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A Solution to Power Failure Problem for Intelligent Articulated Robot Arm in Pick and Place Application Using Limit Switches

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Abstract - In this paper, an articulated type of industrialrobot arm control is discussed. The robot arm is mainly intended to be used in pick and place operation. It will sense the object at the specified place and move it to a desired location. The amount of rotation for each arm is regulated by the limit switches. The operation of the robot arm is very simple but it has the ability of to overcome resetting position after power failure. The robot armcan continue its work from the last position before the power is failed.

Keywords- Articulated Robot Arm, Pick and Place Robot Arm, IntelligentRobot, DC Motor Control, Power Failure in Robot

I. INTRODUCTION

Factory automation has been introduced in today industrial world. Robot technology is used to help factory automation in place of human workers as the robot has better abilities over human workers in the fields that are labor-intensive, dangerous and dirty.

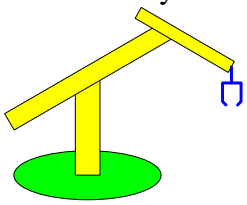

Figure1. Articulated robot.

The articulated robot is a type of robot used in industrial applications. This robot is configured combining of rotary joints as a human arm. It consists of two straight components, corresponding to the human forearm and upper arm, and a gripper as fingers. This type of robot is usually used in pick and place applications.

Robots are those that cannot perform its task without any predefined procedures. For an object pick and place application, we need to know the location of the object so that we can define the position of the robot and gripper to pick the object. We also need to know the point that the object be placed. The locations that the object is picked up and is placed down can be specified locations or conveyors. The path of the robot movement must also be predefined in the program to avoid obstacle in the robot's moving path.

II. OPERATION OF ARTICULATED ROBOT ARM IN PICK AND PLACE APPLICATION

The robot is designed for pick and place application.When the operation is started, the robot will be in its home position. First, the object will be sensed on a conveyor or specified location. If the object is detected, the robot will do its arms down to pick the object up with the gripper.After picking the

object, the robot will do its arms up and will rotate its base to reach the desired side or target position.When the robot reaches the desired point, it will do its arms down to place the object. After placing the object the robot will do its arms up and go back to its normal position.

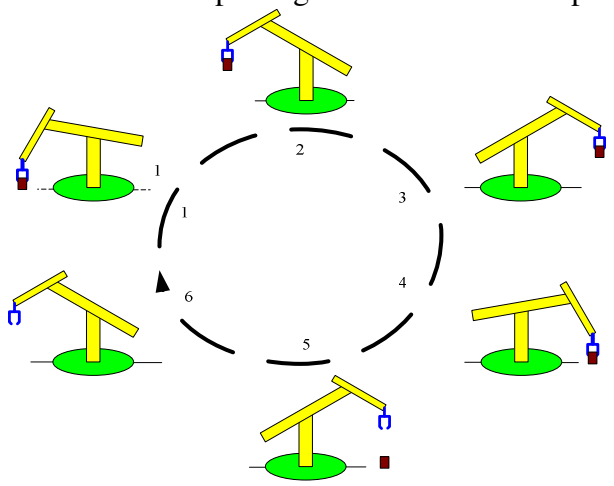

Figure 2.Operation of the robot.

The robot will restart its operation again as the same procedure. The flowchart of the robot operation is shown in "***Figure 3. Flowchart of the robot operation***".

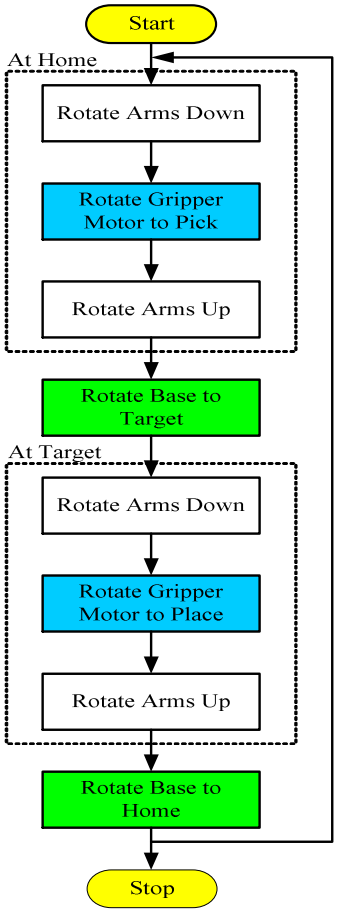

Figure 3.Flowchart of the robot operation.

It is needed to reach the object to the specified location accurately. Therefore, the rotation of each arm of the robot is limited by limit switches not to over rotate its limits. There are two limit switches for each arm: upper limit switch for hanging up condition and lower limit switch for hanging down condition of each arm. There will also be two limits for the base rotation of target and home positions. A limit switch is used in the gripper to detect the object. It is used due to the requirement of the program for more intelligent of the robot.

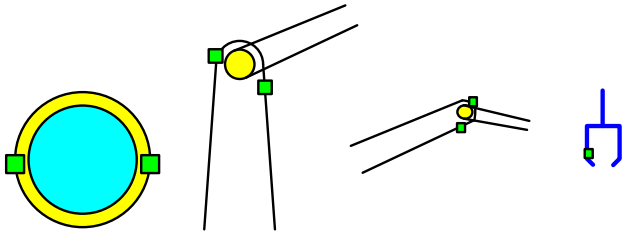

Figure 4.Position of limit switches.

IV. DEFINING THE PROBLEMS

Since the robot is mainly designed for the pick and place application, the robot will start its task as soon as the power is applied to it. It will sense the object, pick the object and place it to the desire location.

In normal condition, there is no problem in the operation. The robot will carry out its simple task according to predefined procedures. However, if the power is suddenly failed during the operation, we cannot store the current position of the robot. When the power is supplied again, the robot will simply start its task, but, there are many problems. The main problem is that the robot position of robot cannot be known. The robot can be at home, between home and target or at target position. In another way, the robot can be on the way to target or on the way to home.

If the robot is at home, there is still a problem. The object will be in the gripper if the robot was just hanging its arms up. If the robot does its arms down to pick the object up, there will be a collision of the objectsas shown in ***"Figure 5. Robot at home with object in the gripper"***.

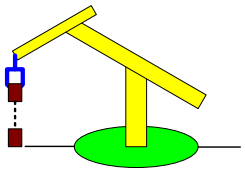

Figure 5.Robot at home with object in the gripper.

The robot must be at home and the gripper must be empty to start the operation simply. But, there is only a little chance to be in this condition. We cannot define the position of the robot when the power is suddenly failed.

V. DEFINING THE OPERATION PROCEDURES

To overcome resetting position after power failure, the lastposition of the robot is to be known. To detect the last position of the robot, the robot arm moving path is divided into many intervals according to base limit switches. There will be three intervals in the operation path: the robot at home, between home and target and the robot at target. When the power is applied, the controller will detect

the object in the gripper. If the object is sensed, it can be assumed that the robot is during the operation directed to the target position. If not, in the home direction.

Even if it is known that the robot is in the operation to target direction, the point that the robot is situated cannot be known. The position of the robot is needed to find. Home and target limit switches are used to know the point.

The limit switch in the target position is first detected. If it is detected, the robot has only to do its arms down, place the object and come back to get the object. If the robot is not in the target point, it can be either at home or between home and target. If the robot is at home position, the must do its arms up and resume its task. If the robot is between the home and target points, the robot base will be rotated to the target. The hanging up operation will be skipped by the program because the robot had already at the upper limits of its arms. ***"Figure 6. Flowchart of the robot operation"*** shows the flowchart of the robot operation.

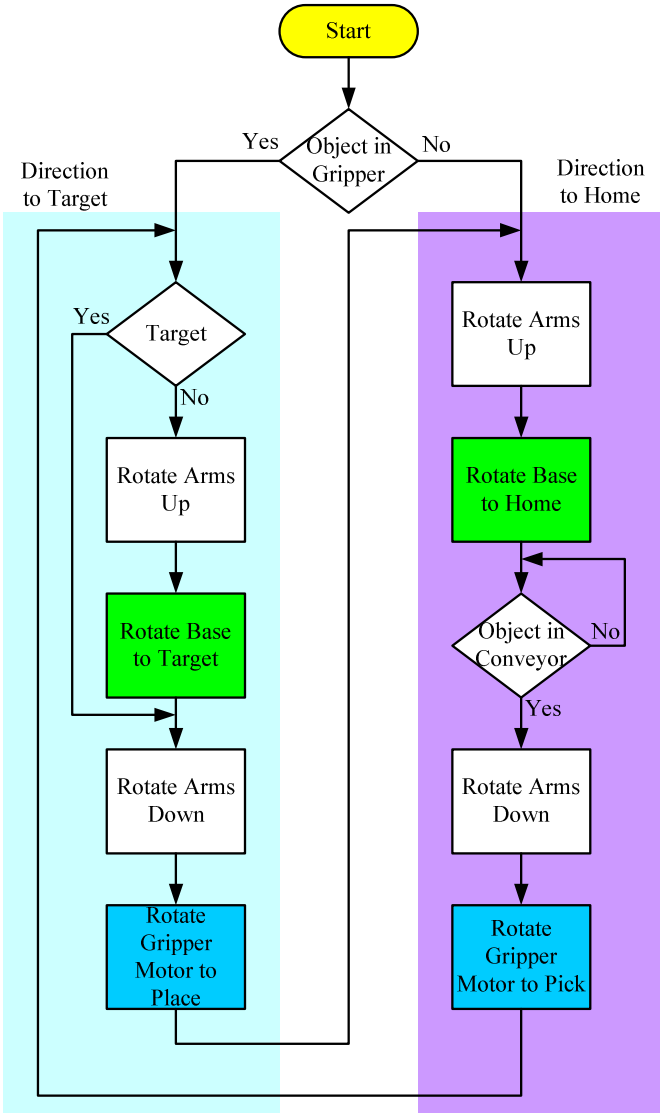

Figure 6.Flowchart of the robot operation.

When the robot is in the operation to home direction, the robot will be in the target point or in the interval between target and home. If the robot is in the target, it must do its arms up and continue its

task. If not, the program will skip hanging up operation automatically by the detection of robot arm's upper limits; the robot will carry out its task continuously.

VI. SIMULATION IN PROTEUS PROFESSIONAL

Proteus 8 professional provides the development environment for revolutionary interactive system level simulator. This product combines mixed mode circuit simulation, micro-processor models and interactive component models to allow the simulation of complete micro-controller based designs. Proteusprovides the means to enter the design in the first place, the architecture for real time interactive simulation and a system for managing the source and object code associated with each project. In addition, a number of graph objects can be placed on the schematic to enable conventional time, frequency and swept variable simulation to be performed.

The operation of the robot is simulated in this software. Arduino Atmega 1280 is used as the controller for robot operation. It uses LEDs instead of motors and switches for limit switches and object detection unit for ease of simulation. Two LEDs are used for each motor, and so eight LEDs for four motors: base motor, lower arm motor, upper arm motor and gripper motor. Seven switches are used: two for base movement, two for forearm movement, two for upper arm movement and one for object detection in gripper. The operation works well in this simulation.

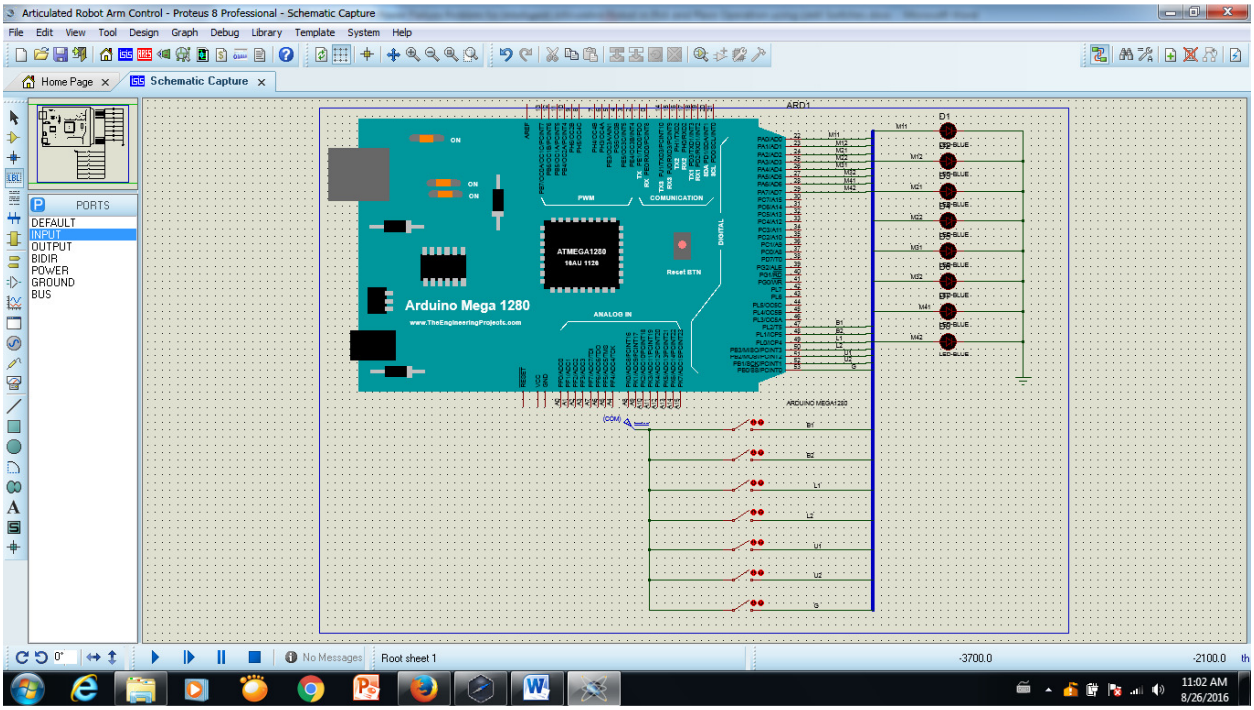

Figure 13.Simulation in proteus 8 professional.

VII. CONCLUSION AND DISCUSSION

In this paper, a solution to power failure problem in articulated robot arm is described for a pick and place application. The operation of the robot is simple and the robot is designed to overcome power failure problem with limit switches. There is a problem in the robot operation. The load pulls the robot's arms down when the power is lost. Some mechanical configuration for the rotation in robot arm should be made to prevent the robot arm from pulling down.The easiest way to overcome this is to use worm gear configuration in DC motors.

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