

## Improvement of Painting and Welding In Automotive Industry Using Robots

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### Abstract

Companies in auto Industry are confronting a focused test to enhance and improve on quality of segments utilized as a part of a car. Nature of paint and welding on a vehicle are critical components which affects the general nature of the item. In the keep going few years, forms, supplies and apparatus have experienced quick mechanical changes, accordingly requesting even more particular devices to control and survey the quality parameters. This paper displays a definite writing audit to evaluate and enhance the nature of painting and welding in the auto business.

### Key Words

Word	Definition
Paint	A dispersion of pigments, optionally including fillers, in a fluid
Automation Control	operating equipment such as machinery, processes
Robotics	A branch of technology that deals with the design, construction, operation, and application of robots
Automation	Use of automatic equipment in a manufacturing or other process
IEEE	International Electric and Electronic Engineering
CAD	Computer Aided Design
ARM processor	32-bit RISC (reduced instruction set computer)
IRBFNN	Radial Basis Function Neural Network
ROI	Return on investment

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### I. Introduction

Fabricating mechanical technology have a significantly enhancing execution of both painting and welding in the vehicles business. Inside industry numerous dreary operations, for example, pick and spot, spot welding, and splash painting, have been effectively robotized. While the operations themselves are differing, an ongoing concept inside almost every one of them is that the robot performing the errand. From a control viewpoint, this implies that the robot require just be controlled to take after a fancied assignment. Robots are settled in the material preparing industry. They are utilized for cutting, welding and stamping of work pieces produced using various materials. Because of their mechanical dormancy, robot arms can't perform sudden changes of speed despite the fact that this is every now and again needed in machining operations. In this article, computerization system is proposed in both painting and welding to enhance quality in vehicle producing, which is to halfway beat the confinements of doing likewise work by utilizing labor.

### II. Literature review

#### 2.1 Introduction

There has been a tremendous improvement of quality in painting and welding of automobile industry by using robotics. In this paper, we investigate through review of various articles how these improvement have revolutionized the automobile painting and welding by use of robotics.

#### 2.2 Improvement of quality in painting of automobile industry by using robotics

Industrial robots are widely used to paint final products in many industries, such as automotive. This has been the latest trend in the automobile industry. It has completely changed the way manufacturers are painting vehicles.



**Figure 1:** Robotics application in automotive painting

A study showcased in the IEEE journal, demonstrates on teachingless shower painting of formed surface by a modern robot. It was observed that a programmed shower painting by a 6-DOF modern robot furnished with an air spread firearm. Since the customary robot control summon era for the splash painting is physically performed by talented specialists utilizing an educating playback capacity of a robot controller, it is a period expending and experience obliged methodology. The study goes for creating the robot control orders without any extraordinary information on splash painting, on account of guards of an auto as a case of designed surfaces. The framework can naturally produce a showering way for the air splash weapon on the premise of CAD date of the workpiece, and change the spreading way into robot control charges. From trial comes about, the framework was discovered to be viable in painting guards of an auto with uniform paint thickness (Asakawa N, 1997).

Case in point at Kawasaki Company, their computerized vision has been advancing extensive automated painting using an impact proof robot arm, shower device, apparatus pumps, shade change manifolds, solenoid valves, transducers and weight controllers, to name a couple.



**Figure 2:** HMI interface for the Kawasaki paint robotics system

Kawasaki offers an alternate line of robot arms in distinctive sizes and outlines to meet any mechanical painting application. Robots have been used as a piece of painting military vehicles allowing them to get vehicles to the officers as fast as could be permitted. Manual painting of cover at the terminal took three individuals seven minutes to apply the tan and 10 minutes to apply the dull, and just 16 vehicles could be painted for reliably with two improvements. Jerry Perez, record director at FANUC Robotics, says that the best advantages of computerization are being able to program veil blueprints confined from the net and being able to regulate varieties in vehicles. They further say that they expect that painting robots will increment rapidly at vehicle producers and Army terminals (Sanjiv Singh, 2008).

An alternate change is the mechanized robot trajectory making arrangements for spread painting of free-structure surfaces in auto fabricating. This computerized robot permits painting to be carried out adequately with consistency all through.



**Figure 3:** CAD-guided robot trajectory painting gun

Programmed trajectory era for splash painting is profoundly attractive throughout today's car fabricating. Creating paint firearm trajectories for nothing structure surfaces to fulfill paint thickness prerequisites is still exceptionally difficult because of the complex geometry of free-from surfaces. A CAD-guided paint weapon trajectory era framework free of charge structure surfaces has been produced. A paint thickness check system is likewise given to confirm the created trajectories. Scoundrel model permits point to point movement, and nonstop movement. Triangular aspects are utilized to rough the part surfaces. It gives 3D data on the segments' geometry crucial for a visual. Scoundrel guided robot way generator is created for the spread painting of compound surfaces usually seen in car producing. Rather than broadly utilized parametric representation of surfaces, a planar feature plan is utilized to estimate the painting surfaces. In this calculation, enormous patches are structured. Consequently, the way arranging is tackled focused around the worldwide attributes of tire part, and the ensuing spread weapon ways are decently acted in the feeling of time, scope, and wastage. The proposed calculation has been actualized and tried utilizing ROBCAD (Heping Chen, 2002).

Prasad clarifies quickly that automated utilization in quality transformation in painting in the auto business is upkeep of uniform car surface splashing. In shower painting applications, it is crucial to produce a spread firearm trajectory such that the whole surface is totally secured and gets an acceptably uniform layer of paint affidavit called the "uniform scope" issue.



**Figure 4:** robotic splash painting

The uniform scope issue is testing on the grounds that the atomizer emanates a non-paltry paint appropriation, in this manner making the connections between the spread firearm trajectory and the affidavit consistency complex. Notwithstanding guaranteeing uniform paint affidavit at first glance it additionally minimize the related procedure process duration and paint waste. Grounded on the relations between the shower weapon trajectory and the yield qualities, the methodology decays the scope trajectory era issue into three smaller obstacles, for example, selecting a seed bend, deciding a pace profile along each one pass and selecting the dispersing between progressive passes (Prasad N. Atkar, 2005).

An article by Daimler Benz, fights that the auto electrostatic tormenting is an alternate change in car industry painting.



Figure5: Electrostatic Powder Painting Liquid Painting Equipment

A robot painting framework for electrostatically artwork a vehicles body that incorporates a paint module adjusted to keep up the auto body in a stationary position and painting car bodies in a stationary position with a scaled down and rapid, gives high effectiveness in paint exchange furthermore dispose of the requirement for extra paint stations faster giving full scope of the car body. The electrostatic paint exchange has a productivity of 80 percent and in addition 100 percent body scope, can be acquired with a robot framework comprising of two or more program-controlled robots, each of which has no less than five degrees of flexibility, conveys a light weight, scaled down rotational chime sort atomizing gadget and moves the atomizing gadget at a little portion of standard painting velocities(Daimler Benz Ag, 2014).

Suh 1991, includes that splash painting has been exceedingly improving applications of apply autonomy with fantastic profits and quality change. Numerous profits have been inferred, for example, consistency and repeatability of a robot's movement have empowered just about flawless quality to the completed products while in the meantime squandering no paint. It has supplanted manual painting with people and thusly secures human administrator from a dangerous substance from the spread spout, perform an extremely able occupation consistently, and while in the meantime expanding work quality, consistency, and cutting expenses. Utilization of automated spreading robots on completion products is possible quicker and at lower costs since the measure of paint that are utilized as a part of a solitary item willbe altered without any loss of paint (Suh S.H, 1991).

Omar, 2006, clarifies that the acclimating toward oneself automated painting framework has likewise enhanced quality in auto painting. Lessened paint utilize and decreased deformities would spare \$683 million yearly for the Big 3 makers and would lower costs and enhance quality for buyer. There are a ton of modern paint deserts in the car painting. Paint structure related abandons, for example, paint maturing and properties because of encompassing conditions, for example, temperature varieties, deserts because of contaminants and dissolvable pop ups. The Toyota Product Inspection source standard (TPS) is accomplished through introducing painting implements like electro-statically charged turning mug, airless showering spout on a robot arm that performs ideal paint affidavit on the target. These deformities have been effective and it has enhanced the nature of painting in auto to a more prominent arrangement(Mohammed A Omar, 2006).

As indicated by the Chinese Journal of Mechanical designing dated 2006, it is clarified that in air shower technique, the spread state of robot splash weapon is not a cone and a circular paint zone stuck to a planar surface is framed, the paint-film thick- ness of oval territory is gotten by a painting try different things with ardent spread firearm. Neural system technique is connected to fit the paint-film surface capacity that signifies the thickness circulation of paint-film in oval zone. Another deliberate paint-film thickness dispersion capacity named as oval double model is proposed by looking at the fitted paint-film profile on some diverse areas in x and y headings. Inalienable calculation (GA) and minimum square are utilized to fit parameters of the new model concurring with analysis datum. This model is another commonsense splash painting firearm model for logged off robot painting programming(ZHANG Yonggui, 2006).

Akanksha contends that, a standout factor in car business is paint quality. There are different elements that influence paint quality in car creation, for example, distance in the middle of firearm and body, Shaping pneumatic force, bell voltage, spray weight, density or consistency, temperature. A machine project are created for demonstrating of the shower painting methodology, reenactment of mechanical spread painting, and

disconnected from the net programming of modern robots for painting of bended surfaces. The machine project empowers the client to focus the painting methods, parameters, and ways which will give the wanted paint thickness. Surface models of the parts that are to be painted are gotten by utilizing a machine aided configuration (CAS) programming. this technique has demonstrated to be viable in change of creation procedure prompting imperfections lessening(Akanksha Tiwari, 2013).



**Figure5b:** trajectory painting robots

Ed Minch, Director of Sales & Engineering-Automotive/General Industries at Kawasaki Robotics (USA) Inc. in Wixom, Michigan contends that there's just about no conflict any more about the estimation of computerization stood out from manual paint application among the auto business. The backing for purchase changes with the economy, the expense of gas, buyer sureness. Everyone is yelling for more point of confinement at this moment. He says the viewpoint is starting to trickle down to diverse organizations. Paint is an amazingly complicated approach. Its dangerous work; its persevering work. It's less requesting to demonstrate to some individual generally accepted methods to program a robot than it is to demonstrate to them best practices to paint (Tanya M. Anandan, 2013).

To attain uniform and the paint thickness is reliant on the administrator's aptitudes yet programmed era of paint firearm trajectories cannot just be time-proficient and minimize paint waste and procedure time, additionally can attain ideal paint thickness. Paint stream rate flux is dead set tentatively by utilizing diverse spread firearm settings and painting parameters. Amid the tests level surfaces are painted by utilizing a solitary painting stroke of the firearm. At that point, paint thickness estimations are made on the surfaces. It is watched that other than the specialized determinations of the splash firearm, air and paint spouts, and paint needle, fundamental settings like paint tank weight, spread pneumatic force, and weapon needle-valve position influence paint cone edge and paint stream rate, which at long last describe the shower painting procedure (M. A. Sahir Arikan andTuna Balkan, 2000).

An alternate application of robots in painting is the Motoman paint robots. They construct finishing quality, consistency and throughput, while essentially cutting down meeting expectations costs and decreasing wasted material.



**Figure 6:** Motoman paint robots.

They give flexibility and unrivaled execution in standard mechanical, auto and flight covering and managing applications. These application-specific paint robots can be used for first stage, base layer, finish spread, clear layer and spread allotting, using water-based, dissolvable based, powder, covering and glue/sticky materials. They capably cover complex parts of very nearly any size and shape, including breaks, curved and shaped surfaces without runs or hangs. Motoman paint robots can be adjusted to apply covering materials to unique scopes of the part to diverse film thicknesses (YM, 2014).

### 2.3 Improvement of quality in welding of automobile industry by using robotics

Presently there are huge change in innovation utilized as a part of any assembling body. The requirement for computerization comes in. Hence, robots have enhanced the nature of welding in the auto business from various perspectives. Robots are utilized for making spot welding, painting, get together, water plane cutting, administering, and taking care of parts. By utilizing robots work is finished speedier.



**Figure 7: Robotic Welding using Servo-Robot Laser Vision**

A welding firearm is appended at end effector of robot and modified to perform arrangement of welds on auto as it lands on workstation. The profits that come about because of mechanization of the spot welding process by method for robots are enhanced item quality, administrator security and better control over creation operation. Enhanced quality is steadier welds, enhanced wellbeing results on the grounds that the human is evacuated, from a workplace where there are risks from electrical stuns and blazes (Mrs Magar J.E, 2013).

Hensley (2014) further keeps up that, welding computerization uses robots to improve welding by growing rate, conveying quality welds and diminishing mix-ups. Mechanical welders apply an impeccable weld each time thus it in a brief time of time. The time it would take a human to apply an immaculate weld and to do it reliably would be more than twice that of a robot. Robot welding fuses strategies like round portion welding, MIG welding, TIG welding, laser welding and spot welding. Utilizing metal-cored wire in motorized welding applications can give purposes of enthusiasm toward assorted parts of the rationality other than the pre-weld and post-weld stages. It offers beating limits is the suitable decision for out-of-position welding, that mix likewise offers central focuses for in position welding. The wear on the contact tip in mechanical welding is huger than in a loader to oneself welding application, since robots can weld more parts for reliably (Hensley, 2014).

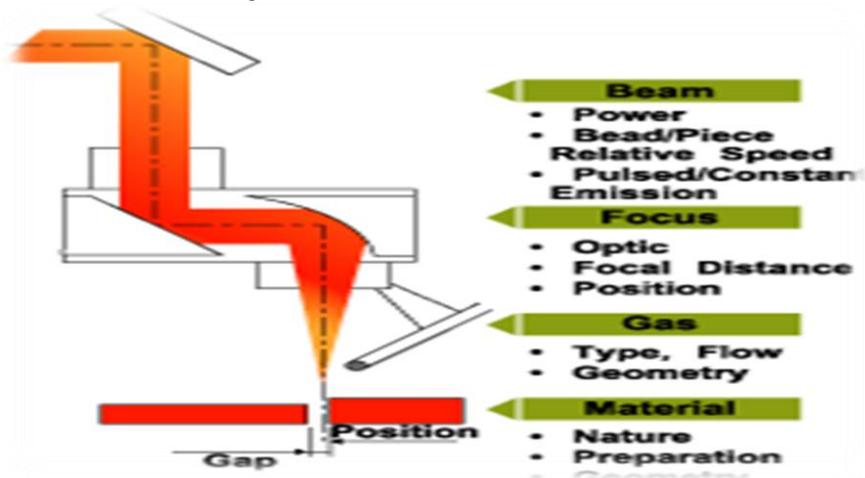
An alternate welding quality change is the utilization of widespread mounting and apparatus plate framework, began building many automated welding installations for the new welding cells by Crown engineers. This allowed each welding gear the capacity to be instantly changed good and done as required or moved from one automated weld cell to the next. When another apparatus is introduced into the welding cell, an administrator rings the put away programming code for the part to be welded by entering a three digit code utilizing a thumbwheel switch on the administrator board of the mechanical weld cell. Case in point, the robot and force source can in a flash switch to Pulse-on-Pulse process when the arm movements to a vertical weld. Regardless of the little unit generation, mechanical welding has helped Crown's general methodology. Crown reports emotional change in benefit by a variable of no less than three or four. Welds are steadier and are general

better in quality. Crown performs ruinous testing on the first run of each one section and occasionally from that point, and the enhanced quality is clear(Gunnar Bolmsjo, 2006).



**Figure8:** Crown engineering robots welding cells

Valavanis, 2004, contends that, an alternate quality change in car welding by means of robots is the utilization of laser cross breed mechanical welding.



**Figure9:** Intelligent controls in automotive-robotic laser welding

Laser welding weld auto offers velocity and effectiveness, and also its similarity with new auto outline criteria and patterns. When joining parts with flaws, for example, eccentric holes or crisscrosses, the nonattendance of filler metal implies that no extra material is accessible to extension those crevices and to make up for inordinate joint variety. Filler metal additionally is helpful in making up for the misfortune in the last weld science and to diminish the hardening breaking particularly basic with aluminum and stirred material. Likewise, it helps keep up joint quality. He further explains that, the competent controls have also upgraded auto mechanical welding. 3-D shape digitization discovers moment weld surrenders and increases enough data to track the joint at a velocity of 1 to 20 meters for every moment, which is perfect with the laser welding technique speed. Turn joints and controlling twist welding frameworks are clear to those for laser and laser cross breed welding(Kimon P. Valavanis, 2004)

As indicated by Markus Bayegan, Chief Technology Officer, ABB Ltd, he battles that quality change in mechanical welding has been extraordinary by the execution of the exactness welding with laser robots.

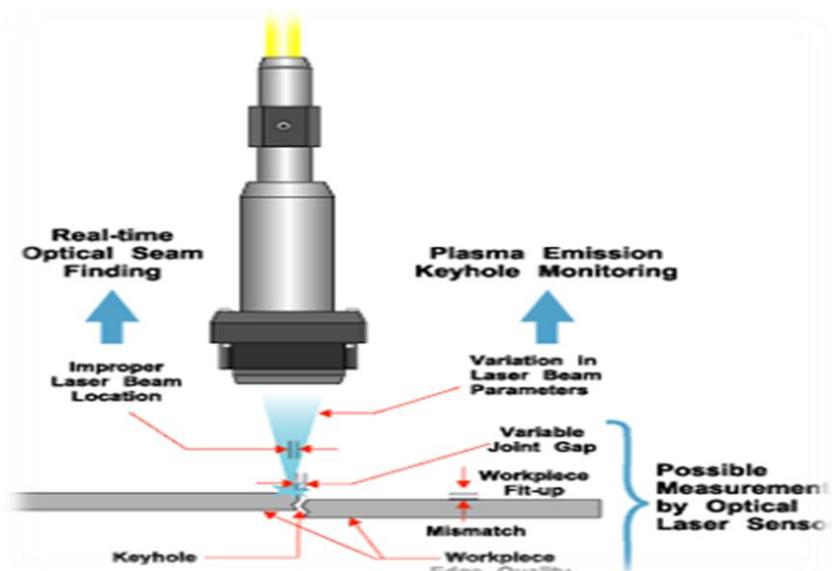


Figure10: intelligent controls automotive robotic welding.

The utilization of a fiber optic association has an alternate critical preference: The welding source is not inflexibly joined to the robot. This saves money on tedious arrangement and conformity. In Seam Tracking, the robot "sees" and takes after the expected welding crease utilizing a center optic. This optic is the same that is utilized to center the fundamental welding shaft. He further clarifies that, the laser welding cell has been actualized effectively in China. A client in China used a robot laser welding framework for assembling a few sorts of stainless steel boxes. The prerequisites set on the welding gear are high in light of the fact that no oxygen may spill into the cases. Adaptable creation. Once the robot is customized, it can keep welding without creation stops for a considerable length of time(Markus Bayegan).

An alternate quality change in car welding is the utilization of curve welding and warm cutting robots in auto industry. A curve welding robot framework is put on a firm establishment so that any vibrations won't deliver a shaking impact on the framework automated controllers are prepared to work in the hardest applications. They likewise give less impedance by utilization of bended arm configuration, counterbalance wrist and thin push that decrease robot obstacle toward oneself, considering bigger general working reaches. An alternate included focal point is Safety agreeability. A robot is modified to move the welding light along the weld way in a given introduction(Pires J. Norberto, 2006).

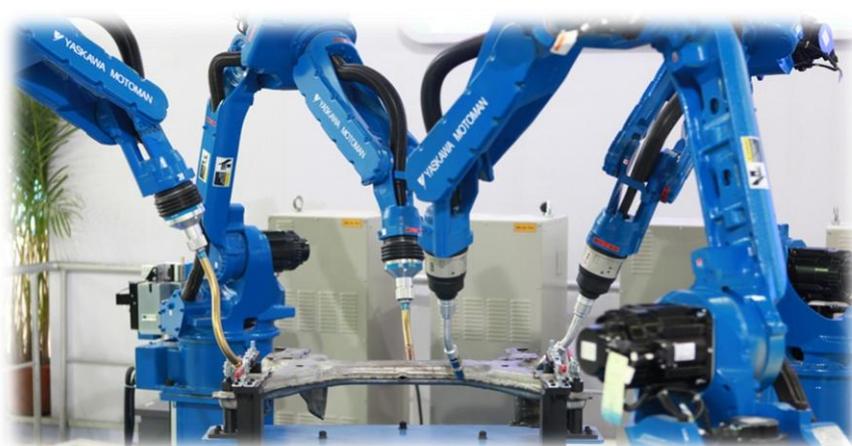


Figure11: Industrial robots welding robot arc welding robot cutting robot

As indicated by a study done by the Beijing Key Laboratory of Information Service Engineering, China, the Adxrs300 micro-mechanical gyro ARM is utilized as the controller to drive the welding firearm contribute plot step engine request to alter the pitch edge of the welding weapon in real-time. The test results show that the adroit control arrangement of the welding firearm posture utilizing the IRBFNN and master framework is doable and it upgrades the welding quality. The control of the welding firearm posture of the

welding robot supplied another way and technique for the entire position auto-programming of pipeline welding weapon stance of the welding robot, it has some utilization for reference with respects to the astute control of robots. Examinations demonstrated that utilizing the master framework focused around an enhanced outspread premise capacity system to control the welding firearm stance is practical. It can improve the welding quality (Jingwen Tian, 2013).

As indicated by Winn Hard, a supervisor in the Robotic Industries Association, Michigan, the auto makers investigate more colorful, lighter-weight materials, robot producers are building better tooling and more proficient safety spot welding frameworks to enhance welding performance. Spot welding is a standout amongst the most develop applications in mechanical technology. The velocity, accuracy, effectiveness, and coming about expense decreases managed via robotized safety spot welding are decently recorded and acknowledged, especially in the car business. End clients, including masters from the Big Three automakers, look always speed and economy from their automated applications as new cars outlines oblige a greater amount of their spot welding robots(Winn Hardin, 2014).

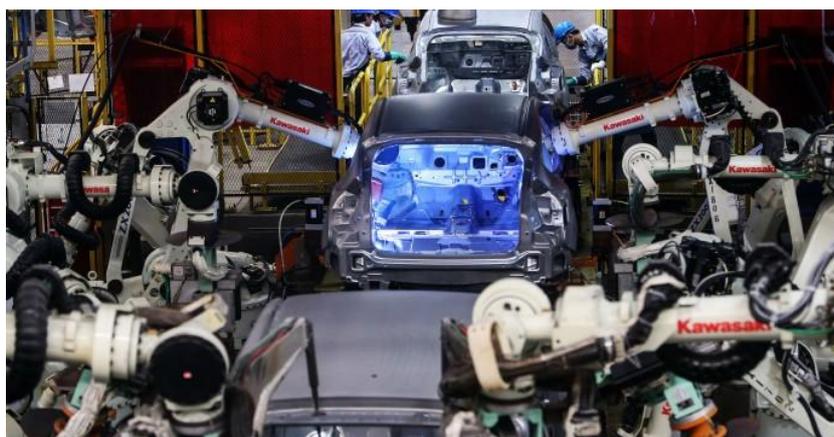
As per John Minto, senior VP Honda Engineering North America, he touts Honda's two new specialized improvement focuses in Ohio. The Honda Weld Department produces complete welded auto bodies from boards supplied both by their own particular Press Department and also outside suppliers.



*Figure12: Honda Weld - Spot Robot Line*

Minto says Honda had the capacity make the new Fit's body lighter and more inflexible because of the new process. The new Fit's inward edge structural parts are gathered in a structure utilizing high-joining effectiveness, and the auto's external body is welded onto the internal casing, Minto says. Honda creates robotized FSW engineering to weld steel and aluminum and connected it to a mass-production vehicle(Yoshihiro Kasuda, 2003).

Automated Welding of Aluminum space frames speeds introduction of sports cars empowered large scale manufacturing of the Ford GT, one of racing's most fabulous vehicles. As indicated by Rick Tepper, mechanical welding organizer for Metro, says that," weld shrinkage can be a main consideration when working with aluminum. Yet we knew by experience and experimentation how to weld these casings and keep contortion to inside a few millimeters on the whole casing. It led to superior vehicle pushing 500 pull and heading off 0 to 60 in four seconds with a top speed around 200 miles every hour," Tepper included. By sequencing the robots to weld substitute sides of the casing, it permits a range to chill off before tolerating an alternate weld, accordingly lessening bending and controlling shrinkage.



*Figure: Welding robots work on cars at a Ford factory*

Tepper further said that, the innovation was essential in permitting Metro to attain the welds important on the 6061 T6 expelled aluminum running in thickness from 1.5 to 8 mm, with 3 mm being the most widely recognized size. Additionally, the digitally controlled inverter force source is equipped for modern curve beginning strategies that assistance to decrease the danger of beginning porosity and help a level, appealing weld dot profile(Carl Occhialini, 2013). The transformational exercises incorporate all the stamping, welding, machining and painting endeavors inside the plants(Maw Maw Htay, 2013).

### **III. Discussion**

The new era of robot controls in the auto business is the aftereffect of improvement work that has seen them develop into compelling methodology controls. Planned above all else to control and check the machine, additionally to screen and control all the parameters that will be pertinent to the process. Change of value in painting and welding of car industry by utilizing mechanical technology has been the main element in car industry rivalry. For instance, the pattern in the Japanese auto industry will be additionally towards utilizing paint robots for covering the external surfaces. In Europe, the first organization to do so was Peugeot, where pneumatic atomizers apply the second layer of basecoat metallic paint. From the writing audit above, it is valid to say that mechanical application has enhanced the quality and improvement of both painting and welding methodology in the vehicle business.

Robots have made the specialty of representation a vehicle into something that is as direct as programming a robot. The way of work that is joined with the auto is unmatched by a human. The robot gives a certain measure of paint consistently which takes out the shot of runs in the paint. Having a painting robot keeps human workers from coming into contact with the destructive fumes that paint contains which makes it a more secure work space. Painting robots can paint a greater number of automobiles consistently than any human laborer could. In addition to painting, robotic welding is another improvement in the automotive industry. Robots have enhanced the nature of welding in the auto business from various perspectives (Juan Manuel Ramos Arreguin, 2008).

Regardless of the increases, however there are advantages and disadvantages to incorporating robotized mechanical frameworks into your working environment. It's critical to require some serious energy to consider the truths and assess your needs.

#### **3.1 Advantages of robotics application in auto industry**

There are various focal points that accompany the application of robots in the business. These are clarified beneath:

Quality:

Mechanical robotized robots have the ability to drastically enhance item quality. Applications are performed with accuracy and high repeatability inevitably. This level of consistency can be difficult to accomplish some other way.

Creation:

With robots, throughput paces increment, which specifically affects generation. Since a computerized robot can work at a steady speed without stopping for breaks, slumber, excursions, it can possibly deliver more than a human laborer.

Security:

Robots build work environment security. Laborers are moved to supervisory parts where they generally won't need to perform unsafe applications in perilous settings.

ROI:

Enhanced specialist security prompts monetary funds. There are less medicinal services and protection attentiveness toward bosses. Computerized robots likewise offer untiring execution which spares significant time. Their developments are constantly correct, minimizing material waste.

#### **3.2 The Disadvantages of robotic application in auto industry:**

Notwithstanding the rehashing focal points, robot application has a few deficiencies as well. These are:

Cost:

The beginning speculation to incorporated robotized mechanical autonomy into your business is critical, particularly when entrepreneurs are constraining their buys to new automated gear. The expense of mechanical robots ought to be computed in light of a business' more noteworthy money related plan. Customary upkeep needs can have a money related toll also.

ROI

Consolidating modern robots does not ensure results. Without arranging, organizations can experience issues accomplishing their objectives.

Ability:

Workers will oblige preparing program and collaborate with the new mechanical gear. This regularly requires some serious energy and budgetary yield.

Safety:

Robots may secure laborers from a few dangers, yet meanwhile, their extremely vicinity can make other security issues. These new dangers must be mulled over.

#### **IV. Conclusion**

To close, from the above clarification, it is clear that the improvement of robotized welding and painting is really amazing and is today one of the focal point in the vehicles business. Robots have prompted a more prominent quality painting of mass auto creation at a quicker and dependable rate. Besides, it has prompted astounding and predictable welding in the business. These welding and painting applications are both recovery and exceptionally solid contrasted with manual or human work. Numerous car producers are pursuing the application with a specific end goal to drive back the solid rivalry in the business. Scrutinizes are going ahead to enhance the productivity despite the fact that it implies substantial venture yet the ROI inferred is of more prominent worth. These favorable circumstances over people, it makes the ideal for applications in vehicles industry to enhance both painting and welding operations.

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