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SELF LOCALIZATION/ECO FRIENDLY ROBOT FOR HOME ENVIRONMENT" SWEBO FIGHTER 3S"

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Abstract—*In this paper, a floor-cleaning robot named "SWEBO FIGHTER 3S" is designed specifically for tough regions in a residence is proposed. This is a robot which can be utilized for domestic use, thereby to provide cleanliness in a well-furnished manner that's efficient than manual cleaning. At present, cleaning robots are available in the market for domestic use that are capable of cleaning flat surfaces. But, our device has the capability to clean tough regions like staircase and also providing surveillance parallel. SWEBO can be utilized for domestic use such as home, office and also in public places like railway station, bus stand, airports, etc., SWEBO's intellect is controlled by ATMEGA 2560. Infrared sensor is used to detect and decide the path to be cleaned. Ultrasonic is used as a preventive functional unit that can elude sudden drop of the robot from an uneven surface. The main advantage in SWEBO is corner and staircase cleaning in association with a Bluetooth interface. This Bluetooth provides the facility of schedule cleaning, selection of cleaning mode and live streaming with an intelligent camera interfaced with Wi-Fi module is used for domestic surveillance.*

Keywords*: Domestic cleaning, ATMEGA microcontroller, Staircase cleaning, Corner cleaning, WI-FI camera.*

1. INTRODUCTION

Domestic cleaning robots that are available in the market are not affordable for a common man. In Indian markets such cleaning robots are manufactured with single function (i.e., either Vacuum or Mop cleaning) with moderately high cost. This can be overcome by our SWEBO at affordable cost price. This name "SWEBO FIGHTER 3S" is nothing but, SWEBO embodies **Swe**eping + ro**bot**, FIGHTER for germs protection, and the 3S is for Surface cleaning, Staircase cleaning and Surveillance.

The structural design of the robot is designed in such a way that it attains the capability of cleaning the above mentioned tough areas. Also the sweeping and mopping functions are carried on by means of the placing them in the front and back of the robot which is in a logical manner. The vacuum cleaning device is placed over the sweeping end to collect the dirt from that unit. The sweeping unit is provided with bristles over the blades for cleaning. In case of the mopping unit a mopping sponge is provided in such a way that it performs both dry and wet cleaning with an associated water supply unit connected to it.

The locomotion of the robot is provided by means of four wheels that are connected with four geared motors to each. By this the locomotion of the robot is made possible for all the directions such as front and rear, left and right by programming for the wheel movements.

The main purpose for which the robot was designed is staircase cleaning which is made possible by a simple logical techniques. Using screw rods and motors in the front and rear to lift the entire robot over the staircase one step at a time and clean the step on which it as landed on. By this the robot climbs over the step one by one and cleans each step till the staircase ends. An ultrasonic sensor is used to make the robot to be stable on all surfaces and also infrared sensors for detecting obstacles and align the path for the robot and clean accordingly. This functions of the robot is maintained and reported to the user by means of a Bluetooth module interfacing with the mobile of the user. An intelligent camera is installed on the robot for surveillance in all 360º and report it to the user using Wi-Fi module.

This paper is organised as follows: The proposed system model and analysis of SWEBO FIGHTER 3S are discussed in section II. In section III, Characteristics of the system is presented. In section IV, Operation modes of SWEBO FIGHTER 3S are briefed. In section V, Result and Discussion are discussed and concluding remarks is given in section VI.

2. PROPOSED SYSTEM

A. *Block Diagram:*

The function of the robot is fancied under the given block diagram illustrated in Fig. 1.

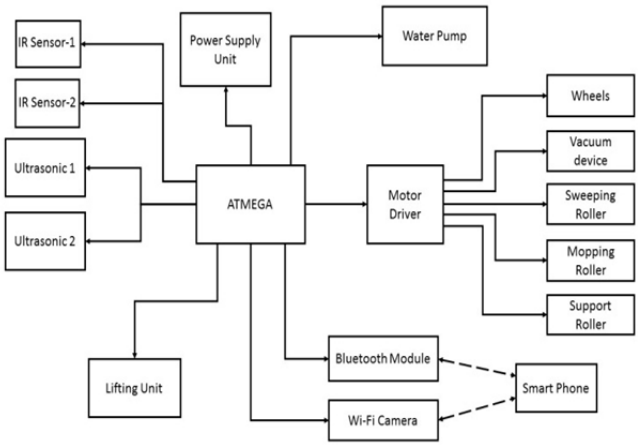

Fig. 1: Block diagram of proposed system

B. *Multiple Surfaces:*

Using multiple cleaning techniques different kinds of floors can be cleaned. In brief, the sweeping rollers placed in the front are meant for basic sweeping which is suitable normal dust cleaning of floors and also carpeted floors. In case if the floor as to be wet cleaned, then the sweeping roller in association with the mopping roller is used with water supply. In case if the floor rapidly changes from normal floor to carpeted floor then the sensors detect the floor type and implies dry or wet cleaning accordingly, thereby making it a smart sensing robot.

C. *Staircase cleaning:*

This is one of the main special feature that makes the robot a unique cleaning device. The robot is designed in such a way that its structural design suits for cleaning the staircase on its own by climbing and getting down the steps. By this feature the robot itself tends to move on the steps thereby cleaning them. This is made possible by means of screw system by which the entire robot is lifted up initially until the surface of the step is detected. As soon as the surface of the step is detected then the motor that operates the screw starts to function thereby the robot is lifted up and then it is placed over the surface of the step which is a one step at a time process as shown in Fig. 2. By repeating the same process the robot moves from one step to another of the staircase and thereby lifting it up and similarly the robot follows the same technique vice versa thereby moving towards the initial point from where the robot started its locomotion.

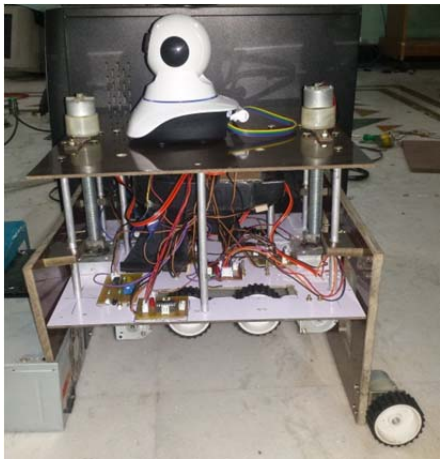

Fig. 2: SWEBO on staircase

D. *Surveillance:*

This is one of the additional feature that has been included in this cleaning robot which enables the user to have a surveillance of their residence during their absence by means of an advanced camera that ensures security in the residence. This camera tends to work over all the 360º that ensures security over the entire place around the robot. This advanced camera is also provided with audio recording and also night vision that enables security throughout the day in all circumstances. Also using surveillance in a cleaning robot will be a secret installation which can never be estimated by the intruder. If an intrusion is confirmed during the absence of the user the information of the detected intrusion is send to the user by means of user's mobile application in the mobile. This further ensures the safety and security of the residence under a full pledged manner thereby creating alertness over the consumers about the safety of their residence. Also a system of door safety alarm is fixed in such a way that when the intruder tries to open the door the information is send to the cleaning robot and that in turns alerts the user by means of a mobile application, so that even the unauthorized entry of any strangers can be detected and the user is alerted.

3. SYSTEM CHARACTERISTICS

SWEBO FIGHTER 3S is implemented by the use of microcontroller, IR sensor, Ultrasonic sensor, Bluetooth module, Wi-Fi camera.

A) Microcontroller ATMEGA 2560
B) IR sensor
C) Ultrasonic Sensor
D) Bluetooth Module
E) Wi-Fi Camera

A. *Microcontroller:*

The high-performance, low-power Atmel 8-bit AVR RISC-based microcontroller combines 256KB ISP flash memory, 8KB SRAM, 4KB EEPROM, 86 general purpose I/O lines, 32 general purpose working registers, real time counter, six

flexible timer/counters with compare modes, PWM, 4 USARTs, byte oriented 2-wire serial interface, 16-channel 10-bit A/D converter, and a JTAG interface for on-chip debugging. The device achieves a throughput of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves a throughput approaching 1 MIPS per MHz, balancing power consumption and processing speed. Pin diagram of Atmel ATmega 2560 is given in Fig. 3.

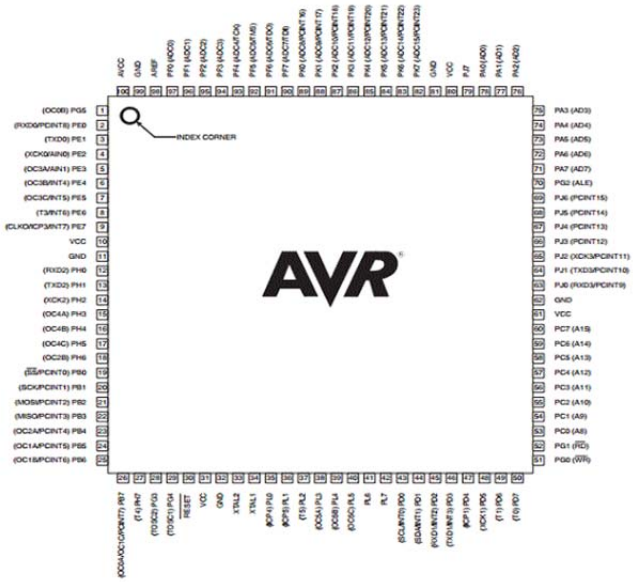

Fig. 3: ATMEGA 2560 – Pin Diagram

B. IR Sensor:

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received.

C. Ultrasonic Sensor:

Ultrasonic transducers (Fig. 4) are transducers that convert ultrasound waves to electrical signals or vice versa. Those that both transmit and receive may also be called ultrasound transceivers; many ultrasound sensor besides being sensors are indeed transceivers because they can both sense and transmit. These devices work on a principle similar to that of transducers used in radar and sonar systems, which evaluate attributes of a target by interpreting the echoes from radio or sound waves, respectively. Active ultrasonic sensors generate high-frequency sound waves and evaluate the echo which is received back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object. Passive ultrasonic sensors are basically microphones that detect ultrasonic noise that is present under certain conditions, convert it to an electrical signal, and report it to a computer.

Fig. 4: Ultrasonic Sensor

D. Bluetooth Module:

HC-05 (Fig. 5) module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm.

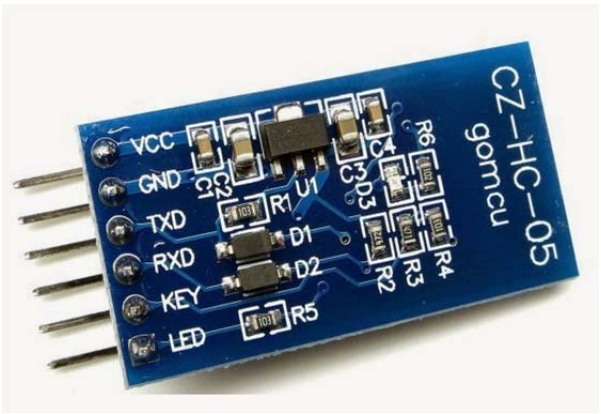

Fig. 5: Bluetooth Module HC-05

E. Wi-Fi Camera:

Wireless security cameras are closed-circuit television (CCTV) cameras that transmit a video and audio signal to a

wireless receiver through a radio band. Many wireless security cameras require at least one cable or wire for power; "wireless" refers to the transmission of video/audio. However, some wireless security cameras are battery-powered, making the cameras truly wireless from top to bottom. Wireless cameras are proving very popular among modern security consumers due to their low installation costs (there is no need to run expensive video extension cables) and flexible mounting options; wireless cameras can be mounted/installed in locations previously unavailable to standard wired cameras. In addition to the ease of use and convenience of access, wireless security camera allows users to leverage broadband wireless internet to provide seamless video streaming over-internet.

4. OPERATION MODES

Here, we have designed SWEBO to operate in different modes. These modes includes the following

A) Only Vacuum
B) Vacuum with Mopping
C) Only Mopping
D) Staircase Cleaning
E) Surveillance

A. Only Vacuum:

In this mode, with the help of smartphone – a command "1" is transmitted to the Bluetooth module HC-05 (Which is present in the SWEBO). While receiving this command, it just powers vacuum motor and vacuum support roller leaving rest to turn off.

B. Vacuum with Mopping:

In this mode, with the help of smartphone – a command "2" is transmitted to the Bluetooth module HC-05 (Which is present in the SWEBO). While receiving this command, it each and every portion of the SWEBO to its full throttle.

C. Only Mopping:

In this mode, with the help of smartphone – a command "3" is transmitted to the Bluetooth module HC-05 (Which is present in the SWEBO). While receiving this command, it just powers mopping roller leaving rest to turn off.

D. Staircase Cleaning:

In this mode, with the help of smartphone – a command "4" is transmitted to the Bluetooth module HC-05 (Which is present in the SWEBO). While receiving this command, it make sure that it is placed near staircase and initialize the front and rear lift with the help of Ultrasonic sensor. Decisions are taken by the SWEBO accordingly.

E. Surveillance:

In this mode, a string is received by the smartphone from the HC-05 module present in the SWEBO. This is received only when the switch placed on the door is triggered. If it is you, leave the message. If not, then you can access the Wireless IP camera with the help of smartphone app. SWEBO will automatically work as surveillance bot by turning off all the features of a cleaning robot. At that time of surveillance, it powers only the 4 driving motors.

5. RESULT AND DISCUSSIONS

This model is well suited for modern day customers as shown in Fig. 6. With its feature of surveillance and smartphone interface, it can operate from anywhere and provides the extra advantage of viewing your residence 24*7. On further analysis over the results and outputs that has been arrived we conclude that this robot ensures cleanliness on all aspects. The highly modernised sweeping system in association with the vacuum sucking system ensures dirt free floor. In addition to that the mopping system that includes wet cleaning by means of a sponge roller and a liquid container that is used to store any special cleaning liquid that has to be applied on the floor for cleaning. This also includes ultra violet light source that enables the device to eradicate germs on the floor while cleaning them.

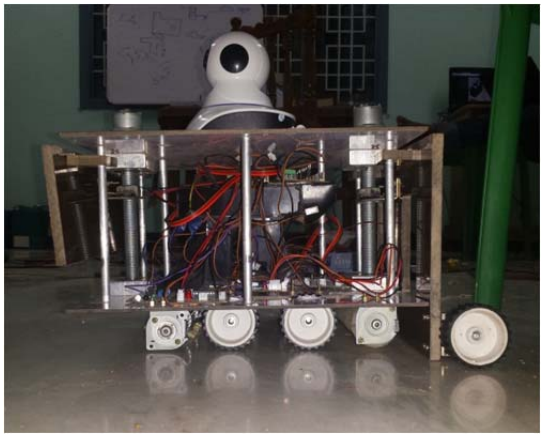

Fig. 6: Side view of SWEBO

In addition to this the infrared sensors present in the device enables the locomotion of the device by identifying the walls and obstacles that is found on the way it crosses and also the same sensor is placed in the bottom for identifying pits or unbalancing over the floor and adjust to it accordingly. Apart from this an additional useful feature for surveillance is added, that alerts the user by means of a text message if any unauthorized entry has been made through the door of the owners residence and after the instruction of the user is received it neither follows the activity of that person by means of advanced camera that is installed in it or just ignore the entry on the advice of the user by their Smartphone.

By this all the activities that happens in the absence of the user can be detected and the user can take actions accordingly which ensures a clean house in addition to a surveillance system. The above mentioned factors and outputs are obtained completely with remarkable improvement that was expected.

6. CONCLUSION

In this paper, a domestic cleaning robot "SWEBO FIGHTER 3S" is proposed and implemented for the enhancement of domestic residential workload of consumers and to improve the understanding between a human and a robot. This system will facilitate the customer to live a sophisticated life with an ensured cleanliness in the living place. The developed system is compact, multifunctional and affordable than any other cleaning robot available in the market with such incredible features.

REFERENCES

[1] Zelun li, Zhicheng Huang, "Design of A Type of Cleaning Robot with Ultrasonic", Journal of Theoretical and Applied Information Technology, January 2013.

[2] PriyaSkukla, Shimi S.L, "Design of Inspection and Cleaning Robot", International Journal of Scientific Research Engineering & Technology, September 2014.

[3] Manreet Kaur, PreetiAbrol, "Design and Development of Floor Cleaner Robot", International Journal of Computer Applications, July 2014.

[4] Coverage Path Planning for Mobile Cleaning Robots, Marten Wanders, University of Twente, The Netherlands 2011, PP. 3-5.

[5] Heung Seok Jeon, "An Efficient Area Maximizing Coverage Algorithm for Intelligent Robots with Deadline Situations", University School of Natural Science, Korea 2013, PP. 1-6.

[6] Basil Hamed, "Design and Implementation of Stair- Climbing Robot for Rescue Applications", International Journal of Computer and Electrical Engineering, Vol.3, No. 3, June 2011, PP. 461-468.

[7] Javier Ruiz de Solar, "Robotics Centred Outreach Activities: An Integrated Approach", IEEE Transaction on Education, Vol. 53, No.1, PP. 38-45, February 2010.

[8] Jamshed Iqbal, Ahmad Mahmood Tahir, Raza ulIslam and Riazun Nabi, "Robotics for Nuclear Power Plants – Challenges and future Perspectives", International Conference on Applied Robotics for the Power Industry, ETH Zurich, Switzerland, September 2012, PP 151-156.

[9] Soowoong Kim, Jae-Young Sim and SeungjoonYang, "Vision Based Cleaning Area Control for Cleaning Robots", IEEE Transactions on Consumer Electronics, Vol. 58, No. 2, May 2012, PP. 685-690.

[10] Joon Seop Oh, Yoon Ho Choi , Jin Bae Park, and Yuan F. Zheng , "Complete Coverage Navigation of Cleaning Robots Using Triangular Cell Based Map", IEEE Transactions on Industrial Electronics, Vol.51, No. 3, June 2004, PP. 718-726.

[11] Jordi Palacin , Jose Antonio Salse , Ignasi Valganon, and Xavi Clua ,"Building a Mobile Robot for a Floor - Cleaning Operation in Domestic Environments", IEEE Transactions on Instrumentation and Measurement, Vol.53, No.5, October 2004, PP.1418-424.

[12] Haydar S, Ahin and Levent Guvenc, "Household Robotics Autonomous Devices for Vacuuming and Lawn Mowing", IEEE Control Systems Magazine, Vol.25, Issue 3, April 2007, PP. 20-23.

[13] Gilles Caprari , Andreas Breitenmoser, Wolfgang Fischer , Christoph Hurzeler Fabien Tache, Roland Siegwart, Patrick Schoeneich, Frederic Rochat Francesco Mondada and Roland Moser, "Highly Compact Robots for Inspection of Power Plants‖, Proceedings of the International Conference on Applied Robotics for Power Industry Delta Centre Ville Montreal", Canada, October 5-7, 2010, PP. 1-6.

[14] Michael Burri, Janosch Nikolic, Christoph Hurzeler,Gilles Caprari and Roland Siegwart , "Aerial Service Robots for Visual Inspection of Thermal Power Plant Boiler Systems‖, Proceedings of 2nd International Conference on Applied Robotics for the Power Industry (CARPI) ETH", Zurich, Switzerland, September 2012, PP. 1-6.

[15] Vincent Pierlot, and Marc Van Droogenbroeck, "BeAMS: A Beacon Based Angle Measurement Sensor for Mobile Robot Positioning", IEEE Transaction on Robotics, Vol. 30, No. 3, JUNE 2014, PP. 533-49.

[16] Alexia A. Economopoulou and Roy M. Harrison, "Methodology for Performance Evaluation of Dust Control Systems with an Application to Electrostatic Precipitators", International Journal of Aerosol Science and Technology, Vol.42, June 2008, PP. 842–853.

[17] D. S. M.J. Bakari, "Human arm like mechanical manipulator the design and development of a multi-arm mobile robot for nuclear decommissioning," International Conference on Informatics in Control, Automation and Robotics, Montreal, Canada, 2006, PP. 168- 175.

[18] Seongsoo Lee and Sukhan Lee, "Visual SLAM Applications for Low Cost Consumer Robots", IEEE Robotics and Automation Magazine, Vol.20, Issue 4, December 2013, PP. 83- 95.

[19] Andres Iborra, Diego Alonso Caceres, Francisco J. Ortiz, Juan Pastor Franco Pedro Sanchez Palma, and Barbar Alvarez, "Design of Service Robots‖, IEEE Robotics and Automation Magazine", Vol. 16, Issue 1, March 2009, PP. 24-33.

[20] Chung – Hsien Kuo, Hung - Chyun Chou and Sheng - Yu Tasi, "Pneumatic Sensor: A Complete Coverage Improvement Approach for Robotic Cleaners", IEEE Transactions On Instrumentation and Measurement, Vol. 60, No. 4, April 2011, PP 1237-1256.

[21] Daniel Schmidt and Karsten Berns , "Climbing Robots for Maintenance and Inspection of Vertical structures", A survey of Design Aspects and Technologies‖, Robotics and Autonomous Systems International Journal, Vol. 61, No. 12, December 2013, PP. 1288– 1305.

[22] Felix Endres, Jurgen Hess, Jurgen Sturm, Daniel mCremers and Wolfram Burgard, "3-D Mapping With an RGB-D Cameral", IEEE Transactions on Robotics, Vol. 30, No. 1, February 2014, PP. 177-187.

[23] Xueshan Gao , Kejie Li, YanWang , Guangliang Men and Dawei Zhou Kok Kikuchi, "A Floor Cleaning Robot Using Swedish Wheels", IEEE International Conference on Robotics and Biomimetic, China, December 2007, PP. 2069-2073.

[24] Ming - Shaung Chang, Jung - Hua Chou and Chun - Mu Wu, "Design and Implementation of a Novel Outdoor Road - Cleaning Robot", IEEE Robotics and Automation Magazine, Vol 24, No 12, January 2010, PP. 85-101.

[25] Masaru Shimizu and Tomoichi Takahashi, "Training Platform for Rescue Robot Operation and Pair Operations of Multi-Robots", International Journal of Advanced Robotics, Vol 27, No 5, April 2013, PP. 385- 391.

[26] Tzung-Cheng Chen, Tzung - Shi Chen, and Ping - Wen Wu, "On Data Collection Using Mobile Robot in Wireless Sensor Networks", IEEE Transactions on Systems, Man, and Cybernetics-Part A: Systems and Humans, Vol. 41, No. 6, November 2011, PP. 1281-1295.