SAE STUDENTS CONVENTION

- TIER 2

MOBILE ROBOTICS CHALLENGE

TEAM: THINK INVERSE

BOT : MATRIX

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**ABSTRACT:**

To design an autonomous ground vehicle (AGV) of the line follower type to perform picking and placing of defective components placed among the good ones using intelligent detection and evaluation by non-destructive methods employing ultrasonic testing(UT). The bot is provided with a sensory unit capable of analysing its ambience. The bot’s micro controlling unit powered by the MCU arduino and its drive unit powered by a combination of servos and geared motors are to be discussed here.

**COMPONENTS OF THE BOT:**

|  |  |  |
| --- | --- | --- |
| **COMPONENT** | **SPECIFICATION** | **QUANTITY** |
| ARDUINO | MEGA 2560-R3 | 1 |
| DC GEARED MOTOR | 6V/60 rpm | 2 |
| DC SERVO MOTOR | Speed:6 deg/sec  6V/7.1 Kg cm | 2 |

**MATRIX’S SPECIFICATION**:

**DIMENSION:**

The MATRIX has a negotiable length and width of **150mm and 140 mm** respectively depending upon the layout which is specified with the arm not extended. The chassis is determined at a height of 50mm.

**TRANSPORTATION:**

The wheels play an important role in an AGV. The bot MATRIX is provided with **a pair of wheels** capable of moving and rotating in both directions.

**MOTOR AND WHEEL DRIVE:**

**TYPE**: **DC GEARED MOTOR DRIVE**

**PURPOSE:**

The matrix needs to meet its power to weight ratio thereby requiring high torque drives which would enable it to cover corresponding long distances within the stipulated time. The DC Geared motor drive which is to be employed on the matrix would satisfy the above echoed demands.

**OTHER SPECIFICATIONS:**

* DRIVER: LM-293 D
* QUANTITY:1
* RATED VOLTAGE:6V
* RATED SPEED: 60 RPM.

The entire wheel drive system is to be interfaced using Arduino MEGA 2560. The driver LM-293D, is to be attached to MEGA board in order to attain the threshold rated current of the motors.

**MANIPULATOR DRIVE SYSTEM:**

**TYPE: DC SERVO DRIVE**

**PURPOSE:**

The Manipulator provided to the bot contains a robotic arm with two degrees of freedom in which all the joints require individual movement with precision. The DC Servo motor has an inbuilt encoder which helps in precise manipulation of the links of the matrix’s arm. Besides precision it also offers other advantages such as efficient usage of power and compatible sizes.

**OTHER SPECIFICATIONS**:

QUANTITY: 2

RATED VOLTAGE: 6V

TORQUE: 7.1 Kg cm

SPEED:60 degree/sec.

**MANIPULATOR SPECIFICATIONS**

The pick and place action of the matrix is to be achieved by the manipulation of the robotic arm. The arm has four degrees of freedom.

* **TYPE :Cartesian**
* **NO.OF AXES : 2**
* **PAYLOAD : 100 g**
* **REACH : 120 mm**
* **DRIVE :DC servo drive**
* **JOINT TYPE :Linear**
* **OPERATION OF CONTROLLER: Intelligent control**

**SENSORY UNIT:**

The bot has a combination of sensors employed, to enable to sense its ambience and to sync with it. These sensors help the bot to navigate between obstacles and in correct identification of defective components.

The bot has the following sensors employed on it

|  |  |  |  |
| --- | --- | --- | --- |
| NAME | TYPE | PURPOSE | QTY |
| QDY 1114 | INFRA RED | LINE DETECTION | 3 |
| HC-SR04 | ULTRASONIC | OBSTACLE DETECTION | 1 |
| TCS3200 | COLOUR SENSOR | TO IDENTIFY THE OBJECT | 1 |

**CONTROL UNIT OF THE MATRIX:**

The matrix’s entire control system is controlled by the microcontroller namely

* Arduino Mega -2560 R3

The driver is connected to the arduino mega board with the D.C. geared motor connected to it. Then the I-R sensors are connected to their respective pins in the arduino mega board and the servo motors are connected to the board. For obstacle detection ultrasonic sensor is used, this sensor is controlled by the mega board. To pick up the objects and to take to their corresponding place colour sensor are used .Once the colour is sensed the gripper automatically pick the object and finishes it’s task by keeping the object in the required area .The whole bot is powered by a 9 volt battery .

**ARDUINO BOARD SPECIFICATION:**

**ARDUINO MEGA -2560 R3**

**PROCESSOR :**AT Mega 2560

**CLOCK SPEED** : 16 MHz

**RAM** : 32 KB

**FLASH MEMORY** : 256 KB

**PIN COUNT** : 54 I/O pins,16 analog pins

**FAULT DETECTION PRINCIPLE:**

Given that the colour is going to be the deciding factor for determining the defective components with the fact that green cubes are the defective ones and the grey cubes are the regular ones, by employing the colour sensor module TCS3200, which detects colours based on the changes in the frequency of the square wave generated by the oscillator circuit present within the module. For e.g. if green cube is detected then the necessary changes in frequency of the oscillator corresponding to that colour is calculated by the module. Here the given colour code to us is in CMYK format for that we were decided to convert the CMYK code to RGB code then TCS3200 used for RGB code then required work will be done.

CMYK code to RGB code for given Colours:

Grey (0,0,0,20) = (204,204,204)

Green (70,0,100,0) = (77,255,0)

**ALGORITHM:**

1. The bot is initialised at the position NODE 0.
2. The bot tends to move.
3. After it crosses the ramp, ULTRASONIC AND COLOR SENSOR turned ON.
4. When ULTRASONIC SENSOR detects the object, the bot stops to move.
5. Then COLOR SENSOR records the colour of the object.
6. Using SERVO GRIPPER, the object is picked.
7. Then ULTRASONIC SENSOR is turned OFF.
8. The bot is turned around 180 degrees, by using DC MOTOR DRIVES.
9. Then its returned back to initial position.
10. After reaching the initial positon, based on the COLOR SENSOR value it turn into right or left.

IF..ELSE CONDITION

IF its non defected object, it turns into right.

After reaching the respective node, the object is placed there.

ELSE it turns into left, since its defected.

Then the object is dropped there.

NOTE:

The same process is repeated for the other 8 objects.

Based on the previous placement of the objects, next placement of the object will be decided.

**CONCLUSION:**

With the above mentioned various drive systems and the sensory unit synchronized by the Arduino based micro control systems ,the matrix will effectively pick and place the target objects identified using colour detection method thereby effectively functioning as an AGV based on line following.