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An Investigation of Application of Artificial Intelligence in Robotic

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Abstract - *This research investigates the social significance of robotics studying robotics development in different industrial robots. Our society accepts the use of robots to perform dull, dangerous, and dirty industrial jobs. AI at their early beginning, the two fields progressed widely apart in the following decades however, a revival of interest in the fertile domain of embodied machine intelligence, which is due in particular to the dissemination of more mature techniques from both areas and more accessible robot platforms with advanced sensory motor capabilities, and to a better understanding of the scientific challenges of the AI-Robotics intersection. During this research on investigation of integration artificial intelligence in robotic welding we are focus on different type of welding robot using Artificial Intelligence technique also gone through various research papers on different type of welding with the help of AI.*

The objective of this research is to contribute to this revival. It proposes an overview of problems and approaches to autonomous deliberate action in robotics. The Project advocates for a broad understanding of deliberation functions. It presents a synthetic perspective on planning, acting, perceiving, monitoring, goal reasoning and their integrative architectures, which is illustrated through several contributions that addressed deliberation from the AI-Robotics welding techniques.

Key Words*: *Artificial intelligence, welding technique, Automation.

1. INTRODUCTION

The term "robot" was first used in a play published by the Czech Karel capek in 1920. R.U.R. (Rossum's Universal Robots) was a satire; robots were manufactured biological beings that performed all unpleasant manual labor. According to Capek, the word was created by his brother Josef from the Czech robota, meaning servitude.

Czech writer, Karel Capek, in his drama, introduced the word robot to the world in 1921. It is derived from Czech word robota meaning “forced labourer”. Isaac Asimov the well known Russian science fiction writer coined the word robotics in his story “runaround”, published in 1942, to denote the science devoted to study of robots.

The erhaps, the best record is of the modern reprogrammable automation dates back to the eighteenth century. Perhaps, the best record is of Joseph Jacquard’s use of punches cards in mechanical looms, which laid the foundations for NC, CNC, and automats, in addition to robotics.

The most famous Japanese robotic automata was presented to the public in 1927. The Gakutensoku was suppose to have a diplomatic role. Actuated by compressed air, it could write fluidly and raise its eyelids. Many robots were constructed before the dawn of computer-controlled servomechanisms, for the public relations purposes of major firms. These were essentially machines that could perform a few stunts, like the automata of the 18th century. In 1928, one of the first humanoid robots was exhibited at the annual exhibition of the Model Engineers Society in London. Invented by W. H. Richards, the robot-named Eric consisted of an aluminum suit of armour with eleven electromagnets and one motor powered by a 12-volt power source. The robot could move its hands and head and could be controlled by remote control or voice control.

2. LITERATURE REVIEW

Many researchers have tried to design a robotic welding. The literature review focuses on the research carried out to develop robotic welding for industries application with their use for enhancing production with safe working condition.

Nolen(2007) has study Automated Welding Conceptual. A robotic welding system has become the standard method for performing welding operations in many industries. In the automotive industry, the Mercedes-Benz Corporation reports that the implementation of robotic welding in the assembly of their auto bodies has significantly improved productivity and quality. The use of these systems is also a standard practice in shipbuilding and in high volume prototyping by many fabrication shops**. (1)**

Oky(2008) has made research on artificial intelligence in the last two decades for improving performance of both manufacturing and service systems. The author have explained artificial intelligence (AI) is an important area of research in virtually all fields: engineering, science, education, medicine, business, accounting, finance, marketing, economics, stock market and law. **(2)**

Norrish (2009) has explained Process control and automation developments in welding. The process control techniques which have been applied to enhance the productivity and quality of welded joints. It seeks to explain the influence of power source design and computer control on these developments. The trends in welding automation are reviewed and in particular the techniques for off line and rapid programming of welding robots and on line monitoring and control techniques will be reviewed.**(3)**

Sahare et al. (2011)made an investigation artificial intelligence in various application of robotics. The research provides basic, background information of global scope on two emerging technologies: artificial intelligence (AI) and robotics. It is important to consider these emerging technologies on the market is anticipated to affect almost every aspect of the lives for future decades. **(4)**

Ingrand, Ghallab (2013) has explained robotics and artificial intelligence. Despite a very strong synergy between Robotics and AI at their early beginning, the two fields progressed widely apart in the following decades. However, we are witnessing a revival of interest in the fertile domain of embodied machine intelligence, which is due in particular to the dissemination of more mature techniques from both areas and more accessible robot platforms with advanced sensory motor capabilities, and to a better understanding of the scientific challenges of the AI–Robotics intersection**.(5)**

Thamilarasi et al (2014) has study robot gas metal arc welding by using taguchi techniques. At obtaining a relationship between the values defining bead geometry and the welding parameters and also to select optimum welding parameters. For this reason, an experimental study has been realized. The welding parameters such as the arc current, stick out, arc voltage, and welding speed which have the most effect factors on bead geometry are considered, and the other parameters are held as constant**.(6)**

Sharma et al (2014) investigated simulation of robotized mig welding using robotstudio. Simulation of a robotized operation before actual operations in a production line is a valuable tool for industry. This work uses Robotstudio software for carrying out the simulation of a robotized MIG welding operation on a tractor component. The simulation of the operation helps in the verification of the robot program which can be subsequently downloaded to the actual ABB robot controller. Moreover, the process time for the operation can be optimized by changing appropriate parameters of the robot like robot speed and zone settings**.(7)**

Devarasiddappa (2014) has study automotive application of welding technology. Welding is invariably used in the automotive industries for joining variety of structural components and engine parts. The constant demand for new improved material requirement for automotive applications necessitates the development of innovative joining techniques. Generally, industries preferred robotic welding. Robotic welding leads to the betterment for higher level industrial systems and a large amount of production welding process.**(8)**

Daisuke et al. (2015) investigates the Robot Welding Technology in Tsu Work. Welding process utilizing robot equipment has been developed and operated at Tsu Works, JFE Engineering for the purpose of production cost reduction and quality improvement of bridges. This paper summarizes the steps taken for such robot welding technology. **(9)**

Ruiwale et al. (2015) investigates on Recent Trends in Robotic Welding.A robot has been extensively used in the industries in order to reduce the capital investment and increase the production. In the current scenario, robots are programmed to perform critical operations such as welding, powder coating, and material handling. The paper highlights the advancements of robotic operations and its applications with various metal joining processes. **(10)**

3. PROBLEM IDENTIFICATION

Robots in today's industries work behind fences. This reduces their field of application, especially when collaboration between humans and robots is needed. One of the reasons for the limited success of robots is their lack of cognitive competence and flexibility. The ability to reason about tasks and problems is a key property for the application of robots in environments that cannot be preconceived completely by the developers. However, artificial intelligence (AI) techniques, that have remarkable success in several areas, are rarely applied to embodied robots, which may be down to the deferent representational formats of robotics and AI. Embodied robots inherently deal with continuous data while AI traditionally employs symbolic world representations.

Problems identified in the research are:

The main Issues that robotic welding system generally facesinclude the following:

I. The flexibility needed for making part after part, in lack of proper control, may fluctuate due to improper fixturing or variations in them in metal forming process.
II. Currently, artificial intelligence and machine learning are being applied in limited ways and enhancing the capabilities of industrial robotic systems. We have yet to reach the full potential of robotics and machine learning, but current applications are promising.
III. The one of the problem would be training an operator for the robot. This is a relatively simple robotic system to operate and finding someone capable of learning it should not be difficult. The implementation also requires more extensive testing of this fixture.
IV. One reason is the impact on current employees. This is an issue that is common when automating a process. Robotic welding is more efficient and would require fewer employees than a manual process. This means that welders could potentially lose their jobs and would negatively impact them and their families.
V. The effort and time needed to program a robot to weld a new part is quite high in small to medium manufacturing or in repair work.
VI. Need of skilled operators with requisite training and knowledge pose greater limitations to robotic welding system.
VII. Less utilization of robots due to incapable to respond in situation of uncertainty.

4. METHODOLOGY

A robot is a machine especially one programmable by a computer capable of carrying out a complex series of actions automatically. Robots can be guided by an external control device or the control may be embedded within. Robots may be constructed to take on human form but most robots are machines designed to perform a task with no regard to how they look.

The branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing is robotics. These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior, or cognition. Many of today's robots are inspired by nature contributing to the field of bio-inspired robotics. These robots have also created a newer branch of robotics: soft robotics.

From the time of ancient civilization there have been many accounts of user-configurable automated devices and even automata resembling animals and humans, designed primarily as entertainment. As mechanical techniques developed through the Industrial age, there appeared more practical applications such as automated machines, remote-control and wireless remote-control.

Robots have replaced humans in performing repetitive and dangerous tasks which humans prefer not to do, or are unable to do because of size limitations, or which take place in extreme environments such as outer space or the bottom of the sea. There are concerns about the increasing use of robots and their role in society. Robots are blamed for rising technological unemployment as they replace workers in increasing numbers of functions. The use of robots in military combat raises ethical concerns. The possibilities of robot autonomy and potential repercussions have been addressed in fiction and may be a realistic concern in the future.

Benefits of Implementing Robots:-

- Reduce operating costs
- Improve product quality and consistency
- Improve quality of work for employees
- Increase production output
- Increase product manufacturing flexibility
- Reduce material waste and increase yield
- Comply with safety rules and improve workplace health and safety
- Reduce labour turnover and difficulty of recruiting workers
- Reduce capital costs
- Save space in high-value manufacturing areas

Types of Industrial Robots

In general, when people hear the word “robot” they immediately think of a piece of machinery that looks and acts like a human. In the world of plant operations, “robot” brings productivity and assembly to the mind of an operator. But even in this specific definition of the machinery, operators often refer to the types of robots in terms of their applications like handling robots, palletizing robots, packaging robots, etc.

A simpler, more complete definition of robotic types can be narrowed down to five types: Cartesian, Cylindrical, SCARA, 6-Axis and Delta. Each industrial robot type has specific elements that make them best-suited for different applications. The main differentiators among them are their speed, size and workspace. Knowledge of each operating aspect of all five types can help machine designers choose the best robot for their process.

Cartesian: The most commonly used robot type for the majority of industrial applications is Cartesian. Plant operators often default to this type because they are easy to use and program. The linear movements of the Cartesian elements give the robot a cube-shaped workspace that fits best with pick-and place applications and can range from 100 millimeters to tens of meters. These robots are also a popular choice because they are highly customizable. Customers can determine the stroke lengths, speed and precision of the robots because most of the parts arrive separately and are assembled by the machine builders. That being said, one drawback to Cartesian robots is the complexity of assembly required. Overall, plant operators choose this robot design most often for the flexibility in their configuration that allows them to meet specific application needs.

Fig. Cartesian robot

Cylindrical: Cylindrical robots are very simple and similar to Cartesian in their axis of motion. Most Cylindrical robots are made of two moving elements: rotary and linear actuators. Because they have a cylindrical work envelope, machine designers might select them for their economy of space. The robot can be placed in the middle of a workspace and, because of its rotation element, it can work anywhere around it. Simple applications where materials are picked up, rotated and then placed work best for Cylindrical robots.

Installation and use are not complex, and they come as fairly complete solutions with minimal assembly.

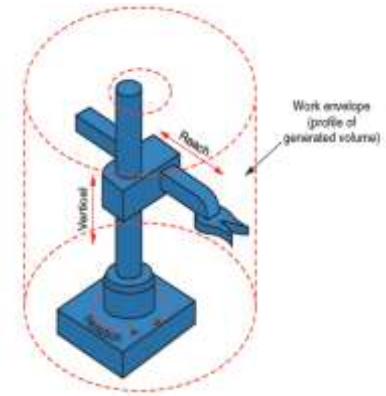

Fig.4.2Cylindrical robot

4.5.3. SCARA: SCARA robots offer a more complete solution than the Cartesian or Cylindrical. They are all-in-one robots, meaning a SCARA robot is equipped with x, y, z and rotary motion in one package that comes ready-to-go, apart from the end-of-arm tooling. The work envelope is similar to cylindrical robots but it has more degrees of motion in a radius or arch-shaped space. Applications are also similar to Cylindrical and Cartesian robots, but SCARA robots can move quicker than the other two. They are seen often in biomed applications due to their small work area. Because SCARAs have the easiest integration they seem like the best solution for the majority of applications, but Cartesians are more common because of their level of customization.

Fig.Service robot

6-Axis: Another all-in-one robot type is the 6-Axis. Though sometimes 6-Axis robots can be almost toy-sized, they are typically very large and used for large assembly jobs such as putting seats into a car on an assembly line. These robots operate like a human arm and can pick up materials and move them from one plane to another. An example of this would be picking a part up from a table top and putting it into a cupboard — something the other robot types cannot do easily. 6-Axis robots can move quick and come in complete solutions like SCARAs, however, their programming is more complicated. The robots can get so large and move so quickly that, if roller coaster seats were attached to them, they could simulate an amusement park ride. Because they are one of the largest of the five robot types, most designers choose them for their ability to make movements that others cannot to compensate for the loss of space.

Fig. 6-Axis robot

Reasons for using or investing in industrial robot

Manufacturing companies invest in industrial robots in order to reduce cost and increase their profit, to increase their productivity, to produce quality of work, to be competitive in the global market and in order to transfer dangerous and hard work that man cannot stand to a robot. These advantages of a robot have been the ultimate goals of manufacturing companies to invest in industrial robots.

The following list consists of the reasons of using industrial robots in manufacturing companies:

- Industrial robots are used to extend automated sequence continuously from one part to batch.
- Industrial robots can operate without supervision
- Industrial robots increase production uptime there by eliminating breaks that cause delays during the production
- Industrial robots can be placed in dangerous areas or unfriendly environments such as high temperature and dusty areas that are difficult for humans to work in addition they can be used for lifting heavy equipment.
- Industrial robots are used for good accuracy and constant quality works.

Robotic safety aspects

This discuss safety regarding robotics is described, where to find regulations and what they include and what existing technology there is that can be used to make the work safe for the operators.

4.7.1 Safety and regulations of robotics

There are a couple of different rules, regulations and ISO-standards that must be considered when working with industrial robots. There are laws about what is legal to do

and there is ISO-standards guiding companies how to follow these laws. In Sweden, it is foremost Mask in directive a company has to comply to. It is a commission which regulates what is legal regarding machines in general, how the machines must be designed to be legal to sell within EU e.g.

An industrial robotics classified as a partly completed machinery. That means that an industrial robot must follow all regulations regarding partly completed machinery. Some of the regulations about how industrial robots have to be designed in Sweden can be found on the Swedish work environment authorities. The main regulations are presented in Swedish Work Environment Authorities provisions about machines.

All of the regulations have a common demand;a total risk analysis has to be perform sure the safety of the humans. The risk an analysis must look at all possible errors that can occur in all thinkable situations to finally be able to decide if the system can be considered as safe or not.

ABB has developed a mode for their robots to make them more safe to work together with and it is called SafeMove2 (second edition). Safe Move is installed to the robot controller and connected to sensors that continuously register the position of the present operators. Depending on the operators position the robot works in different speeds. Slower the closer the human is to the robot. Different zones are usually painted or in some way visualized on the floor. The zones are supervised by the sensors and the sensors control the speed of the robot.

Sensors and safety systems: Sensor can be used for different applications. They can be used to measure and detect differences in distances, to read bar codes and register products, recognition of geometries and much more. Deferent types of sensor are used for deferent applications. One thing that all sensors have in common is that they can be integrated to a larger system. A system that can control a robot depending on the sensor e.g. the sensors most relevant for this study is described below.

Scanners: The most common scanners monitor an area, a 2D field. It can detect if something enters the area and also when the area is empty again. Many scanners can divide the are in deferent fields that can work individually. 3Dscanners also exist but they are usually not used for safety purposes partly because according to SICK the technology is relatively new compared to 2D scanners and not yet tested for safety purposes.

Safety light curtain: A safety light curtain is made up of 2 parts. One is the transponder and one is the receiver of the signals. By this a 2D field is created but it is much more regulated than it is for a scanner, it cannot be wider than the length of the 2 parts. Since the technology is simpler the product is also cheaper.

Vision system (Camera): For recognition of geometries a special kind o camera can be used. The cameras can also detect the position of a detail and send that information to a larger system so that e.g. an industrial robot can get the information on how it should pick up a product. 3.5 Prerequisites for HIRC found in literature in this section, the prerequisites for HIRC at GKN that can be found from the theory will be summarized.

5. CONCLUSIONS

In this way, artificial intelligence can achieve great discoveries and advances for humanity due to its multiple possibilities. Most artificial intelligence systems have the ability to learn, which allows people to improve their performance over time. The adoption of AI outside the technology sector is at an early or experimental stage. The evidence suggests that AI can provide real value to our lives.AI bases its operation on accessing huge amounts of information, processing it, analyzing it and, according to its operation algorithms, executing tasks to solve certain problems. Due to the new computing architectures of the cloud, this technology becomes more affordable for any organization.

Aspects of intelligent behavior, such as solving problems, making inferences, learning, and understanding language, have already been coded as computer programs, AI programs outperform human experts. The necessity of providing solutions that work efficiently in the real world has propelled AI research along significant new paths of investigation in perception and planning. For the endeavor to succeed, further advances will be needed from AI in the areas of belief revision and learning. Therefore, having robots helps business owners to be competitive, because robots can do jobs better and faster than humans.

In this research work effect of main input welding parameters on the tensile strength of welded joint in metal inert gas welding process were investigated Results show that among main input welding parameters the effect of the welding speed is significant. Increasing the welding speed and decreasing the current increases the ultimate tensile strength of welded joint. In this research work it was observed that the voltage did not contribute as such to weld strength. Regardless of the set of the quality characteristic, Machines take the place of people in factories because for many years the prevalent belief has been that business competitiveness is primarily achieved by reducing the cost of labor. And robots have long been viewed as the solution to the problem of labor costs.

But if we now look at modern factories, they are very different from those of 20years ago. From an employment point of view, however, the total number of employees in factories today is not significantly different than it was two decades ago. Factory employment did not decrease as many futuristic forecasts had suggested. What changed was the distribution of personnel between various business roles.

China is going all out for automation. The country has become the world's leading buyer of industrial robots – and is increasingly manufacturing them at home. The government shares and actively pursues its vision of 'Replacing Humans with Robots' with mega-corporations.

The national programme 'Made in China 2025' plans to transform the 'world factory' into a strategic base of 'intelligent' manufacturing. Productivity per worker must rise – which often translates as fewer jobs in industry.

From the systematic investigation it is found that industrial robots are very beneficial for manufacturing & thus producing the goods & finished products. As the industrial robots focused on

- Improved labor productivity
- Reduction in cycle time and floor space utilization
- Quality and reliability improvement
- Consistency in processing
- Reduction of waste
- Lower production costs

With advancements in technology, many jobs typically performed by humans are being replaced by **artificial intelligence (AI)** and robots. Below are seven industries that are significantly impacted by automation:

1. Transportation

Fully autonomous vehicles, or self-driving cars, will be hitting the road in the next few years. In fact, personal self-driving cars are expected to be on the market by 2018, with commercial applications not far behind. Self-driving cars will gain even more popularity as Uber plans to acquire 24,000 autonomous Volvo SUVs.

This means you can expect to see more people being dropped off at places without a driver in the near future. Although this may put many transportation workers out of business, Morgan Stanley predicts that driverless cars will save the U.S. $1.3 trillion a year by 2035 to 2050, for a global annual saving of $5.6 trillion. As well, self-driving cars will help improve transportation in many ways including, decreasing the risks of accidents, alleviate traffic congestion, and lower energy costs.

However, when it comes to aero planes, automation isn't new. Commercial aero planes have been already run on autopilot for a long time; pilots are still responsible for providing all the commands and monitoring various conditions and situations, including tracking fuel consumption. Nevertheless, with developments in AI, this could change in the future.

2. Manufacturing

It's no surprise that manufacturing industries made the list. From 2000 to 2010, Canada and U.S. have seen 5.6million factory jobs disappeared in which a whopping 85 percent of job losses resulted from automation, compared with only 13 percent of job losses due to international trade.

Manufacturing is one of the first industries to use AI robots to assemble products and package them for shipment. These are used to assemble more complicated items, including electronics, cars, and home appliances. Not only this, these robots have drastically increased manufacturing output in the last years.

3. Packaging and shipping

In addition to manufacturing, packaging and shipping industries have incorporated robots for some time to make distribution more effective. When it comes to shipping, Amazon is at the forefront of automation. In 2014, the e-commerce company began rolling out robots to its warehouses, using machines developed by Kiva Systems, a company Amazon bought for $775 million two years earlier. Today, Amazon has over 100,000 robots in its warehouses worldwide and intends to add much more to the mix.

4. Customer service

If you recently ordered a hamburger at McDonald's or have purchased groceries from a supermarket chain, it's likely that you have seen an automated kiosk or self-checkout (so that you don't have to interact with a human). Cashiers, retail salespeople, and food counter attendants are among the jobs that are at a high risk of being affected by automation, according to a 2016 report by the Brookfield Institute for Innovation + Entrepreneurship. In fact, it is predicted that more than 23,000 customer services will be deployed worldwide by 2022. While AI customer service agents don't interact the same way as humans do, it's becoming far more advanced. For instance, automated customer service company Digital Genius is developing chatbots that could harness natural language processing and machine learning to create friendly robots that could imitate human speech. Very soon, you won't be able to tell whether you're having a conversation with a real person or an AI.

5. Finance

Many financial services companies are turning to AI to keep up with an increasing amount of financial data. Robots can use predictive systems and market data to forecast stock trends and manage finances, more efficiently than humans. On top of this, financial advice is being automated with a growing trend towards "robo-advisers" to provide suggestions for simple financial problems. Automation is also replacing certain accounting jobs, in which it can be

used to record journal entries, conduct ledger account reconciliation, perform intercompany transactions, maintain accounting master data.

6. Healthcare

Medical and pharmaceutical companies are using AI machines to complete a variety of medical procedures, such diagnose diseases, deliver anesthesia, and perform surgery. In some cases, such as with IBM's Watson, these machines are more accurate in their tasks than human doctors. As well, For example, Robear, designed by scientists from the Sumitomo Riko Company in Japan, can aid patients in walking or getting out of bed.

7. Agriculture

With the world population expected to reach 8.5 billion by 2030, sustainability is becoming an increasing challenge. However, many sustainability issues could be addressed by developments in AI and automation. For instance, a startup called AgriData is developing a way for machines to manage the productivity of its fields, by scanning trees to pinpoints fruits and determine their yield.

Drones are also gaining popularity in agriculture, replacing the use of satellite imaging to get detailed maps of farmland—a very time-consuming process. Drones equipped with multispectral sensors can survey land, take images, and reveal the fertility of specific patches of soil, the number of water crops need, among other valuable information.

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