Implementation of Motion Controlled Virtual Robot for Military Application

Chethan N[1], Abhilasha S T[2],Deepthi S[3],Gangadhar B[4],Vibha Raj Nag[5]
UG Student, Dept. of ECE, Atria Institute of Technology, Bangalore, Karnataka, India[1234]
Assistant professor, Dept. of ECE, Atria Institute of Technology, Bangalore, Karnataka, India[1]

***Abstract*— This project aims to build an automated robot which can effectively function in the military unit for the purpose of commanding and location accessing. The idea is to design a robot whose operations are controlled remotely with the help of accelerometer and flex sensors. It can be used to give the voice command output from the commander to the military unit which may be under the enemy attack or to spy the enemy area secretly.**

***Keywords*— Flex sensor, Accelerometer, Ultrasonic sensor, Voice command output.**

I. INTRODUCTION

Previously the robots were designed to perform only specified function and required to be controlled manually with the help of switches and buttons. These days the development in the field of science and technology has lead to the enhancement in various other applications and one such field is robotics [1].

There may occur some situations in military unit during the enemy attack that the commander may not be able to communicate or instruct his soldiers, there comes the significance of this remotely controlled robot. In such situations this robot could be sent near the soldiers and could be used to give out the voice commands that instruct the operations to be performed by them.

The robot movement controlling and the commanding functions are controlled by tilting the accelerometer and the robot is stopped when the obstacle is detected, where an ultrasonic sensor helps in obstacle detection. The current location of the robot can be accessed through GPS and this could be viewed using a camera incorporated with this robot body.

The Robot moves and acts in the manner depending on the gestures made by the fingers and hand from a distance. The robot moves in left or right directions and captures the surrounding environment with the help of camera affixed over it. It is also controlled by different hand gestures. The whole project basically comprises of three units. The two hand gloves with individual circuit board and a Self empowered robot. The system makes use of sensors like flex sensor and accelerometer, RF module CC2500, Geared DC motors, motor driver LM293, GPS module, LCD display and wireless camera.

II. ZIGBEE TECHNOLOGY

Zigbee is a latest evolved technology with the effort of Zigbee alliance and IEEE 802.5.11 based on the demand for low power, low data transfer rate, low cost, low complexity wireless network technology. Most of wireless sensor network and control systems which connect and communicate among thousands of tiny sensors use Zigbee, communication efficiency is very high as these sensors require very small amount of energy to send data from one sensor to another sensor through radio waves in a relay way. Zigbee is a standard that defines a set of communications protocol for low data rate short range wireless networking. 868 MHz, 915 MHz, and 2.5 GHz are the frequency bands in which zigbee based wireless devices intend to operate in. Short distance, low power, low data transfer rate, low cost, low complexity wireless network technology are the key features of Zigbee which communicate among thousands of sensors.The maximum data rate is 250k bit per second and is mainly designed for battery powered applications.

The ZigBee specifications are as follows:

i. *It* is intended to be simpler protocol.
ii. It is cheaper than other WPANs, such as Bluetooth.
iii. It is a radio-frequency (RF) application which has provisions such as low data rate, which require secure networking and long battery life

While other wireless protocols add more and more features, zigbee aims for a tiny stack that fits on 8-bit micro controller. ZigBee nodes are used for tying an entire network, control, for security home or factory together, convenience and safety.

For a huge number of controls and sensors nodes can be incorporated and for automation applications this nodes are built into big infrastructures like home automation, industrial automation, remote metering, medical equipment, automotives, security systems, temperature control systems, patient monitoring, lighting and, asset tracking systems.

III. PROJECT DESCRIPTION

This project contains 30 pin and 64 pin Renesas microcontroller, LCD, Zigbee, Mp3 audio player, Flex sensor, ultra sonic sensor and accelerometer sensor through which we

control the 2 wheel robot movement as well as Mp3 audio Player and GPS location accessing. Here using flex sensor we can generate around 2-3 commands and 8 commands from the accelerometer , using those commands we are here controlling the robot movement , access GPS and give commands to the Mp3 audio Player. For position of the accelerometer sensor we are assigning particular motion and through flex sensor we are accessing the current location of the robot. Here communication is through Zigbee which is a wirelessly communicating device which forms a vital component in transmission and reception of control signals.

Block Diagram:

Control unit:

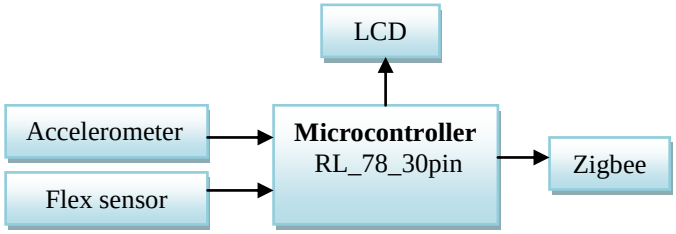

Fig.1 Transmission of Control Signals

Robot unit:

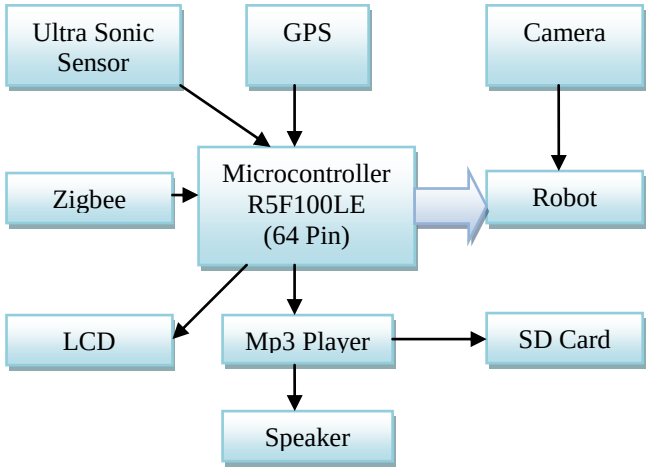

Fig.2 Receiver Block with voice output and ultrasonic sensor

An ultra sonic sensor is used to detect the obstacle if any present in the way of robot. Here we are using two Zigbee one at the controller unit and another at the robot unit. LCD is used to display all the operations which are being executed. An alert message is generated on the LCD when an obstacle is detected and transmitted and displayed on the LCD of the control unit via Zigbee. There is a camera affixed over the robot to monitor and view the current location of the robot.

In this project, based on the accelerometer and flex sensor values the control unit controller sends the commands to the robot unit through Zigbee and on the other side the controller of robot unit will receives the same commands and based on the received commands robot is controlled.

IV. HARDWARE IMPLEMENTATION

A. *RL78/R5F102AA*

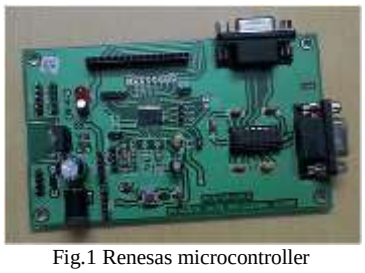

Fig.1 Renesas microcontroller

Feature

- It has flash memory of 2KB, RAM of 2KB and ROM storage of 16 KB
- On-chip debug function and has a high speed on-chip oscillator with frequency of 24,16,12,8,4,1 MHz
- 16-bit timer: 8 channels
- Watchdog timer: 1 channel
- ADC: 8 Channel 10 bit
- Total of 10 ports with 26 input /output pins
- 3 UART channels

B. *Flex Sensor*

Fig.2.1 Glove with flex sensor **fig.2.2 Flex sensor**

Flex sensors are normally attached to the glove using needle and thread. They require a 5-volt input and output between 0 and 5 V, the resistivity varying with the sensor's degree of bend and the voltage output changing accordingly. The sensors connect to the device via three pin connectors (ground, live, and output).

The device can activate the sensors from sleep mode, enabling them to power down when not in use and greatly decreasing power consumption. The flex sensor pictured below changes resistance when bent. It will only change resistance in one direction. A inflexed sensor has a resistance

of about 10,000 ohms. As the flex sensor is bent, the resistance increases to 30- 40 kilo ohms at 90 degrees. The sensor measures ¼ Inch wide, 4-1/2 inches long and 0.19 inches thick.[2]

C. Accelerometer

Fig.3 Accelerometer chip

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration.

The user selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for the X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis.

The ADXL335 is a complete 3-axis acceleration measurement system. The ADXL335 has a measurement range of ±3 *g* mini-mum. It contains a poly silicon surface-micro-machined sensor and signal conditioning circuitry to implement an open-loop acceleration measurement architecture. The output signals are analog voltages that are proportional to acceleration. The accelerometer can measure the static acceleration of gravity in tilt-sensing applications as well as dynamic acceleration resulting from motion, shock, or vibration.

D. RF Module

Fig.4 CC2500 module

Applications

- Sensor Networks / Data collection.
- Wireless metering.
- Access control / Identity discrimination.
- Home Automation.
- Smart house products / Security Systems.
- Remote control / Remote measurement system.
- Weather stations.
- Multi Slave Communication.
- Up to 250 Device can communicate with each other.[2]

E. MP3 module

Fig.5 Mp3 module

- Supports MP3 and WAV decoding.
- Supports FAT16 and FAT32 file system.
- 24-bit DAC output and supports dynamic range 90dB and SNR 85dB.
- Supports AD key control mode and UART RS232 serial control mode.
- Supports maximum 32GB micro SD card and 32GB USB flash drive.
- Audio files are sorted by folders; supports up to 99 folders, and each folder can be assigned to 255 sound files.
- Supports inter-cut advertisements.
- Supports playback of specifying folders.
- Support random playback.
- Built-in 3W amplifier that can direct drive a 3W/8Ohm speaker.
- 30 levels adjustable volume.

F. Ultrasonic Sensor

Fig.6 Ultra Sonic Range Sensor

SONAR, acronym for Sound Navigation and Ranging which is a detection system based on the reflection of underwater sound waves, just as radar is based on the reflection of radio waves in the air. A typical sonar system emits ultrasonic pulses using a submerged radiating device and it listens with a sensitive microphone, or hydrophone, for reflected pulses from potential obstacles. The ultrasonic sensor detects the objects from 0-inches to 254-inches (i.e.6.45-meters) and provides sonar range information from 6-inches out to 254-inches with 1-inch resolution. With 2.5V - 5.5V power the ultrasonic sensor provides very short to long-range detection and ranging, in an incredibly small package.

V. APPLICATIONS

[1] This automated robot can be widely used in the field of military for the communication during emergency situations.
[2] It can be used effectively for spying purpose.
[3] This gesture controlled robot can be implemented in medical field for automatic patient monitoring.
[4] Can be used by the paralyzed patients for communication with the doctor.
[5] This remotely controlled robot can be implemented in home automation technology for old people.

VI. RESULT

The final product of all the efforts to design a robot for military purpose is successfully achieved with the desired and expected features. The designed robot is effectively controlled using an accelerometer chip and tracked with the Flex sensor through GPS. Obstacle detection and a webcam are the implementation which enables this motion controlled robot to effectively implement it in military applications.

Fig. 7 Robot unit with an ultrasonic sensor and controller

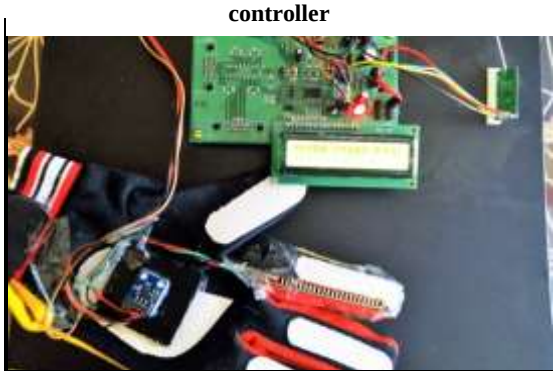

Fig.8 The control unit with accelerometer and Flex sensor mounted on hand glove with

VII. CONCLUSION

In this project, we aimed to build an automated robot especially applicable for military purpose which is used to give voice commands. It works on the gesture moments. It is a wirelessly communicating device using Zigbee transceiver. This robot design ensures high flexibility and security. The objective of preparing these projects is to control the robot operation using accelerometer and sensor and interface them with smartest microcontroller. Also it has been beneficial to understand the concepts of programming of controller. More outcomes from the project are to learn PCB designing, etching, soldering, assembling processes employed in any project design.

VIII. ACKNOWLEDGMENT

We gratefully acknowledge the guidance of Mrs.Vibha Raj Nag, Asst. Professor, Electronics and communication Department, Atria Institute of Technology, Bangalore who was the constant source of inspiration and guidance to us. Also, we would like to thank her for being a good supportive edge during the entire work.

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