

G. Manla, N. M. White and M. J. Tudor, "Numerical Model of a Non-Contact Piezoelectric Energy Harvester for Rotating Objects," in *IEEE Sensors Journal*, vol. 12, no. 6, pp. 1785-1793, June 2012.

doi: 10.1109/JSEN.2011.2175721

Abstract: Energy harvesting is an attractive technique for powering wireless sensors and low power devices. Harvesters delivering sufficient power from rotation for sensor applications have been developed, but difficulties are encountered when the devices to be powered are located off-axis on a rotating object. In such cases, harvesters are not adapted to low frequency and high amplitude of motion, where the input force amplitude is higher than the mass available displacement. A novel approach, based on using non-contact piezoelectric energy harvester to generate power from magnetic forces due to the effect of the centripetal force is proposed in this paper. In this approach, the pre-stressed piezoelectric beams are deformed by interaction with an oscillating magnet that is supported by magnetic levitation system. Because the magnetic levitation system is nonlinear, the nonlinear spring enables operation over a wide range of large centripetal accelerations. A model of the system is presented and analyzed in order to identify the parameters that control the performance of the harvester. Theoretical investigations are followed by a series of experimental tests to validate the response predictions. With an off-axis distance of 75 mm the prototype, occupying a volume of approximately 17.74 cm³ and weighting 46 g, generated an output power ranging from 0.2 μ W to 3.5 μ W when the rotating speed changes from 3 rps to 5.55 rps. Further optimization of the piezoelectric harvester is carried out in order to improve the power density. An application in which the harvester can be used in tire pressure monitoring systems. In this case, the harvester can replace the battery of the pressure sensors located inside the vehicle tire. keywords: {energy harvesting;magnetic forces;magnetic levitation;numerical analysis;piezoelectric transducers;wireless sensor networks;centripetal force;distance 75 mm;input force amplitude;large centripetal accelerations;low power devices;magnetic forces;magnetic levitation system;mass 46 g;mass available displacement;noncontact piezoelectric energy harvester;nonlinear spring;numerical model;oscillating magnet;power 0.2 μ W to 3.5 μ W;power density;pre-stressed piezoelectric beams;pressure sensors;rotating objects;vehicle tire pressure monitoring systems;wireless sensor network;Electron tubes;Force;Generators;Magnetic levitation;Magnetic resonance;Magnetomechanical effects;Magnetic force;Thunder beam;non-contact based generator;piezoelectric curved beam;piezoelectric energy harvester;rotational energy},

URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6078388&isnumber=6189422>

S. H. Kim, C. H. Yu and K. Ishiyama, "Rotary-Type Electromagnetic Power Generator Using a Cardiovascular System As a Power Source for Medical Implants," in *IEEE/ASME Transactions on Mechatronics*, vol. 21, no. 1, pp. 122-129, Feb. 2016.

doi: 10.1109/TMECH.2015.2436910

Abstract: Power-harvesting devices have received attention as power supplies for implantable medical devices. Power-harvesting technologies can overcome the limitation of a battery, such as limited battery lifetime and repeated surgical interventions. However, micropower generators do not meet the energy requirements of medical implants such as neural recording, implantable hearing aids, and implantable wireless sensors. They require an electrical power from 1 to 10 mW. This paper introduces an electromagnetic power generator using blood flow and blood pressure to drive an implanted medical device. The fabricated power generator, which is composed of a tiny rotor with magnets and external coils with ferrite cores, operates within a wide blood pressure range from 6.75 to 54.75 mmHg. In addition, the total volume and weight of the generator are 3.16 cc and 24 g, respectively. Using animal and mock-up tests, we verified the ability of the self-powered device to drive the medical implants. In the animal test, we utilized a blood pump to control the blood flow and blood pressure. The generator generated a maximum electrical power of 3.4 mW (conversion efficiency of 1.04%) at a blood pressure drop of 54.75 mmHg and blood flow of 2.68 L/min.

keywords: {biomedical equipment;blood flow measurement;blood pressure measurement;cardiovascular system;coils;energy harvesting;magnetic cores;power supplies to apparatus;rotors;animal test;blood flow;blood pressure;blood pump;cardiovascular system;external coil;fabricated power generator;ferrite core;implantable medical device;magnet;medical implants;micropower generator;mock-up test;power 1 mW to 10 mW;power source;power supplies;power-harvesting device;pressure 6.75 mm Hg to 54.75 mm Hg;rotary-type electromagnetic power generator;self-powered device ability;tiny rotor;Blood flow;Generators;Magnetic circuits;Magnetic cores;Magnetic flux;Rotors;Blood flow;Implantable electromagnetic power generator;blood flow;cardiovascular system;implantable electromagnetic power generator;milliwatt power generation},

URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7118749&isnumber=7410147>

A. A. Kshirsagar and S. Hippargi, "Design and implementation of wireless sensor node for noncontact measurement of liquid," *2014 Annual IEEE India Conference (INDICON)*, Pune, 2014, pp. 1-5.

doi: 10.1109/INDICON.2014.7030661

Abstract: A need often arises to precisely measure water and other liquids in many industrial and commercial places wirelessly. Along with water, other liquids may be measured by Noncontact method, detailed in this paper. Many measurement techniques for liquid such as float, pressure gauge, ultrasonic and radar are available. Cumulative error, which increases with time, and their cost are hindrance in adopting them. So, an immediate need is felt for measuring the level of liquid with reasonable accuracy, Noncontact principle and low cost. The proposed sensor node is used to measure a considerable range, by using magnet and sensing floating switch (Noncontact), with a minimum error and communicate with remote terminal wirelessly. Wireless feature is essential for ease of recording readings, database management, and to remove wiring complications at difficult to reach places. The sensor node is Noncontact, green device having low power requirement, good measuring accuracy device with wireless transmission capability. It overcomes the problems faced by other gauges and is suitable for Noncontact measurement of almost any liquid. A solar panel and battery backup aid the gauge to be installed at remote places where supply is partially or not available at all, making the unit self dependent. An additional feature to wirelessly control the sensor node from the master unit makes it single person operating device. A smart self powered sensor node with wireless data transmission capability, self power cut on maloperation is implemented and presented in this paper.

keywords: {level measurement;magnets;switches;wireless sensor networks;battery backup;green device;liquid level;magnet;noncontact liquid measurement;sensing floating switch;solar panel;wireless sensor node;wireless transmission capability;Accuracy;Liquids;Measurement uncertainty;Switches;Ultrasonic variables measurement;Wireless communication;Wireless sensor networks;Liquid;Magnet;Measurement;Noncontact;Wireless},

URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7030661&isnumber=7030354>

"Table of contents," *2014 8th International Conference on Future Generation Communication and Networking*, Haikou, 2014, pp. v-vii. doi: 10.1109/FGCN.2014.4

Abstract: The following topics are dealt with: capacity evaluation; mmWave-based multispot beam cellular system; handover

performance; M2M application; authentication scheme; M-Coupon systems; rate flexible coded digital phase modulation; RFID network topology design; Internet of Things; intention preservation; deterministic multithreading; line-selection; analytic hierarchy process; fuzzy optimization; decanter centrifuge; job-shop scheduling algorithm; small batch MES; LEACH routing protocol; wireless sensor networks; localization; privacy preservation; cognitive radio networks; tree search based determination; graph isomorphism; RF-MEMS switch analysis; lattice structure; driving cycle; differential evolution algorithm; constraint joint replenishment problem; streaming media video terminal; embedded Linux; adaptive dynamic state prediction control algorithms; quantitative weighing system; semantic metadata describing; ontology; cutting breaking process; solid ice-snow; vehicle anti-theft system; D-S evidence theory; optimal capital structure; equipment manufacturing industry; enterprise value; intelligent granary monitoring system; lithium battery; fuzzy self-tuning PID control; polarization errors; all-fiber optic current sensors; face recognition; SVM; ATA interface hard disk memory card; video image data; fuzzy immune PD algorithm; self-balancing two-wheeled robot; numerical control workshop; Ethernet; integrated management system; nuclear power valve; thermal regenerated fiber Bragg grating; field oriented control; permanent magnet brushless hub motor; four-wheel drive electric vehicle; event-triggered model; disaster retrieval; meta search interface; fly ash; compressive strength hydration products; magnesium oxysulfate cement; debris cloud; hypervelocity impact; pressure vessels; catastrophic front-side bursting; hypervelocity impact; and industrial design hand-painted renderings training.

keywords: {Bragg gratings;Internet of Things;Linux;adaptive control;analytic hierarchy process;brushless machines;cellular radio;cognitive radio;compressive strength;data privacy;electric vehicles;evolutionary computation;face recognition;fibre optic sensors;fly ash;fuzzy control;graph theory;hard discs;job shop scheduling;local area networks;machine vector control;media streaming;memory cards;microswitches;mobility management (mobile radio);multi-threading;ontologies (artificial intelligence);optical fibres;permanent magnet motors;phase modulation;radiofrequency identification;rendering (computer graphics);routing protocols;secondary cells;self-adjusting systems;semantic networks;support vector machines;telecommunication network topology;three-term control;tree searching;wireless sensor networks;ATA interface hard disk memory card;D-S evidence theory;Ethernet;Internet of Things;LEACH routing protocol;M-Coupon systems;M2M application;RF-MEMS switch analysis;RFID network topology design;SVM;adaptive dynamic state prediction control algorithms;all-fiber optic current sensors;analytic hierarchy process;authentication scheme;capacity evaluation;catastrophic front-side bursting;cognitive radio networks;compressive strength hydration products;constraint joint replenishment problem;cutting breaking process;debris cloud;decanter centrifuge;deterministic multithreading;differential evolution algorithm;disaster retrieval;driving cycle;embedded Linux;enterprise value;equipment manufacturing industry;event-triggered model;face recognition;field oriented control;fly ash;four-wheel drive electric vehicle;fuzzy immune PD algorithm;fuzzy optimization;fuzzy self-tuning PID control;graph isomorphism;handover performance;hypervelocity impact;industrial design hand-painted renderings training;integrated management system;intelligent granary monitoring system;intention preservation;job-shop scheduling algorithm;lattice structure;line-selection;lithium battery;localization;magnesium oxysulfate cement;meta search interface;mmWave-based multispot beam cellular system;nuclear power valve;numerical control workshop;ontology;optimal capital structure;permanent magnet brushless hub motor;polarization errors;pressure vessels;privacy preservation;quantitative weighing system;rate flexible coded digital phase modulation;self-balancing two-wheeled robot;semantic metadata describing;small batch MES;solid ice-snow;streaming media video terminal;thermal regenerated fiber Bragg grating;tree search based determination;vehicle anti-theft system;video image data;wireless sensor networks},

URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7024326&isnumber=7024321>

A. T. Evans, J. M. Park, S. Chiravuri and Y. B. Gianchandani, "Dual drug delivery device for chronic pain management using micromachined elastic metal structures and silicon microvalves," *2008 IEEE 21st International Conference on Micro Electro Mechanical Systems*, Tucson, AZ, 2008, pp. 252-255.

doi: 10.1109/MEMSYS.2008.4443640

Abstract: This paper describes a dual-chamber drug delivery microsystem that provides regulated flow from two spring- pressurized balloon reservoirs using independent microvalves. A preliminary prototype has been constructed with the primary components. Micromachined bulk metal springs (Co-Ni-Cr alloy), with an in-plane spring constant exceeding 300 N/m, are used in conjunction with 18.8 mL reservoirs, and provide 15 kPa pressure when the balloons are fully inflated. A piezoresistive pressure sensor that is embedded in the microvalves monitors reservoir pressure with a sensitivity of 250 ppm/kPa, and is used to regulate bolus delivery. Two control plans for the valve and their respective limitations are presented. In a demonstration of regulated bolus delivery, 1.5 mL bolus doses are delivered at different rates.

keywords: {bioMEMS;chromium alloys;cobalt alloys;dosisometry;drug delivery systems;elastic constants;intelligent sensors;micromachining;microvalves;nickel alloys;piezoresistive devices;pressure sensors;silicon;springs (mechanical);CoNiCr;Si;bolus doses;chronic pain management;dual drug delivery device;dual-chamber drug delivery microsystem;flow regulation;in-plane spring constant;metal springs;micromachined elastic metal structures;microvalves monitors;piezoresistive pressure sensor;pressure 15 kPa;regulated bolus delivery;silicon microvalves;spring- pressurized balloon reservoirs;Batteries;Costs;Drug delivery;Microvalves;Pain;Prototypes;Reservoirs;Silicon;Springs;Valves},

URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4443640&isnumber=4443570>

K. Watanabe, "Design and Fabrication of a Small Test-bed Aimed for Basin Experiment of Underwater Multi-agent System," *2007 Symposium on Underwater Technology and Workshop on Scientific Use of Submarine Cables and Related Technologies*, Tokyo, 2007, pp. 574-580.

doi: 10.1109/UT.2007.370778

Abstract: The underwater multi-agent technology using many types of underwater robot has great potential for various underwater activities in the near future. To realize the underwater multi-agent system, we must experience many situations and problems to be solved in that development by using real systems as well as the computer simulations. So we are now building basic systems of basin experiment for the development of AUV multi-agent behavior. In this paper I will introduce our concept of the underwater multi-agent application in the near future and the hardware/software design of our laboratory's AUV small test-bed, precise ultrasound ranging system and LBL coordinate detection system now we are developing. We designed a small thruster which is composed of a 4.5W coreless motor with planetary gear and a rotary encoder. We designed and fabricated the magnet coupling for watertight seal of the thruster to reduce the production cost. The total weight in air is about 3kgf. So the total size is small (0.4m[L]_ 0.4m[B]_ 0.2m[H]) that we can handle it easily and many robots can swim in our basin(6m[L]_ 3m[B]_ 3m[H]). The hull is designed to bear the pressure at least 10m water depth. We selected Lithium ion battery for power supply and the total capacity is 450Wh. By power consumption calculation we may use it about 2 hours with one full charge of the batteries. The main PC is PC104 module (Advantech PCM3350) of which MPU is NS-Geode 300MHz and 64MB RAM. I implemented the Linux based program system in 1GB compact flash card from which the

system boots. It controls the total system through PIC based subsystems. An electric compass TCM2 is used to detect the heading angle and roll, pitch. Each device like electric compass has its own PIC and all serial communication line is multi-dropped using RS232 through the communication interface PIC. The 6 underwater connector are attached for ultrasound transducers, thrusters, power supply and ethernet. As we mounted a wireless CCD camera in- side, we can see the underwater image as far as the robot is near water surface. keywords: {control engineering computing;image sensors;mobile robots;multi-agent systems;multi-robot systems;remotely operated vehicles;underwater vehicles;NS-Geode;basin experiment;coreless motor;planetary gear;power 4.5 W;rotary encoder;serial communication line;small test-bed fabrication;underwater connector;underwater image;underwater multi-agent system;underwater robot;wireless CCD camera;Application software;Batteries;Buildings;Computer simulation;Fabrication;Multiagent systems;Power supplies;Robot kinematics;System testing;Ultrasonic imaging},

URL: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4231108&isnumber=4231074>