Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 2, Issue. 11, November 2013, pg.291 – 296

RESEARCH ARTICLE

A Surveillance Robot with Climbing Capabilities for Home Security

Dipali Chavan[1], S.A. Annadate[2]

[1] Electronics and Telecommunication Department

[1] Jawaharlal Nehru Engineering College, Aurangabad, (M.S.) INDIA

[2] Electronics and Telecommunication Department

[2] Jawaharlal Nehru Engineering College, Aurangabad, (M.S.) INDIA

ABSTRACT:

Automation and security is getting the highest priority all over the world. Automation and security at various places like home, office etc can be achieved by using different types of surveillance robots. Most of the traditional surveillance robots have problems with obstacle avoidance and staircase. This paper presents the development of the surveillance robot with staircase climbing capability. The proposed robot can climb up stairs of certain height and width proportional to the dimension of the robot. The proposed robot uses wireless camera, LPG gas sensor, PIR sensor for surveillance purpose and wireless serial RF modem for wireless data communication. It can provide the reliable range of 30 m at 2.4GHz band.

Key Words: Stair case Robot; Home surveillance; Automation; RF modem

I. INTRODUCTION

Home surveillance refers to the use of computer and information technology to control home appliances and features (such as windows or lighting). Systems can range from simple remote control of lighting through to complex computer/micro-controller based networks with varying degrees of intelligence and automation. Home automation is adopted for reasons of ease, security and efficiency. Remote monitoring and control is some issues of indoor security system [1].Traditional indoor security system use some monitoring device like video camera mounted on wall at multiple place. It increases cost of indoor security system. These systems with multiple cameras are costly and complicated to install and use. They are not flexible to implement monitoring system in indoor security system [2].

The proposed system uses stair case climbing robot with camera to monitor indoor environment. The camera in robot can move on various locations to take photos with different angles. These cameras are more flexible than fixed camera at single location. Traditional indoor security system is wheeled robot that can work on flat floors. They have problem with staircase climbing, irregular surfaces and obstacle avoidance or any stuff. The proposed robot is wheel base robot having arm on the front side which can rotate through 180 degree. By properly managing the arm position robot can climb the stair of height

proportional to its dimension of the robot. It uses the wireless RF modem for wireless data communication. On the flat floor the arm position is up word and when staircase or any obstacle get sense then the arm will come down word, horizontal to robot and will climb the stairs. For surveillance different sensors are used like smoke sensor PLG sensor, PIR sensor.

II. SYSTEM OVERVIEW

The major components used in the proposed surveillance robot are

- Microcontroller
- DC motors
- L293D
- Ultrasonic distance sensor
- Angle sensor
- Wireless module

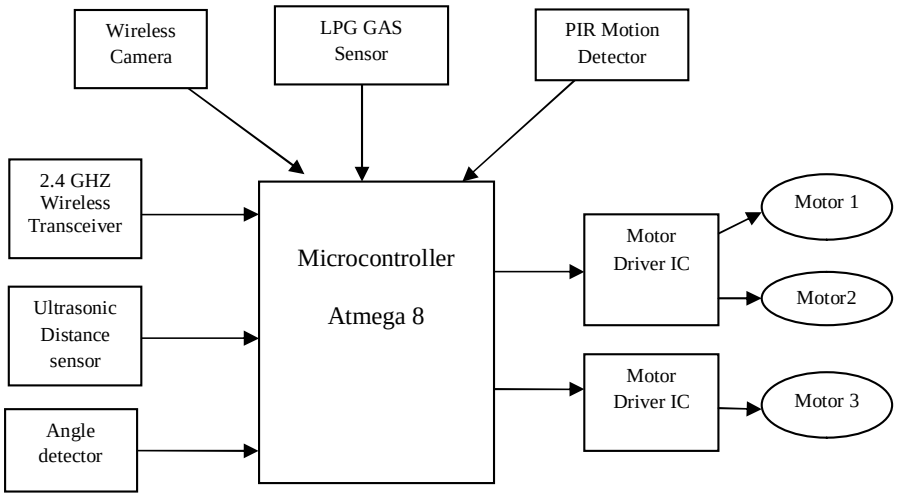

Fig. 1 Block diagram of Surveillance Robot

A. Microcontroller:

The heart of the robot is the atmega8 microcontroller which is an 8bit AVR RISC architecture Microcontroller which is fastest in the 8bit segment with single cycle execution of every instruction. Atmega has different features like it had three pulse width modulated(PWM) channels, analog to digital(ADC) converters, programmable serial universal synchronous asynchronous receiver transmitter (USART).

B. DC motors:

DC motors are the electromechanical device that can be use to do the physical work. So DC motors can be use for the movement of the robots. These DC motors can be easily controlled by microcontroller. We can start it, stop it or we can make it to rotate in clockwise or anticlockwise direction. By using DC motors we can control the movement of the robot. In this system we are using 12V DC motor.

C. L293D:

To drive the DC motors L293D driver is used. L293D is quadruple high-current half-H driver[5]. All inputs are TTL compatible. Each Output is a complete totem-pole drive circuit with a Darlington transistor sink and a pseudo Darlington source. The L293D has some features such as wide supply voltage range 4.5V to 36V, separate input logic supply, thermal shutdown, high noise immunity inputs, output Current 600mA per channel, peak output current 1.2mA per channel and output clamp diodes for inductive transient suppression.

D. Ultrasonic distance sensor:

Ultrasonic Distance sensor is perfectly used to perform measurements between moving and stationary objects. The sensor provides precise and stable noncontact distance measurements from about 2 cm to 5 meters with very high accuracy. It can easily be interfaced to microcontrollers where the triggering and measurement can be done using two I/O pin. The sensor transmits an ultrasonic wave and produces an output pulse that corresponds to the time required for the burst echo to return to the sensor. By measuring the echo pulse width, the distance to target can easily be calculated [3].

E. Angel Sensor:

The angle sensor will give the angle of movement of arm position in terms of voltage. Initially the arms of surveillance robots are in up word direction and when the obstacle will get sense by ultrasonic sensor then arms will get downward by the angle depending on the values provided by the angle sensor.

F. Wireless module :

We are using Wireless serial RF modem which works in 2.4GHz band and can provide range up to 30mtrs.RF modem can be used where we need two way wireless data transmission. It is having adjustable data rate and reliable transmission distance. The communication protocol is self controlled and completely transparent to user interface. By using RF module it is very easy to setup wireless communication as it is having automatic switching feature between transmitter and receiver Operation.

III. STRUCTURE DESIGN

Fig.2 Prototype of the surveillance robot

The prototype of the proposed Surveillance robot is as shown in fig 2.The surveillance robot has the mechanical structure composed of set of four wheels of radius 9cm and two arms attached to the front two wheels. The length of the each arm is 20cm, height is 10cm and width is 5cm. The four wheels are used for moving the robot on flat surfaces and while climbing the stairs front two arms are used. For the movement of the robot in forward, left, right, clockwise and anticlockwise direction 12 v DC motors are used. In this robot structure we use three motors, two motors for moving the robot and one motor is for the upward and downward motion of the arm. While moving if any obstacle or stair will get sense by the distance sensor

then the angle sensor which is attached internally will give the angle value. The front two arms will get down word by that angle and will climb the staircase. For the surveillance related information different types of sensors such as PIR sensor for any human detection, LPG gas sensor to sense if there is any leakage of gas is used. LPG gas sensor has the high sensitivity to Propane, Butane and LPG gas. Sensor's conductivity is higher as concentration of gas increases. By using simple electronic circuitry we can convert change of conductivity to corresponding output signal of gas concentration. In the same way we can use Fire sensor or smoke sensor. In addition camera is mounted on the front side of the robot. If any human get detected by the PIR sensor then camera will capture the image immediately and it sends the captured images to the host PC through the wireless network. For communication between the robot and PC, wireless RF modem at 2.4 GHz is used. It provides reliable range of 30 m and the communication protocol is self controlled and transparent to the user. The robot can work in two different modes. In the patrolling mode, the surveillance robot wonders around in the rooms and if any security related information is there then it will immediately send it to the user PC through wireless network. In second mode of operation, if any obstacle or staircase will get detected by ultrasonic sensor then the robot will directly climb the stairs and can perform the surveillance task. While climbing the stairs also it does the surveillance task.

IV. WORKING OF THE SURVEILLANCE ROBOT

Operation of the robot can be explained with help of schematic diagram. The schematic diagram of the proposed surveillance robot is as shown in fig3.

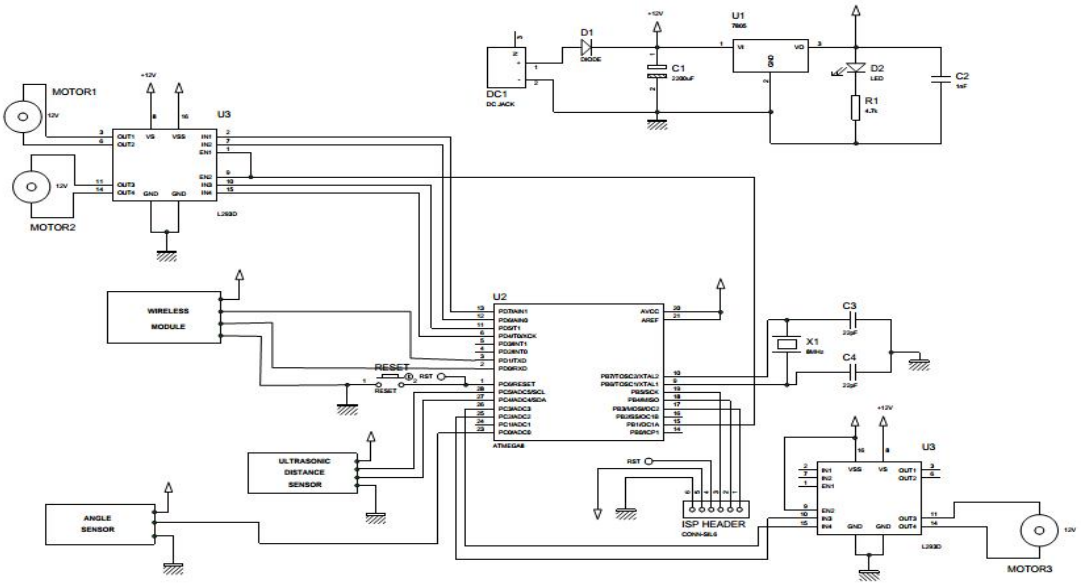

Fig.3 Schematic diagram of the surveillance robot

When the robot is switched on, microcontroller will give the command to the DC motors. The high output of the microcontroller drives the motor driver (L293D)[4]. Output Port pins drive motors M1 and M2 in forward direction. Similarly, motors M1 and M2 move for left turn, right turn, backward motion and stop condition. The motor M3 is for the movement of arm of the robot. The clockwise direction of M3 motor is upward motion for arm and the counter clockwise direction of M3 motor is downward motion for arm. The ultrasonic distance sensor attached to the controller gives distance reading to the controller. The "trig" pin receives 10 microsecond pulse from microcontroller and the "echo" pin gives signal to the microcontroller. Microcontroller counts the distance travelled by the ultrasonic wave, and thus calculates the distance. While moving on the flat surface if any obstacle or stair will get sense by the ultrasonic distance sensor within 20cm range it stops the robot for the moment, at this instant of time arms attached to the front side come downwards by an angle depending on the value given by the angle sensor. Angle sensor will provide values in terms of voltage. Once the arms come horizontal to the robot, it will climb the staircase and again starts moving on the flat surface. If any human being will get sense by the PIR sensor, the camera fix on the body of robot will immediately capture the images and sent it to the user terminal PC by using wireless RF

modem which have automatic switching characteristic between transmitter and receiver without interference. Then after receiving the information from robot user will take the appropriate action. Also we have used LPG gas sensor to sense if there is any leakage. LPG gas sensor has the high sensitivity to Propane, Butane and LPG gas. Sensor's conductivity is higher as concentration of gas increases. By using simple electronic circuitry we can convert change of conductivity to corresponding output signal of gas concentration and once the information will get transferred to user through wireless network preventive action will take place. For the power supply Lithium ion battery is used for the robot.

The operational flowchart of stair climbing mechanism is as shown in fig 4. The proposed surveillance robot will work in two modes. In the first mode, it will move on the flat surface , in the right and left direction todo the surveillance related task if any. In the second mode of operation, while moving if any obstacle or stair will get detected by the sensor then the robot will climb the staircase. If there is no obstacle in between then it will simply move on the surface. The angle sensor value will continuously vary between 0-5.

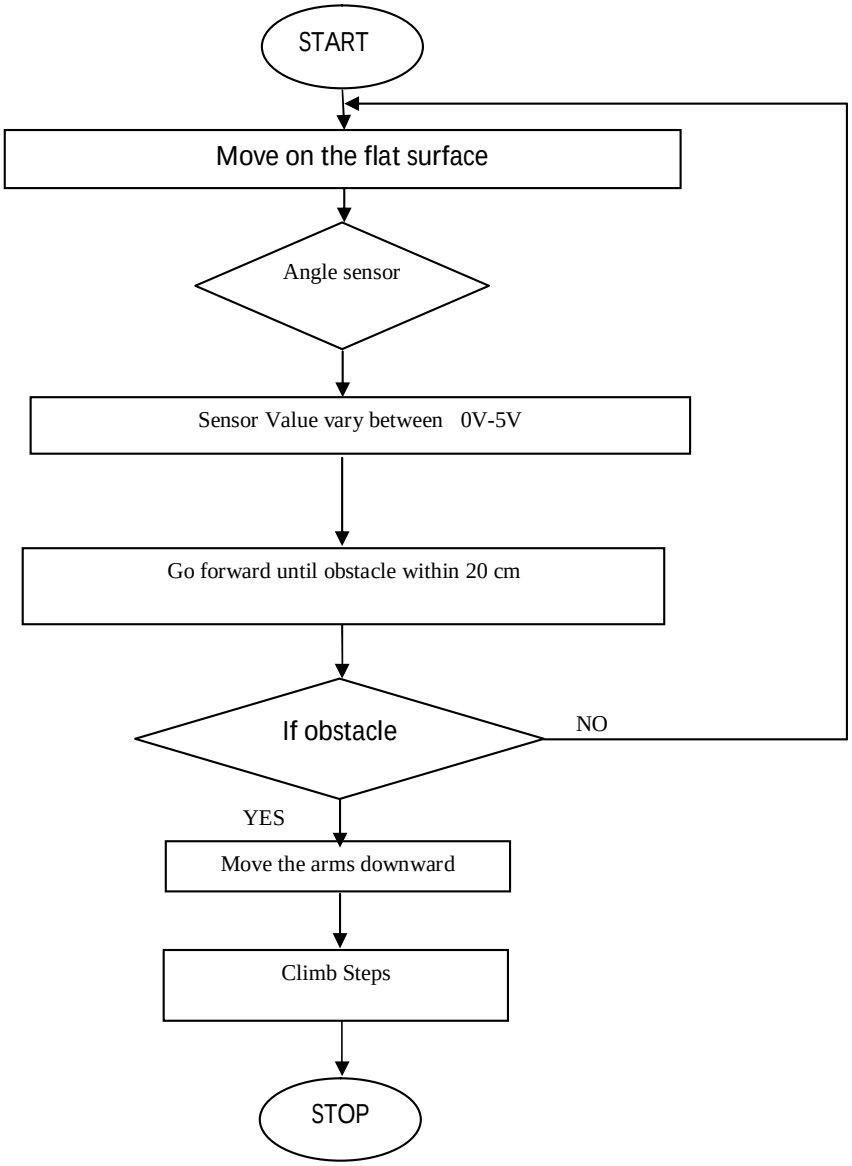

Fig .4 Flowchart of Mechanism of climbing steps

V.EXPERMENTAL RESULT

We designed several experiments to test the function of the proposed system. In fig 5 different poses of the proposed robot are shown. In first picture it moves on flat surface and in second and third picture, when staircase gets detected the robot will climb the staircase.

Fig.5 Different poses of the surveillance robot while climbing staircase

VI.CONCLUSION

The proposed home surveillance robot is capable of negotiating cluttered home environments by a hybrid rolling-hopping locomotion mode. It adopts the RF 2.4 GHz protocol for wireless communication. Experimental results show that the prototype robot can climb the staircase of variable step size which is proportional to the dimension of the robot which greatly helps the robot navigate freely in cluttered home environments while performing surveillance tasks.

REFRENCES

[1**]** C.D. Nugent, D.D. Finlay, P. Fiorini, Y. Tsumaki, and E. Prassler, "Home Automation as a Means of Independent Living," IEEE Trans. On Automation Science and Engineering, vol. 5, no. 1, pp. 1-9, 2008

[2] R.C.Luo, P.K. Wang, Y.F. Tseng and T.Y. Lin, "Navigation and mobile security system of home security robot", in *IEEE Int. Conf.on Systems, Man and Cybernetics,*Vol. 52, Taipei,Taiwan, 2006,pp.169-174.

[3]Yoon-Gu Kim, Han-Kil Kim, Suk-Gyu Lee and Ki-Dong Lee,"Ubiquitous home security robot based on sensor network", in *IEEE/WIC/ACM Int. Conf. on Intelligent Agent Technology*, Hong Kong, China, 2006, pp. 700-704.

[4] "Microcontroller" datasheet. [Online] Available: http://www.microchip.com/downloads/en/devicedoc/ 39564c.pdf.

[5] "L293D" datasheet. [Online]. Available: http://idmax.free.fr/Aide/stepper/i293.pdf

