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WIRELESS POWER TRANSFER TECHNIQUE USING NANO IN ROBOTICS

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Abstract: The recharging system of a mobile robot must guarantee the ability to perform its tasks continuously without human intervention. Since mobile robots are powered by rechargeable batteries, their energy and operating times are limited. Limited onboard power supplies significantly hamper long term autonomous mobile robot operation, particularly when working with swarm-sized populations. In this paper an efficient wireless power transfer system by running the vhdl code, that heats an IC which get converted by nano wires that observes the heat and produces the electricity. The prototype consists of a power surface that provides power to an initial evaluation test robot consuming 350mW. An investigation on power transmission between a IC and nano wires has carried out depending upon the material used. The power received is evaluated by the amount of heat that gets converted as electricity. Since Pyroelectricity is one of the form to generate the temporary voltage. Whether it is for business purposes or personal use, we need an efficient way of charging the battery of electronic drives. A possible application of this method includes powering of swarm robots.

Keywords: Charging of Mobile Robot, vhdl code, Pyroelectricity, nano wires and Wireless Power Transfer.

I. INTRODUCTION

Mobile robots can be used in many missions such as surveillance, space and underground exploration, rescue assistance after disasters, etc [2-3]. As most mobile robots are powered by batteries, their energy and operation times are deficient. Therefore, how to minimize energy consumption and keep mobile robots stay alive becomes an important problem. Limited onboard power supplies significantly hamper long-term autonomous mobile robot operation, particularly when working with swarm-sized populations. In these situations, battery life usually varies depending on the activity level of each robot. This adversely affects researchers‟ ability to examine new algorithms and sensor systems both by creating troublesome logistical barriers and preventing the evaluation of large numbers of robots or algorithms with long running times.

The recharging system for a mobile robot must guarantee the ability to perform its tasks continuously without human intervention. To stay alive, the system need to guarantee that if a robot does not have enough energy, it should be able to return to a docking station for battery changing or recharging, which needs to be done in an energy-efficient way to save energy. Therefore, how to reduce energy consumption and keep mobile robots to stay alive becomes a crucial problem. Previous solutions in the literature have relied on battery exchange, docking or recharging schemes, or specialty power sources such as fuel cells.In this paper, the research focuses on vhdl codes to heat an IC that get utilized by the nano wires. The power received is to bring efficient drive system with long lasting performance. The design improves from previous literature [1] including a power management system and improves the power transmission, which gets, implemented to achieve a faster and more efficient drive system. As an illustration of long-term autonomy, the proposed system shows that, the robot is able to carry out a monitoring task for far longer than it would have been able to return for recharging.

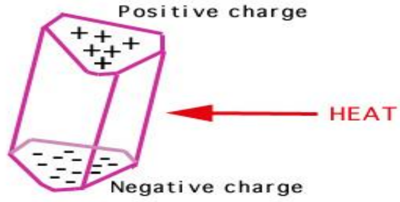

Fig.1 Production of pyroelectricity

To realize the wireless energy supply, the microwave, the laser energy transmission is considered to be the most hopeful. The microwave energy transmission has an advantage of higher energy conversion efficiency and can be used through the cloud, but it is not easy to concentrate the power in a small region. The Laser method of power transfer requires an uninterrupted line of sight which

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cannot be used in underground exploration. Recently, the use of a docking station has even been adapted to several commercial cleaning robots. However, all docking stations which have been suggested by researchers and then commercialized suffer from the following three significant problems: (i) the low error tolerance of the docking mechanism, (ii) the low adaptability of the docking mechanism for various mobile robots as the most docking mechanisms are specifically designed to match the shape and size of their own robots, (iii) the requirement for the mobile robot to be shut down during recharging, turned on by the user and returned to the previous task after full recharging. These are impediments to the development of mobile robots as independent systems are able to perform tasks continuously without external assistance.

II. RELATED WORK

Many techniques have been developed to transmit power without wires. The solution is a complete system for the autonomous charging of a mobile robot's motor. As for the charging procedures, we integrated the essential electrical circuits a solid and firm structure to supply the needed power. In the method the VHDL code which is already located at the memory of swarm robot get induced for compiling by a signal from the docking systems which controls the mobile robot. This helps in identification of the charging condition of the drives. Docking system which has to controls all the drives when they are tends to do the research purposes. If any of the drives memory is corrupted the signal from the docking system are not loaded and utilized, so that the system is controlled and observed properly. The corrupted memory can also be corrected by the test vectors by wireless transmission.

There are many types of nano wires that get used in transformation of heat energy to electrical energy. Thus the highly sensitive sensors, which are of nano scale provides the high efficiency. The output and compatibility of the wires are the major parameters which have to taken in account in the designing purpose. Electricity produced by the nano wires, gets connected to the pins which absorbs and charge the robots. Since the basic concept is that the code gets executed by compiler and it is to be run continually for the finite number of time and that heats the sensor. The number of execution of the code depends on the size of the battery and the robot. The continual running should not affect the compiler and other library functions. The nano wire placement is also a important factor, that they have to absorb the complete amount of heat.

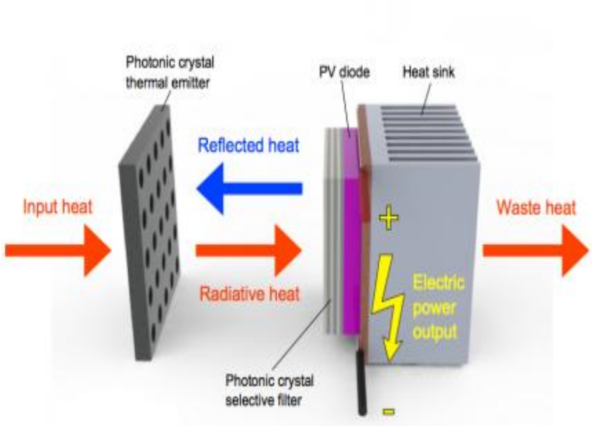

Fig.2 wireless transmission of power

III. DESIGN OVERVIEW

A. vhdl codes to heat an IC

There are two types of widely used hardware description languages i.e. Verilog HDL with C-language like syntax, easy to learn and another is VHDL which follows the structure of ADA programming language. Verilog and VHDL each have about 50% share of the commercial user base [8]. VHDL is acronym for VHSIC i.e. very large scale integrated circuit hardware description language. It was standardized by IEEE. VHDL is used for synthesis construct and implement a design on silicon. VHDL is used for simulation to imitate real world scenarios for verification. If you want to run the HDL simulator on the different drives. When both applications run on the same prototype, we have the choice of using shared memory or TCP sockets for the communication channel between the two mobile drives. After coding one of the models's components in VHDL or Verilog and simulate it in the HDL simulator environment, the integration part of the HDL with the specific IC's which is ready to change its normal condition. Thus the atomic values get changed, which tends the IC to produce heat

B. Program to heat a ASIC

```
TEMP_CSN : out   std_logic;-- Temp Sensor SPI Select
-- TEMP_SCK : out   std_logic;-- Temp Sensor SPI Clock
-- TEMP_SDO : inout std_logic;-- Temp Sensor SPI Data
SPI_i: block
begin
TEMP_SDO <= 'Z';
process (Clk, Rst)
  variable BitCnt : integer range 0 to 16;
begin
  if Rst='1' then
    WrTemp    <= '0';
    TEMP_CSN  <= '1';
    TEMP_SCK  <= '0';
    Sign      <= '0';
    stSPI     <= spiBoot;
```

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```
    BitCnt     := 0;
    FPGA_uW_SIOr<= '0';
    TempH <= (others=>'0');
    TempL <= (others=>'0');

  elsif rising_edge (Clk) then

    WrTemp <= '0';

    FPGA_uW_SIOr <= TEMP_SDO or TEMP_SDO;

    case stSPI is

      when spiBoot =>
        if Tick4us='1' then
          stSPI <= spiIdle;
        end if;

      when spiIdle =>
        TEMP_CSN <= '1';
        TEMP_SCK <= '0';
        if Cnt05s(Cnt05s'high) = '1' then -- read temperature
~ 2 times / s
          TEMP_CSN <= '0';
          TempH <= (others=>'0');
          TempL <= (others=>'0');
          BitCnt := SPi_Nbits;
          stSPI <= spiRead1;
        end if;

      when spiRead1 =>
        if Tick4us='1' then
          TEMP_SCK <= '1'; -- rising edge
          stSPI <= spiRead2;
          if BitCnt = SPi_Nbits then
            Sign <= FPGA_uW_SIOr;  -- Shift the sign in...
          else
            if TempL < 5 then
              TempH <= TempH(2 downto 0) & '0'; -- no carry
              TempL <= TempL(2 downto 0) &
(FPGA_uW_SIOr xor Sign);
            else
              TempL <= "-"(TempL,5) (2 downto 0) &
(FPGA_uW_SIOr xor
Sign);
              TempH <= TempH(2 downto 0) & '1'; -- carry
            end if;
          end if;
          BitCnt := BitCnt-1;
        end if;

      when spiRead2 =>
        if Tick4us ='1' then
          TEMP_SCK <= '0';
          if BitCnt /= 0 then
            stSPI <= spiRead1;
          else  -- No more bit
            TEMP_CSN <= '1';
            if Cnt05s(Cnt05s'high) = '0' then
              WrTemp <= '1';  -- signal we want to display the
temp
              stSPI <= spiIdle;
            end if;
          end if;
        end if;

    end case;

  end if;

end process;

end block;
```

C. pyroelectricity and power generation

Pyroelectricity can be visualized as one side of a triangle, where each corner represents energy states in the crystal: kinetic, electrical and thermal energy. Although artificial pyroelectric materials have been engineered, effect was first discovered in minerals such as tourmaline. These materials are said to exhibit ferro electricity. All pyroelectric materials are also piezoelectric, the two properties being closely related. However, note that some piezoelectric materials have a crystal symmetry that does not allow pyroelectricity. Very small changes in temperature can produce an electric potential due to a materials' pyroelectricity. Progress has been made in creating artificial pyroelectric materials, usually in the form of a thin film, out of gallium nitride (GaN), cesium nitrate ($CsNO_3$), ($LiTaO_3$) is a crystal exhibiting both piezoelectric and pyroelectric properties, which has been used to create small-scale nuclear fusion ("pyroelectric fusion").

The pyroelectric coefficient may be described as the change in the spontaneous p temperature

$$p_i = \frac{\partial P_{S,i}}{\partial T}$$

Where p_i ($Cm^{-2}K^{-1}$) is the vector for the pyroelectric coefficient.

D.Adaptations of nano wires

Thermoelectric conversion efficiency is measured by a number dubbed ZT. Several factors go into that number, and it can be increased both by lowering the thermal conductivity of a material and by increasing its electrical conductivity. Whereas bulk silicon at room temperature has a ZT of 0.01, the Berkeley team increased that to 0.4, and the Caltech team increased it to 0.6. That puts silicon

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nanowires about on par with bismuth telluride, the compound from which commercial converters are made despite the fact that it is relatively expensive and challenging to work with. Making thermoelectric devices out of silicon, which is abundant, cheap, and easily handled, could help create a new market for the devices.Both research teams found that they could decrease silicon's thermal conductivity--and therefore increase the conversion efficiency--by fashioning the material into nanowires with diameters of 10 to 100 nanometers and introducing defects in the silicon that slowed the flow of phonons--the acoustic vibrations in the crystal lattice of a material that carry heat

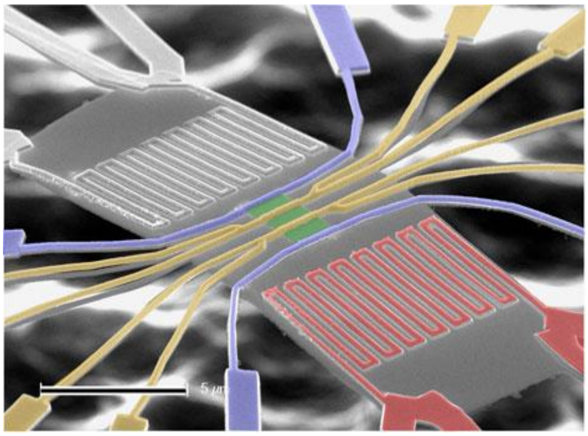

Figure 3. Nano wires

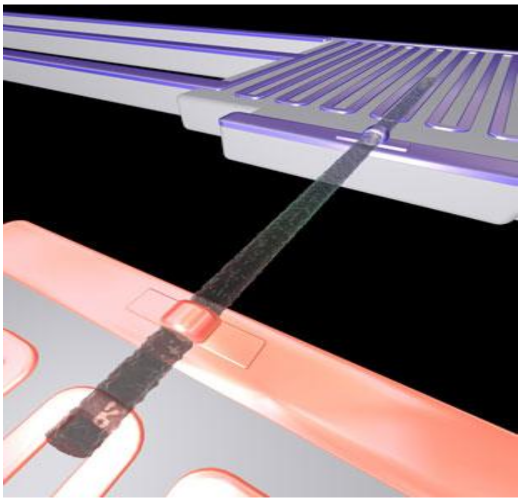

Figure. 4 Nanowire Thermoelectric converters

The difference in temperature between two sides of a chip [red is hot, blue is cold] cause electrons to flow in a roughened silicon nanowire. They fabricated an array of silicon nanowires that are between 20 and 300 nanometers in diameter. Nanowire synthesis often involves liquefying a nanoparticle and inducing it to grow, much like a hair. But that produces nanowires with smooth surfaces.

TABLE I

Electrical Properties

Power**	20 Watts	Minimum
Load Voltage	1.65 Volts	±0.1
Internal Resistance	0.15 Ohm	±0.05
Current	10 Amps	±1
Open Circuit Voltage	3.5 Volts	±0.3
Efficiency	9.5 %	Minimum

Using "rough" silicon wires, produced by a process known as "electroless etching," where silicon nano-wires are synthesized in an aqueous solution, over a thin, semiconductor crystallized base, the scientists have been able to exploit the process of galvanic displacement of silicon. Lighter weight batteries that can be constantly recharged could be carried onto the battlefield to power communications or other equipment.

IV. RESULT AND DISCUSSION

The temperature produced by the ASIC, gets observed by the sensors completely and the process of conversion of heat to electrical energy gets regulated. Since the process begins when the charge of the mobile robots get utilized for their purposes. As the heat dissipated at the time of the usage of the charges get noted and that heat also get converted to charge the mobile robots. By increase of the temperature the output current also increases. Though various other techniques is also used in charging the drives but if the drives are not controlled by the docking system then the total process is of waste. By the VHDL code which is already present at the mobile robot it can be executed easily. In case of drives lose its control from the docking system, the heat that dissipated from the battery of the mobile drive heats a sensor and so it gets activated again.

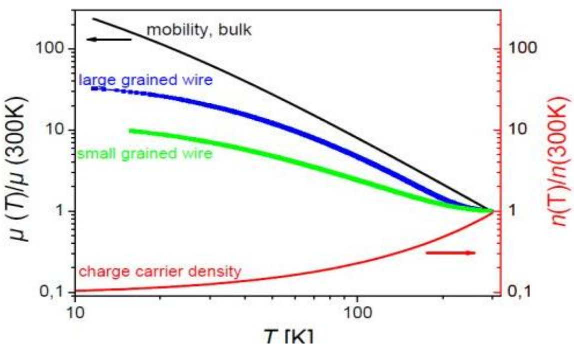

Figure .5 , various nano wires used

A new power generation technology that uses heat as a source of electricity for low-power wireless applications. Electrical connections can be made using the on-board 2-pin or 6-pin connectors. The 6-pin connector is a Texas Instruments connector that mates to the eZ430 wireless target board, making the WPG-1 an ideal wireless power

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source for the eZ430 development platform. The power transmission efficiency was estimated by comparing the generated heat of ASIC and the output power of the nano wires. The results that obtained by using the various types of nano wires helps the robot to recharge the system. Efficiency of the nano wires get increased by the material that used to construct them.

V. CONCLUSION

The test results showed that the wireless power transmission system can supply relatively constant power throughout a large working area. Multiple times of execution of the VHDL code to charge the single mobile robot, avoids the wastage of time. As a cost of these features, this power transmission system has a relatively reasonable efficiency. This method gives a positive result both in long run and in expense. By properly selecting the types of nano wires and thermo diode which is of appropriate sensitivity, size will bring up the efficiency. From the experimental set up the following observations has been made. It is estimated that the cost of the power reception and conditioning circuitry on the swarm robot to be approximately $2.00 per robot. This can be compared very favorably with the cost of lithium ion batteries and their associated charge control circuitry. The achieved result shows an unlimited long run time of the autonomous vehicle through wireless energy transfer thereby bringing up a new trend in the enhancement of robot performances. If the system is designed for many small sized robots like swarm robots, the use of batteries and can be eliminated there by cost is minimized. It also provides an eco friendly environment. Hence this method makes the mobile robot to involve in all rescue operation and investigation areas with long run-time performance.

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BIOGRAPHY

J.Dhanasekar completed M.E in VLSI Design in Sri Eshwar College Of Engineering, Coimbatore.
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