REVIEW ON APPLICATIONS OF ROBOTS

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ABSTRACT

Robotics application has slowly increasing for the past 2 decades in various industries. This paper reviews the robotics application in various industries to understand different robotics applications, to learn the different design of robots, to outline the problems and adaptability improvements in the robotics application. The design and control of robot should be such that it can be operated from any place and for different surface environments from steel, glass, ceramic, wood, concrete etc. with low energy consumption and cost.

Keywords: *Robot, Unmanned Vehicle (UAV), industry, applications.*

1.0 INTRODUCTION

The advancement of robotics has caused robots to become more widespread across various industries ranging from manufacturing, health care, surveillance and rescue applications. They offer accuracy that can't be achieved with human labour with high speed as compared to humans. Robots can also reduce operating costs, reduce scrap and are flexible for future changes, even though high initial costs. Robots performed jobs in industrial production lines with programming and replaced employees from repetitive, monotonous jobs and put them in better, more challenging ones. Nowadays robots are user-friendly, intelligent, and affordable [21]. In health care the tiny robots are performing the surgery with the help of doctors where the doctors cannot able to use their hands in a comfort way.

2.0 CLASSIFICATION OF ROBOTS

There are various types of robots available. The most commonly used robot is articulated robots, SCARA robots, Delta robots and Cartesian coordinate robots [6]. In the context of general robotics, most types of robots are with robotic arms that exhibit varying degrees of autonomy. Some robots are programmed to carry out specific actions with a high degree of accuracy. These actions are determined by programmed routines that specify the direction, acceleration, velocity, deceleration, and distance of a series of coordinated motions. Some robots are much more flexible

that are working in different operating conditions. Artificial intelligence is becoming an increasingly important factor in the modern industrial robot [21].

3.0 REVIEW ON VARIOUS ROBOTS

3.1 Assembly robots

A Generic articulated robot arm has been noted for application in traversing and performing manipulation in nuclear reactor facilities with small cross section and its projected ability to change elevation and maneuver over obstacle [1].

Understanding objects and completing missions are very important for a robot. In this paper, an Affordance-based Ontology (ABO) was proposed for easy robot dealing with substantive and non-substantive objects. If the substantive object is not available, the robots have the understanding ability, and give a non substantive object in order to complete the mission, such as giving raincoat or hat instead of getting stuck due to the unavailability of substantive object, e.g. umbrella. The experiment is done in the Ubiquitous Robotics Technology (u-RT) Space of National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan [11].

Praveen Sharma [16] designed and manufactured a Stair Climber, considering the aspect of wheel modification. It can climb stair or move along very rough surface. The uses of this special vehicle include the frequent lift of goods such as books for library, medicines for hospital, regular mails for any institutes, or transportation of any toxic material for industries and give freedom to the retarded person or paralyzed patients to move anywhere over flat surface as well as stairs. Pugh chart is used for selection of best concept for different wheel climbers. It reduces the labour cost and electrical power lifting of heavy loads.

This paper proposes a stair climbing robot that looks like a similar as the human leg and can adjust itself according to the height of the step and it was connected to an Android device that has an application programmed in OpenCV with an Arduino in Host mode. This design was employed in an Arduino Mega ADK 2560 board to control the robot and other home fabricated custom PCB to interface it with the Arduino Board. It was powered by Li-Ion batteries and Servo motors [17].

3.2 Fire fighting robots (FFR)

Fire fighting is a risky task and profession. Fire fighting professionals have to carry heavy hoses, climb ladders in order to reach the tallest point of the building and carry people out of the building. In addition to that they have to carry masks, oxygen cylinder. They may require working in different adverse environment like high temperature or radio-active and also in high unsafe

building. During those life threatening operations many fire fighters had lost their lives under such conditions the fire fighting robots are used.

LUF60 is a diesel powered mobile fire fighting machine which is equipped with air blower and a water beam fog equipped with rubber track system which is rated to 400 degrees Fahrenheit. The rubber track system enables the robot to climb the stair and able to operate on a slope of maximum 20 degrees with the ventilation tube at a maximum 45 degree angle [14].

FFR-1 is a remote controlled double-tracked robot that carry monitor and used to extinguish fire, which is designed to operate under hazardous environment conditions as high temperatures, poisonous materials and inside unsafe buildings. FFR-1 is a highly maneuverable robot with cross country capabilities. It runs on treads and can climb up to 30 degree incline dragging a 3 inch fire hose [15].

3.3 Painting robots

A study on automatic spray-painting by a 6-Degree of Freedom (DOF) which is aimed to generate a robot control commands without any special knowledge on spray-painting for bumpers of a car and for sculptured surfaces. The system can automatically generate a spraying path for the air spray gun on the basis of CAD date of the work piece, and change the spraying path into robot control commands. The results show that the system was found to be effective in painting bumpers of a car with uniform paint thickness [26].

3.4 Rescue robots

The stair climbing robots are used to climb the stairs for different purposes such as in military and in rescue operation. A paper on rescue robot aimed to invent a robot which can climb a stair automatically and detect a black line to stop immediately [7].

In this research, a hexapod robot with maneuverable wheel was designed and developed to ease the movement on the flat surface and on the inclined surface with maneuverable wheel while on incline surface, the robot will climb using its legs. The decision for the robot to use either wheel or legs is based on the sensor devices and algorithm develops at the controller attached to the robot [10].

Hasin [12] designed and implemented a feedback control system for an Radio Frequency (RF) remote-controlled stair climbing robot integrated control architecture and communication strategy for a system of reconfigurable robots that can climb stairs and the robot system is implemented by using MikroC and visual basic programs and experimental trials showed that the implementation of the behavior control systems was successful [12].

3.5 Mine scavenging robots

Mine scavenging robots are widely used as unmanned machine to check the geo-mining atmosphere through wireless control for rescue team [6].

3.6 Pipe line inspection robots

A design aimed to provide minimal resistance to fluid flow by providing a low frontal area and by distributing the body of the robot towards the edge of the pipe, where the flow is slowest and the analysis of the robot's degrees of freedom, a derivation of the robot's inverse kinematics equations, and a static force analysis are presented along with a description of the robot's proposed locomotion algorithm [2].

Wheeled robots are widely used for piping application due to their simple design and control methodologies, energy efficiency and potential for miniaturization [3].

Inchworm-type robots, like wheeled robots, are relatively simple to control and allow the robot to navigate the various features inside the pipe [4]. Similarly, snake robot used for pipe inspection was developed which consists of several modules connected together using actuated joints. Movement is primarily achieved through the use of travelling wave locomotion [5].

3.7 Surveillance robots

Köse [8] designed a prototype of the robot caterpillar and it was created in real dimension by using solid modeling software. MSP430 LaunchPad control device is used for controlling of whole system.

The climbing robot comprises of two limbs like lizard and it has two suction cups. The suction cups are used to stick on to the surfaces. The two limbs are connected to two servomotors, one for each. The air removal from suction cups is done using vacuum pump. A microcontroller is used to control the relays that in turn switch electricity to solenoid valves. Suction pipes are used to connect solenoid vales to suction cups. Up and down, right and left movements are controlled by the servomotors. Gears and joints are used to convert the rotational motion of the servos to linear motion of the robot limbs [19].

A wireless controlled robot system for surveillance purpose was developed that can be controlled by a human operator, sometimes from a great distance. In such type of applications wireless communication is more important [23].

A surveillance robot with staircase climbing capability was proposed that can climb up stairs of certain height and width proportional to the dimension of the robot. The proposed robot uses wireless camera, LPG gas sensor, PIR sensor for surveillance purpose and wireless serial RF modem for wireless data communication. It can provide a reliable range upto 30 m at 2.4GHz band [24].

3.8 Electrical applications robots

The basic operation of robot also included in narrow and hazardous with efficient and economic approach in electrical related areas. Robot is used in power system boiler for maintenance purpose because human maintenance is too difficult due to high temperature. Some of the examples are 1. Crack detection test in boiler inner wall, 2. Any type of physical operation at nuclear reactor. 3. Clearing any obstacle in a hollow channel. 4. Commissioning any instrument in a narrow space. This type of operation by human is very troublesome, injurious and harmful. Sometimes it may causes death [20].

3.9 General applications robots

Jure Bezgovsek [9] developed a robot that mimics the movement of a live snake. It was constructed using six links. Robots shape was modified using torque actuators between the links. Anisotropic friction between the links and the ground generates the force that propels the robot. A control variable that determines actuator angles is used to achieve a wave-like body motion.

Pedro et al also proposed in detail for non-expert programmers, to instruct and program a robot just showing it what it should do, in an intuitive way. This is done by the two most natural human interfaces (gestures and speech). They observed that the robotic system presented is suitable to enable users without programming expertise to rapidly create robot programs. Results show that it was used for different users [13].

Fred delcomyn [2000] has described a six-legged robot based on the features of an agile insect, the American cockroach, Periplaneta americana. The robot was designed with insect-like leg structure and placement, and actuators that mimic muscles. A test leg is also described that shows how sensory feedback can serve as the basis of the control system for the robot in order for it to achieve the degree of adaptability of locomotion over rough terrain exhibited by insects [18].

Vijayakumar et al [2014] has developed and tested a robot which could spray chemicals under grapevine trellis. From the test, it was observed that the robot system made precise spraying operation and its precise operation record possible. A demo model of such equipment, which performs the operation very effectively. Such types of robots, which are used in the agricultural fields, are called as agrobots [22].

IGC (Intelligent Garbage Classifier) is a system which was separated the solid waste products. At present, the separation effort is based on manual work, from household separation to industrial waste management. Taking advantage of the technologies presently available, a system was built that can analyze images from a camera and control a robot arm and conveyor belt to automatically separate different kinds of waste [25].

4.0 CONCLUSION

The paper reviews robotics application in industries, surveillance was reviewed, discussed and understood. With these improvements, industries will increase their efficiency, consistency and quality. Reducing downtime of their whole production system before any break down was to happen. It can be used in welding, painting, cutting, material handling, grinding, vision, processing, surgery, electrical applications, mine scavenging, rescue, fire fighting, pipe line inspection, etc.

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