DESIGN AND CONSTRUCTION OF A DYNAMIC AND SONIC SCARECROW USING ATMEGA 328P MICROCONTROLLER

A CASE STUDY: TILDA LTD IN BUGIRI DISTRICT

A final year project report submitted to Kampala International University in partial fulfillment of the requirement for the award of the degree of Bachelor of Science in Electrical Engineering

by

Ngabijai Guleet
BSEE/44731/143/DU

Majid Yassin
BSEE/43478/143/DU

EXPLORING THE HEIGHTS

SCHOOL OF ENGINEERING AND APPLIED SCIENCE
DEPARTMENT OF ELECTRICAL AND TELECOMMUNICATION ENGINEERING

SEPTEMBER 2018

DECLARATION

We declare that the contents of this project report are entirely our research and not a copy or duplicate of any work that has been submitted to any university by any other person for the award of any academic qualification.

....

Ngabijai Guleet

BSEE/44731/143/DU

....

Majid Yassin

BSEE/43478/143/DU

APPROVAL

This final year report under the title "Design and Construction of Dynamic and Sonic Scarecrow" has been fully supervised and examined for the award of the bachelor's degree in Electrical Engineering from Kampala International University.

Name of project supervisors **Signature**

.... 02/Oct/2018 ....

WILLIAM. FREDRICK

Mr. Mukalazi ~~Alvin Williams~~ Date

02/10/18

....

Adabara Ibrahim Date

Asst. Lecturer

Email. technologyvigilant@gmail.com

Website: **technologyvigilant.wordpress.com**

DEDICATION

We dedicate this project design to our family and friends and our fellow students of electrical engineering as well as other people who assisted us in its compilation, financially and ethically. May the almighty God bless you all.

ACKNOWLEDGMENT

In the first place, we would like to take this opportunity to thank the Almighty God for His wisdom and knowledge granted to us.

We would also like to extend our sincere appreciation and gratitude to our supervisors Mr. Mukalazi Alvin Williams and Mr. Adabara Ibrahim for their tireless efforts which enabled the accomplishment of this great work through advice whenever we approached them.

We also thank our friends especially Mr. Patrick Ssonko for having rendered his service in this project. And also our parents for supporting us financially throughout the project.

ABSTRACT

Dynamic and sonic scarecrow technology is an easy and reliable way to control major avian crop pests like birds and or animals. This Scarecrow decreases crop damage by dispersing birds in a safe and human way.

The main aim of the project was to design and construct a bird repellent prototype that is dynamic and play sounds of distress to disperse off the birds. Two wireless communicating devices being controlled by an Amega328P microcontroller were developed with the help of RF modules consisting of sound producing system, rotating system and a motion sensor which were used as inputs to the microcontrollers when motion is detected, and the servo motors and the buzzer are activated.

When the system design was powered the servo motors rotated, and a sound of distress was produced after motion detection. In conclusion, the technology of this modern scarecrow has many applications which include reducing financial loss due to crop damage caused by birds, reliable, human and safe agricultural bird dispersal, and the chosen bird control system for farming industry.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ACRONYMS

I/O: Input/output

BJT: Bipolar Junction Transistor

DC: Direct Current

FET: Field Effect Transistor

ICs: Integrated Circuits

MHz: Megahertz

PIR: Passive Infrared

RF: Radio Frequency

RX: Receiver

TX: Transmitter

UV: Ultra Violet

LED: Light Emitting Diode

CPU :Central Processing Unit

ADC: Analogue to Digital Conversion

CHAPTER ONE:

INTRODUCTION

1.0 Introduction

Dynamic and sonic scarecrow technology is an easy and reliable way to control major avian crop pests like birds and or animals. This Scarecrow decreases crop damage by dispersing birds in a safe and human way. The nature-inspired technology uses bio-acoustics to protect farmland and agricultural areas. The technology of scarecrow has many applications which include reducing financial loss due to crop damage caused by birds, reliable, human and safe agricultural bird dispersal, and the chosen bird control system for the farming industry.

1.1 Background of the study

Hungry birds have always been a problem for farmers. Sometimes the birds could eat so much corn or wheat that a farmer and his family would not have enough food to last through the winter. So for more than 3000 years, farmers have been making scarecrows.

The first scarecrows in recorded history were made along the Nile River to protect wheat fields from flocks of quail. Egyptian farmers put wooden frames in their fields and covered them with nets. Therefore, protection of agricultural production areas from various animals having a tendency to damage the fore mentioned areas is an age-old problem. Farmers today still use scarecrows all over the world. In countries like India and Arab nations, old men sit on chairs and throw stones at the birds trying to eat or damage their crops.

It has been proposed, for example, to scare birds from a field through the use of stationary devices, such as scarecrows. The effectiveness of these devices, however, decreased after a short period of time because the birds or other animals became accustomed to the presence of the devices and lost their fear thereof (Sullivan, 2011). It has been proposed to scare birds from a field through the use of loud noise. Such loud noise may be produced by an air gun that ignites combustible gas at predetermined intervals (Kim, 2011). After a period of use of loud noises, however, birds became accustomed to the noise, and the scaring effect is diminished.

Farmers have also attempted to employ the use of young boys who patrolled the fields to scare away animals or birds destroying crops by physical chasing, scaring off by beating sonorous bodies like tins and jerry cans and by use of clappers to make noise to chase away birds (Wilfred, 2006). The disadvantage of this system, however, is costly especially for farmers with a large plot of fields.

In a survey carried out in 2006 by Wilfred Odongola in the main districts growing cereals (rice) in Uganda, 1375 individual farmers were interviewed, and 97.3% acknowledged that they were experiencing problems with cereal (rice) pests and diseases attacking their crops, particularly birds and rodents. Birds chew, squeeze, and feed on the grains in the milky stage of the crop. The damage shows milky white substances covering the grains. At grain maturation, birds remove the entire grains. Birds also perch panicles resulting in crop lodging.

The study identified several bird control techniques that were being used by farmers, amongst which were;

- Physical chasing, shouting and scaring off (83.5%).
- Beating sonorous bodies like tins and jerry cans (5.8%).
- Poisoning and trapping (1.2%).
- Use of stationary scarecrows (1.3%).
- Use of tapes that make whistling sounds around crop fields (0.6%).

Despite all the above attempts by the majority of the farmers, 7.6% of the farmers surveyed said that they completely did nothing about the problem of birds in cereals (Wilfred 2006, 39-40).

Although the adverse impact of birds on cereals (rice) has received much international attention in the past and is still generally recognized, little research on bird damage control is currently conducted. Therefore, it is desirable to provide a system to repel birds, and that overcomes the disadvantages of the prior arts.

1.2 Problem statement

Due to physical damage of paddy fields as a result of hungry birds feeding on them, farmers are facing a considerable loss in their paddy yield harvest in terms of quantity, quality, and monetary gains they expected to acquire from their harvests because the current traditional techniques employed by these farmers such as the use of static scarecrows are only effective for very small fields. Large commercial rice farmers also faced extensive labor requirements for bird scaring which is very expensive and sometimes it may not be available when needed. The lethal methods used for bird control such as treatment of paddy fields with avicides (chemical substances lethal to certain bird species) are not environmentally friendly since they can also be dangerous to human beings.

1.3 Objectives of the study

1.3.1 Main objective

To design and construct a bird repellant prototype that is dynamic and plays sounds/signals of distress to scare away quelea birds.

1.3.2 Specific objectives

1. To identify the current techniques used to chase away or control bird pest in the paddy fields.

2. To design a wireless communicating devices using an RF module

3. To design a sound producing system and a motion detection devices using a buzzer and a PIR motion sensor.

4. To design a rotating system using servo motors

1.4 Significance of the study

This project scares off avian pests from the paddy fields hence reducing on the physical damage the birds would cause to the crops. And thus increasing on the quantity and quality of the rice harvest as well as increasing the monetary gains to the farmers. The device saves the large-scale commercial farmers on money they would spend annually on the labor of the bird scarers. And also it is environmentally friendly compared to the lethal technique used by some farmers such as treatment of field with avicides hence making it a more desirable technique of bird rice damage control.

1.5 Scope of the study

1.5.1 Context scope: The project design is mainly limited to detection of motion of birds and animals using a PIR motion sensor which then activates the buzzer to produce sound and also servo motors for arm's rotation.

1.5.2 Geographical scope: The research survey focused majorly on rice fields in the eastern and northern parts of Uganda in the districts of Bugiri and Amuru and considers Tilda Ltd formerly known as Kibimba rice scheme as area of case study since it is the largest commercial rice scheme in Uganda producing the highest quantity of rice in the country both for export and domestic use making it the best place where bird pest control would be of significantly great importance.

1.5.3 Time scope: The entire project design took a period of about eight (8) months right from the initial topic identification up to the final design of the project. (Ref Gantt chart in Appendix 5)

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter covers the current bird pest control strategies used by farmers and their degree of effectiveness in controlling bird pest. It also covers the technologies we use in the construction of our prototype.

Many techniques are available to protect crops from bird damage. The main conclusion of this study is that the effectiveness of each technique varies with bird species involved and that optimal bird control methods combine several techniques or use them in a random fashion. Human operated scaring techniques were the most effective; lethal methods are of only short-term benefit. In Africa, traditional, low-cost methods are mainly used.

2.1 Existing systems

The bio-acoustic deterrent is a device that emits sound with frequency levels targeting different bird species and covers a wide range acoustic spectrum from below that human perceive (infrasonic) to above our hearing range (ultrasonic). Although many of the commercially available sonic pests show poor results, the use of sound as a viable treatment option still exists (DE Gomez, 2014). However, this device loses its effectiveness if they are not moved regularly and have their best results in combination with a variety of techniques.

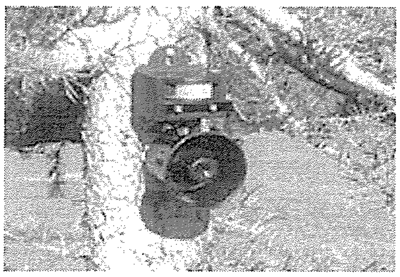


Figure 1: Showing Bio-Acoustic deterrent

The preventive method aims at not attracting birds to the field and can be subdivided into lethal and non-lethal techniques. Lethal techniques are aimed at suppressing pest bird population and are primarily implemented by national or regional (governmental) crop protection units. They include manual nest destruction, treatment with avicide (chemical substances lethal to certain bird species) and the use of explosives or flamethrowers. Non-lethal techniques include agronomic practices such as vegetation management, good weed management (as weeds attract bird), specific planning of the production season and choosing a variety with bird resistant characteristics. Religious techniques such as shamanism and fetishes are also still widely adopted in Africa (Demont, 2013).

Protective methods focus on protecting the rice crop when birds do visit the field. These include the use of repellents (chemical substances aimed at deterring birds), protecting fields or nurseries with nets or wires, covering the individual heads of ripening crops with grass or clothes, and manual bird scaring efforts. The latter may consist of a combination of auditory (e.g., noise-making devices, shouting), visual (scarecrows, flags, reflective tape) and physical measures (e.g., throwing rocks or mud) (Demont, 2013).

Motion Sensor Activated Water Spray is a deterrent that is controlled by a motion sensor that sprays a jet of water once movement is detected. The shape is also designed to resemble a large predator bird to act as an additional visual deterrent. This device is relatively ineffective in scaring birds because its effective area is governed by how far the water jet can spray, and how far the sensor can detect movement. This device is best used in very small areas such as residential gardens.

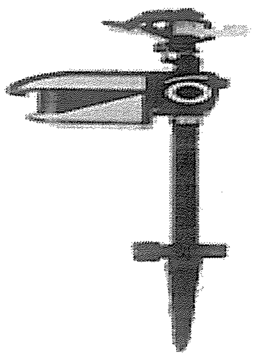


Figure 2: Showing jet water spray

In general, traditional protective methods such as manual bird scaring, flags and scare-crows can provide satisfactory protection on small-scale, privately owned farms when bird numbers are low. However, when pest bird pressure is elevated, these methods become ineffective (R. a. Bruggers, 1982) (de me, 2012). Also on large-scale governmental production schemes, these methods are impractical, costly and ineffective (R. Bruggers, 1980). This study suggests that the development of bird populations needs to be monitored and farmers need to be protected against the consequences of massive bird invasions through insurance systems (PINORD 2009). Large-scale, chemical control techniques to reduce population levels of pest birds to non-pest levels are still widely adopted in many African countries (Mullie, 1999). Literature suggests that these are ineffective, however, because they do not significantly lower populations due to the pest bird's high productivity potential and high mobility (Ward, 1979). The frequent inaccessibility of areas in which birds resides also creates a barrier to the efficient application of these chemicals. In contrast, lethal control to locally reduce pest bird numbers in the vicinity of important cereal production areas to give temporary relief has been applied successfully. However, the success of this approach varies regionally and by the control method deployed (R. a. Bruggers, 1981). It is worth noting that these approaches entail severe environmental hazards when avicide is applied (mullie, 1999).

2.2 Components used in the project

Indicators LEDs:

This allows current to flow in only one direction. By convention, current can only flow from the anode (positive) to the cathode (negative).

Current is what determines how bright a LED is. More current means more light. LED current should typically be between 10 to 20mA.Therefore a current limiting resistor is used to keep the bias current in the above range.

When current flows through the LED; a forward voltage drop of about 1.6V will develop between it spins, depending on the current. So this of this resistor as a valve-reduce it to increase LED brightness, or increase it to limit wasted power in the circuit.

Consider an LED at maximum brightness. To achieve this, a typical LED current required. Now we need to calculate the forward voltage drop across this diode with this current. Forward voltage drop is not just a function of current, but also LED color and temperature (because of the different LED chemistries) as shown in the table below.

Table 1: LED color PD definition

LED color	**Potential difference**
Infrared	1.6v
Red	1.8v to 2.1
Orange	2.2v
Yellow	2.4v
Green	2.6v

To keep the bias current in between 10 and 20mA, the following applies.

5V Supply generated by LM7805 chip has been used in this system.

Using Ohm's Law (V=IR);

(Voltage applied – Forward voltage drop)/Forward current = Resistor value (5V-vdV)Id A=Rd ohms

Where 5V is the applied voltage and Id A is the forward bias current in amperes of the LED, Vd V is the drop across the LED dependent on color and Rd is the current limiting resistor of the diode

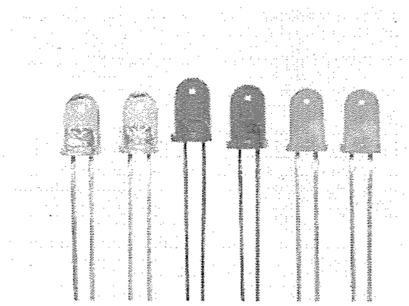
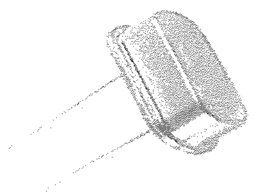


Figure 3: LED indicators

Crystal oscillator

The crystal oscillator is an electronic oscillator circuit that uses mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time to provide a stable clock signal for digital integrated circuits and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric used is the quartz crystal, so oscillator circuits incorporating them became known as a crystal oscillator. An ATMEGA328P microcontroller has a clock system with a maximum speed of 20MHZ(20mips). However, the internal system clock has a maximum rating of 8MHZ thus for a faster performance an external clock source is connected to the microcontroller pins inform of the crystal oscillator. The oscillator must be connected to two ceramic capacitors to enable its operation especially 22PF to provide a 16MHZ frequency to the microcontroller.



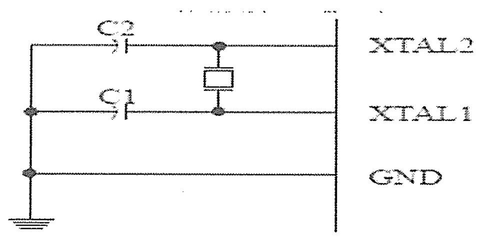


Figure 4: Crystal oscillator

Resistor

A resistor is a passive component that implements electrical resistance circuit element. Resistors act to reduce current flow, at the same time, act to lower voltage levels within circuits. Resistors may have fixed resistances or variable resistances, such as those found in thermistors trimmers, photoresistors and potentiometers .The current through a resistor is in direct proportion to the voltage across the resistor's terminals. This relationship is represented by Ohm's law:

$V=I/R$

Where I is the current through the conductor amperes, V is the potential difference measured across the conductor in units of volts, and R is the resistance of the conductor in units of ohms (Ω).

The ratio of the voltage applied across a resistor's terminals to the intensity of current in the circuit is called its resistance, and this can be assumed to be a constant (independent of the voltage) for ordinary resistors working within their ratings.

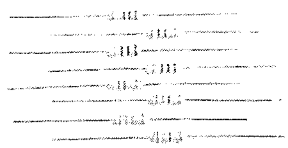


Figure 5: Resistors

Diode

Diodes are used to convert AC into DC. These are used as half wave rectifier or full wave rectifier. A semiconductor device with two terminals, typically allowing the flow of current in one direction only.

Transistor

It is composed of semiconductor material with at least three terminals for connection to an external circuit. A transistor is a semiconductor device used to amplify and switch electronic signals and electric power. A voltage or current applied to one pair of the transistor's terminals changes the current through another pair of terminals.

The RF modules

This RF module comprises of an RF transmitter and RF receiver which is used for wireless communication. The two communicating devices must be frequency matched that is the transmitter and receiver operating at the same frequency. The RF transmitter (FS1000A) is a low power transmitter that has a frequency band of 315MHZ to 433MHZ. It receives serial data and transmits it wirelessly through its antenna. The transmission occurs at a rate of 1Kps-10kps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.

The RF module is often used along with a pair of encoder/decoder. The encoder is used for encoding parallel data from transmission feed while reception decoded by a decoder. HT12E-HT12D and HT640-HT648 are some of the commonly used encoder/decoder pair ICs.

Features of FS1000ARF Transmitter

Operating voltages of 3.5-12V

Maximum distance covered is 300m

The frequency range of 315MHZ-433MHZ

XD-RF-5V(XY-MK-5V)RF receiver(RX)module:

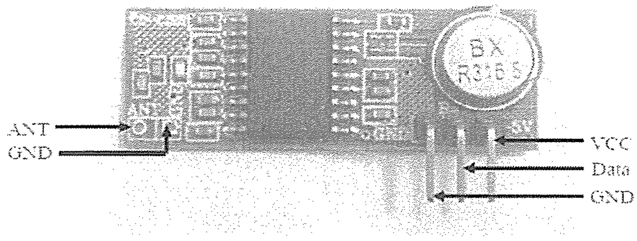


Figure 6: RF receiver module

These RF receiver modules are very small in dimension. The low-cost RF Receiver can be used to receive RF signal from the transmitter at the specific frequency which determined by the product specifications. Super-regeneration design ensures sensitive to weak signal. Cytron Technologies provides 2 types of RF Receiver Modules at either 315MHz or 433MHz for user:

Product Code Description

RF_RX_315RFReceiver315MHz

RF_RX_433RFReceiver433MHz

The application includes:

•Industrial remote control, telemetry and remote sensing.

•Alarm systems and wireless reception for various types of low-rate digital signal.

•Remote control for various types of households appliances and electronics projects.

Antenna

It is a device used to extend the electrical signal to cover a wide arrange. The user may use any soft or hardware (like Drawbars antenna) as an antenna. If the soft wire is used, do make sure it is fully extended. The distance of reception will be Influence by the length of the antenna;

The RF range without an antenna is very limited. Putting an antenna on only the Transmitter greatly extends the communication range, but putting one on each will extend it even farther. A small hole "ANT" is provided in the module to solder an external antenna. An antenna must be tuned (matched) to the same frequency band as the radio system to which it is connected. Otherwise, reception and/or transmission will be impaired. Antenna size (height) is relative to wavelength as a quarter the wavelength of operation.

The way to calculate the antenna length is to divide the speed of light by the frequency to calculate the wavelength and divide that by 4 to get a quarter length. In my case, the frequency is 433MHz to obtain rapid signal transmission.

The speed of the light is 3x10^8m/s

Wavelength=Speed of light(c)/Frequency (f)

= (3x10^8)/ (433x10^6)

=0.693m

Antenna height (h) =Wave length/4

=0.693/4=0.17m=17cm

Important Notes

If the module is used with a microcontroller, the clock frequency should be under 4MHz. Please try to keep a distance between the oscillator and the RF Receiver module To avoid the disturbance from the oscillator. The voltage supply need to stable, and the ripple voltage needs to be as low as possible, multi-level filtering is needed. (For example, add ferrite bead, inductor, and capacitor.)

Specifications RF Receiver

1. Operating Voltage5.0V±0.5V
2. Operating Current≤5.5mA@5.0V
3. Operating Principle Monolithic superheterodyne receiving
4. Modulation OOK/ASK
5. Frequency 315MHz, 433.92MHz
6. Bandwidth 2MHz
7. Sensitivity-100dBm
8. Rate＜9.6Kbps (315MHz@-95dBm)
9. Data Output TTL
10. Antenna Length 24cm (315MHz), 18cm (433.92MHz)

Power Supply with (Voltage Regulation)

It is a three pin IC used as a voltage regulator. It converts unregulated DC current into regulated DC current. Normally we get fixed output by connecting the voltage regulator at the output of the filtered DC (see diagram below). It can also be used in circuits to get a low DC voltage from a high DC voltage (for example we use 7805 to get 5V from 12V).

LM 7805 Voltage Regulator

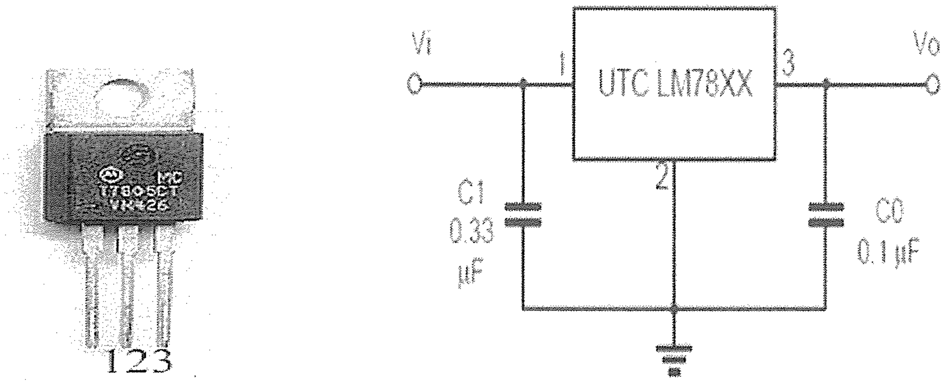


Figure 7: voltage regulator

5V Zener Diode:

A zener diode is a device that acts like a typical PN-junction diode when it comes to forward bias, but it also has the ability to conduct in the reverse-biased direction when a specific break down voltage (VB) is reached. Zener diodes typically have a breakdown voltages in the range of a few volts to a few hundred volts (although larger effective breakdown voltages can be reached by placing zener diodes in series).

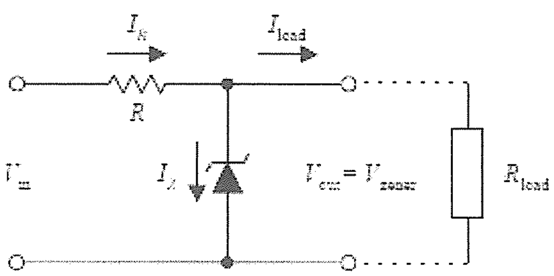


Figure 8: Zener diode as a voltage regulator

In this project design, a 5V zener diode is used to regulate the voltage supplied to a load. When Vin attempts to push Vout above the zener diode's break down voltage (Vzener), the zener diode draws as much current through itself in the reverse-biased direction as is necessary to keep Vout at V zener, even if the input voltage Vin varies considerably.

Microcontroller (ATMega328P)

The high-performance Atmel 8-bit reduced instruction set computing (RISC)-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 2KBS RAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timers/counters with compare modes, internal and external interrupts, 6-channel10-bit A/D converter (8-channels), programmable watchdog timer with internal oscillator, and five software's electable power saving modes.

The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

The ATmega 328P provides the following features:

4/8/16/32K bytes of In-System Programmable Flash with Read-While-Write capabilities,/1KbEEPROM, 2K bytes SRAM, 23 general purpose I/O lines,32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte-oriented 2-wire Serial Interface, an SPI serial port, a6-channel10-bit ADC (8channels in TQFP and QFN/MLF packages),a programmable Watchdog Timer with internal Oscillator, and five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, USART,2-wire Serial Interface, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupter hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except a synchronous timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption.

The device is manufactured using Atmel's high-density non-volatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional non-volatile memory programmer, or by an On-chip Boot program running on the AVR core. The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel AT mega 328P is a powerful microcontroller that provides a highly flexible and cost-effective solution to many embedded control applications.

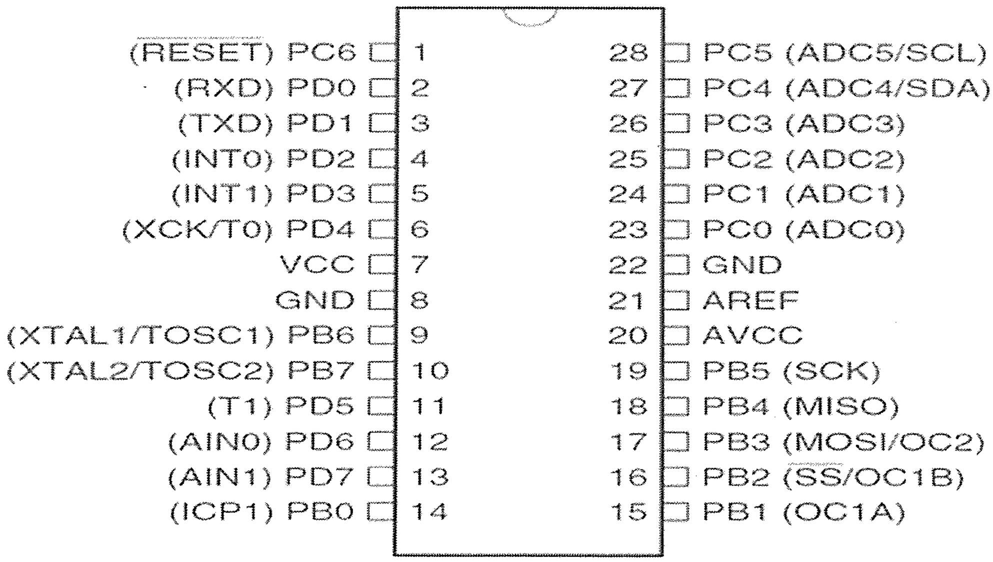


Figure 9: Microcontroller unit (ktechnics.com)

HC-SR501PIR sensor:

HC-SR501 is based on infrared technology, automatic control module, using Germany imported LHI778 probe design, high sensitivity, high reliability, ultra-low-voltage operating mode, widely used in various auto-sensing electrical equipment, especially for battery-powered automatic controlled products.

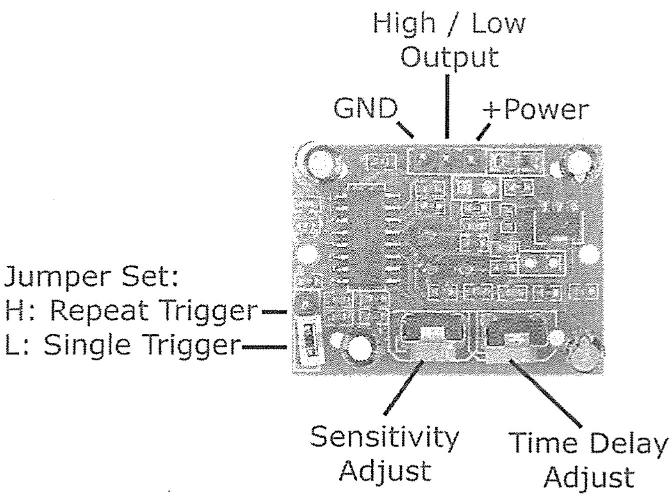


Figure 10: HC-SR501PIR sensor:

Features:

Automatic induction: to enter the sensing range of the output is high; the subject leaves the sensing range of the automatic delay off high, output low.

Photosensitive control (optional, not factory-set) can be set photosensitive control, day or light intensity without induction.

Temperature compensation (optional, factory reset): In the summer when the ambient temperature rises from 30°C to 32°C, the detection distance is slightly shorter, temperature compensation can be used for performance compensation.

Triggered in two ways: (jumper selectable) non-repeatable trigger: the sensor output high, the delay time is over, the output is automatically changed from high level to low level; repeatable trigger: the sensor output high, the delay period, if there is human activity in its sensing range, the output will always remain high until the people left after the delay will be high level goes low (sensor module detects a time delay period will be automatically extended every subject activity, and the starting point for the delay time to the last event of the time).

With induction blocking time (the default setting: 2.5s blocked time): sensor module after each sensor output (high into low), followed by a blockade set period of time, during this time period sensor does not accept any sensor signal. This feature can be achieved sensor output time “and” blocking time “interval between the works can be applied to interval detection products; this function can inhibit a variety of interference in the process of load switching. (This time can be set at zero seconds–a few tens of seconds).

Wide operating voltage range: default voltage DC4.5V-20V.

Micropower consumption: static current<50 microamps, particularly suitable for battery-powered automatic control products.

Output high signal: easy to achieve docking with the various types of circuit.

Buzzer

A buzzer is an electrical device used to make a buzzing sound, for example, to attract someone's attention or to give an alert signal. In this project it's actually going to be used to create extra awareness of the linesmen in case there is an interruption with the system during password re-entering, i.e., A sound will be produced when a wrong password is inserted

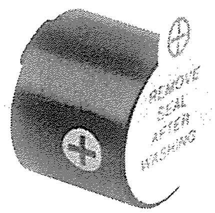


Figure 11: Buzzer

Servo motor

A servo motor is an electrical device which can push or rotate an object with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of the simple motor which runs through a servo mechanism. If the motor used is DC powered, then it is called a DC servo motor, and if it is an AC powered motor, then it is called an AC servo motor. We can get a very high torque servo motor in a small and lightweight package. Due to these features, they are being used in many applications like a toy car, RC helicopters, and planes, Robotics, machines, etc.

Servomechanism

Controlled device

Output sensor

Feedback system. It is a closed system where it uses the positive feedback system to control motion and final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal.

A servo motor has got 3 leads. The color of the leads varies between servo motors, the red lead is always power, and black or brown is ground. The other lead is the controlled lead, and it's usually orange or yellow.

A high voltage capacitor (470µF) is usually connected between the power and the ground terminal of the motor to act as a reservoir of electricity for the motor to use so that when the motor starts, it draws charge from the capacitor as well as the Arduino supply in order to avoid misbehaving since it takes in a lot of power especially during the startup process

Figure 12: Servo motor

Languages Used:

Embedded C Language:

An embedded system is an application that contains at least one programmable computer (typically in the form of a microcontroller and microprocessor or digital signal processor chip) and which is used by individuals who are, in the main, unaware that the system is computer-based. This language was used for writing the codes for the system

DC battery. This is a power supply device that is used to store the charge from the solar and later use it to provide a 12V DC voltage supply for powering the system

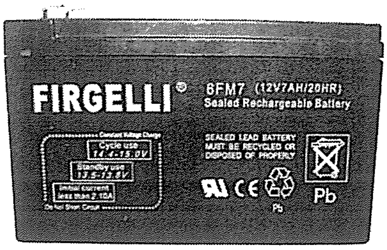


Figure 13: 12V DC battery

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter deals with the preliminary design analysis of the sonic and dynamic device. It has the general procedures for designing the control circuits, the selection of materials for construction, and design for some structural parts of the scarecrow (arms and support).

3.1 Data collection method

This involved research through textbooks, past reports in the existing bird control techniques, journals patents and browsing the different websites on the internet on the content relating to the project. In a survey carried out by Wilfred Odongola in Uganda, 1375 individual farmers were interviewed, and 97.3% acknowledged that they were experiencing problems with birds attacking their rice which could feed on the grains in the milky stage of the crop.(Wilfred,2006)

A visit was made to different farms mainly in Amuru and Tilda (U) ltd especially to farmers growing cereal crops (rice) to determine the current techniques being used for bird's control.

3.2 Analysis of the data collected

The data helped us determine various techniques being used and how we should make our design be more efficient and effective

It also helped us to know which components should be used to obtain a reliable and accurate design and also to determine which materials to be used for the arm construction and the length of each arm to cover a given space.

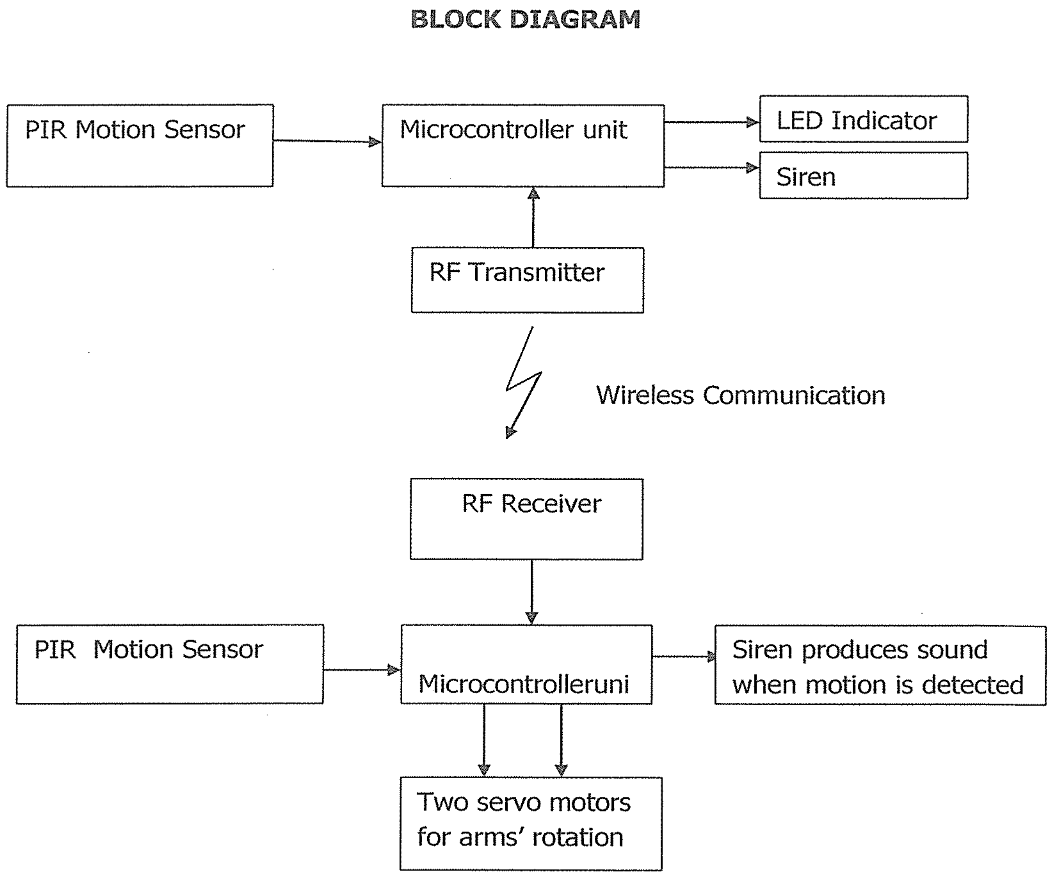


Figure 14: system block diagram

The block diagram above consisted mainly of two communicating devices designed with the help of RF modules that's a transmitter and a receiver both operating at the same frequency. The PIR motion sensor is used as an input to the microcontroller which processes the data and then provides wireless communication between the transmitter and the receiver and both the buzzer and the servo motors are activated on receiving the signal.

3.3 General description of the mode of operation of the dynamic and sonic scarecrow

The designed and fabricated sonic scarecrow consists of mainly two systems, that is, the motion producing the system, and the sound producing system. The motion gesturing system comprises of two high torque metal geared servo motors to act as arms while the sound producing system consists of siren horn speaker switched on and off by a transistor which is activated by a passive motion sensor that is integrated with the system.

3.4 System construction procedures

A transmitter circuit is made up of an RF transmitter, LED indicator, a buzzer and a PIR motion sensor connected to the microcontroller digital pins 3, 13, 10 and 2 respectively. The power terminal of the motion sensor is connected to a 12v supply. A crystal oscillator of 16MHZ was connected with two ceramic capacitors between the pins XTAL1 and XTAL2 to provide accurate timing and very fast performance of the system. A power transistor with a resistor at the base to limit the base current is connected to the ground terminal of the buzzer for switching it ON and a 12V DC voltage directed to its power terminal. A LED indicator with a resistor of 1kΩ at its power terminal to maintain the current is connected to pin 13 for indication of signal transfer. A pull up resistor of 10kΩ is connected to the RST pin to enable the system to be reset when needed. A 12V DC supply voltage from the battery is regulated and filtered to a 5V DC voltage with the help of (0.1µF, 0.33µF) electrolytic capacitors, 7805 voltage regulator and a 5v zener diode and then supplied to the microcontroller.

The receiver circuit is made up of an RF receiver, LED indicator buzzer and motion sensor connected to the same microcontroller digital pins as in the transmitter circuit. Two high torque servo motors were connected to a microcontroller on a separate circuit via two 470µF electrolytic capacitors used as an electrical reservoir to the pins 6 and 7.The signal terminal of the motors was then connected to the receiver microcontroller pins 6 and 7 for signal coordination and the power and ground terminals connected directly to a 12v power terminal and ground respectively.

Figure 15: Receiver circuit diagram:

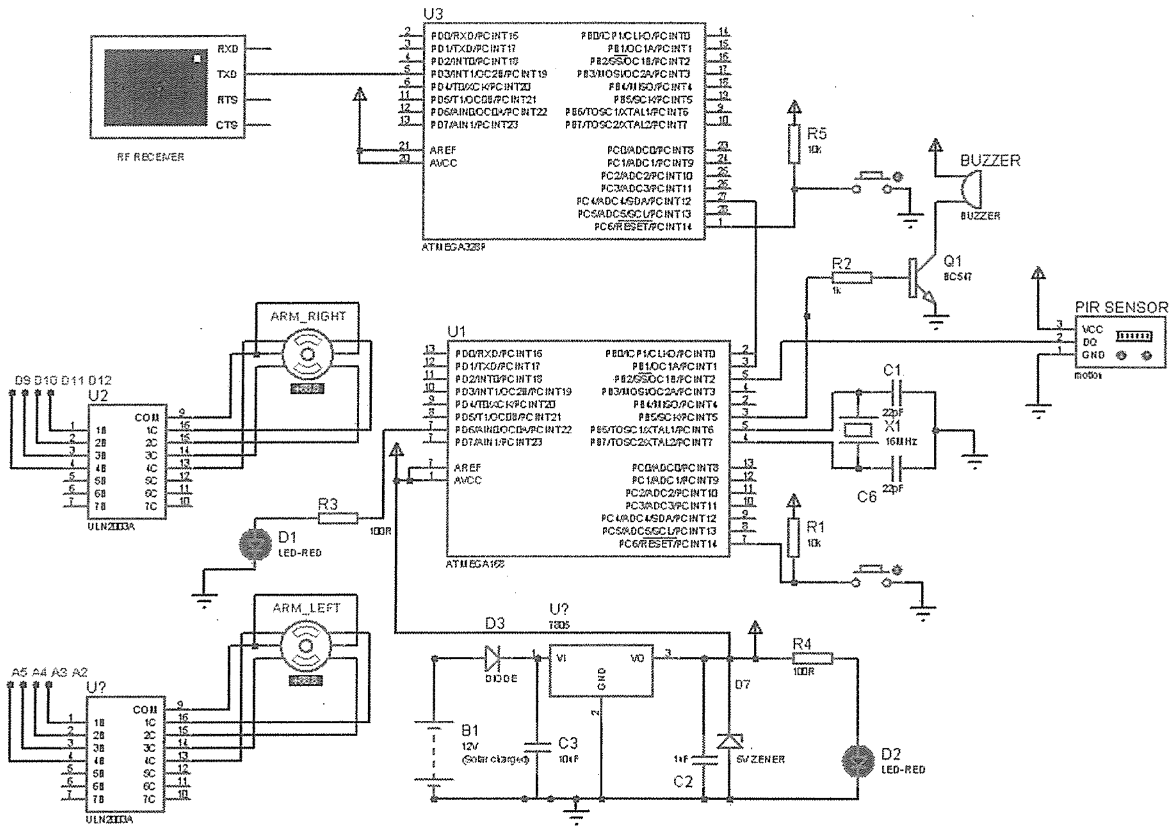
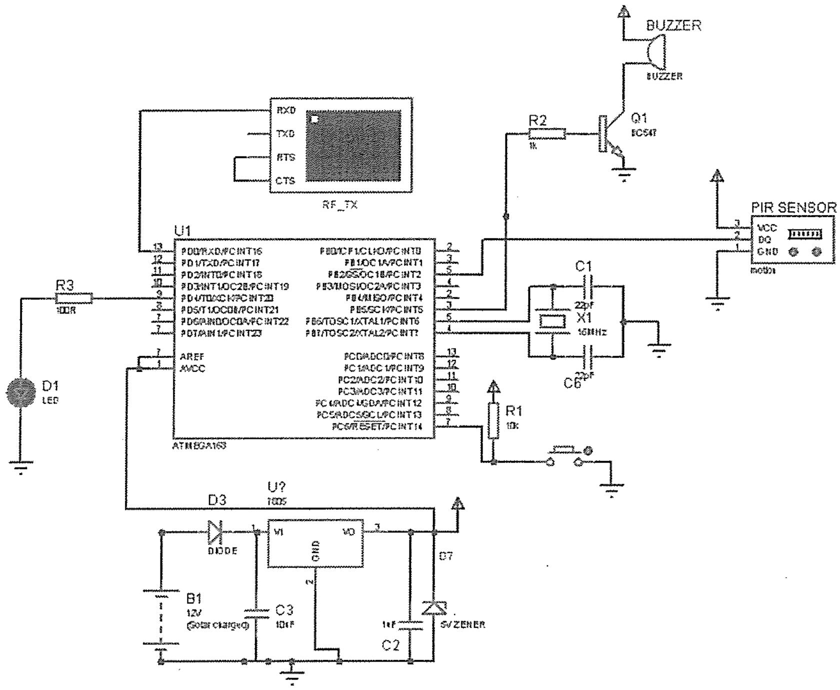


Figure 16: **Transmitter circuit diagram:**



3.5 Detailed description of the system

The system is wholly automatic and is turned on for a predetermined time interval and off by a passive infrared motion sensor set by the designer in the program uploaded into the microcontroller. The dynamic and sonic scarecrow consists of two separate subsystems operating as one system in order to make the scarecrow effective in scaring off the quelea birds from the fields making it difficult for the birds to get accustomed to the scaring technique implemented.

These two subsystems are the motion gesturing system and the sound producing system working simultaneously. The working principle of each subsystem is described in detail as below;

Motion system

The operating principle of the motion system is that a PIR sensor acts as an input to the microcontroller which sends a digital high (1/ON) or digital low (0/OFF) signal to the microcontroller depending on the differential changed sensed by it to trigger on or off the rotation system. A high digital signal is sent to the microcontroller from the PIR sensor when a bird is detected to trigger on the two servo motors to flap its arms at defined angles up and down for a specified period of time set by the designer as motion is detected. Otherwise, the PIR sensor sends a low digital signal if no bird is detected in its proximity, which means the system remains at the same state of no motion.

Sound producing system

This system consists of a siren horn speaker producing 110db of sound level intensity at 12V at 10 W, a receiver and transmitter module communicating with radio frequency between 315 MHz and 433MHz, and two PIR sensors.

The operation of this system is that the PIR sensor acts as input to the microcontroller just as the motion system. When motion is detected by the PIR on the scarecrow in its range of detection of motion, it sends a digital high signal (1/ON) to the microcontroller to switch on the siren which produces multiple sounds for a predetermined time as written in the program by the designer to produce sounds of high intensity and frequency to irritate and scare off the birds. Also a transmitter placed at different point in the field with a PIR sensor attached on sends a high digital signal whenever it detects motion to the receiver to trigger on the siren for the same predetermined time and a servo motor attached to the receiver circuit triggers the arms rotation and goes off until motion is again detected by the PIR sensor, otherwise the system sends a low digital signal which keeps the siren off till motion is detected.

Power source supply

The energy from the sun is utilized by a solar panel to charge a 12V DC battery. The 12V DC voltage is then filtered by electrolytic capacitors and regulated using a voltage regulator to provide a pulsating 5V DC .the zener diode is used to provide a fixed 5v DC supply for the microcontroller and a direct 12V DC for the siren and the servo motor

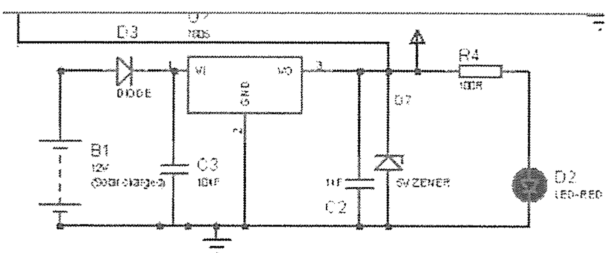
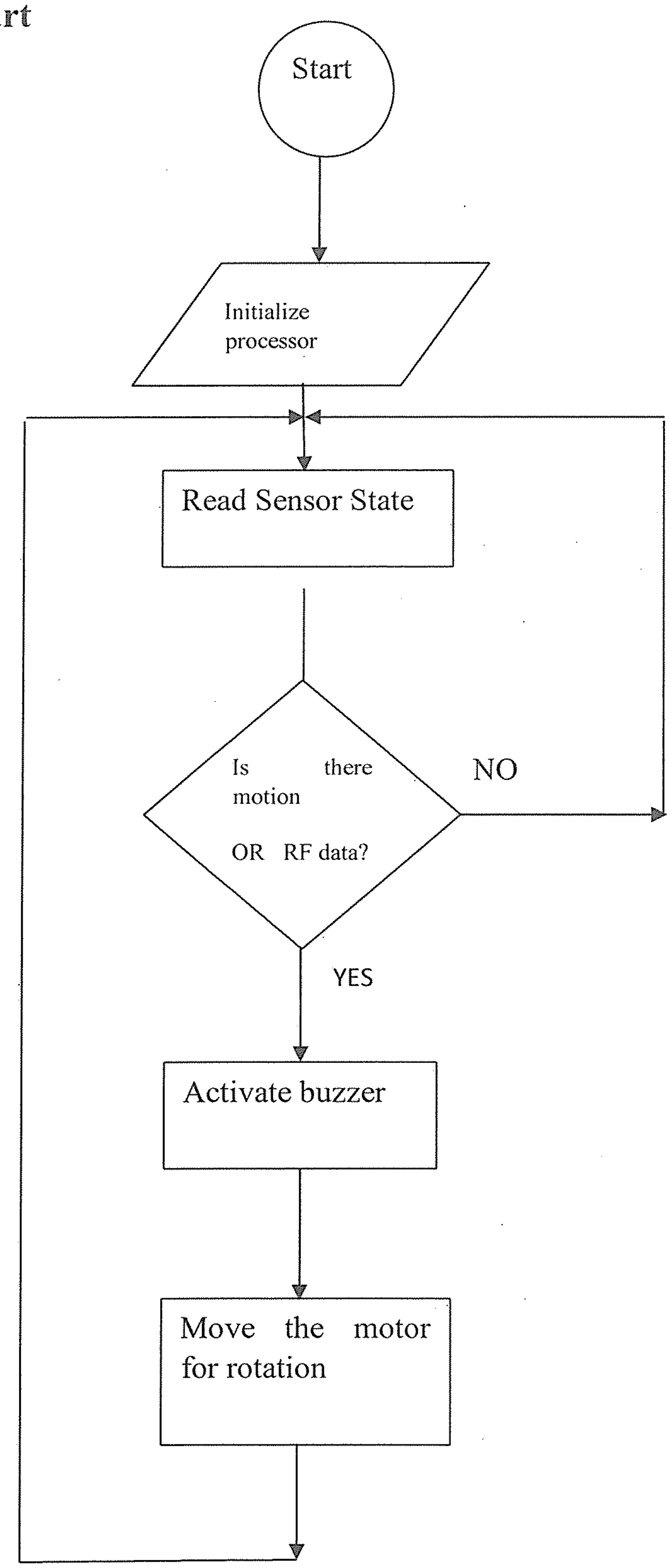


Figure 17: Power source supply

Flow Chart



The flow chart above shows the flow of command from the initial stage when motion is detected, and the output is produced in the form of motor rotation and sound production by the buzzer.

CHAPTER FOUR

SYSTEM ANALYSIS AND DESIGN

This section explained how the constructed motion system, sound producing system, and the rotating system were achieved after the design.

The transmitter circuit shown below was designed using a PIR motion sensor for motion detection, a buzzer that produced sound when motion is detected and a transmitter for sending a wireless signal to the receiver circuit. When the design was connected to a 12V dc supply, a wireless signal was transmitted to the receiver placed at the center of the garden after motion detected and a varying sound was produced.

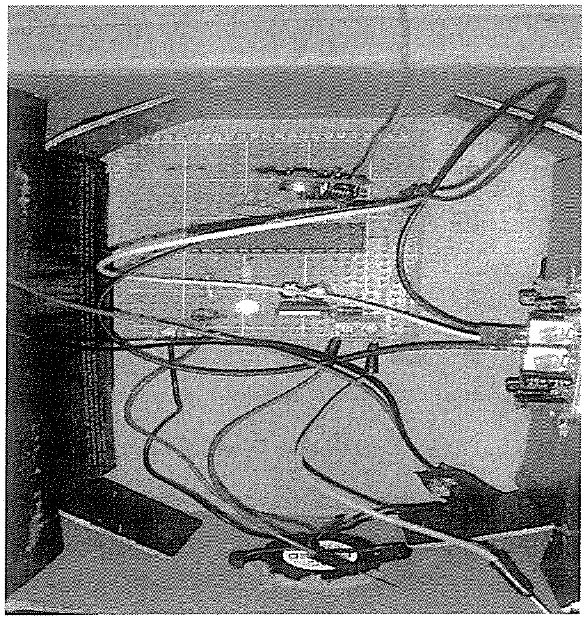


Figure 18: Transmitter circuit design

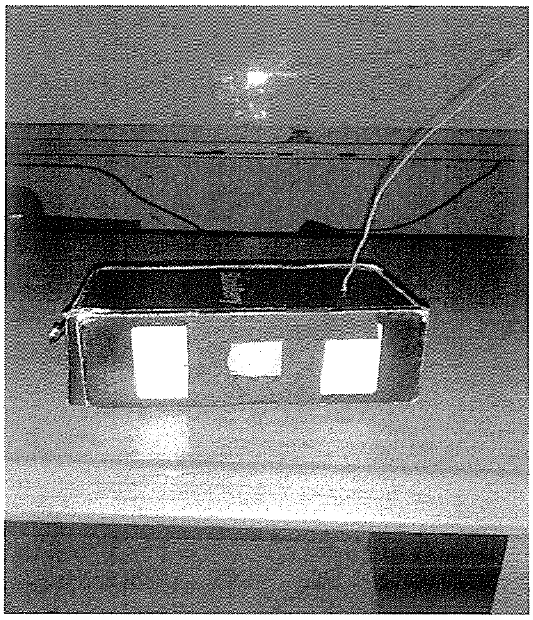


Figure 19: Packaged transmitter design

The receiver circuit was made up of a sound producing system, a rotating system , motion sensor ,receiver and a switch for disabling the design during working time. This device was activated by a wireless signal received from the transmitter circuit placed a distant away after which a varying sound was produced and the two servo motors rotated in clockwise and anticlockwise direction through 180◦ .it is placed at the center of the garden such that a good range that is up to a maximum of $300m^2$ area of the garden is covered.

Figure 20: Complete packaged receiver circuit design

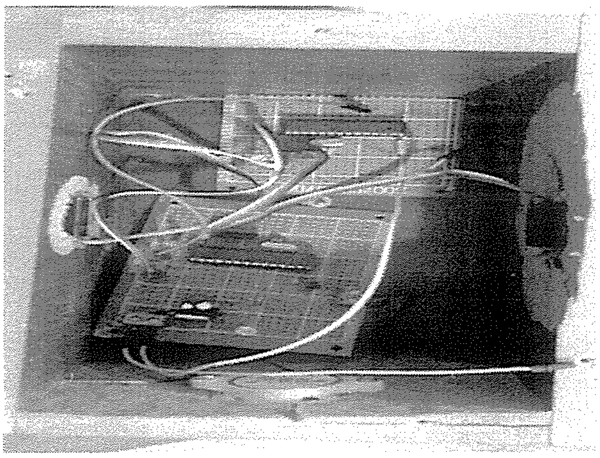


Figure 21: a Receiver circuit

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

Ultimately, the dynamic and sonic scarecrow is a very loud and dynamic device with the strong potential to scare off avian pests from the gardens of rice farms. The device has the potential to work all by itself. The system can also be used to chase away birds from airports, roofs of residential and commercial buildings, learning institutions, and offices that cause sound or noise pollution when they are in large flocks, or cause a problem of sanitation where they drop their excreta.

5.2 Recommendation

Although the device has been built to be waterproof, it is not recommended to use in a heavy downpour. The component with the highest risk of damage from moisture is the circuit board that controls the sound system and flap and rotation of the scarecrow. However, the entire device can handle light rain, foggy, hot and windy conditions.

The use of a remote switch is also highly recommended such that when workers are in the garden, the device is turned off automatically.

For a big garden, it is recommended to use more stage transmitter circuit in all corners of the garden with a master receiver circuit placed in the middle of the garden for wide and complete communication coverage of the garden.

5.3 Further research

More research should be carried out especially on image detection of birds such that bird's motion is differentiated from animals.

Real life sound encoding such as dog sound, human being and so on, should be worked upon in order to make the design more effective and reliable in the field.

REFERENCES

Works Cited

Bishop J, McKay, PARROTT, D. and Allen. (2003).*Review of international research literature regarding the effectiveness of auditory bird scaring techniques and potential alternatives.*

Bruggers, R.L, and Jaeger, M.M. (1981).*Bird pests and crop protection strategies for cereal of the semi-arid African tropics.* International Symposium on Sorghum.

Bruggers, R.L. (1980).*The situation of grain-eating birds in Somalia. proceedings of the 9th Vertebrates pest conference.* California: University of California.

Bruggers, Ruelle. (1982) *Traditional approaches for protecting cereal crops from birds in Africa. Proceedings of the tenth vertebrate pest conference.* California: University of California.

DeMey, Y.Demont and Diagne. (2012). *Estimating bird damage to rice in Africa." Journal of agricultural economics.*

DE Gomez, Nicholas Aflitto and Tom. (2014*).Sonic pest repellents.*

Demont, Yanne de Mey, and Matty. (2013).*Bird damage to rice in Africa Evidence and control.*

Kim, Chang Hwoi. (2011*).Countermeasure system for birds. Korea Patent US20110144829A1.*

Mullie, W.C.,A.O,Gadji,B' and Ndiaye.(1999).*Environmental hazards of mobile ground spraying with cyanophos and fenthion for quelea control in Senegal." Ecotoxicology and environmental safety.*

PINORD. (2009).*Study of the Agricultural Risks in the Senegal River Valley*. Senegal.

Sullivan, Brian E. (2010). *Bird or animal repellent system.*

Wilfred, Odongola R. (2006).*Final survey report on the status of rice production processing and marketing in Uganda.* Kampala.

https://ktechnics.com/shop/atmega328p-pu/

APPENDICES

APPENDIX1: BILL OF QUANTITY

S/N	PARTICULARS	QUANTITY	UNIT PRICE	AMOUNT
1	Atmega328 microcontroller	2	48000	96000
2	16 Hz crystal oscillator	2	7000	14000
3	22pF ceramic capacitor	4	1500	6000
4	PIR Sensor	2	48000	96000
5	IC Socket	2	10000	20000
6	PCB	2	10000	20000
7	Siren(speaker)	2	80000	160000
8	7805 Regulator	2	5000	10000
9	10μF Electrolytic capacitor	2	1000	2000
10	1μF Electrolytic capacitor	2	1000	2000
11	5v zener diode	2	3000	6000
12	LED	6	500	3000
13	Resistors	30	500	15000
14	RF Modules	1 Pair	65000	65000
15	Servo motor	2	160000	320000
16	Connectors	10	1000	10000
17	Transistors	5	2000	10000
18	Solar panel (20w)	2	40000	80000
19	Rechargeable battery	2	80000	160000
20	Miscellaneous			100000
	TOTAL			**1,165,000**

APPENDIX II : RECEIVER CODE

```
#include <VirtualWire.h>


const int indicator=13;

const int buzzer=10;

const int PIR=2;

const int servos=A5;

int x;

void setup()

{

  pinMode(PIR,INPUT);

  pinMode(buzzer,OUTPUT);

  pinMode(servos,OUTPUT);

  digitalWrite(buzzer,LOW);

  digitalWrite(servos,LOW);

  vw_set_ptt_inverted(true); // Required for DR3100

  vw_set_rx_pin(3);

  vw_setup(2000);  // Bits per sec

  pinMode(indicator, OUTPUT);

  vw_rx_start();       // Start the receiver PLL running
```

```
}
  void loop()
{
   noTone(buzzer);
  uint8_t buf[VW_MAX_MESSAGE_LEN];
  uint8_t buflen = VW_MAX_MESSAGE_LEN;

  if (vw_get_message(buf, &buflen)) // Non-blocking
  {
      if(buf[0]=='1')
      {
        digitalWrite(indicator,HIGH);
        digitalWrite(servos,HIGH);
    for(x=50;x<2000;x++)
  {
    tone(10,x);
  }

  delay(2000);
  digitalWrite(13,0);
  digitalWrite(servos,LOW);

      }
```

```
        else
        {
         noTone(buzzer);
         digitalWrite(13,0);
        }
delay(200);
}
}
```

APPENDIX III: CODE FOR SERVO MOTOR

```
#include <Servo.h>

Servo myservo;  // create servo object to control a servo

int pos = 0;
void setup() {
  myservo.attach(7);  // attaches the servo on pin 9 to the servo object
}
void loop() {

  for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
    // in steps of 1 degree
    myservo.write(pos);              // tell servo to go to position in variable 'pos'
    delay(15);                       // waits 15ms for the servo to reach the position
  }
  for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
    myservo.write(pos);              // tell servo to go to position in variable 'pos'
    delay(15);                       // waits 15ms for the servo to reach the position
  }
}
```

APPENDIX IV: TRANSMITTER CODE

```
//simple Tx on pin D12
#include <VirtualWire.h>
 char *controller;
 int i;
void setup()
{
 pinMode(13,OUTPUT);// pin for LED indicator
 pinMode(2,INPUT);//pin where smoke digital pin is connected
  pinMode(10,OUTPUT);// pin for LED indicator
  digitalWrite(10,0);
 vw_set_ptt_inverted(true); //
 vw_set_tx_pin(3);//pin where transmitter is connected
 vw_setup(2000);// speed of data transfer Kbps
}


void loop(){
 if((digitalRead(2)==HIGH))//if motion is detected
 {
   //digitalWrite(10,1);
   for(i=50;i<2000;i++)
   {
```

```
      tone(10,i);
    }

   controller="1" ;
   vw_send((uint8_t *)controller, strlen(controller));
   vw_wait_tx(); // Wait until the whole message is gone
   digitalWrite(13,1);
   delay(1000);
   digitalWrite(13,0);
   delay(1000);

  }
else
{
   noTone(10);
   digitalWrite(13,0);
}

}
```

APPENDIX V: GANTT CHART SHOWING PROJECT TIME FRAME