

Android Based Pick and Place Robot Vehicle for Industries

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Abstract - Robotics researchers regularly endow robot platforms with new capabilities that increase the breadth of potential applications and push the boundaries of autonomy. In contrast, industrial automation is driven by a pragmatism dictated by the need to optimize throughput and reliability. The hope of both is that, as multi-purpose robotic platforms become more capable, they will be able to take over an increasing fraction of the tasks currently handled by application-specific, fixed installation automation, thereby granting all applications a greater level. This project is designed to develop an Industrial Robotic Arm. Typical applications of Industrial ARM include welding, painting, assembly, pick and place (such as packaging, palletizing and SMT), product inspection, and testing; all accomplished with high endurance, speed, and precision.

This Industrial Robotic ARM has 3 Degree of Freedom and the end of ARM has a Gripper Mechanism, which is used to Pick and Place any Object. Geared Motors are used in this ARM Mechanism of 3.5 RPM and 10 RPM. L293D Motor Driver is used to control the Motor of the ARM. This Robotic ARM can move in forward, backward, left and right Direction. It has a user-friendly interface on its control using an Android Application. This Android Application can be installed in any Mobile Phone to get control over this Industrial Arm.

1. INTRODUCTION

A pick and place robot vehicle are used to pick up an object and place it in the desired location. It can be a cylindrical robot that provides the movement in horizontal, vertical and rotational axes or a spherical robot providing two rotational and one linear movement.

The basic operation of a pick and place robot vehicle is performed by its joints. Joints are homologous to human joints and are used to join the two consecutive rigid bodies in the robot. There can be either a rotary joint or a linear joint. To add a joint to any link of a robot, we need to know about the degrees of freedom and the degrees of movement for the corresponding body part. The Degrees of freedom implements the linear and rotational movement of the body whereas the Degrees of movement imply the number of axes that the body can move. A simple pick and place robot

consists of two rigid bodies on a moving base, connected with a rotary joint. A rotary joint is the one that provides rotation in 360 degrees around any one of the axes.

In this project, we have designed a 3 Degree Freedom Industrial ARM. These types of Industrial ARM are mostly used in Automobile Industries, Automatic Welding, Packaging Industries, and Painting Industries. Movement of this ARM includes Sideways (Left / Right, Up / Down), and Gripper Control (Open / Close). ATmega16 Microcontroller is used as a Brain of this Industrial ARM. An Android Application is used to control the ARM for various movements. We can control this ARM using Mobile Phones / Tablets that has Android Operating System. We also use Bluetooth technology to communicate with Mobile phones and the ARM. This Android Application is developed using MIT App inventor online web platform. The android application device transmitter acts as a remote control that has the advantage of adequate range, while the receiver acts as an end Bluetooth device is fed to the microcontroller to drive DC motors via motor driver IC for necessary work.

The user first connects the Android Application with the ARM. After the successful connection a message called "Bluetooth Connected" will be displayed in the LCD module of the ARM. Once the Bluetooth is connected, the indicator light on the Bluetooth module will turn off. Now users can access the ARM using the controls (UP/ DOWN /LEFT /RIGHT/OPEN/CLOSE). Robotic Vehicles can move-in forward, backward, Left and right directions. To Disconnect the Application from the device, the user has to press "Disconnect".

This entire system is powered using a 12V/4.5Ah battery. The power supply and Charging section of the system contains a step-down transformer of 230/12V, used to step down the voltage to 12VAC. To convert it to DC, a bridge rectifier or diode is used. The capacitive filter is used which makes use of a 7805 voltage regulator to regulate it to +5V DC power will be needed for the microcontroller, LCD display, and Bluetooth module to operate, to remove ripple. The capacitive filter is used which makes use of a 7812 voltage regulator to regulate it to +12V DC power will be needed for the DC motors.

2. BLOCK DIAGRAM

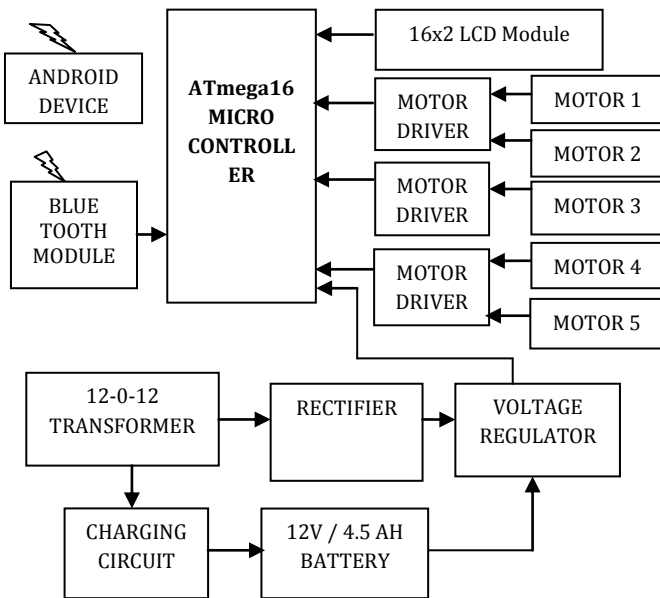


Fig. Block Diagram for pick and place robot vehicle

3. MAJOR COMPONENTS USED

3.1 ATmega16 Microcontroller

Atmega16 Microcontroller has very high performance and low power consumption rate in an 8-bit single-chip Microcontroller. It is based on reduced instruction set computing which helps in fast response within less time. It consists of 131 pre-determined instructions that help to activate the robot and most of these instructions are used in one single machine cycle. It works maximum frequency of 16 MHz and 16 kb programmable flash memory and its working ROM is around 1Kb. It contains 40 pins and each has its functions and it has four 8 bit ports that are used for fast computing and quick response for the robots. In these pins, it also consists of 32 input and output lines in these 40 pin Microcontroller. The reason behind this fast response is it contains two user communications ports that help the input from the user to verify the output to reduce the errors.

This type of Microcontroller is mainly used in industrial robots and fast response generating CNC machines and automation. It is also used to in executing multiple programs which is very helpful in flexible automation.

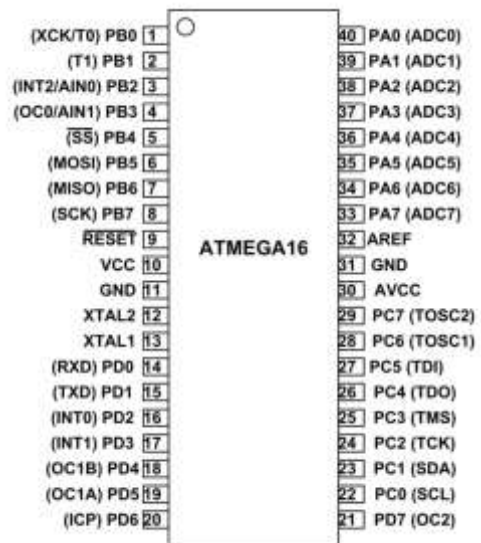


Fig. ATMEGA16 Pin Configuration

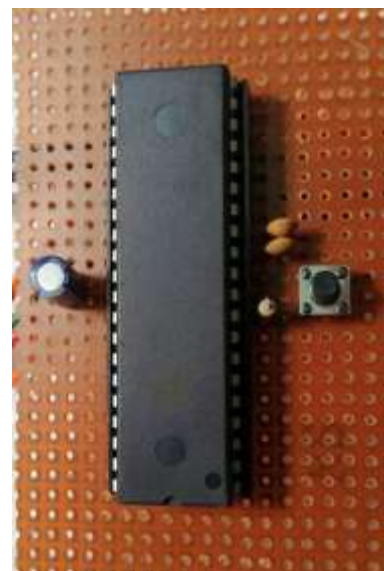


Fig. ATMEGA16 Microcontroller

3.2 DC Geared Motor

A DC geared motor is a developed model of normal DC motor to increase the speed so the torque of the shaft also increases. A normal dc motor has a rotating shaft contained with coil wound on it and magnets around it. When electricity passed to it the shaft starts rotating due to the attractive and repulsive force of the magnet but in geared DC motor, the obtained force from the normal motor is connected to gears as to increase the speed and torque of the motor but it has one problem that is the gears have wear and tear problem so it cannot effort much load. It is operated in a predetermined load but in the normal motor it has no such defects if load increase it stops and there is no wear and tear problem. A geared motor helps in generating large force with low speed is the main advantage of it. A geared motor takes

the input in between 6V and 12V where at 6V it has low RPM and at 12V it has its maximum RPM.



Fig. DC Geared Motor

3.3 16x2 LCD Module

An LCD module is a display device that is used to display input and output for the given data. It also helps in detecting the errors while giving the command and cross-checking the output. An LCD is one type of display device and the liquid crystal display device is an electronic display device that uses light modulated properties of liquid crystal to display the function given to it. These LCD devices are used in various applications like instrument panels, television, aircraft cockpit displays, clocks, watches, telephones, calculators, and so on but the purpose is to display the functions given to it. The use of LCD is due to its low power consumption, fast response and accurate display as per the given program and cheap. An LCD device consists of 16 pins used in data transfer, power supply, register data and ground connections.

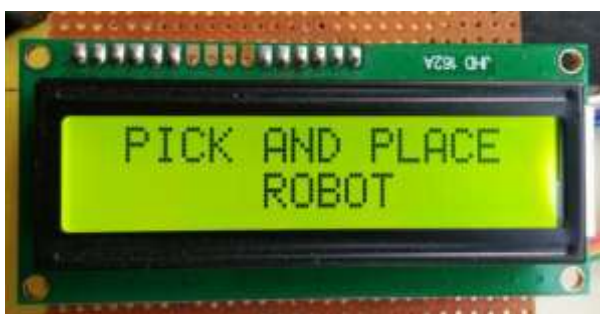


Fig. 16x2 LCD Module

3.4 End Effectors

End Effector is known as the end of arm tooling or gripper. There are many different types of end effectors are there but based on there working they are classified. They are grippers, tools, universal finger type end effectors. The mostly used end effector is gripper and they contain different types. They are of mechanical, magnetic, vacuum, and adhesives. End Effectors are like two fingers (thumb and

any of the remaining fingers) which can hold an object (pen, pencil) this holding of an object helps in many industries to do the work like spraying, welding, pick and place, etc.

An End Effector is an object attached to the robot arm to complete the given task. End Effector may be grippers, sensors, tool holders and so on to do the given task.

In some cases it acts as a tool holder and the robot must have the ability to adjust the tool to the work part or to do the job. An end effector must have some characteristic features they are

- It must have the ability to hold and release the object as per the requirements.
- It should sense the object presence in its grippers with the help of sensors
- The end effector must be very light but it must hold very tight.
- It should able to check the presence of components, speed, and load when there is a power loss.



Fig. End Effector

3.5 BLUETOOTH MODULE

A Bluetooth module is an electronic circuit board that contains all Bluetooth functions that help in wireless data transmission. There are so many types of Bluetooth modules for fast data transmission, serial communications, parallel communication, and many others that are used according to its purpose and type of data transmission requirement. In this project, we had used HC-05 Bluetooth module which helps in serial communication. It means sending the data one bit at a time, it is a slow process but for a robot, at times it can do the single operation so it requires serial communications. But we use parallel communications, it can send two or more data bits transmission at a time but there is a chance of sending wrong instructions and robot operations/job may fail. To reduce this type of errors we had used HC-05 Bluetooth module. This Bluetooth module consists of the serial port protocol which helps for transparent wireless transmission and serial communications with an understandable user interface.



Fig. Bluetooth Module

3.6 TRANSFORMER

A transformer is an electrical device that works on the principle of mutual induction. A transformer helps in transferring electrical energy from one circuit to another circuit by electromagnetic induction. They are of two types. They are

- Step-up transformer which helps to increase the output voltage. In this primary winding has less as compared to the secondary winding.
- Step down transformer which helps to decrease the output voltage. In this primary winding, it has more coils than secondary winding.

A transformer is a very simple device. It consists of primary winding and secondary winding which helps in the increase or decreases the voltage and in between the two windings, a magnetic core is placed which helps in creating a magnetic field around it. This magnetic field helps in mutual induction and conversion of electrical energy. There are different types of transformers for various specific electrical applications but their principles and basic characteristics are same. They are

- Autotransformer
- Capacitor voltage transformer
- Distribution transformer
- Phase angle regulator transformer
- Scott-T transformer



Fig. Transformer

4. Working principle

The working of the robot is mainly dependent on its arms control, joints, end effectors, and sensors. In this robot we had designed a three degree of freedom with simple in construction. Joints place the main functions in industrial and pick and place robot. The Degrees of freedom means how many linear and rotational movements can a robot takes place is called as degrees of freedom. In this robot it consists of two axes movable joints and a revolute joint involves in the bottom of the robot.

A pick and place robot simply consists of two fixed bodies placed on a moving base which is connected with a rotating joint. The rotary joint provides a full 360-degree rotation which helps in picking up, holding, placing the object in any direction about any axes. This type of pick and place robot is mainly used in painting, packing, welding, spraying, tool changing, inspecting, automotive manufacturing, and at so many different places. The movement of the robot is done by using Bluetooth module android application either in android mobile or on a computer. This module consists of all the instructions like left, right, up and down and the gripper movement is of open and close. ATmega16 microcontroller is the main processing and operating function for the robot.

First the user must connect the arm with an android application then a message of connected successfully is obtained then one can operate the robot in its precise degrees of freedom as the robot is designed. Then for disconnecting the robot arm the user just needs to press disconnect in an android application then it is disconnected successfully. The entire system is running by using a 12V battery that supplies power to the entire robot. A step-down transform and a DC rectifier are used to reduce the power supply and to regulate voltage for the working of a robot.

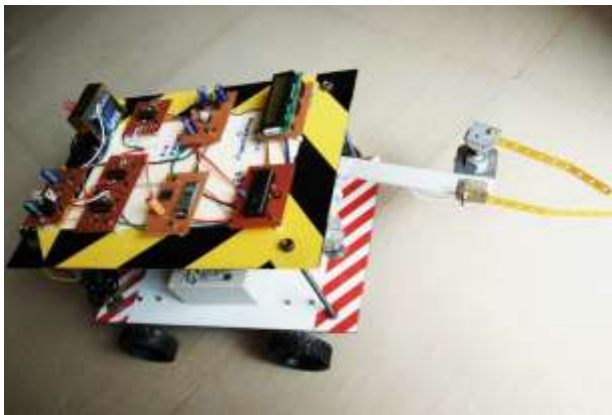


Fig. Pick and Place Robot Vehicle

5. CIRCUIT DIAGRAM

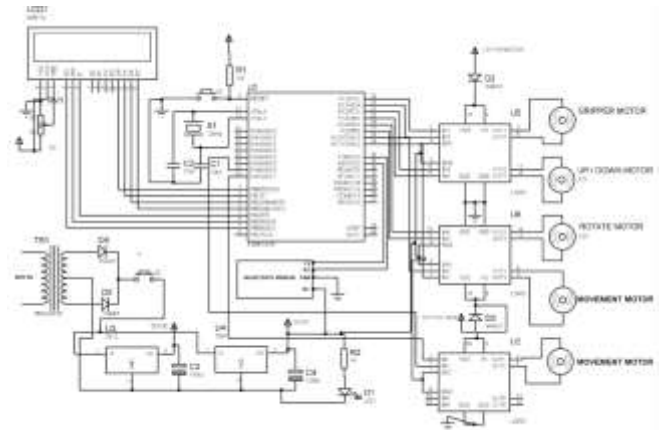


Fig. Circuit Diagram

The above circuit diagram shows all the connections among various components of the robot vehicle. The ATmega16 microcontroller receives the command from the Bluetooth module and provides the digital signal to the motor driver L293D. The motor driver L293D receives the signal from the ATmega16 microcontroller pins and drives the motors by using a 12V battery power source. One motor is for the gripper, two motors are for tracking wheel drivers and the two motors are for arm rotation and movements.



Fig. Power supply to the robot using batteries

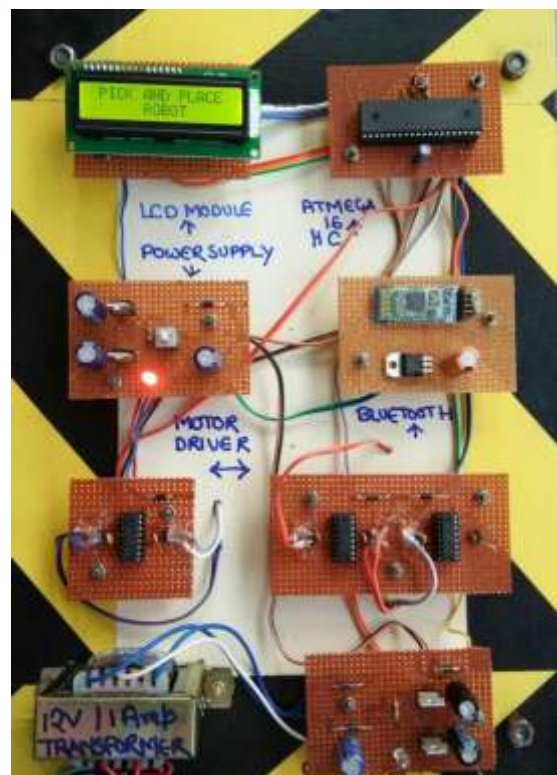


fig. Connected components

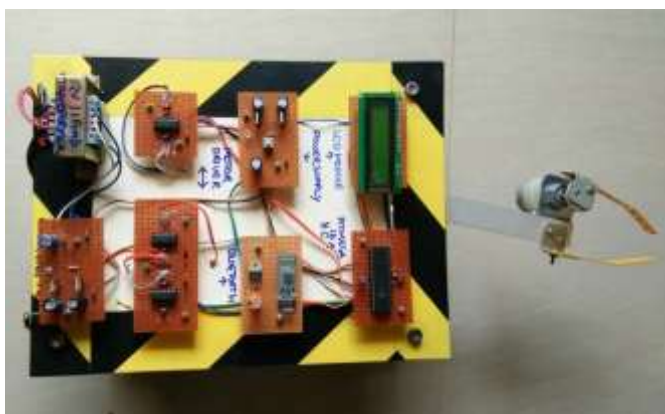


Fig. Top view of the robot vehicle

6. MIT APP INVENTOR

MIT App Inventor is used for creating Android Apps where we can design the app of our own choices such as the user interface and features. Like re-arranging puzzle pieces, you can set how your app will respond to different events by simply signing into your account so that the App Inventor server can save your work and help you keep track of our project.

It consists of two phases:

- App Inventor Designer
- App Inventor Block Editor

In-App Inventor Designer, you can select the components for your app while in App Inventor Block Editor you can assemble program blocks that specify how the components should behave visually, re-arranging together like pieces of a puzzle. After completing the above phases you may run your app directly in your Android phone. Moreover you may even download your app and install and run it on your Android device directly.

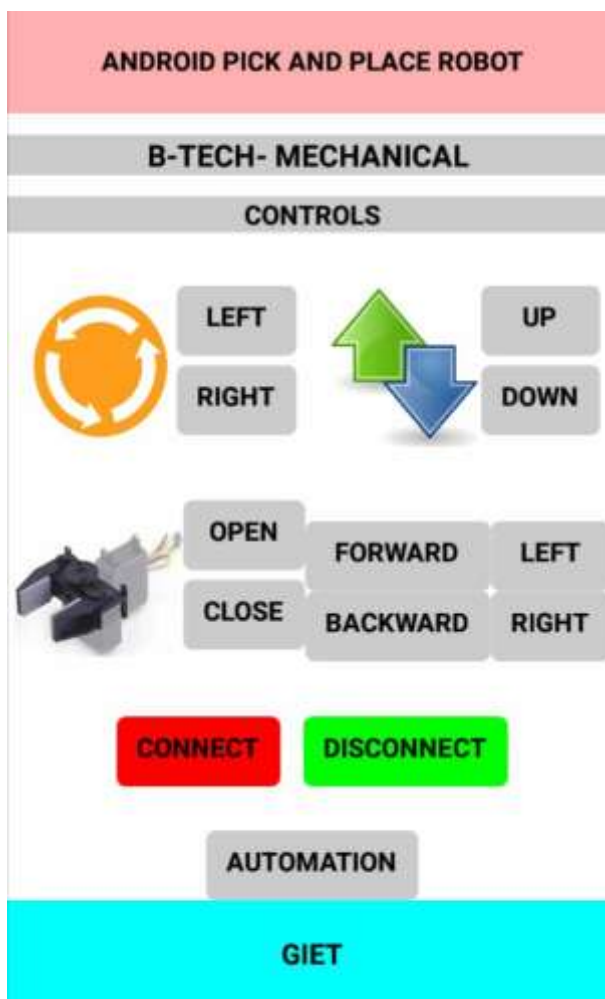


Fig. App Interface

7. ADVANTAGES

- This pick and place robot is portable since it is easy to carry here and there.
- It consumes less power.
- One of the main advantages is that the robot can be programmed easily due to its flexible nature.
- Robots are ideal if you are looking to conserve floor space.
- Depending on the weight and the size of a part, moving it from one place to another can be very demanding work.
- They are able to work without taking breaks or making mistakes.
- Incorporating pick and place robots can effectively cut your costs.
- The maintenance costs are very less and almost nil.
- It protects the workers from some hazardous situations.

8. FUTURE SCOPE

In the past times, Radio Frequency (RF) was used for the robots to operate. But it covers very less range. Hence, it is out dated now. In our pick and place robot vehicle, we are using a Bluetooth module for the communication of the robot. We can operate using our mobiles without any wire connections up to a specified range i.e around 100meters. In the future, we can include IOT technology to expand its range. Thus, we can operate the robot from anywhere in the world using internet access.

9. LITERATURE REVIEW

- [1] Ravikumar Mourya, Amit Shelke, Saurabh Satpuite, Sushant Kakade, Monoj Botre have main objective of their project are to design and implement a four DOF pick and place robotic arm. They conclude that the CAD tools like Creo1.0 and Auto CAD are used to model the desire manipulator. To determine the end effectors position and orientation, theoretical analysis of inverse kinematics are carried out. Ansys software is used for FE Analysis.
- [2] Prof. S.N.Teli, Akshay Bhalerao, Sagar Ingole, Mahesh Jagadale. This project aims to design and fabricate the pneumatic arm for pick and place of cylindrical objects. They conclude that arm is controlled by manually flow control and direction control valve. Arm rotation and movement is done by pneumatic cylinder using helical slot mechanism. Total arm weight is 25 kg. The model is expected to lift at least 10 kg weight.
- [3] S.Premkumar, K.Surya Varman, R.Ballamurgan, Experimental aim is to collaborate the gripper mechanism and vacuum sucker mechanism working in single pick and place robotic arm. These robot can perform tasks like gripping, sucking, lifting, placing, releasing, in a single robotic arm. It will

reduced the cycle time, Ideal time, cost of operation, space consumption. It is user friendly and effectively used in glass handling system.

- [4] S.C.Gutierrez, R.Zotovic, M.D.Navarra, M.D.Meseguer. Their purpose of work is to manufacture a light weight robot arm with a low cost budget. They conclude that to avoid negative influence on the total weight of the arm, the plastic material reinforced with fiber is used and vacuum infusion man process is used for manufacturing. Local reinforced elements must be included during construction of arm shell. The mast light gear reducer, harmonic drive types are used but because of lack of alignment causes disassembly of gear package to avoid these flexible couplings are required.

10. CONCLUSIONS

In this project, we had designed a three degree of freedom pick and place an industrial robot which can move from one place to another place. This ability helps the industrial robots not only to pick up and place the objects around it but also helps in picking the objects from one place and drop at another place. This helps the industrial robots to do multiple tasks. These types of robots have both fixed and flexible program type automation.

Most of the robots only consist of two degrees of freedom which are also of fixed at one point and used for a single purpose. These types of robots are mainly used for batch production of products in industries. Some robots contain three degrees of freedom which are either programmable type, these are also fixed at one place but can do various purposes like for every product manufacturing it will have a different manufacturing process that means its process planning programs are different. So fixed type cannot be used for the manufacturing of multiple products but the programmable type can program functions for different products.

In this project it not only has the ability of programmable type industrial robot but also it has the ability of picking of an object from one place and placing the object at another place and it can be used for various purposes like transporting the objects, checking the transport line for line followers, welding industries, spraying, and so many different abilities.

End effectors play the major role in operations because for some products cannot be picked and placed easily like magnetic materials, delicate materials like glass cannot be handled by same end effectors or gripper, so there are different types of end effectors like magnetic gripper to hold magnetic materials and vacuum gripper to hold delicate material like glass and so many types of grippers. This robot has the settings to change the end effectors of the robot so to

assist as many operations. These are the key features of this robot and its main use in industries.

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BIOGRAPHIES



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