

VI. CONCLUSION

A mathematical model of the ball and beam system was developed using physical and electrical laws. A simplified mathematical model was derived through system parameters. The controller parameters values (K_p , K_i and K_d) were obtained by using manual tuning method from practical model so as to perform best system response. From experimental results, it is found that the best controller parameters which gave the best response of the system are: $K_p=4$, $K_i=1$ and $K_d=2$. The accuracy of the system is tested by adjusting the position of the ball at three different points and it found that the accuracy doesn't affected by changing the set point.

REFERENCES

- [1] E. P. Dadios, R. Baylon, R. D. Guzman, A. Florentino, R. M. Lee ve Z. Zulueta, Vision Guided Ball-Beam Balancing System Using Fuzzy Logic, 26th Annual Conference of the IEEE Industrial Electronics Society, Cilt 3, pp. 1973-1978, 2000.
- [2] J. Whelan ve J. W. Ringwood, A Demonstration Rig for Control Systems Based on the Ball and Beam with Vision Feedback, Proc.3rd IFAC Symposium on Control Education, Tokyo, 1994.
- [3] S. Sridharan ve G. Sridharan, Ball and Beam on Roller: A New Control Laboratory Device, Proceedings of the 2002 IEEE International Symposium on Industrial Electronics, Cilt 4, 2002, pp. 1318-1321.
- [4] Sıtkı KOCAOĞLU, Hilmi KUŞÇU: "Design and Control of PID-Controlled Ball and Beam System" *Unitech. Int. Science Conference, Gabrovo, 2013, PP: 41-46.*
- [5] Basil Hamed "Application of a LabVIEW for Real-Time Control of Ball and Beam System" *IACSIT International Journal of Engineering and Technology, Vol.2, No.4, August 2010. PP: 401-407.*
- [6] S Sathiyavathi and K Krishnamurthy "PID Control of Ball and Beam System – A Real Time Experimentation" *Journal of Scientific & Industrial Research; Vol. 72, August 2013, PP: 481-484.*
- [7] Chinju Joseph, Nitha Thomas, Jefin Thomas, Elizabeth Rajan, Reema Mathew. A "Mathematical Modelling of on a middle Supported Beam" *International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE) ISSN: 0976-1353 Volume 8 Issue 1 – APRIL 2014. PP: 286-289.*
- [8] Krzysztof Nowopolski "Implementation of Ball-and-beam Control System as an Instance of SIMULINK to 32-Bit Microcontroller Interface" *Poznan University of Technology Academic Journal; Electrical Engineering; No 7 – 2013. PP: 31-38.*
- [9] Oskar Lundberg, Svante Finnveden, Ines Lopez and Stefan Björklund; "Non-linear contact forces for beam/ball-interaction and its influence on the dynamic response of the beam" *inter noise: Noise control for quality of life; Australia 15-18 September 2013.*
- [10] Carlos G. Bolívar-Vincenty, Gerson Beauchamp-Báez; "Modelling the Ball-and-Beam System From Newtonian Mechanics and from Lagrange Methods" *Twelfth LACCEI Latin American and Caribbean Conference for Engineering and Technology; July 22 - 24, 2014 Guayaquil, Ecuador.*
- [11] Santosh Kr. Choudhary; "Fractional Order Feedback Control of a Ball and Beam System" *International Journal of Computer, Information, Systems and Control Engineering Vol:8 No:7, 2014; PP: 1120-1126.*
- [12] Mohammad Keshmiri, Ali Fellah Jahromi, Abolfazl Mohebbi, Mohammad Hadi Amoozgar and Wen-Fang Xie; " Modelling and Control of Ball and Beam System Using Model Based and Non-model Based Control Approaches" *International Journal on Smart Sensing and Intelligent Systems, Vol. 5, NO. 1, March 2012, PP: 14-35.*
- [13] N. N. Aziz, M. I. Yusoff, and R Akmeliawati; "Two Degree of freedom Control of Ball and Beam System" *IOP Conference series: 5th international conference on mechatronics, 2013, PP: 1-12.*
- [14] Robert C. Rice, "PID Tuning Guide A Best-Practices Approach" *NovaTech. PP: 20-26.*