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Biped Robot: Balance Center of Gravity on Uneven or Smooth Terrain

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Abstract--- *We present a system whereby the human motion is replicated so as to provide cost effective methods to move the biped robots in to the industrial age which is still tender with articulated and collaborative robots by using maximum of 7 axis freedom or motion and rover robots with less agility over lands of war to mimic human movements in battle zones. This led us to device a biped robot for better walking and balancing. Its mechanical structure including the joint configuration and specification, the structure of knee joint, the speed reduction mechanism in the servo motor by programming, and the mechanical cross bracing are used are described in detail. A specific control system ATmega2560 on the Mega 2560 (Arduino Board) for biped that is a serial and distributed network and consists of a microcontroller, bootloader, servo input and output pins, sensor input and output pins, TWI/I2C system. With the developed biped robot, biped walking and one-leg balancing and weight shifting while walking for better gate motion in 5000[ms] are implemented as basic and verification experiments for fast walking and balancing.*

Keywords--- *Human Gait Movement, Biped, Servo Motor, Robotics.*

I. INTRODUCTION

In this study, we designed a novel biped robot with multiple purposes. Potential benefits of such a biped structure are as follows. First, a better structure can be used in prosthetic biped locomotion and will provide the capacity to do real work, mimicking the movement capability of a real human legs and therefore improving the living standards and/or comfort of people who have lost their legs for a variety of reasons from waist. Second, it can be used in defense with a proper design to upper body it can be then subjected to any type of harsh situations. The most important requirement for the reliable and reasonable design of a biped robot is to have a simple control system and user-friendly operations with user-friendly interface. Today's advanced commercial bipeds are mostly controlled by mobile processor such as Intel Atom processor multiple accelerometer and digital gyroscope. The signals are sent by using pressure sensors or tactile sensor that perceive force associated with the motion and converts and sends them into electrical pulses. The controller in the biped robot interprets several channels of PWM acquired from various sensors or accelerometer and gyroscope, and consequently it drives the appropriate actuators to perform the intended activity.

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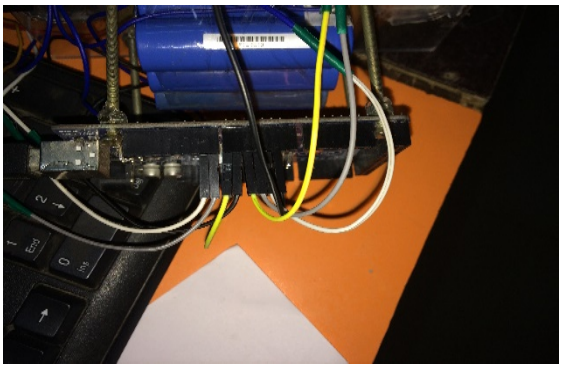
Experiments have shown that though a number of subjected load under could control environment on the biped still eliminates error for using in multiple environments training and experimentation will be required, the main shortcoming of this servo driven approach is that most degrees of freedom (DOF) cannot be achieved, as they need to more number of geared motors to perform appropriate rotation in hip and legs. Due to the huge requirement power source is there to make biped portable a Li-MH battery pack is used, until now only Li-Ion batteries have been agreed upon as an acceptable solution. In order to make models portable. We have shown with right amount of effort it can switch to other battery packs too.

II. Fabricated Parts And Working

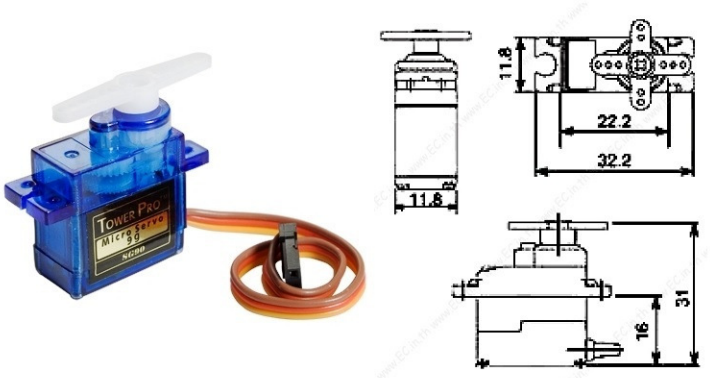
The Accelerometer Module

The module could recognize difference in slight tilts in all three axes. It receives variations The ADXL335 uses a single structure for sensing the X, Y, and Z axes. As a result, the three axes' sense directions are highly orthogonal and have little cross-axis sensitivity. Mechanical misalignment of the sensor die to the package is the chief source of cross-axis sensitivity. Mechanical misalignment can, of course, be calibrated out at the system level. In ADXL335 there is no quantization error or non-monotonic behaviour, and temperature hysteresis is very low, this is the reason we use this accelerometer.

Connected with the Arduino Mega2560 board. The variations are received as input to the microcontroller. By using the program written



III. Servo Motor



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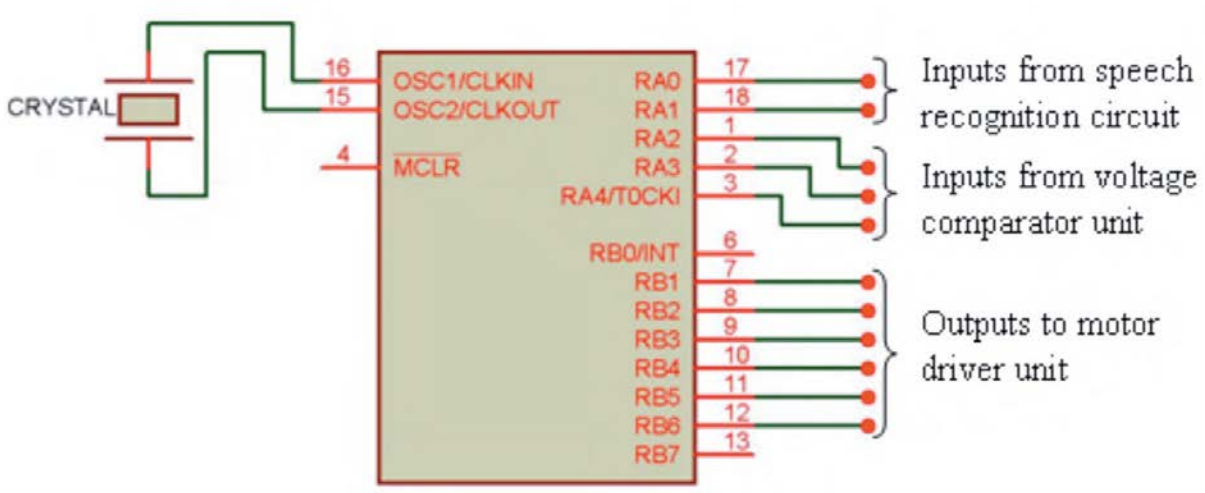
Introduction

Tiny and lightweight with high output power. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but *smaller*. You can use any servo code, hardware or library to control these servos. Good for beginners who want to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. It comes with a 3 horns (arms) and hardware.

Specification

- Weight: 66 g
- Dimension: 40x20x28 mm approx.
- Stall torque: 17 kgf·cm
- Operating speed: 0.1 s/60 degree
- Operating voltage: 4.8 V (~7.4V)
- Dead band width: 10 μs
- Motor Type: Coreless

IV. MICRO CONTROLLER



The microcontroller must not work when the speech recognition circuit generates error codes. In order to exclude these error codes from being recognized by the microcontroller, we designed an interface unit. This unit comprises 2 logic gates, a latch, and a BCD-to-decimal converter. The combination of NAND gate and OR gate is used at the speech recognition circuit's most significant digit (MSD) output. The output of this combination is used as ENABLE of the 74LS373 latch.

The binary values of the speech recognition circuit's least significant digit (LSD) output are inputs for the same latch, as in Figure 10.

The binary output is converted to decimal value using IC4028. Hence, whenever an error code is generated, the number is ignored; otherwise, a decimal value of LSD is generated as output.

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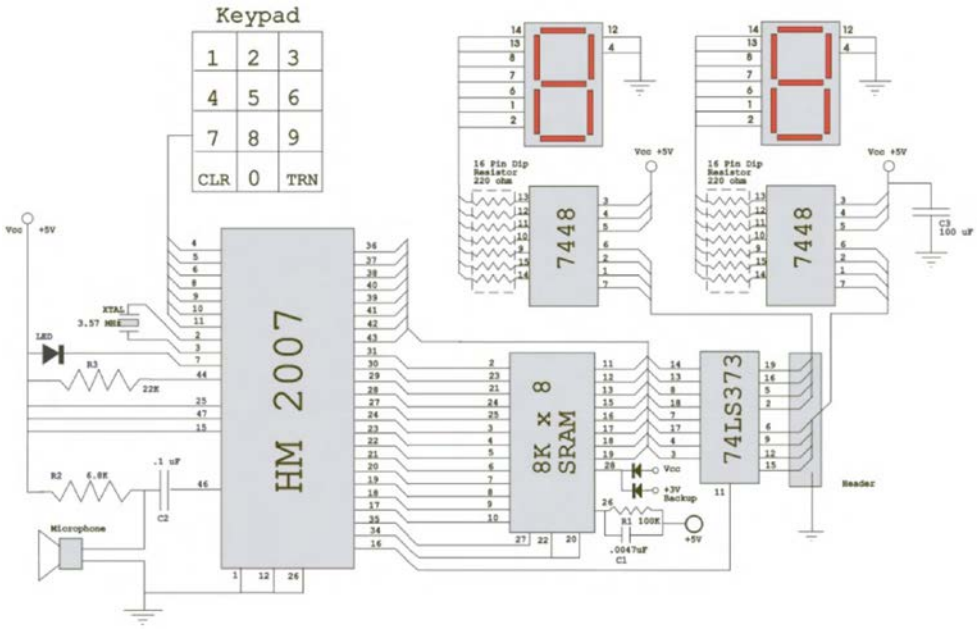
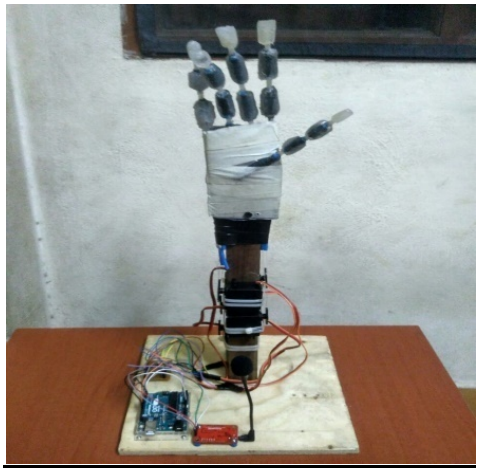
V. SPEECH RECOGNITION CIRCUIT



The speech recognition circuit (SRC) is capable of controlling the prosthetic hand using voice commands (Images SI, Inc., Staten Island, NY, USA). The ability to communicate with a prosthetic hand through speech is ASYALI, YILMAZ, TOKMAKC, I, SEDEF, AKSEBZEC˙I, MITTAL: Design and implementation of a voice-controlled..., the ultimate user interface. The user needs minimal experimentation and/or training with the prosthetic hand before using it for any practical purpose.

The main component of the SRC is the HM2007 speech recognition chip. The HM2007 chip is a CMOS voice recognition chip with voice analysis, recognition process, and system control functions. The other major components are the 64K CMOS Static RAM chip, a microphone, a 12-button keypad, and a 74LS373 chip, as shown in Figure 8. Data can be written and read from the SRAM chip, and the 74LS373 functions as a latch with 3-state outputs.

VI. PROPOSED MODEL



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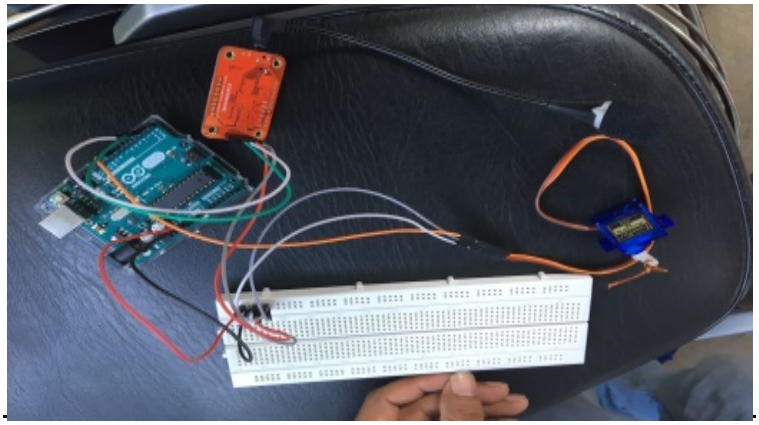

VII. IMPLEMENTATION

The main goal of our project is to a introduce Spoken Natural Language interface for Robotics control. We also set some requirements, which are mentioned in the Introduction.

- The Spoken Language interface should be in English Language
- The robot should understand the task from the dialogue
- The system should be speaker independent
- The robot should have some user feedback; such as, if the robot doesn't understand the user commands, it gives the user feedback - "I don't understand".

VIII. APPLICATIONS

- Home Entertainment and Control
- Wireless sensor networks
- Industrial control
- Embedded sensing
- Medical data collection
- Smoke and intruder warning
- Building automation

IX. CONCLUSION

Human-Robot interaction is an important, attractive and challenging area in HRI. The Service Robot popularity gives the researcher more interest to work with user interface for robots to make it more user friendly to the social context.

Speech Recognition (SR) technology gives the researcher the opportunity to add Natural language (NL) communication with robot in natural and even way. The working domain of the Service Robot is in the society-to help the people in every day's life and so it should be controlled by the human. In future we have a plan to build it commercially for mankind. It is helpful for all of the robotic research and project based work.

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REFERENCES

[1] Thooyamani, K.P., Khanaa, V., & Udayakumar, R. (2014). Virtual instrumentation based process of agriculture by automation. *Middle-East Journal of Scientific Research*, *20*(12): 2604-2612.

[2] Udayakumar, R., Kaliyamurthie, K.P., & Khanaa, T.K. (2014). Data mining a boon: Predictive system for university topper women in academia. *World Applied Sciences Journal*, *29*(14): 86-90.

[3] Anbuselvi, S., Rebecca, L.J., Kumar, M.S., & Senthilvelan, T. (2012). GC-MS study of phytochemicals in black gram using two different organic manures. *J Chem Pharm Res*., *4*, 1246-1250.

[4] Subramanian, A.P., Jaganathan, S.K., Manikandan, A., Pandiaraj, K.N., Gomathi, N., & Supriyanto, E. (2016). Recent trends in nano-based drug delivery systems for efficient delivery of phytochemicals in chemotherapy. *RSC Advances*, *6*(54), 48294-48314.

[5] Thooyamani, K.P., Khanaa, V., & Udayakumar, R. (2014). Partial encryption and partial inference control based disclosure in effective cost cloud. *Middle-East Journal of Scientific Research*, 20(12), 2456-2459.

[6] Lingeswaran, K., Prasad Karamcheti, S.S., Gopikrishnan, M., & Ramu, G. (2014). Preparation and characterization of chemical bath deposited cds thin film for solar cell. *Middle-East Journal of Scientific Research*, *20*(7), 812-814.

[7] Maruthamani, D., Vadivel, S., Kumaravel, M., Saravanakumar, B., Paul, B., Dhar, S.S., Manikandan, A., & Ramadoss, G. (2017). Fine cutting edge shaped Bi2O3rods/reduced graphene oxide (RGO) composite for supercapacitor and visible-light photocatalytic applications. *Journal of colloid and interface science*, *498*, 449-459.

[8] Gopalakrishnan, K., Sundeep Aanand, J., & Udayakumar, R. (2014). Electrical properties of doped azopolyester. *Middle-East Journal of Scientific Research*, *20*(11). 1402-1412.

[9] Subhashree, A.R., Parameaswari, P.J., Shanthi, B., Revathy, C., & Parijatham, B.O. (2012). The reference intervals for the haematological parameters in healthy adult population of chennai, southern India. *Journal of Clinical and Diagnostic Research: JCDR*, *6*(10), 1675-1680.

[10] Niranjan, U., Subramanyam, R.B.V., & Khanaa, V. (2010, September). Developing a web recommendation system based on closed sequential patterns. In *International Conference on Advances in Information and Communication Technologies*, *101*, 171-179. Springer, Berlin, Heidelberg.

[11] Slimani, Y., Baykal, A., & Manikandan, A. (2018). Effect of Cr3+ substitution on AC susceptibility of Ba hexaferrite nanoparticles. *Journal of Magnetism and Magnetic Materials*, *458*, 204-212.

[12] Premkumar, S., Ramu, G., Gunasekaran, S., & Baskar, D. (2014). Solar industrial process heating associated with thermal energy storage for feed water heating. *Middle East Journal of Scientific Research*, *20*(11), 1686-1688.

[13] Kumar, S.S., Karrunakaran, C.M., Rao, M.R.K., & Balasubramanian, M.P. (2011). Inhibitory effects of Indigofera aspalathoides on 20-methylcholanthrene-induced chemical carcinogenesis in rats. *Journal of carcinogenesis*, *10*.

[14] Beula Devamalar, P.M., Thulasi Bai, V., & Srivatsa, S.K. (2009). Design and architecture of real time web-centric tele health diabetes diagnosis expert system. *International Journal of Medical Engineering and Informatics*, *1*(3), 307-317.

[15] Ravichandran, A.T., Srinivas, J., Karthick, R., Manikandan, A., & Baykal, A. (2018). Facile combustion synthesis, structural, morphological, optical and antibacterial studies of Bi1− xAlxFeO3 (0.0≤ x≤ 0.15) nanoparticles. *Ceramics International*, *44*(11), 13247-13252.

[16] Thovhogi, N., Park, E., Manikandan, E., Maaza, M., & Gurib-Fakim, A. (2016). Physical properties of CdO nanoparticles synthesized by green chemistry via Hibiscus Sabdariffa flower extract. *Journal of Alloys and Compounds*, *655*, 314-320.

[17] Thooyamani, K.P., Khanaa, V., & Udayakumar, R. (2014). Wide area wireless networks-IETF. *Middle-East Journal of Scientific Research*, *20*(12), 2042-2046.

[18] Sundar Raj, M., Saravanan, T., & Srinivasan, V. (2014). Design of silicon-carbide based cascaded multilevel inverter. *Middle-East Journal of Scientific Research*, *20*(12), 1785- 1791.

[19] Achudhan, M., Jayakumar M.P. (2014). Mathematical modeling and control of an electrically-heated catalyst. *International Journal of Applied Engineering Research*, *9*(23), 23013.

[20] Thooyamani, K.P., Khanaa, V., & Udayakumar, R. (2013). Application of pattern recognition for farsi license plate recognition. *Middle-East Journal of Scientific Research*, *18*(12), 1768-1774.

[21] Jebaraj, S., Iniyan S. (2006). Renewable energy programmes in India. *International Journal of Global Energy Issues*, *26*(43528), 232-257.

[22] Masthan, K.M.K., Babu, N.A., Dash, K.C., & Elumalai, M. (2012). Advanced diagnostic aids in oral cancer. *Asian Pacific Journal of Cancer Prevention*, *13*(8), 3573-3576.

[23] Asiri, S., Güner, S., Demir, A., Yildiz, A., Manikandan, A., & Baykal, A. (2018). Synthesis and Magnetic Characterization of Cu Substituted Barium Hexaferrites. *Journal of Inorganic and Organometallic Polymers and Materials*, *28*(3), 1065-1071.

[24] Vellayappan, M.V., Jaganathan, S.K., & Manikandan, A. (2016). Nanomaterials as a game changer in the management and treatment of diabetic foot ulcers. *RSC Advances*, *6*(115), 114859-114878.

[25] Vellayappan, M.V., Venugopal, J.R., Ramakrishna, S., Ray, S., Ismail, A.F., Mandal, M., Manikandan A., Seal S., & Jaganathan, S.K. (2016). Electrospinning applications from diagnosis to treatment of diabetes. *RSC Advances*, *6*(87), 83638-83655.

[26] Bavitra, K., Sinthuja, S., Manoharan, N., & Rajesh, S. (2015). The high efficiency renewable PV inverter topology. *Indian Journal of Science and Technology*, *8*(14).

[27] Vanangamudi, S., Prabhakar, S., Thamotharan, C., & Anbazhagan, R. (2014). Design and fabrication of dual clutch. *Middle - East Journal of Scientific Research*, *20*(12), 1816-1818.

[28] Sandhiya, K., & Kaviya, B. (2014). Safe bus stop location in Trichy city by using gis. *International Journal of Applied Engineering Research*, *9*(22), 5686-5691.

[29] Selva Kumar, S., Ram Krishna Rao, M., Deepak Kumar, R., Panwar, S., & Prasad, C.S. (2013). Biocontrol by plant growth promoting rhizobacteria against black scurf and stem canker disease of potato caused by Rhizoctonia solani. *Archives of Phytopathology and Plant Protection*, *46*(4), 487-502.

[30] Sharmila, S., & Jeyanthi Rebecca, L. (2012). GC-MS Analysis of esters of fatty acid present in biodiesel produced from Cladophora vagabunda. *Journal of Chemical and Pharmaceutical Research*, *4*(11), 4883-4887.

[31] Ramkumar, M., Rajasankar, S., Gobi, V.V., Dhanalakshmi, C., Manivasagam, T., Thenmozhi, A.J., Essa M.M., Kalandar A., & Chidambaram, R. (2017). Neuroprotective effect of Demethoxycurcumin, a natural derivative of Curcumin on rotenone induced neurotoxicity in SH-SY 5Y Neuroblastoma cells. *BMC complementary and alternative medicine*, *17*(1).

[32] Sharmila, S., & Jeyanthi Rebecca, L. (2013). Md Saduzzaman., Biodegradation of domestic effluent using different solvent extracts of Murraya koenigii. *J Chem and Pharm Res*, *5*(2), 279-282.

[33] Asiri, S., Sertkol, M., Guner, S., Gungunes, H., Batoo, K.M., Saleh, T.A., Manikandan A., & Baykal, A. (2018). Hydrothermal synthesis of CoyZnyMn1-2yFe2O4 nanoferrites: magneto-optical investigation. *Ceramics International*, *44*(5), 5751-5759.

[34] Rani, A.J., & Mythili, S.V. (2014). Study on total antioxidant status in relation to oxidative stress in type 2 diabetes mellitus. *Journal of clinical and diagnostic research: JCDR*, *8*(3), 108-110.

[35] Karthik, B. (2014). Arulselvi, Noise removal using mixtures of projected gaussian scale mixtures. *Middle-East Journal of Scientific Research*, *20*(12), 2335-2340.

[36] Karthik, B., Arulselvi, & Selvaraj, A. (2014). Test data compression architecture for low power VLSI testing. *Middle - East Journal of Scientific Research*, *20*(12), 2331-2334.

[37] Vijayaragavan, S.P., Karthik, B., & Kiran Kumar, T.V.U. (2014). Privacy conscious screening framework for frequently moving objects. *Middle-East Journal of Scientific Research*, *20*(8), 1000-1005.

[38] Kaliyamurthie, K.P., Parameswari, D., & Udayakumar, R. (2013). QOS aware privacy preserving location monitoring in wireless sensor network. *Indian Journal of Science and Technology*, *6*(5), 4648-4652.

[39] Silambarasu, A., Manikandan, A., & Balakrishnan, K. (2017). Room-temperature superparamagnetism and enhanced photocatalytic activity of magnetically reusable spinel ZnFe 2 O 4 nanocatalysts. *Journal of Superconductivity and Novel Magnetism*, *30*(9), 2631-2640.

[40] Jasmin, M., Vigneshwaran, T., & Beulah Hemalatha, S. (2015). Design of power aware on chip embedded memory based FSM encoding in FPGA. *International Journal of Applied Engineering Research*, *10*(2), 4487-4496.

[41] Philomina, S., & Karthik, B. (2014). Wi-Fi energy meter implementation using embedded linux in ARM 9. *Middle-East Journal of Scientific Research*, *20*, 2434-2438.

[42] Vijayaragavan, S.P., Karthik, B., & Kiran Kumar, T.V.U. (2014). A DFIG based wind generation system with unbalanced stator and grid condition. *Middle-East Journal of Scientific Research*, *20*(8), 913-917.

[43] Rajakumari, S.B., & Nalini, C. (2014). An efficient data mining dataset preparation using aggregation in relational database. *Indian Journal of Science and Technology*, *7*, 44-46.

[44] Karthik, B., Kiran Kumar, T.V.U., Vijayaragavan, P., & Bharath Kumaran, E. (2013). Design of a digital PLL using 0.35 Î¼m CMOS technology. *Middle-East Journal of Scientific Research*, *18*(12), 1803-1806.

[45] Sudhakara, P., Jagadeesh, D., Wang, Y., Prasad, C.V., Devi, A.K., Balakrishnan, G., Kim B.S., & Song, J.I. (2013). Fabrication of Borassus fruit lignocellulose fiber/PP composites and comparison with jute, sisal and coir fibers. *Carbohydrate polymers*, *98*(1), 1002-1010.

[46] Kanniga, E., & Sundararajan, M. (2011). Modelling and characterization of DCO using pass transistors. In *Future Intelligent Information Systems*, 86(1), 451-457. Springer, Berlin, Heidelberg.

[47] Sachithanandam, P., Meikandaan, T.P., & Srividya, T. Steel framed multi storey residential building analysis and design. *International Journal of Applied Engineering Research*, *9*(22), 5527-5529.

[48] Kaliyamurthie, K.P., Udayakumar, R., Parameswari, D., & Mugunthan, S.N. (2013). Highly secured online voting system over network. *Indian Journal of Science and Technology*, *6*(S6), 4831-4836.

[49] Sathyaseelan, B., Manikandan, E., Lakshmanan, V., Baskaran, I., Sivakumar, K., Ladchumananandasivam, R., Kennedy, J., & Maaza, M. (2016). Structural, optical and morphological properties of post-growth calcined TiO2 nanopowder for opto-electronic device application: Ex-situ studies. *Journal of Alloys and Compounds*, *671*, 486-492.

[50] Saravanan, T., Sundar Raj M., & Gopalakrishnan K. (2014). SMES technology, SMES and facts system, applications, advantages and technical limitations. *Middle - East Journal of Scientific Research*, *20*(11), 1353-1358.