Automated Micro Controlled Shed

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Submitted to the faculty of Department of Electrical Engineering,
Military College of Signals, National University of Sciences and Technology, Islamabad,
in partial fulfillment for the requirements of B.E Degree in Electrical (Telecom) Engineering.

June 2022

In the name of ALLAH, the Most benevolent, the Most Courteous

CERTIFICATE OF CORRECTNESS AND APPROVAL

This is to officially state that the thesis work contained in this report
"Automated Micro Controlled Shed"

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under my supervision and that in my judgement, it is fully ample, in scope and excellence, for the degree of Bachelor of Electrical (Telecom.) Engineering in Military College of Signals, National University of Sciences and Technology (NUST), Islamabad.

Approved by

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DECLARATION OF ORIGINALITY

We hereby declare that no portion of work presented in this thesis has been submitted in support of another award or qualification in either this institute or anywhere else.

ACKNOWLEDGEMENTS

Allah Subhan'Wa'Tala is the sole guidance in all domains.

Our parents, colleagues and most of all supervisor Lt Col Imran Javed without your guidance we would not have completed our project.

The group members, who through all adversities worked steadfastly.

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ABSTRACT

For many years, the conventional design of the bird's cage has been in use. In most cases, a healthy bird will actively whistle at any given time. Temperature and humidity are two parameters that have an impact on the bird's health. In typical circumstances, the temperature and humidity of the bird's cage should be kept between 25 and 30 degrees Celsius, with a humidity of 77 to 80 percent. The temperature and humidity are increased much higher or lower than they should be in unusual circumstances. This inconsistency is generating health problems for the bird, such as increased or decreased appetite, lethargic activity, and abnormal whistling behaviour. The new bird cage design was implemented in order to increase the quality of the birds' health. It is supplemented with an Arduino microcontroller that controls the lamp and fan to maintain the temperature and humidity in the cage. In the event of real-time monitoring using a smartphone, it also integrated with the internet of things utilising things view. As a result, the new cage design demonstrates that the cage is kept in a normal state at all times. As a result, avian breeding has considerably improved.

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Chapter 1: Introduction

As per the American Pet Products Association's (2021 to 2022), National Pet Owners Study, approximately 91 million families in the United States own different pets. This was about 56% of American homes in 1988, and 67% in 2019. This calculation collected through birds' study that was conducted early. A table 01 is represented the number of different organism's included cats, dogs, birds, and other animals that was consider in survey [1].

Table 1: National pet survey in US shows different pets and their approximate number

Pet	Number
Freshwater fish	139.30 million
Small animal	14.00 million
Reptile	9.400 million
Cat	94.20 million
Marine fish	19 million
Dog	90 million
Horse	08 million

According to this study pet placed at fourth number among all other organisms. By observing this information, we can say that pet industry is establish business and need a lot of money to run this business. In the United States, overall pet sector spending round about $103 billion, that increased up to 06.7 percent from the year 2019. Now in 2021 the expenditure of this industry reached up to $109.6 billion [1].

Table 2: comprehensive summary of expenditures ($ billions) that bear by owner of pet industry.

Pet	Number
2012 -2014	53 to 58 $ billion
2014 – 2016	58 to 67$ billion
2016 -2018	67 to 91 $ billion
2018 -2020	91 to 104 $ billion
2021	124 $ billion

The birds are beautiful creature with attractive sounds and feathers. There breeding and growth required a lot of care. There are different types of cages used to provide protection and necessary

things to birds for better health. But at the same time common cages have pose a lot of problems in term of disease and ineffective control of external factors like immediately spread of infectious diseases to the other birds, maintaince of optimum temperature, light, and special care in term of food. The bird's waste muster checked is perform on a routine basis inside the cage to prevent sickness and as well as extend safety of organisms So, there is a need for more efficient cages that work smartly. They should monitor the different variables (temperature, nutrients requirement, light) and as well automat clean the cages from the waste of birds and promote healthier environment [2], [3].

1.1 Overview

The pet industry is very important as we discuss above and to run this industry an appropriate capital is required. The cost effective and efficient cage in smart shape is necessary to run all function efficiently. There are different variables (seasonal changes, humidity, and temperature) that are necessary to control for well being of birds as these factors affect the breeding period of the birds. According to the literature review optimum temperature for a lot of bird's population is in range of 25 to 300C. Water is crucial as birds regulate their body temperature and as well discharge waste material. Birds can live without food for up to one day, but they can't survive without water. So, water monitoring is very important. The bird poop is another hurdle that hurts people and birds are harmed. The humidity is another very important factor that greatly important during breeding, according to the previous experiments the ideal atmospheric humidity level is between 77-80%. Therefore, to monitor all these factors new and modern cages is required. As smart cage has ability to monitor and control humidity, temperature, eating, cleanliness, and drinking of birds [4].

Fig. 1. 1: This picture represents commonly use four different types of cages for birds. A: is iron rolling birds cage, B: is stainless steel birds cage, C: breeder birds cage, D: simple bird cage

1.2 Problem Statement

United States is one of the developed countries that contain a huge number of pet animals as exact numbers of different pets mention above. Birds are ranked 4th among observed pets. Common cages for their protection generally used that postured a lot of problems. To counter the drawback of common cages the efficient and automatic control innovative cage is desirable. The purpose of this project is to design smart bird cage that automatic controlled by owner, this cage is design to perform following tasks like:

- Programmed cleaning of bird's waste
- Automatic control on feeding
- Remote monitoring of cage
- Proper maintenance of temperature, light, and humidity

This novel cage connected with android application. The owner can check application anytime and switch its featured according to the need of the birds.

1.3 Proposed Solution

The major goal of our proposed solution is to continuously monitor the birds cage and keep all variables in optimum range. Traditional cage of pets must be replaced by smart automat controlled novel cages. The proposed innovative cage can optimize all factors by different sensors to maintain healthy environment within the cage. Another important feature of our proposed cage is to detect temperature variation and properly manage the environment by switching electric fan our light according to the situation. The aim of this research is facilitated and maintain healthy environment so that birds can enjoy healthy life and capable to fight with disease.

1.4 Working Principle

The automatic controlled cage keeps Android and Arduino to control and monitor internal environment of cage. The temperature is mange by Arduino. If temperature move upward from the optimum limits the electric fan turn on and at the same time light turn off. If the opposite situation is occurred, then lighter senser observe the situation and light turn on and at the same time fan turn off. In this way sensors properly manage the situation. One other function of Arduino is cleaning. The pump and motor automatically clean the waste of birds. Various types of sensors used for efficient working of the cage. The internet connection is required for safe monitoring of the novel cage [5], [6]. The smart bird cage is monitor by Mobile application that has following parts:

- ESP32S use for microcontrollers
- HC-SR04 ultrasonic sensor

- Micro Servo Motor SG90
- Water pump
- DS18B20-Temperature sensor
- Electric Fan
- DC gear motor
- Firebase database

1.5 Objectives

“To build an innovative state of the art software integrated hardware prototype guided by smart coding and providing a smart solution for bird health and safety.

1.6 Scope

This project finds its scope wherever there is birds sanctuary or movement of birds in truck for far away areas. It is an innovating state of the art software integrated hardware prototype providing a smart solution to enhance the bird care. its not only about saving life of birds but provide and artificial intelligent solution which reduce the labour cost.

1.7 Structure of Thesis

Chapter 2 contains the literature review and the background and analysis study this thesis is based upon.

Chapter 3 contains the design and development of the project.

Chapter 4 introduces detailed evaluation and analysis.

Chapter 5 contains the conclusion of the project.

Chapter 6 highlights the future work needed to be done for the commercialization of this project.

Chapter 2: Literature Review

A unique product is introduced by altering and upgrading the features of formerly launched identical products. A literature review is a crucial step in turning an old concept into a new product. Similarly, when it comes to smart pet cage creation and replacement of traditional pet cage into innovative smart bird cage a thorough examination of all similar proposals is required. Our research is divided into the following points.

- Examination of existing birds' cage
- Advantages and disadvantages of generally used cage
- Automatedly controlled smart birds' cage

Various families in US contains different types of pets and in these large variety of pets birds ranked 4th [7]. Generally, these birds kept in cages that has some advantages but at the same time these cages pose a lot of problems like no control on external and internal factors. These cages manually operated for lighting, drinking, and eating. People with a hectic schedule or who often leave the house will find manual cage maintenance tough. As a result, the researchers came up with the idea of creating an innovative Smart Bird Cage that operate automatically. Researchers are concerned about the advancement of studies on animal cage automation as technology becomes more sophisticated. The use of latest technology to decrease the workload of actual people involved in the birds raising process is smart mobile applications. This application is monitor and automatically control the smart bird cages. In smart birds cage the automatic control system used microcontroller hardware and software and different decision-making approaches is used for better performance. Until date, automatic control systems for residences, animal cages, the environment, and roadways have been the focus area of research for research community. A monitor system is needed for an automatic control for examining the object's condition anywhere

at any time [8]. If the examined object is located far away from the control centre, remote monitoring technology becomes a viable option. The Internet of different things is one type of application that cannot be isolated from an automatic control system at present moment. All operations can be monitored and managed remotely using a wireless network. It is feasible to develop a system for bird nests which will make caring for birds for breeders. Smart Bird Cage is a bird cage management system that is design for final project. Smart Bird Cage is a smartphone-based bird cage management solution that can assist birds in breeding. Here, ESP32S use for microcontroller, HC-SR04 ultrasonic sensor, Micro Servo Motor SG90, Water pump, DS18B20-Temperature sensor, Electric Fan, DC gear motor, Firebase database are used to make automatic controller systems. As a result, the smart bird cage load may be remotely regulated and monitored. The researcher expects that by creating this mobile application, bird breeders will be able to better care for and monitor their bird cages when they are not at home [6], [8].

Chapter 3: Modules

3.1 Microcontroller

Microcontrollers are compact microprocessors that used to control inserted systems in office equipment, robots, home appliances, smart birds cage, automobiles, and a variety of other devices. Memory, peripherals, and, most crucially, a CPU are all included in a microcontroller. Here author used NodeMcu ESP-32S modules as microcontroller to build smart bird's cage. The microcontroller NodeMCU ESP32 is an ESP-WROOM-32 module, it is a breadboard friendly form factor. By using this module, you can create your idea on a breadboard. The program created on this device by connecting with computer by using Micro-USB cable. The red LED represent power supply option and placed high on the device. Then move toward Tools and select port according to desired ESP [9].

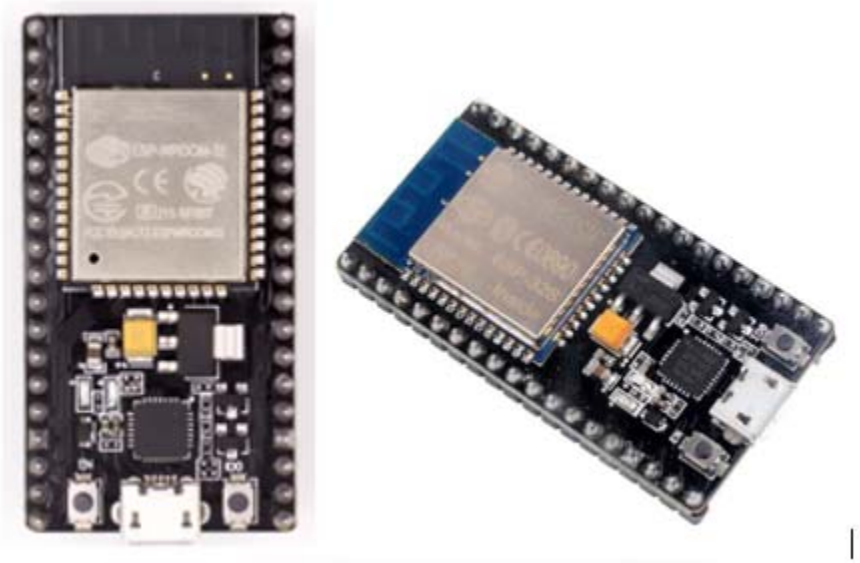

Fig. 3. 1: NodeMcu ESP-32S

3.2 HC-SR04 ultrasonic sensor

The ultrasonic distance sensor HC-SR04 is seen here. With a range accuracy of up to 3mm, this affordable sensor provides non-contact measurement functionality from 2cm to 400cm. Its main

function is distance determination in target and the sensor, it has high accuracy detection and consistent readings in a simple package. It generally comes with four pins. This sensor primarily catches sound waves [10].

Fig. 3. 2: HC-SR04 ultrasonic sensor

3.3 Micro Servo Motor SG90 & water pump

The SG90 micro servo motor is a small and light server motor that has high output power. The servo can spin 180 degrees as whole and 90 degrees in each direction. The functions in the same way as the regular types but is smaller. Motor use servo code library or hardware for controlling purpose. The water pump used along this motor that perform cleaning function [11].

Fig. 3. 3: Micro Servo Motor SG90

3.4 DS18B20-Temperature sensor

A little temperature sensor with an integrated 12-bit ADC. This sensor effortlessly connects to an Arduino software. The sensor uses a one-wire bus to communicate and requires few extra components for proper function. The accuracy of sensors ±0.50C in the range -100C - +850C [12].

3.5 Electric Fan

The smart birds cage has electric fan, it is used to optimize the temperature according to the desirable condition. When the temperature exceeds the stated maximum limit of 300C, the electric fan appears to work, and the lights goes turn off [13].

3.6 DC Gear Motor

A gear motor combines a motor and a gearbox into single unit. When a gear head is added to a motor, the speed is lowered but the torque output is increased. The best gear motor for smart birds' cage is choose after accurate calculation of speed, torque and load. The efficiency of gear motor can be increased by adding the unique gearheads [14].

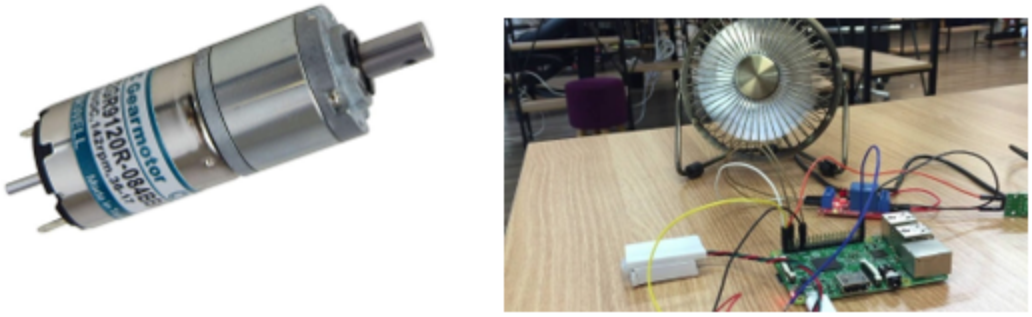

Fig. 3. 4: DC gear motor & electric fan

Chapter 4: Function of smart bird's cage

4.1 Cleaning system

The cleaning system of smart bird's cage consists of different components like VNH2SP30 single monster motor driver, DC gear motor, conveyer belt, conveyer roller, L298n motor driver, ultrasonic sensor, cleaning brush and water pump. During the wash cycle, the motor drives the brush forwards then back to the original position and while the pump moves, the pump also sprays water during the moving process, so the brush moves while spraying water on the cage's base. In this way smart bird cage clean automatically.

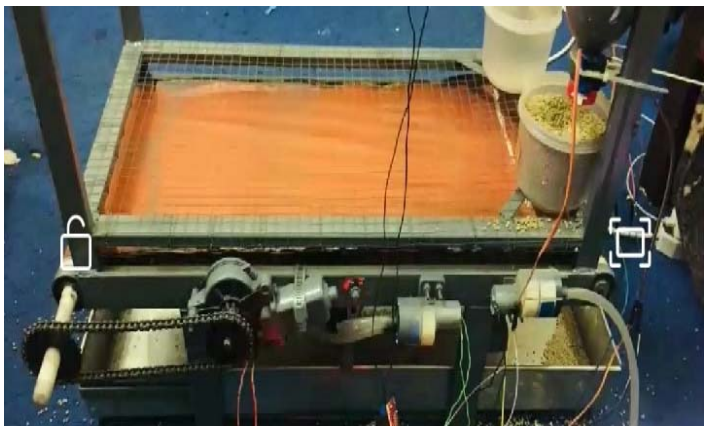

Fig. 4. 1 Cleaning system of SBC

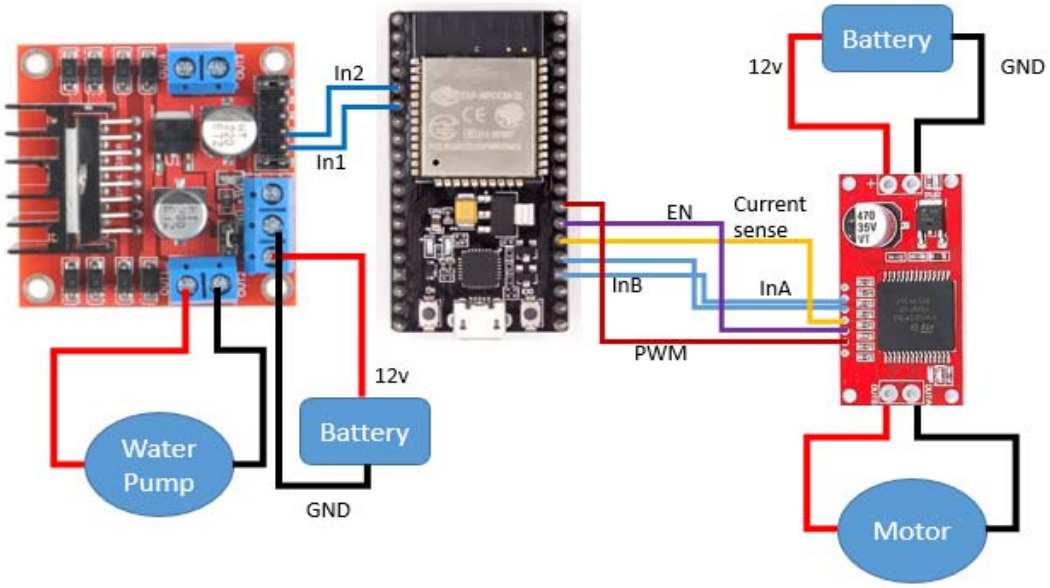

Fig. 4. 2: Circuit Diagram of cleaning System

4.2 Feeding System

The feeding system of the smart birds' cage consists of following components like ultrasonic sensor, servo motor, water pump and L298n motor driver. The feeding is performed by using these small devices that act combinedly. The working principle of each device described individually in above section. The figure 7: represent the feeding circle of smart birds cage.

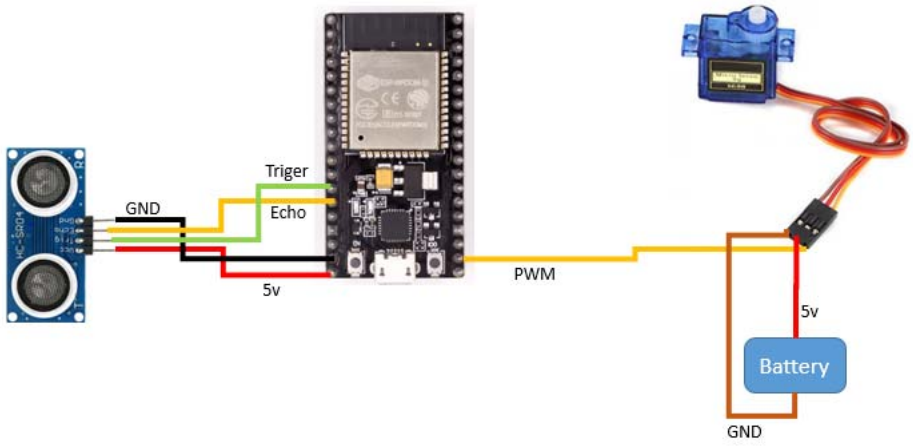

Fig. 4. 3: Circuit Diagram of feeding System

4.3 Temperature Maintenance

The Temperature is kept within the optimum range with the help of DS18B20 temperature sensor and L298n motor driver and electric fan. The circuit diagram represents the working principle of temperature maintenance.

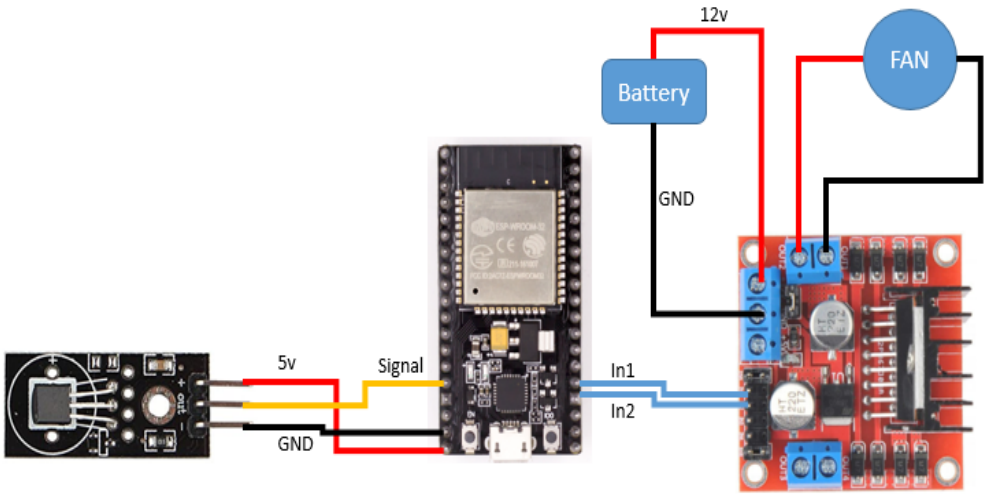

Fig. 4. 4: Circuit diagram of temperature maintenance

4.4 Monitoring

The monitoring is performed by V380 IP Cam. This digital outdoor camera has high precision digital zoom system. The has effective night visibility & motion detection.

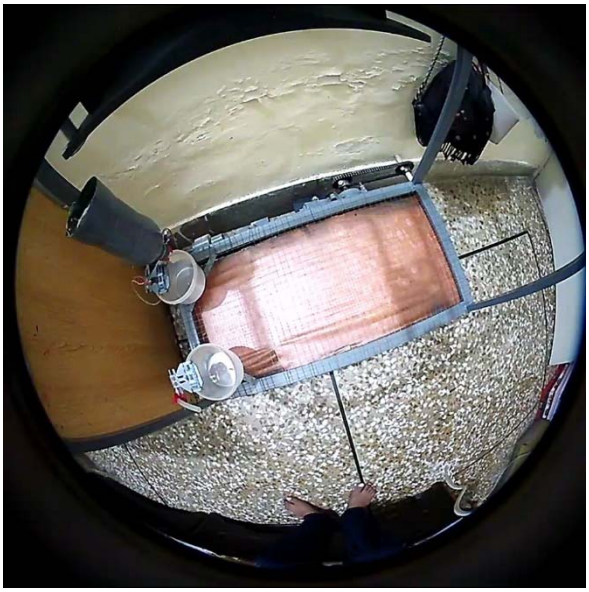

Fig. 4. 5: View of SBC with IP CAM

4.5 Software

The software used to perform mobile application these are Arduino IDE & Android Studio. The Arduino IDE software is an open-source programme for developing and submitting code to Arduino boards. The IDE programme is compatible with a variety of operating systems as it used to support the programming languages C++. The author use this software as it has a lot of benefits like easy to use, and low cost. It can be used for beginners to develop simples' devices as well as it can be used for advanced purposes. The Android Studio is a unified development environment that allows author to create apps for different devises like android, auto mobile phones, tablets, android wear, android TV, and. Structured code modules. It can perform different tasks independently for more efficient working [15].

Fig. 4. 6: Arduino IDE and Android Studio software

Chapter 5: Conclusion

In this thesis, we discussed a novel automatic control cage that can handle different variables (feeding. Cleaning, temperature, light, and surveillance of birds on demand) smartly and more efficiently than the typically used birds' cage. Our proposed smart bird cage has an advantage over other traditional pet cage due to the latest microcontroller system used for the detection of appropriate condition of the cage. Various component (ESP32S-microcontroller chip, HC-SR04 ultrasonic sensor, Micro Servo Motor SG90, Water pump, DS18B20-Temperature sensor, Electric Fan, DC gear motor) used in our proposed mobile application. The application monitored and checked by two software (Arduino IDE, Android Studio). The Arduino Software (IDE) is integrated develop environment. The coding is done by text editor and a series of menu contain a message area, button for common operation, and toolbar. The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. It links to Arduino to upload and communicate with programmes. Android Studio it is also integrated software for operating automatic control function. This software specifically used for mobile application. The proposed pet cage performs different tasks like automatic cleaning of cage performed by water pump that minimize the risk of disease spread. The internal temperature operates by DS18B20-Temperature sensor. These sensors detect the changes in temperature and handle the situation according to the desired needs by using electric current and light. The feeding need of the birds is also observed by this mobile application. Based on the findings of the research it is conducted that on android, the temperature changes is displayed, that function correctly in real time over an internet connection. When the temperature falls below the set minimum

temperature, the software can turn on the light and when the situation moves in reverse phase the electric fan is turn on if the temperature rises above maximum optimum limit. So, in this novel cage the temperature can be regulated in acceptable bounds. The smart bird cage is clean the waste of birds. When cleaning bird droppings from the cage base, the tool can instantaneously turn on the motor to move the brush and the pump to spray water for cleaning purpose.

Chapter 6: Future Work

Future milestones that need to be achieved to commercialize this project are the following.

6.1 Access to real life traffic signal:

The main objective of this project is to produce a product that is portable, easily attached and operate at mobile application. During the preparation of this project, we tried to access this project from lab to large scale but due to limited and we were unable to gain this target. For real time processing, in future we are looking forward to acquiring more accurately controlled and increased real life of smart bird cage.

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