

DESIGN OF MULTIPURPOSE WIRELESS SMART ROBOT FOR VARIOUS APPLICATION

PROF R.B.KHULE¹, SHRUTI RAMTAKE², CHETANA KHOBRADE³,
CHINMAY HIRDE⁴, AKSHAY HIWASE⁵, GITESH SAHARE⁶

¹Prof., Dept. of Electronics Engineering, K.D.K. College of Engineering Nagpur

^{2,3,4,5,6}UG Student, Dept. of Electronics Engineering, K.D.K. College of Engineering Nagpur

ABSTRACT

The proposed work presents designing and development of a multipurpose smart robot car using wireless camera detecting alive humans, fire, harmful gases, metals, obstacles at remote areas and send information to main location. The proposed system uses machine intelligence to provide immediate response from sensors. The robot system is equipped with sensors those can alert the user when some anomaly appears within the range while robot is working. The main feature of this robot differentiating it from others is execution of versatile tasks in night and rough areas. This whole robot system works in two modes. Mode one is automatic mode and the other is user controllable mode. By default, robot works in automatic mode in which all sensors like human detecting sensor, temperature sensor, gas detecting sensor, metal detecting sensor, obstacle detecting sensor, Ultrasonic sensor are functional for automatic action. The movement of robot in automatic mode is controlled through obstacle detecting sensor and ultrasonic sensor. In user controllable mode, user sends the signal to robot car using RF module and controls it manually. User could watch the surroundings through wireless camera built in the robot car and gives directions to change the path accordingly. In both modes, user could hear the talk of humans at the border areas with the help of microphone in wireless camera.

General Terms

Surveillance, Inspection, Robot Car, Dimensions, Wireless Sensor Network, Program Implementation, Wireless Camera, DC Gear Motor, Acrylic Sheet, automatic mode, User Controllable Mode.

Keywords

Detector, Surveillance, Inspection, Human Detector, Gas Detector, Fire Metal Detector, Obstacle Detector, Ultrasonic Detector, Wireless Camera, RF Module, Border Areas, Robot Car, Remote Control.

1.0 INTRODUCTION

Webster defines a robot as “An autonomous device that performs functions normally ascribed to humans or a machine in the form human.” Generally, it is machine that functions in spite of a living person. Robots are used for special applications like handling hazardous situations and tasks that need high accuracy and speed. A danger event is normally happened by the negligence of humans. To implement real time inspection and surveillance of the border security, intelligent remote monitoring system is developed. Wireless sensor network is used to monitor physical or environment conditions such as temperature, gases, humans, metals etc. Our

System consists of sensory network, embedded system and intelligent program on the robot vehicle. Whenever there is any deviation from the original state of sensors occur at robot side (i.e. VEHICLE SIDE) it transmits the signals to remote side (i.e. USER SIDE) where detected quantity showed on LCD. It can also climb terrain at certain angles. This project surely creates revolution in defense systems as a surveillance and inspection robot.

2. PROPOSED SYSTEM

Sensory network in our proposed system detect parameters like human presence, harmful gases, pistols, bombs, mines, fire etc at remote areas. In border areas, we know the entry of any human is totally prohibited. Through

PIR (Pyroelectric Infrared Sensor) sensor we can detect presence of any human being in prohibited areas. In this proposed system, Metal detection sensor, gas detection sensor, temperature sensor, PIR sensors are used. Metal detector is used for detecting metals at the border areas because mines, bombs, pistols, electronic circuits are made up of metals. Temperature sensor measures the temperature of outside environment [10] and when temperature goes beyond the limits then according to feeded algorithm robot transmit the signals to user side where user is available to take action. Switching from automatic mode to user mode is very fast and from without any delay.

3.HARDWARE REQUIREMENTS

3.1 Microcontroller

Microcontroller is a general purpose device having large number of the components of a microprocessor system on a single chip. Now a days, a variety of microcontrollers are available in a market we can use any of them. Here, we are using microcontroller ATmega16 for this vehicle. It had 1kb of RAM, 4K bytes of on-chip ROM, compatible with MCS-51 products, 32 programmable I/O Lines, Programmable Serial Channel, Six interrupt sources, low-power idle and power-down modes.

2.2 Metal Detector

The main module of metal detector is the inductive oscillator circuit which detects for high frequency current losses in a coil. Hence, metallic body can be detected with the variations in the high frequency Eddy current losses. Output signal level is altered when a metal object is approached. When supply voltage is given to the sensor then no current flows hence the output of this sensor is +5V. If the metal object is close to the searching coil, the output current flows more and output voltage given by sensor is 0V.

2.3 Human Detector

PIR (Pyroelectric sensor) is used for detection of humans. It is a pyroelectric device that detects motion by measuring changes in the infrared (heat) levels emitted by surrounding objects. This module consists of Fresnel lens and motion detection circuit. PIR sensor consists of material made up of crystalline that generates electric charge when exposed to infrared radiation. Voltage is generated when striking of infrared radiation on Fresnel lens changes. Fresnel lens focuses the infrared radiations onto the element. The PIR Sensor has a range of approximately 20 feet (6 meters). Output of this sensor becomes high when sudden change in motion occurs [5], [9]. This is used for detection of humans or intruders at border areas.

2.4 Ultrasonic Sensor

This sensor is used for distance measurements from the obstacles. The output of this is in the form of serial data. So this data is given to the receiver pin of microcontroller which receives data and firstly and then according to algorithm present in microcontroller our robot will move in automatic mode [9]

2.5 Temperature Sensor

Temperature sensor (LM35) is used for detection of fire. Output of this sensor is in analog form and varies directly with temperature and it is calibrated directly in Celsius [9]. It is used for fire detection in an area where robot is moving. It detects the temperature of the environment. Range of this sensor is -55 C to 150 C.

2.6 Wireless Camera

Wireless camera will send audio and video signals to user side. The Camera is wired to a wireless transmitter and the signal travels between the camera and the receiver. The wireless camera picture is sent by the transmitter and the receiver collects this signal and outputs it to our Computer or laptop. Wireless camera sends real time audio and video inputs which can be seen on a remote monitor in the base station from where the robot is being controlled by user in user mode. This camera having range of 150 foot (line of sight), providing full motion, real time, color video with no delay. It can easily conceal in box made by us and the built-in microphone provides great sound quality. We used T.V Tuner card for watching the A/V signals on our laptop.

2.7 RF Module

This module consists of 433.92 MHz transmitter and receiver modules. Transmitter transmits the signal to receiver module where receiver receives and gives signal to microcontroller. The RF module has been used in conjunction with a set of four channel encoder/decoder ICs. Here HT12E and HT12D have been used as encoder and decoder respectively. The conversion of parallel inputs into serial set of signals is done through

encoder. These signals are serially transferred to the receiver side through RF. The decoder is used after the RF receiver to decode the serial format and regain the original signals as outputs. Encoder IC (HT12E) receives parallel data in the form of address bits and control bits. Control signals coming out from sensor outputs along with 8 address bits compose a set of 12 signals in parallel. The encoder HT12E encodes these parallel signals into serial bits for transmission. Here four channel means we give 16 commands to our vehicle side and vehicle also sends 16 signals through wireless communication through RF module. In this we are using four signals to control the four directions of robot car that are forward, left, right and backward direction. These transmitter and receiver are connected to encoder and decoder ICs which encodes or decodes the 12 bits of data (8 address and 4 data bits) into serial data which is used to control the directions. Address bits of transmitter and receiver are same that is why when data bit at the transmitter changes then at the receiver that only that particular bit is changed.

3. PLACEMENT AND DIMENSIONS

Acrylic sheet is used for the manufacturing of the top of the chassis base for robot vehicle because of unique properties like light weight, more impact resistance, more flexible, excellent resistance to chemicals, insulator, weather resistance and many more advantages.

Tapping is provided at the front side of robot vehicle to avoid damage of sensors which are placed inside the tapping box which is made up of acrylic sheet. Whole robot is painted with dark black color so that intruders can't see the robot. Wireless camera is mounted at below inside the slot in robot vehicle so that user can clearly see the objects in front of it. Batteries and PCBs are placed inside into the box.

Placement and dimensions on sensors are shown in figures: figure1, figure2 and figure3. Figure1 shows the front view and dimensions of slots for ultrasonic sensor, human detector and wireless camera and metal detector is mounted at the below with the help of clamps.

FEATURES

- 1) PIR detecting sensor detects motions from up to 600cms.
- 2) Metal detecting sensor detects metals up to 6cms.
- 3) The detectable range of obstacle sensor is up to 10cms.
- 4) Ultrasonic sensor detects the obstacle from 400cms.
- 5) Robot can control from 200feet through remote with the help of 434 MHz RF transmitter and receiver module.
- 6) Robot can work in rough areas and it can climb at certain angles.
- 7) Wireless camera sends real time audio and video signals at remote location and its range is 150feet.
- 8) Ground clearance of our robot is 3.2cms.

PROS AND CONS

- Our robot can work in rough areas.
- It is best for surveillance and inspection purposes.
- Our robot can send real time audio and video signals at user side without any delay.
- Our robot is fully autonomous and also controlled through remote but its range is 500feet.
- Our robot can detects humans, metals, harmful gases, fire at border areas.
- It is a low cost and low speed robot which is best of border security. We can use multiple of these robots at border security.
- Disadvantage of this robot is that range of controlling the robot is short and fixed.

REFERENCES

- [1] L. Srinivasavaradhan, G. Chandramouli and A.G. Maniprashanna, 2009. 7TH sense. A multipurpose robot for military. MEMSTECH 5th International Conference on Perspective Technologies and Methods in MEMS Design.
- [2] C. Marques, J.Cristovao, P.Lima, I.Ribeiro, R.Ventura, J.Fraza. 2006. RAPOSA: Semi-Autonomous Robot for Rescue Operations, Intelligent Robots and Systems,IEEE/RSJ International Conference.
- [3] Hou Tsan Lee, Wei Chuan Lin, Ching Hsiang Huang, Yu Jhih Huang. 2011 "Wireless Indoor Surveillance Robot," SICE Annual Conference Waseda University, Tokyo, Japan.

- [4] S.Naskar, S. Das, A.K Seth, A. Nath. 2011. Application of Radio Frequency Controlled Intelligent Military Robot in Defense. Communication Systems and Network Technologies (CSNT), International Conference.
- [5] Luo, R.C., Chou, Y.T., Liao, C.T., Lai, C.C., Tsai, A.C. 2007. NCCU Security Warrior: An Intelligent Security Robot System. Industrial Electronics Society, 2007. IECON 2007. 33rd Annual Conference of the IEEE.
- [6] <http://www.robotshop.com/inspectorbots-toughbotsurveillance-inspection-robot.html>.
- [7] YuanYuan Li; Parker, L.E. 2008. "Intruder detection using a wireless sensor network with an intelligent mobile robot response," Southeastcon, IEEE.
- [8] <http://www.sunrom.com/>
- [9] <http://www.acrylicsindia.com/products/acrylicsheets.htm>
- [10] Hou Tsan Lee, Wei Chuan Lin, Ching Hsiang Huang, Yu Jih Huang. 2011 "Wireless Indoor
- [11] Surveillance Robot," SICE Annual Conference Waseda University, Tokyo, Japan.
- [12] S.Naskar, S. Das, A.K Seth, A. Nath. 2011. Application of Radio Frequency Controlled Intelligent Military Robot in Defense. Communication Systems and Network Technologies (CSNT), International Conference.
- [13] Luo, R.C., Chou, Y.T., Liao, C.T., Lai, C.C., Tsai, A.C. 2007. NCCU Security Warrior: An Intelligent Security Robot System. Industrial Electronics Society, 2007. IECON 2007. 33rd Annual Conference of the IEEE.
- [14] <http://www.robotshop.com/inspectorbots-toughbotsurveillance-inspection-robot.html>.
- [15] YuanYuan Li; Parker, L.E. 2008. "Intruder detection using a wireless sensor network with an intelligent mobile robot response," Southeastcon, IEEE.
- [16] <http://www.sunrom.com/>
<http://www.acrylicsindia.com/products/acrylicsheets.ht>

