To Find the Optimum Light Intensity to Get Maximum Egg Production in the Poultry Industry

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering.

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APPROVAL

This Project titled "**To Find the Optimum Light Intensity to Get Maximum Egg Production in the Poultry Industry**", submitted by MD Nwoshad Alam Chowdhury and MD ABDULLAH AL MASUD to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 4th January, 2022.

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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Dr. Fizar Ahmed, Assistant Professor, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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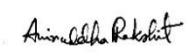

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ABSTRACT

With the growing of population, the poultry industry is also growing simultaneously to increase egg production. Therefore, maximum egg production in the poultry industry will be beneficial for both vendors and consumers. There are some major factors such as feed consumption, water intake, light intensity, disease, environmental factors, parasite infestation, and numerous management which can affect egg production. So, this work has focused on the impact of light intensity to get maximum egg production. Therefore, we have observed at poultry layers egg production over four weeks in a light-controlled house and collected the light intensity value for the duration of an average of 6-8 hours each day. We have also increased and decreased light intensity after 3-4 days respectively to monitor the egg production at various light intensities. So, our dataset contains light intensities along with dates and times and for observation, we have developed a web application and through the web application, we have recorded per day egg production with respect to a specific date and we have also observed that when light intensity remains 5-15 lux the egg production is higher than light intensity 15-30 lux. For the purpose of predict the egg productions over different light intensities, we have used several machine learning approaches such as linear regression, logistic regression, support vector regression, and random forest regression which provides around 99% of accuracy.

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CHAPTER 1
Introduction

1.1 Introduction:

The egg is not only one of our indispensable daily needs but also contributes immensely to the economy. Egg contains protein, vitamins, and minerals. At the same time, many people become financially self-reliant by doing the business of egg production. The need for eggs getting increasing day by day. According to 'Poultry World', global egg production is growing significantly, with recent figures suggesting a 24% increase over the past decade. Projections from 'The Food and Agriculture Organization' (FAO) of the United Nations suggest that global egg consumption will rise from 1997 to 2030 approximately 2.4 kg per person per year in developing countries and 0.3 kg per person per year in developed countries.

Additionally, FAO predicts that the world's production of eggs will reach 89.9 million metric tons in 2030. If we look at the economic relevance of the egg sector, then it makes clear that a total of 4 million persons are employed by the egg sector. According to 'International Egg Commission' (IEC), the economic value of the egg sector at the farm level is estimated to be 92,000 million US$ and this goes up to 145,000 million US$ at retail level.

To achieve these goals, light intensity is one of the vital elements to consider seriously. The number of lumens falling on a surface is referred to as light intensity. Optimum light intensity is required to get the ideal result of egg production. Light can help by releasing the hormones which are responsible for reproduction. It also enhances the reproduction and behavior of poultry. The light helps the development of vitamins and enzymes. Photostimulation has engaged with the age of the first egg. Laying rate, egg production, egg weight, and egg number.

To stimulate laying poultry during the reproductive period, the optimum light intensity is need with the aim of diluting production costs and complying with environmental sustainability requirements. So, we need to find out the optimum value of light intensity in poultry firms. To do this, we would collect light intensity data using an IoT device and to visualize this data we will build an PWA (progress web application) and by using the application we not only can visualize data but also can record the total amount of egg productions per day. With the help of machine learning, we could able to analyze egg production rates under those light intensities. Thus, we can get our expected optimum value of light intensity.

1.2 **Motivation:**

From the very beginning, we had an interest in researching in the field of agriculture and our supervisor has informed us about the poultry industry. When we were studying the poultry industry, we noticed egg production. If we consider our country, Bangladesh is a developing country and many people in Bangladesh live below the poverty line and the price of eggs is increasing day by day rapidly. We know the necessity of eggs because of their rich protein. To fulfill the lack of protein, eggs are essential for everyone. National health strategy recommends that 120 g of meat every day and 104 pieces of eggs per year for adult people. The egg production rate in Bangladesh is 63.65% which does not meet those requirements. [1] No doubt that at present Bangladesh have more than 54,411 are broiler chicken farms, 18,954-layer chicken farms, and also growing poultry farms every year but this is not sufficient for the vast amount of people. And also, the price of feed is increasing every year. For example, in 2021 the Savar and Manikganj farmers had spent around 5.5 takas to produce an egg but the wholesale price was 4.1 to 4.5 taka which is currently 6.5 to 8 takas [2]. Like this factor, there are so many factors that lie behind the increasing price of eggs. By considering the situation, we got motivated to research how to get maximum egg production. We know that there are so many factors that impact egg production but we got motivated to work on the impact of light intensity because when we were analyzing egg production of layers, we knew that birds act differently at a various artificial light intensity and its impact on their growth as well as egg production

also [3]. So, we got motivated to figure out how to get optimum light intensity for maximum egg production by observing the layers.

1.3 Rational of the Study:

Every year the number of poultry industries increases rapidly and the maximum number of poultry industries situated in rural areas therefore the production of poultry eggs is also increasing which is not sufficient to fulfill the requirement of protein for the whole country. To get maximum egg production farmers should take care of some factors which we discussed above and the intensity of light also has a major impact not only for producing more eggs but also for producing more meat. To get maximum egg production an optimum light intensity should be maintained. Basically, due to release of FSH and LSH hormone the birds nursed in the increased daylight produce more eggs and for the bird which nursed into multi-duck cage system they need about 5.38 lux light intensity needed in the lower duck and for layer houses about 10.76 lux light intensity needed to get maximum egg production [2].

For the observation of this branch of massive data an application is required and with the help of react js which is a library node js library we can achieve it and the application will support both web and smartphones. Basically, node js is a platform which contains a vast number of libraries and react js is one of them to achieve front-end of web application. This library does not load the whole web page, rather it loads only a single component which needs to be loaded. Therefore, it is called a single page web application. And d3 is also a node js library which helps to visualize data.

Machine learning classifiers can be used to predict for a specific light intensity which have a specific range how many eggs can be produced. There are mainly two types of classifiers which are supervised learning and unsupervised learning. Supervised learning learns from a known dataset which is used to make predictions. There are also two types of supervised learning algorithm which are classification and regression. Classification algorithm learns all the features and labels of the training data to assign labels to the new

observations depending on what it has learned from the training data where the regression algorithm helps in determining how one variable influences another variable. On the other hand, an unsupervised learning algorithm does not have any label while it can learn by itself. This project we will use regression algorithms which will fit to our project.

1.4 Research Questions:

There are so many drawbacks we have faced while collecting the data because to set up the sensors and to maintain the light intensity we have faced so many difficulties. And also faced difficulties to choose the best platform for building the app which cost a lot of time. Bringing the expected accuracy was a bigger challenge. So, the questions appear in our mind are given below:

1. How can we set up the sensors?
2. How can we consume data from sensors?
3. How can we sort the dataset for further approaches?
4. Which library will we choose for visualization of data?
5. Which library will we choose to build the application?
6. How can we know which machine learning algorithms will be best for our project?
7. How can we achieve better accuracy?

1.5 Expected Outcome:

Our main motive was to find optimum light intensity in poultry industry to get maximum egg production. And also, to build a progressive web application to visualize the comparison of dataset for user-end. By using different machine learning techniques and algorithms we are able to find the accuracy of our data which is 98.18%.

1. By applying supervised based regression, we are able predict the value of light intensity for maximum egg production which is approximately optimum.

2. At first time we got lower accuracy which is 78.6% but after enrichment of our data our accuracy has boosted up and which is 99.16% for random forest regression.
3. Through this project a vendor may benefited by using the application and a vendor will also can sort out the optimum light intensity for his poultry farm to get maximum egg production.

1.6 Project Management and Finance:

Table 1.6: Required equipment and their finance for collecting the light intensity data

Hardware	Quantity	Cost(taka)
NodeMCU esp8266	1	500
Bread board	2	120
Connecting wire	1(pac)	40
BH1750	2	1000
	Total Cost	1660

For collecting the light intensity values, we needed some equipment such as light intensity sensors, NodeMCU esp8266 to operate the sensors and communicate with the database. As shown in table 1, BH1750 is a light intensity sensor which can measure the intensity of light in lux and the range it can measure is between 0 to 57000 lux. For the stability of measuring the light intensity value we have chosen BH1740 light intensity sensor for our project and pass this data through server side we have used NodeMCU esp8266. The esp8266 is a Wi-Fi module which can communicate with servers through Wi-Fi therefore there is no need for cabling to communicate with servers. The financial cost is mentioned in table 1 which is 1660 taka for the IOT equipment.

Chapter 2
Background

2.1 Terminologies:

In this section we will discuss briefly about related works, comparative analysis and summary, scope of problem and challenges respectively which has been discussed below. In the related work section, we deal with some research papers and websites which are related to our research work. We have discussed how light intensity impacts egg production, how they have collected their data set, how they analyze their dataset, how they figure out the optimum light intensity, in which circumstance they had done their research works. In comparative analysis and summary, we have tried to figure out the optimum light intensity value while observing the productions. We also have tried to choose the appropriate machine learning algorithms for predicting the optimum light intensity. Therefore, we have to label up our dataset in order to increase the accuracy level and finally we have achieved 98% accuracy for our dataset. In the scope of problems, we have discussed the problems we have faced while setting up our sensors, choosing the database type, building our application, visualizing the dataset in our application and we also faced problems to choose the appropriate machine learning algorithm for better performance. In the challenges section we have discussed while setting up sensors and collecting the data the difficulties we have faced and as well as creating our android application and machine learning approaches also.

2.2 Related Works:

Light is accountable for the release of hormones which are responsible for reproduction. It performs a crucial role in the release of various hormones. It also enhances the working efficiency of factors related to the reproduction and behavior of poultry. [4]. Moreover, light accelerates the development of reactive materials in embryos like vitamins and enzymes [5]. The patterns of light energy which can reach the hypothalamic part of the brain can control the secretion of ‘Gonadotropin Receptor Hormone (GnRH) stimulates

the pituitary gland to release gonadotropins, follicle-stimulating hormone (FSH), and luteinizing hormone (LH). The number of gonadotropins and their release of time make an impact on the rate of sexual maturation and the ovulatory cycle. Extra retinal photoreceptors in the hypothalamus area of the brain are sensitive to different wavelengths. These are involved in photostimulation. [6] In poultry, the age of the first egg is related to photostimulation. Lighting length, photoperiod, intensity, regimen, and spectra have been marked as factors for manipulating the reproduction performance of poultry [7][8][9]. Laying rate, egg number, egg production, and egg weight affect by Lighting length. [10[11].

The production of eggs will be reduced if the light intensity is insufficient. [12] Poultries perceive light through both the transcranial and the ocular routes. [13] A daily period of 14 hours of light is suitable for optimum egg production. But more than 17 hours of light can negatively affect egg production. Because poultries respond to light radiation within the visible spectrum range of 664-740 nm. The lamps used in layer houses should transmit light in this range. As 10 lux is the minimum light intensity for egg production, light intensities more than 10 lux will not make any additional benefits. Rather it may have negative effects on egg production. [14]

Broilers who grew up under 500 lux light got sexual maturation nine days before those under 1 lux light. Chickens who were raised under 1 lux had a 12% reduction in egg production and also gain an additional 23 g of abdominal fat. [15]. Male turkeys who grew up under 100 lux light had a lower semen volume than those who were under 6.5 lux [16]. Similarly, chickens who were raised under 150 lux light had a lower body weight compared to those who were under 5 lux [17]. Broilers under 5 lux, 50 lux, or 200 lux showed no cabalistic odds in body weight or mortality. But chickens who were lived under 50 lux or 200 lux light indicated more activity than those who were under 5 lux [18]. Chickens in upper lighting intensity like 100 lux resulted in greater semen activity than the low lighting intensity like the 5-lux group. [19]

2.3 Comparative Analysis and Summary:

We monitored the production of eggs for various light intensities. We have observed about the duration of 7-8 hours for each day and at the beginning we kept the light intensity around 10-20 lux. For the range of light intensity 10-20 lux, we noticed that the average egg production was between 235-250. The reduced the value of light intensity at the last stage and that was between 5-7 lux. For the range of light intensity between 5-7 lux we noticed that the average production increased between 260-275 which was our expected outcome.

Then move on to the machine learning approach and we have tried classification algorithms and for features we have used the value of lux, egg production and duration we have monitored and for level we have categorized our outcome such as good, bad and average and we have applied several classification algorithms such as SVC (Support Vector Classifier), Random Forest Classifier, KNN Classifier and Decision Tree. But the accuracy of those algorithms was between 60-65% which was disappointing. Then we have tried regression analysis by removing the category and we have taken features as average light intensity value with durations it taken and label as our production. Then we have used several regression algorithms such as Linear Regression, Logistic Regression, SVR (Support Vector Regression) and Random Forest Regression and the accuracy of our algorithm is between 98-99% (shown in table 2) which is better than classifier analysis. We have also predicted different light intensities between 5-30 lux for different algorithms and approximately every time Linear Regression and Random Forest regression provide us the number of productions which is approximately similar to our dataset.

Table 2.3: Accuracy of machine learning algorithm

Algorithm Name	Accuracy
Linear Regression	99.07%
Support Vector Regression	98.64%
Logistic Regression	99.07%

Random Forest Regression	99.16%

2.4 Scope of Problems:

While working we have to face a couple of problems several times and below, we will describe scope of these problems:

1. We could not figure out the perfect strategy while we began our research work therefore, we have drawn a plan and divided each and every individual topic into sub-category and which helps us to do this research work faster.

2. We faced a big problem while preprocessing the data because for the first time we have chosen mySQL as our database but maintaining such a huge amount of data in mySQL creates more complexity for us and firebase helps us to reduce this complexity though it is a non-sequential database and as well as free of hosting.
3. While we were about to create our app using Netbeans we have faced more and more complexity because for every device it is working properly and programming and designing in Netbeans is more time costly thus Node js provides a solution to us though PWA (Progressive Web Application).

4. In our application visualization of data was the toughest part because we have used d3.js for visualizing the data in our application and also there was need to be changes in our dataset but through d3 documentation and updating the changes of our dataset we have overcome this problem.

5. Applying machine learning algorithms were big challenges to us because firstly we have tried classification analysis where the accuracy was not good as well. But using regression analysis we have got better results.

2.5 Challenges:

The major challenge was to set the sensors to the appropriate place and consume the appropriate intensity value with respect to the date and time. The more challenging part appears when our database becomes larger and it takes too much time to inject the data into mySQL and soonly the dataset becomes more and more complex. Creating an application that can run both web and android is also a big challenge for us and also visualizing this big dataset in real time is also a big challenge for us. Then another challenge appears when we move forward to the machine learning approaches that we cannot figure out the appropriate algorithms and for this reason to gain better accuracy was also a great challenge for us. Below figure 1 which is shown the challenges we have faced.

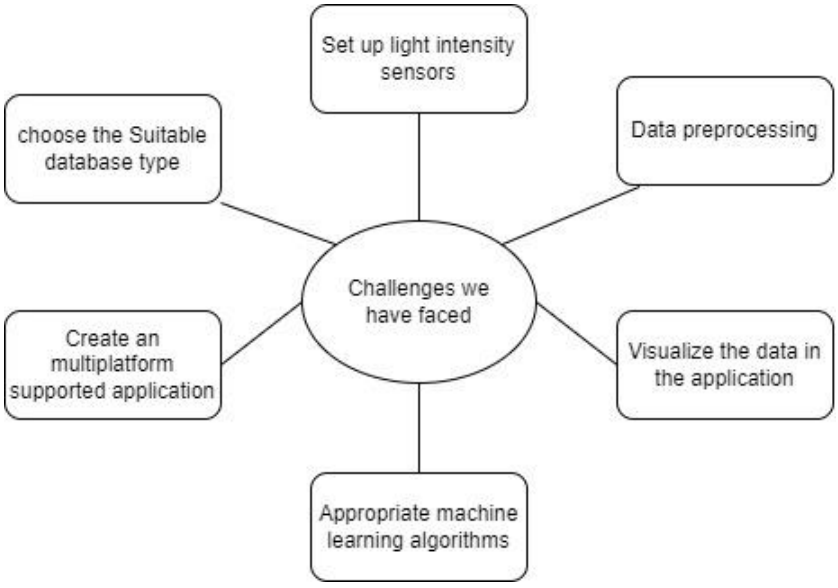


Figure 2.5: Challenges we have faced

Chapter 3
Research Methodology

3.1 Research Subject and Instrumentation:

Our research topic is “To find the optimum light intensity to get the maximum egg production in the poultry industry”. Before selecting our topic, we have seeked for many other fields and spent a lot of time and finally we have figured out that we have interest in the field of agriculture. Due to increasing egg prices every year we thought it is high time to analyze this problem and detect how to maximize the egg production over light intensity. We have used a BH1750 light intensity sensor to get the light intensity value and NodeMCU esp8266 to operate our necessary sensors as hardware parts. To operate the NodeMCU esp8266 we have used the Arduino IDE as a software part which helps us to operate our instructions and by using the Arduino IDE we have communicated with firebase and store sensor data to the firebase. By using react js which is the library of node js we have created our application front-end and using d3 js which is also a library of node js we have visualized data in our application which works real time. We have used google colab which is used for python development. In google colab we have used several libraries such as pyrebase, numpy, pandas, matplot, seaborn and sklearn.

3.2 Data Collection Procedure:

Firstly, we have collected light intensity sensor data by using the BH1750 sensor. By collecting the only light intensity sensor data it does not mean anything because that is raw data. To make this data meaningful we have to take some steps. We need to provide time stamps which means we need to provide specific date and time while collecting each light intensity value. NTPclient library makes things easier for us because it is a network time protocol which is a client/server application. By using NTPclient we can get the exact date and time while we collect our light intensity data. Figure 3.2.1 one shows the structure of data.

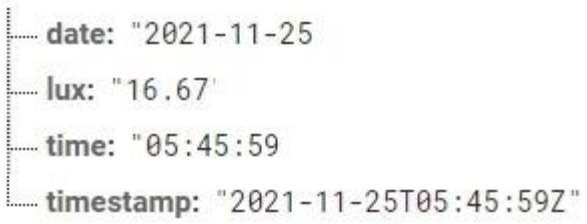


Figure 3.2.1: Sample data set

Secondly, we have to collect the production of each date. Therefore, we have done some preprocess to our data. We have to convert the time into numerical form which is in string format in order to calculate the duration. After converting hours and minutes into numerical form we have subtract the end time with the beginning time and thus we got the duration of light intensity value record time. Then from our application we recorded the total number of egg production for the specific date and also, we have calculated the mean value of light intensity values for the specific date and margin all of this data along with data we have stored in another dataset to store the records. Below figure 3.2.2 is the example of a dataset with mean lux, specific data, duration and production and 3.2.3 is the steps of preprocessing our data.

Figure 3.2.2: Dataset with production

3.3 Statical Analysis

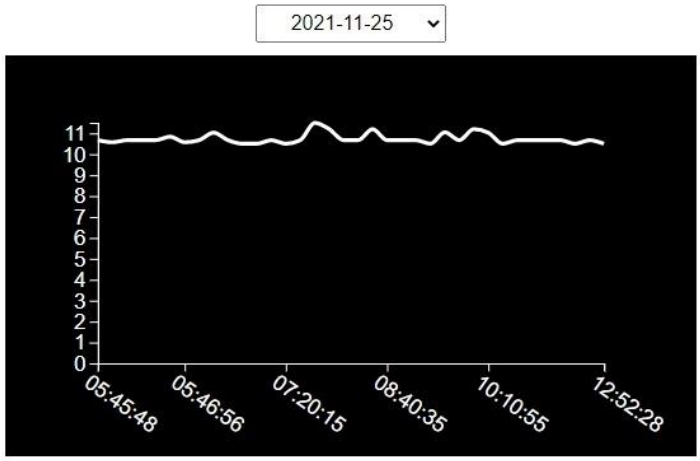
In this research we have not only applied supervised machine learning approaches but also, we have created a PWA (Progressive Web Application). In the below section the working procedures illustrate step by step.

A. Collection and properties of dataset:

While collecting light intensity data we had taken an interval of 15 seconds for next data and overall, it is a huge amount of data. Initially our dataset contains lux, date, time, timestamps which is shown in figure 3.2.1.

B. Analyze light intensity data from app:

Figure 3.3.1: Time vs light intensity data



While we collect the dataset to monitor them in real time, we have visualized the light intensity value with respect to time. From this visualization we can analyze whether our light intensity values are fluctuating or not and by selecting the specific date we can check the specific dates observations. The example of visualization is shown in figure 3.3.1

C. Dataset distribution:

We have total of 42 days data in our database. For machine learning approach we need to work with productions with respect to light intensity values there we need to reform the data set which we will describe in next part. For machine learning approaches we have changed our dataset structure and the example is given in figure 3.2.2. Now we have total 42 rows as we have collected 42 days data. Therefore our 20% of data used for testing purpose and 80% of data used for testing purpose out of 42 data.

D. Preprocess of our data:

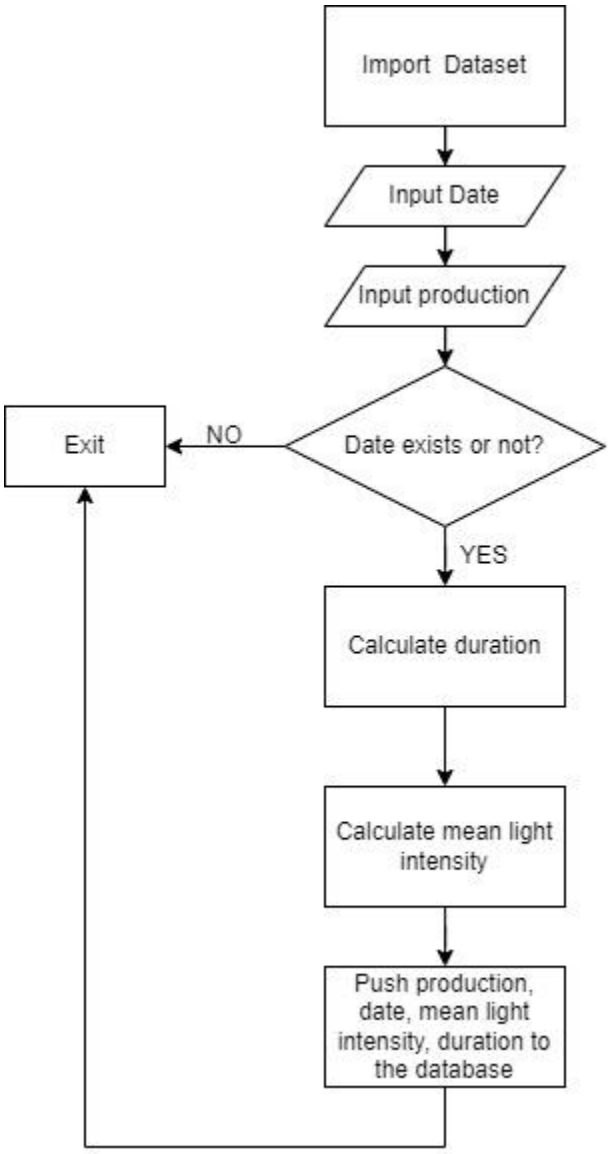


Figure 3.3.2: Preprocessing of dataset

For data preprocessing for machine learning and further analysis we have to do the following steps as figure 3.3.2. First of all, we have imported our actual data set to preprocess the data. There is no production in our dataset which is required to fulfill the project. Therefore, we take the production from user input through our application. We have taken the date also for the purpose to check whether the date exists or not. After

fulfilling this requirement, we have taken the mean light intensity value and total duration also which we have discussed in the section 3.2.

In the completion of preprocesses, we have set new dataset properties such as average lux, date, production and duration respectively.

E. Statical analysis of light intensity values with productions:

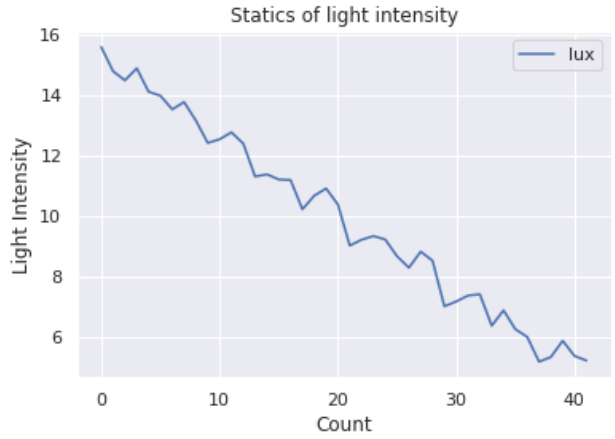


Figure 3.3.3: Statics of light intensity values

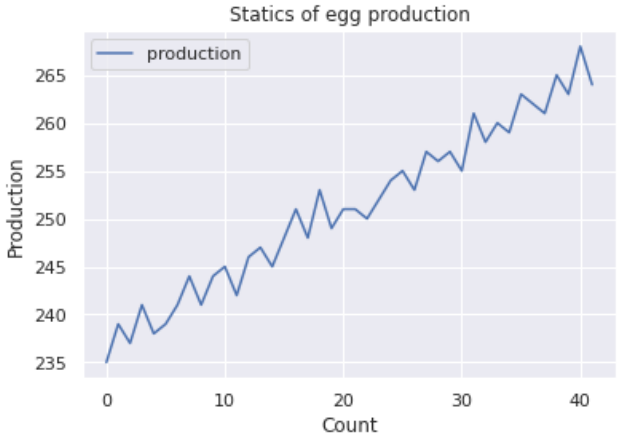


Figure 3.3.4: Statics of egg productions

After getting the average light intensity values of each date along with egg productions we have visualized them in graphical form to analyze them which is shown in figure 3.3.3 and 3.3.4. By observing the graph, it is clear that while light intensity values decreasing the

productions of egg goes high and while light intensity value increase the production rate goes to low though we have decreased the light intensity value approximately 5 lux.

3.4 Applied Mechanism

This project we have worked on IoT devices, PWA and Machine learning. Below we will describe the mechanism for this project separately.

IoT devices:

By using the IoT devices we have collected our data. As IoT devices we used light intensity sensors and NodeMCU esp8266. Basically, Light intensity sensor detects the brightness or intensity from a light source. By converting the spectrum of light into digital signal light intensity sensors provide the output. In our project the light intensity sensor measures the intensity of light between 0 to 57000 lux.

Secondly, NodeMCU is an open-source platform and it is based on the esp8266 module which can connect objects and let data transfer through Wi-Fi. NodeMCU also can provide some special features of micro controllers such as GPIO, PMW, ADC etc. The BH1750 light intensity sensor is based on the I2C bus which is supported by NodeMCU. We can operate NodeMCU from an Arduino IDE.

In our work we have used NodeMCU to operate the light intensity sensor. Though NodeMCU is a microcontroller it has in-built memory and ram which helps us to store our instructions. We have used several libraries in NodeMCU such as esp8266, firebase, BH1750 and NTPclient. NTPclient library used to get date and time from ntp server protocol and using BH1750 library we have received data from the light intensity sensors. As we chose our database as firebase, therefore using this library we have pushed our data to the database and esp8266 library allows us to connect with the server through a Wi-Fi connection.

PWA (Progressive Web Application):

In order to create our application, we have chosen node js framework which is JavaScript based and used for back-end development. In node package manager there are a lot of libraries and frameworks available. We have chosen react js library for our application and d3 js library for visualizing our data. Using react js we can build and design the front-end and it is called a single page application because it only loads single components without loading the whole web page. D3 js is used for creating data visualization. By binding the data and graphical elements to the DOM (Document Object Model) d3 js visualize data. By using react js along with d3 js we have achieved real time visualization when data changes.

Machine learning:

We have created a model using machine learning techniques on how to predict maximum egg production. There are three broad areas of machine learning and among them we have chosen the supervised learning approach because of its compatibility. We have done preprocessing in our web application for this reason we have only pre-process our data for test and train split which is known as features and label respectively. We have used a regression model because we do not have any specific outcome rather, we just want to predict the outcome. We have applied Linear Regression, Logistic Regression, Support Vector Regression and Random Forest regression models. Each or regressor described below.

1. Linear Regression: Basically, linear regression is used as a type of predictive analysis. There are basically two types of regression one is simple linear regression and another is multiple linear regression and, in our project, we have used simple linear regression because we need to predict one data for one time and this is how linear regression works. Below figure 3.4.2 is the formula for linear regression.

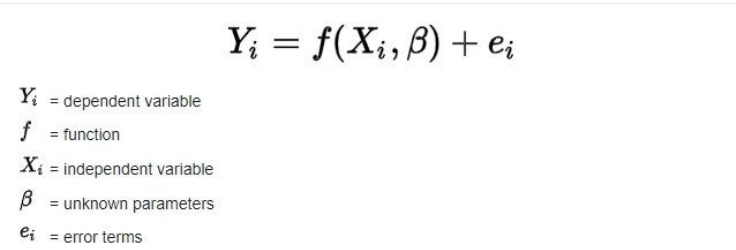


Figure 3.4.2: Formula of linear regression

2. Logistic Regression: When the dependent variable is binary or dichotomous then logistic regression is the appropriate regression analysis to conduct and like other regression analysis it is also a predictive analysis. Mathematically, with two possible values the binary logistic regression model has a different variable. Below figure 3.4.3 is the formula for logistic regression.

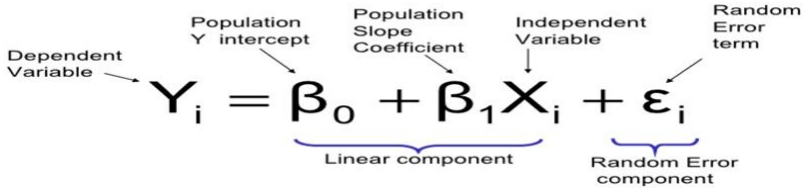


Figure 3.4.3: Formula for logistic regression

3. Support Vector Regression: Usually support vector machines are used for classification problems and in support vector machines it separates the data into classes by creating a line or a hyperplane. The support vector regression is built by using the same principle of the support vector machine. Below figure 3.4.4 is the formula for support vector regression.

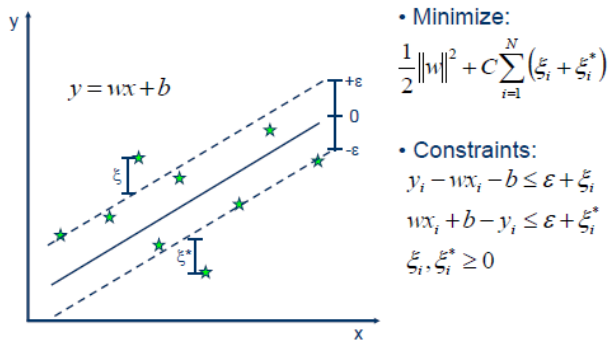


Figure 3.4.4: Formula of support vector regression

4. Random Forest Regression: Basically, a random forest algorithm is based on an ensemble learning method of regression where an ensemble learning method is such a technique which can combine predictions from multiple machine learning algorithms to make a more accurate prediction than a single model. During training time random forest algorithm constructs several trees and provide output as the mean of the classes as the prediction of all the treen. Following figure 3.4.5 shows how random forest works.

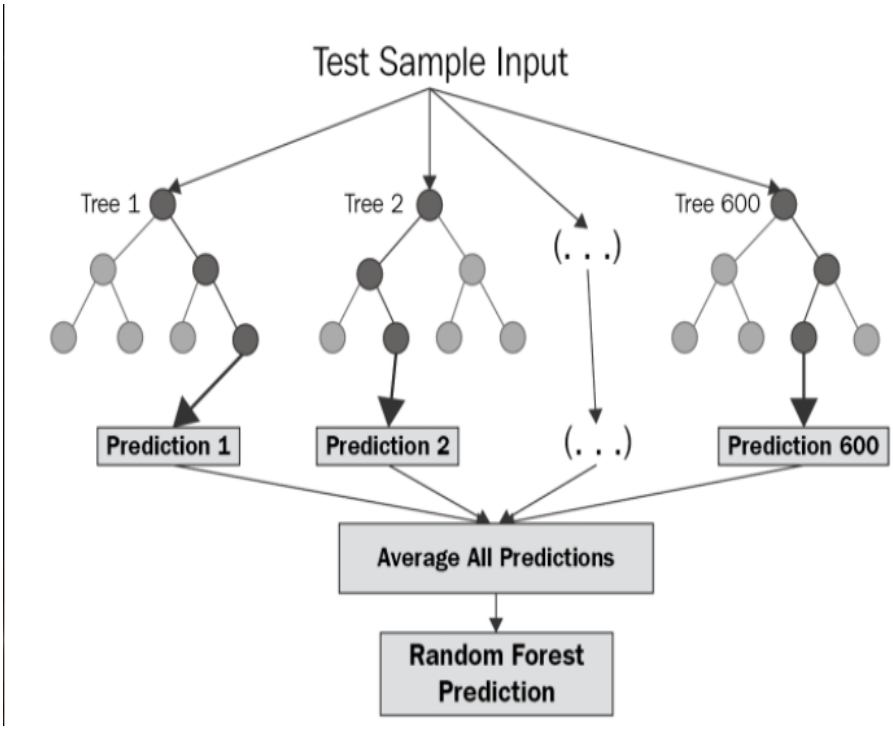


Figure 3.4.5 Formula of random forest regression

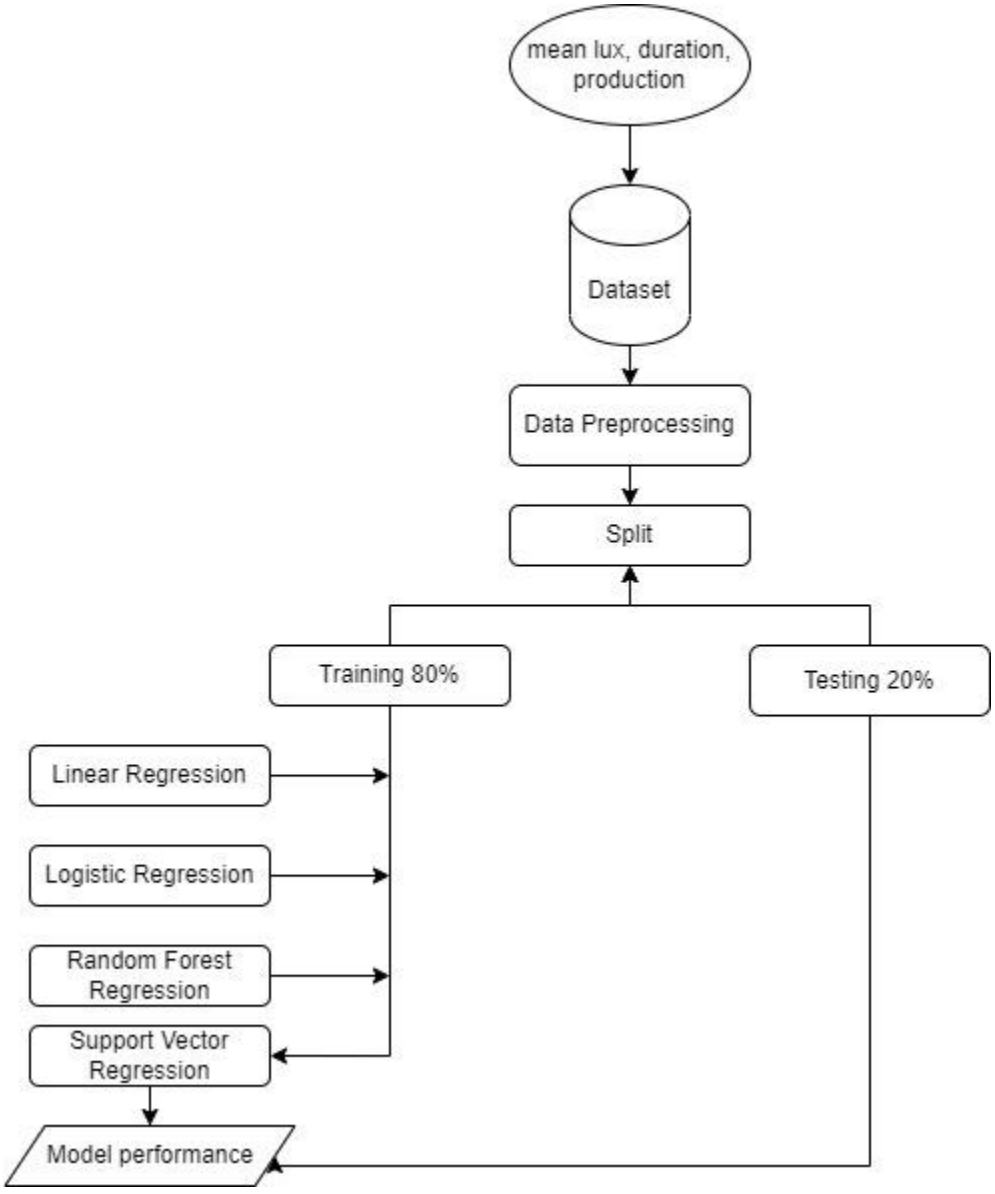


Figure 3.4.6: working procedure

Figure 3.4.6 is shown our working procedure. Though we have use regression approaches therefore we to calculate our applied algorithms accuracy through calculation mean absolute error or mean square error. There is no square value in our dataset therefore we have calculated the accuracy by using mean absolute error which formula is given in figure 3.4.7.

$$MAE = \frac{\sum_{i=1}^{n} |y_i - \hat{y}_i|}{n}$$

Figure 3.4.7: Formula of mean absolute error

3.5 Implementation Requirements:

Following require below we have used to developed our project.

Software or Hardware Requirements:

1. NodeMCU esp8266
2. BH1750 light intensity sensor
3. OS(Windows)
4. RAM (minimum requirement of 4 GB)
5. HDD (minimum requirement of 128 GB)
6. Web Browser

Developing Tools:

1. Arduino IDE
2. Visual Studio Code
3. Google Colab
4. Drawing Tools

Chapter 4
Experimental Result and Discussion

4.1 Experimental Setup:

For experimental set up first of all we had set up our firebase configuration and also have to note down all the access information along with API key because we are going to use firebase as our database and we have to access it through NodeMCU esp8266, Node js and Google colab. Then we had set up all the sensors in the laying farm to get the light intensity data. We had set up all the operations for NodeMCU on Arduino IDE to operate the sensors. After we had imported all necessary libraries, such as react js, node js, d3 js and firebase to create our web application from npm (node package manager). Before going to the machine learning approach, we had set up a new form of dataset by adding average light intensity, production, duration. In google colab we had to import pyrebase library to consume the data. Then we had set up our supervised machine learning approaches by importing sklearn library and using matplot library we had visualized our data.

4.2 Experimental Result and Analysis:

For checking initial accuracy, we have applied several classification algorithms of supervised machine learning but we have faced many problems and the accuracy remain 50-60%. Soonly our data increased and our accuracy was increased a little and the result is we have to reform our dataset. After that we have applied regression algorithms of machine learning and at first time the accuracy of our dataset is increased to 97-98% and while the dataset enriched the accuracy goes to 98-99% which is shown below in figure 4.2.1.

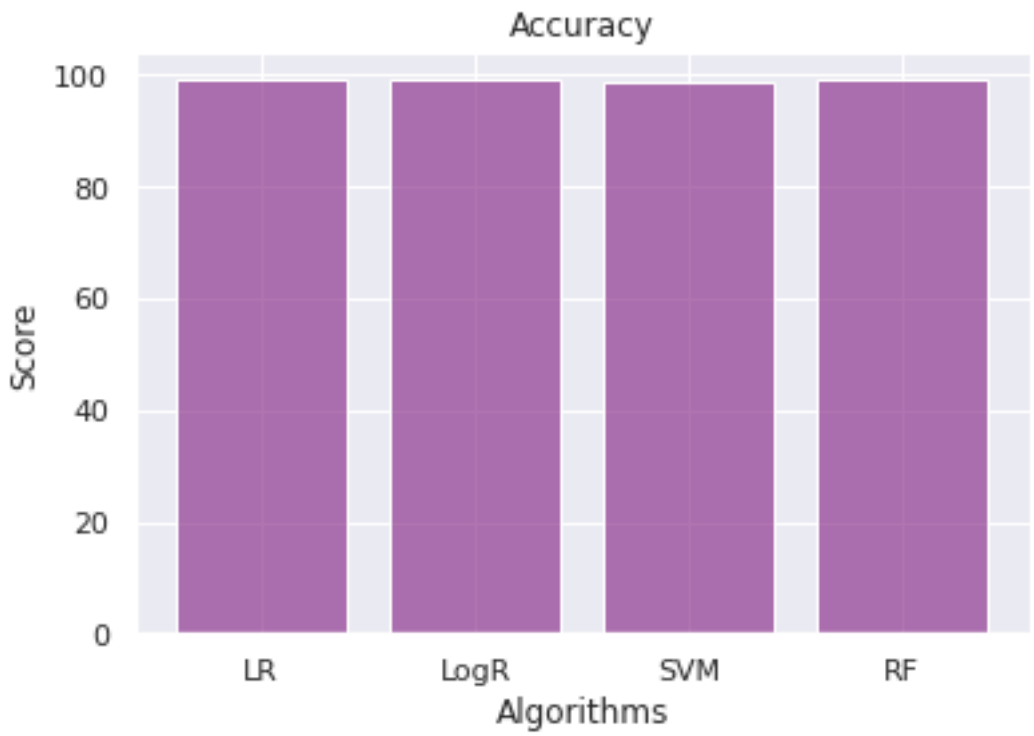


Figure 4.2.1 accuracy of different machine learning algorithms

Percentage of accuracy for linear regression = 99.07%, logistic regression = 99.07%, support vector regressor = 98.64% and random forest regression = 99.16%. We have predicted by using different data for different lux intensity values to all of these algorithms but all of them leaner regression and logistic regression provides us better result which is similar to our data set.

Our web applications result is also important. Expected outcome from our web applicate is to visualize the appropriate data. We have successfully visualized example is given on figure 4.2.2 and figure 4.2.3. Figure 4.2.2 describe the amount of egg production per dates and figure 4.3.3 describe for which light intensity how many eggs production we have. From our web application by analyzing these graphs its easy to go for the conclusion.

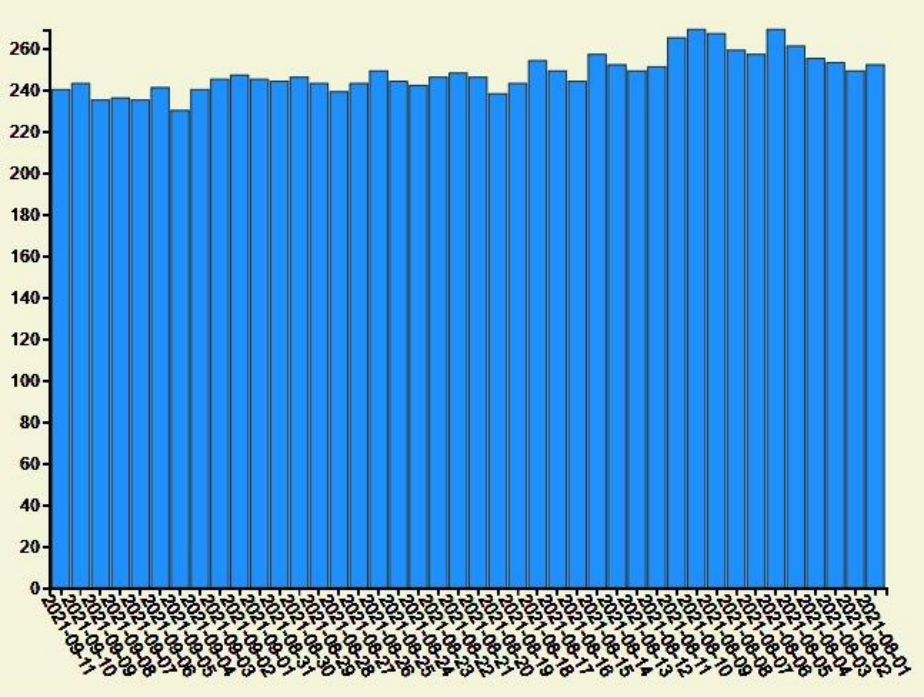


Figure 4.2.2: Histogram of date with production

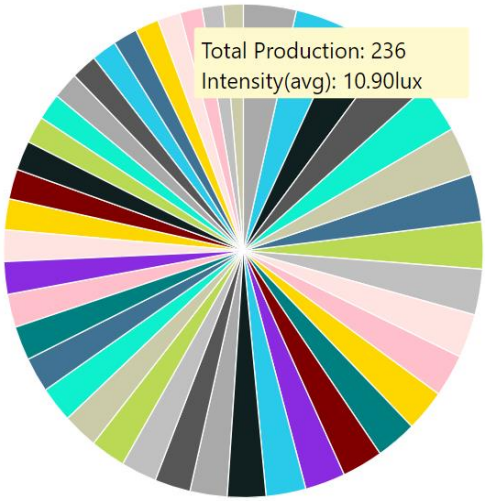


Figure 4.2.3: Pi chart of production and light intensity value

4.3 Result Discussion:

After increasing the dataset and changing the processes we have achieved the better accuracy. Now for calculation the accuracy we need the mean absolute error and by using the equation which is mentioned in figure 3.4.7 we have calculated our mean absolute error and by dividing this error with label and multiply by 100 we have reached our accuracy. And for justify the accuracy we have predict several times by changing different values and every time we have got the correct prediction. Example is given in below table.

Table 4.3: Predicting the production on different algorithms

Algorithms	Prediction value (lux, duration)	Output (production)
Linear Regression	5.38, 7.20	264
Logistic Regression	5.38, 7.20	263
Support Vector Regression	5.38, 7.20	258
Random Forest Regression	5.38, 7.20	264

We have also tried changing the value of light intensity and every time these algorithms almost predict correct output which is approximately similar to our dataset and among all of this algorithm The linear regression and random forest regression always provide us more accurate outputs.

Chapter 5

Impact on Society, Environment and Sustainability

5.1 Impact on Society:

In our country the number of poultry industries is not sufficient compared to our population. On the other hand, the egg production rate of our country is 63.65% which is not sufficient per person. In fact, in our country eggs are the least costly source of protein compared to other foods which are easily affordable for every class of people and included in most if not every meal that a regular person has every day. But unfortunately, the price is fluctuating towards the higher side and for this very purpose of making eggs more accessible in number and more affordable for the people belonging to the lower class we have researched to find the optimum light intensity value which helps to produce more eggs. Therefore, our contribution may help the society.

5.2 Ethical Aspects:

Excess use of chemicals in poultry food has increased the production of egg but has made the eggs lesser healthy sometimes harmful. As eggs are one of the most accessible and affordable food items for most classes of people. People consume egg from various sources like fast-food and home-made food it is essential to keep the eggs as healthy as possible. So, we are trying to keep it healthy as possible by using less chemicals.

5.3 Sustainability Plan:

In future we might plan to use our research project as a commercial source of income. So, we must a sustainability plan to identify some factors like,

1. Needs to be sustained.
2. Required resources
    - Cash
    - Talent

- Housing space
- Training space
- Trainers
- Sustainable advanced technology
- Satisfactory manpower

3. Financing Strategies
    - Business profits
    - Investments
    - Loans and credits
4. Potential business partners
5. An effective action plans
    - Task distributor
    - Effective communications
    - Proper and effective marketing

Chapter 6

Summary, Conclusion Recommendation and Implication for Future Research

6.1 Summary of the Study:

In the field of machine learning there is no work completed done to predict the production of eggs in the aspect of optimum line intensity. We achieved about 98-99% of accuracy for different supervised machine learning algorithm by collecting data from a light-controlled layers farm and then pre-processed the data by taking average value of light intensity for the duration of one day. This process was repeated for about 41 days. We also had to implement our designed sensors in the layer farm to collect the light intensity .value.

For the purpose of visualizing and collecting the egg production data with the aspect of specific time period, we have created a web application for user-end which is converted to progressive web application. By using this web application, we not only can monitor the production activity but also can preprocess the data to apply machine learning algorithms.

6.2 Conclusion:

The population of our country is increasing day by day which is also increasing the number of mouths that are needed to be fed. Eggs comes with a huge impact on that feeding process. So, we have found the optimum light intensity to get the maximum egg production rate. We have achieved about 98-99% accuracy in that aspect by using machine learning. The web application will help the users to find the optimum light intensity by observing the visualization of average light intensity and egg production.

From this research we aim to provide healthy and affordable protein source like egg to every class of our society. We aim to reduce vitamin deficiency to a certain extent even if it is a small amount.

6.3 Implication for Future Study:

We tried to do as much as we could in the given time period but there are some more aspects that can be explored in the future in this field. Like,

1. We wish to conduct our research in aspect of temperature.
2. We also wish to cover the feeding sector that can affect the egg production.
3. In future machine learning algorithms can be instigated in the web application. Therefore, egg production can be estimated by using the web application.

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To Find the Optimum Light Intensity to Get Maximum Egg Production in Poultry Industry

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