SMART DAIRY FARM

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"Artificial intelligence is not a silver bullet, but it can help us find silver bullets." - Fei-Fei Li

Abstract

Artificial intelligence (AI) is increasingly being used in the dairy industry to improve productivity, efficiency, and animal welfare. AI applications in dairy farming include automated milking systems, precision feeding systems, and cow behavior monitoring systems. These technologies use sensors, data analysis, and machine learning algorithms to optimize milking times, create personalized feeding plans for individual cows, and detect health issues in cows. AI can also help farmers make data-driven decisions about breeding, herd management, and milk production. By using AI, dairy farmers can reduce labor costs, increase milk yields, and improve animal health and welfare. However, the adoption of AI in the dairy industry also presents some challenges, such as the need for specialized skills, high initial costs, and concerns about data privacy and security. Despite these challenges, AI is expected to continue to transform the dairy industry in the years to come.

Problem Statement

How can artificial intelligence be effectively implemented in the dairy industry to improve productivity, efficiency, and animal welfare while addressing the challenges of high initial costs, specialized skills requirements, and data privacy and security concerns?

Some of the problems faced by the Dairy Farmers are :

- Inefficient Milking
- Inaccurate Feeding
- Health Issues
- Breeding Decisions
- Labor costs

In this report we majorly look at cattles as cows and buffaloes.

Assessments

1. Market Need Assessment

The adoption of AI in the dairy industry has grown significantly in recent years due to the benefits it provides. To assess the market need for AI in the dairy industry, we need to consider the following factors:

- ***Growing Demand for Dairy Products:***

The demand for dairy products has been steadily increasing, and this trend is expected to continue. As a result, the dairy industry is under pressure to increase production while maintaining high-quality standards. AI can help farmers optimize their production processes and enhance milk quality, ensuring that they meet the growing demand for dairy products.

- *Increasing Competition:*

The dairy industry is highly competitive, and dairy farmers are constantly looking for ways to gain a competitive advantage. AI can provide this advantage by enhancing production efficiency, reducing costs, improving animal welfare, and enhancing milk quality, ultimately increasing profitability and competitiveness.

- *Labor Shortage:*

The dairy industry is facing a significant labor shortage, and dairy farmers are struggling to find enough workers to perform the necessary tasks. AI can help overcome this challenge by implementing AI-powered robots that can perform tasks such as milking, feeding, and cleaning. This reduces the need for human labor and can help ensure that the farm operates efficiently.

- *Sustainability:*

Sustainability has become a critical factor in the dairy industry, and consumers are increasingly demanding sustainable practices. AI can help farmers implement sustainable practices by reducing feed and water wastage, optimizing production processes, and enhancing animal welfare.

- *Technological Advancements:*

Technological advancements have enabled the development of AI technology, making it more accessible and affordable for dairy farmers. This has led to increased adoption of AI technology in the dairy industry, and it is expected to continue to grow in the future.

2. Customer Need Assessment

To assess the customer need for AI in the dairy industry, we need to consider the following factors:

- *Improved Milk Quality:*

Consumers are increasingly concerned about the quality of the products they consume, and milk is no exception. AI can help farmers optimize milk quality by monitoring cow health, feed quality, and other factors that affect milk quality. By ensuring high-quality milk production, farmers can meet the growing consumer demand for high-quality dairy products.

- *Animal Welfare:*

Animal welfare is a critical factor for consumers when it comes to choosing dairy products. Consumers want to ensure that the animals producing their dairy products are treated humanely and ethically. AI can help improve animal welfare by monitoring the behavior and health of cows, ensuring that they are comfortable, healthy, and happy.

- *Sustainable Practices:*

Consumers are increasingly demanding sustainable practices in all aspects of their lives, and dairy products are no exception. AI can help farmers implement sustainable practices by reducing feed and water wastage, optimizing production processes, and enhancing animal welfare. This can help meet the growing consumer demand for sustainable dairy products.

- *Traceability:*

Consumers are increasingly interested in the origin of the products they consume, and traceability is becoming a critical factor when it comes to choosing dairy products. AI can help farmers track and monitor every aspect of their dairy farm operations, from cow health to milk production, ensuring that the products they produce are traceable and meet the required standards.

- *Cost-Effective Products:*

Consumers are always looking for high-quality products at an affordable price. By implementing AI technology, farmers can optimize their production processes, reduce costs, and ultimately offer cost-effective dairy products to consumers.

3. Business Need Assessment

The dairy industry is constantly evolving, and with the advancements in technology, the adoption of AI in dairy farming has become increasingly popular. To assess the business need of AI in the dairy industry, we need to consider the following factors:

- *Production Efficiency:*

The primary business need for AI in the dairy industry is to enhance production efficiency. The dairy industry is heavily reliant on production efficiency, and any improvements in this area can significantly impact the

profitability of a dairy farm. AI can help farmers monitor and analyze various data points, such as milk production, feed intake, and the behavior of dairy cows, to optimize their dairy farm operations.

- *Cost Reduction:*

Another critical business need for AI in the dairy industry is cost reduction. Dairy farmers face various challenges, including rising feed costs, labor costs, and equipment costs. AI can help farmers reduce costs by optimizing feed intake, reducing wastage, and minimizing labor costs. By implementing AI-powered robots that can perform tasks such as milking, feeding, and cleaning, farmers can reduce the need for human labor and ultimately cut down on labor costs.

- *Animal Welfare:*

Animal welfare is a crucial factor in the dairy industry, and it can directly impact the business. Poor animal welfare can result in decreased milk production and quality, increased veterinary costs, and negative publicity. AI can help improve animal welfare by monitoring the behavior and health of cows, ensuring that they are comfortable, healthy, and happy.

- *Milk Quality:*

The quality of milk produced is a critical factor in the dairy industry, and it can impact the profitability of the farm. AI can help farmers optimize milk quality by analyzing data collected from the farm and identifying factors that affect milk quality, such as feed quality and cow health. By optimizing these factors, farmers can ensure that the milk produced is of high quality and meets the required standards.

- *Profitability:*

The ultimate business need for AI in the dairy industry is to increase profitability. By enhancing production efficiency, reducing costs, improving animal welfare, enhancing milk quality, and increasing revenue, dairy farmers can increase their profits. AI can help dairy farmers gain a competitive advantage, improve their operations, and ultimately increase their profitability.

Target Specifications and Characterizations

The customer characteristics for implementing AI in the dairy industry can be broadly classified into the following categories:

Large-Scale Dairy Farms:

Large-scale dairy farms are one of the primary customers for implementing AI in the dairy industry. These farms typically have a large number of cows, and AI can help manage and monitor the health and well-being of the animals. AI can also help optimize milk production, improve feed efficiency, and reduce labor costs, which are essential for the profitability of large-scale dairy farms.

Technologically Advanced Farms:

Customers who are technologically advanced are more likely to adopt AI technology in their dairy farms. These customers have a better understanding of the potential benefits of AI, and they are more willing to invest in advanced technology to improve their operations. They are also more likely to have the infrastructure required to implement AI technology, such as sensors, cameras, and other monitoring devices.

Farms Focused on Quality:

Customers who are focused on producing high-quality dairy products are more likely to implement AI technology in their farms. AI can help monitor cow health, milk quality, and other factors that affect the quality of dairy products. By ensuring high-quality milk production, farmers can meet the growing consumer demand for high-quality dairy products.

Farms Focused on Sustainability:

Customers who are focused on sustainability are also likely to adopt AI technology in their dairy farms. AI can help farmers implement sustainable practices by reducing feed and water wastage, optimizing production processes, and enhancing animal welfare. This can help meet the growing consumer demand for sustainable dairy products.

Farms Focused on Traceability:

Customers who are focused on traceability are more likely to adopt AI technology in their dairy farms. AI can help farmers track and monitor every aspect of their dairy farm operations, from cow health to milk production, ensuring that the products they produce are traceable and meet the required standards.

External Search

For building ML model, I have taken the data from Kaggle and some other external resources :

Health Monitoring of Cows using Machine Learning:

- (https://www.kaggle.com/datasets/shivamagarwal29/cow-lumpy-disease-dataset)

Milk Quality Prediction of cows:

- (https://www.kaggle.com/datasets/cpluzshrijayan/milkquality)

Milk Production data in USA:

- https://usda.library.cornell.edu/concern/publications/cz30ps66x?locale=en

Some are the Research papers related to this field:

Calving / Pregnancy information:

- (https://www.sciencedirect.com/science/article/pii/S0022030217304113?via%3Dihub)
- (https://reader.elsevier.com/reader/sd/pii/S0167587720309211?token=D21BF63A78623FD63ACB6C26AD8E76A11378FD3391E147666512585ACEA9B04CF023CBAE1DB496DFB39E1BCFDCFBADB5&originRegion=eu-west-1&originCreation=20230228192650) ***This** research paper contains various applications of machine learning to improve dairy farm management.

Digital Identity:

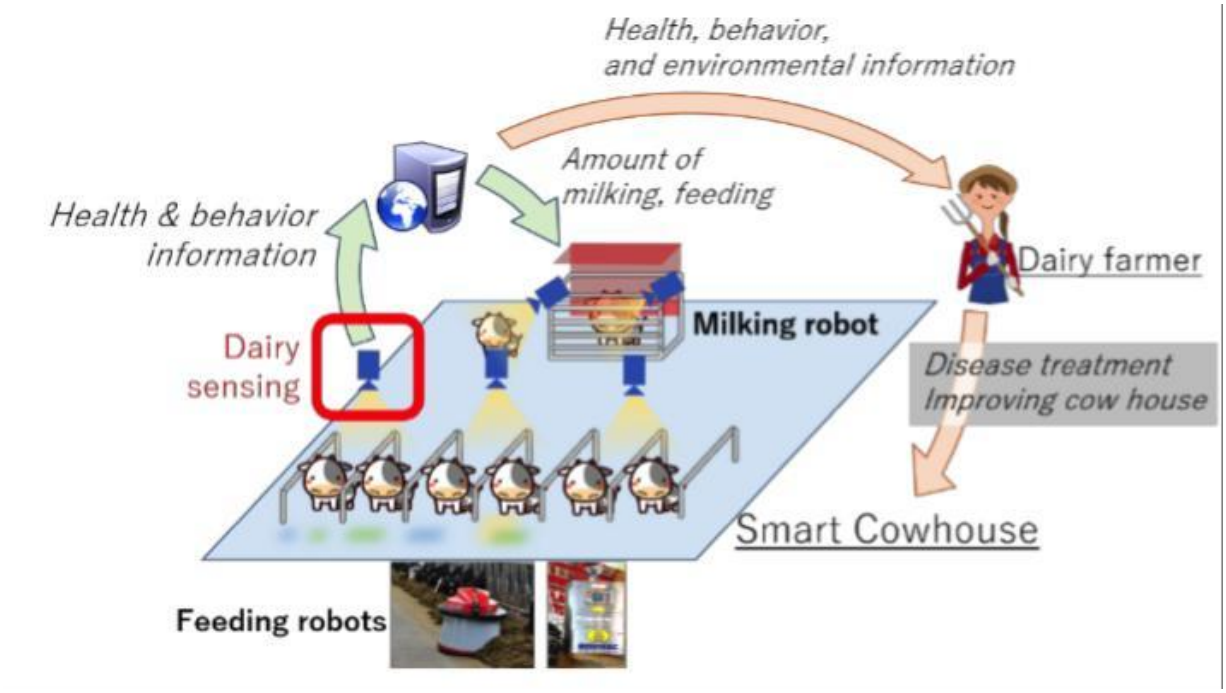
Cattle in a lot of countries, including EU countries, the UK and the US, have "cattle passports," which authorities use to track infectious disease outbreaks, ensure the effective rollout of government schemes, and make insurance claims. In practice, this means that many cattle are identified by tags punched into their ears. Not only are these tags painful for the animals, but are unreliable as well. In some developing countries, including India, farmers cut

the cattle's ears to commit identity fraud and make fraudulent insurance claims.

Cattle facial recognition, which is also called the Aadhar of cattle in India, is the perfect solution for this cattle identity problem. It is also a technically validated solution, thanks to the recent advancements in machine vision

AI-Powered Image Analysis Could Transform Dairy Farming:

- https://www.photonics.com/Articles/AI-Powered_Image_Analysis_Could_Transform_Dairy/a62229

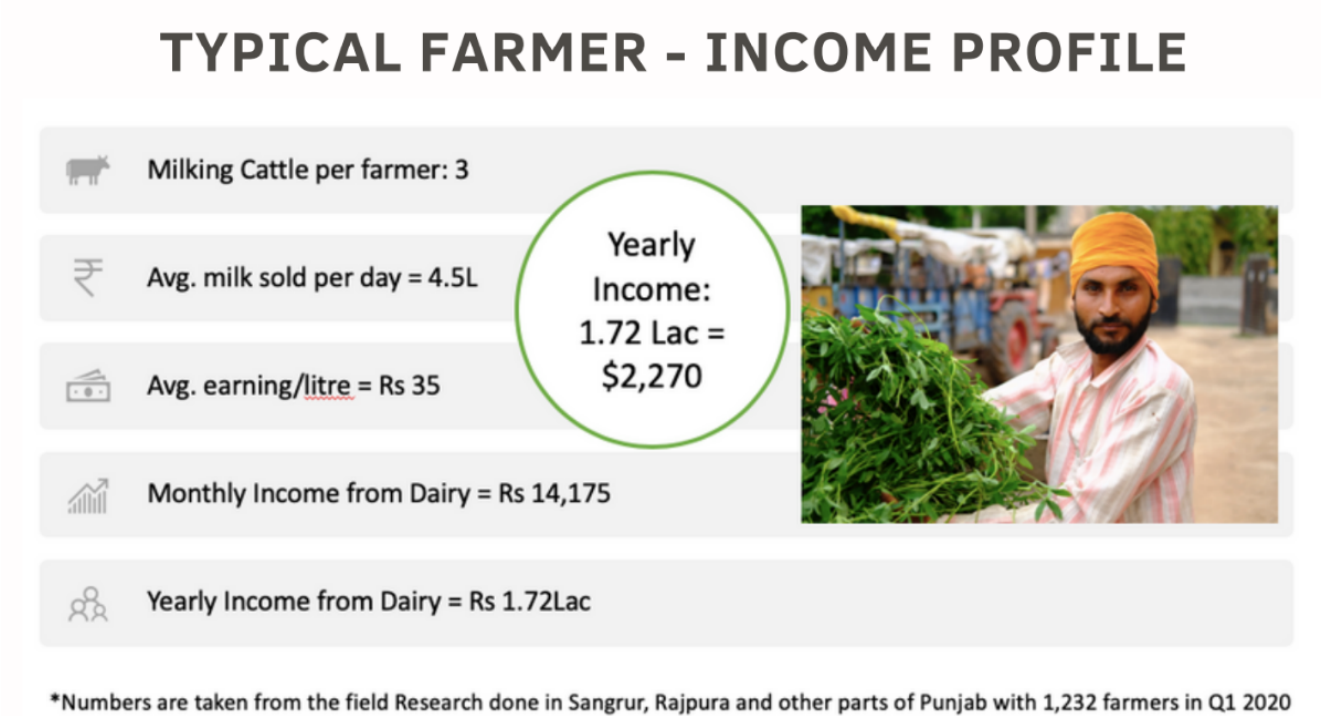


Artificial Intelligence Applied to a Robotic Dairy Farm to Model Milk Productivity and Quality based on Cow Data and Daily Environmental Parameters:

(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7285505/)

Benchmarking alternate products

MoooFarm, an AgriTech start-up with the mission statement "to make farmers prosperous," is working to produce the technology at scale and work with the government to build a robust cattle identity mechanism. This technology can become the foundation of multiple auxiliary services like cattle insurance, cattle loans and government subsidies. Other companies including **Cainthus**, **Techvantage's Moo-ID**, and **Stellapps**, are also working to roll out a market-ready version of this product. Below is the MoooFarm profile for dairy farmers, which shows all the information related to cattles.



Applicable Patents

- Dairy technology start-up, Stellapps Technologies Pvt Ltd, has been granted a 20-year patent for its invention – farm and herd management system, which helps dairy stakeholders to remotely monitor and manage their farms through mobile devices.

Applicable Regulations

In general, governments around the world are increasingly recognizing the potential benefits and risks associated with the use of AI and are actively developing policies and regulations to govern its use. In the context of dairy industries, some potential regulatory considerations may include:

- *Data privacy and security:* Dairy industry operators may need to comply with regulations related to the collection, storage, and use of customer and production data, particularly if AI systems are used to analyze this data.

- *Ethical considerations:* The use of AI in the dairy industry may raise ethical concerns, particularly in relation to animal welfare and the impact on human workers. Governments may develop guidelines or regulations to ensure that the use of AI in this industry is ethical and transparent.

- *Safety and quality standards:* The use of AI in the dairy industry may have implications for the safety and quality of dairy products. Governments may establish regulations to ensure that AI systems used in dairy production are reliable and accurate, and that they do not compromise the safety or quality of dairy products.

- *Liability:* As AI systems become more sophisticated and autonomous, there may be questions around who is responsible in the event of errors or accidents. Governments may develop regulations to clarify liability in these cases.

These are just some potential regulatory considerations related to the use of AI in dairy industries.

Applicable Constraints

There are several constraints that may need to be considered when implementing AI in dairy industries. Some of these constraints may include:

Data quality: AI systems require large amounts of high-quality data to be trained effectively. However, dairy industry data may be complex and variable, and may require significant preprocessing to be useful for AI applications. Ensuring the quality and quantity of data may be a constraint for implementing AI in dairy industries.

Cost: Implementing AI systems can be costly, particularly if the dairy industry does not have the necessary infrastructure or resources in place to support them. The cost of hardware, software, and personnel may be a constraint for some dairy industry operators.

Compatibility with existing systems: Many dairy industry operators may already have existing systems in place that are not compatible with AI systems.

Integrating AI with existing systems may require additional development and customization, which can be costly and time-consuming.

Regulatory compliance: As mentioned earlier, governments may have regulations and guidelines in place for the use of AI in the dairy industry. Dairy industry operators may need to ensure compliance with these regulations, which can also be a constraint for implementing AI.

Skilled personnel: Developing and implementing AI systems requires specialized skills and expertise. Finding and retaining personnel with the necessary skills may be a constraint for some dairy industry operators.

Ethical considerations: The use of AI in the dairy industry may raise ethical concerns, particularly in relation to animal welfare and the impact on human workers. Dairy industry operators may need to consider ethical implications when implementing AI systems.

Prototype Selection

Feasibility: The AI model can be built and deployed in a few months as a SaaS(Software as a Service), also the IoT device can be made and deployed in one year.

Viability: As an AI model of SaaS needs only some updates from time to time, but that means only maintenance, also the sensors in the IoT device will be portable and easy to replace so it is more viable and lasts for 20-30 years.

Monetization: There are several ways to monetize an AI-powered dairy farm management business, including:

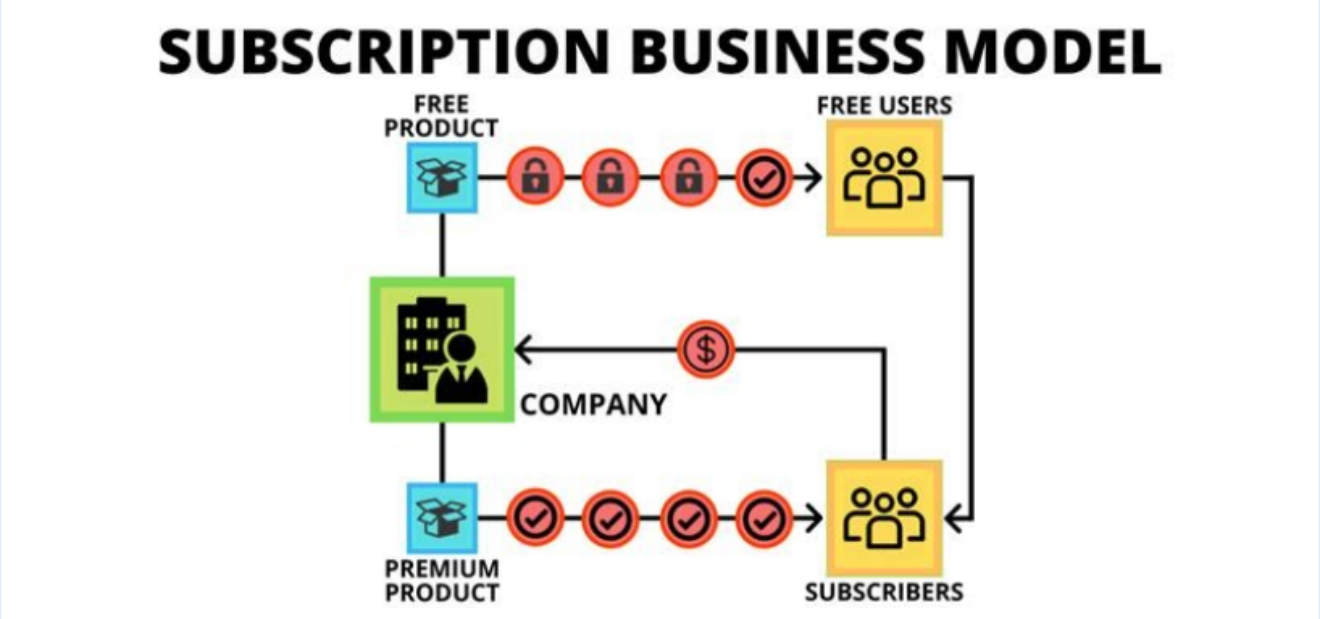
- Subscription-based model: Charge customers a monthly or annual fee to access the platform and its features. This could be based on the number of cows, the level of functionality required, or a combination of both.
- Pay-per-use model: Charge customers based on the number of cows monitored and the frequency of monitoring. This could be appealing to smaller farmers who may not need the full suite of features offered by a subscription-based model.
- Data monetization: Analyze the data collected by the platform to generate insights and recommendations for customers, and charge for access to this data. This could be particularly valuable to larger dairy

farms or industry stakeholders looking for insights into trends and patterns within the industry.

- Value-added services: Offer additional services such as veterinary support, data analysis, or customer training to help farmers make informed decisions and maximize the value of the platform.
- Partnership and collaboration: Partner with other companies in the dairy industry, such as feed manufacturers or milk processors, to provide a more comprehensive solution and generate additional revenue streams.

Business Model

Subscription based Business Model:



A subscription-based business model can be particularly helpful for the above product prototype of an AI-powered dairy farm management system in several ways:

Predictable revenue: By charging customers a monthly or annual fee for access to the platform, the business can generate a predictable stream of revenue. This can be helpful for planning and forecasting, as well as for securing financing or investment.

So basically, we provide a mobile application where the consumers have to answer some questions and then this app will give the entire insights of the cattles, including the Milk production per day, Amount of food consumed by cattles per day. We also provide the premium version in which We plant sensors and some IoT devices to monitor the daily behavior of the cow, so that the consumer can predict the calving period as well as predict if any disease in the cattles.

Environmental monitoring: AI can be used to monitor environmental factors such as temperature, humidity, and air quality. This can help farmers optimize barn conditions to improve cow comfort and health.

Train staff: Staff training is essential for the successful implementation of AI in dairy farming. Dairy farmers should provide training to their staff on how to use and maintain AI-powered systems. So our Application will provide all the required training to the farmers.

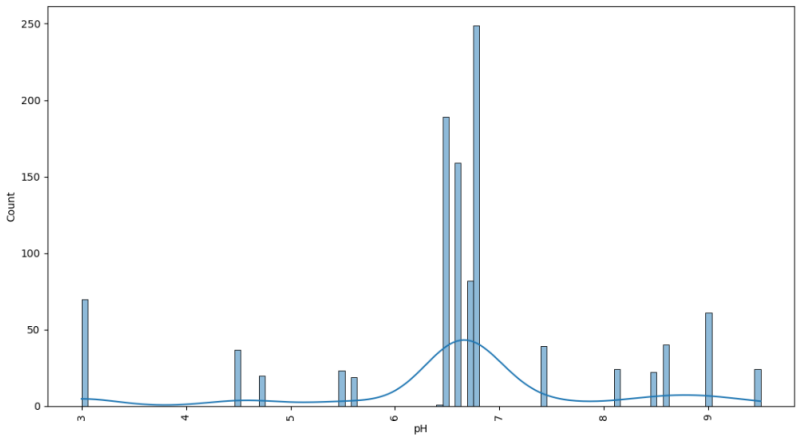
Concept Generation and Concept Development

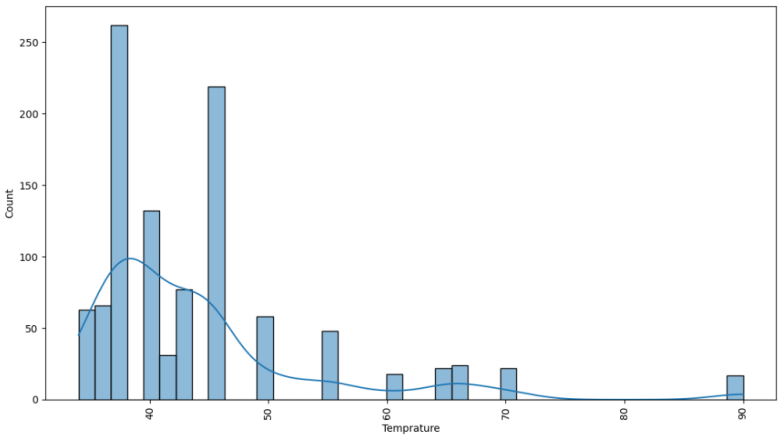
Basically the main areas of interest in dairy farms are caring for the cattles health, producing good quality milk, producing good quality fodder for cattles, predicting pregnancy/calving period of cattles. These can be easily solved using AI. Here I am taking one of the examples and building an ML model for this. For this We can also build a portable IoT device using various types of sensors like pH sensors, Turbidity sensors etc, which can be useful for the Dairy Farmers so that they can measure the pH level, turbidity etc. In this IoT device we feed the output data from different sensors and record the measurements for different features, then we feed this data to our ML model to predict the quality of the Milk.

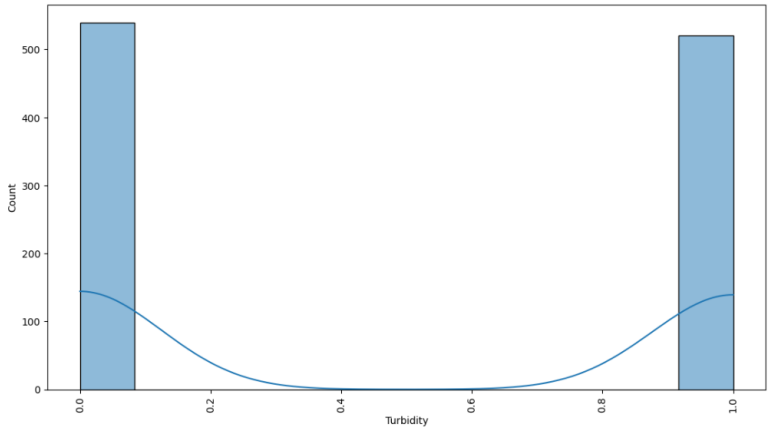
Turbidity Sensor

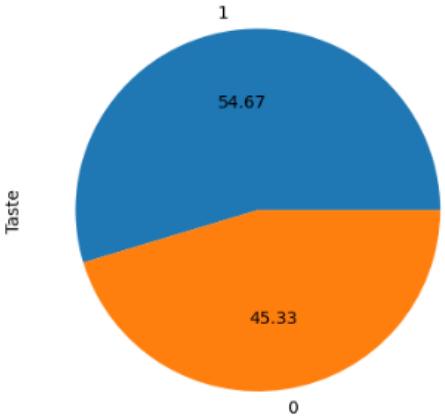
pH Sensor

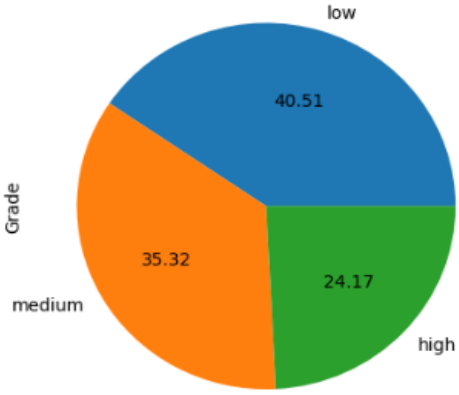
Now we come to the building of the ML model. I have taken a dataset from **Kaggle**, and then I performed exploratory analysis on the datasets, then checked various types of ML Classifier for the prediction of milk quality.

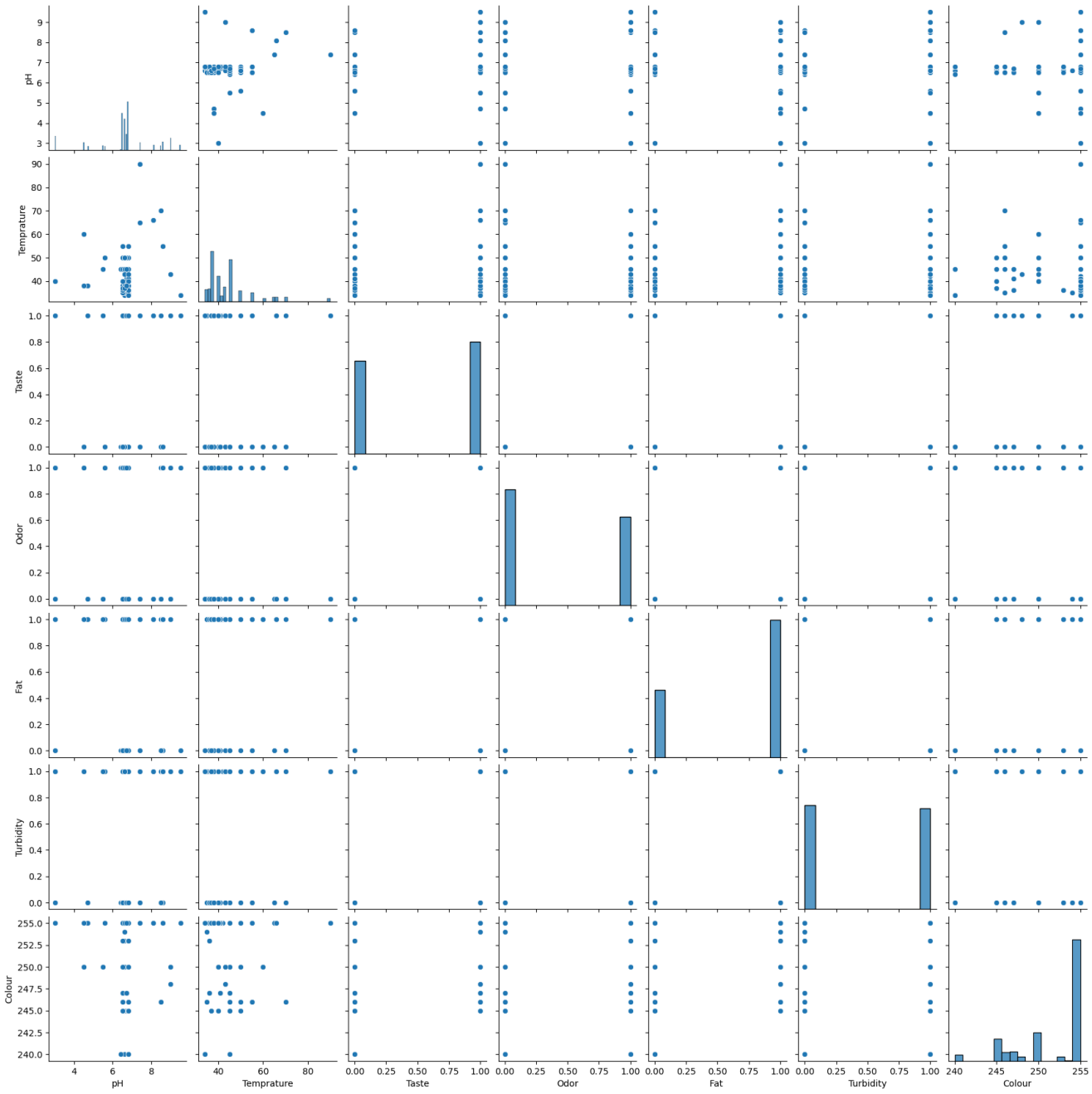





Count
Turbidity
0
100
200
300
400
500
0.0
0.2
0.4
0.6
0.8
1.0


Taste
1
54.67
45.33
0


Grade
low
40.51
35.32
medium
24.17
high



We will now select various ML models for the Milk Quality prediction and then see how different model gives different accuracy:

K Neighbours Classifier:

In [48]:
```
from sklearn.neighbors import KNeighborsClassifier
knn = KNeighborsClassifier()
knn.fit(x_train,y_train)
```

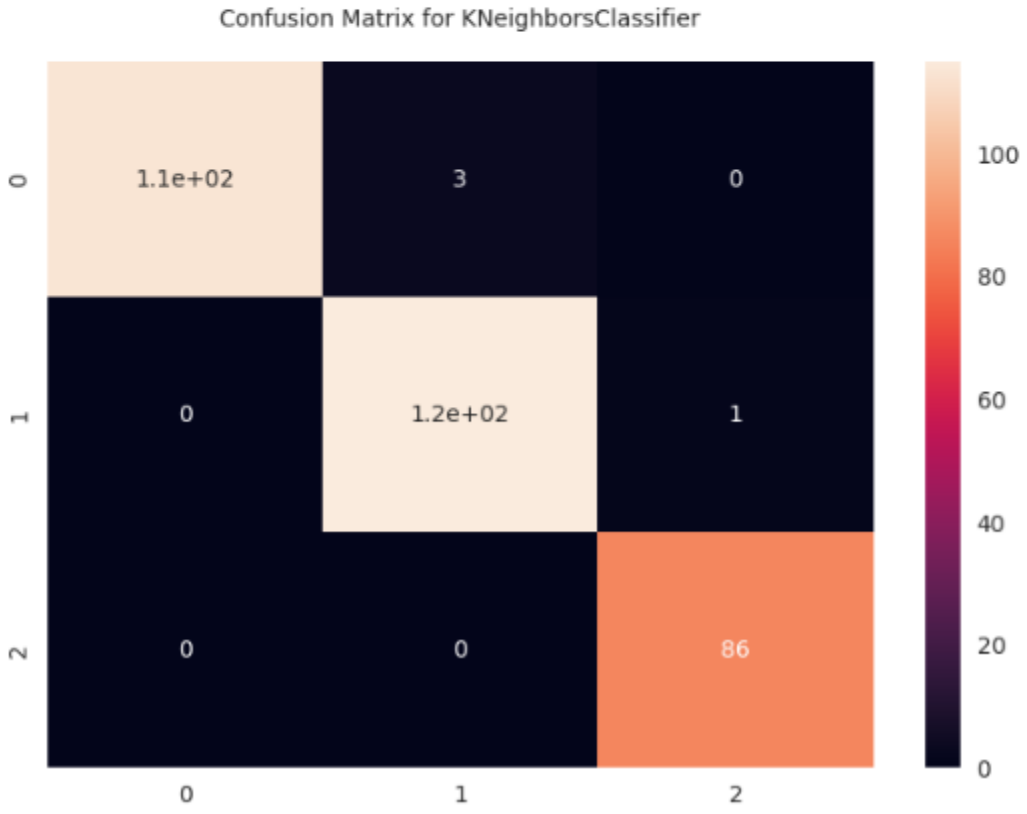
Out[48]:
```
KNeighborsClassifier()
```

In [49]:
```
print("Training Accuracy :",knn.score(x_train,y_train))
print("Testing Accuracy :",knn.score(x_test,y_test))
```

```
Training Accuracy : 0.9919028340080972
Testing Accuracy : 0.9874213836477987
```

In [50]:
```
from sklearn.metrics import confusion_matrix, classification_report
y_pred_knn = knn.predict(x_test)
cf_matrix = confusion_matrix(y_test, y_pred_knn)
sns.heatmap(cf_matrix, annot=True)
plt.title("Confusion Matrix for KNeighborsClassifier", fontsize=10, y=1.03)
```

Out[50]:
```
Text(0.5, 1.03, 'Confusion Matrix for KNeighborsClassifier')
```



Random Forest Classifier:

In [30]:
```
from sklearn.ensemble import RandomForestClassifier
rfc=RandomForestClassifier()
rfc.fit(x_train,y_train)
```

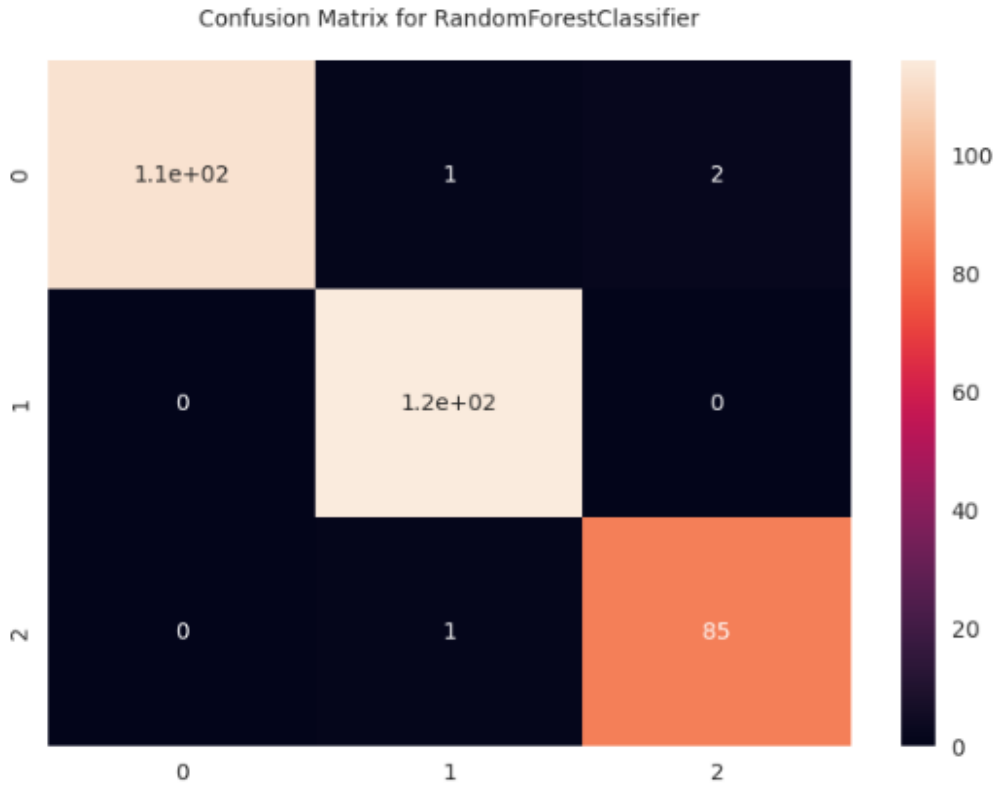
Out[30]:
```
RandomForestClassifier()
```

In [31]:
```
print("Training Accuracy :",rfc.score(x_train,y_train))
print("Testing Accuracy :",rfc.score(x_test,y_test))
```

```
Training Accuracy : 1.0
Testing Accuracy : 0.9874213836477987
```

In [32]:
```
from sklearn.metrics import confusion_matrix, classification_report
y_pred_rfc = rfc.predict(x_test)
cf_matrix = confusion_matrix(y_test, y_pred_rfc)
sns.heatmap(cf_matrix, annot=True)
plt.title("Confusion Matrix for RandomForestClassifier", fontsize=10, y=1.03)
```

Out[32]:
```
Text(0.5, 1.03, 'Confusion Matrix for RandomForestClassifier')
```



XGBoost:

In [44]:
```
from xgboost import XGBClassifier
xgb = XGBClassifier()
xgb.fit(x_train, y_train)
```

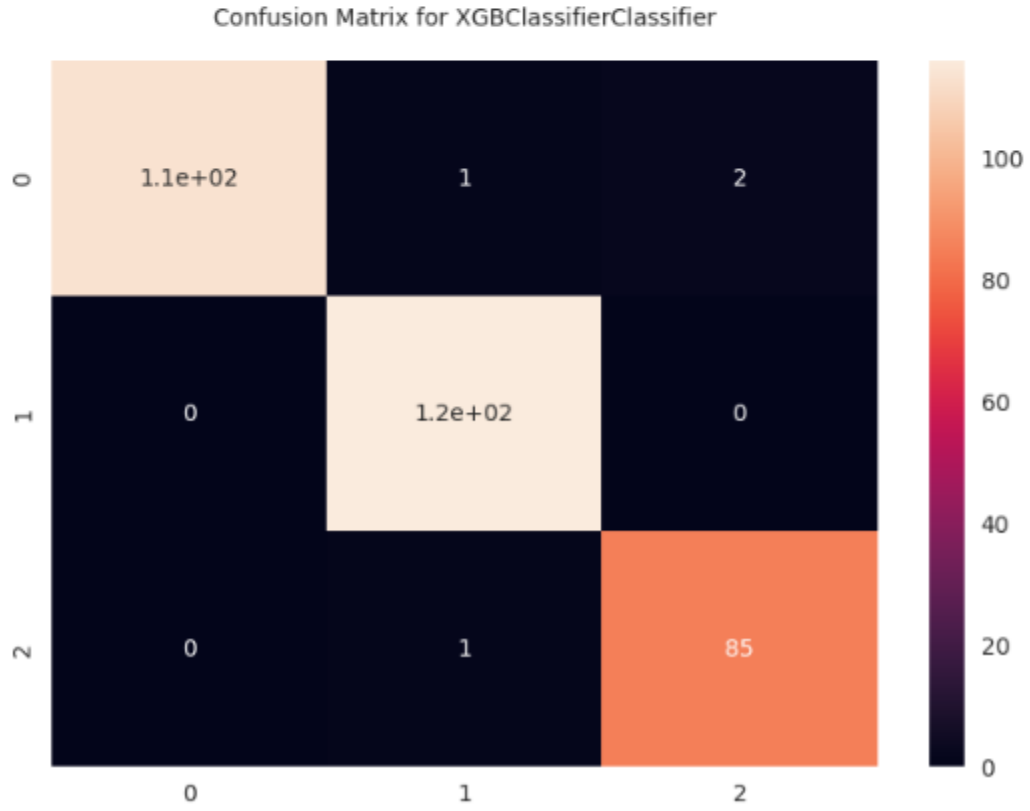
Out[44]:
```
XGBClassifier(base_score=0.5, booster='gbtree', callbacks=None,
              colsample_bylevel=1, colsample_bynode=1, colsample_bytree=1,
              early_stopping_rounds=None, enable_categorical=False,
              eval_metric=None, gamma=0, gpu_id=-1, grow_policy='depthwise',
              importance_type=None, interaction_constraints='',
              learning_rate=0.300000012, max_bin=256, max_cat_to_onehot=4,
              max_delta_step=0, max_depth=6, max_leaves=0, min_child_weight=1,
              missing=nan, monotone_constraints='()', n_estimators=100,
              n_jobs=0, num_parallel_tree=1, objective='multi:softprob',
              predictor='auto', random_state=0, reg_alpha=0, ...)
```

In [45]:
```
print("Training Accuracy :",xgb.score(x_train,y_train))
print("Testing Accuracy :",xgb.score(x_test,y_test))
```

```
Training Accuracy : 1.0
Testing Accuracy : 0.9874213836477987
```

In [46]:
```
from sklearn.metrics import confusion_matrix, classification_report
y_pred_xgb = xgb.predict(x_test)
cf_matrix = confusion_matrix(y_test, y_pred_xgb)
sns.heatmap(cf_matrix, annot=True)
plt.title("Confusion Matrix for XGBClassifierClassifier", fontsize=10, y=1.03)
```

Out[46]:
```
Text(0.5, 1.03, 'Confusion Matrix for XGBClassifierClassifier')
```



Decision Tree:

In [26]:
```
from sklearn.tree import DecisionTreeClassifier
dtc=DecisionTreeClassifier(criterion='entropy',random_state=42)
dtc.fit(x_train,y_train)
```

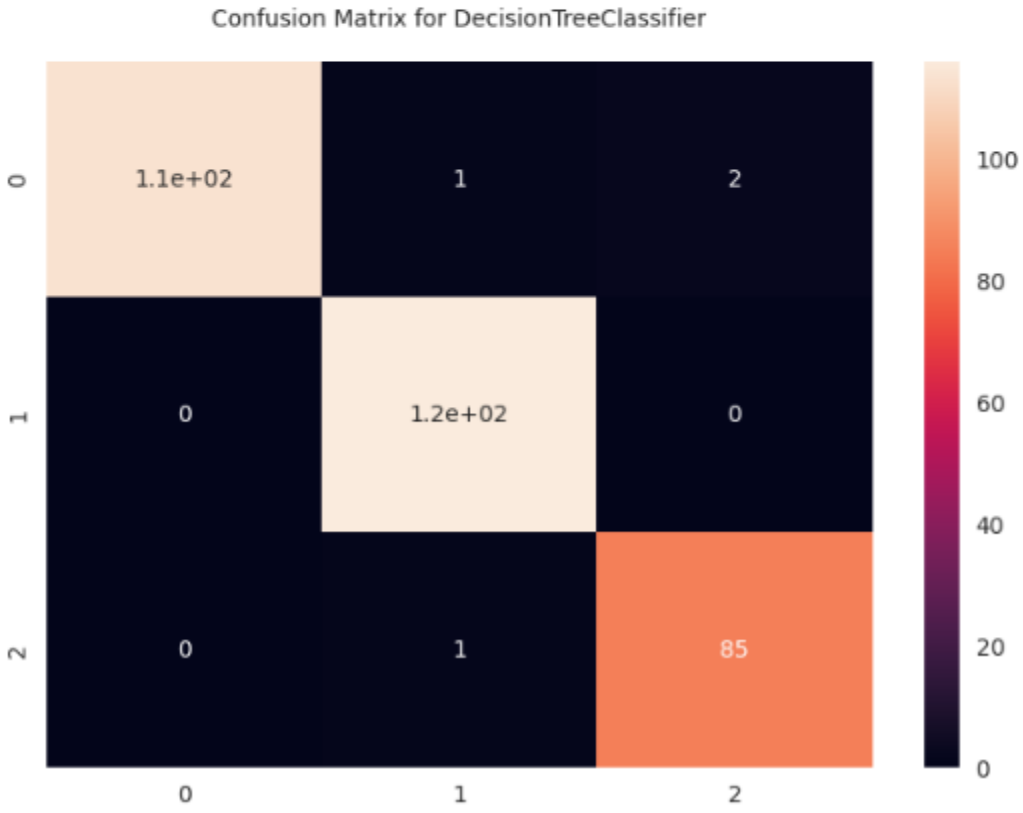
Out[26]:
```
DecisionTreeClassifier(criterion='entropy', random_state=42)
```

In [27]:
```
print("Training Accuracy :",dtc.score(x_train,y_train))
print("Testing Accuracy :",dtc.score(x_test,y_test))
```

```
Training Accuracy : 1.0
Testing Accuracy : 0.9874213836477987
```

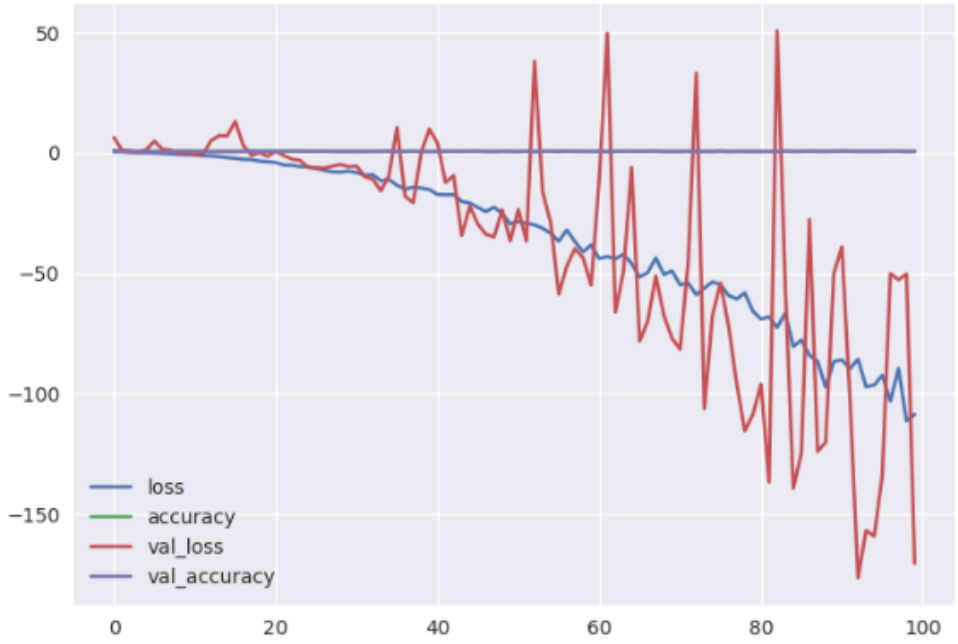
In [28]:
```
from sklearn.metrics import confusion_matrix, classification_report
y_pred_dtc = dtc.predict(x_test)
cf_matrix = confusion_matrix(y_test, y_pred_dtc)
sns.heatmap(cf_matrix, annot=True)
plt.title("Confusion Matrix for DecisionTreeClassifier", fontsize=10, y=1.03)
```

Out[28]:
```
Text(0.5, 1.03, 'Confusion Matrix for DecisionTreeClassifier')
```



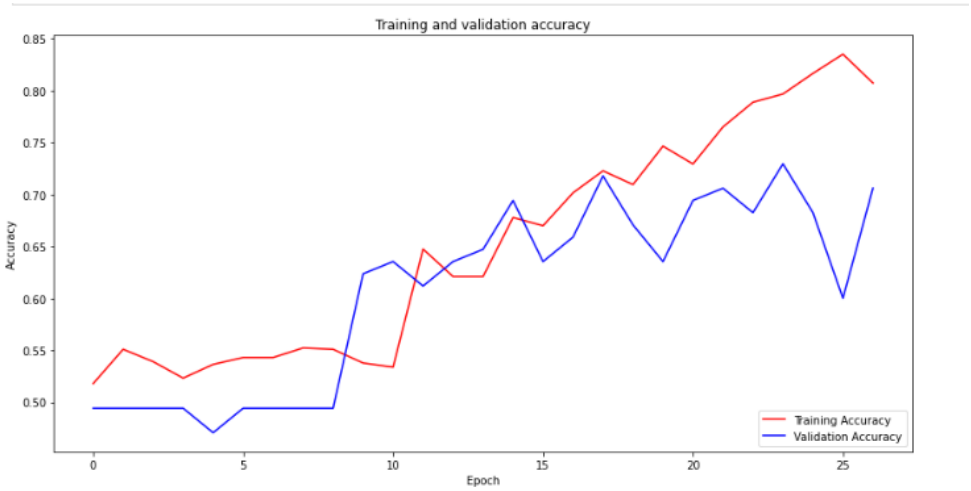
Artificial Neural Network:

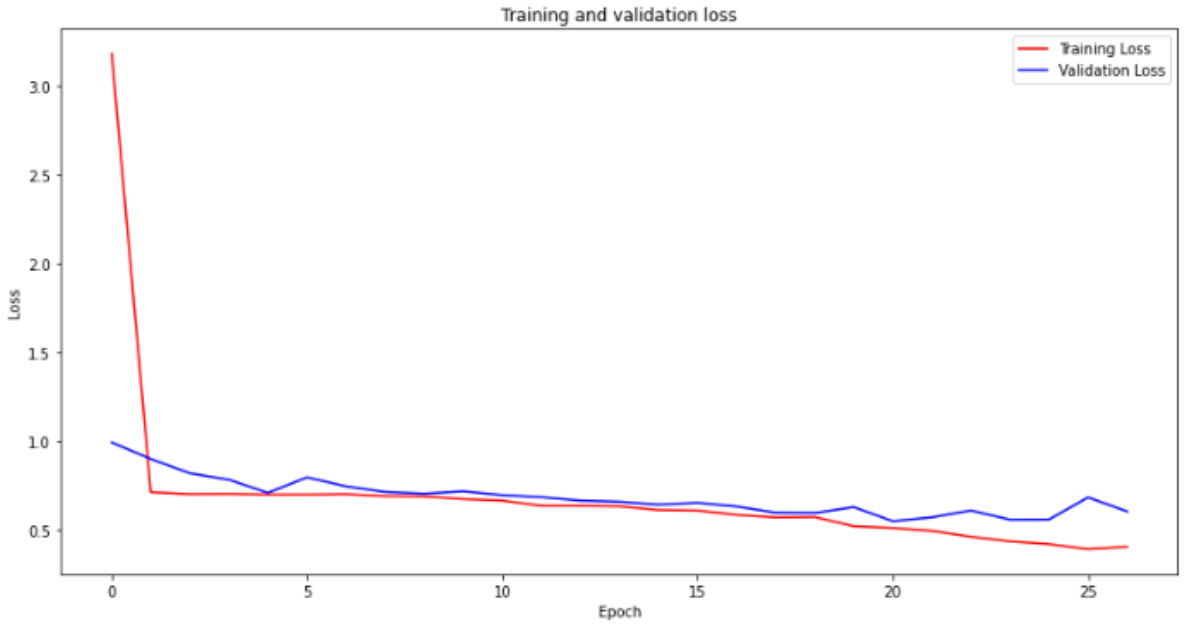
```
In [60]: loss_plot = pd.DataFrame(ann_model.history.history)
         loss_plot.plot()

Out[60]: <AxesSubplot:>
```



So this is all about Milk Quality prediction, and then we also build an Application for classifying the disease in the cows, and we implement an ML model for this.

This is the training and validation accuracy of the CNN model for the Cow's Disease Prediction:

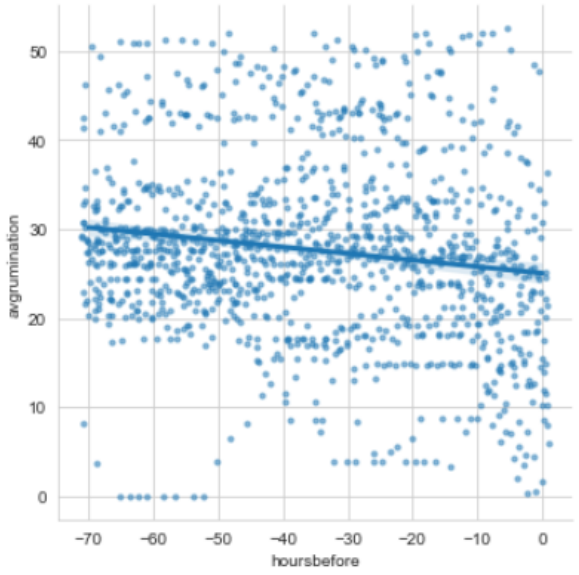





```
n [15]: pred = model.predict(X_test)
        pred = np.argmax(pred,axis=1)

n [16]: y_test.shape
        pred.shape

ut[16]: (94,)

n [17]: accuracy = np.sum(pred==y_test)/np.size(pred)
        print("Accuracy on testing dataset: {:.2f}%".format(accuracy*100))

Accuracy on testing dataset: 63.83%
```

Machine learning based calving prediction from activity lying and rumination behaviors:

Some of the insights are:


avgrumination
hoursbefore
50
40
30
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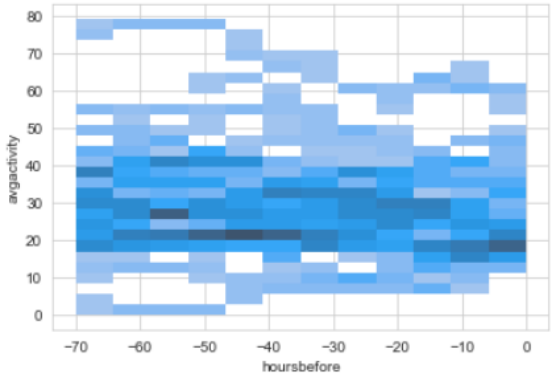
avgactivity
hoursbefore
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70
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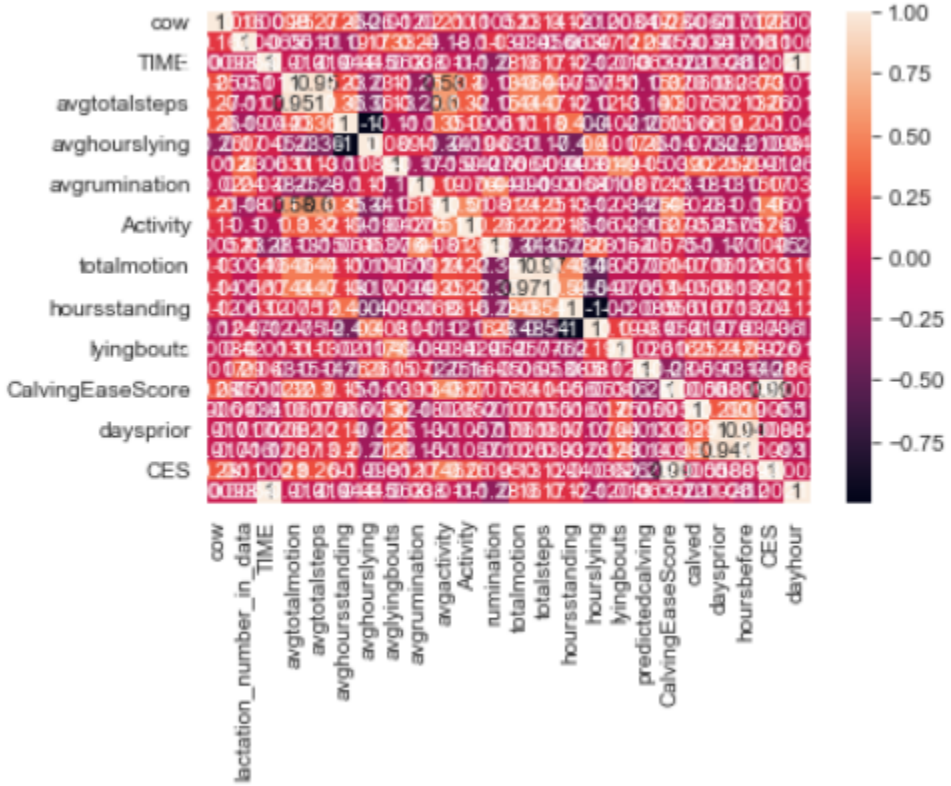
0


cow
TIME
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totalmotion
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lyingbouts
CalvingEaseScore
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CES
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TIME
avgtotalmotion
avgtotalsteps
avghoursstanding
avghourslying
avglyingbouts
avgrumination
avgactivity
Activity
rumination
totalmotion
totalsteps
hoursstanding
hourslying
lyingbouts
predictedcalving
CalvingEaseScore
calved
daysprior
hoursbefore
CES
dayhour
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75

Final Product Prototype

For Final product, we have to supply some of the below services:

1. An IoT device to measure the quality of milk. In this the dairy farmers just dip this device into the container full of milk and then , the sensors take all the measurements which is our input data from the milk, and then it feeds the data into the ML model inside it, and performs the prediction of the quality of milk.
2. A Mobile Application, for the detection of disease in cows, by which farmers scan their cattles and then the application takes that input image and feeds it to the ML model inside it, and then gives the correct output after classification.
3. A Mobile Application, for the prediction of the calving period of the cows, by which farmers fill some of the health features of their cattles like temperatures and then the application takes that input data and feeds it to the ML model inside it, and then gives the correct information about the calving period of the cattles.
4. An application with Insight Dashboard for all the data of production of milk in years or months, also all the sales data, customers data, location data, basically that application will do the customer churning for dairy market.
5. A fully implemented mobile application which contains all the information about the food of cattles, which also gives the insight for when to feed the cattle , and in how much, so the production is high, this all can be implemented through ML model.

Financial Modeling:

Here's a potential financial equation for the business model for AI in the dairy farm industry:

Total Revenue = (Monthly Subscription Price x Number of Farms) x 12 Months

Total Costs = (Product Development Costs + Marketing and Sales Costs + Customer Support Costs)

Profit = Total Revenue - Total Costs

In this equation, Total Revenue is the total amount of revenue generated from monthly subscription fees for the AI-based dairy farm solution. The Monthly Subscription Price is the price charged to farmers on a monthly basis, and the Number of Farms is the total number of farms subscribed to the solution. Multiplying the Monthly Subscription Price by the Number of Farms gives the total monthly revenue, which is then multiplied by 12 months to calculate the annual revenue. Let's say the monthly subscription price is **Rs. 1200** and the cost of making the product including the AI model and the IoT device are **Rs. 10,00,000.**

Total Costs includes all the costs associated with developing and delivering the product to the market. This includes Product Development Costs, such as research and development, software development, and hardware costs, Marketing and Sales Costs, such as advertising, sales commissions, and promotional events, Customer Support Costs, such as training, troubleshooting, and customer service.

Profit is the difference between Total Revenue and Total Costs. A positive profit indicates that the business is generating revenue in excess of its costs, while a negative profit indicates that the business is operating at a loss.

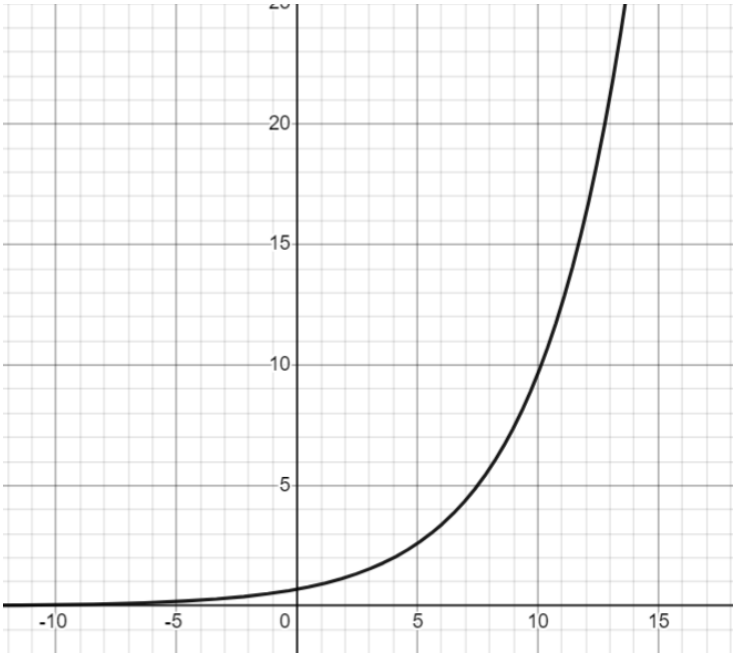
Now the Equation will be exponential:

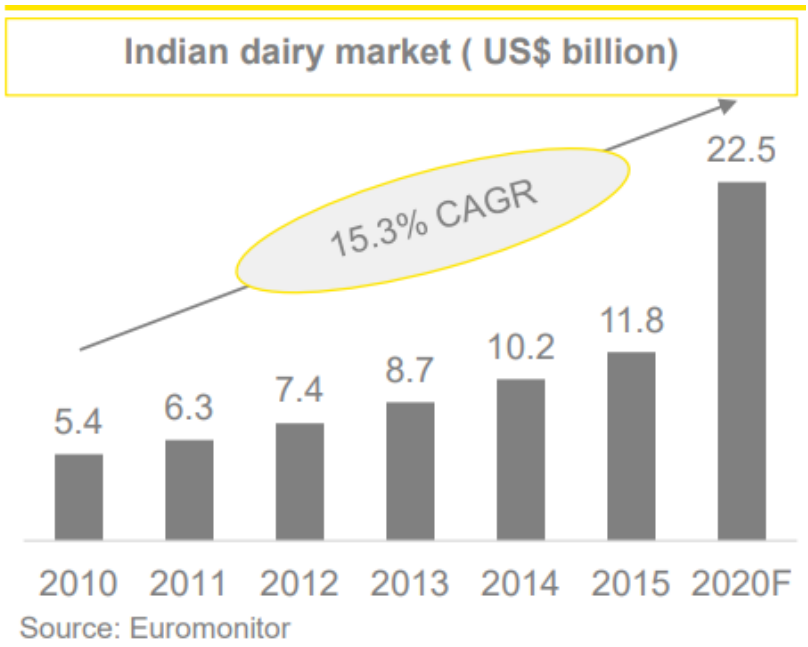
Y = X * (1 + n)^(t)

where Y is the Profit over time, X is the total price of product, **n** is the growth rate, **t** is the total time

Let's say growth rate is 0.5

Y = (X)* (1.5)^t





The potential for exponential profit growth depends on the ability of the company to effectively market and sell the solution to its target customers. This could involve building relationships with dairy farmers and other stakeholders, providing excellent customer service, and demonstrating the value of the solution through case studies and testimonials. If the company is successful in building a strong customer base and expanding its reach, the potential for exponential profit growth could be significant.

Github Link:

https://github.com/ashish-sadan/Feynn-Labs/tree/main/Task%202%20%7BAL%20in%20dairy%20farm%7D

https://github.com/khaderather/AI-in-Dairy-farm

https://github.com/Nandaraj-m/feynnlabs/tree/main/EDA%20of%20Dairy%20farm%20task%203

https://github.com/Ashwani015/CV/blob/main/MilkQuality.ipynb

References:

https://www.tastingtable.com/754854/how-artificial-intelligence-could-change-the-dairy-farming-industry/

https://theprint.in/opinion/how-ai-can-help-indian-dairy-farmers/544611/

https://www.nature.com/articles/s41598-021-93056-4

https://www.sciencedirect.com/science/article/pii/S0167587720309211

https://www.weforum.org/agenda/2020/11/how-ai-can-improve-indias-dairy-ecosystem/

https://gaic.gujarat.gov.in/writereaddata/images/pdf/21-high-tech-dairy-farming-unit.pdf

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[1] *Thank you*