DESIGN AND CONSTRUCTION OF AUTOMATIC ACCESS CONTROL WITH GATE AS THE PROTOTYPE

BY

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AUGUST 2003.

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A THESIS REPORT SUBMITTEDIN PARTIAL FULFILMENT FOR THE AWARD OF BACHELOR OF ENGINEERING [B. ENG] DEGREE IN THE DEPARTMENT OF ELECTRICAL /COMPUTER ENGINEERING SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY MINNANIGER STATE.

AUGUST 2003.

CERTIFICATION

I hereby certify that this project titled [THE DESIGN AND CONSTRUCTION OF AUTOMATIC ACCESS SYSTEM WITH GATE AS THE PROTOTYPE] was carried out by UNUAFE UFUOMA PAUL under the supervision of :

Engr. MUSA D. ABDULLAHI.

And submitted to the Department of Electrical/ Computer Engineering, school of Engineering and Engineering Technology Federal University if Technology Minna Niger State. In partial fulfillment for the award of Bachelor of Engineering [B.Eng] degree in Electrical/ Computer Engineering.

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HEAD OF DEPARTMENT	**DATE & SIGN**
EXTERNAL EXAMINER	**DATE & SIGN**

DECLERATION

I UNUAFE UFUOMA PAUL, hereby declare that this project work is an original work of mine and that it is a record of my research work.

Unuafe Ufuoma Paul.

97/6136EE

09-10-2003

DEDICATION

This project is dedicated to Almighty for his divine grace towards me and my parents and all the people He used as instrument to affect my life positively throughout my university education.

ACKNOWLEDGEMENT

First of all I want to thank God Almighty for keeping me alive throughout these years and also for granting me the opportunity and strength to undergo my academic work successfully especially my university education.

I am grateful to my parents Mr. & Mrs. Unuafe Gabbuth for their love, prayer, concern, and support throughout my university life.

I am also grateful to my able project supervisor Eng. M. D. Abdullahi, for his guidance in the course of my research, writing and construction of my project work. And also for taking pains to guide me through every detail of my project and offering constructive criticism with his characteristic simplicity that was very encouraging.

To my H.O.D. and all the lecturers of the department of Electrical / Computer Engineering Department I wish you all God's blessings.

My gratitude also goes to all my well wishers and friends that has helped me in one way or the other especially Francisca Peter, Ugoh, Oruru, Wallexy, Ibro, Zibiri, Michael, Amanoh, Obekpa, Ekpobedafe, Osyke, Warri Felix, Karen, and all my numerous friends.

ABSTRACT

The principal aim of this project work is to design and construct an automatic access system with gate as the prototype. It is a security system with exit [gate in this case] that opens and closes automatically when infrared ray from a transmitter [Remote Control] reaches a receiver.

It is applicable to security exits such as warehouse, stores, vaults, security post and other restricted areas.

The system consist of a transmitter, a receiver, an amplifier with electric brains that sense forward and reverse signal and controls feedback to an electric motor which is responsible for the forward and backward movement [i.e. open and close operation] done by the gate, a mechanical timer that automatically reverses the current flow to the motor and reverses the rotation of the motor and thus closes the gate at a regulated time of ten seconds. And lastly an electromagnetic device is incorporated on the system that serves as a key that locks the gate after the system has been utilized.

In this project, general principles of electromagnetism and remote control switching device are discussed. And this project has been carried out to reveal the hidden details of the design and construction of the of the component parts of the system.

The approach is to consider each circuit on the descriptive basis in order to give a clear understanding of the systems behavior. The design approach was based on choice of values of component and material used.

The result of the testing of the operation of the constructed device is very encouraging.

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CHAPTER ONE

1.1 INTRODUCTION

Automatic access system as designed and constructed in this project work is a remote control security system that is rarely used in this part of the world. There are three different approach as to the design of the system. They are:

1.2 CONTACT SWITCH APPROACH

For this approach, the system can be designed in such a way that a switch is connected under a slab or tiles supported by an elastic spring positioned about a meter before the gate. As soon as a person steps on the slab or tiles, the terminals of the switch gets contact and a current is sent to a motor that controls the opening and closing operation of the gate thus the motor rotates and the gate opens and remains in this position for ten seconds after which a reverse current is sent back to the motor and reverses the rotation of the motor and the gate closes. The ability for the gate to remain in its open position and close after ten seconds as a result of the of the reverse rotation of the motor is controlled by a ten seconds mechanical timer connected across the terminals of the motor.

1.3 PHOTODIODE APPROACH

For this approach, the automatic system can be designed in such a way that as soon as a person gets close to the entrance, he breaks a contact, usually a ray of light emitted from a source at one end of the entrance incident on a photo diode on the other end of the entrance. As soon as the emitted light is cut off by the obstruction of an opaque object [a person], the photodiode sense it and sends signal to an electronic device that controls the electric motor responsible for the opening and closing operation of the gate. Automatically the motor rotates backward bringing the gate to an open position. The gate remains open for ten seconds and after which it closes as a result of a ten seconds mechanical timer that controls the forward and reverse current flow across the terminals of the motor causing the forward and backward rotation of the motor as well as the time delay.

1.4 REMOTE CONTROL APPROACH

Lastly, the design can be achieve by the use of a transmitter and receiver [Remote Control] circuit. In this case, when a person reaches the entrance, a security personnel at the security post controls the transmitting operation and the receiver receives the infrared rays from the transmitter and sends it to the amplifier with an electric brain that sends forward or reverse current to the electric motor responsible for the opening and closing operation of the gate.

As soon as the receiver receives the infrared rays, current is sent to the motor and the gate opens and remain in this position for ten seconds after which a reverse current is

sent back into the motor and reverses the rotation of the motor and the gate closes. This operation of the ten seconds delay and the reversed motor rotation is as a result of a mechanical timer connected across the terminals of the motor.

More so, as the gate gets to the end of the entrance, it closes a switch that powers an electromagnetic device that serves as a key that locks the gate.

Our emphasis as to the design of this project would be laid on the remote control approach. A block diagram of the remote control automatic system is shown below in fig. 1.1

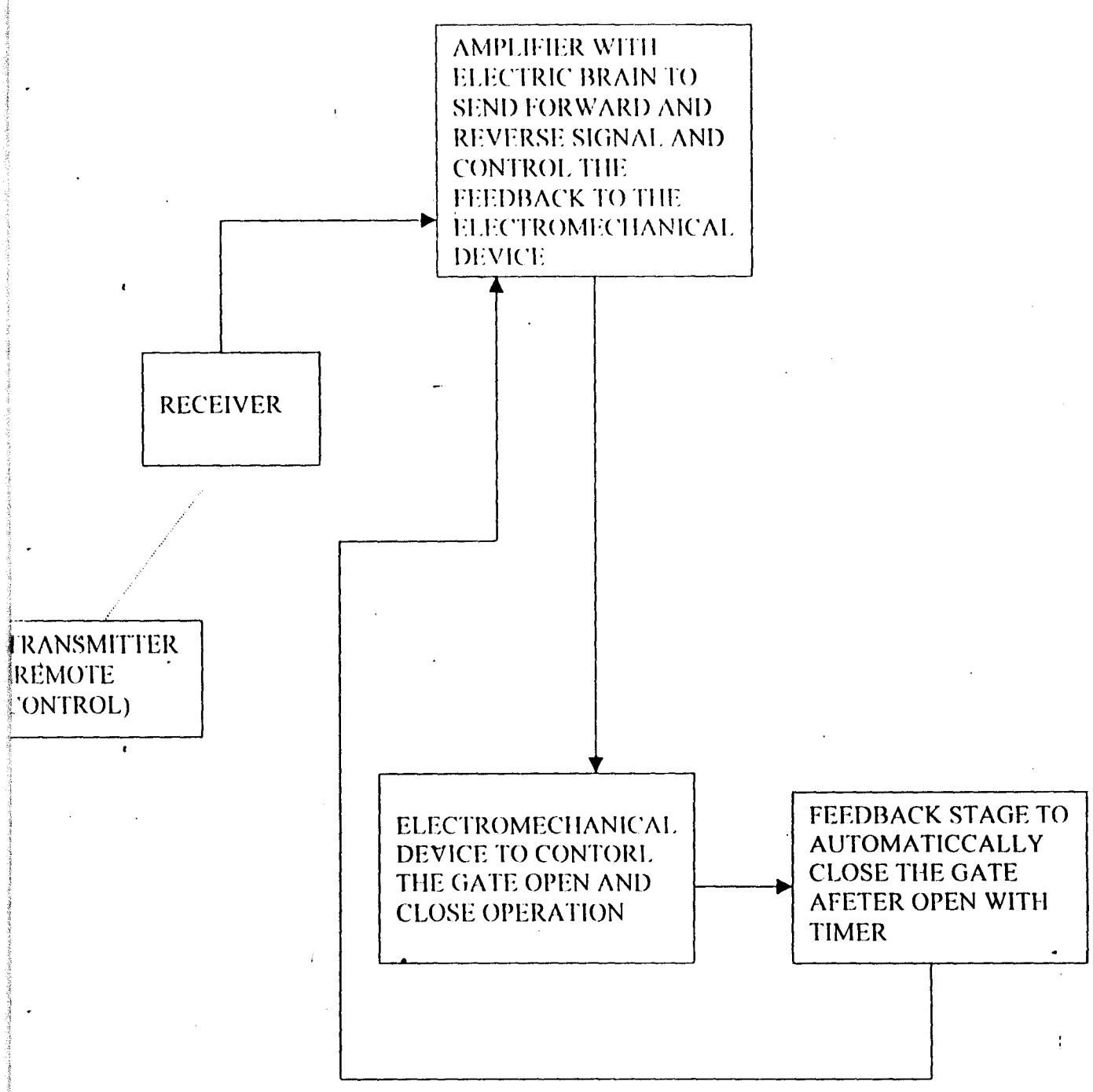


Fig. 1.1

BLOCK DIAGRAM OF AUTOMATIC ACCESS SYSTEM

CHAPTER TWO

2.1 POWER SUPPLY

The function of the power supply is to provide the necessary DC voltage and current with low level of AC ripple and good stability. Also a stable DC output voltage must be provided irrespective of fluctuation of supply voltage.

2.2 METHODS OF PROVIDING DC SUPPLY

Basically there are three methods of producing Direct Current power supply. They are:

- Direct Current generator
- Battery
- Conversion of AC to DC –Rectification.

The method of supply used is that of conversion of AC into DC by rectification, using Bridge Full Wave Rectifier. The rectification of the power supply unit is made up of:

- Transformer
- Diodes Bridge connected circuit
- Filter Circuit

2.3 TRANSFORMER

Transformer operation is based on the alternating magnetic flux produced by alternating current on the mutual induction between two magnetically connected circuit.

The transformer is an electrical machine used either for raising or lowering the voltage of an emf supply with corresponding decrease or increase in current. This is done with high degree of efficiency and without any change in the frequency.

A transformer consist of essentially two coils wound on a closed magnetic circuit of low reluctance made up of laminated iron core. Such coils with high mutual inductance. The arrangement is as shown below:

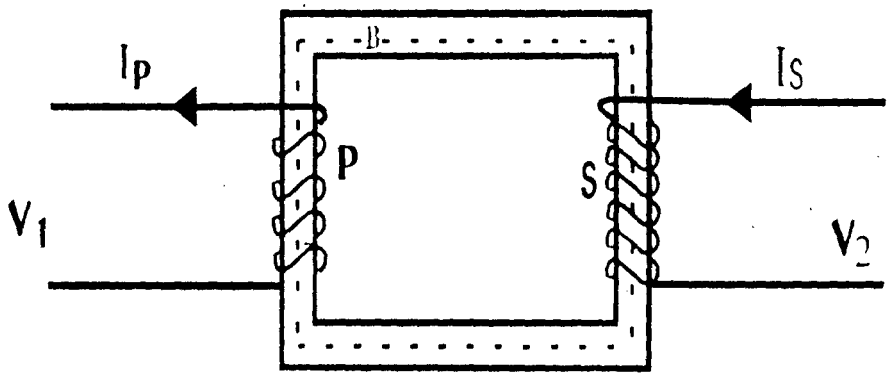


Fig 2.2

Where P = Primary windings

S = Secondary windings

O = Magnetic flux hiking the two windings

N1 = Primary number of turns

N2 = Secondary no of turns

If the primary coil is connected to an AC supply, a current will flow and an alternating flux will be set up in the core most of which will link the secondary coil. An emf of mutual inductance will be set up in this secondary coil and if its circuit is complete, current will flow. Since the magnetic field is an alternating field, the induced

emf in the secondary coil is likewise alternating at a frequency equal to that of the current in the first coil i.e. the primary coil.

Let N1 and N2 be the number of turns in the primary and secondary windings respectively. Then:

Total emf induced in the Secondary = N2 * emf per turn = N2 ------- (i)

Total emf induced in the Primary N1 * emf per turn

When the secondary is on open circuit, its terminal voltage is the same as the induced emf. The primary current is then very small, so that the applied voltage V1 is practically equal and opposite to the emf induced in the primary . Hence

$$\frac{V2}{V1} = \frac{N2}{N1} \quad \text{----------(ii)}$$

Since the full load efficiency of a transformer is nearly 100% .

I1V1 * Primary power factor __ I2V2 * Secondary power factor.

But the primary and Secondary power factors at full load are almost equal.

Therefore,

$$\frac{I1}{I2} = \frac{V2}{V1}$$

But $$\frac{V2}{V1} = \frac{N2}{N1}$$

Therefore

$$\frac{V2}{V1} = \frac{N2}{N1} = \frac{I1}{I2} \quad \text{---------- (iii)}$$

2.4 BRIDGE RECTIFIER CIRCUIT

Bridge connected Rectifier circuit is commonly used as full wave rectifier unit in most power supply unit. It is made up of four diodes connected in such a way that only two diodes conduct at any particular time. This arrangement of diodes is connected to appropriate transformer secondary that supplies the bridge with AC voltage. The output of the bridge is DC voltage. The circuit is shown in figure 2.3

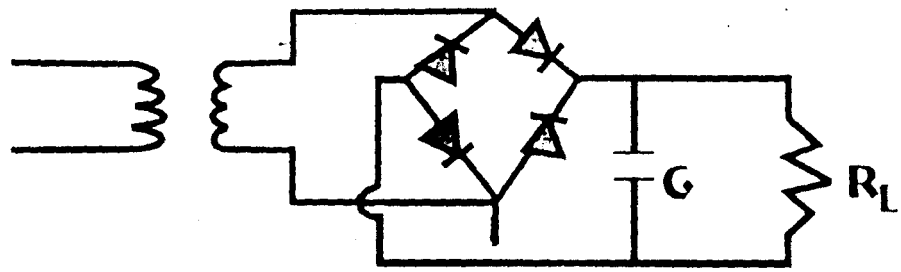


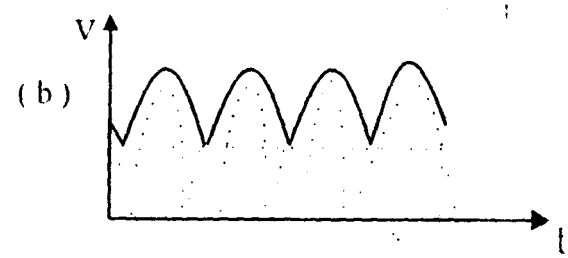
Fig 2.3

2.5 FILTERS

It is seen from the above output wave form, the output of rectifier contains ripples, in other words it's pulsating, for this reason filtering device are used to smoothen the wave form. Capacitive filter is chosen and used for this project. It is connected as shown in the above circuit. The output waveform are as shown in fig2.4(a & b).

Rectifier output

Without filter.



Rectifier output

Without filter

fig. 2.4

CHAPTER THREE

3.1 THE TRANSMITTER / RECEIVER UNIT

3.2 THE TRANSMITTER UNIT

The transmitter unit is a digital logic unit which involve descrete signals represented by binary codes of 1s and 0s.

Button 1 gives output 10

Button 2 gives output 11 logic circuit

The transmitter as part of this project generates infrared signal from the infrared source which is amplified and transmitted if there is presence of codes (high) from the logic circuit and not transmitted for absence of code (low) from the logic circuit.

When any of the two buttons is depressed, the corresponding code is stored in the 4013 (Latch). The Stepper / Controller (4017) does the inputing. The same logic unit sends the code one by one (in serial form) through the multiplexer and through the VMOS which powers the infrared source. The output logic allows only a complete code transfer.

The Oscillator divider powered by a 32.78KHZ crystal produce the control clock so that a complete code is sent within 0.5 seconds. It takes 0.25 seconds for each bit.

3.3 THE RECEIVERS UNIT

The receiving part of this project consist of a receiver but manly logic circuit as it is in the transmitting part. The receiver receives the incoming infrared signal. The amplified signal (code), (x), is linked with the receiver logic circuit. It also has an

Oscillator / divider (4060B) operating at the same speed (37.786KHZ) as the transmitter so as to be compatible with incoming signal.. the controller / Stepper arranges the incoming code into the shift register. After the whole code enters. a corresponding JK 4027 flip flop is clocked. The 7805 regulates a 5V supply for the digital circuit. from the 12V supply.

Analysis below give the detailed explanation of the different parts in the transmitting and receiving unit.

3.4 SHIFT REGISTER AND LATCH

Latches and registers are used to hold a set of bits even if the input changes. Shift register can be made of RS flip flop. D – flip flop and JK flip flop etc. A set of JK flip flop constitutes register. At each clock pulse the pattern of O's and 1s in the register shift to the right with the data at the first D input entering from the left. The latch on the other hand operates in such a way that the output follows the input when enabled and hold the last value when disabled.

3.5 CRYSTAL CONTROLLED OSCILLATOR AND STEPPER

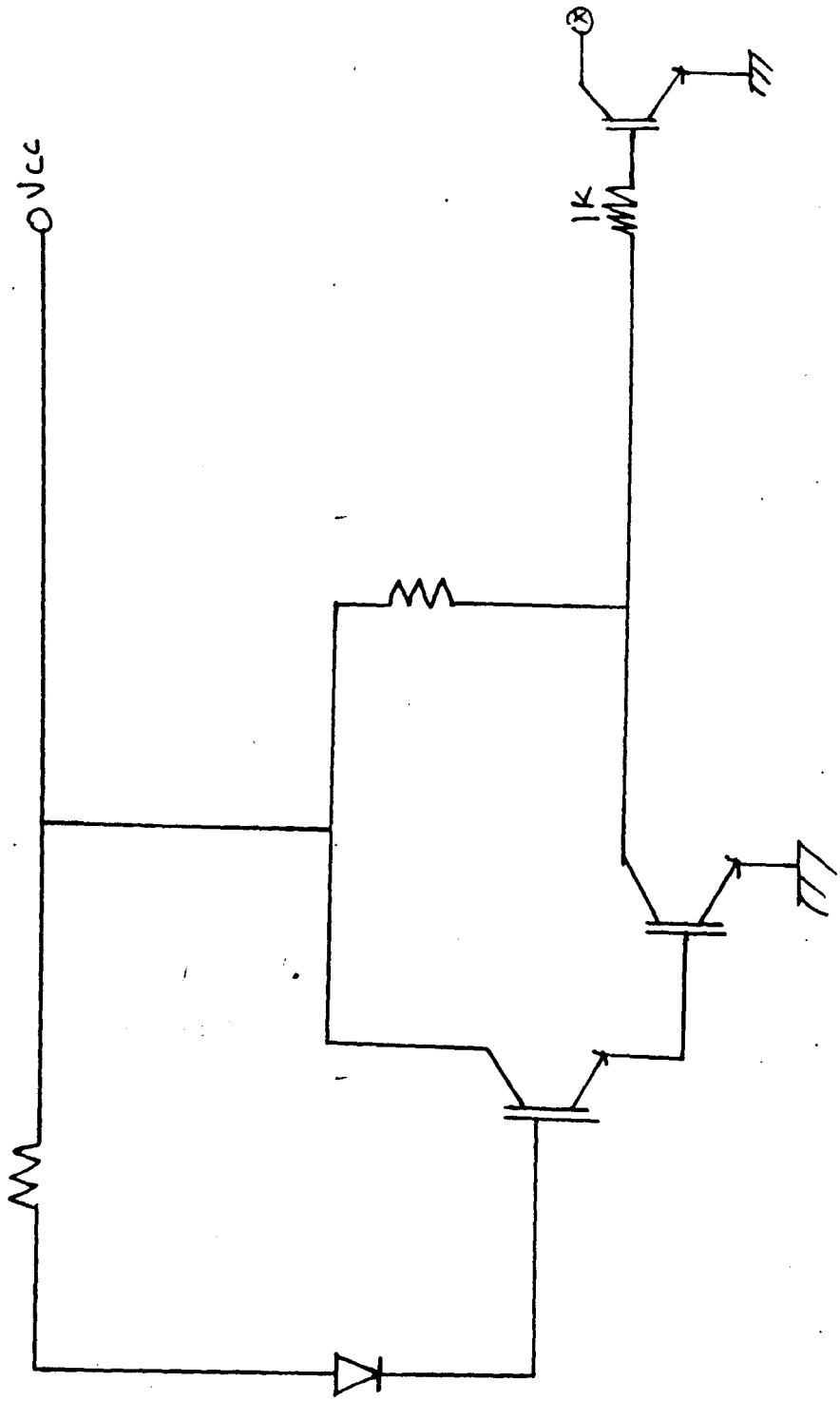
The Stepper controller does the inputing of the codes through the multiplexer and the VMOS which powers the infrared source. The clock generator circuit provides the basic thing signal to all parts of the system while the control stepper divides the pulses of the clock. Each pulse will now be used to clock any of the logic circuit according to the operation of the circuit.

3.6 JK FLIP FLOP

Considering the data sent from the transmitting part when push-button 1 was pressed. code (10) of different binary bit will be generated which will now be used to transmit signal generated by the transmitter received by the receiver and finally decoded by the logic circuit of the receiving part.

The electric motor is connected to the 4027 which is responsible for the clockwise and anticlockwise movement of the motor causing the opening and closing operation of the gate.

The circuit diagram for the transmitter and receiver is shown below.


Vcc
1K

CHAPTER FOUR

THE ELECTRIC MOTOR

4.1 MOTOR PRINCIPLE

An electric motor is a machine that converts electric energy into mechanical energy. Its action is based on the principle that when a current carrying conductor is placed in a magnetic field, it experience a mechanical force whose direction is given by Fleming's left hand rule and whose magnitude is given by F = BIL (Newton) .....(i)

Where B = Flux density, I = current, L = length

For a DC motor, when its field magnet are excited and its armature conductor are supplied with current from a source, they experience a force tending to rotate the armature. Armature conductors under N – pole are assumed to carry current upward. By applying Fleming's Left Hand Rule, the direction of the force on each conductor can be found. It will be seen that each conductor experiences a force (F) which tends to rotate the armature in anticlockwise direction. These force collectively produces a driving tongue which gets the armature rotating.

4.2 MOTOR ACTION

As the armature of the motor starts rotating, induced emf is produced in the armature conductor. The direction of this induced emf is in direct opposition to the applied voltage, and it is called counter emf or back emf Eb and its given as:

Eb = (QZN) x (P/A) (volts)..... (ii)

Where ∅ = Flux

Z = Total number of armature conductor

P = No. of motor poles

A = No. of parallel paths in armature

N = Armature rotation.

The applied voltage (V) has to force current through the armature conductor against its back emf. The electric work done in overcoming this opposition is converted into mechanical energy developed in the armature.

The power required to overcome this opposition generated by the back emf is given as:

$P = Eb\ Ia$ ..... (iii)

Where Ia = Armature current.

4.3 VOLTAGE EQUATION OF A MOTOR

The voltage (V) applied across the motor armature has to overcome the back emf and supply the armature ohmic drop.

$\therefore V = Eb + Ia^2 Ra$ ..... (iv)

If we multiply both sides by Ia,

$VIa = Eb\ Ia + Ia^3Ra$

VIa = Electric input to armature

EbIa = Electric equivalent of mechanical power developed in armature.

Ia^2Ra = Cupper loss in the armature.

The efficiency of the motor is given as $\frac{EIa}{VIa} = \frac{Eb}{V}$ ..... (v)

Thus the higher the value of Eb compared to V the higher efficiency of the motor.

Thus the gross mechanical power developed by a motor is given as

Pm = Via – Ia^2R ..... (vi).

4.4 ARMATURE TORQUE OF A MOTOR

Torque is the turning or twisting movement of a force about an axis. It is assured by the product of force and the radius at which this force acts.

Consider a pulley of radius r metre acted upon by a circumferential force of F Newton which causes it to rotate at Nr.p.m.

Then torque T= F x r (Nm) ..... (vii)

Work done by this force in one revolution is given as:

W = Force x distance = F x 2πr x N (jonle / sec or watt)..... (ix)

= (F x r) x 2πN watt.

But 2πN = angular velocity (w) in vadian / sec

∴ Power developed = T x w (watt) ..... (x)

If N is in rPm. then

$$W = \frac{2\pi N}{60} \times T = \frac{2\pi}{60}.NT = \frac{NT}{9.55} \quad \text{..... (xi)}$$

Let Ta be the toque developed by the armature of a motor running at N (.p.m) then power developed is given as Ta x 2πN (watt).

We also know that electrical power converted into mechanical power in the armature is given as

Eb Ia (watt)

Equating equation (iii) and (x) we have:

$$Ta \times 2\pi N = Eb\ Ia$$

Since $Eb = \varnothing ZN \times (P/A)$ volt, we have

$$Ta \times 2\pi N = \varnothing ZN\ (P/A).\ Ia$$

$$Ta = \frac{1}{2\pi} . \varnothing Zia\ (P/A)\ N.M$$

Thus the armature torque of a motor is given as:

$$Ta = \frac{1}{2\pi} . \varnothing Zia\ (P/A)\ NM.$$

CHAPTER FIVE

5.1 ELECTROMAGNETIC DEVICE FOR LOCKING GATE

In this work, only one of the three universally known effects of electric current (heating, chemical and magnetic effects) are relevant. It is the magnetic effects.

The magnetic effect forms the basis of the effective operation of the electromagnetic device discussed in this project. It an electric current is made to flow through a coil of wire wound round a piece of iron, a magnetic field will be set up around and in iron. The iron will be capable of magnetically attracting any magnetic material brought close to it. If the electric eurrent flow is disconnected, the magnetism is referred to as an electromagnet. It is this interesting effect of electric current that is being exploited in the construction of generators, lifting magnets, relays, which depend of the principles of electromagnetism for their various operations.

5.2 MAGNETIC CIRCUIT

5.3 INDUCTANCE

When current (I) 'ampere' flows in an electric circuit which is linked by magnetic flux, the circuit is said to have an inductance. Inductance (L) is a property of a physical arrangement of conductor.

It is a measure of magnetic flux which links the circuit when a current (I) ampere flows in the circuit.

Inductance is also a measure of how much energy is stored in magnetic field of an inductor such as a coil or a solenoid.

Flux linkage may be defined as the flux that links all the circuit multiply by the numbers of turns (N).

5.4 SELF INDUCTANCE

When the flux linkage produced is due to the current (I) ampere in the circuit itself. it is said that the circuit has self inductance (see figure 5.1 (a) below).

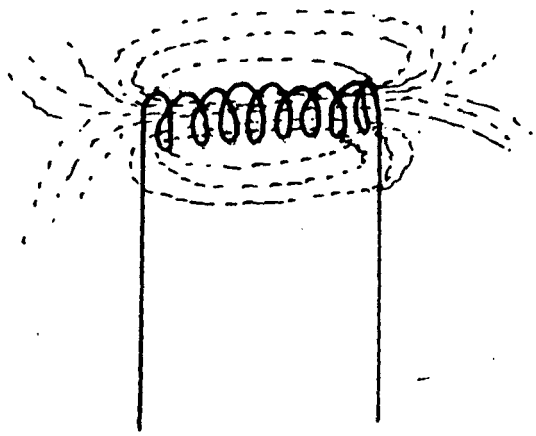


FIG. 5. 1 (a) SELF INDUCTANCE

5.5 MUTUAL INDUCTANCE

When the flux linkage in a circuit is produced by the current (I) ampere in another circuit, the circuit is said to have mutual inductance. (see figure 5.1 (b) below).

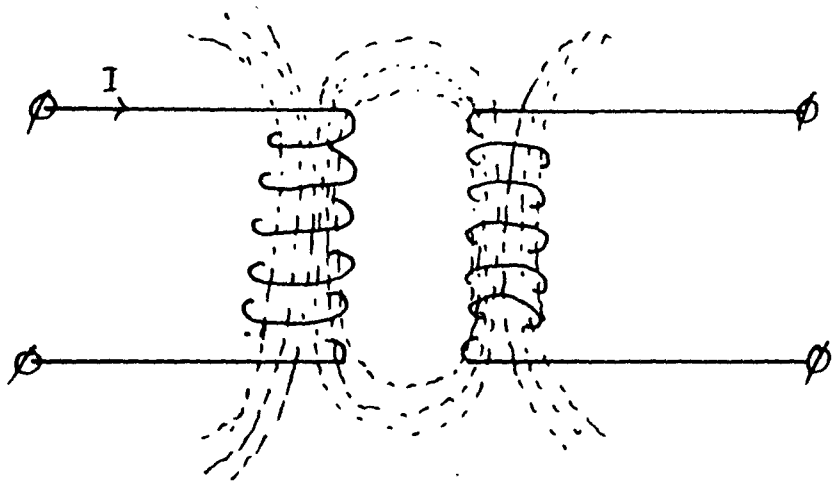


Fig. 5. 1 (b) MUTUAL INDUCTANCE

5.6 INDUCED EMF

When there is a change in the magnetic flux linking an electric circuit there will be an induced emf in th circuit. The induced emf is expressed by Lenz Law as:

$$e = \frac{d\lambda}{dt} \quad \text{..... (I)}$$

The polarity of induced voltage is such as to produce a current (I) ampere in direction as to oppose any change in the flux.

To pass a current (I) through an inductor it is necessary to apply a voltage.

$$V = \frac{iR + Ldi}{Dt} \quad \text{..... (II)}$$

Where R is the resistance of the winding

λ is the flux linking the winding

If the flux linkage (λ) in a magnetic circuit is due to it own current (I) then,

$$V = iR + L\frac{dt}{Dt} \quad \text{..... (III)}$$

Where (L) is the self inductance in the winding.

Comparing equations (II) and (III)

$$V = iR + \frac{d}{dt} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (II)$$

$$V = iR + L\frac{di}{dt} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (III)$$

$$\therefore \frac{d\lambda}{dt} = L\frac{di}{dt}$$

$$\therefore \lambda = iL$$

$$\therefore L = \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (IV)$$

Where (L) is self inductance.

If electrical circuit has N- turns the equation (V) becomes.

$L = \frac{N\varnothing}{I}$, Where $\varnothing$ is the

Magnetic flux linking the circuit.

5.7 INDUCTANCE OF A SOLENOID

In the solenoid; flux density (B), at the centre of the solenoid is a good approximation of the flux density (B) in the solenoid that links all the turns.

Then, $B = MOH$

Where H = Ampere-turns per metre length

$= \frac{IN}{I}$ (L is the length in metres)

$$B = \frac{MOIN}{L} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (VI)$$

If flux leakage is ignored, then the flux in solenoid is given as:

$= AB$

$= \prod r^2 B$

Where A = Cross section area.

$= \prod r^2 B \text{ No } \frac{NI}{L}$ ..... (VI)

Flux linkage for N-turns

$\lambda = \varnothing N$

$= \prod r^2 \text{ No } \frac{N^2 I}{L}$ ..... (VII)

Therefore the self inductance of the solenoid is

$L = \frac{\lambda}{i}$

$= \prod r^2 N2 \ \frac{N^2}{L}$

$= \frac{NoN^2A}{L}$ ..... (VIII)

It can be seen that apart from No, the inductance of a solenoid depends only on geometry of the solenoid.

$M = MoMr$

If an iron core is introduced into the solenoid the inductance will become,

$L = MoMr \ \frac{N^2A}{L}$

Where Mr is relative permiability

Mo is the permiability of free space

$= 4\prod \text{ x } 10^{-7} \text{ x/11.}$

The figures below show the physical arrangement of a solenoid.

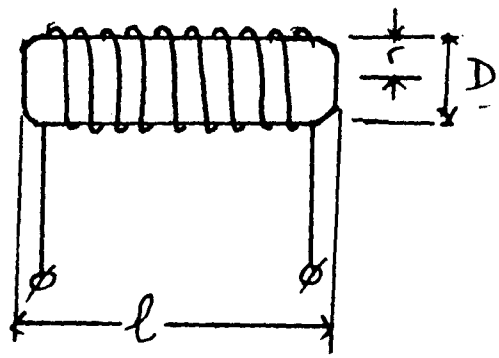


Fig. 5.2 (a)

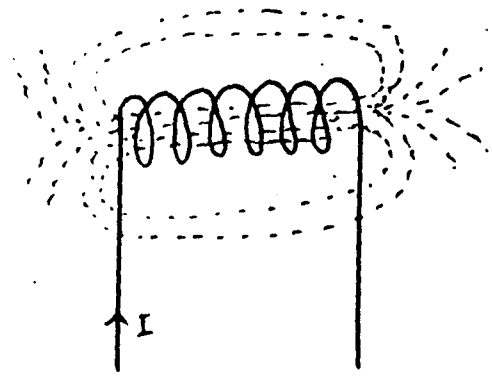


Fig. 5.2 (b)

5.8 FORCE OF MAGNET

Magnetic materials such as iron will always be pulled into regions of stronger magnetic field. A ferrous magnetic material which is brought into the field of a magnet will have poles induced in such a way that the induced North pole is opposite to the south pole.

The result is that there will be attraction of the object by the magnet. To understand why magnets attract ferrous objects, one will view the space between the object and the magnet as a gap since magnetic poles of opposite polarity exist at the ends of the air gap they will attract each other and the effect of the magnetic field will be to exert a force which will tend to close the gap. This is the reason why a relay closes and electromagnet can carry loads.

Figure 5.3. below illustrate the action between a magnet and an iron body.

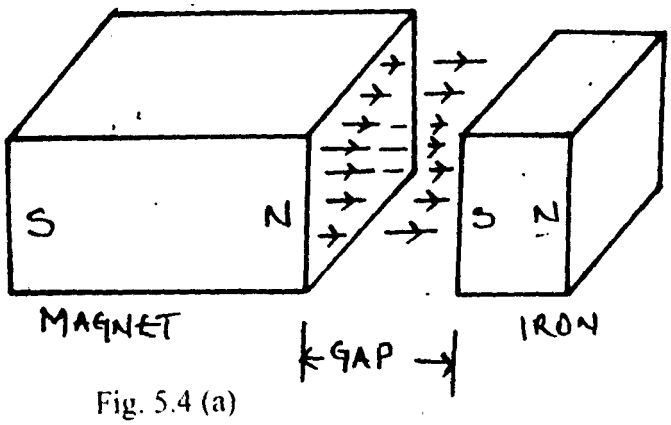


Fig. 5.4 (a)

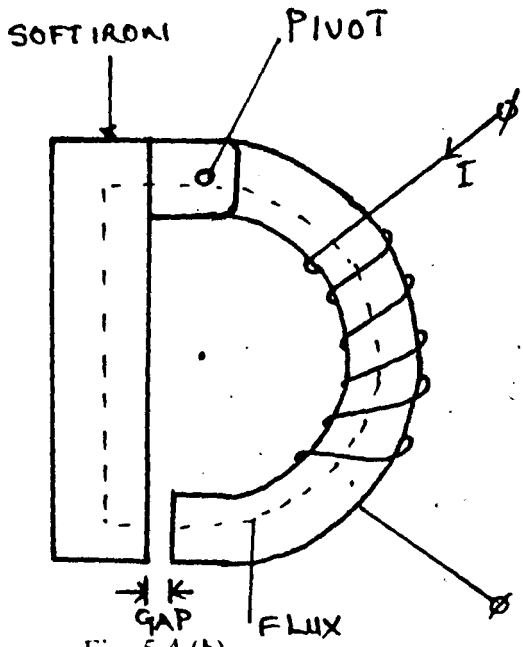


Fig. 5.4 (b)

The lifting force of an electromagnetic can be determined.

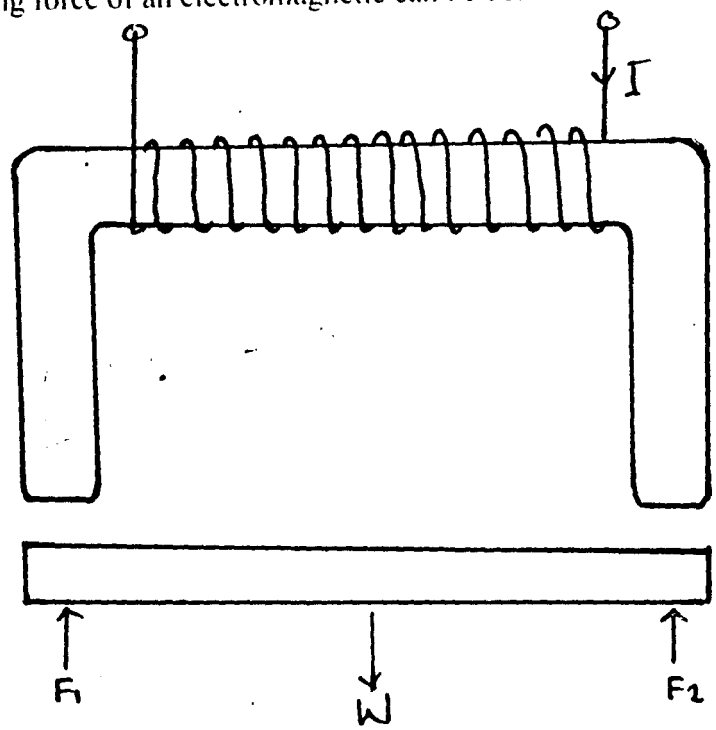


Fig. 5.4 (c)

Let 'A = Area of a small gap (x) between the upper and lower sections of electromagnet, assume tat fringing is negligible. the energy stored in each air gap is given as

$W = \frac{1}{2} MoH^2 Ax$ ..... (x)

Where Ax is the volume of the air gap.

Assume that the current (I) in the coil is allowed to change so as to keep the flux $\varnothing = AB$ through the magnetic circuit constant. Then a change is the magnetic energy (dw) of the system can occur only as a change of energy stored in the air gap.

Let a mechanical force F (Mech). Pull the two-half sections apart through a distance (dx) then the work it must do is given by dw (mag) therefore.

$W2 = 1/2M\,oH^2A\,(x + dx)$

Therefore the change in energy

$Dw\,(mag) = W2 - W1 = \frac{1}{2} MoH^2A\,(x + dx)$ ..... (XI)

Because the air gaps involved are two then

$dw\,(mag) = \frac{2M\,oH^2A\,dex}{2}$

$= MoH^2Adx$ ..... (XII)

The two energies dw (mech) and dw (mag) involeved must be equal i.e.

dw (mech) = dw (mag). before one can think of lifting. This gives for the magnetic force:

$F = MoH^2A$ ..... (XIII)

$B = MoH$

$\therefore = \frac{B}{Mo}$

Substitute for H in eqn ..... (XIII)

$F\,(mag) = \frac{B^2A}{Mo}$

$= \frac{\varnothing 2}{}$ ..... (XIV)

MoA

This actually is the lifting force.

The magnetic pressure is define as force per unit area. the the magnetic pressure on each pole face can be defined as

$$P = \frac{F}{L}$$

$$= \frac{1}{2}\frac{MoH^2A}{A}$$

$$= \frac{1}{2} MoH^2$$

$$= \frac{1}{2}\frac{B^2}{Mo} \quad \text{..... (XV)}$$

This is the same expression as the energy density for the magnetic field in the air gap.

If the air gap involved is only one like in the electromagnetic device then,

$$F = (mag) = F = \frac{1}{2} MoH^2A \quad \text{..... (XVI)}$$

$$\text{But } H = \frac{IN}{L}$$

$$\text{Substitute } H = \frac{IN}{L} \text{ in egn} \quad \text{..... (XVI)}$$

$$F(mag) = F$$

$$= \frac{1}{2} Mo \left(\frac{IN}{L}\right)^2$$

$$= \frac{(IN)^2}{2L^2} MoA \quad \text{..... (XVII)}$$

Where I = The current (I) ampere

N = The number of turns of the coil

L = Length of the air gap

A = Area of the air gap.

CHAPTER SIX

6.1 CONCLUSION AND RECOMMENDATION

The design and construction of the automatic access control was quite eventful. Some of the components used were not readily available but modifications were made to some readily available components to suit the purpose of the design.

From the test of the prototype, the project work proved successful. I sincerely believe and hope that the circuit would be appreciated and utilized by target domestic and industrial concerns where it is applicable.

6.2 RECOMMENDATION

I recommend that for further improvement, the project work should be modified for a real life situations where applicable.

Also, further improvement should be made on how to use the work for an inge gating system – which will give a precept for multipurpose application.

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