

Research Article

Multifunctional Robotic Vehicle for Industrial and Security Applications

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Abstract

In any industry or household work, the picking and placing are very basic operations and have been required to do it again and again. One way is the use of a small vehicle capable of doing pick and place type of work. The system proposed will include the robust assembly for these types of functions with the wireless operation and control using RF module. The system will have a wireless camera that will be used for continuous monitoring of the surrounding environment where the vehicle will be placed. Another important aspect is the security of workplace for some natural hazards and also from thefts. The model will also include fire sensor and theft detection system that is taken on LED which is placed in front of continuous monitoring wireless camera. It will also buzz the alarm at the same time of detection. Hence it will provide total security in the night time or when the workplace is off. The total functions will be built around AVR microcontroller with obstacle and metal detection also. Hence the vehicle will have total of five applications right from mechanical work, monitoring to the security and alarming.

Keywords: RF module, GSM module, AVR microcontroller.

1. Introduction

In the modern age, every country is more advanced and everything is more sophisticated. Robot is defined as a mechanical design that is capable of performing human tasks or behaving in a human-like manner. Building a robot requires expertise and programming. It's about building the systems and putting together motors, sensors and wires, among other important components (U.Jyostna Sai Prasanna, M.V.D.Prasad, 2013). A robot can be defined as a reprogrammable, self-controlled device consisting of electronic, electrical, or mechanical units. More generally, it is a machine that functions in place of a living agent. Robots are especially desirable for certain work functions because, unlike humans, they never get tired; they can work in physical conditions that are uncomfortable or even dangerous; they can operate in airless conditions; they do not get bored by repetition; and they cannot be distracted from the task at hand. The robot is powerful, reliable and can be use in hot temperature area where a human after working for so long can become sick and exhausted. It is implemented so that it can work repeatedly without any cost. This project will introduce a new era in industries to use automated machine and robot for more precise, cost

effective and reliable work (Mir SajjadHussainTalpur, MurtazaHussainShaikh, 2012).

The robotic system can be used to implement some real time applications by considering some workplace and building some applications around it. We took an example of a small scale industry or mall or a retailer shop or simply a room in house. After analyzing the common needs and problems we found some applications to be worked on and these are:

- 1) There is a need of some guided vehicle for bringing some small objects from one place to another.
- 2) There should be a monitoring system for continuously monitoring the work area and also the vision of the vehicle.

Along with these applications, there are some problems or chances of some calamities and that are:

- 1) There are chances of the fire in the workplace while it is closed and there would be no one to inform for it.
- 2) Along with this, there are some antisocial activities like thefts who are unauthorized people that invade the work area.

2. Design Analysis

As discussed earlier there are some needs of the workplace and some problem of the workplace so to

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fulfill the requirement of the workplace overall system divides into three parts.

Analysis for Need of the Workplace

In first part, the needs of the workplace will be fulfilled such as for bringing some small objects from one place to another and continuously monitoring system in the work area. For these work robotic vehicle should be capable of doing pick and place type of work and have continuously monitoring system connected to it.

A. Pick and Place

Arm Movement Circuit

- The output of HT12D is given to the pin 2,7,10 and 15 of L293D which is a driver IC used for controlling the motors. This motor driver IC is act as an interface between the RF receiver and the motors in the robot.
- L293D is a 16 pin IC
- It consists of 4 channels, pin 1 is used to enable the channel 1 and channel 2
- Pin 2 and pin 7 are the inputs to channel 1 and channel 2 respectively
- Pin 9 is used to enable the channel 3 and channel 4
- Pin 10 and pin 15 are the inputs to channel 3 and channel 4 respectively
- The motors are connected pin 3,6,11 and 14
- Pin 4,5,12 and 13 are grounded
- Vcc is connected to pin 16 for the internal working of IC
- The voltage that is required to drive the motor is given to pin 8
- When the high signal (1) is given to the pin 3 and 14 and the low signal (0) is given to pin 6 and 11 then the motor will move in forward direction.
- When the low signal (0) is given to the pin 3 and 14 and the high signal (1) is given to pin 6 and 11 then the motor will move in reverse direction.

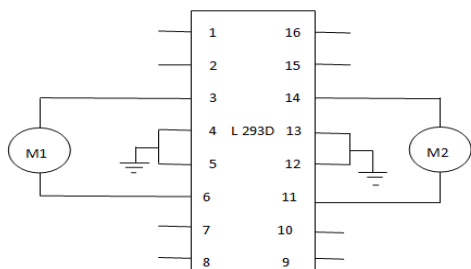


Figure 1: Design Circuit for Arm Movement

Wheels Movement Circuit

- For the movement of wheels, we are using four motors i.e. motor 1, 2, 3 and 4 of 150 rpm.
- Motor 1 and motor 3 are parallely connected to pin 3 and 6

- Motor 2 and motor 4 are parallely connected to pin 14 and 11

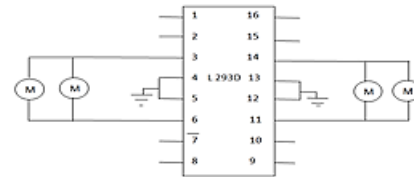


Figure 2: Design Circuit for Wheels Movement

Transmitter Circuit

- Transmitter circuit consist of an encoder IC HT12E
- This is an 18 pin IC, from which first eight pins are the address lines named A0 to A7 and the address is given as per the connection of switches connected to the respected pins. The pins 10 to 13 are the data pins.
- Pin 15 and 16 are shorted through the resistor of 1.1Mohm.
- Pin 18 of the encoder IC and pin 3 of RF transmitter are connected to Vcc.
- Pin 17 of the encoder IC and pin 1 of RF transmitter are connected to GND, also pin 9 of encoder IC is grounded.
- The parallel data and the address are converted into serial data by using the encoder IC HT12E and is given to pin 2 of the RF transmitter.
- This serial data is transmitted by antenna connected to the pin 4 of RF transmitter.

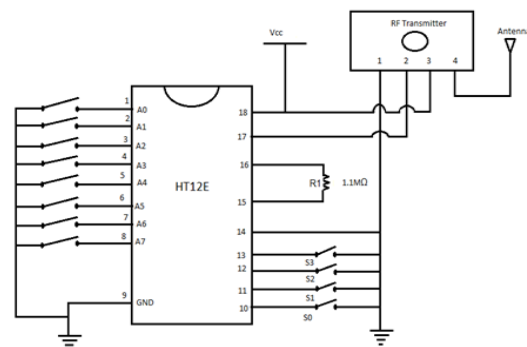


Figure 3: Design Circuit for Transmitter Section

Receiver Circuit

- Receiver circuit consist of an decoder IC HT12D and RF receiver
- This is an 18 pin IC from which first 8 pins are address lines and pin 10 to 13 are data line.
- Data and address is received on the pin 8 of RF receiver through antenna and it is given by the pin 2 and 3 of RF receiver to the pin 14 of decoder IC.
- Then the decoder IC covertes the serial data and address into parallel address and data.
- The decoder IC then checks the received address if it matches with the address present in the decoder

and if it matches then the data is sent through the data pins.

- This data lines are connected to pin.2, 7, 10 and 15 of driver IC L293D which is use for driving the motor.
- Pin 1, 6, 7 of RF receiver is grounded.
- Pin 4 and 5 of RF receiver are connected to Vcc and given to pin 1 and 16 of driver IC.
- Pin 15 and 16 of decoder IC are shorted through a resistor of 51 kohms and pin 9 is grounded.

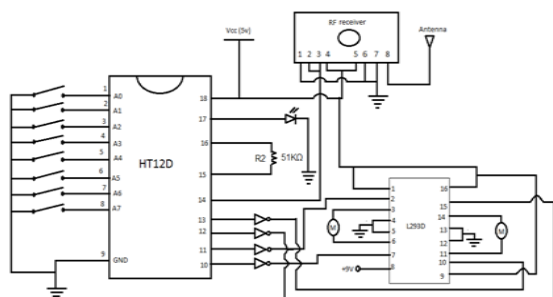


Figure 4: Design Circuit for Receiver Section

Supply Circuit

- In our project we use the battery of 12V which gives the current of 1.2 ampere in one hour.
- As we require the supply of 5V we use IC 7805.
- IC 7805 is a voltage regulator IC which provides constant power supply of 5V.
- It protects from thermal overloading.

Continuous monitoring

- Camera used here is a wireless camera and placed at the receiver section
- It transmits the signal at 1.2 Ghz.
- This camera is mounted on the shaft of the dc motor of 10 rpm for controlling the rotation of the camera.
- Thus by giving proper inputs to the DC motor, the camera will move and it can rotate in 360 degree.
- The motor is controlled using RF module.
- At the control room a TV tuner is used as a receiver of the signals sent by the camera.
- This TV tuner is directly connected to the PC in that room so we can see the videos sent by camera.

B. Analysis for the Problem of the Workplace

In second part, robotic vehicle will be capable to overcome the problems of the workshop such as natural hazards like fire and antisocial activities like thefts. For these problems, Fire detection and Theft detection circuits are included in these project.

Fire Detection

- Fire detection circuit consists of AVR, DRIVER IC, BUZZER and LM35 sensor.

- AVR has four ports , Port A (PA7-PA0) Port A serves as the analog inputs to the A/D Converter, Port B (PB7-PB0) Port B is an 8-bit bi-directional, Port D (PD7-PD0) Port D is an 8-bit bi-directional I/O port with internal pull-up resistors I/O port internal pull-up resistor, Port C (PC7-PC0) Port C is an 8-bit bi-directional I/O port with internal pull-up resistors RESET Input.
- A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running.
- XTAL1 is the Input to the inverting Oscillator amplifier and input to the internal clock operating circuit.
- XTAL2 is the Output from the inverting Oscillator amplifier
- AVR has ADC of 10 bit and 8 channel. here only we are using 0 channel for input and output
- The circuit consists of two sensors, they are IR sensors that are connected to all sides of robot and other is LM35 sensor which senses temperature
- LM35 sensor is connected to port PA.0. Accordingly it gives output through port PB.0 which is connected through Driver IC to buzzer.

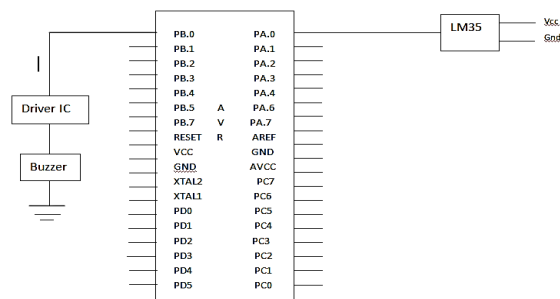


Figure 5: Design Circuit for Fire Detection

Theft Detection

- The theft detection circuit consists of two circuits.
- This second circuits is dependent on first circuit.
- The circuit is attached to door.
- A 5v supply is given to IR transmitter through 270Ω resistor as we want voltage of just 3V
- The circuit consists of IC LM324
- The IC in all have 14 pins , Pin no 4 and 11 are VCC and ground respectively
- As soon is the door is opened the circuit cut and variable output is given by pin 13 to the driver IC to the relay .
- The relay is switch which turn on the light of workplace
- The other circuit also consists IC LM324 b.along with the LDR (LIGHT DEPENDENT RESISTANCE) which senses the light and gives output same as first circuit to driver IC to either to buzzer or microcontroller.
- This circuit works only at night time in initial stages when there is no light.

- For day time PIR sensor is used , PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason they are commonly found in appliances and gadgets used in homes or businesses.

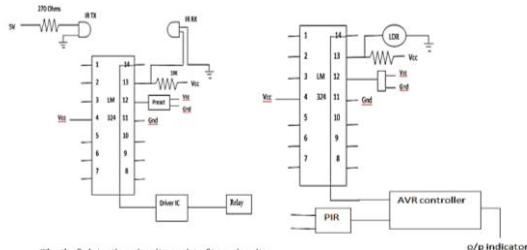


Figure 6: Design Circuit for Theft Detection

C. Analysis for it's own Problem

In third part, Obstacle detection circuit is added in the system to overcome it's own problem of not detecting the obstacle from the back side.

Obstacle Detection

- Obstacle detection circuit mainly consists of IC LM324, IR transmitter, IR receiver, indicator.
- The 5V supply is given to IR transmitter connected through 270 Ω resistor.
- In IC LM324, pin 4 is given VCC, pin 11 is grounded. The IR waves are transmitted by IR emitter.
- Whenever it detects obstacle the transmissions are reflected and that are detected by photodiode which is used a IR detector.
- The comparator then compares to the given input and provides the inverted output through pin no 14 to indicator.

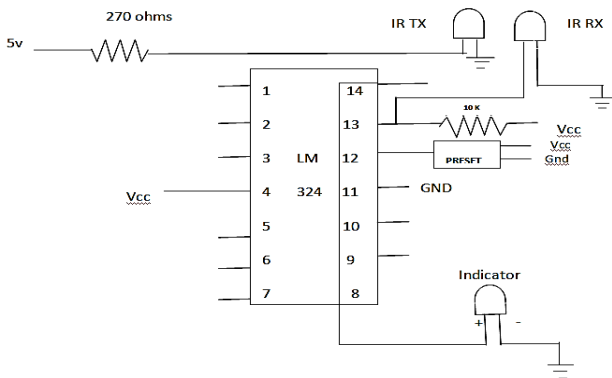


Figure 7: Design Circuit for Obstacle Detection

3. Results

As per design the robotic vehicle consists of overall five functions. The results of each function are shown below

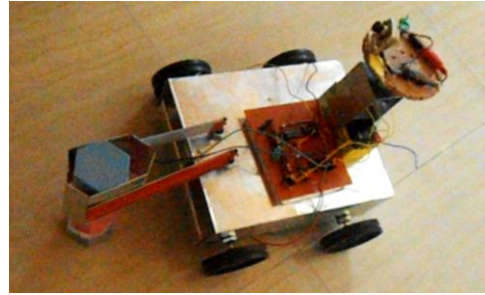


Figure 8: Result of the function pick and place

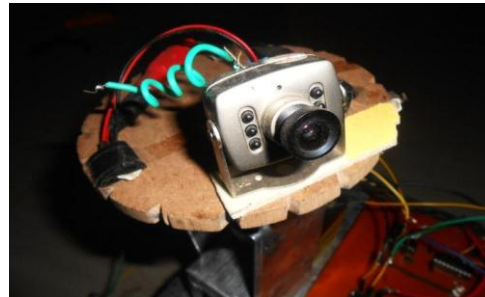


Figure 9: Shows the function of continuous monitoring

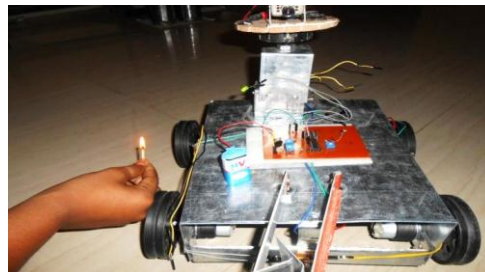


Figure 10: Results of the fire detection circuit

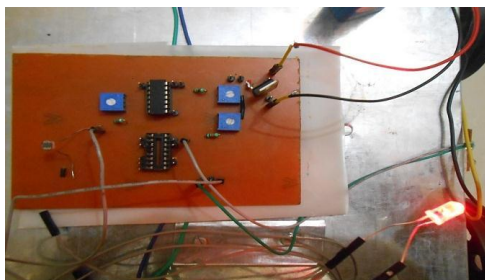


Figure 11: Results of the theft detection circuit



Figure 12: Results of the obstacle detection circuit

Conclusion

The robot is able for producing the basic walking movements by using four dc motors and arm movement for the application of pick and place is carried out using 2 dc motors. A robot is developed with a very good intelligence so is easily capable to sense the obstacle and by processing the signal coming from the sensor. It is capable of sensing fire in the workplace provides protection of workplace from natural hazards also. Robotic vehicle is capable for theft detection. It provides safety to the workplace. It also provide continuous monitoring system through which user can observe condition in the workplace in the control room.

They provide us greater efficiency to detect the flame and it can be extinguish before it become uncontrollable and threat to life. Robot movement is precise, accurate, and is easy to control. The robotic arm has been developed successfully as the movement of the robot can be controlled precisely. In the industry if any fire accident occurs, there is a need of person to monitor continuously and rectify it. The conclusion is to provide security of home, laboratory, office, factory and building is important to human life. We develop a fire detecting system in our daily life. We design the fire detection system using sensors in the system, and program the fire detection using sensor.

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