TECHNICAL INSIGHTS

ADVANCED MANUFACTURING

TECHNOLOGY ALERT

05th May 2014

1. ROBOTIC SYSTEMS TO AID RESCUE PERSONNEL

Firefighters, police, military personnel, and other rescue personnel often need to enter a room with very little information about the possible presence of harmful gases and other dangerous substances in the room. Students from the Arizona State University (United States) have been developing a novel robotic system that would help in eliminating the uncertainties during such situations.

The research team consisting of engineering students has been working on developing a room mapping system that can be used to survey an area in a three-dimensional (3D) space. Sandia National Laboratories, a US Department of Energy research facility, has collaborated with the students in developing this innovative method of scanning a room before the personnel enter it. The system that the research team is building consists of a laser sensor attached to a motor that sweeps the complete area of the room, thereby taking 700 to 800 individual scans with almost 680 unique data points. The information collected by the sensor is then transmitted to a computer program that creates a picture of the room with all the contents present in the room. The person controlling the robotic system remotely would be able to see and analyze the data in real time. For instance, a firefighter would be able to avoid entering into a room in flames by mapping it beforehand and determining whether it is safe to go inside. Soldiers can also benefit from this as they would be able to identify potential threats, thereby enabling them to plan operations with a greater chance for safety and success. Another potential application for this robotic system is by rescue workers during an emergency scenario in a building, to determine whether it is safe for humans to enter due to the danger of the building collapsing. This system could be used for surveying the physical damage to the infrastructure of the

building, which is not visible from outside of the building, without risking the lives of people.

A key area of focus for Sandia National Laboratories is on developing systems and technologies for enhancing security. Currently, the research team has been able to discover various potentials and limitations of this system. For instance, the prototype that has been currently developed does not have the ability to scan reflective surfaces and objects present in a room. By finding out such limitations, the research team is able to improve the technology and make this robotic system more suitable for real-time scenarios.

This innovative technology has potential for adoption in robotic systems used in the rescue operations, once it is commercially available.

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2. 3D PRINTER FOR MANUFACTURING PRODUCTS USING FABRICS

Typically, only products based on metals and plastics have been manufactured on a large scale using the three-dimensional (3D) printing process. A university in the United States has developed a novel 3D printer for manufacturing products using fabrics.

Researchers from the Human-Computer Interaction Institute of Carnegie Mellon University (CMU) in Pennsylvania have developed a novel 3D printer. This printer is capable of producing fabric objects or products using wool and wool blend yarns that people use on a daily basis. The research has been supported by Disney Research, USA. According to the researchers, this innovation would help extend the range and variety of materials that can be used for 3D printing and also would open up newer applications in the years to come. Some of the potential application areas for this innovative printer are apparel manufacturing; accessories, such as, scarves, and hats; and toys. It can also be used in manufacture of soft robots that are designed to be in touch with or near humans. Soft robots have been finding enhanced opportunities. This innovative printer was showcased at the ACM CHI Conference on Human Factors in Computing Systems, which was held on the April 28, 2014 in Toronto, Canada.

This 3D printer is capable of manufacturing objects and products like any other printer that is currently available. The products can be manufactured

directly from computer aided designs (CAD), which makes it suitable for rapid prototyping and customization of the parts and products being manufactured. The operation of this printer is very similar to the fused deposition modeling (FDM) technique. FDM is one of the most commonly used techniques in 3D printers, which allows the plastic materials to be extruded to form layers. The layers are then added one above the other; as the materials cool down, the layers stick to one another, and the desired shape of the product is achieved. In this new printer, the head of the printer feeds out the yarn instead of lines of melted plastic material that are used in other 3D printers. A needle attached to the head of the printer then pierces the yarn, thereby bringing down the individual fibers into the yarn layers that are already formed}. When the individual fibers are made to come in contact with the other layers, the entangling of the fibers and the bonding of the layers takes place. According to the researchers, compared to conventional 3D printers, the dimensional accuracy of this printer is not high as the yarn is much thicker than the layers of plastic that are deposited in FDM printing. They have also said that if the soft objects are to be attached with a hard object, then a layer of nylon mesh fabric will have to be incorporated in the printing process. The nylon mesh would help in preventing the material from falling apart at the point of attachment. The researchers are currently working on developing techniques that help in joining soft and hard materials in a single fabrication cycle, and also for incorporating electronic components into these soft objects.

This 3D printer has the potential to be adopted by a wide range of industries for manufacturing various products. It is also seen as a key development and breakthrough in the 3D printing industry, which is growing at a rapid pace across the world.

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3. INNOVATIVE ROBOT FOR CARRYING OUT TASKS AT THE INTERNATIONAL SPACE STATION

Robots perform various vital tasks in outer space, and significant research is being carried out in this field. Researchers from NASA's Human Exploration and Operations and Space Technology mission directorates, in collaboration with

General Motors (United States), have developed and showcased an innovative robot named R2 that is capable of assisting humans for carrying out various tasks that are done in space or on earth, at any manufacturing facility. The robot consists of a head, a body, and two arms, in addition to newly developed climbing legs that have been attached to it. With these features, the robot is capable of helping astronauts by carrying out some of the tasks that are significantly hard and dangerous for humans at the space station.

When the R2 robot was first developed, it did not have legs, and in order to incorporate the climbing legs, the researchers had to make changes to the components used inside the body of the robot. Some of the changes that were incorporated in the robot include a new computer system, wiring, and mechanical assembly, in addition to interfacing the legs with the robot's main processor. This entire process of incorporation is said to have taken 14 hours to complete, spread across several steps at a time. According to the researchers, the legs allow the robot to move around the space station in carrying out various tasks in a humanoid manner. The toe-like structures attached to the robot are called end effectors, and the R2 robots can also use sockets and handrails to move around. With these legs, the robot would be able to help the crew in various tasks, while one of its legs is secured to the space station. The legs are highly flexible and can be oriented non-humanoid ways. The flexibility is due to the legs having many joints, which provides the elasticity. In the first test that was carried out on the robot, the researchers made it climb inside the space station and carry out simple tasks. The researchers are currently working on upgrading the R2 robot to enable it to carry out more complex and dangerous jobs outside the space station, which would be very beneficial for the crew of the space station. The researchers believe that these developments to the R2 robot could be a major advance for the future of Robonauts and for making them more reliable.

Some of the advantages of this robot are that it could significantly reduce the risk associated with carrying out certain tasks by humans in the International Space Station and that it potentially increases the number of tasks that can be carried out. A potential application area of this robot is in manufacturing facilities for carrying out work alongside humans.

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4. PATENT ANALYSIS OF PLASTIC INJECTION MOLDING

Plastic injection molding (PIM) is a molding process that is primarily used for manufacturing products using materials such as polystyrene, nylon, polypropylene and polythene. These raw materials are commonly known as thermoplastics. Thermoplastics are heated and then pressurized in a mold cast where they can be formed into different shapes and sizes. In the first step of PIM, the raw materials are converted into fine granules of plastic powder and are then poured or fed through a hooper. The hooper acts as a storage unit and releases the required amount of raw materials when needed. The granules of raw materials are then fed into the heater from the hooper, where they are heated in the heating chamber until they reach a significantly high temperature, after which a screw thread starts rotating. The screw thread is operated by a motor, which pushes the granules along the heating chamber. This melts the raw material into a liquid form. Once the liquid of the material is attained, it is forced into a mold where it is cooled to attain the desired end product shape. After the desired shape is obtained and the mold of the final product is left to cool down completely, the mold is opened and the finished product is taken out. One of the advantages of the plastic injection molding process is that significantly less post production work is required in the finished product. All the scrap material obtained from the process can be re-used for another cycle, thereby the cost incurred for raw materials is reduced significantly.

From the patents exhibited, it can be seen that research has been carried out to enhance the process automate this process. For example, Shangai Tian Electronics Co. Ltd. (China)has a patent pertaining to an automatic reshaping fixture of a precise injection molded part, while Wang Jingbo has a patent pertaining to production processes for novel injection molding, casting, and point plastic mold. There are also patents pertaining to applications; for example, Borromini S.r.L. (Italy) has a patent related to an injection molding process and apparatus for obtaining a lens in a plastic material.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Automatic reshaping fixture of precise injection-moulded part	September 11, 2013/ CN 203185660 U	Shanghai Tian Electronics Co., Ltd.	Hu Jianli	The utility model discloses an automatic reshaping fixture of a precise injection-moulded part The automatic reshaping fixture of the precise injection-moulded part is characterized by comprising a base, wherein a lower fixing fixture is arranged on the base;. Guide pillars are respectively arranged at the two sides of the base, a lower fixing plate is arranged above the base, and the guide pillars are arranged in the lower fixing plate in a penetrative manner by virtue of guide sleeves to be connected with an upper fixing plate above the lower fixing plate; a cylinder is arranged on the upper fixing plate, the movable end of the cylinder is sequentially exposed from the upper fixing plate and the lower fixing plate to be connected with a polyurethane pressure head fixing plate, and at least one polyurethane movable pressure head is arranged at the lower side of the polyurethane pressure head. The automatic reshaping fixture of the precise injection-moulded part is applicable to injection-moulded parts or hardware encapsulation parts, an injection moulding technique can not improve poor flatness after post shrinkage is carried out on a product, post processing on flatness of the injection-moulded part is carried out, and shrinkage deformation of the automatic reshaping fixture of the precise injection-moulded part is effectively prevented.
Injection molding process and apparatus for carrying out said process	August 14, 2013/ EP 2625016 A1	Borromini S.r.L.	Claudio Bariselli	It refers to an injection molding process and to the related apparatus for carrying out a lens (50) in a plastic material, comprising a first portion or ceiling (30) for the passage of light, and a second portion or body (40) for the coupling of the lens (50) with the structure of the headlight. The process and the related apparatus allow to obtain a lens (50) in which the ceiling is perfectly homogeneous, without any reliefs or recesses.
Production process for novel injection molding, casting and point plastic mold	July 17, 2013/ CN 103203833 A	Wang Jingbo	Wang Jingbo	The invention relates to a production process for novel injection molding, casting and point plastic mold, and relates to the technical field of mold production The production process comprises the steps of putting a template on a substrate;. Putting the substrate with the template on a special extruder / glue-dripping machine / casting machine; filling plastic rubber in empty spaces of various shapes on the template; then putting a layer of transparent film on the template filled with the plastic rubber; taking the template filled with the plastic rubber out from the substrate; putting the template filled with the plastic rubber on an ejector plate;. and ejecting the shaped plastic rubber products by the ejector plate The layer of the transparent film is arranged on the product, and all the plastic rubber products are adhered on the . plastic film and ejected out together Different concave-convex molds are designed on the same mold, so that plastic products with different shapes can be made by one mold; and production efficiency is increased.
Injection molding process of PC (poly carbonate) plastic car lamp shade	July 10, 2013/ CN 103192509 A	Jiang Su Hongchang Technology Co., Ltd.	Du Zhengqing	The invention relates to an injection molding process of a PC (poly carbonate) plastic car lamp shade The injection molding process comprises the following steps of.. (1) raw material drying; (2) pretreatment by using an injection molding system and an injection mold; (3) plasticizing; (4) injection; (5) pressure maintaining; (6) cooling forming;. and (7) demolding According to the invention, the forming cycle and production cost of a car lamp liner frame are reduced, and the quality of a finished product is effectively improved. The prepared car lamp shade is simple in producibility, has high impact resistance, high strength, excellent chemical resistance, good dimensional stability and good surface smoothness.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Plastic injection molding process	June 14, 2011/ US 7959844 B1	Maxi-Life, Inc.	Victor A. Sahm, III, Charles Hansen	Plastic containers are injection molded of HDPE blow molding grade resin having a density of about 0.960 to 0.965 g/cc and a melt index of about 0.7 to 1.0 g/10 min. at injection temperatures of 570° F. to 670° F. and mold cavity pressures of 20,000 psig to 27,000 psig. Relatively thin walled, rigid, livestock feed containers can be manufactured using about 20% to 50% less material while retaining strength and durability comparable to containers molded of HDPE injection molding grade resins.
injection molding plastic sheet with 3d texture and its manufacturing process	July 22, 2010/ US 20100182699 A1	Yi-Ren Ye	Yi-Ren Ye	In a manufacturing process for an injection molding plastic sheet with 3D texture, a mold with 3D texture is prepared, and then a plastic layer is formed by injection molding on the surface of the mold 3D texture. After the mold is released, a plastic board with 3D texture is formed. A photo-interfering layer is formed on the 3D texture of the plastic layer by vacuum electroplating or direct spraying. Finally, a protective layer with flat surface is formed on the photo-interfering layer.
Device and process for injection molding of hollow plastic parts	July 5, 2005/ US 6913719 B2	Battenford Gmbh	Helmut Eckardt, Stephan van der Steen, Marc Wülfrath, Rolf Schwesinger, Norbert Bielich	Device and process for injection molding of molded parts made from plastic material having at least one cavity, which has means for injecting plastic melt into the cavity of an injection-molding die along a melt flow path and means for injecting a fluid into the still molten plastic material, wherein the means for injecting a fluid are designed in order to inject a liquid at preset pressure and preset quantity. Provision is made in that the means for injecting a liquid includes a first part element, which is arranged centrally and remote from the injection-molding die and supplies at least one injection-molding die, and includes at least one second part element, which is arranged in the immediate vicinity of the injection-molding die, and a third part element, which is arranged locally on the injection-molding die at least during injection of the liquid.
Process and apparatus for injection molding of molded parts having at least one cavity	March 23, 2004/ US 6709625 B2	Battenfeld Gmbh	Marc Wulfrath	Process and apparatus for injection molding of molded parts made from plastic material having at least one cavity, which includes: a) injection of plastic melt from an injection unit along a melt flow path into the cavity of an injection-molding die; b) injection of a fluid into the still molten plastic material, so that the latter is pressed against the walls of the cavity; c) allowing the plastic material to solidify until the latter forms the molded part in self-supporting manner; and d) releasing the molded part from the cavity of the injection-molding die.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Plastic bottle crate injection molding process, involves molding grip enhancement material onto the crate handle in a separate tool	September 11, 2003/ DE 10208845 A1	Oberland Engineering Gmbh	Hartmut Goetz	The crate(1) is molded with at least one handle(2) and then part or all of the handle gripping surface is provided with an additional material(8) giving a more comfortable grip for easier carrying. An Independent claim is made for a plastic crate with a handle having an additional material layer, at least on the underside.
Process of injection molding a foamable plastic composition	June 12, 2001/ US 6245263 B1	Chisso Corporation	Michio Yoshizaki, Koichi Honda	A process of injection molding a foamable plastic composition which comprises filling completely a molten foamable plastic composition into a cavity, while reducing a volume of the cavity in the middle of injection or immediately after injection; cooling the composition to the state wherein a solidified layer in contact with a mold surface mingles with a molten inside layer; enlarging the volume of the cavity to that of the desired molded article; and after further cooling, removing the molded plastic foam article. This molded article comprises a layer having a non- or low-foamed, dense structure on the surface and a high-foamed layer at the inside, and has a light weight, good appearance and stiffness.

Exhibit 1 depicts patents related to plastic injection molding.

Picture Credit: Frost & Sullivan

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