

# Robotic Arm Using Microcontroller

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*Abstract: In the present work an automated bowling arm has been designed and tested. This has been developed with the intension to reduce the requirement of a person to constantly bowling. It is also developed with the aim to reduce the injuries caused to the bowler while bowling since the human bowlers cannot bowl over a extended periods .The bowling arm consists of dc motor which imparts the necessary torque for the bowling. The servo motor coupled with the gripper helps in the grabbing action. For the swing action another servo motor is provided at the wrist position of the motor. The bowling action of the arm is governed by the microcontroller.*

**Index Terms—** DC Motor, servo motor, relay, Microcontroller.

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## I. INTRODUCTION

The introduction of the bowling machine as a new cricket training tool in the last quarter of the twenty first century. It has evolved the conventional approaches of improving batting technique through a new paradigm in cricket science. Elite cricketing teams have become progressively dependent on bowling machines as they strategically prepare their players by accounting their training load and recovery phase before competing in various formats of the game. The robotic bowling arm is not as the conventional bowling machine. This robotic arm imitates the human hand by means of the bowling action. The ball is grabbed by the gripper.

The gripper is designed in such a way that it could grab the ball firmly with the 3 finger like projections. The arm is then rotated by the 500 rpm dc motor. Once the arm picks the ball the dc motor is switched on by the 6V relay. The timing at which the ball has to be rotated is coded into the microcontroller. The microcontroller used here is ATmega2560. When compared with our previous work, we have installed a ball feeder which feeds the arm continuously after every bowling.

## II. LITERATURE REVIEW

Chien-Wei Chen - Nowadays, controlled robotic arms had been widely used for factory automation and contactlessly control and operation in the dangerous environment. Even the famous da Vinci Systems for the operation of surgery, had used the similar technique to control the robotic arms.

Jegede Olawale - Robotic arm has become popular in the world of robotics. The essential part of the robotic arm is a programmable microcontroller based brick capable of driving basically three stepper motors design to form an anthropomorphic structure. The first design was for experimental use on a human-size industrial robot arm called PUMA 560 used to explore issues in versatile object handling and compliance control in grasp actions (Bejczy & Jau, 1986). This paper explains the method of interfacing the robotic arm stepper motors with the programmed 8051-based microcontroller which are used to control the robot operations.

Mohammad Javed Ansar - Robotics has been a tremendous successful field of research in last few decades. Regarding the development of robotics, many developed robotic arm has been deployed in industrial purposes like automation, sophisticated fabrication etc.

Prof. Ahmad Rateb Al-Najjar - A Robot is a virtually intelligent agent capable of carrying out tasks robotically with the help of -some supervision. Practically, a robot is basically an electro-mechanical machine that is guided by means of computer and electronic programming. Robots can be classified as autonomous, semiautonomous and remotely controlled. Robots are widely used for variety of tasks such as service stations, cleaning drains, and in

tasks that are considered too dangerous to be performed by humans. A robotic arm is a robotic manipulator, usually programmable, with similar functions to a human arm.

### III. DESIGN AND METHODOLOGY

#### A)Electrical Aspect

##### DC MOTOR:

The first axial for the arm is supported by a dc motor. The dc motor provides 500rpm which facilitate different bowling speeds. The dc motor is energized by 12v battery. The ability to lift heavy objects is determined by the current being supplied.

This is because torque is dependent on the current. Speed of the dc motor is controlled by means of PWM signal. The PWM signals are provided by the microcontroller. The switching of dc motor is done by using relay. Since we need steady angular momentum we are going for the dc motor.



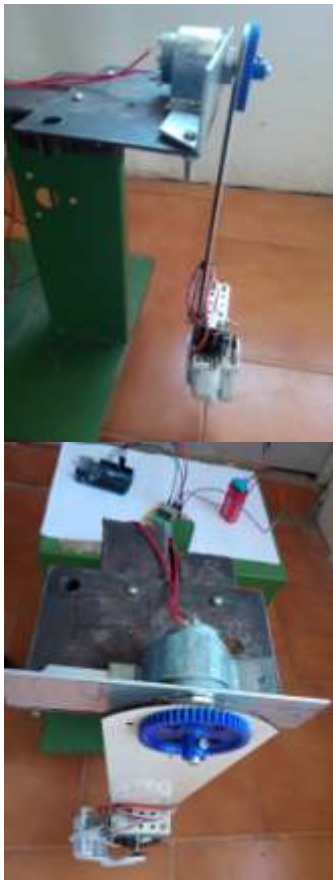
##### SERVO MOTOR:

The second and third axial is supported by two servo motor. Since the servo motor provides the angle control we are going for the servo motor. The major part of the electrical aspect is with the servo motor. The servo motor is energized by 5v from the arduino. The angle of the servo motor can be controlled by PWM signal. The servo motor is used for grabbing of the ball and for the wrist movement.

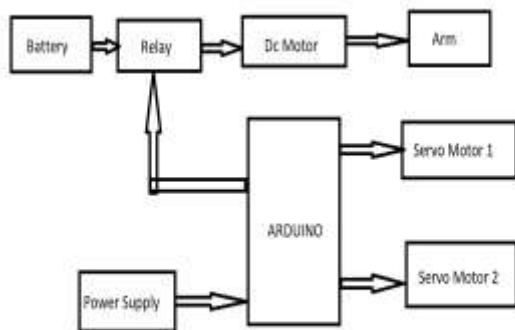


##### WORKING:

The first part of the working is the detection of the ball by the arm. This is achieved with the help of strain gauge. It is placed below the arm. If the output of the transducer is high then the next part of the working is initiated. Then the ball is grabbed by the gripper with the help of servo motor. Once the ball is grabbed, the dc motor is energized and the bowling action is initiated. Through the code the right time to release the ball is facilitated. By the time the arm reaches the position then the gripper releases the ball. The time of release is different for different bowling style by considering the spin. The third servo comes into action. This servo placed at the wrist position after grabbing the ball starts to run thus providing the required spin action. The entire operation is coordinated by the program that is fed into the microcontroller.



**IV. BLOCK DIAGRAM**



**V. TORQU EQUATION**

The equation for torque developed in a DC motor can be derived as follows:  
The force on one coil of wire is

$$F = I \times l \times B, (1)$$

Torque equation;

$$T = K I^*a (2)$$

## VI. ARDUINO

Arduino Mega 2560 Microcontroller Board is based on the Atmel ATmega2560 8-bit microcontroller (MCU). Arduino Mega 2560 features 54 digital input/output pins (15 of which can be used as PWM outputs) and 16 analog inputs. This Arduino MCU board also includes 4 UARTs (hardware serial ports), a 16MHz crystal oscillator, a USB connection, a power jack, an In-Circuit Serial Programming (ICSP) header, and a reset button.

Mega 2560 includes everything the user needs to support the MCU. The user can get started by connecting the Mega 2560 to a computer with a USB cable or by powering it with an AC-to-DC adapter or battery. Arduino Mega 2560 board is compatible with most shields designed for the Uno and former boards Duemilanove or Diecimila. Mega 2560 is an update to the earlier Arduino Mega board.

### Features

- ATmega2560 Microcontroller (MCU)
- 5V operating voltage
- 7-12V input voltage (recommended)
- 6-20V input voltage (limit)
- 54 digital input/output (I/O) pins
- 15 of which provide PWM output
- 16 analog input pins
- 20mA DC current per I/O pin
- 50mA DC current for 3.3V pin
- 256KB Flash memory
- 8KB used by boot loader

### Power

- Can be powered via USB connection or with external power supply
- Power source selected automatically

### Communication

- Features a number of facilities for communicating with a computer, another board, or other MCUs
- ATmega2560 provides four hardware UARTs for TTL (5V) serial communication
- An ATmega16U2 (AT mega on the revision 1 and revision 2 boards) on the board channels one of these over USB and provides a virtual com port to software on the computer.



## VII.RELAY

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches.

In a basic relay there are three contactors: normally open (NO), normally closed (NC) and common (COM). At no input state, the COM is connected to NC. When the operating voltage is applied the relay coil gets energized and the COM changes contact to NO. Different relay configurations are available like SPST, SPDT, DPDT etc, which have different number of changeover contacts.



## VIII. TESTING AND RESULT

The results has tested and performed using a golf ball as a prototype dimpled ball and the basic speed measuring formula, with the distance being constant and the voltage being supplied to the motors being varied. 10 feet pitch has been taken as an analogy for this purpose.

The developed bowling arm offers greater mobility to pitch the ball at desired line & length, as well as spin in the required direction at speeds ranging between 60 to 90kmph. The machine was tested and found to deliver satisfactory results, in very close terms of the objectives enlisted. However, the performance of the arm can be improved.



### Advantages Of The Arm

Reduced bowler requirement, Compact size, cost is low, Batsman can adjust as per the requirement, it can delivered at various different speeds by using pulse width modulation, speed accuracy is good.

### Future works

By achieving these three different rotational movements, i.e. pitch, yaw and roll, ball can be bowled at an angle to the batsman, thus opening possibilities to a wide range of deliveries.

By making the electronic speed control of the motors automated, viz. remote-controlled, the machine can be made to bowl at any required speed with close accuracy. This can further enhance the ability of a coach to guide batsmen by being beside them during training, as the machine can be controlled by the hand-held remote.

An electronic display which shows the speed at which a ball is being bowled can be of great advantage to practicing batsmen. This can be achieved by using a digital signal processing and a LCD screen on the bowling machine.

An improved ball feeding mechanism which can hold suitable number of balls in it and bowl it onto the batsmen at his convenience is desirable. This ball throw-rate control can be added to the hand-held remote control, thus providing effective overall control.

### CONCLUSION

In this paper an automatic bowling arm has been designed. The batsman can design or programmed by an arduino software the bowling arm can rotate as per his/her requirement. The pulse width modulation used to controlling the speed of the dc motor. For 12 V dc supply, it gives the speed from 65 Km/hr.

### REFERENCES

- [1] S.S.Roy et al, Design of an improved cricket ball throwing machine, Proc. of National Conference on Machines and Mechanisms (NaCoMM), 2005, pp 401- 404.
- [2] Abhijit Mahapatra, Avik Chatterjee and Shibendu Shekhar Roy' "Modeling and simulation of a ball throwing machine", 14<sup>th</sup> National Conference on Machines and Mechanisms (NaCoMM09), NIT, Durgapur, India, pp. 416-422, December 17-18, 2009.
- [3] S. Tickoo, D. Maini, and V. Raina, CATIA V5R16 for Engineers & Designers, Dreamtech Press, 2007.
- [4] Akshay R. Varhade, HrushikeshV Tiwari and Pratik D. Patangrao, "Cricket Bowling Machine", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181 vol. 2 Issue 12, pp. 1920-1924, December 2013.
- [5] P.R. Upadhyay, K.R. Rajgopal and B.P. Singh, "Design of a compact winding for an axial flux permanent magnet brushless DC motor used in an electric two wheeler", IEEE, Transactions on Magnetics, Vol. 40, Issue 4, pp. 2026-2028, July 2004.
- [6] Zhe Li, Sridhar Kota, Virtual Prototyping and Motion Simulation with ADAMS, Journal of Computing and Information Science in Engineering, Transactions of the ASME, Vol. 1, 2001, pp. 276-279.
- [7] Wang Guo-qiang, Zhang Jin-ping, Ma Ruo-ding, Virtual Prototype Technology and its Realization based on ADAMS, Xian: Press of Xian University of Industrial,2002.
- [8] Raza Ali, Diegel Olaf and Arif Khalid Mahmood "Robowler: design and development of a cricket bowling machine ensuring ball seam position", Central South University Press and SpringerVerlag Berlin Heidelberg, Vol. 21, pp. 4142-4149, 2014.
- [9] Rene´ E.D. Ferdinands, Uwe G. Kersting and Robert N. Marshall, "A new taxonomic system for the sub-classification of cricket bowling actions", Sports Technology, pp. 1-13, 2014.
- [10] Paul S. Glazier and Jonathan S. Wheat, "An integrated approach to the biomechanics and motor control of cricket fast bowling techniques", Springer International Publishing, Switzerland, 2013.

- [11] Wang Yong, Zhou Wen-Wei, Yu Li and Yang Xi-Yin, "Research on the precise control method based on the new style PWM with variable pulse width", IEEE, International Conference on Embedded Software and Systems (ICISS), pp. 288-495, 2008.
- [12] Zhu Haishui, Wang Dahu, Zhang Tong and Huang Keming, "Design on a dc motor speed control", IEEE, International Conference on Intelligent Computation Technology and Automation, pp. 59-63, 2010.
- [13] A. Gung, IGAP Raka, S. Huda and I WA Wijaya, "Speed control of DC motor with pulse width modulation (PWM) method using infrared remote control based on AT mega 16-Microcontroller", IEEE, International Conference on Smart Grid Technology in Electrical and Information System (ICSGTEIS), pp. 108-112, 5-7 Nov. 2014.
- [14] <http://www.adams.mscsoftware.com/>
- [15] Y.S. . Ali, S.B.M. Noor, S.M. Uashi and M.K Hassan, "Microcontroller performance for DC motor speed control system", IEEE, National Power and Energy Conference (PECon), Bangi, Malaysia, pp. 104-109, 2003.
- [16] Md Mustafa Kamal, Lini Mathew and S. Chatterji, "Speed control of brushless DC motor using intelligent controllers", IEEE, 2014.
- [17] A. Tashakori and M. Ektesabi, "Stability analysis of sensor less BLDC motor drive using digital PWM technique for electric vehicles", IEEE, pp. 4898-4903, 2012
- [18] P.S. Bhimra, "Electrical machinery", Khanna Publication of India, 3rd Edition 2003.
- [19] Caldwell, R. D., N. Ye and D. A. Urzi, Reengineering the product development cycle and future enhancements of the computer-integrated environment, International Journal of Computer Integrated Manufacturing, Vol. 8, No. 6, 1995, pp. 441-447.
- [20] Carmadi Machbub, Ary Setijadi Prihatmanto and Yoseph Dwi Cahaya, "Design and implementation of adaptive neural networks algorithm for DC motor speed control system using simple microcontroller", pp. 479-483, IEEE, 2001
- [21] S.D. Barman, A. Hussain and T. Ahmed, "Speed control of DC motor using PWM technique: Pulse Width Modulated DC Motor Control, LAP Lambert Academic Publishing, 2012.
- [22] Rooks, B., A shorter product development time with digital mock up, Assembly Automat, Vol.18, No.1,1998, pp.34-38.
- [23] G. Rajeshkanna, "Modern speed control of separately excited dc motor by boost converter fed field control method", IEEE, International Conference on Computer Communication and Informatics (ICCCI), Coimbatore, India, Jan. 09 – 11, 2013.
- [24] J. Nicolai and T. Castagnet, "A flexible microcontroller based chopper driving a permanent magnet DC motor", The European Power Electronics Association, pp. 200-203, 1993.
- [25] Tseng, M.M.; Jiao, J.; Su, C.J., Virtual Prototyping for customized product development, Integrated Manufacture System, Vol. 9, No.6, 1998, pp.334-343.