# Cricket Bowling Machine

Akshay R. Varhade
*Dept. of Elec. & Telecom.*
*S.G.B.A.University*
*Amravati MS (India)*

HrushikeshV. Tiwari
*Dept. of IT*
*S.G.B.A.University*
*Amravati MS (India)*

Pratik D. Patangrao
*Dept.of Elec. & Telecom.*
*S.G.B.A.University*
*Amravati MS (India)*

## Abstract

*Science is basically passive observation of the universe as it exists to generate knowledge and Engineering is making use of that. Engineers always look upon the problem from technical point of view. An engineering project is balanced cocktail of the practical aspect of the humanity and economics. New ideas and inventions are the part of engineer's life.*

*Ball pitching devices have been used in sport practice from many years. The aim of this project is to design a cheapest ball pitching system ever to throw the balls automatically at different suitable adjustable speeds for the cricket practice. Typically balls are thrown from a device using motors ,discs and swing can also be set by the operator. The report shows all the design criteria (including mechanical and electronical aspects) to develop a professional cricket-pitching machine.*



## Keywords

DC-Direct Current, AC-Alternate Current, PMDC-Permanent Magnet Direct Current Motors, R-Resistor, C-Capacitor, SCR- , RPM-Rotations per Minutes, SCR-Silicon-controlled rectifier

## 1.0 INTRODUCTION

The concept of the cricket-pitching machine provides accurate and consistent batting practice for cricketers of all standard. It is a best cricket practice facility available to all cricketers at an affordable price, which have recognized a very tangible and enjoyable way to improve batting performance. Since the successful launch of the first BOLA in 1985 which was purchased by Surrey Country Cricket Club and shortly afterward the England Test Side, Stuart & Williams. And this have encourage other for continuous improvement and development of this dynamic instrument (thus to us also). The main mechanism of the machine consists of two heavy wheels, Between 30 and 55 cm in diameter with rubber tires, each rotated by its own electric motor. These are fixed on a frame such that the wheels are in the same plane with a sliding arrangement, about 8 cm apart. The slider block can slide over the base member by means of a screw and nut mechanism, which is attached at each end of the base member for accommodating balls of different diameters.

The whole assembly is fixed on a other frame so that the plane of the wheels is roughly at the height that a typical bowler would release the ball. The motors are typically powered by a DC source, and can be rotated in opposite directions. A controller allows variation of the speed of each wheel, allowing the machine to be slowed down for less experienced batsmen and swing bowling can also be achieved.

## 2.0 MECHANICAL ASPECTS

Bowling machine includes a pair of adjacent ball ejecting wheels, each provided with a concave surface formed in body of an elastic material. These wheels are mounted on base for axial rotation in a common plane, and the gap between the wheels should be slightly less than the diameter of a ball to be thrown and at last speed of each wheel can be adjustable independently. This machine transfers the kinetic energy to the ball by frictional gripping of the ball between two rotating wheels. The base is provided by a tilting assembly, which is mounted on a bracket so that the required angular adjustment of the rotational plane of the wheel about axis parallel to direction of delivery of ball and its perpendicular axis is possible. Controls are provided for controlling the speed of the wheel. These adjustments of relative speeds and rotation of plane of the wheels gives wide variations in the speed and swing of the ball. [1]

Cricket Bowling Machine consists of slider mechanism (l), which holds the wheel and corresponding DC motor. The slider mechanism can slide over the base member by means of a screw and nut mechanism, which is attached at each end of the base for balls of different diameter.

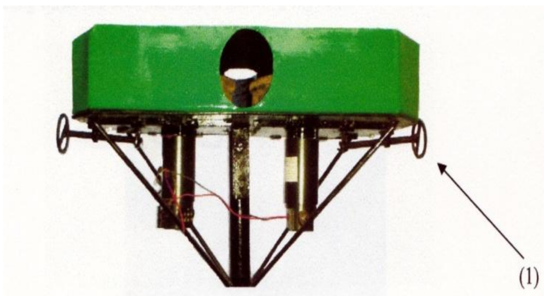


**Fig.1- Sliding arrangement**

Cricket Bowling Machine consists of a nut and screw mechanism (2) that allows the machine to tilt from its horizontal position. This allows us to change the length of the ball i.e. full length, good length or short length. Accordingly, the ball arriving position of a ball can be decided.

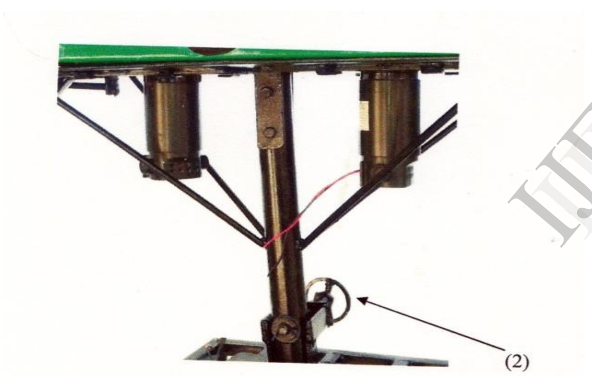


**Fig.2- Tilting arrangement**

Cricket bowling machine also composed of mechanical job (3) on which rotating wheel has been mounted as shown in fig. below. [1]


**Fig.3- Mechanical job**

## 3.0 ELECTRONICAL ASPECTS

### 3.1 DC Motor

#### 3.1.1 General Description

In any electric motor, operation is based on simple electromagnetic concept. A current-carrying conductor is placed in an external magnetic field; it will experience a force proportional to the current through conductor, and the strength of the external magnetic field. As you are familiar with kids playing with magnets, opposite (North and South) polarities attract, while like polarities (North and North, South and south) repel. The internal configuration of a DC motor is designed to harness the magnetic, interaction between a current carrying conductor and an external magnetic field to generate rotational motion. [2]Thus it causes the shaft to rotate.

#### 3.1.2 Working

Let's start by considering a simple 2-pole DC e Every DC motor has six basic parts axle, rotor, stator, commutator, field magnet(s), and brushes. In most common DC motors, external magnetic field is produced by high strength permanent magnet. The stator is the stationary part of the motor - this includes the motor casing, as well as two or more permanent magnet pole pieces. The rotor rotates with respect to the stator. Electric motor is as shown below.



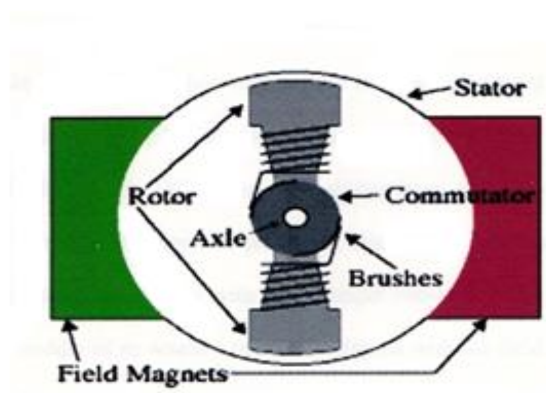


**Fig.4- Construction details for DC motor**

The rotor consists of windings (on a core), the windings are electrically connected to the commutator. The above diagram shows a common motor layout with the rotor inside the stator (field) magnets.

### 3.1.3Driving & Opposite torques

The construction of the brushes, commutator contacts, and rotor windings are such that when power is applied, the polarities of the energized winding and the stator magnet(s) are misaligned, and due to which the rotor will rotate until it is almost aligned with the stator's field magnets. As the rotor reaches alignment, the brushes move to the next commutator contacts, and energize the next winding. Given our example two-pole motor, the rotation reverses the direction of current through the rotor winding, leading to a "flip" of the rotor's magnetic field, driving it to continue rotating. In real life, though, DC motors will always have more than two poles. In particular, this avoids "dead spots" in the rotation. You can imagine how with our example two-pole motor, if the rotor is exactly at the middle of its rotation (perfectly aligned with the field magnets), it will get "stuck" there. Meanwhile, with two-pole motor, there is a moment where the commutator shorts out the power supply (i.e., both brushes touch both supply, waste energy, and damage motor components as well. Yet another disadvantage of such a simple motor is that it would exhibit a high amount of torque "ripple" (the amount of torque it could produce is cyclic with the position of the rotor). [2]

## 3.2 PMDC Motor Speed Control Circuit

It is a simple triac base circuit. In this circuit, the triac is fired at some delay angle during positive and negative half cycles. when triac is off, the power supply voltage appears across it, but when it is fired, it acts as short circuit and supply voltage appears across PMDC motor thus after firing of triac, for the rest of part that half cycle, the voltage appears across PMDC motor, the delayed firing of triac in each half cycle phase control over the rms voltage supplied to PMDC motor, and speed control is achieved.

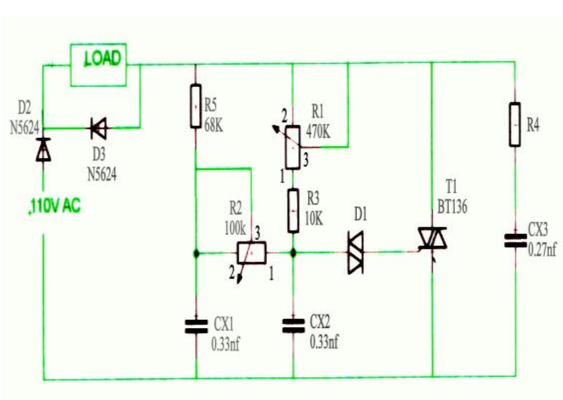


**Fig.5- Circuit for motor speed control**

The above circuit diagram shows the triac based voltage regulator in which 110V input supply voltage is achieve by a step-down transformer(transformer should have significant current rating as per requirement of the motors).As per the working is concern, during positive half cycle , the capacitor charges through resistance R3.When the capacitor voltage reaches to breakdown voltage of diac, the diac turned on , causing the capacitor C2to discharge through diac and triac Thus gate current is supplied to triac and it is turned on. Once triac is turned on, it acts as short circuit and for the rest part of half cycle the supply voltage appears across the motor. The firing instant is delayed by the time equal to the time required for capacitor to charge (RC). Thus by varying the resistance R3, the charging time constant RC and rms value of voltage supplied to motor is controlled.

To minimize the snap effect, in this circuit, the capacitor C1 recharges main capacitor C2, after triggering, to approximately breakdown voltage. Thus the residual voltage at start of half cycle will be slightly less than breakdown voltage of opposite polarity, and early triggering in that half cycle is prevented. The capacitor C1 also helps the capacitor C2 to charge to breakdown voltage beyond the limit maximum triggering angle and hence the maximum triggering angle is not limited to point where supply voltage is equal to breakdown voltage. However, if diac should switch after $180^0$, the triac will be triggered in the beginning of next half cycle. Hence to avoid this, the coupling resistance R2 is properly adjusted for minimum power level in the load at maximum setting of R1.

When triac is employed in AC circuit, it is supposed to conduct in both the half cycles with proper gate control. Even though the operation of the triac is similar to two anti-parallels connected SCRs each SCR conducts alternatively in half-cycles and the next half-cycle is available for turn-off, but with triac, it has to conduct in each half cycle along with proper gate control. At the end of conduction in one half cycles, triac has to turn-off in short duration and in the next half cycle it has to turn-on as per gate pulse.

For resistive load, turn-off and turn-on is fairly simple to accomplish because comparatively more time is available for triac to turn-off from the instant when current drops below holding current to the instant when reversed voltage reaches to a value sufficient to force latching current through triac in applying gate pulse.

With inductive loads, the triac commutation is more difficult. Due to Inductive load, current lags behind voltage by some angle, therefore load voltage and load current do not become zero simultaneously. Due to the reversed voltage and in base regions, the reverse recovery current flows. This current after attaining its peak, reduces to zero. This recovery current is also supported by discharging current of the junction capacitance when this reverse recovery current is becoming zero; the triac gains the voltage blocking ability. The voltage across triac starts building up at rate dv/dt. The reverse recovery current can act as virtual gate current and turn the device back on. The rate of rise of voltage during commutation (dv/dt) cans also turn-on the device. For higher inductive loads, current lags more angles and the triac is subjected to more dv/dt during commutation. Thus triac can be false triggered by large dv/dt and gate control is lost .To provide protection against dv/dt ,the snubber circuit comprising R4 and C3 is used, Thus , after rectification we get variable DC supply which can be fed to. PMDC motor (LOAD) and ultimately motor speed control is achieved.

## 4.0 SWING MOTION OF THE BALL

Using this machine, we are capable of having swing motion of the ball. When the motors are running at different speeds, swing bowling can be simulated. The direction of swing of the ball is given by Magnus Effect.

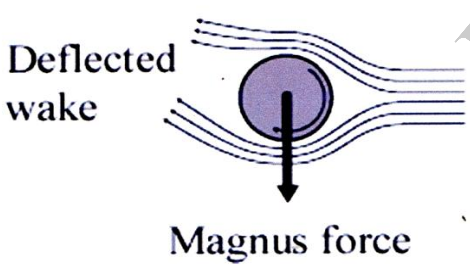


**Fig.6 - Magnus force acted on the ball**

The Magnus effect is the phenomenon in which a spinning object flying in a fluid creates a whirlpool of fluid around itself, and creates a force perpendicular to the line of motion. The resultant behavior is similar to that around an airfoil with a circulation which is generated by the mechanical rotation causing a horizontal force that moves the ball from a straight-line in its trajectory. The Magnus force depends upon the spin direction whatever direction the front most point of the ball is turning is the direction of the force. Also, the more spin given to the ball, the more it will curve. We can achieve both swings i.e. towards the batsman and away from the batsman. [3]

**Fig.7- Cricket Bowling Machine**



## 5.0 ADVANTAGES

- Speed of the ball is adjustable.
- Swing and Spin bowling practice is also possible.
- The machine is portable and low cost.
- Improve bating skill of the batsman.
- Reduce the efforts of the bowler.
- Practice at various speeds, spin swing is possible.
- Positive adjustment of line and length of bowling are possible.

## 6.0 CONCLUSION

The designed bowling machine is capable to bowl at different speeds with necessary swing action. Thus the machine is suitable for use in batting, fielding and keeping practice.

Experimental results is as follows-

| Sr. No | RPM of left wheel | RPM of right wheel | Nature of ball |
|---|---|---|---|
| 1 | 900 | 900 | Straight |
| 2 | 1100 | 1100 | Straight |
| 3 | 1450 | 1450 | Straight |
| 4 | 1650 | 1650 | Straight |
| 5 | 2100 | 2100 | Straight |
| 6 | 2400 | 2400 | Straight |
| 7 | 2100 | 1500 | In-Swing |
| 8 | 2400 | 1500 | In-Swing |
| 9 | 1300 | 2100 | Out-Swing |
| 10 | 1500 | 2300 | Out-Swing |

**Table 1- Experimental results**



## REFERENCES

[1] Shibendu Roy, Sankar Karamkar, N. P. Mukherjee, Uma Datta “Design and development of indigenous cricket bowling machine” Journal of Scientific and Industrial Research, Vol.65, February-2006, pp.148-152

[2] DC Motors-“How they work, in 4 parts Principles of operation”-12 November, 2001http://www.solarbotics.net/starting/200111_dcmotor/200111_dcmotor2.html

[3] The 50 cent Toy Hovercraft / Helicopter-Demonstrate the Magnus Effect http://www.instructables.com/id/The-50-cent-Toy-Hovercraft-Helicopter-Demonstra/?lang=pt