Automatic Docking System for Home Surveillance Robots

Priyadarshani R. Meshram, Prof. S. P. Tondare

Abstract—Home security is usually provided by appointing watchman outer to the home. Apart from that forever we cannot depend on watchman for all the time. This project is designed for home surveillance. The goal of such paper is the expansion and modified rule of a surveillance robot through automatic docking abilities for home protection. Automatic recharging has to be done to the robot to deliver uninterrupted surveillance. The robotic part trip due to LPC2148 through CMOS camera with a man spotting sensor plus docking area because of wireless power transfer part for surveillance robot. Communication of monitoring unit plus robot is refined throughout IEEE 802.15.4. The interrupt will give an intimation to the camera. Here the robot model may rotate over different angles due to spontaneous as well as manual power to cover the entire room. The Computer will manage the camera in the rest condition under the lack of person. The project also aims to demote the power utilization of robot. In such system the docking part can be transfer the power from one coil to the other coil via wireless power transmission approach due to home surveillance robot. Ultrasonic signal authenticates the surveillance robot is inside the power transmission area. This system applies the Matlab software as the picture vision.

Index Terms—ARM 7 LPC 2148, Zigbee, Camera, Sensors module, home surveillance robots, docking system.

1. INTRODUCTION

WIRELESS communication technologies and microelectronics has modified briskly over the time.

Mobile robots are greatly played in industrial robotization, home robotization as well as in hospitals, space exploration, military, etc[1].

House-based safety is the typical characteristic applications of home surveillance robots. Monitoring devices can be build up on windows, doors and walls for house safety plan.

It is not convenient to install and carry on many appliance and sensors inside the places. Some parts of the rooms cannot be covered by the sensors because of untypical place structure and several corporal limit of sensors. Thus it is essential to have additional modifiable and additional effective solution for house safety to spread out a mobile robot fit with oversight devices like cameras and pyroelectric infrared sensors. A house safety method which include an intelligent safety robot and various remote interaction is explained in this paper[4].

The aim of this project system is the expansion and representation of a surveillance robot due to spontaneous docking competencies for house safety[5].

- ***Ms. Priyadarshani R. Meshram,*** *M. Tech Electronics-VLSI, Department of Electronics, Bharati Vidyapeeth College of Engineering, Pune, India,(e-mail: priyadarshani.meshram@gmail.com).*
- ***Prof. S. P. Tondare****, Assistant Professor, Department of Electronics, Bharati Vidyapeeth College of Engineering, Pune, India,(e-mail: sptondare@bvucoep.edu.in).*

2. METHODOLOGY

This system is classified into Two parts. First part is the Robot Unit and Second part is the Docking System.

2.1 Robot Unit

Robot consists of different module such as microcontroller, camera, RF transceiver; DC motor, DC motor driver circuit etc. Microcontroller controls the angle of rotation of two Servo Motors. The cannon is positioned aiming at the intruding object. At last cannon will get fired. DC motor is used for the movement of the robot in left, right, forward, backward direction. DC motor driver IC is IC L293D.

Digital section includes the ARM –LPC2148 Controller along with required interfaces like Display Keypad and communication drivers.

The Power section include the power supply, design required for various parts of machine like controller, motors etc.

The Firmware part include to write the software which required to control various operation, also it helps to program various parameters and setting of machine. Also it covers the communication with PC.

The block diagram is as shown in Figure 1 below.

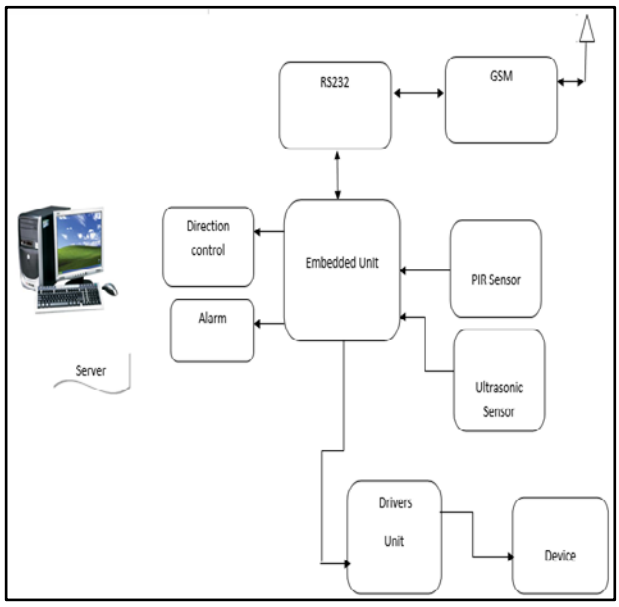

Figure 1: Block Diagram of Surveillance Robot Unit

ARM Controller is the main controller board. It consists of various input and output circuitry. Signal is used for giving the pulses to motors. Accordingly rotation will be 90°& 180 °. Motor Driver IC is used for driving the motors. DC motors are used for movement of robot like forward, backward, right and left directions. DC Motor is used for robot motion Power supply unit converts input power to DC power required by various parts of project. ARM controller used for the development of Hardware and software required for the system. Programming is done by using embedded – C language.

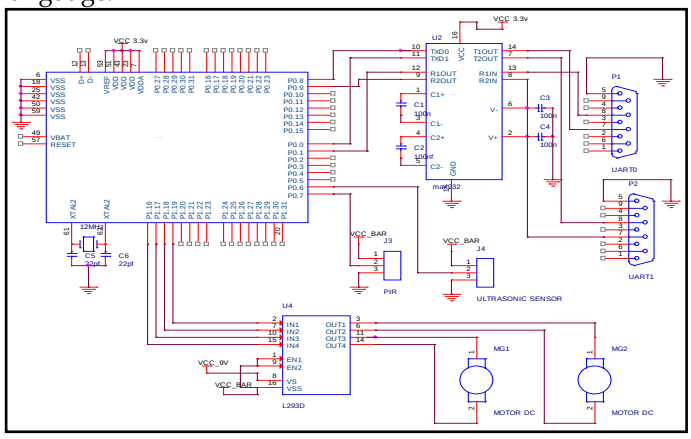

Figure 2: Circuit Diagram of Robot

Robot consists of different module such as microcontroller, camera, RF transceiver; DC motor. DC motor driver circuit etc. Microcontroller control the angle of rotation of two Servo Motors.

DC motor is used for moving the robot left, right, forward, backward direction. IC L293D is the DC motor driver IC. IC L293D is nothing but a duplex purpose H-bridge motor driver integrated circuit. Motor driver uses a lower-current power wave and gives a higher-current power wave because it works as current amplifiers. Higher current signal is applied to move the motors. IC L293D comprises of two built-in H-bridge driving circuits. Two DC motors can be drive concurrently, both of them in the reverse and forward direction due to its common mode of operation. The operation of the two motors can be regulated by given input logic at pins 2 and pin 7 as well as pin 10 and pin 15. logic 00 or 11 is given as input to quit the parallel motor. Logic 01 will turn in clockwise and logic 10 will turn in anticlockwise direction. Pins 1 and 9 (parallel to two motors) are enabled may be high for motors to move suddenly. The attended driver becomes enabled which enable input is higher. As a result, the output turn out to be operative and working in phase with that inputs. Similarly, when the enable input is low, that driver is disabled. Outputs are off. They are in high-impedance condition.

LPC2148 microcontroller board is the 16-bit/32-bit ARM7 TDMI-S CPU through concurrent imitation. It also has embedded outline hold. It has microcontrollers due to embedded high-speed burst memory range from 32 KB to 512 KB. LPC2148 has been prepared by a USB apparatus regulator so as to enable 12 M bit/s data swap through a USB host organizer.

ARM7TDMI core is hugely used 32-bit embedded RISC microprocessor. The ARM7TDMI core is based on Non Neumann architecture by a 32-bit information bus. This bus carries data and instructions. ARM7TDMI solution supplies the lower energy utilization and has advantage of smaller amount. It gives high performance.

In the given Figure 2 a PIR based movement detector has been used. It is operated to feel the motion of animal, persons, or additional things. PIR detects the broken field for a "normal" temperature. In order to register vary; the field need not have to be broken down via an entity through a dissimilar temperature. Greatly susceptible sensors will make active with the movement of Moving things of the same temperature will produce recognition. It detects motion regardless of temperature. The PIR sensor is frequently increase in amount on a printed circuit board holding the electronics essential to infer the signals as of the sensor that same one. The entire assemblage is generally restricted inside a accommodation which is raise into a position somewhere the sensor can cover up region to be monitored[6].

Figure 2 includes Ultrasonic sensors. These sensors produce high frequency echo waves and estimate the echo which is arriving reverse by the sensor. Ultrasonic sensors work on a rule similar to radar or sonar. Sensors determine the time period among transfer the signal and delivery the echo to conclude the space towards an objective. Ultrasonic is applied to identify the object[7].

2.2 Docking system

If the surveillance robot wish to recharge with its individual and the battery voltage is low then it should

navigate back to the docking region and join through the docking station repeatedly. various key methods include local and global lane planning, self-localization, docking and charging status recognition, and fault-tolerant proceeding. In docking system we are using ultrasonic locker to set place of robot at docking as shown in Figure 3 below.

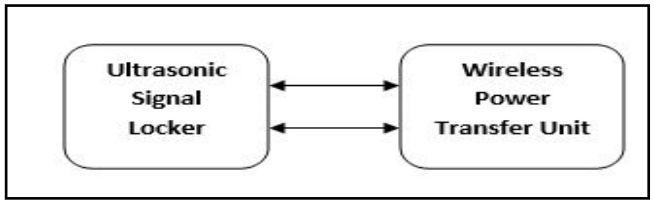

Figure 3(a): Block Diagram of Docking Station[2]

Following circuit of Figure 3(b)is used for wireless charging

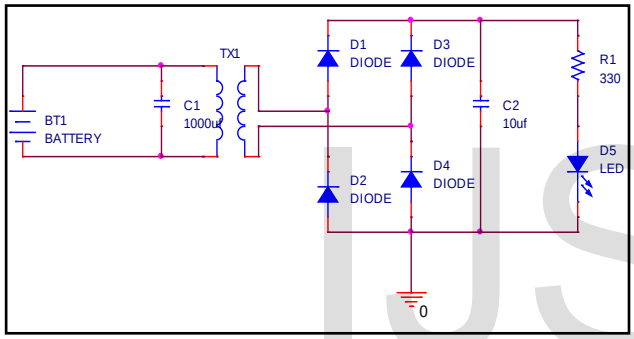

Figure 3(b): Circuit Diagram of Docking Station

In transformer electrical energy is transformed as of one level near further with no a few straight forward electrical correlation in addition to among the help of mutual induction between two windings. Mutual induction in between two or more winding is dependable for transformation act in an electrical transformer. It transpose energy from one circuit to the another circuit lacking varying its frequency other than may be in dissimilar voltage level. So whatever input we are giving according to that it transmit to second coil. When the current in the primary coil is altered the flux coupled to the secondary coil also vary. It dependent in the lead Faraday's law of electromagnetic induction. As shown in Figure 2, the second part of coil we will connect bridge rectifier n capacitor filter which will give 3vdc supply which will glow led. Battery BT1 is connected for input as shown in Figure 2. Bridge rectifier is connected on the secondary side of transformer. Capacitor filter is connected along with bridge rectifier which gives 3Vdc supply to glow LED. Thus wireless transmission is obtained[3].

3. ALGORITHM

Algorithm is given below:

I. Start
II. Initialize peripherals of the controllers
III. Initialize GPIO ,UART .
IV. Connect UART to PC
  a) Receive signals from PC perform task according to that
  b) Check data received
  c) case 'W' - " Move Forward "
  d) case 'S' - " Move Backward "
  e) case 'D'- " Turn Right "
  f) case 'A' - " Turn Left "
  g) case 'E' - " Rotate Clockwise"
  h) case 'Q' - " Rotate AntiClock"
  i) case 'O' - " Rotate 90"
  j) case 'P' - " Rotate 180'"
  k) case 'Z' - " Frwd Continuously"
  l) case 'X' - " STOP "
  m) Receive command for docking
  n) Check ultrasonic signal for docking
  o) If signal received then dock robot
V. Stop

4. IMPLEMENTATION FLOW

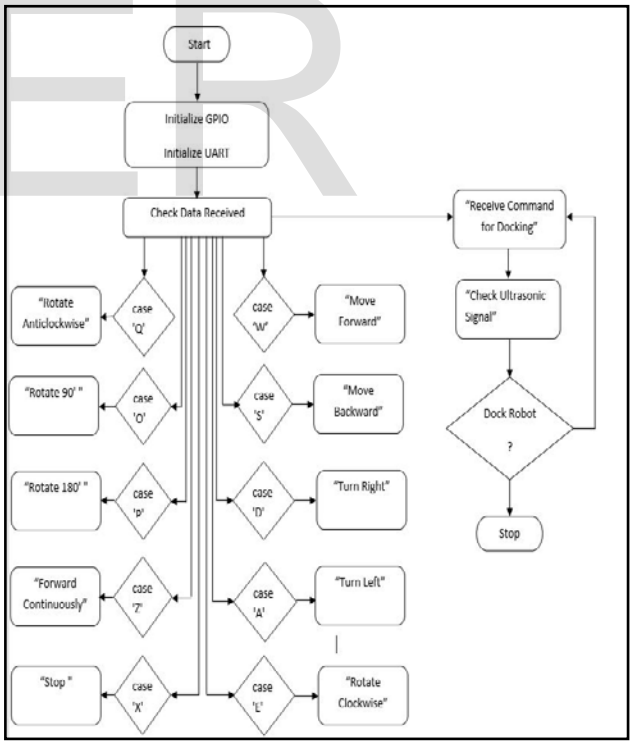

Figure 4: Implementation Flow For Robot and Docking

5. RESULTS

The Dijkstra's Algorithm works on a weighted graph with

non-negative edge weights. It gives a Shortest Path Tree. This Algorithm mimics the working of Breadth First Search and Depth First Search. It is used in network routing. It calculates the path from a network device A and B in a network which would have the maximum bandwidth. It can be used by the GPS in a car to calculate the shortest path between two locations. In the presented paper it is used to find shortest path. Following results can be obtained by using Matlab code with dijakstras algorithm. Figure 5 shows the Graph of all nodes before applying algorithm.

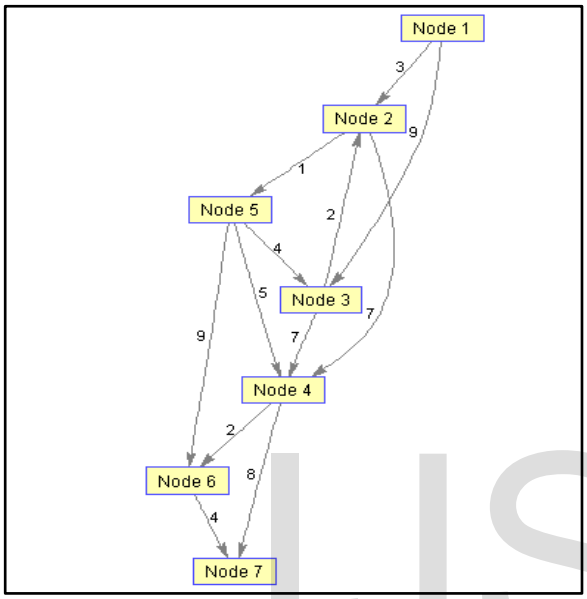

Figure 5: Graph of all nodes before applying algorithm.

The Shortest path from node 1 to node7 is shown in figure 6.

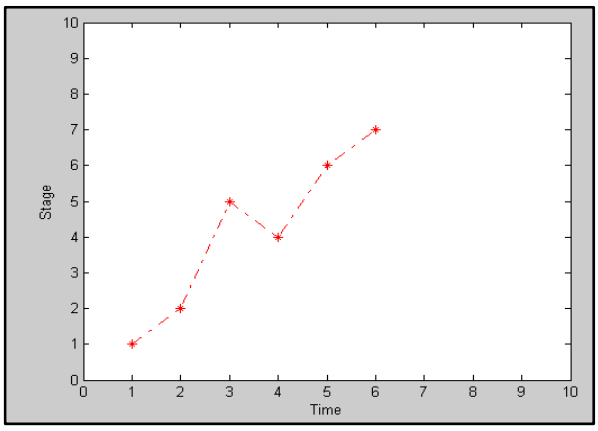

Figure 6: Shortest path from node 1 to node7

Figure 7 shows the shortest path with nodes.

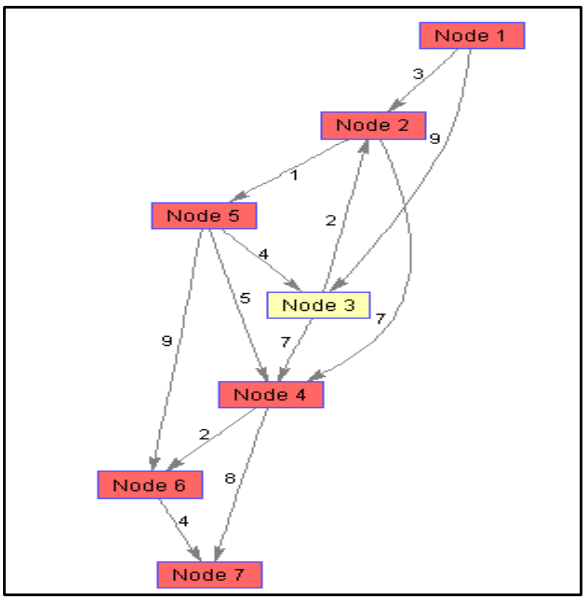

Figure 7: shortest path with nodes

The automatic docking test are classified into three types. The first is the docking test in that the surveillance robots begins docking straight from inside

Docking Types		Success	Failure
Docking			
IR1	IR2		
1	0	9	1
0	1	8	0
1	1	8	1
0	0	8	1
Navigation			
Start from (0,0)		9	0
Start from (0,7)		9	0
Navigation and Docking			
Start from (0,0)		8	1
Start from (1,7)		7	1
Total		66	5

Table 1: Results of the Automatic Docking Attempts[1]

docking region. The second is the navigation test in that the surveillance robot navigates return to the docking region. The third is the navigation and docking test in that the surveillance robot performs complete automatic docking task.

The success and failure charge of every form of docking attempts are shown in Table 1. The docking experiment is repetitive 9 times for every type. IR1 and IR2 correspond to the outputs of the two infrared sensors on the docking system. The output value of 1 specify that the surveillance robot is find out. The output value of 0 specify that the surveillance robot is not find out. The surveillance robot has passed the docking area in all of the navigation challenge.

6. CONCLUSION

The proposed paper presents the plan and execution of surveillance robot by way of automatic docking and abilities in favor of house safety. The suggested network has a docking approach whichever is predicated on the self-localization of the robot and the infrared sensors of the docking position. It is observed that the robot can come back to the docking station when the on-board battery is too low. Monitoring easily through the Computer. The proposed docking part transforms the energy from one coil to the other coil.

References

[1] *Guangming Song, Hui Wang, Jun Zhang, and TianhuaMeng, "Automatic Docking System for Recharging Home Surveillance Robots"IEEE Transactions on Consumer Electronics, Vol. 57, No. 2, May 2011*

[2] G. Song, Z. Wei, W. Zhang and A. Song, "A hybrid sensor network system for home monitoring applications", IEEE Trans Consum Electron, Vol. 53, No. 4, pp. 1434-1439, 2007.

[3] Yoo Oh, Jae Yoon, Ji Park, Mina Kim and Hong Kim, "A name recognition based call-and-come service for home robots", IEEE Trans ConsumElectron,Vol. 54, No. 2, pp. 247-253, 2008.

[4] G. Song, K. Yin, Y. Zhou and X. Cheng, "A Surveillance Robot with Hopping Capabilities for Home Security," IEEE Trans Consum Electron, Vol. 55, No. 4, pp. 2034-2039, 2009.

[5] C. D. Nugent, D. D. Finlay, P. Fiorini, Y. Tsumaki and E. Prassler, "Home automation as a means of independent living," IEEE Trans. Autom. Sci. Eng., Vol. 5, No. 1, pp. 1-8, Jan 2008.

[6] Y. W. Bai, L. S. Shen and Z. H. Li, "Design and implementation of an embedded home surveillance system by use of multiple ultrasonic sensors", IEEE Trans Consum Electron, Vol. 56, No. 1, pp. 119-124, 2010.

[7] W. Lao, J. Han and Peter H.N. de With, "Automatic video-based human motion analyzer for consumer surveillance system", IEEE Trans Consum Electron, Vol. 55, No. 2, pp. 591-598, 2009