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# Megatron: The Delivery Robot

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**Abstract:- Few years ago Self Driven Delivery Robots was a stuff of science fiction. But now they are bringing revolutions in case of foods, groceries, and package deliveries. In-fact robots are becoming a part of our daily life. There are several companies who are using self-driven delivery robots for delivering day to day goods. The typical size of delivery robots is like a luggage. The delivery robots can go from a starting point to a destination point while navigating through a crowded space environment and do so while avoiding numerous obstacles[1]. In our paper, we have tried to enhance the experience of using delivery robots. We have used the Bluetooth module RN42 & ultrasonic sensor HC-SR04 for for better experience. We have used the latest version of raspberry pi (4B) in our project. We have used the ArduinoUno to connect the motor driver with our raspberry pi.**

***Keywords:-*** *Self-Driven, RN42, HC-SR04, Raspberry pi.*

## I. INTRODUCTION

Human beings in India, performs most of the deliveries. The fundamental concept behind the self-driving system is too have a robot capable of moving tangible goods from one location to another. To assist humans in various ways, the field of robotics aims to crate these intelligent machines.Artificial intelligence (AI) refers to the theory to the computer system to perform tasks which take normally human consciousness [2]. Operational speed, accuracy, safety, dependability, cost-effectiveness, convenience, space-efficiency, and eco-friendliness are the main criteria for any autonomous delivery system. In these operations, the research has been considerably low due to the lack of trained experts. The most importantparameter that would decide the logistics would be the gross time taken by a vehicle to enter and deliver the goods.Although advanced technology is very fascinating but it may not be very cost effective method.

The use of AI in these robots allows them to navigate through complex environments and avoid obstacles in real-time. It also enables them to learn from their surroundings and improve their performance over time. There are several types of autonomous delivery robots that use AI, including ground-based robots, aerial drones, and even water-based robots. These robots can be programmed to deliver packages to specific locations and can even use machine learning algorithms to optimize their delivery routes. We have used raspberry pi 4B along with Bluetooth module RN42 to add wireless connectivity in our project. The robot will consist of a Arducam day-night vision camera for live monitoring purpose and a siren & speaker for anti-theft monitoring purpose.

## II. DESIGN AND BUILD SPECIFICATIONS

- *Components Required:*

The required hardwares are mentioned below in the table with proper specifications:

Table 1 Components Required

| Sl. No. | Components | Specifications | Quantity |
|---|---|---|---|
| 1. | Ultrasonic Distance Sensor | HC-SR04 | 1Pc |
| 2. | Bluetooth Module | RN 42 | 1Pc |
| 3. | Rasberry Pi | 4B | 1Pc |
| 4. | Motor Driver | L298N | 2Pc |
| 5. | MPU 6050 IMU | | 1Pc |
| 6. | LED and Siren & Speaker | Red, 6V | |
| 7. | Batteries | 9V | 3Pc |
| 8. | Johnson motor & wheels | 300rpm | 4Pc & 4Pc |
| 9. | Wires & Breadboard | – | |
| 10 | Camera | Arducam Day-Night VisionCamera | 1Pc |
| 11. | Lidar sensor | navigate their surroundings object identification collision avoidance | 1pc |

- *Ultrasonic Distance Sensor:*

The ultrasonic distance sensor we are utilizing is the HC-SR04. An ultrasonic transmitter, a receiver, and a control unit make up each HC-SR04. VCC(Power), TRIG(Trigger), Echo(Receive), and GND(Ground) are the four pins. Sonar is used by the HC_SR04 ultrasonic sensor to calculate the separation between two objects. With a 0.3cm(0.1inch) accuracy, this sensor measures distances between 2 and 400cm (0.8 and 157 inches)[3].

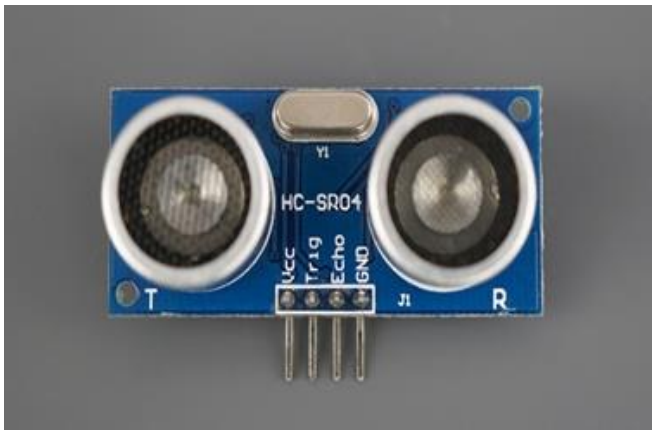


Fig 1 Ultrasonic Model (HC-SR04)

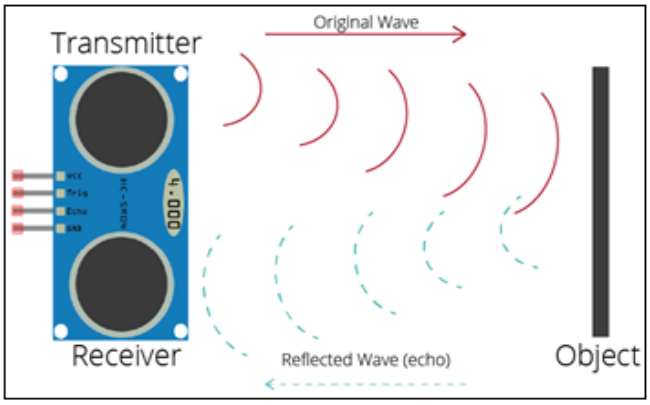


Fig 2 Distance Detection using HC-SR04

- *Bluetooth Module:*

We are using Bluetooth module RN-42. It can control a robot via PC, cell phone or any other microcontroller. The RN-42 Bluetooth Module is breadboard-friendly and is compatible with all 5 V and 3.3 V microcontroller platforms [4].

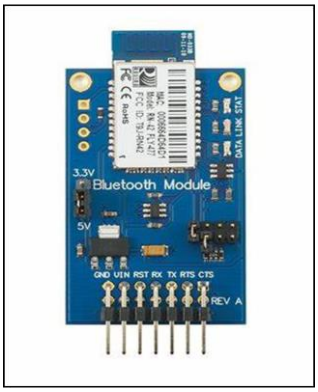


Fig 3 Bluetooth module RN42

- *Rasberry Pi -4B:*

The project's brain is the Rasberry Pi. The DonkeyCar library will be operated by it. It is necessary to install all the softwares and the DonkeyCar library on the Rasberry Pi initially, as well as on a different host computer. The autopilot must be trained using Tensorflow on the host computer. This autopilot file will be used to guide the delivery robot along the intended route, boosting precision without the need to mark the route in advance.

Fig 4 Rasberry Pi-4B

- *Motor Driver:*

We have used L298N as our motor-driver in the project. Here are the general steps to connect an L298N motor driver with a Raspberry Pi 4B:

- ✓ Power off both the Raspberry Pi and the L298N motor driver.
- ✓ Connect the power supply to the L298N motor driver [5]. The L298N can handle a wide range of input voltages, so make sure to choose a voltage that matches the requirements of your motors. The power supply should be connected to the "+" and "-" terminals on the L298N.
- ✓ Connect the motors to the L298N. The L298N has two H-bridge channels, each of which can control one DC motor. Connect the positive and negative leads of each motor to the "OUT1" and "OUT2" pins for one channel, and to the "OUT3" and "OUT4" pins for the other channel.
- ✓ Connect the L298N to the Raspberry Pi. The L298N can be controlled by the Raspberry Pi's GPIO pins. Connect the "ENA" and "IN1" pins to one GPIO pin, and the "IN2" pin to another GPIO pin. Repeat this for the second channel, connecting "ENB" and "IN3" to one GPIO pin and "IN4" to another GPIO pin.
- ✓ Connect the ground pins. Connect the ground pin of the Raspberry Pi to the ground pin of the L298N, and also connect the ground of the power supply to the ground pin of the L298N.
- ✓ Power on the Raspberry Pi and the L298N motor driver.

Once the hardware is set up, we have to configure the Donkeycar software to use the L298N driver by editing the configuration file.

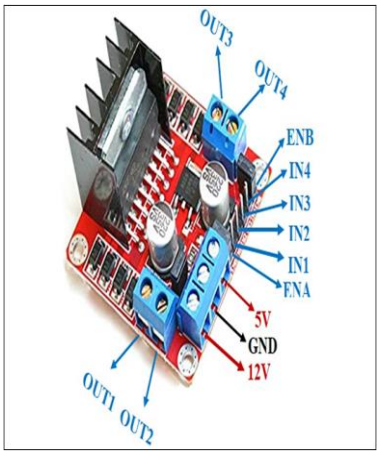

Fig 5 L298N

- *MPU 6050 IMU:*

The MPU-6050 IMU is an accelerometer and gyroscope sensor with three axes of motion. The gyroscope measures rotational velocity, while the accelerometer measures gravitational acceleration. This module additionally measures temperature. For identifying the orientation of a moving object, this sensor is perfect.

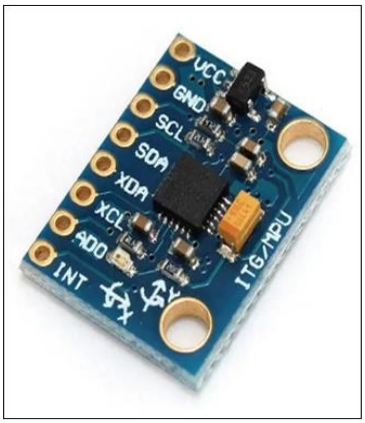

Fig 6 MPU 6050 IMU

- *Arducam Day-Night Vision Camera:*

This is a 2MP wide-angle USB 2.0 camera with a motorized IR-cut filter and infrared LEDs. Motorized (switchable) IR-CUT filters and infrared LEDs can be turned on/off to block or pass infrared light depending on the lighting environment.


Fig 7 Arducam Day-Night Vision Camera

- *Lidar Sensor*

LIDAR is essentially a ranging tool that calculates the distance to a target. Sending a brief laser pulse and timing the interval between it and the detection of the reflected light pulse are used to determine the distance. To "scan" the object space, a LIDAR system may employ a scan mirror, many laser beams, or other techniques.

➢ *Block Diagram:*

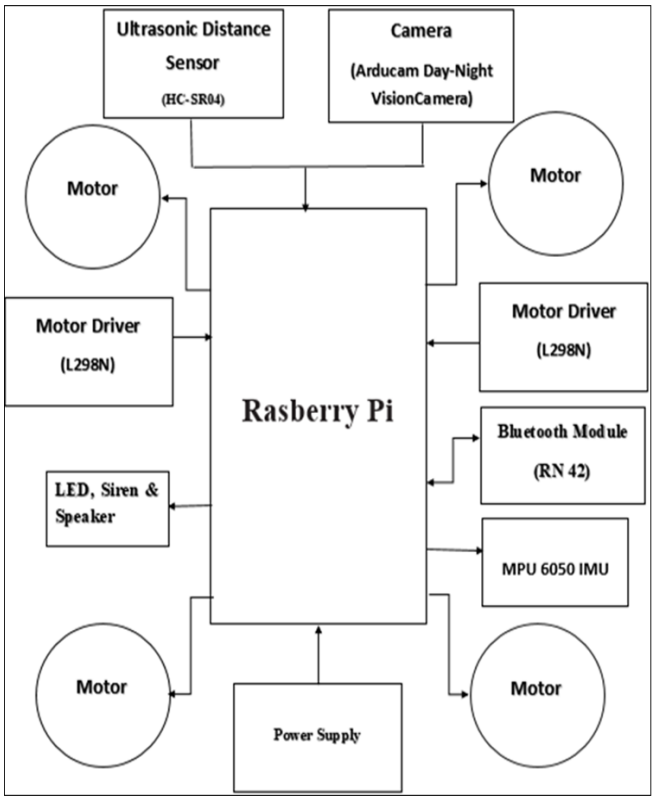

Fig 8 Block Diagram of Megatron

Following fig 8 shows the block diagram of our project. The ultrasonic sensors and the camera acts as inputs to the rasberry pi. There are two motor drivers (L298N), which each is connected to two motors. The bluetooth module RN42 acts as a communication channel between the bot and mobile application. The motor drivers will get inputs from the rasberry pi. LED, siren and speaker will acts like output devices. The gyroscope measures the rotational motion of the device, while the accelerometer measures its linear motion. By combining these measurements, the MPU-6050 can accurately determine the device's orientation, velocity, and acceleration.

➢ *Circuit Diagram*

- *Connecting HC-SR04 Ultrasonic Sensor to Rasberry Pi 4B:*

✓ Connecting the HC-SR04 sensor to the breadboard. We have to make sure the pins are correctly alligned with the breadboard's holes.
✓ Connect the VCC pin of the HC-SR04 to

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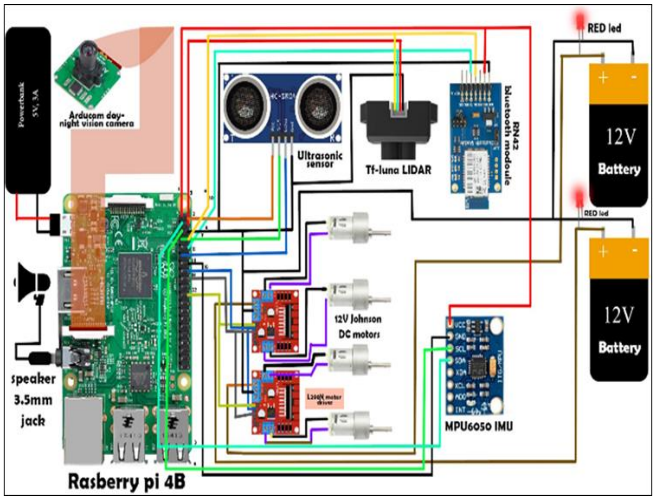

Fig 9 Circuit Diagram of Rasberry Pi 4B

- *The 5V pin of the Rasberry Pi.*

✓ Connect the GND pin of the HC-SR04 with the GND pin of the Rasberry Pi.
✓ Connect the TRIG pin of the HC-SR04 to the GPIO pin 17 of the Rasberry Pi.
✓ Connect the ECHO pin of the HC-SR04 to the GPIO pin 27 of the Rasberry Pi.
✓ We have to add a resister between ECHO pin and GND pin of the HC-SR04 to avoid errors caused by reflections.
✓ We have to do the coding part using python.
✓ To measure the distance, we send a 10 microsecond pulse to the TRIG pin. The sensor will send out an ultrasound signal and wait for it to bounce back. The ECHO pin will then output a signal with a duration proportional to the distance to the object.
✓ We can use the duration of the signal to calculate the distance using the followingformula:

- Distance = duration * speed of sound/2,
- Where the speed of the sound is 343 meters per second.

- *Connecting RN42 Bluetooth module to Rasberry Pi 4B:*

✓ Connect the RN42 module to the breadboard.
✓ Connect the VCC pin of the RN42 to the 3.3V pin of the Raspberry Pi.
✓ Connect the GND pin of the RN42 to the GND pin of the Raspberry Pi.
✓ Connect the RXD pin of the RN42 to the TXD pin of the Raspberry Pi.
✓ Connect the RXD pin of the RN42 to the TXD pin of the Raspberry Pi.
✓ Connect the TXD pin of the RN42 to the RXD pin of the Raspberry Pi.
✓ Power the RN42 module with a 3.3V power supply.
✓ Now we have to do the coding part using Python.
✓ To communicate with the RN42 module, we will need to use a serial port. We can use the PySerial library to do this.
✓ Once we have opened the serial port, we can send commands to the RN42 module to configure it and establish a Bluetooth connection with another device. The RN42 module uses a simple ASCII command interface, which means we can send and receive commands as text strings.

- *Connecting L298N with Rasberry Pi 4B:*

We have to connect the following pins on the Rasberry Pi to the corresponding pins on the motor driver:

✓ Pin 2 (5V) on the Rasberry Pi to the 5V pin on the motor driver.
✓ Pin 6(Ground) on the Rasberry Pi to the GND pin on the motor driver.
✓ GPIO pins on the Rasberry Pi to the IN1, IN2, IN3, and IN4 pins on the motor driver. You can choose any available GPIO pins on the Rasberry Pi.

- *Connecting MPU 6050 IMU with Rasberrry pi 4B:*

✓ Pin 1 of Rasberry Pi is connected to VCC of the MPU 6050 IMU.
✓ GND of Rasberry Pi 4B is connected to the GND of MPU 6050 IMU.
✓ SCL of MPU 6050 IMU is connected to the pin 5 of Rasperry Pi.
✓ SDA of MPU 6050 IMU is connected to pin 3 of Rasberry Pi.

## III. NAVIGATION SYSTEM

Firstly request by the customer is received in the webpage of the robot delivery system. The webpage is connected to robot wirelessly with Rasberry Pi module. When a request for delivery is received by the robot, the robot calculates the distance between the reciever and itself and checks whether the end point is in it's range. The robot sets a starting point and end point between the reciever and itself via accessing the GPRS (MAP) of the locality and chooses the shortest route to deliver the items in time without any problems or obstructions by using the A* algorithm. As the robot starts from its starting point the user recieves a notification that the robot left for its destination and time will show how much it will take to reach its destination.

Fig 10 Diagram of Navigation System

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For eg: Suppose A is the starting point of the robot and B is the destination to which the medicine is to be delivered, when the robot leaves it creates a point on its path thoughout its all possible route to point B. The GPRS calculates the number of point towards its destination thus minimizing the total distance. The next point in the path from the robot's current location is used as an intermediate set point for the robot to travel to its endpoint.

If the robot encounters with any avoidance in its path of delivery such as road blockage or any physical interference by foreign materials , etc. The robot would change its path from the point where it was being stopped. In worst case the robot would return to its base from where it started if it as being intruded at extreme level.

The robot features a 3-axis accelerometer and 3-axis gyroscope sensor in its MPU 6050 IMU(Inertial Measurement Unit), which it utilizes to scan the area and examine or evaluate objects in its route. The gyroscope measures rotational velocity, while the accelerometer measures gravitational acceleration. It helps the robot to accelerate in smooth flow eliminating any kind of jerks and keeping the items safe.

➢ *Collision Avoidance:*

Using an Ultrasonic Distance Sensor and a Lidar sensor, the robot stays clear of obstacles along its route. With an accuracy of 0.3cm(0.1inch), this sensor measures distances between 2cm and 400cm. Lidar is used to scan the surrounding area and ultrasonic sensor is used to determine the location of obstacles on all sides of the robot. If any obstacles appear in the immediate path of the robot, the robot will stop moving and wait for the obstacle to move out of the path such that the robot can safely continue forwards.

Fig 11 Collision Avoidance

## IV. METHODOLOGY

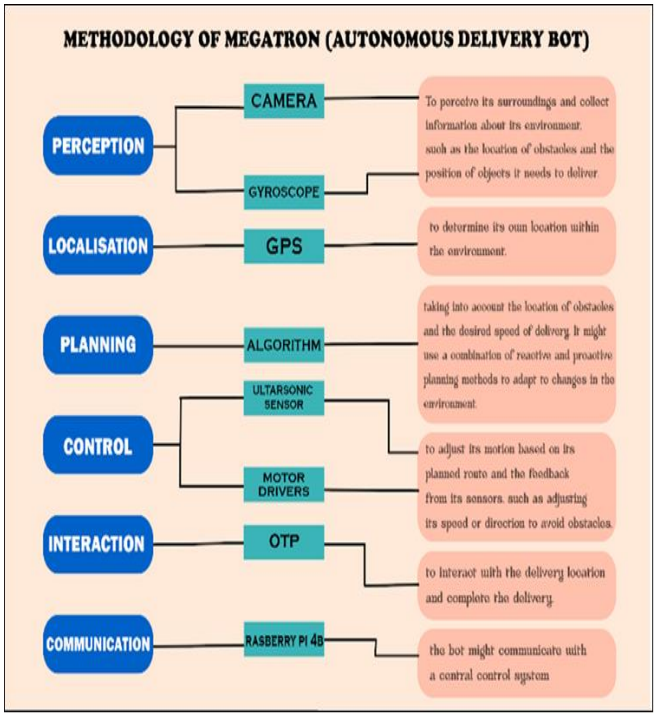


Fig 12 Methodology

Methodology is used to explain the step by step working of the megatron delivery bot. There are Methodology is used to explain the step by step working of the megatron delivery bot. There are few steps to divide the working odf the autonomous delivery bot. Perception, is used to collect the information of the sarroundings. Localosation, it is used to know the location of the bot. Planning, it is bacically the algorithm of the bot. Control, it is used to adjust the designated route of the bot. Interaction, to interact with the customer. Communication, it is the central brain of the whole circuit which will control the bot.

## V. ALGORITHM

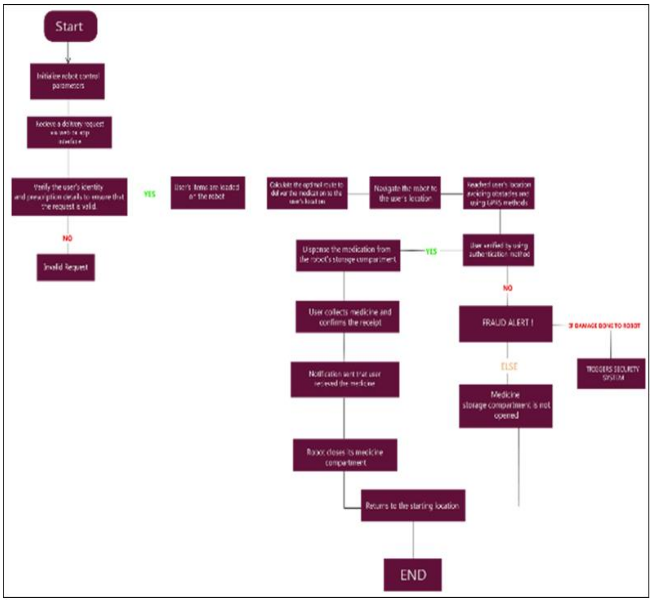


Fig 13 Alogorithm of Megatron

## VI. FUTURE SCOPE

After the outbreak of corona virus, Deliveries a concern for every people in recent years. So humans depend on autonomous robots to deliver their needs. In the ongoing development of the robot market, according to the International Federation of Robotics, investment in delivery robots can make a big step in the robotics market conditions. These robots can be supported with artificial intelligence and computer vision so that these new applications can better suit the robots to maintain accuracy of delivery at each location, increase their speed in low light and avoid unknown obstacles in real time. Robotics companies have already boosted the robot market for this contact-less delivery, and it will continue to grow many more in the upcoming years. Voice recognition systems with text-to-speech and speech-to-text can be implemented and connected to the internet and cloud to enable the ability to speak each customer for better feedback. These autonomous delivery robots can be used in various sectors such as medical emergencies, food delivery, at airports, for receiving essentials, for dispensing medicines in hospitals and doctor's clinics. These robots with communication features can be used to deliver prescribed medicines to selected home addresses of patients so that they can avail this facility from their homes.Also a big step in bringing daily essentials home, this robot can deliver daily food and other daily essentials to that selected address These robots can play a huge role in carrying luggage at airports, and in the coming years, these autonomous robots can be used in every restaurant, which can reduce the need for staff and have the potential to make the work faster and more efficient. In the future these robots can be made more powerful to carry heavy luggage and deliver over long distances. The time is not far when these autonomous delivery robots will become a reliable source of bringing daily essentials to the doorstep.

- This can have a major impact on the lives of every life's.
- But people have to look at the price and affordability of this robots.

## VII. CONCLUSION

We used the latest version of Raspberry Pi (4B) in our project to handle the task. This robot can deliver essential items through a container that is locked by password, which can operate without any human help. Our robot ensures product and transportation security, password protected distribution accuracy. Even the use of Ardu-Cam enables the robot to deliver products even in low light. .The perfect accuracy of password protection means that products can be delivered without being touched, damaged or stolen, even with a red siren that can detect the robot's immobility. This robot can become very useful in delivering food, groceries and daily necessities to the desired destination anytime. Also, at this time of extreme pressure on the healthcare system, providing medical equipment to hospitals can be very risky. Our robots can also play an important role in therapeutic drug delivery. At the same time, robots can be an effective smart logistics system to solve important logistics problems in the supply chain, especially last mile delivery reducing cost and time. The robot provides customers with a simple user interface, which makes it smart and user friendly. Also, the lightweight construction of our robot makes it crash-safe, thus it can effectively contribute to reducing urban congestion, and accidents.

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