DESIGN AND CONSTRUCTION OF A SIMPLE ELECTRIC BELL

BY

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MAY, 2026

DECLARATION

I **Cheptoyek Enos** do here by affirm that this project work is my own original presentation and no part of this project work and report has been copied or submitted to any University or other institution of higher learning for any academic award. Where other people's work has been used, it has been duly referenced.

Signature ....

Date 4TH, 06, 2026

APPROVAL

The project work and report entitled design and construction of a simple electric bell by Cheptoyek Enos has been directly under my supervision and with my approval, it's now ready to be presented to the board of examiners and senate of Busitema University for further Examination

Supervisor.

Signature...

Date 08th | 06 | 2026

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DEDICATION

I dedicate this work to my cherished beloved parents Mr. Musobo Stephen and Mrs. Chemutai Phillis, whose unwavering love, countless sacrifices, and relentless belief in my dreams have been the cornerstone of my success.

To my three brothers Kibet Ezekiel, Kiplimo Cornel and Chelangat Israel, whose patience, laughter and moral support turned difficult days into bearable ones.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

AC: alternating current

DC: direct current

EMF: electromotive force

IR: internal resistance

SDG: Sustainable Development Goal

RPM: Revolution per minute

ABSTRACT

This project focused on the design and construction of a simple electric bell system using a DC motor. The aim was to demonstrate the conversion of electrical energy into mechanical motion and subsequently into sound. A DC motor was powered using a DC supply, and a striker mechanism attached to the motor shaft was used to hit a bell to produce sound. The system was tested under varying voltages, and the relationship between voltage, motor speed, and ringing frequency was analyzed. Results showed that motor speed increases with applied voltage and directly influences the frequency of the bell sound. The project successfully demonstrated a simple and cost-effective alternative to the conventional electromagnetic bell.

CHAPTER ONE: INTRODUCTION

1.0 Introduction

This chapter presents the general background of the project. It talks about the specific aspects of the project; problem statement, aims and objectives, scope and significance of the project. The chapter concludes by highlighting the brief description of the remaining parts of the proposal.

1.1 Background of the study

An electric bell is a simple yet effective device that has been used for signaling, communication, and alarm purpose for many years. Traditionally, electric bells operate on alternating current (AC) and rely on electromagnetic principles to produce sound **(**Elson, 1918). The core mechanism involves an electromagnet that attracts a metal armature, causing a hammer or striker to hit a bell, which then produce sound (Elson, 1918). However, these traditional designs often require complex circuits, multiple components, and sometimes AC power sources.

The first practical electromagnetic bell was developed by Hans Christian (1701-1744). However, the modern electromagnetic bell was refined by William E. Redfield in 1830s. Redfield's design used an electromagnet to attract a metal armature, which struck a bell, creating a ringing sound (Rifka Alkhilyatul Ma'rifat, I Made Suraharta, 2024) . This design became the basis for many later applications, including electric bells used in telegraphs and alarm systems.

The modern electric bell mechanism had its origin from vibrating "contact breaker" mechanism devised to break the primary current in induction coils vibrating "harmer" invented by Johann Philipp Wagner (1839). This was developed into a buzzer by (Froment, 1847). John Mirand around 1850 added a clapper and Cong to make the standard electric bell for use as a telegraph sound

In recent years, there has been a growing interest in simplifying electrical devices, especially for educational and practical application. With advancement in motor technology and control, direct current motors offer a compelling alternative for creating a simpler, yet effective mechanism in electric devices (Chironis, 2012.). This approach not only simplifies the electromechanical design but also potentially enhances the efficiency of the bell apparatus compared to traditional designs.

1.2 Problem statement

Conventional electric bell designs typically rely on an electromagnet-armature mechanism that requires complex circuit configurations, multiple moving parts and often AC power sources to operate. These traditional designs are prone to mechanical wear due to continuous contact breaking, difficult to calibrate, and less accessible in low resource setting where AC power may be unavailable or unreliable. Although DC motors offer a simple alternative for generating mechanical motion, no systematic attempt has been made to design and evaluate a DC motor-driven electric bell. Therefore, this study aims to design, construct and test a simple DC motor-driven electric bel, establishing the relationship between applied voltage and ringing frequency.

1.3 Aims and objectives

1.3.1 Aims

To design and construct a simple electric bell that utilizes a direct current (DC) motor as the primary mechanism for producing sound

1.3.2 Objectives

a) To design and construct a simple electric bell system that uses a DC motor as the primary mechanism for sound production.
b) To determine the relationship between voltage and frequency of rotation (motor speed).
c) To calculate the armature resistance of the motor and motor constant k experimentally

1.4 The scope of the study

The study focused on the design, construction and testing of a simple electric bell using a DC motor. The project involved the use of locally available materials such as a DC motor, battery, connecting wires, switch, striker mechanism and metallic gong. The study was limited to a low voltage DC motor powered bell.

1.5 significance of the study

The designed electric bell system serves as an effective teaching aid for demonstrating the practical application of electromagnetism, energy conversion (electrical to mechanical to sound), and DC motor principles. This hands-on model enhances conceptual understanding among learners.

The study provides a simplified low-component alternative to the conventional electromagnetic bell. It demonstrates that DC motor can reliably produce a ringing mechanism, reducing design complexity and maintenance costs and can be used as low power affordable signaling system in environments where traditional electric systems are not feasible or due to lack of AC power.

CHAPTER TWO: LITERARURE REVIEW

2.0 Introduction

This chapter reviews the theoretical foundations and existing literature related to electric bells and DC motors. The review is organized under the following headings: historical development of the electric bell, structure of an electric bell, mode of operation, electromagnetic principles, and DC motors.

2.1 Historical Development of the Electric Bell

The development of the electric bell is closely linked to the broader advancement of electromagnetism and early electrical communication systems in the 19th century. The discovery that an electric current could produce a magnetic field laid the foundation for devices that convert electrical energy into mechanical motion (Anton & Sodano, 2006). Early experiments by Hans Christian Ørsted in 1820 demonstrated the relationship between electricity and magnetism, while subsequent work by André-Marie Ampère and Michael Faraday helped to establish the theoretical principles necessary for electromagnetic devices such as electric bells (Boldea & Fellow, 2017).

The first practical applications of these discoveries were seen in the development of the electromagnetic telegraph in the 1830s. Inventors such as Samuel Morse utilized electromagnets to create signaling devices capable of transmitting information over long distances. In these early telegraph systems, simple "sounders" were used to produce clicking sounds when an electric current passed through an electromagnet, attracting a metal armature. These sounders are considered the direct predecessors of the electric bell (Morse, 1844).

By the mid-19th century, the concept of using an electromagnet to repeatedly strike a metal gong had been developed into what is now recognized as the electric bell. One of the most significant improvements was the introduction of the self-interrupting mechanism, in which the movement of the armature breaks and restores the electrical circuit automatically. This innovation allowed continuous ringing without manual switching (Swinburne, 1890). According to Institute of Electrical and Electronics Engineers historical archives, this mechanism became a standard feature in electric bell designs and remains fundamental to their operation.

In the late 19th and early 20th centuries, electric bells became widely used in homes, schools, and industrial settings, particularly as doorbells and alarm systems (Clark, 2023). The expansion of electrical power distribution systems made these devices more accessible and reliable. During this period, improvements were made in materials, including better insulating wires, stronger electromagnets, and more durable mechanical components, which enhanced efficiency and longevity.

With the advancement of electronics in the 20th century, traditional electric bells began to be supplemented or replaced by electronic buzzers and chimes. However, the fundamental principle of electromagnetic actuation has remained relevant. Modern designs often integrate solid-state components, but many still rely on the same basic mechanism developed in the 19th century. The continued use of electric bells in educational demonstrations highlights their importance in illustrating key concepts in electromagnetism (Dori & Belcher, 2005).

2.2 Structure of a Conventional Electric Bell

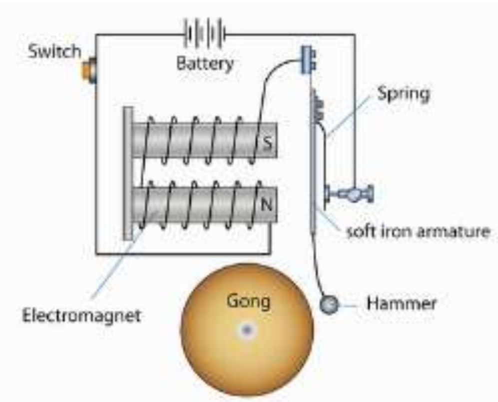

Figure **2.1**: structure of a conventional electric bell

A conventional electric bell consists of several key components that work together to produce sound: the electromagnet, armature, metal gong (bell), spring, contact screw, and power source (battery). When an electric current is passed through the electromagnet, it becomes magnetized and attracts the armature, which then strikes the gong (Elson, 1918). The spring returns the armature to its original position, and the contact screw re-establishes the circuit, allowing the process to repeat.

2.2.1 Parts of an electric bell and its functions

Armature; The armature is a small, metal plate or spring that is attached to the bells housing. The armature is attracted to the electromagnet when the current is on. This movement causes the bell to ring.

Electromagnet; The electromagnet is the core component of the electric bell. It is made up of a coil of insulated copper wire wrapped around a magnetic core. When an electric current flow through the coil, it creates a magnetic field that attracts the metal armature (Boldea & Fellow, 2017).

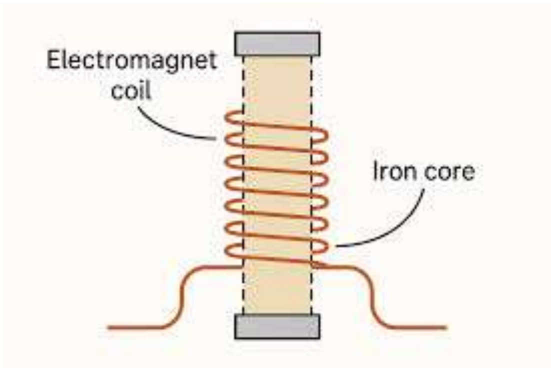

Figure **2.2**: Electromagnet

Bell(gong); The bell is a metal ring that is attached to the armature. When the armature swings, it strikes the bell, causing it to vibrate and produce a ringing sound

Spring; A spring is attached to the armature and the bell it is usually a triton spring that provides a restoring force. The spring ensures that the armature returns to its original position after being pulled by the electromagnet.

The conduct switch; The conduct switch is part of the electrical circuit that controls the flow of current to the electromagnet. The switch is usually a mechanical switch that closes when the circuit is completed allowing current to flow through the electromagnet.

Battery or power source; The electric bell is powered by a battery or power supply. It provides the electric current needed to energize the electromagnet

2.2.2 The electric bell mode of operation

The electric bell operates based on the principle of electromagnetism. The coil is wound on two soft iron cores. One end is connected to the positive terminal of the battery, and the other end is connected to the contact screw positioned behind the armature. The armature is constructed such that it is normally in contact with the contact screw (Rifka Alkhilyatul Ma'rifat, I Made Suraharta, 2024). When the switch is turned on, current flows through the electromagnet circuit, causing it to become a magnet temporarily. Upon becoming a magnet, it attracts the soft iron armature, which strikes a metal gong, thereby producing sound. During attraction, the circuit is broken at its contact with the contact screw. This causes the soft iron core to lose its magnetic properties completely, allowing the armature to return to its normal position (Guo et al., 2008). The same process of magnetization and demagnetization repeats with each cycle, producing a ringing sound in a fraction of a second.

2.3 Electromagnetic principles

Electromagnetic bells operate based on the principle of electromagnetism, which is the interaction between electric currents and magnetic fields. The key concepts include;

Amperes law

Amperes law relates the magnetic field around a closed loop to the electric current passing through the loop

$$\oint \boldsymbol{B}.\boldsymbol{dl} = \boldsymbol{\mu_{0 I_{enc}}}$$

Where;

B= magnetic field

dl= infinite segment of the length

μ_0 = permeability of free space

I_{enc} = is the total current enclosed by the loop.

The law is fundamental in in understanding how electric currents generate magnetic fields.

Faradays law of electromagnetic induction.

This law describes how a changing magnetic field induces an electric current in a conductor.

$$\mathcal{E} = - \frac{d\varphi_b}{dt}$$

Ɛ= induced electromotive force

φ_b= magnetic flux through the low

The negative sign indicates Lenz’s law (induced current opposes the change in flux. The movement of the bell’s striker is often induced by a changing magnetic field (Webster, 1999).

Ohms law

Ohms law relates the current, voltage, and resistance in an electrical circuit.

$$V = IR$$

Where;

$V =$ voltage

$I =$ current

$R =$ resistance

The law is used to calculate the current flowing through the coil of an electromagnetic bell, which in turn generates the magnetic field.

2.4 Relationship between voltage and frequency of rotation

The speed of a DC motor depends largely on the voltage supplied to it. When voltage is increased, the current flowing through the armature increases, resulting in greater electromagnetic torque and higher rotational speed torque (Ling et al., 2021). As the motor rotates, back electromotive force is generated and opposes the applied voltage. Consequently, motor speed increases until a balance is achieved between the applied voltage and the opposing back EMF. Similarly, studies on educational DC motors have demonstrated a nearly linear increase in rotational speed with increasing voltage under moderate loading conditions.

In applications involving mechanical systems such, increased rotational speed results in increased striking frequency (Guo et al., 2008). This implies that the ringing frequency of a bell powered by a DC motor should increase with increasing voltage.

2.5 Armature Resistance and Motor Constant

Armature resistance is an important parameter in DC motor analysis because it determines the voltage loss within the motor windings and influences motor efficiency. The relationship between voltage, current, and resistance is described by Ohm's law. According to electrical machine theory, armature resistance can be determined experimentally by plotting a graph of voltage against current and obtaining the slope of the graph.

Another important parameter is the motor constant, which relates the rotational frequency of the motor to the generated back electromotive force (Bumby & Martin, 2015).Researchers have shown that the motor constant provides useful information about motor performance and efficiency because it represents the relationship between electrical and mechanical quantities within the motor. Experimental determination of armature resistance and motor constants is widely used in physics and engineering laboratories because it helps learners understand practical applications of electrical machine theory (Bumby & Martin, n.d.). Low-cost experimental setups have been found to be effective in demonstrating these concepts.

2.6 Motor theory

A DC motor operates based on the principle of electromagnetic interaction, where a current-carrying conductor placed in a magnetic field experiences a force. This principle is explained by Lorentz Force Law, which states that a conductor carrying current in a magnetic field experiences a force perpendicular to both the current and the field. In a DC motor, this force produces rotational motion of the armature (Chironis, 2014.).

When a voltage is applied across the motor terminals, current flows through the armature windings. The interaction between this current and the magnetic field generated by permanent magnets (or field coils) produces a torque that causes the motor shaft to rotate (Faiz, 2012). As the motor continues to rotate, the conductors cut through magnetic field lines, and this induces a voltage in the opposite direction to the applied voltage. This induced voltage is known as back electromotive force (back EMF**)** **(**Liu et al., 2017**)**.

The electrical behavior of a DC motor can therefore be described by the standard motor equation:

$$V = IR + E_b$$

Where;

V = applied voltage

I = current

R = internal resistance

E_b = E_b is the back EMF.

The back EMF is directly proportional to the rotational speed (or frequency) of the motor, and is given by:

$$E_b = kf$$

Where;

k = motor constant

f = rotational frequency

Substituting this into the main equation gives:

$$V = IR + Kf$$

This equation shows that the applied voltage is divided into two parts: one used to overcome the internal resistance of the motor (IR) and the other associated with the motor's rotation (Kf).

$$K = \frac{V - IR}{f}$$

CHAPTER THREE: MATERIALS AND METHODS

3.0 Introduction.

This chapter presents the procedures and methods that were used in the design and construction of a simple electric bell using a DC motor. It explains the materials used, the design considerations, construction steps, working principle, and methods used to test and evaluate the performance of the device.

3.1 Materials

The following materials were selected based on local availability, cost-effectiveness and suitability for constructing a simple DC motor-driven electric bell.

Dc motor (6V rating); A small permanent-magnet DC motor rated at 6V was used as the primary electromechanical actuator. It converts electrical energy from the battery into continuous rotational mechanical energy.

Figure **3.1**: DC motor

Switch; A push switch was used to open and close the circuit manually. This allows the user to start and stop the ringing action conveniently.

Gong; An old bicycle bell made of steel was used as a sounding element. It vibrates when struck by the striker mechanism producing sound.

Figure **3.2**: Bicycle bell

Striking mechanism; A small bolt placed in a plastic pulley and attached to the motor shaft acted as a striker.

Wooden board; A rectangular wooden board (3cm×5cm) served as the mounting platform. It provides mechanical stability and supports the motor, switch, and gong in fixed positions.

Connecting wires; Insulated copper wires were used for all electrical connections. The insulation prevents short circuit and ensures safe current flow between the battery, switch, and motor.

Figure **3.3**: connecting wires

Power source (6V battery); A 6V DC dry cell battery provided the necessary voltage and current to operate the motor. It provided stable power during testing.

A nut; A long nut and matching bolts were used to secure the gong to the wooden base and to adjust the striker's position.

Figure **3.4**: A nut

3.1.1 Design Considerations

The design of the electric bell was based on simplicity, cost-effectiveness, and availability of materials. The system was designed such that a DC motor acts as the driving component to produce continuous rotational motion, which is then converted into periodic striking motion to generate sound.

The voltage rating of the DC motor was carefully selected to match the available power supply, typically between 3V and 4V. The speed of the motor was also considered, since excessively high speeds would reduce the clarity of the bell sound, while very low speeds would make the ringing ineffective. Therefore, a moderate-speed DC motor was preferred.

The striker mechanism was designed in such a way that it repeatedly hits the bell surface as the motor rotates. Additionally, proper alignment of components was ensured to minimize energy loss due to friction and misalignment. The materials used were lightweight but strong enough to withstand continuous operation.

3.2 Methods

This section describes the system design, construction procedure, experimental setup and the methods used to determine the armature resistance and motor constant of the DC motor.

3.2.1 System Design

The system consists of two main parts: the electrical circuit and the mechanical arrangement. The electrical circuit provides power to the DC motor, while the mechanical part converts the rotational motion into striking action.

3.2.1 Circuit Diagram

Below is a simple circuit diagram showing the connection of components:

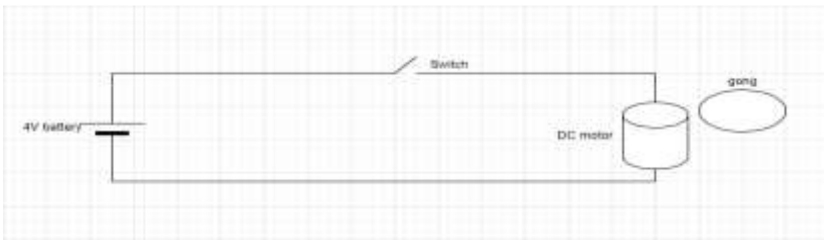

Figure **3.5**: Circuit diagram

This circuit allows current to flow through the motor when the switch is closed, causing it to rotate.

3.2.2 Construction Procedure

The construction of the electric bell was carried out in several stages, ensuring that each component was properly installed and tested before proceeding to the next step.

Step 1: preparation of the base.

A rectangular wooden board (3cm × 5cm) was prepared to act as the support structure for all components. The board was cleaned and smoothened to ensure proper mounting.

Step 2: Mounting the DC Motor

Figure **3.6**: mounting the DC motor

The DC motor was firmly fixed onto a wooden board using screws or strong adhesive. Proper alignment was ensured to allow free rotation of the motor shaft without obstruction.

The mounting board served as the base for the entire system and provided stability during operation.

Step 3: Fabrication of the Striker

Figure **3.7**: Attaching the striker

A small metallic bolt was attached to the shaft of the motor. The bolt arm acted as the striker that hits the bell. As the motor rotates, the striker moves in a circular path and repeatedly strikes the bell.

The length and position of the striker were adjusted to ensure effective contact with the bell.

Step 4: Fixing the Bell (Gong)

The metallic bell was mounted close to the rotating striker such that each rotation of the motor results in a strike on the bell surface. The spacing was adjusted to allow periodic contact between the striker and the bell.

Figure 3.**8**: Fixing the gong

Step 5: Electrical Connections

Connecting wires were used to connect the battery, switch and motor in series. Proper insulation was ensured to avoid short circuits.

Figure **3.9**: Connecting the switch

Step 6: Testing the system; The switch was turned on to test the operation of the bell. Adjustments were made to the striker position until a clear ringing sound was obtained

The operation of a simple electric bell is illustrated in the block diagram shown below

6V BATTERY → DC MOTOR → SWITCH → BICYCLE BELL

3.2.4 Experimental setup.

The experimental setup consisted of DC power supply, a switch, an ammeter, a voltmeter, and a DC motor connected in series. The ammeter was connected in series with the current flowing through the circuit, while the voltmeter was connected in parallel across the motor to measure the potential difference.

When the switch was closed, current flowed through the motor, causing it to rotate. The rotational motion of the motor shaft drove the striker mechanism, which repeatedly struck the bell to produce sound. Measurements of current and voltage were taken for different working conditions.

Figure 3.**10**: Experimental set up

3.2.5 Determination of the armature resistance.

The armature resistance of the motor was determined experimentally using ohm's law.

Ohms law is given by;

$$v = IR_a$$

R_a = armature resistance, v = voltage and I = current flowing though the motor.

A graph of voltage against current was plotted, and the slope of the graph was used to determine the armature resistance of the motor.

3.2.6 Determination of the motor constant.

From the standard DC motor equation;

$$V = IR_a + Kf$$

Where;

$K =$ motor constant and

$f =$ rotational frequency

Values of voltage, current and frequency were substituted into the equation below to determine the motor constant experimentally.

$$K = \frac{V - IR_a}{f}$$

CHAPTER FOUR: RESULTS AND DISCUSSION

4.0 Introduction

This chapter presents the results obtained from testing the constructed electric bell system. It includes observations, data analysis, and discussion of the system performance based on the objectives of the study.

4.1 System Testing and Observations

After completing the construction, the electric bell was tested under different operating conditions. The system responded as expected when power was supplied.

Figure **4.1**: Constructed electric bell system

When the switch was closed, the DC motor rotated immediately, causing the attached striker to hit the bell repeatedly. A continuous ringing sound was produced as long as the circuit remained closed. When the switch was opened, the motor stopped, and the sound ceased instantly. It was observed that the strength and clarity of the sound depended on the speed of the motor and the positioning of the striker relative to the bell

4.2 Relationship Between Voltage and Frequency of Ringing

Table **4.1**: Relationship between voltage and frequency of rotation

Voltage (V)	Current (A)	Time for 20 complete oscillations (s)			Period T (s)	Frequency (s^{-1})
		Trial 1	Trial 2	Average		
0.30	0.0195	11.0	12.0	11.5	0.575	1.739
0.35	0.0203	10.0	10.0	10.0	0.500	2.000
0.39	0.0213	8.0	9.0	8.5	0.425	2.353
0.42	0.0226	6.0	7.0	6.5	0.325	3.077
0.46	0.0229	5.0	6.0	5.5	0.275	3.636

The results in table 4.2 shows a steady increase in frequency as the applied voltage increased. At an applied voltage of 0.30 V, the frequency was 1.739 Hz, while at 0.46 V the frequency increased to 3.636 Hz.

This trend indicates that increasing the supply voltage increased the rotational speed of the motor. Since the striker was directly attached to the motor shaft, an increase in rotational speed resulted in more frequent impacts on the gong and consequently a higher ringing frequency.

The increase in frequency was not accidental but reflected the fundamental operating principle of DC motors. Greater voltage supplied more electrical energy to the motor, enabling it to overcome internal losses and rotate faster.

A graph of frequency against voltage was plotted using row data in table 4.2 as in figure 4.2

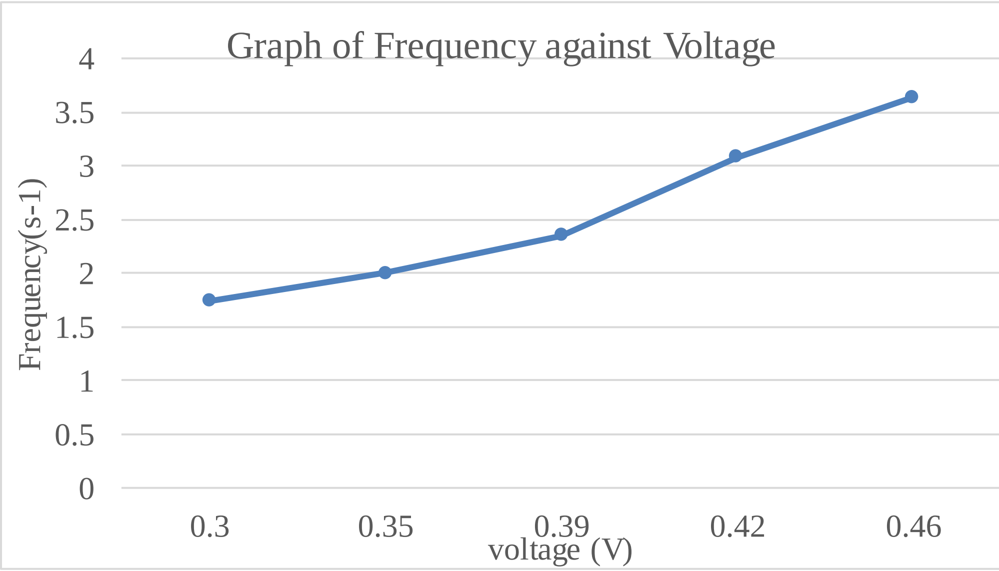

Figure **4.2**: Graph of frequency against voltage

The graph of frequency against voltage shows a positive relationship between the two variables. As voltage increased, frequency also increased.

The trend suggests that the ringing frequency of the bell can be controlled by varying the supply voltage. This characteristic may be useful in applications where different ringing rates are required.

4.3 Calculation of armature resistance and motor constant

4.3.1 armature resistance

Measurements of voltage and current were taken while the motor was operating. These values were used to investigate the electrical characteristics of the motor and determine its armature resistance A graph of voltage against current was plotted using row data in table 4.2 as shown in figure 4.3

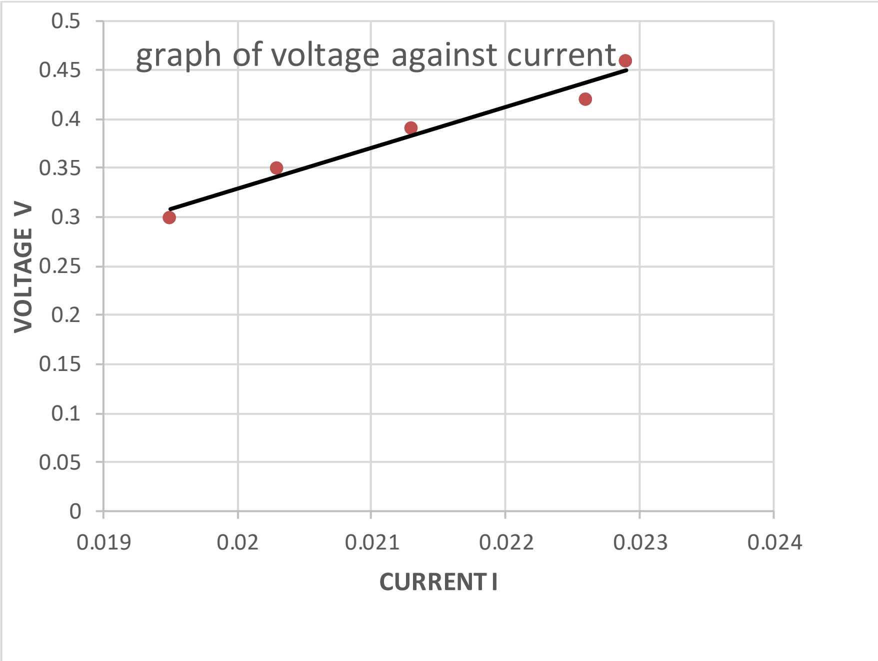

Figure **4.2**: Graph of voltage against current

figure 4.3 shows a graph of voltage against current to be approximately straight-line relationship, indicating that the motor obeyed Ohm's law within the operating range investigated. The linear nature of the graph suggests that voltage and current changed proportionally during operation.

The slope of the voltage-current graph was used to calculate the armature resistance of the motor. The armature resistance obtained experimentally was approximately 14.5 Ω. This value represents the opposition offered by the armature windings to the flow of electric current.

4.3.2 Motor constant

The motor constant was calculated using the experimental values of voltage, current, frequency, and armature resistance.

Table **4.2**: Values of motor constant

V-IRa	Frequency (s^{-1})	Constant K
0.0173	1.739	0.0099
0.0557	2.000	0.0278
0.0812	2.353	0.0345
0.0923	3.077	0.0299
0.1279	3.636	0.0351

Table 4.2 shows that the calculated values of the motor constant had a slight variation from one experimental run to another. The average motor constant obtained was (0.0274). This value represents the relationship between the rotational frequency of the motor and the back electromotive force generated during operation.

4.5 Discussion of findings

The sound produced by the system was clear and continuous. Unlike conventional electromagnetic bells which produced buzzing sounds. The constructed system produced a distinct metallic ringing sound because the striker hit the bell surface. The quality of sound depended on the speed of the motor, position of the striker and the strength of the bell material.

The observed relationship between voltage and frequency agrees with the theoretical behavior of DC motors. Motor speed depends largely on the applied voltage because the voltage determines the amount of current flowing through the armature windings and the resulting electromagnetic torque. The findings imply that voltage is a significant factor affecting the performance of the constructed bell. Higher voltages resulted in faster motor rotation and increased striking frequency. The results are consistent with DC motor theory, which states that motor speed increases with increasing supply voltage under normal operating conditions. The findings therefore support the theoretical expectation that ringing frequency in a DC motor-powered bell is directly influenced by the supply voltage.

The experimentally determined armature resistance confirms that part of the supplied voltage was lost within the motor windings. Such losses are expected in all practical electrical machines because conductors possess finite resistance. The armature resistance influences the amount of current drawn by the motor and therefore affects the overall efficiency of the system. A higher resistance would result in greater energy losses in the form of heat, while a lower resistance would improve electrical efficiency. The obtained value was reasonable for a small low-power DC motor and indicates that the motor was suitable for the intended application.

The motor constant is an important parameter because it characterizes the electrical and mechanical performance of the motor. The small variations observed in the calculated values may be attributed to; human errors in timing measurements, fluctuations in the power supply, mechanical friction within the rotating parts and slight variations in striker loading during operation. Despite these sources of error, the values were reasonably close to one another, suggesting that the measurements were reliable and the experimental procedure was consistent. The experimentally determined armature resistance and motor constant further confirmed the applicability of DC motor theory to the constructed system. The values obtained were consistent with the expected behavior of small DC motors and demonstrated that the motor operated within normal electrical limits.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.0 Conclusions

The project successfully demonstrated the design and construction of a simple electric bell using a DC motor. The constructed system operated successfully, demonstrating that a DC motor can effectively replace the electromagnet mechanism. The system effectively converted electrical energy into mechanical motion and sound. Experimental results confirmed that motor speed increases with voltage and directly influences ringing frequency.

5.1 Recommendations

Developing a charging system

Future improvements should include the integration of a rechargeable power system, such as a battery charging circuit, to enhance portability and reduce dependence on disposable power sources. This would make the electric bell more sustainable and suitable for continuous use in practical applications.

Automating the system

The system can be improved by incorporating an automatic control mechanism, such as a timer or sensor-based switch, to enable operation without manual intervention. This would increase efficiency and expand its application in automated signaling systems.

Using bell gongs that produce higher vibrations

It is recommended to use bells made from materials with higher vibrational properties to improve sound intensity and clarity. Such modifications would enhance the effectiveness of the bell, especially in noisy environments.

Measuring sound volume and comparing with conventional bells

Future studies should include the measurement of sound intensity using appropriate instruments such as a sound level meter and compare the results with conventional electromagnetic bells. This would provide a more quantitative evaluation of the system's performance.

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