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IMPLEMENTATION OF SOLAR BASED WIRELESS SURVEILLANCE ROBOT FOR SECURITY APPLICATIONS

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ABSTRACT:

The intention of designing a robot would be used tofacilitate the human beings through giving security and working as a helping hand through reprieving. Surveillance is one among the valuable system in the security-based monitoring. In association with, the automation system works a vital role in surveillance based security system. In this paper, the main need is to design and develop a portable and efficiently useful surveillance robot for civilian and military applications. It aims to utilize solar power for operation and embedded controller for control of the robot. Usually the powering of the robots for surveillance are based on conventional methods and shortest path algorithm based on increasing targets to reduce complexity. The paper shows the implementation of an obstacle avoidance system to produce the amicable solution. It consists of embedded controllers, H-bridge drivers and solar tracker system. It can be applied to multipurpose household and war field applications.

Keywords: Embedded controller, Obstacle detection, Surveillance robot, H-Bride driver, shortest path algorithm.

I. INTRODUCTION

Robot usually observed as, it is hard to carry out manual surveillance in various situations where also the factors are hostile for sending in personnel (fires , hostage scenario) or the available manpower is not enough to dispatch workforce at our disposal (patrolling large complexes) (G . Song and Y .Zhou 2009) also the recharge times of robots in Warfield or surveillance robots in far off destinations often becomes problematic. In these situations it becomes beneficial to have a platform that may negotiate these challenges while still remaining economically viable. A moving microcontroller based surveillance technique is one such option. Solar energy tracking for robot/vehicles is normally done by using fixed solar panels which can be disadvantageous. This paper provides the hardware design and implementation of a system which succeeds intelligent solar tracking (Mummadi , veerachary2002) and operating the automatic robot with solar energy that can be used for surveillance and watching the operations (Tomas de J . Mateo, Sanguino Justo E 2013). This development aims to present a microcontroller depending surveillance platform that is helpful as a surveillance tool in both civilian and armed forces applications.

The aim of our paper is to make the panel to rotate in accordance with the sun’s direction from morning to evening time without human intervention so that the panel grabs the solar energy to the maximum extent achievable throughout the day. The solar based surveillance Technique is used to power (F .Y .C. Albert, C .H .S Mason 2014). This system of power generation is easy and is taken from a natural resource .Obstacles could be present in and around the home environment, e .g. Walls, furniture, body of a human, etc. These kinds of physical obstacles can hamper the data transmission direction between sensor nodes any BS. Therefore, data reception problems or data inconsistency issues have been occurring in home automation networks. An obstacle avoidance data direction-finding scheme can alleviate and minimize reception problems and increase the performance of the home monitoring network (Prasenjit Chanak, Indrajit 2014). Newly, a mobile sink based data collection technology has become an important research topic in best home

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network design. The mobile sink depending data collection scheme tremendously develops the network performance and lifelong.

The Zig Bee traditional has offered a simple solution for a scalable and then flexible home automation network design due to its advantages in low power, low cost, and low two way communication overhead (Zualkernam I, Jabbar M 2009) proposed another power efficient targeted traffic scheduling algorithm for IEEE 802 .15 .4 based on home automation networks, where an efficient plan method was implemented to increase the network lifetime. This technique implemented a multi-hop Zig Bee network as well as single hop star topology developing an efficient scheduling scheme. However, the above approaches are unable to detect the presence of obstacles within the watching environment (Dongsheng Guo, Yunong Zhang 2014). Therefore, these kinds of techniques are unable to avoid data reception failures in the presence of obstacles. Besides, Zig Bee based systems only support static sink based data routing strategies (K .Gill, S. H. Yang 2009). The mobile sink moves along the minimum path to collect data from deploying fixed sensor nodes. The work has clear applications to intelligent pervasive mobile devices, for instance, robotic vacuum cleaners and security robots.

II. LITERATURE SURVEY

The proposed automatic smart home monitoring system for this research which consisted of static sensor nodes and a robot-type mobile sink. Static sensor node 1 to node 9, scattered in different locations in the home. These nodes collect data from the monitoring environment and then transmit data to the mobile sink. The mobile sink moves along different paths by avoiding obstacles and collects data from the static sensor nodes to transmit to the BS (Prasenjit Chanak, Indrajit 2014) show in the figure. Static sensor nodes are coupled to each other through IR based signal transmission for detecting the presence of obstacles between them. Similarly, the mobile sink also transmits an IR signal to the static sensor nodes for detecting the presence of obstacles on its moving path. Each static node detects the emitted IR signal. The BS is used to send the sensed information to other networks.

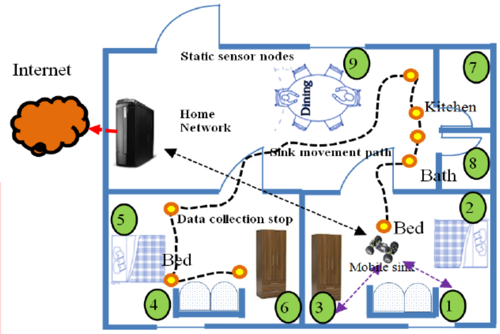

Fig. The Proposed system Home Monitoring Layout

The Zig bee traditional is used for communication between the static nodes and the mobile sink. The main goal of this research was to detect obstacle avoidance by forming an optimal sink movement path under a smart home network. The optimal sink moving scheme can efficiently improve network performance and lifetime. However, another goal is to design a mobile sink based obstacle avoidance routing scheme, which can maximize the reliability of the network (Chih-Yung Chang, Jang-Ping Sheu 2009).

The figure shows the total tour length travelled by the mobile sink as a function of the number of obstacles. As the lot of obstacles arises then as expected the tour length required also increases because mobile sink needs to find an alternate path for data collection.

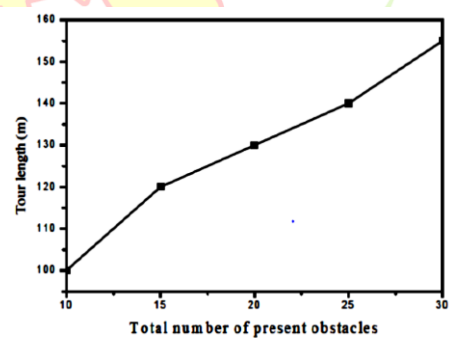

Fig. Tour Length versus Number of Present Obstacles

The total energy consumption of the proposed scheme and the M-RGP scheme (C. -Y. Chang, C. -T. Chang 2010). (In units of Joule) is depicted in Figure. As can be seen, the proposed scheme derived from this research performs significantly better

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compared to the M-RGP scheme primarily due to the optimal sink mobility that reduces the energy loss of the static sensor nodes.

This paper presents the development and then characterization of a monitoring robot with hopping capabilities for home security. The proposed surveillance robot, which is composed of two wheels and a hopping leg, can overcome obstacles up to 40cm in height.

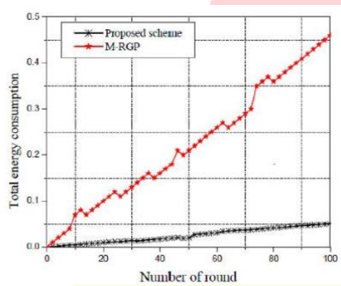

Fig. Total Energy Loss Comparison

It adopts the Zig Bee protocol for wireless transmission and therefore are generally included with a Zig Bee-based home control network as a mobile video sensor node. All of these features make the proposed robot a powerful home security machine that is able to patrol in cluttered home locations with ease (J. Zhang, G. Song, G. Qian 2011). The parameters like the Energy consumption and power achieved, Speed, Distance covered (m) and Voltage variation in solar panel is illustrated in Table.

S.NO	Technology	Energy consumption and power achieved	Distance covered(m)	Speed
1	Mobile sink based data collection	(8Hours-40wats)	15rounds 120(m)length	-
2	Maximum power point tracking	23∞C with solar irradiance of 940 W/m2 4000(mw)	-	0.6 m/s
3	Wireless sensor network	The average power consumption in the vertical jumping mode is 506mW.	Communication range 20(m)	10 m/s

Fig. Comparison of Surveillance Robot

III .PROPOSED SYSTEM

In the proposed system, the communication can be done making use of the Zig bee wireless communication network. In this system, the entire control is residing with the microcontroller. Furthermore, solar dual tracking and obstacle detection are included. In this, the robot can go through the rugged surfaces also. The control of the robot from remote specific location is done with a computer. The information to the computer is carried out by the advanced concept named Zig bee Technology. Whenever a control signal is given from the computer, it is transferred with the help of Zig bee. The video receiver receives the video clip signals from the camera. The surveillance robot operated with the help of solar dual tracking machines. Initial point discussions resulted in some primitive sketches and a high-level viewpoint on the requirements for a dual axis solar tracking system and viewpoint for such a system. The main idea was to make certain with the help of sensors it could efficiently incline in itself and solar panel towards the light. So to analyze where the maximum illumination is giving the system artificial intelligence using sensors. The primary demands for this solution are easy to use, minimal initial and management hardware cost, minimal software maintenance cost.

Overview of Solar Based Surveillance Robot for Security Applications

The PIC Microcontroller is the key part of this paper. It is really programmed to control the motor driver and camera control motor. The RS232 is utilized to interface of PC and then PIC microcontroller. Applying software's can monitor in PC. Power supply for microcontroller is 5V. The solar based surveillance robot for security function was shown in the figure.

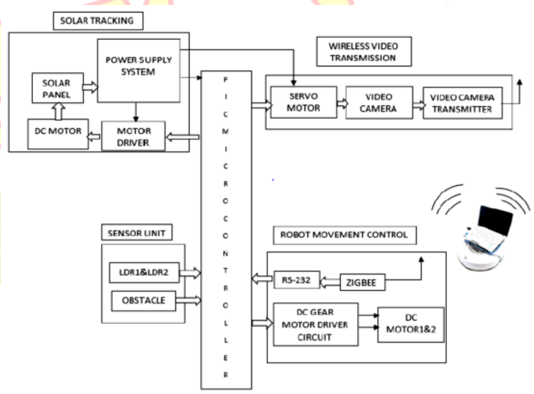

Fig. Block Diagram of Solar Based Surveillance Robot for Security Application

a) Solar Dual Tracking

The main plan was to ensure that with the help of sensors it would efficiently incline itself and solar

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panel to the light. So to studies where the highest point light is giving the system artificial intellect using sensors. The primary requirements for this resolution are easy to use, minimal initial and maintenance components cost, minimal software maintenance cost, given our requirements, always keeping the solar tracking system as simple as possible is good, because it limits the cost to make and maintain. Therefore, it was decided that the system would be autonomous and provides several components (discussed in higher detail in the next sections). It moves corresponding to the readings obtained from the sensors and adjust it position towards most sunlight. The conventional solar powered Dual Tracking is shown in the figure (a), (b). Assume the sun, if on the correct side and the panel is an in the figure As a result the LDR2 are obtaining sunlight and LDR1 might be in darkness. On sensing this the microcontroller may rotate the motor to right up until it sense light on both sensors as shown in figure. The microcontroller may do it repeatedly and it wants light on both sensor and take rest if there is equal light on both sensors. The mathematical model is given as blow.

MATHEMATICAL MODEL

sinϴ = sinφ. sin§ + cosφ.cos§. cosω

Where

ϴz◦ is the altitude angle of the system

ϴz = 90◦-zenith angle of the sun

Φ is the latitude (Φ =30◦ for example)

ω is the hour angle (15◦ /hour), where ω=0 at local noon.

§ is the solar declination.

The § is calculated from cooper's equation.

§=23.45 sin [360/365(284+N)]

Here, N is the day of the year (1 to 365),

N=1 on the 1st of January

The rotational angle of the system in the horizontal plane (va) is calculated from the equation:

sinϴa = cos§. sin ω/cos ϴz

ϴa is the azimuth angle of the system.

b) Obstacle Avoidance

Ultrasonic sensor sends a brief chirp with its ultrasonic speaker and permits the BASIC stomp to measure the time it takes the echo to keep coming back to its ultrasonic microphone. The BASIC stamp starts by transmitting the sensor a pulse to start the measurement. Then, the sensor waits for enough time for the BASIC stamp program to start a pulsing command. The time measurement is how long it got sound to go to the object and back. With this measurement, it can then use the speed of sound in air to make the program to calculate the object's range in centimeters, inches, feet, etc. Based on the range calculation with minimum distance the automatic robot detects obstacle and changes the direction of route to right or left. The Ultra Sonic Sensor Interfacing shown in the figure.

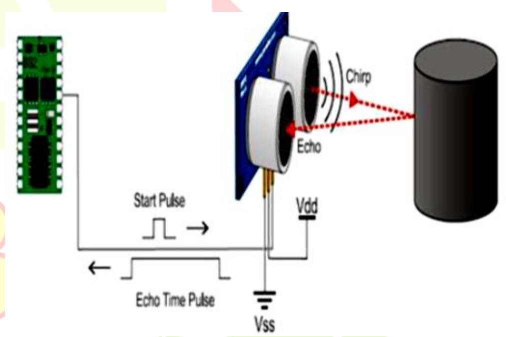

Fig. Ultra Sonic Sensor

IV. RESULT AND DISCUSSION

The solar powered robot and solar tracking The design of proposed surveillance robot for security applications is analyzed using Proteus version mechanisms is implemented based on LDR output. The solar tracking system comprises of DC powered motor and set of LDR sensors. The control of robot movement is achieved based on signals received from Zig bee also these Zig bee outputs is processed as a control signal of robot by embedded controller.

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a) Solar Dual Tracking

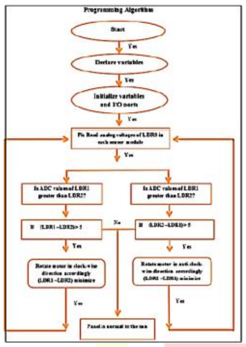


Fig. Flow Chart Solar Dual Tracking

The solar dual tracking flowchart is as shown in figure. The step by step process of execution are shown in programming algorithm. The process starts with declaration of LDR1 and LDR2 variables. The PIC controller reads the ADC value from both LDR and it checks the condition for equal, lesser and greater. Based on the condition, the solar panel, starts tracking to help of DC motor. 1 and 2 values are compared and analog values are given to the ADC of PIC 16f877a The DC motor controls the solar panel movement which is attached to it.

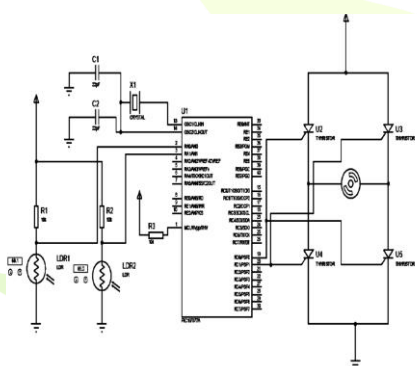


Fig. Solar Dual Tracking Using Proteus Design

If the LDR1 value is greater than LDR2, then the Thyristor U2 and U5 will be in ON state (U3, U4 is OFF state) and the motor rotates in clockwise. When the LDR1 value is lesser than LDR2, then the Thyristor U3 and U4 will be in ON state (U2, U5 is OFF state) and the motor rotates in anti-clockwise. If LDR1 and LDR2 values are equal, the motor stops working and sunlight is absorbed.

S. NO	INPUT		OUTPUT	
	LDR1	LDR2	H-BRIDGE	DC MOTOR ROTATION
1.	High	Low	(U2,U5)Thyristor ON	Clockwise
2.	Low	High	(U3,U4)Thyristor ON	Anticlockwise
3.	Equal	Equal	(U2,U3,U4,U5)OFF	Stop

b) Obstacle Detection

From the figure Obstacle Detection using the Proteus design system, the ultrasonic echo pulse are to measure and detect the obstacle

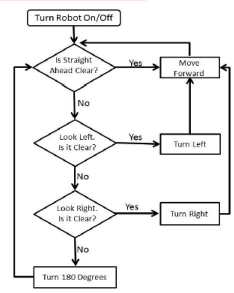


Fig. Flow Chart Obstacle Detection

. The ultrasonic sensor receives trigger input from the PIC microcontroller. In response to the ultrasonic sensor to interfacing with microcontroller it provides two lines, namely TRIGGERED and then ECHO. The trigger pin is an input pin which triggers the ultrasonic sensor for producing echo pulses. The microcontroller sends a 10us high pulse on this line to tell the HC-SR04 to start by taking a measurement. As soon as the HC-SR04 received this input pulse it sends out ultrasonic waves to hit the obstacle and return to the sensor.

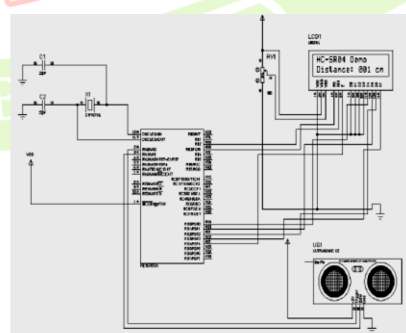
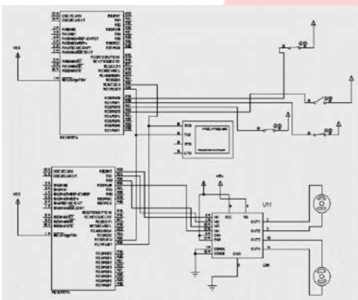


Fig. Obstacle Detection Using Proteus Design

Thus an echo pulse is produced by the sensor and a simple calculation can find the distance to obstacle using the echo pulse. If there is any presence of obstacles, the path direction was made to move automatically in the way of either left or right.

S.	INPUT	OUTPUT
NO	OBSTACLE DISTANCE	ROBOT DC MOTOR
1.	Above 100 cm	Straight
2.	Below 25 cm	Left or right

c) Wireless Remote Control Robot Movement

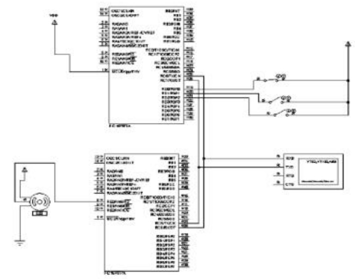


From the figure Wireless Remote Control Robot Movement using Proteus design, the Keypad plays an important role in the directions of the robot to move based on receiving the ASCII value of the any one of the arrow keypads. In keypad arrow if pressed forward key it enables the L298 driver circuit to control motor 1 and motor 2 rotate clockwise direction. So the robot are moving forward direction. When press reverse, key it enables the L298 driver circuit to control motor 1 and motor 2 rotate anti clockwise direction. So the robot is move reverse direction. Otherwise the left key or right key is pressed the robot move left or right direction. Motor 1 is ON (Motor 2 OFF) the robot move in right direction. Motor 2 is ON (Motor 1 OFF) the robot move left direction.

Screenshot of the ISIS Proteus schematic capture and the motor Design and Construction of Wireless Two DC Motors Control System Based on PIC Microcontroller using RF Module or ZIGBEE and control simulation environment is shown in the following simulation design.

S. NO	INPUT			OUTPUT	OUTPUT
		DC MOTOR 1	DC MOTOR 2	Motor 1 and Motor 2	robot movement
1.	Forward Button	ON	ON	Clockwise	Forward
2.	Reverse Button	ON	ON	Anticlockwise	Reverse
3.	Left Button	ON	OFF	M1 clockwise M2 stop	Left
4.	Right Button	OFF	ON	M1 stop M2 clockwise	Right

d) Wireless Video Camera Control



From the figure. Wireless video camera control using protease design, the data from wireless video camera sent to Zig bee Tran's receiver section to monitor on a PC. To control the motion of the camera using servo motor when input from the keypad is given to the controller, it rotates motor for an angle of 360 degree to monitor the environment and again input from the keypad to the controller, it rotates servo motor to original position. The data from zig bee is lively monitored on the PC.

S.NO	INPUT(SWITCH)	OUTPUT(SERVO MOTOR)
1.	switch 1 on	rotate 90° return 0°

Fig. Wireless Video Camera Control Using Proteus Design

V. CONCLUSION:

The necessity for the land-based surveillance for defense applications is increasing day by day due to the illegal activities happening in the tough forest areas and other Terrains. But, the difficulties faced in implementing this land based surveillance system are majorly due to the insufficient energy management and obstacle avoidance scheme. A portable economically viable alternative surveillance robot for civilian and military applications has been presented. Our proposed system, dual axis tracking technology has higher energy gain comparing with both fixed solar panel and single axis solar tracking technologies. The tracking system presented has the following advantages, the tracking system is not obligated by the geographical area of development of the solar panel since it is designed for searching the maximum solar irradiance in the completely azimuth and then tilt angle (excepting hardware limitations) during day times, namely the angle of betterment probably will not need to be corrected periodically. The operator interference is minimal because of not needing to be adjusted. The complexity of control is reduced using a shortest path algorithm which is dependent strongly on the performance of the ultrasonic range finders were discussed as well.

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BIBLIOGRPHY

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