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Table Cleaning Robot Using GSM and Sensors

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Abstract - *In order to improve the amount of time used to clean the home, the users are trying to develop more time saving devices like small robots which helps us to clean space inside the home very easily. In this project I am developing a small robotic device which can clean any table surface easily without any help from the user. The device can able to work in two different modes. It can be controlled by using sound and by using a mobile phone. This device consist of a chassis in which four motor wheels are connected. And each motor wheel is connected to a microcontroller which helps the device to move around the surface. At-mega 8development board is used to control the device. Another circuit board is used to include the necessary components used to control the device with the help of mobile phones. It can be also controlled with the help of a sound sensor which is connected to the microcontroller. A twelve volt rechargeable battery is used to give power the device. The device is controlled by the codes which is written in c program in AVR Studio the HID Boot Loader is used to install the program into the microcontroller. Before installing the program into the device the boot loader will convert the c file into .hex file which helps the device understand the commands. DTMF technology is used to control the device.*

Key Words: **ARV; DTMF; technology; codes; microcontroller, etc**

1. INTRODUCTION

Automated machine cleaners are pivotal in modern era for modern living due to its effective lowering of labor cost of a human being [1-3]. Besides for large office/hotels/hospitals automated machine based cleaning saves both time and money. Most of these cleaners are designed purposely to satisfy specific need of the consumers. Additionally consumer friendliness and sophistication is a major consideration in any automated floor cleaning machines. The cost of the machine cannot be neglected too. Other factors are the NRE cost and the performance criterion

In principle, RF (Radio Frequency) can be regarded as the control which deals with the use of radio signals to remotely control any device. A remotely controlled vehicle may be defined as any mobile device which is controlled by means that it does not restrict its motion with an origin external to the device i.e. the possibility of an existence of a radio control device, a cable between the control and the vehicle or an infrared controller. A RCV is always controlled by a human operator and takes no positive action autonomously. The IR system follows the line of sight approach which involves the process of actually pointing the remote at the device being controlled; this makes communication over obstacles and barrier quite impossible.

To overcome such problems, a signaling scheme utilizing voice frequency tones is employed. This is known as Dual Tone Multi-Frequency (DTMF), Touch Tone or simply tone dialing. A valid DTMF signal is the sum of two tones, one from a low group (697-941Hz) and the other from a high group (1209-1633Hz) with each group containing four individual tones. DTMF signaling therefore play an important role in distributed communication systems such as multiuser mobile radio.

In this paper, phones making use of the GSM network interfaced directly with the DTMF decoder and the motor driver is used to remotely control an unmanned robotic vehicle thus overcoming the distance barrier problem and communication over obstacles with very minimal or no interference but is solely network dependent

It can also be controlled by using a Sound sensor module which is connected to the controller, which is an at-mega 8 microcontroller initially the device will be placed in the center of the table and the sensors can be placed according to the seating arrangements of the table on each side of the chair there will be a sensor module. Whenever the user get finished having his food he can make a sound around the sensor .the sensor which is connected to the device with the help of a thread wire. When the user wave his hand around the sensor the device will get activated and starts to clean the table and will go back to its original position whenever its get finished.

TCR is mainly working with the help of an atmega8 microcontroller which is connected to four motors and a pair of infrared sensors. It also contain an additional motor which is connected to a brush which is used to clean the surface of the table. Is also has an ultrasonic sensor to find the dust particle. The sensors will the device to stay on top of the building. AVR studio is used to write the code for this device and the code is written in c ++ with additional AVR libraries, and this code is converted back to a hex file and it will be uploaded into the atmega8 microcontroller with the help of a application called HID boot loader. Each time when the microprocessor is connected it will show the connection details and other related data. After the code is loaded into the microcontroller the device starts to work. We can use an additional 12v battery to remove the USB wire from the device allowing it to work more efficiently

2. LITERATURE SURVEY

2.1 Robust obstacle detection method for robotic vacuum cleaners

In this paper the authors suggest that the conventional robotic vacuum cleaners (RVC's) with ultrasonic or infrared (IR) sensors present problems in detecting obstacles when the clean the floor in complex situations, for example, under tables or chairs with thin legs. This paper present a robust obstacle detection (OD) method based on the triangulation principle for RVC's operating in various home environment. The proposed method uses the IR emitter of the RVC's to project a horizontal IR beam towards the floor, following which the RVC's wide angle vision camera captures an image include the IR line reflected by the floor or an obstacle. Obstacles are detected by the image coordination of the pixels that belong to the IR line in the captured image. Accurate separation of the IR line from the image background is accomplished by defining and minimizing an energy function based on the characteristics of the IR line. The proposed method was tested on the embedded RVC system and was shown capable of achieving OD performance compared with existing models.[1]

2.2 Smart floor cleaning robot (CLEAR)

In this paper the authors suggest that with the advancement of technology, robots are getting more attention of researchers to make the life of mankind more comfortable. This paper presents the design, development and fabrication of a prototype called smart floor cleaning robot (CLEAR) using IEEE standards 1621(IEEE standard for user interface elements in power control of electronic devices employed in office/consumer environments). Subject robot operates in autonomous mode as well as in manual mode along with additional features like scheduling for specific time and bag less dirt container with auto-dirt disposal mechanism. This work can be very useful in improving lifestyles of mankind.[2]

2.3 Development of Wall Climbing Robot for Cleaning Application

The purpose of the present study is to develop the wall climbing robot for cleaning a single large windowpane such as a show window. It requires the following demands to apply the window cleaning robot for the practical use: 1) adhere or stick the robot to glass surface with the help of suction cup vacuum .2) Clean the glass surface of window with help of wiper attached to the front panel of robot.3) After cleaning off wiper & then climb (walk) the robot as per instruction to microcontroller. For adhesion of robot to surface we have seen different type of adhesion technique like adhesion by magnetic force, adhesion by micro spine etc. But, here we develop Electro chunks (Creation of vacuum in suction cup by using injection syringe operated by DC .Motor) to obtain adhesion of robot. Electro chunks are similar to suction cup in which required vacuum is created by pulling a piston rod from the cylinder like structure mounted on suction cup. The dimensions of prototype are approximately 690 mm times 400 mm times 160 mm and its weight is approximately not more than 3 kg.[3]

2.4 GSM controlled robotics using PIR

In this paper the authors suggest that the robot is a machine which is controlled by a mobile phone, after receiving a call on attached mobile phone to the robot. In this project the user can control the robot directions like forward, backward, left and right by sending a special type of tune called the DTMF tone which is converted into binary code using DTMF decoder. The components of this GSM controlled robot are the DTMF Decoder, ARM7 (LPC2178), GSM, PIR sensors, GPS and motor driver web application is also developed at the client side. This project mainly consist of two sections, one is the mobile unit and the other one is the robot unit. In the course a call, if any preprogramed button is pressed, corresponding tone will get generate that generated tone will get received by a mobile device which is attached with robot. This tone is called "Dual tone Multiple-Frequency (DTMF) tone". The robot perceives this tone with the help of the phone stacked on the robot. Here after receiving the DTMF tone ARM7 microcontroller is coming to the picture. The received tone is processed by the ARM7 microcontroller with the help of DTMF decoder MT8870 the decoder decodes the DTMF tone in to its equivalent binary digits and this binary digits will send to the microcontroller which are programmed to take a decision and give commands to a motor driver in order to drive the motors in forward and backward direction or to turn left of to right direction. [4]

2.5 Design And Fabrication Of Automatic Floor Cleaner

Automatic floor cleaner is a system that enables cleaning of the floor by the help of highly stabilized and rapidly functionalized electronic and mechanical control system. Current project work targets to use automatic floor cleaner for large floor in house-hold purposes and office floors. The cleaning purpose is specifically carried out by continuous relative motion between a scrubber and the floor surface. During the cleaning and moving operation of vehicle a propulsion mechanism such as driven wheels and guide wheels for the dry tracking on the floor surface to be cleaned, suction of water is carried out by vacuum pump, scrubbing action is done by the scrubber directing water towards rear end. Preferably, a sweeper mechanism is mounted on the body forwarded by propulsion mechanism and operated with such control system for advance sweeping of a debris-laden floor surface. A PID controller is used to govern the motion of system which takes the input from sensor circuit and feeds it back to microcontroller which gives rise to the simulation of wheel in a synchronized manner. The new automatic floor cleaner will save huge cost of labor in future. The basic advantage of this product is that it will be cost effective and no human control is needed. Once put in on mode it will clean the whole room without any omission of surface.[5]

2.6 Design and Development of Floor Cleaner Robot (Automatic and Manual)

This floor cleaner robot can work in any of two modes i.e. "Automatic and Manual". All hardware and software operations are controlled by AT89S52 microcontroller. This robot can perform sweeping and mopping task. RF modules have been used for wireless communication between remote (manual mode) and robot and having range 50m. This robot is incorporated with IR sensor for obstacle detection and automatic water sprayer pump. Four motors are used, two for cleaning, one for water pump and one for wheels. Dual relay circuit used to drive the motors one for water pump and another for cleaner. In previous work, there was no automatic water sprayer used and works only in automatic mode. In the automatic mode robot control all the operations itself and change the lane in case of hurdle detection and moves back. In the manual mode, the keypad is used to perform the expected task and to operate robot. In manual mode, RF module has been used to transmit and receive the information between remote and robot and display the information related to the hurdle detection on LCD. The whole circuitry is connected with 12V battery.[6]

3. PROPOSED MODEL

The proposed model consist of mainly three modules the first one is the GSM module, the second module is the Bluetooth module and the third one is the cleaner module. The GSM module consist of a breadboard an mt8870 DTMF decoder which is connected to a motor driver called L293D. A call is made from the cellphone which acts as a transmitter and the call is automatically received by an another cellphone which acts as a receiver which is placed in the device the signal decoder will convert the signal and send it to the motor driver whenever the user presses a button in the transmitter cellphone the corresponding button is selected on the receiver cellphone and the tone which is created by the phone is converted to binary code with the help of a decoder and the motor driver starts to control the motor

The second module is the Bluetooth module, in this module an infrared sensor is connected to the Bluetooth module and it is also connected to a 5v battery. This module is use to control the device manually by the user. This module is mainly used to provide signal to the device to start its function whenever there is a need to clean the table. The device cannot detect when it should start cleaning , so by using this module the user can able to control the device whenever he likes.

The third module is the cleaning module. This module is used to clean the surface of the table. Both GSM and Bluetooth module is connected to the cleaning module and to the motor driver. The cleaning module consist of an ultrasonic sensor and an 700 rpm motor. The coding of this device is done using a software called AVR studio. The codes are written in c ++ which also include special AVR libraries. In order to upload the created code into the atmega8 microcontroller an another application is used called HID boot loader which is used to transfer the code to the device. The microcontroller will only execute the .hex extension files, so with the help of HID boot loader we can able to convert a C++ file into a hex file.

4. PROPOSED SYSTEM DESIGN

Block Diagram of the proposed model

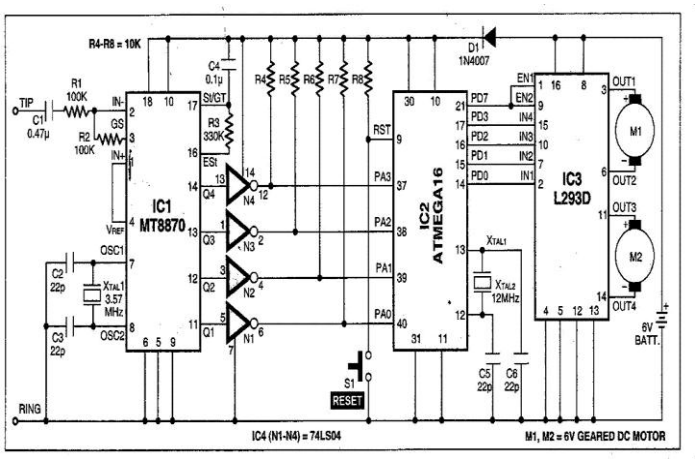

Fig1.1

Fig.1.1 is the circuit diagram of our proposed device. Structurally motor1 and motor2 are connected to voltage regulators Z which drive the receiver circuit. Additionally the two motors propel the two wheels in both clockwise and anticlockwise direction simultaneously; thereby moving the machine purposely. Besides there are five relays (R1, R2, R3, R4, R5), each of them are connected to scrubbing motor (i.e. motor connected to scrubber) and LED. All the relays are driven by a 433MHZ driver circuit. Additionally antennas are provided for smooth running of the machine. The authors here emphasize in making the circuit less power consuming and thereby only a 6v chargeable battery is incorporated in the design.

Motor driver:

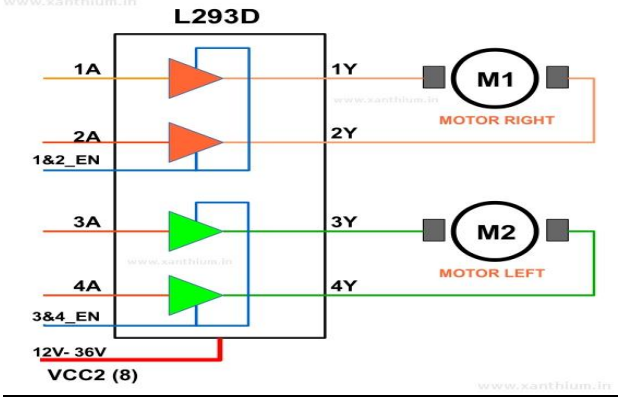

Fig 1.2

Fig 1.2 shows the block diagram of the motor driver which is connected in the left and right.

DTMF Decoder:

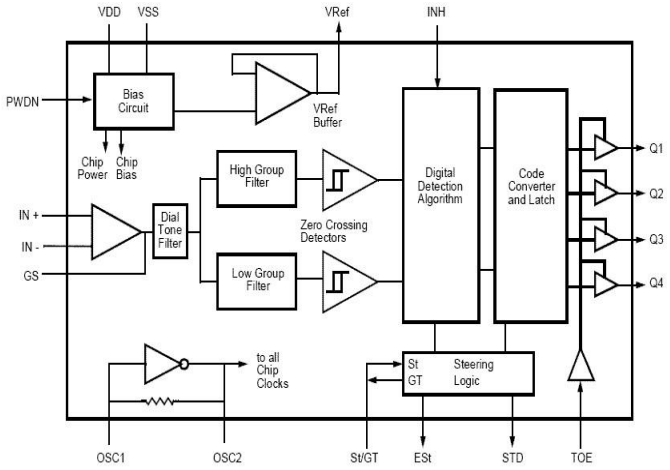

Fig 1.3

The MT8870 is a complete DTMF receiver integrating both the band split filter and digital decoder functions. The filter section uses switched capacitor techniques for high and low group filters; the decoder uses digital counting techniques to detect and decode all 16 DTMF tone-pairs into a 4-bit code.

ATMEGA 8 Block Diagram:

A monitoring and protection circuit for 1-cell and 2-cell Li-ion applications that require high security and authentication, accurate monitoring, low cost, and high utilization of the cell energy. The microcontroller includes 8KB self-programming flash program memory, 512-Bytes SRAM, 256-Bytes EEPROM, 1 or 2 cells in series, over-current, high-current and short-circuit protection, 12-bit voltage A/D converter, 18-bit coulomb counter current A/D converter, and debug Wire interface for on-chip debug.

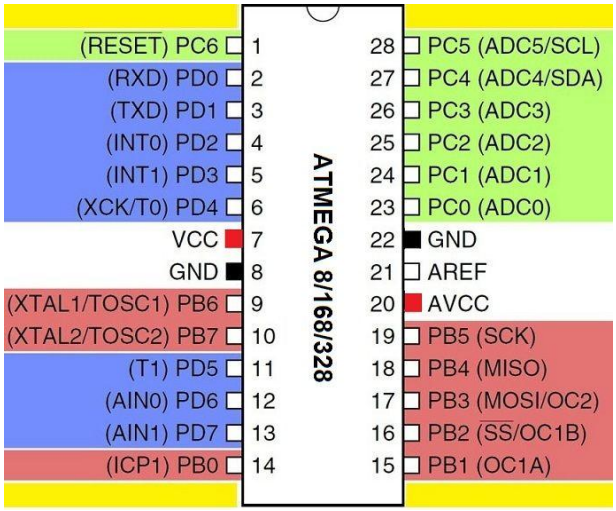

Fig 1.4

The device features autonomous battery protection during charging and discharging, and supports very accurate accumulated current measurements using an 18-bit ADC with a resolution of 0.84??V. It also supports up to 4 MIPS throughput at 4MHz. 1.8 - 9V operation.

5. SYSTEM IMPLEMENTATION

5.1 Modules

There are five modules in this project.

5.1.1 Power supply module

5.1.2 IC CM8870 Connections module

5.1.3 IC L293D connections module

5.1.4 12V DC motor connections module

5.1.5 Universal Headphone Jack Connection module

5.1.1 Power Supply:

1. -Take the breadboard and connect the battery holder in horizontal position.

2. -Insert the positive and negative wire of battery snap in holder.

3. -Attach IC 7805 (Voltage Regulator), and place one 10 µF capacitor in IN & GND connection of IC 7805 and other in GND & OUT connection.

4. -Take the positive supply from the battery holder via breadboard wire and place it in IN of IC 7805, and also connect its negative supply in the last row of the breadboard.

5. -Place the GND of IC 7805 in the last row of the breadboard, and transfer its OUT to the first row of the breadboard.

6. -As a result of these connections, +5V power is obtained in the first row of the breadboard. 7. To check the power flow path, an LED is given a positive supply via 1K Resistor.

5.1.2 IC CM8870 Connections:

1. -Connect 1st & 4th pin of CM8870 (DTMF Receiver) together.

2. -Pick one 100K resistor and place one side of it in 2nd pin and other side to the 0.1 µf capacitor.

3. -Pick another 100K resistor and connect 3rd and 2nd pin.

4. -Provide GND connection to 5th, 6th, and 9th pins. 5. -Couple 7th and 8th pins with 3.58 MHz Oscillator. 6. -Provide +5V supply to 10th and 18th pins. 7. -Take one 300K resistor, and place one side of it to 16th pin and other to 0.1 µf capacitor from 17th pin. 8. -Connect 0.1 µf capacitor to the 18th pin.

5.1.3 IC L293D Connections:

1. Insert IC L293D (Motor Controller) in the breadboard.

2. Supply +5V power to 1st, 8th, 9th, and 16th pins.

3. Provide ground connection to 4th, 5th, 12th and 13th pins.

4. Attach 2nd, 7th, 10th, and 15th pins of L293D to 14th, 13th, 12th, and 11th pins of IC CM8870 respectively.

5.1.4 12V DC Motor Connections:

1. Take the wire of Right Motor and insert it in 3rd and 6th pins of IC L293D.

2. Also, place the wire of Left Motor in 11th and 14th pins of IC L293D.

5.1.5 Universal Headphone Jack Connection:

1. There are three different layers in Universal Headphone Jack such as a Sleeve, Tip, and Ring.

2. A closer view of the three layers is shown in the circuit diagram clearly.

3. Connect the sleeve to the output of 0.1 μf capacitor (2nd pin) in the IC CM8870.

4. Provide GND connection to the tip and ring.

6. PERFORMANCE ANALYSIS

FREQUENCY READING

KEY	LOWER FREQUENCY (Hz)		HIGHER FREQUENCY (Hz)	
	TH.	EXP.	TH.	EXP.
2	697	672	1336	1320
4	770	731	1209	1201
6	770	731	1477	1475
8	852	855	1336	1322
5	770	735	1336	1325

Table 1.1

Table 1.1 shows the frequency readings of the device which helps us to determine the performance of the device

Hex readings corresponding to robot's movement

KEY PRESSED	OUTPUT OF MT8870	INPUT OF L293D	ROBOT'S NET MOVEMENT
6	0110	0110	Forward
9	1001	1001	Left turn
4	0100	0100	Right turn
2	0010	0010	Backward
0	0000	0000	Stop

Table 1.2

Table 1.2 shows the hex readings in accordance with the movement of the robot when the key 6 is pressed the robot will start move in forward direction, when the key 9 is pressed the device will start to turn left, and the device will turn right when the key 4 is pressed and start to run backwards when the key 2 is pressed and the device will stop function when the key 0 is pressed.

7. CONCLUSION AND FUTURE ENHANCEMENT

Comparing the results from both existing and proposed system it is known that the proposed system known as TCR is more efficient than the existing system. TCR can be enhanced in many different ways in the future. One is by adding a high definition camera which can used as an eye for the device which will increase the working efficiency of the robot. It can be upgraded to a food serving robot by installing an additional robotic arm which can able to move in 360 degree. We can make it more efficient by providing two hands to the device which will improve overall performance of the device.

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