**Autonomous Garbage Collector Robot**

**Features:**

* **Obstacle Avoidance:** There are 3 sonar sensors in the front of the robot vehicle to avoid obstacles in the pathway of the robot. There is a sonar at the back of the robot vehicle as well to avoid collision while moving backwards. The sonars in the front can rotate from 0 to 90 degrees with the help of the servo which helps the sonar sensors to increase the range of coverage on the left and right side of the robot. IR sensors are also used to put firm in the obstacle avoidance functionality. So both the sonars and IR sensors are used to avoid any type of collision. There is a IR sensor on the robotic arm at height 35cm just below the claw. This sonar helps to avoid any obstacle present in the range of the height of the robot arm.
* **Living Beings Avoidance:** There is a PIR motion sensor in the front of the robot. A passive infrared sensor (PIR) is an electronic sensor that measures infrared light radiating from objects in its field of view. It helps to detect any kind of movement in front of the robot. So if there will be any sort of movement that means there is a living thing nearby, the robot will not approach in that direction, to avoid collision with any living beings including human, pets, birds etc. A Thermal sensor (OMRON MEMS) is combined with PIR sensor in order to detect living being more precisely.

**Later Improvement: “Detect living being from webcam through image processing.”**

* **Movement Accuracy:** The robot is based on image processing. So it will get a direction from the camera servo. Initially the camera servo starts rotating and if it detects any garbage nearby it will send the camera servo angle to the Arduino. Depending on the motor rpm robot will get an initial rotation time to rotate in that direction given by camera servo. While rotating the MPU6050 sensor (gyroscope, accelerometer) will confirm the rotation. As the robot moves forward both IR and Sonar sensor will confirm the remaining distance of the garbage from the robot. The total combination of camera servo, Arduino, MPU6050, IR and Sonar sensors together confirm the movement accuracy of the robot.
* **Security:** A GPS is attached to the rover so that we can identify its location through google map. It is very important as any autonomous robot can be misused and stolen if we don’t use GPS system. For example: If anyone picks up the robot and takes it out from it designated coordinates, a notification will be sent to the control. The robot will also start a loud siren sound awaring any nearby people. Besides, we can also detect whether the robot is working properly or not by seeing its location. For example: During autonomous mode if the robot is stuck in a specific location for more than 2 minutes, a notification will be automatically sent to the control room**.**
* **Live Feedback:** If there will be any sort of misbehave from the robot the system will identify it and sends a message to the control room with the help of Arduino and SIM900A module. A sim card will be inside the module and it will send the error message to the control room.
* **High Power Motors which helps to move over small or medium sized objects.**

Maximum weight 4 motor can lift: 3.3kg x 4 = 13.33 kg. Since out robot is 6kg, it can easily move around its environment without any difficulties.

* **Future Implementation:**
* Using Reinforcement Machine Learning Algorithm the robot will be taught the surrounding environment and will make its own decision whether to move next after grabbing one garbage. Obviously there will be an increase number of sensors to support this mechanism.
* Another addition implementation is identifying valuable objects. The robot will collect garbage as well as identify any valuable object such as money bag, ornaments, jewelries, mobile phone etc. After that it will pick it up, separately store in a chamber of its basket and return to the control room asap.
* One more addition will be detecting massive garbage in any specific portion of the region. For example, if the robot is working in a park it will detect if there is a massive chunk of garbage anywhere and after detecting it will update the google map with the help of its own GPS system. Controller can see the map and will take necessary action to collect that garbage.
* Add solar chargers to the robot so that it can automatically charge itself when it runs out of power.
* Improve dataset by adding more images to it. This will increase the detection and accuracy level to a great extent.