Application of Robots – A review

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Abstract: In current market, robots are used in various sectors like automotive, medical, military and aerospace. The design and manufacturing of robots depends upon its applications. The current research reviews the design of various robots with different type of materials like polycarbonates, composites which are light weight and low cost.

The use of laser and infrared for navigation of robots is also studied by various scholars.

Key Words: Robot, Manufacturing, Design

1. INTRODUCTION

Robotics is the branch of science that deals with fabrication, functioning, coding and articulation of robots. The study involves development of robots from designing, coding, fabricating and testing. The robotics encompasses interdisciplinary knowledge of electronics, mechanical and electrical engineering. Now a days, Robotic arms has been mostly used for industry automation and operation in the hazardous environment. Many robotic controls are very expensive, due to high-precision actuators and custom machining of components. Robotic components can be manufacturing by conventional subtractive manufacturing or with the use of additive manufacturing techniques. Additive manufacturing has several advantages as compared to subtractive manufacturing. Topology optimization is an access method that utilizes the make use of mathematical equipment to access material that are to be distributed while designing. In earlier times, traditional manufacturing methods were used for developments of topology optimization that cause complex geometries in designing. This complex geometry causes obstruct in the optimization of topology and efforts are not fully realized. In the arrival of additive manufacturing (AM) methods, it becomes feasible to make a layer upon a layer directly from three-dimensional (3D) model and proved that complex shape geometry is not such a big issue. The achievement of optimization using AM gives engineers full freedom for designing.

2. LITERATURE REVIEW

This paper deals with designing a Robotic arm in the national Science Foundation Engineering Senior Design Projects for the person having some disability in arms and legs. Its name was Clutching and Gripping Device developed by Arizona State University [1].The similar Kind of project was made by the University of Massachusetts named as "Assistive Reach Mechanism". This device was having capacity to reach objects up to four feet from it and lifts five pounds of load. MultiDOF Robotic Assembly for Press Shops is another example of robotic arm. This project deals with the design, fabrication and control or monitoring of a robotic arm used for loading and unloading the metal sheets into a press. It consistsof two stepper motors, out of which one control the motion of the arm and other the orientation of the wrist [2]. A robotic arm operating on Haptic technology having four degrees of freedom is unique concept on which these experts perform their research. It is designed for picking up certain object of specific weight and placing at desired location is presented in this project. The robotic arm is made of Polycarbonate material. The points having certain angle of rotation are fittedwith potentiometer. The microcontroller named Arduino duenmlanove consist of a Temega- 328 as a processor is used to read potentiometer input signal in electrical form and convert it into digital pulse form (PWM), which drives the servomotors or the arm.[3].The new concept of designing a robotic arm with additive technology is explained in this paper. There objective was to design and built a customized, lightweight and low cost robot, capable to fulfil many industrial working tasks such as palletizing mobile telephone covers.[4]. Solid works software was used to designing and optimizing the robotic structure. Articulated robotic arm is used for handling and separating waste in waste management facility. This project focuses on thorough analysis on the design project of robotic arm for waste management application. The CAD software, Solid Works is used to model the detail design of the robotic arm, and to simulate the motion of the device.[5].This paper proposes a study on the workspace of the guiding device mechanism of a parallel topology robot is presented. The kinematical scheme and the geometrical model of the guiding device mechanism of the parallel topology. The lengths of binary links between the platforms determine the shape and the volume of the parallel robot's workspace; different boundaries of the workspace are presented. Thus, variation of the workspace in both volume and shape is studied, depending on the binary link lengths, using for modeling and simulation Solid Works software [6].

A kinematically redundant manipulator is a robotic arm posses extra degree of freedom(DOF) than those required to establish an arbitrary position and orientation of the end effector. A redundant manipulator offer several potential advantages over a non-redundant manipulator [7].

Development of versatile robotic hand just like artificial arm or humanoid robot is need of today. In this paper, Omnidirectional bending mechanism called "double-screw-drive mechanism" was applied to drive a robotic hand. Robotic hand having three fingers as gripping part was built, and experimentation was carried out, in which each finger was controlled so as to track the elliptical orbit.[8]

In Argall et al. [9], a method of teaching by demonstration is described, in which primitive components of motions are learned by a robot through teleoperation. This method is able to extrapolate from a set of basic motions to the development of a complete task without the user having to demonstrate all aspects of the task. Another approach is to use gestures to show the mobile manipulator what it should pick up or where it should go (Pedersen, et al. [10]). This requires the definition of gestures that are both easily communicated by humans and easily recognized and disambiguated by the sensors on the mobile robot. Some researchers have also investigated ways in which a robot can ask for help. Rosenthal and Veloso [11] describe a mobile robot that can navigate around an office environment but has no manipulator, so, for example, cannot push the elevator button. The robot has algorithms to enable it to find people and ask them for help, taking into account the imposition on the people it asks (the travel distance to the help location) and the robot's own need for a short task completion time. Another issue to consider when people are in the environment is addressed by Sisbot et al. [12]. Here, a planner is developed that computes paths that take into account the comfort and expectations of people that may be near the robot. The plan assures that the robot both keeps a safe distance from all people and tries to keep the robot in the field of view of the people to prevent surprise appearances.

Personal care robots have been developed into advanced human-robot interactive systems. For example, Care-O-bot (Graf et al. [13]) is now in its third generation with characteristics that are potentially very useful to the industrial mobile robot community. Navigation (via odometry measurements of vehicle motion) is improved by simultaneous localization and mapping (SLAM) based on front and rear laser scan data that is compared with a global map. A three-level hierarchical controller includes single wheel control, four-wheel control, and a trajectory planner to enable path planning around obstacles and through narrow passageways. The omni-directional mobile manipulator includes a tray & robot arm and can compute collision-free manipulation paths based on data from a color camera and light detection and ranging (LIDAR) sensors. The system also implements spatial segmentation for obstacle learning and interpretation of the three-dimensional cloud of points detected by the LIDAR sensors for object recognition.

Azizi and Howard [14] describe some of the factors that reduce the effectiveness of odometry-based methods and ways of improving their performance using models of the errors and of the vehicle. Floor spots or magnets are an extension of wire guidance which use floor-embedded magnets to localize the automated guided vehicle at the magnet and correct for odometry errors that accumulate between magnets. Wire guidance has been expanded to magnetic and chemical tape guidance. An example of mobile robots that use tape-based path sensing is discussed in Horan et al. [15]. These vehicles use cameras to view the floor tape. Similar research was performed at NIST to follow a lane having tape lines as boundary markers instead of a single center line. At the end of the lane, unique, temporary markers could be placed on the floor that would indicate to the vehicle that it should use its perception system to navigate through unstructured environments to a particular endpoint. Ceiling-mounted bar codes are available as an alternative to laser triangulation and are used in large warehouses where center supports for reflectors may not be available. The unique bar codes are two-dimensional patterns read by an onboard camera and the system can determine the position ofthe vehicle with an uncertainty of approximately 5 cm. Range-based wall-following is typically used in confined spaces, such as during truck loading applications.

Biswas and Veloso [16] describe a fast algorithm for localizing a mobile robot using planes extracted from depth information that is projected into a 2D map of the environment. They make use of a Microsoft Kinect sensor that produces color images registered with range information. Since they are working indoors, they make use of the fact that there are typically many flat surfaces in the environment. Planes are extracted from the range data and matched with boundaries in the 2D map. The boundaries are typically places where walls meet or where the floor meets a wall. It is thus relatively easy to locate traversable regions including doors, corridors, etc. and to map the work area. Navigation is done by planning paths through the resulting map, with the three-dimensional information being used to check for and avoid obstacles.

Creed and Lakaemper [17] also take advantage of the prevalence of planar regions in man-made environment. They project linear features into a two-dimensional map and use consistency to build a representation of the environment based on line segments. Moving objects are detected as obstacles and are not placed into the map. Their system is able to modify the map to deal with slow changes to the environment, such as when a door is opened and remains open for a significant time.

3. CONCLUSION

The design and development of robots is based on several parameters which are influenced by its applications & limitations which may be internal or external. The internal limitations may be power, motor toque and external limitations may be operating conditions like terrain, smooth surface. The tracking and navigation are one of the important prerequisites for efficient design of robots. The tracking and navigation of robots is done using motion sensors, IR sensors.

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