling, joining, and hazardous places where humans cannot make a move. Even healthcare requires robotics to carry out complex surgery, where operating by hand leads to damage of other organs. Nowadays robotics found its application in almost all fields including health care, assembly line, fire extinguisher and others. Robots are used widely because of their accuracy, precision and almost nil errors. The current article overviews the industrial applications of robots along with the advancement occurred in Industry 4.0.

Keywords: *Automation, Industry 4.0, Robotics, Health care*

1.0 Introduction

The study of the construction, operation, articulation, and programming of robots falls under the purview of the scientific discipline known as robotics. The development of robots, including their designing, coding, fabricating, and testing, is the focus of study. The field of robotics requires knowledge from multiple fields, including electronics, mechanical engineering, and electrical engineering. These days, robotic arms are used almost exclusively for the automation of industrial processes and for work in potentially dangerous environments. The high-precision actuators and component machining that are required for many robotic controls drive up their overall cost significantly. Both traditional methods of manufacturing known as subtractive manufacturing and more recent methods known as additive manufacturing may be utilised in the production of robotic components. When compared to subtractive manufacturing, additive manufacturing offers a number of beneficial alternatives, topology optimization is a method of access that makes use of mathematical tools to access materials that are to be distributed while designing. This method of access is known as topology optimization. In days gone by, conventional manufacturing techniques were applied to the process of developing topology optimization, which led to the creation of designs with complex geometries. The optimization of the topology is hindered as a result of this complex geometry, and the results of the efforts put in are not fully realised. With the advent of additive manufacturing (AM) techniques, it is now possible to construct a layer upon a layer directly from a three-dimensional (3D) model, proving that the geometry of complex shapes does not pose as much of a challenge as previously believed. The realisation of optimization through the use of AM grants designers and engineers unrestricted freedom.

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2.0 Review of Articles

There are many fields where robots are used nowadays, the current article mainly focuses on healthcare, military, industry, agriculture etc.

2.1 Agriculture

In this fast-paced world, both the human population and the need for food are rising at an alarming rate, yet the available agricultural resources are getting smaller. In this rapidly developing globe, both the human population and the requirement for food are expanding at the same rate. However, both the traditional forms of agricultural labour and the available agricultural resources are dwindling. Many researchers in the field of agriculture are considering and experimenting with the use of robots in order to improve productivity in the areas of harvesting, picking, and other tasks that have shown to be particularly effective. The use of agriculture robots needs to become more feasible and practical. The researchers in the scientific community have proposed splitting the effort in half. They separated it into two parts: (1) Designing, and (2) Developing a cloud-based service that would link the robots to the phones of the field labourers. In order to construct these types of robots, they make use of the tools and apparatus that are available. Only for a little period of time have these proven successful robots are not yet totally self-sufficient, and their main focus was on software rather than hardware abstraction[1]. This robot's design allows it to do a wide variety of functions, and it also allows it to be reprogrammed, in order to raise both the quantity of food produced and its overall quality, while simultaneously reducing the number of skilled labourers needed in the agricultural sector. This concept of robotic agriculture is not a new one; in times past, many engineers have attempted to develop a tractor that does not require a driver, but they have not been successful. Why? Mostly due to the fact that they did not grow up in this hectic modern society. The following step is for them to consider and design robots utilising modern technology to carry out seed mapping, weed mapping, and micro spraying. These robots are now also available since they cut down on the amount of work that needs to be done by humans and save time. And these robots meet the food requirements of the world's population, which is somewhere around 9.6 billion people[2]. Agriculture robots, sometimes known as ground robots, are being developed for use in the farming industry to assist people in doing particular duties and to take over farming entirely. In this industry, there are primarily two categories of robots. 1. mobile robots capable of moving on their own power. 2. clever robots. Applications for the type one robots require little to no electricity. Some commercial and nearly commercial robots, such as Xaver, which is a seeding robot, and container handling robots. These robots take the place of the heavy machinery in the field and also help to lessen the impact that machinery has on the soil. The second category of robots are the ones that are designed specifically for specific tasks. The transplantation of seeds, the thinning of lettuce, and the mechanical weeding are all done by these Smart robots. The question of why these type 1st robots, which are intended for automation, can't be employed in flower and green fruit thinning to control crop load arises.. Food security is currently confronted with significant obstacles, such as climate change, the depletion of soil, the loss of biodiversity, the scarcity of water, and growing populations. Therefore, in order to meet these issues, knowledgeable people have proposed using the recent developments in the science and engineering of robots to transform the way farming is done. And these robots are employed extensively to fulfil the requirements of the agriculture industry. They believe that this will lessen the amount of work that needs to be done by humans and animals. And to lessen the workload of people so that agricultural production can generate a higher profit while simultaneously reducing the amount of water used and the amount of labour required. The majority of the time, robots are utilised in the processing, packing, and general handling of food[3]. Teleoperation is a relatively new concept in the domain of agricultural production. It includes the advantages of combining human know-how and accuracy provided by robots, as well as the removal of people from potentially dangerous situations, such as spraying plants with chemicals. These teleoperation robots have improved both in terms of their usability and their performance. A PS3 gamepad or a keyboard can be used to remotely control the robots in this scenario. The operators of the robots can monitor the progress of their work through the use of digital glass, cameras, or the screens of personal computers. These also use the Wrap tracker because it enables the software and monitor operator to properly direct the view in the appropriate direction and angle. To teleoperate the robots, the operator is located away from the actual field and uses the images captured by cameras mounted on the robots themselves. In light of this information, the crops are sprayed with the chemicals. The user interfaces of these teleoperated robots are being updated on a daily basis so that they can become more effective as agricultural sprayers[4]. It is anticipated that modern farming would result in the production of more natural goods of a higher quality at lower prices. The use of manpower and animals results in a higher cost. Therefore, we made preparations to utilise robots in this. Not only do robots provide the sensor technology, but they also provide a constant gathering of data from the field. It is necessary for the robots to touch, sense, and manage the crops. In addition, these robots were designed to operate in unstructured surroundings and perform a variety of unknown jobs. The autonomous harvesting system, which incorporates the specialised mobile platforms and cutting-edge grippers, has shown to be the most beneficial familiar. Why is this gripper included in the commercial greenhouse spraying that is done for pest control? The technique of removing leaves from plants and also known as plant pruning. In addition, greenhouse companion robots were implemented after their introduction. These make it possible for people and robots to work together. These are mobile carts with four wheels that are used for controlling harvesting and pest activity. Agri Robots not only improve the health of the soil but also increase crop harvests[5]. Robots have also found applications in the marine system, most notably as unmanned vehicles for use in underwater surveillance. In other words, they are put to use in the process of identifying the dangers that lurk beneath the ocean floor. The safety of the human operators is the primary focus of the strategy of substituting robots for human pilots in unmanned underwater vehicles (UUVs). The use of unmanned vehicles in the surveillance system has a great number of advantages; for example, they can perform low-level tasks in place of humans. UUVs are able to carry many different types of sensors. These can be acoustic echo sounders (Single and Multi Beam), which produce a three-dimensional map of the area, or they can be acoustic ones like side scan sonar (SSS) and synthetic aperture sonar (SAS), which produce an image of the sea bottom seen from the side.. This assists human beings in obtaining information about places and things that they are unable to access directly. These robots are equipped with the ability to carry a variety of sensors onboard, which enables them to perform a wide range of tasks. Robots in underwater surveillance play a critical role in locating and neutralising explosives and other potentially dangerous devices. This is one of their most important tasks. The illustration to the right provides a visual representation of the concept of unmanned underwater vehicle systems for use in surveillance[6].

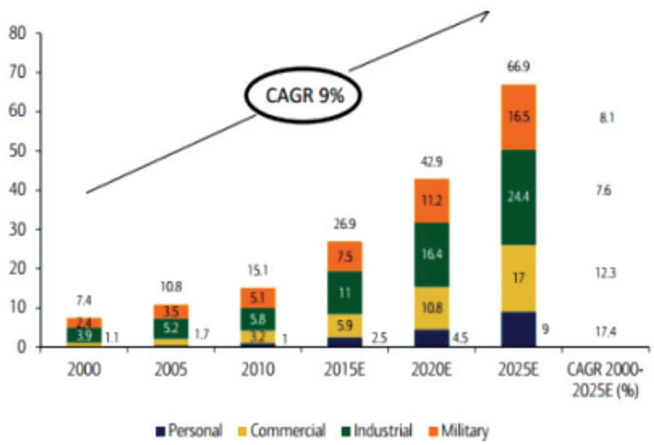

Figure 1: The graph showing robotic marketing in upcoming years

2.2 Under Water Applications

Several significant sensing technologies will be covered in the debate, including underwater acoustic, underwater optical, underwater magnetic, and underwater bionic sensing. With the help of this technology, it is feasible to apply underwater visual sensing, underwater robot docking, underwater human-machine interaction, underwater pipeline monitoring, and underwater shipwreck reconstruction. Some of the uses for underwater 2D visual sensing include underwater item tracking, underwater object restoration, and low-quality underwater photographs. Underwater acoustic, underwater optical, underwater magnetic, and underwater bionic sensing are some of the different types of sensing technologies for underwater robots[7]. Because of the flexibility they offer, reconfigurable robots have become an appealing topic of research in the field of robotics. The manufacturing industry was the primary force behind the conception of reconfigurable robots in the field of robot manipulators. This concept has been used to a variety of subfields within robotics, including land-based robots and underwater robots. The modular design concept is a prominent idea for reconfigurable robots. The robot can connect or disconnect its complementary elements, according to this notion. One recent example is a modularly reconfigurable robot with autonomy that is driven by vision. This type of robot is capable of completing difficult tasks by dynamically redesigning itself in response to the environmental information that it detects[8]. For exploration and manoeuvring at deep or in disturbed surface waters, it may be more effective to mimic the propulsion strategies used by fish and other marine animals. This is made possible through the utilisation of soft manipulators, which make it possible to safely handle delicate coral reef samples. Although soft robots offer a lot of potential, several challenges need to be overcome before we can fully utilise the capabilities of bio-inspired intelligent soft systems[9]. It is now possible to manufacture and test several designs of soft robots and optimise their morphological and material features while they are submerged thanks to such advancements in 3D printing techniques for soft materials. The huge number of degrees of freedom that are formed as a direct result of the significant deformation of the soft materials that make up soft robots pose a number of obstacles for their actuation.. As a result, soft robots are under actuated systems that are more difficult to control. The fully pliable robot makes use of totally pliable microfluidic logic to regulate gas generation brought about by the breakdown of chemical fuel, which ultimately results in actuation. Controlling the robot's entire body deformation is the main duty of soft robotics controllers. This duty may also include controlling the exact placement and orientation of an end effector in the case of soft manipulators[10]. The untethered underwater vehicle, often referred to as an autonomous underwater vehicle, first started to appear in the 1970s as a response to the limitations imposed by manned submersibles and remotely controlled vehicles (ROVs). Architectures: There are several challenging problems that the architecture for high-level control of autonomous underwater systems must be able to address. These difficulties include the unique characteristics of the undersea environment, the need to operate in real-time, the cutting edge of the current architectures, and the ability to work with partial and ambiguous data. Search and clearance efforts for shallow water mines. Off-board sensors installed on submarines. Clandestine survey and reconnaissance survey of the ocean and evaluation of the resources; the building of subsea structures as well as their upkeep and maintenance; Arctic region offshore oil and gas production and exploration inspection of the ship's hull and interior examination of its tanks investigating nuclear power plants; Underwater mapping and exploration, installation, and inspection of communication and power lines; Search and rescue operations for missing ships and people in the ocean; Underwater adventures as entertainment; Underwater ranger in the fisheries reactivity: The undersea system must react swiftly and effectively to severe alterations in the environment[11].

Figure 2: PEMEX's ROV for underwater oil finding monitoring

2.3 Industrial Applications

Welding, painting, transportation and material handling, assembling and manufacturing are among the most common uses found in industrial settings. Robots can be found operating in a diverse range of environments, and they are utilised for an equally broad spectrum of tasks. One of the fundamental aspects of a function is how a robot uses a tool or handles a piece of work. Two human-performed tasks that are essential to the operation of every robot installation are programming and routine maintenance. Applications that make use of robots are most likely to fit into some of the categories. Mainly, the machine's safety falls within the first category. It is clear that more focus should have been placed on the development and application of safety-related procedures. It is clear that the usage of robots affects safety, and it is also clear that more focus needs to be placed on developing and implementing safety protocols. Because it is challenging for people to achieve the needed precision, accuracy, or quality in such repeated jobs, industrial manipulators of the second category have been employed in significant numbers. Economic factors were generally more appealing than ergonomics issues in the introduction of robots into the companies that were analysed. This was the case for both reasons for the introduction of robots. a more prolonged exposure to mechanisation. The use of robots was favoured above the implementation of "hard" automation[12]. The application in the automobile sector is discussed in this article. A robot is a device that can be controlled, reprogrammed, and used for several purposes. Robotics is the most important subfield of automation in all industries, not just the mechanical one. The manipulation of robots, technological robots, universal robots, and special robots are the primary uses of this technology. In this one, you can relatively adjust the position and orientation of things in industry products; you can be also be well designed the procedures of painting; you can wielding of machine; you can perform different sorts of works; and lastly, we can use for performing in any specific circumstances also. In addition, the production of motor vehicles is the most important part of the automotive industry. To improve the efficiency of the production process, we can use two important pieces of machinery: CNC machine tools and industrial robots. These machines will make the process more accurate, and they can perform a variety of complex tasks[13]. The relationship that exists between research organisations and businesses is critical to the process of driving innovation through the use of new approaches. However, we may utilise them in three different domains, the first of which is the sector of healthcare, which is currently brooming stronger in the market. The researchers in this study are primarily concerned with the applications of military robots. Secondly, in terms of potential markets for agricultural robots and their associated business models. Thirdly, they are employed for the purposes of the public interest, such as rescue, civic infrastructure, or law enforcement, all of which are considered to be under the category of the civil market. Robots are applied in business concepts that include individual clients, such as vacuum cleaners, and examples include the following: The term "consumer market sector" can be used to refer to the human robot industry. Human robots are placed into a variety of carefully considered technological categories[14]. One of the industrial sectors that is growing is the industrial robotics industry, which offers standardised technologies that are perfect for a range of automation tasks. Industrial robots are versatile manipulators. The trends of robots can help identify the most pertinent ethical, technological, and scientific uncertainty that is restricting for the goal of implementation. There are two different kinds of applications that can be carried out by robots. (1) The traditional and (2) The contemporary. The traditional robot strategies impose restrictions on the number of humans allowed in the workplace, allowing robots to potentially take over for human labourers while also enhancing the design, control, and sensing capabilities of robots. In the not too distant future, neural network–based control algorithms will be implemented using robots. The primary component of a contemporary strategy is the utilisation of collaborative robots. These days, we also have the ability to recognise the object and tailor the design specifically to it. In the realm of medicine, it is also going to be utilised for the purpose of surgery. After that, this can be useful for the planning of the path and the optimization of it. Researchers may well be able to help with the creation of intelligent robot companions, as well as with the development of signal processing and decision-making systems, and we might even modify the robots themselves[15]. The historical context of industrial robots is presented in this paper. The intent is to highlight the close connection between industrial communication systems and smart factories' industrial robots as well as the role that highly developed communication infrastructures play in promoting these machines. 1967 saw the introduction of the first industrial robot in Europe. Included in the common fields are spot welding, spray welding, robotic electronic testing, metrology, assembling, and machining. Another significant trend that has emerged in robots recently imparts knowledge about providing services rather than products as the latest trend in robotics[16]. Both new and established models of doing business need to be rethought in the context of production and demand for flexibility in conjunction with manufacturing processes. There are nine different components that make up the business model canvas. These elements include of the value proposition, clientele, client relationships, channels, income streams, key activities, key partners, key resources, and cost structures. By utilising robots, Industrial Revolution 4.0 facilitates the collection of technology, including both physical and visual components, as well as interactions with machines, intelligent products, and internet-based solutions. Alterations can also be made to the prevailing weather pattern if necessary[17].

2.4 Healthcare Sector

By incorporating robots into the healthcare industry, not only may frontline healthcare workers be shielded from the risk of becoming infected with the coronavirus, but also the need for medical people can be reduced since robots are able

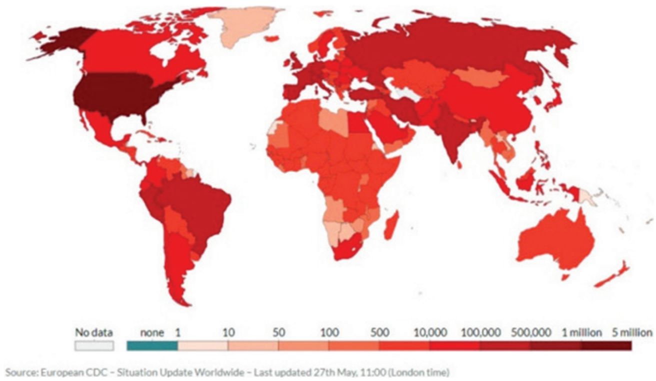

Figure 3: World map showing death rate due to Covid-19 per million people

to partly assume certain medical responsibilities. Part one provides an overview of the technical specifications of healthcare robots; part two discusses the various types of cutting-edge healthcare robots that are being used to fight the pandemic; part three explains the classification and operation of various robots; part four synthesises the findings that have been derived from this research; and part five provides an analysis of what can be done to improve the efficiency and dependability of existing robots. Robots are required to execute autonomous cardiac ablation on a beating heart since a surgeon can't do this procedure correctly without a surgical robot's ability to put exact lesions in the patient's heart. As a result, the majority of surgical robots are quite useful during the pandemic. The burdensome burden placed on the shoulders of healthcare professionals could be reduced by using these robots to perform challenging procedures on COVID-19 affected individuals[18]. Direct robot users, medical professionals, and caregivers – all of whom are likely to use robotics technology on a daily basis – are the study's main beneficiaries. Researchers are another group of possible users. Secondary beneficiaries include those involved with the usage of robots technology in healthcare settings, such as health administrators, robot manufacturers, and environmental service personnel. Although they do not directly employ the robots to assist the health and welfare of DRUs, these people all gain from the use of robotics technology in healthcare settings. Since they are interested in using robots to provide care for their clients but are unlikely to use the robots directly, policymakers and advocacy groups are seen as tertiary beneficiaries. Novel methods for delivering 3D registration in real-time while traversing both flexible and rigid surfaces, new approaches for managing uncertainty, and intuitive physical and cognitive engagement between the user and the robot. Other potential future research directions include the development of new methods for managing uncertainty. In the area of wearable robots for DRUs, there has been tremendous advancement in the last few years in the areas of actuated robot orthoses, prostheses, and exoskeletons. Robotics manufacturers frequently place a premium on a robot's functional skills. This covers issues including whether the robot can complete its task safely and dependably in light of the constraints imposed by the workspace, environment, and platform[19]. Automation and robot use in healthcare and related industries are expanding daily. According to the International Federation of Robots, demand for medical robots will increase over the next few years. Hospital receptionist robots, hospital nurse robots, and other robots in these categories. The Roomba cleaning robot is a newly discovered intelligent navigation vacuum pump for drying[20]. It's crucial to understand that the robots themselves differ widely before going into the numerous roles that they can and have performed in mental health research. The user's interaction with a robot is influenced by the manner in which it communicates with them. A compatibility between the user's personality and the robot's "Personality" is associated with increased time spent with the robot. With the aim of creating cost-effective robots for therapy, researchers are already working on low-cost therapeutic robots and directly addressing clinician concerns about robot programming. It's true that perceptions of robot safety can be influenced by preconceptions, and genuine and perceived safety issues are barriers[21]. It aims to: describe articles based on distribution, bibliometrics, and scientometrics, critically appraise articles and identify domains of focus related to health, nursing, and human-computer interaction, analyse research articles based on human-computer interaction attributes, and investigate the features and morphology of healthcare robots found in the literature. The majority of articles used older adults as study subjects and primary robot users, with only a few including nurses and other healthcare professionals as primary robot users. Active controlling interaction with a tele presence robot that has been improved robots have the potential to help nursing students learn new skills[22]. Nanorobot-based gene therapy medical nano robots can rapidly identify genetic illnesses by comparing the molecular structures of DNA and proteins found in the cell to known or desired reference structures. The nano robot for brain aneurysm prognosis, employing computational nanotechnology for medical device prototyping. The same technology can now be applied to the development and research of medical nano robots. The electrochemical sensor on the Nano robot generates a feeble signal of less than 50 nA when it detects NOS in trace levels or within a typical gradient. Assuming that the NOS concentration in this situation is within tolerable intracranial NOS levels, the nano robot ignores the NOS concentration. The model takes into account each time the cell phone has received at least a total of 100 nano robots greater proteomic signal transduction as strong indication of an intracranial aneurysm as a practical threshold for medical diagnosis in

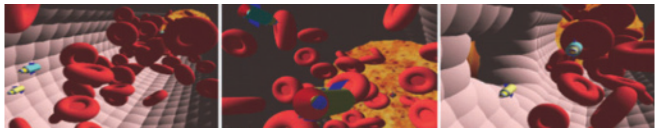

Figure 4: Working of Nano robots on brain aneurysm

order to prevent noise distortions and obtain higher resolution. Nano agglomerated discrete nanoparticles that are uniformly dispersed in resins or coatings are used to create nano-composite materials. Nano robots in medicine offer a lot of potential, including the ability to eradicate disease and slow down the ageing process[23].

2.5 Space Applications

With the evolving development in the varied fields, the knowledge of robots is in the booming sector. The range of development and the source of knowledge have been the factors implementing the scenario. This mainly concentrates on the constraint that was faced initially to uphold in the astronomy field. The fact that, how to implement the technology was discussed by the several workshops which was conducted on board. The simpler the rang the more efficient it was to be implemented[24]. Recent technology has opted to alter due to a variety of circumstances. It is challenging to comprehend and anticipate the decisions that must be taken in light of the operational changes in the environment. This illustrates how the tasks – satellite testing, signal transmission, object mobility, and organised image capture – are actually carried out by a robot machine[25]. The very word "robotics" itself stands for the robustness. Data acquisition, information fetching, flexibility, and latency have been improving. With the well-equipped target the navigation can be improved. The main ideology is to determine and observe the timely changes. Thereby to evaluate the continuous monitoring of orbital expression. Updating the autonomous system and the dynamic coupling the presion can be made[26]. The aura of space science is correlated with robotics. The evolution of work, keeping track of the satellite, the space machine, systems coexistence and much more is controlled by the robotic machines. With the space sensors, testing machines, management of target, high speed system, intelligent system of robots makes the work simpler and navigate the results to other system with presion[27]. The cost of data has be trained in order to sequentially arrange it. The transmitter, supervised directory, quantum mechanism, training and replacing the data set has to be made. This will help the scientific study so as to improve the automation of a robotic machine. The several algorithms have been implemented over this such as breadth first search, traveling salesman problem, decision tree[28]. The satellites and rockets which are launched in other space, this centres the robotic operation which is the major implementation. A lot of data

Figure 5: Robotic Dog in military

which has to be stored and then retrieved by the robotics machine. The goal of the autonomous system is to sense the minute information which has been sent from the space station. This in turn implements the robotic performance and improves the efficiency of the system[29]. The use of robotics in military has been world-wide. The features of result matching from the database which is selected has to be in contrast. The surveillance of machine, continuous involvement need to be done so has to develop the complete autonomous robot. The guidance of the system has to be monitored by the human so as to proliferate whether the system has been running in a proper condition or not[30]. The real world problem is that of the security, spy and the feedback. All these need to be under control. The system should be developed as it makes the human effort much simpler. The technologies such as the, image processing, capturing of images so as to build a proper contact with the scaling mood in order to get a clear image has been a major criteria so as to detect the weapons and other dangerous tools[31]. The payload functioning, reconnaissance, team operations and the network commands need to be in function. A robot must have a capability to perform multiple tasks at a time. The raw data has to be categorized based on the input. The spanning tree algorithm is the main criteria so as it deal with the data. The experimental results, location statistics will be maintained so as to reach the task. The IPV6 extension has the power bandwidth which is used for the networking[32]. This article mainly deals with the development of the military services which is present in the robotics automation. The autonomous system is that which is used so as to develop a gain in the recent technological fields. The robot build has to be less in space and of more accuracy in the control management. This needs to be long lasting which are completely graded. The flash marks have to be present between the data[33]. The commodities such as the security has to be in progress. The system needs to be secure so that no one needs to be able to hack it. The communication system, sensing capabilities, signals from the different part of the world, capacity of the system and the robustness serves as the major purpose. The guidance to the system is to be sure that all the predictions can be made based on the current environment[34]. The electromagnetic vibrations and the optimization results need to be monitored. The self-sufficient ways needs to be evaluated and then categorized according to the needs. The response to the particular instruction and the processing time will be present in order to respond for a command. The limitations are to be in solved so as to replicate the original data in order to maintain the proper working of the autonomous system[35].

2.6 Security and Surveillance

The most crucial subset of automation is robotics. Based on the features of the primary application, industrial robots can be categorised. The most prevalent kind of robots are manipulation robots, which can change the position and orientation of objects. A machine created specifically to carry out a technological task is known as a technological robot. Industrial robots that can handle a variety of jobs are known as universal robots. Special robots are created just to carry out that one task. For instance, the automotive sector is well known for having one of the greatest rates of robot adoption, accounting for 33% of the total robot supply in 2019 as shown in the graph below[36].

Although surveillance and security robots have similar designs, they serve very different purposes. Security robots, on the other hand, are used to safeguard and protect something, whereas surveillance robots use their payload to search for an area. Surveillance robots gather all of the data from their payload and transmit it back to the terminal. Surveillance camera data is either saved for later use or forwarded to exploitation centres for processing. Security data can be processed or sent to the operator console for real-time monitoring or minimal post-processing onboard the robot[37].

For decades, autonomous mobile robots have served as surveillance and law enforcement tools for tasks like checking for barriers, spotting intruders, creating virtual environments or maps, neutralising explosives, and spotting unusual human behaviour. Surveillance robots are autonomous, solitary machines that decide according to a set of rules. When aberrant behaviour is found within a scanned

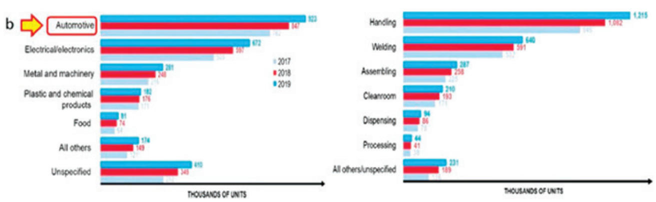

Figure 6: Implementation of robots in different industry

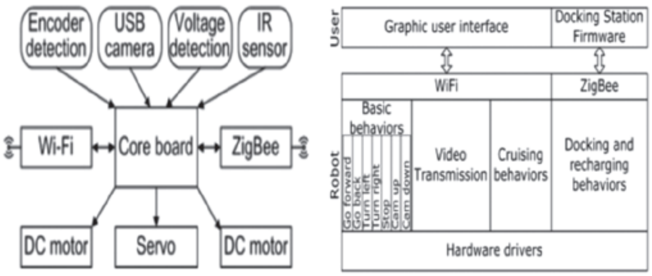

Figure 7: Hardware components and software architecture of surveillance robot

region, the rule base instructs them to alert a remote employee; this activity typically denotes the presence of an intruder. The principal objective of this paper is to define an Intelligent Security Robot (ISR). Following the perception-to-action loop is an important and necessary component for such robots. We identify four primary classes that have appeared in recent decades. These are robots that can watch, assess, warn, or engage in combat.

1. Teleoperated robots - Robots that are controlled remotely and rely on the operator's perception fall under this category.
2. Distributed robots – The term "distributed" refers to a type of multiagent and network robots that includes distributed and presenting architectures.
3. Surveillance robots – Surveillance robots are autonomous solitary robots that make decisions based on a set of rules.
4. LERs – LERs are self-driving and semi-autonomous vehicles that are used in criminal investigations[38].

Commercial surveillance uses include using robots to detonate explosives, accessing remote or dangerous regions, and patrolling. For homes and buildings, mobile robot-assisted security systems must be integrated in a centralised or distributed fashion. Every event generated by every sensor connected to the system must be sent to the central control unit, which must then decide what to do. The occurrence can be reported in a distributed manner to a number of control units, which should then discuss the best course of action. The control modules combine sensor and motion data to improve sensor odometry, provide rudimentary navigation, and perform basic application-specific operations like replaying a message over the speakers and requesting identification[39]. Robots are also used in the marine system, specifically as unmanned underwater surveillance vehicles. That is, they are used to identify threats lurking beneath the seabed. The primary goal of using robots as UUVs is to lower the risk to human operators. Because they may take the place of people in low-level jobs, unmanned vehicles can be utilised in surveillance systems for a number of reasons. A wide range of sensors can be installed on UUVs. These can include echo sounders like Single and Multi Beam that produce a 3D map as well as acoustic sonars like side scan sonar (SSS) and synthetic aperture sonar (SAS), which produce a side-looking image of the seafloor. This makes it easier for people to learn about things and locations they can't access. These robots are handy for a wide range of tasks since they may be fitted with a variety of sensors. One of the most crucial jobs for robots in underwater surveillance is locating and containing explosives and hazard devices. The idea of submerged[40].

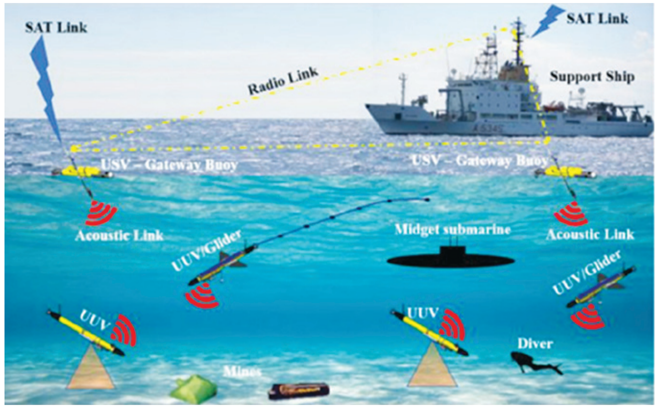

Figure 8: concept of underwater surveillance based on unmanned vehicle systems

Security for those who dwell there is this building's most crucial purpose. This can be accomplished using an Intelligent Security Robot (ISR), which receives the status of the building appliance's security system and controls the module via a radio frequency interface. The security robot is an active system that detects intruders, detects fires, and protects people. The sensory system is made up of a number of subsystems that receive sensory signals, process them with an amplifier and a calibration circuit, and then transmit the sensory data to the IPC via interface devices. The upper and lower bodies of this security robot are separate. The main controller is located in the upper body. An ultrasonic driver can provide information about the distance between obstacles to the robot's main controller via a series interface[41]. Robots are cyber-physical systems that integrate hardware, software, operating systems, and sensors to interact with the physical world. These days, robots can move, communicate, and recognise items in the cloud thanks to cloud services. Robots will assist in facilitating secure human-to-human connection in this cyber-sensitive industry. Depending on whether they are employed for industrial services or to carry out significant activities that humans cannot, these robots are often split into two categories: industrial and service robots. Robots are employed in this sector to stop cybercrime, including data breaches, identity theft, and other issues[42]. As a result of the current technological revolution, robots have evolved more than ever in industries like agriculture, medicine, manufacturing, cyber security, and many others. The most recent technological revolution has led to an excessive reliance on artificial intelligence (AI), and the emergence of robots in the Internet of Things (IOT) is known as the Internet of Robotics Things. These intelligent robots are employed in a wide range of industries, including construction and building maintenance, agriculture, industry, and, most significantly, the military, where they are employed in logistics and lethal warfare[43].

3.0 Conclusions

Following points are concluded based on discussion.

1. To combat the rising requirement of food it is necessary to implement robots in agriculture. The usage of agri robots is being increased day to day, but greater effort is needed by scientist as well as farmers.
2. Finding out the resources under sea and to study aquatic life, where even sunlight can't pass easily was quite challenging, but efforts have been made in the direction by using some of the advanced robots.
3. In unconditional work areas, the Human-Robot Interface aids in avoiding danger to humans. Labour can achieve deliberate quality work life in an effective way by reducing cycle time with robot interaction, but accuracy also improves, and it can optimise labour from hazardous environments.
4. Even frontline workers perished in instances like Covid-19, when the infection was spreading more quickly. By reducing or eliminating direct human touch, a medical robot aids in those areas. Medical robots can even perform crucial procedures that cannot be finished using conventional means, saving lives in the process.
5. Soldiers life will be at lot of risk, since they need to protect the country from outer enemies and they need to arrive at rescue position if needed by internal, this will be aided by robots to a greater extent by reducing risks with accuracy in performance.
6. Security robots is a need of todays world since continues surveillance is required for the safety. This security is provided by CCTV and other robotic aids.

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