Dairy Farm House Monitoring based on IoT Technology

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***Abstract*—Currently, dairy-monitoring technologies are gaining interest. The systems allow monitoring cow health and milk production. The Dairy farm house monitoring, Based on IOT have opened many new opportunities for monitoring animals. This system is going to monitoring cow feeding position and tracking taken food quantity with milk production. The animals in farm House requires additional support to the animal husbandry activities. Such support must include the monitoring and the conditioning of animal location and behavior, specially their feeding posture. IOT network is performed to own processing ability. The cloud platform consist the machine learning feature and Data mining. it is used to extracting of relevant information from the Data gathering by IOT network. This paper proposes a Dairy farm House monitoring platform Based on IOT Data techniques monitoring. It includes an iot network to gathered Data from animals and cloud platform with storage and processing capability. This platform was evaluated for detecting the animal posture Different account machine learning algorithm are used to comparing the animal posture.**

Keywords: Animal monitoring technology, Data mining, IoT. Machine Learning

I. INTRODUCTION

Weed control is a noteworthy problem in vineyards. It demands from winemakers significant economic and labor efforts. Moreover, the solutions currently used, either mechanical or chemical, are intended to be avoided by producers in order to increase the quality of their products. Thus, sheep, by their propensity to feed from weeds, are seen as an alternative and environment friendly solution. However, to protect cultures, the Sheep IT project proposes a system to condition the posture and location of sheep while they graze in vineyards.

Improvements in nutrition, management processes and animal welfare in general could lead to increased performance of dairy cows. However various factors such as diseases, low detection rates of insemination moments, and reproductive health problems still have a negative impact on overall economic performance of the dairy industry. These problems reflect in reduced milk production, early removal of potentially useful cows and long calving intervals resulting in fewer calves [1].Driven by the innovations in the field of Internet of Things (IoT), such as new low power communication networks and the further miniaturization of sensors, precision dairy-monitoring technologies (PDMT) to overcome the mentioned problems are gaining interest. Sensors which continuously and automatically monitor animal behavior and other parameters can provide information about nutrition, reproduction, health, and overall well-being of dairy cows. Because traditional monitoring methods often translate into subjective visual inspections,which are labor intensive, time consuming and require continuous presence of skilled personnel, PDMTs are also expected to reduce labor costs [2]. Several studies indicate the added value of PDMT [3-4] such as an improvement in the cow's reproductive efficiency, neonatal viability and their value in detecting the insemination moment. However, these cases often focus on only one aspect of dairy management such as better detection of the insemination moment and monitoring cow health.

Designing an IoT-based PDMT system requires multiple trade-offs between the functional requirements and the technological specifications of different IoT aspects. The wide choice set of available protocols, sensors, processing and communication technologies often shift the focus of the design process to a pure technical perspective.

However including also strategic and economic considerations in the design process of an IoT-system have an important impact on the outcome and help further narrowing down the technological choice set.Therefor the goal of this paper is to present a methodology to design a smart PDMT system based on functional, technical and economic requirements, as well as to evaluate the economic impact of such a system from a farmer's perspective.

II. LITERATURE SURVEY

A number of international projects have developed system for the storage and management of animal tracking data. These include:
Bishop-Hurley **e**t al ,Remote monitoring of animal behavior offers great potential to improve livestock management however technologies able to collect data at high frequency and accurate data classification methods are required. The objective of this study was to develop a methodology capable of performing unsupervised behavioral classification of electronic data collected at high frequency from collar-mounted motion and GPS sensors in grazing cattle. Two independent trials were conducted, one for developing the classification algorithm (4 groups of 11 steers) and a second for its evaluation (14 steers). Each steer was fitted with a collar containing GPS and a 3-axis accelerometer that collected data at 4 and 10 Hz, respectively. Foraging, ruminating, traveling, resting and 'other active behaviors' (which included scratching against objects, head shaking, and grooming) were observed and recorded continuously at the nearest second in animals wearing collars. Collar data were aggregated to 10-s intervals through the mean (indicative of the position of the neck and travel speed) and standard deviation (SD; indicative of activity level) and then log transformed for analysis. The histograms of travel speed showed 3 populations and observations revealed these populations represented stationary, slow and fast travel behaviors. The histograms of the accelerometer X-axis mean showed populations corresponding with behaviors of head down or head up. The histograms of the accelerometer X-axis SD showed 3 populations representing behaviors with high, medium and low activity levels.
Major advantages of mixture models include computational efficiency suitable for large data sets (e.g. >2 million data lines), minimal requirement for training datasets, and estimation of threshold values for individual animals under unknown and varying environmental conditions. The technology and methodology allows for the automatic and real-time monitoring of behavior with high spatial and temporal resolution which could benefit livestock industries beyond the research domain for improved animal and ecological management. The present study showed that information collected at high frequency (10 and 4 Hz) by accelerometers and GPS sensors embedded in cattle collars have the ability to capture fine scale spatial -temporal differences in the position and activity level of the neck while cattle are engaged in various behaviors in the paddock.
This ability to capture behavior at fine spatial- temporal scales may help improving the accuracy of behavioral classification methods and to develop a consistently reliable means to remotely access data from the collars in real-time for virtual fencing and management applications.

Ross G. Dwyer **e**t al[7] common e-Science infrastructure to support the management, pre-processing, analysis and visualization of animal tracking data generated . This paper describes the technical challenges and design decisions associated with the development of the OzTrack system. Finally this paper outlines the systems' current limitations and preliminary results and feedback from its evaluation to date. By adopting a common, open access approach to the management and analysis of these large and diverse datasets, OzTrack facilitates the sharing of data and knowledge that will hopefully expedite scientific research in the field of animal telemetry. In addition, by providing online, integrated access to the suite of services most frequently used by wildlife ecologists, OzTrack will reduce the time and effort required by researchers to extract valuable information that can be used to inform decisions associated with wildlife management. This paper describes the technical challenges we faced in developing OzTrack. The greatest challenge now is the constant evaluation, adaptation and maintenance of OzTrack required to ensure that existing users are retained and new users are attracted.

Md. Sumon Shahriar **e**t al The detection of heat events in dairy cows fitted with on-animal sensors using unsupervised learning. Accelerometer data from the cow collars were used to identify increased activity levels in cows associated with recorded heat events. [6] Time series data from the accelerometers were first divide into windows before features were take out. K-means clustering algorithm was then request across the windows for grouping.
The groups were labelled in terms of their activity force high, medium and low. Detected events in AIxL were compared with recorded heat events and observed significant associations between the increased activities through high values and the observed heat events. We achieved overall perspective of 82–100% with 100% sensitivity when change detection technique is applied to activity index level. We presented heat detection using unsupervised learning for pasture-based dairy cows with activity sensors. Accelerometer data from cow collar activity sensor are used in heat detection using time series clustering. Heat events are identified using a change detection technique on the high activity index derived from the clustered time series data. Detected heat events are further validated with ground truth events that were determined from milk progesterone levels, calving date and patches.

III. EXSITING SYSTEM

The detection of moments where sheep present a posture that could put in risks the vines and grapes.The placement of grazing animals in vineyards requires additional support to the animal husbandry activities. Such support must include the monitoring and the conditioning of animal location and behavior, specially their feeding posture. A data set composed of collars' sensor data was build and stored taking advantage of the existing platform and each entry was manually classified. Different ML algorithms were then evaluated in order to assess the platform power. All algorithms showed similar accuracy but the results obtained using DT are especially relevant since, their easier interpretation, helped to the Definition of posture control algorithm to be implemented on collars .

DISADVANTAGES

- Existing platform and each entry was manually classified.
- It is not suitable for environments with a large amount of data besides the security and integrity mechanisms.
- High energy consumption of the system.
- High time consuming.

IV. PROPOSED SYSTEM

This system is going to monitoring cow feeding position and tracking taken food quantity with milk production. To reach such goal, the system comprises several different blocks (and respective interactions), each of them being responsible for particular tasks. Among these tasks, the data collection, data aggregation, data processing and data representation may be highlighted.Collars are collecting data from sensors, being as well responsible for the supervision of the animal's behavior and location. As these devices individual processing abilities and because it is not acceptable to wait for a decision to be handled and transmitted by a central node with more processing power, due to the delay associated, the posture control algorithm runs locally, analyzing sensors' data and applying remedial stimuli (e.g. electrostatic and auditory cues). Thereafter, the relevant data for the user is transmitted to an infrastructural network composed by fixed beacons. These devices are installed accordingly to the intended grazing areas and besides being responsible for collecting collar's data, they implement a periodical and synchronized beaconing signal emission all over the network that allow collars to evaluate their location through the use of RSSI-based localization techniques, and the network to trace back animal location. At the same time going to capture the quantity of the food content also. The platform includes a REST API framework to allow the WEB development. With this, it is possible to interact directly with the user but also with other relevant platforms. For instance, information about animals could be directly integrated within legal databases for animal registry.

ADVANTAGES

i) Accuracy (ACC) that represent the correctness of the prediction within the entire population.

ii) True Positive Rate (TPR) or sensitivity that identifies how often the model predicts true when it is actually true.

iii) True Negative Rate (TNR) or Specificity, that identifies how often it is false when it is actually false.

iv) Precision or Positive Predictive Value (PPV) that identifies, when it predicts true how often it is correct and v) The Receiver Operating characteristic Curve (ROC) and the Area Under de Curve (AUC).

vi) Milk production

V. RELATED WORK

1. IoT network
2. Cloud Platform
3. ML use case detecting sheep's posture infractions
4. Machine Learning Algorithms comparison
5. Upload Daily activity
6. View upload file
7. Analyzing cow & milk quantity
8. Analyzing food& milk quantity
9. Result analysis

IoT network

Collars are used to collecting data from sensors, being as well responsible for the supervision of the animal's posture behavior and location. it is not suitable to wait for a decision to be handled and transmitted by a central node with more processing power, due to the delay associated, the posture control algorithm runs locally, analyzing sensor data and applying corrective stimuli (e.g. electrostatic and auditory cues). the relevant data for the user is transmitted to an infrastructural network composed by fixed beacons. These devices are installed accordingly to the intended grazing areas and besides being responsible for collecting collar's data, they implement a periodical and synchronized beaconing signal emission all over the network that allow collars to evaluate their location through the use of RSSI-based localization techniques, and the network to trace back animal location.

Cloud Platform

The Cloud platform, is composed by five different interconnected modules, responsible for the aggregation, analyze and processing of stream data. The Message Oriented Middleware (RabbitMQ),allowing message routing through producers and consumers.

It receives JSON messages from the Gateway and make them available to the data processing .RabbitMQ works as an intermediary between the Gateway and the remaining platform, managing all the received messages prompted by the Gateway in a First-In- First-Out (FIFO) queue. Also, the RabbitMQ allows security mechanisms to be employed, such as SSL/TLS certificates.

ML use case detecting cow's posture infractions

Detecting if a cow is feeding on the food is not straightforward, being necessary to evaluate more than one sensor to avoid bad decisions. Thus, ML was chosen to help on the process, namely resorting on supervised algorithms, which means that the learning algorithm learns from a training set and then applies the learning model to a test set to be evaluated. Which measurements of neck pitch and distance to the ground. Cow were released onto a plain field and their activity recorded on video for about 3 hours. collars continuousl retrieved time stamped raw sensor data and sent it into the network in order to be automatically classified.

Machine Learning Algorithms comparison

Taking advantage of the ML module integrated within the computational platform, different ML algorithms were evaluated to asses with which accuracy cow's posture infractions could be detected. Different algorithms were tested, particularly the most popular in classification problems: Random Forest, Decision Trees (DT) using C50 , XGBoost, K-Nearest Neighbors (KNN), Support Vector Machine (SVM) and Naïve Bayes.

Fig1: Result Analysis

Upload the daily activity

In this module the user can upload the daily activity of the cow.The daily activity contains food, milk, health details, etc.The uploading file contains the entire details of the cow health.

View upload file

This module is used to view the uploading file.When the user try to upload the file

Analyzing cow and milk quantity

In this module the cow health and the milk quantity is monitored. This module is used to analysis the milk quantity based on the cow health

Analyzing cow and milk quantity

The module is used to analysis the milk quantity based on the food given to cow. Based on the food taken by the cow the milk quantity is analyzed.

Result analysis

In this module the overall process is displayed based on the user query. In the result prediction module the user can view the cow health details and also the milk quantity based on the analysis.

VI.ALGORITHM DETAILS

Animal monitoring based on IoT technologies

1. Capture or Upload data
2. Detecting Animal's Posture
3. Detecting Animal's Feed Quantity
4. Detecting Animal's Milk Produce Quantity
5. Result

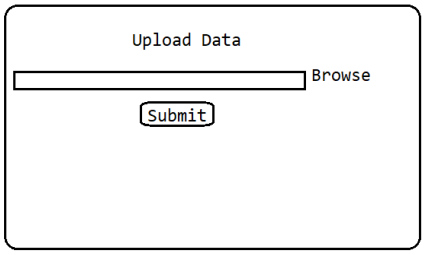

Fig2:Upload data page

Upload data format will be,

1. Date
2. Animal Id
3. Food Name
4. Quantity
5. Position(x , y)
6. Approx Milk Produce Quantity

Algorithm

Random Forest, Decision Trees (DT) using C50 and RPart packages, XGBoost, K-Nearest Neighbors (KNN), Support Vector Machine (SVM) and Naïve Bayes.

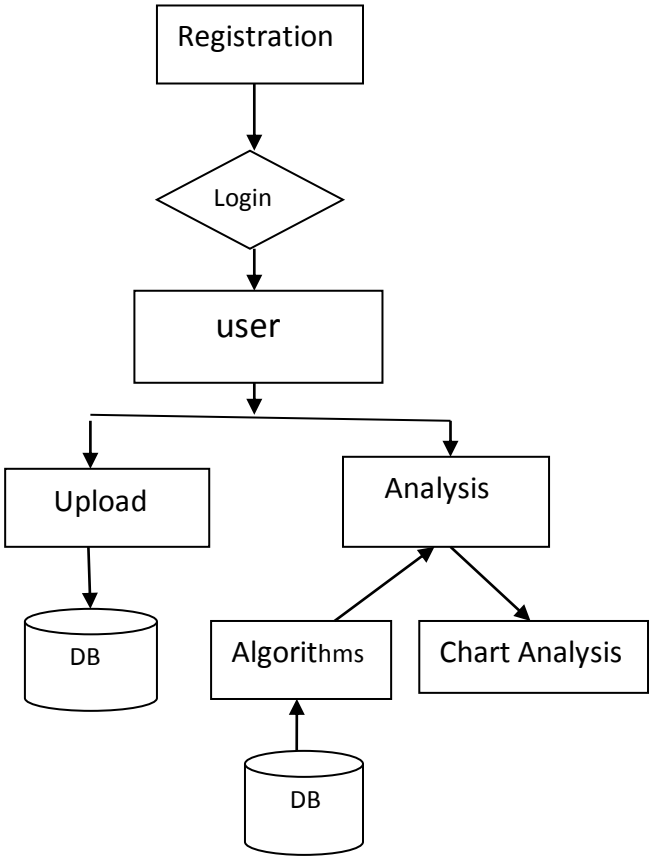

Fig3: Data flow

Applications

Needs at Diary House, Cattle Feed Products Manufacturing Companies Our system helps to cattle companies as below,

1. Produced with the optimal blend of required nutritional elements.
2. Made with ultra modern technology which helps in producing a high quality product.
3. Increases milk production.
4. Improves body condition and overall herd health.
5. Formulated with superior quality raw materials resulting in a highly palatable cattle feed.
6. Gradually increases milk yield without causing stress to the animal and without compromising on the solid non-fat (SNF) and total fat contents of the milk.
7. Suggesting the foods to good.

Fig4: milk quantity

VII.CONCLUSION

The project used to increasing milk production on farm house. It demands from milk significant economic and labor efforts.Moreover, the solutions currently used, economic are intended to be avoided by producers in order to increase the quality of their products. This system is going to monitoring cow feeding position and tracking taken food quantity with milk production. Thus, cow, by their propensity to feed from food, are seen as an alternative environment . Besides the local operation, the system comprises a computational platform running on the cloud that receives the data gathered locally and process it in order to retrieve additional information from them. One of the mechanisms that may be used is Machine Learning.

This paper presents the overall system architecture, from collars, the mobile nodes carried by cow, up to the cloud platform with different tasks as data analyses, data processing or data storage. In addition, this paper presents the evaluation methodology and results of the added value of a Dairy farm house monitoring from a dairy farmer's perspective.

VIII.FUTURE WORK

It would be worthwhile to extend the model in the future with other common dairy diseases such as rotation of the lumbar or other use cases for farm monitoring such as customized feed distribution or monitoring the animal welfare. Next it would be very interesting to see what other livestock (e.g. meat cows, mules, goats) could benefit from this monitoring system. detecting panic attack and patterns of movement.

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