Multipurpose Robot for Patients and Military Applications

A Robotrover for Multiple Disabled Persons, Patients and Military Applications

Nirmal T M
M.Tech Embedded Systems Scholar
Sahrdaya College of Engineering & Technology
Kodakara, Thrissur, Kerala, India

Abstract—**This multipurpose robot rover is specially met for the patents having various disabilities to help them to take their own food and medicines without the help from others. The robot rover contain a miniature robotic hand for pic and place the medians, food and items for the persons. The controlling of this rover can be done by the patient or an external person according to its disabilities. The main contorting techniques that included are voice controlling and a joystick controlling. Also this rover is helpful for sensing the presence of flammable gas, humidity, temperature, and flame and an obstacle detectors for remote sensing applications in military and for helping the patients. All monitoring data's will be displayed and controlling will be done in wireless remote equipment and it have a practical range of about 750meaters. The LCD character display in remote will displays the sensing contents in real-time manner. The voce analyzing and controlling is done by an EasyVR present in remote controller.**

Keywords-Voice Recoginisation;Humidity Sensor; Miniatue Robotichand; Easy Vr; Xbee.

I. INTRODUCTION

The most exciting and interesting field in electronics nowadays is obliviously robotics. It is the most emerging and developing field where everyday a new innovation is out there in the market. Basically robot is an electromechanical device means it is a combination of electronics and mechanics. The main goal to design a robot which imbibes several specific and selective features .This work has been done so as to project my and measure our skills and ideas that I have gained.

Multipurpose Robot as the name indicates is a multi-task performing device. With the improvements of new technologies in communication and high performance systems we have implemented faster and smarter robots using new robot control devices, new drivers and advanced control algorithms .The main feature of this project is to control the robot with voice recognition technique. This Robot can perform several operations like picking a remote item, taking photo of remote place, detecting the presence of temperature, humidity, light, gas leakage, fire and sending the observations in form of a message to the controller.

The main principle behind operation of our robot is based on RF transmission and receiving. With the help of voice recognition module in controller section, our instruction signals (Example: Move left, right, forward, backward, pick, place) given by the user is converted to actions performed by robot. The things are run by using Xbee technology. The various sensors in robotic section detects presence of temperature, humidity, light, gas leakage ,fire and sends the observations which are displayed in the LCD screen. The values of measured temperature and humidity are displayed on screen.

II. LITERATURE REVIEW

The Robotic systems are not much familiar to all. And in our system mainly includes the helping the humanity, security, remote sensing etc. the system works with the principle of voice reorganization, wireless transmission and reception, sensing technologies. This robot system is controlled completely by human vocal commands.

The existing robotic systems are comparatively less efficient. It has its own advantages and disadvantages. The main disadvantage is it will not work by the human vocal commands also real time sensing is not possible. And the robots made in now a days are mainly focused to some special applications only. No one gives the facilities that given by ours. Our voice reorganization robot has many applications in this present world. Also the olden robots need mobile coverage or starlight coverage but in our case there is no such thing are needed. And the robot will send the present time atmospheric stats, so according to that we can take actions majority of such actions can be done using this robot. But it can't be possible in olden robots.

The main thing that we included in this is it can help physically handicapped persons; robot can take medicines, check room conditions according to tat it will produce alarm and necessary steps. The present world is looking forward to a new Robotic system. So our new invention Multipurpose Robot system will be a mile stone in the commercial field. This highly efficient system can introduce in the airports, educational institutions, industrials, houses, shops, hospitals, military and every place the human present or not.

III. Design and Development

The work is divided in to two different parts for the implementation purpose, which includes user system and robot system both are described below.

A. User Control Unit

Any of the electronic robots to function it need some controller circuit; in our project also we need a controller for controlling the robot as the wish of user. And in this multipurpose robot the control unit consisting of speech reorganization and real-time sensor indicator.

The voice reorganization will recognize the command that is said by user and give to controller and the controller will send the command according to the user give to robot unit via a wireless system and hear we use Xbee [11] for that. Also the robot unit will send back the real time sensing data to control unit and it will display it through LCD, also according to data if there is any harm found out by the robot it will generate an indication, hear we use buzzer and LED to indication. This unit will work with the power supply variation form 5-12V.

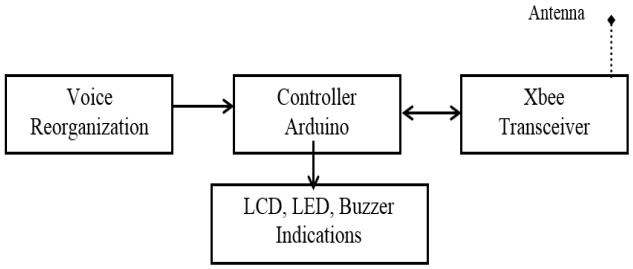

Figure 1: Block Diagram of User Controller

B. Robot Unit

The major part in our project is Robot Unit. It is having a moving vehicle and a robotic hand. The vehicle movements as well as the hand functions are done as per the instruction given by control unit. Also it consisting of water motor this is used to put out fire and irrigation purpose and a buzzer for robot's current place reorganization.

Also it contains the real time senor section, which includes ultrasonic transducer for obstacle detection, flame sensor for fire detection, humidity sensor for measuring relative humidity [4], temperature sensor for measuring Absolut temperature, light sensor for finding denser light presence and gas sensor for finding the presence of leakage of flammable gas.

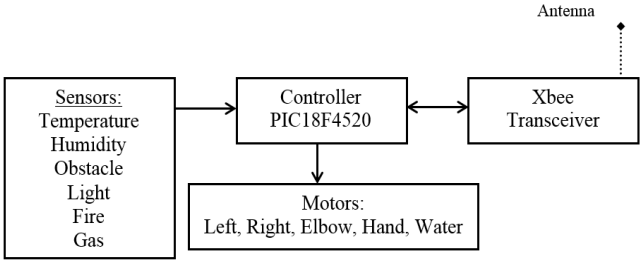

Figure 2: Block Diagram of Image Robot Unit

The sensed data[12] is send to the control unit for displaying through wireless transceiver in this we use Xbee, and the robot movement comments also received via the same and the controller will direct the robot according to the received command.

IV. Circuit Level Implmentation

The circuit level implementation includes the circuit design and developing the final circuit of two sections of this robot.

A. User Control Unit

For the design of user control unit the main control section is programmed in Arduino (ATmega328) board, the display of all sensory items is displayed in a LCD of 16x2 Alphanumeric [3].

The voice reorganization is done using an Easy VR module which helps to avoid using of MATLAB and PC's for the voice reorganization [10] conventional method. The resistor design is made by LED current rating is almost 50mA

$$R = 5/0.05 = 100\ \Omega. \qquad (1)$$

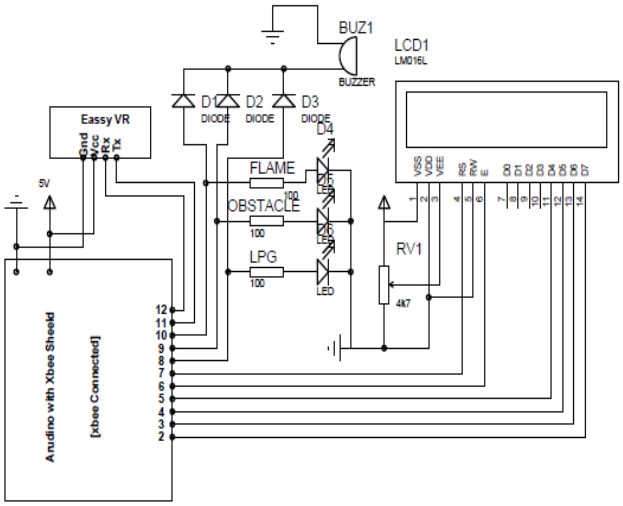

Figure 3: Circuit Diagram of User Control Unit

The EasyVR will recognize the human commands, that is pre defend. And given to software serial pins of Arduino and according to the commands it will send the data to robot unit via Xbee. The robotic unit will send back the details of sensed data. The Arduino will process the received data and display the sensor parameter on LCD display. Also according to the sensor data it will produce the indications, if any gas, obstacle, fire detected the buzzer will produce sound also the corresponding LED will glow.

B. Robot Unit

It is the main part of our design and it contain all the parts o a robot. The unit is divided in to various sections, which includes ultrasonic transmitter and receiver, temperature sensor, gas sensor, Relative humidity sensor, light sensor, motor driver section and microcontroller with wireless transceiver section. All these sections are described below [1]. All sensors are interfaced in Port-A and Port-C, the outputs for motor and other are taken form Port-B and Port-D. Also for regulation we use voltage regulator 9V, 5V, 3.3 V as 78L05, 78L09 and 78L33 respectively.

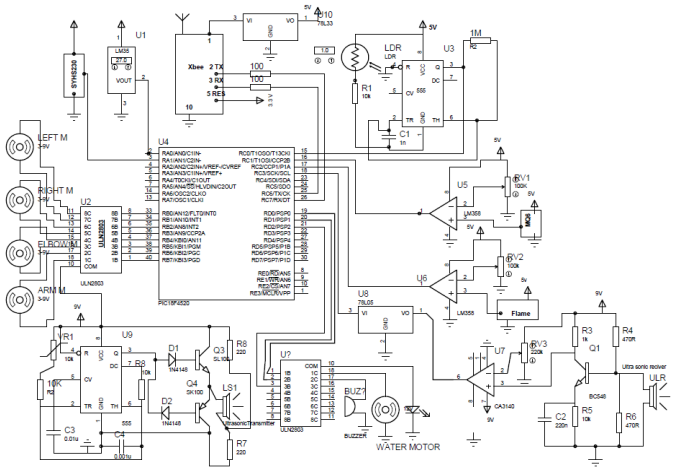

Figure 4: Circuit Diagram of Robot Unit

1) Ultrasonic Transmitting section

The ultrasonic transmitter and receiver for detecting the obstacle. Supply voltage: 9V, for driving the transmitter. Required frequency = 40 kHz, Use Asable Multivibrator using 555 IC, Assume R8 = 10kΩ and c = 0.001µF.

$$F = 1.414/(R1+2R2)C = 1.414/((R1+20K)0.001\mu) = 40k \quad (2)$$

$$R2 = R8 = 15.35k = (10+5.35K) = 10k +10k\ Pot. \quad (3)$$

The ultrasonic transmitter is highly current driving so need to include a complementary amplifier so SL100 and SK100 complementary combination (Class AB amplifier) will take to give input to that we uses high frequency diode 1N4148.

2) Ultrasonic Receiver section

Signal from ultrasonic receiver will be very small voltage. So need to amplify that. The transistor selected was BC 547 for amplification.

$$VCC = 9V \quad (4)$$

$$IC = 0.5\ mA \quad (5)$$

$$hfe = 200 \quad (6)$$

$$VRE = 85\%\ OF\ VCC \quad (7)$$

$$RC = 7.65/0.5m = 15.3k\ (Use\ 15k\ Std.) \quad (8)$$

Design of RE:

$$VRE = 65\%\ VCC \quad (9)$$

$$RE = 5.85/0.5m = 11.7k\ (Use\ 12k\ Std.) \quad (10)$$

Design of R1 & R2:

$$IB = IC/hfe = 0.5m/200 = 2.5\mu F \quad (11)$$

$$VBE = 3V \quad (12)$$

$$VRE = 5.85V \quad (13)$$

$$VR2 = VBE + VRE = 3+5.85 = 8.85V \quad (14)$$

$$VR2 = 9IBR2 = 8.85V \quad (15)$$

$$R2 = 8.85/(9*2.5\mu) = 393.33k \quad (16)$$

(Use 390k Std)

$$VR1 = VCC - VR2 = 9 - 8.85 = 0.15V \quad (17)$$

$$VR1 = 0.15/(10*2.5\mu) = 6k\ (Use\ 10k\ Std) \quad (18)$$

Design of CE :

$$XCE < RE/200 \quad (19)$$

$$CE \geqslant 1/(25*10k*68) = 0.234\mu F \quad (20)$$

(Use .22µF Std)

The output given to a high frequency comparator and output of comparator will be around 8.3V so a regulator IC 7805 is used to interface that with microcontroller.

The ultrasonic transmitting the sound [3] at 40 kHz all time. When an obstacle or any wall appeared the sound will reflected back, then it will fall on ultrasonic receiver will sense and generate an output logic level on. That will interface with microcontroller, so according to the obstacle the robot can change its path.

3) Temperature Senor

For measuring the temperature the low cost sensor is used which is LM35, it can be directly interface with ADC input of PIC microcontroller.

The LM35 can sense temperature from -55oC to 150oC according to that the voltage level varies [2]. So the according to ADC output we find the current temperature.

4) Gas Senor

For measuring the flammable gas such as LPG or CNG the common sensor which used for this device is MQ-6. The sensor gives output as high for the presences of flammable gas.

The MQ-6 can sense gasses LPG, iso-butane, and propane. According to that the presence of gas it gives output as high so we can directly interface to microcontroller.

5) Relative humidity Senor

The humidity will discover the water content in the atmosphere, for sensing the relative humidity the SY-HS 230 sensor is used [6]. It is directly interface with ADC input of PIC microcontroller.

The SY-HS 230 can sense relative humidity according to that the voltage level varies [5]. So the according to ADC output we find the current Relative humidity.

6) Light Senor

We designed in such a way that the 555 timer IC [4] want to ON for all time except the reset application. In this case we get the output for all time and while application of reset the output will zero, the 555 IC reset is an active low, so the voltage across the 4th pin go down the IC taken it as reset. That is done by LDR.

The main property of LDR [7] is its negative resistance coefficient,

$$Denser\ Light\ resistance < 86\ \Omega \quad (21)$$

$$No\ light\ (Dark)\ resistance > 10\ Meg\ \Omega \quad (22)$$

$$Let\ C1 = 1000pf \quad (23)$$

$$R2 = 1meg\ \Omega \quad (24)$$

Then, R1 = 1 k Ω (25)

When light is present the 555 will give output as high and when light is not present the 555 will be in a reset condition. So output will be zero.

7) Motor Driver Section

For the working of robot movement and miniature robotic arm the device need to interface 4 motor for robot and one motor for water supply. For that we include a ULN2803 and ULN2003. The ULN2803 can drive 4 DC motor. Two motors are used for the robot movement and 2 for hand operation. And in ULN 2003 we interface water pumping motor [8]. The robotic movement control signals are driven form Port-B, and other for port-D.

When a port bit line is high according to that the ULN gives output as high volt and it can drive up to 150mA.

8) Microcontroller & Wireless Transceiver Section

PIC18F4520 is selected for the controlling robot unit, which having 4 Ports. Two ports can be programmable to work as ADC. The port 'A' as analog input, and RA0 is for interfacing temperature sensor, and RA1 for Relative humidity. Port C used as other sensor inputs. RC0 for light sensor, RC1 for Gas sensor, RC2 for Flame sensor and RC3 for obstacle detector [9]. The Port B for driving the robot motors and Port D for driving other motor and LED's, indications etc… the clock frequency selected for the controller is 20 Mhz.

For communication between remote unit the wireless lik is made using Xbee 1mW wire antenna [13], Connected in RX and TX pins of PIC.

The Xbee will receive the transmitted signals form user control unit, and process the data in microcontroller and drive the motors accordingly. Also the sensed data is transmitted through Xbee. The robot movement will be fully controlled by the user control unit.

V. Result and Discussions

The robot was mad in successful manner. A multipurpose robot with voice recognition system was created. The working of the robot was demonstrated and we succeeded in implementing it at minimum cost and at maximum efficiency. The voice recognition system incorporated with the robot will helps to control it, even with our voice. It is also having a capability to sense various physical parameters such as light, temperature, humidity etc. and convey its results to the user by using a 16x2 LCD display.

Cases:

a) Speaking Forward to Robot: Robot move to forward direction.

b) If robot detected the fire: Buzzer ringing on the control unit also LCD displays it.

c) Speaking stop to robot: Robot stops its movement.

Due to high complexity of the circuits we couldn't extend the range of the antenna and hence the robot can be operated only within a short distance it is approximated to 750meaters.

VI. Suggestions for Futher Work

The main disadvantage is not included was camera and display interface. If that is included in this the robot can send the video to user interface, also by using processing the image if a person/property is detected the robot can take necessary movement or action. Also the robot can't speak to the human, which can also possible by including voice storage and voice analysis in robotic section also. In our project we use Xbee transceiver for data transmitting and receiving between robot and control unit, its range can be increased by using Xbee PRO. Also for very large distance application we can use GSM technology. If we are inculpating 3G, the video facility also can be included.

Human experience is marked by a refusal to obey our limitations. We´ve escaped the ground, we´ve escaped the planet, and now, after thousands of years of effort, our quest to build machines that emulate our own appearance, movement and intelligence is leading us to the point where we will escape the two most fundamental confines of all: our bodies and our minds. Eventually, voice recognition and speech recognition will become commodity items for robotics work. New microcontroller architectures including multi-core, parallel processing designs, will enable developers to access PC-class processing power on small footprint devices. However, the elusive goal of speech understanding won't be addressed by faster hardware .New software algorithms and approaches to speech understanding must be developed. Toward this end, the current generation of voice and speech recognition products represents an experimental platform upon which innovative experimenters can work toward the elusive dream

These are the major suggestions for future if it are implement, it will be the world's fully improved and advanced Robotic system.

VII. Conclusion

The use of voice recognition as the primary user interface to a robot has value beyond providing a semblance of intelligence. Examples of voice recognition applied to practical problems range from the hands-free guidance of motorized wheelchairs and similar devices by the disabled and surgical assistant robots for surgeons. In this paper, we try to implement the robotic arm manipulation system and manipulate it by voice command. It can understand any human voice; doesn't need to depend on specific user voice. To do that sometime it can't recognize command because of different pronunciation and different tone of different people. It has an extra facility it can be controlled by wireless. So that user doesn't need to physically appear in the working area, it can be used in. It has a great advance provided that wireless control system always in the range. In near future we have a plat to build it commercially for mankind. It is helpful for all of the robotic research and project based work.

References

[1] A. Anand Kumar "*Basic Fundamentals of Digital Circuits*" Second Ed. PHI Learning.

[2] Neamen "*Electronic Circuits – Analysis & Design*" McGraw Hill.

[3] Millman J. &Taub H., "*Pulse, Digital & Switching Waveforms*" Tata McGraw Hill

[4] Simon Haykin, "*Communication Systems*"Wiley India, New Delhi, 4Ed. 2008

[5] http://www.rhydolabz.com/index.php?main_page=product_info&cPath=124&products_id=1025

[6] http://www.rhydolabz.com/index.php?main_page=product_info&products_id=1080

[7] D. A. Bell, S. P Levine, Y. Koren,, L. A Jaros, J. Borenstein, "*Design Criteria for Obstacle Avoidance in a Shared-Control System*", RESNA'94, Nashville, 1994.

[8] R. A. Brooks, "*New Approaches to Robotics*", Science 253, 1991, pp 1227-1232.

[9] Victor Milenkovic, Elisha Sacks, and Steven Trac, "*Robust Complete Path Planning in the Plane*", IEEE Transactions On Automation Science And Engineering, Pp 1- 10.

[10] Illah Nourbakhsh, Emily, Thomas Hsiu, Mark Lotter and Skip Shelly, "*The Design of a Highly Reliable Robot for Unmediated Museum Interaction*" IEEE Trans. Circuits Syst. Video Technol.,vol. 19, no. 5, pp. 564-572, May 2009.

[11] Wireless temperature monitoring system based on the ZigBee technology Li Pengfei; Li Jiakun; Jing Junfeng Computer Engineering and Technology (ICCET), 2010 2nd International Conference

[12] Bob Kiaii, MD, W. Douglas Boyd, MD, Reiza Rayman, MD, Wojciech B. Dobkowski, MD, Sugantha Ganapathy, MD, George Jablonsky, MD, Richard J. Novick, MD, "*Robot-Assisted Computer Enhanced Closed-Chest Coronary Surgery: Preliminary Experience Using a Harmonic Scalpel and ZEUS*" The Heart Surgery Forum #2000-18998, Pp 194-197

[13] Chatterjee, A, Pulasinghe, K, Watanabe, K., Izumi, K., "*A particle-swarm-optimized fuzzy-neural network for voice-controlled robot systems*", Industrial Electronics, IEEE Transactions on Volume:52 , Issue: 6 , Pp 1478 – 1489 Dec 2005.