# Bird Flu Tracking System usingNaive Bayes Classifier

Kedar Sawant[1], Sairaj Kapadi[2], Sakshi Kenavdekar[3], Sanket Marathe[4] and Rhutik Parab[5]
[1]Computer Engineering, Agnel Institute of Technology and Design, Panaji, INDIA
[2]Computer Engineering, Agnel Institute of Technology and Design, Panaji, INDIA
[3]Computer Engineering, Agnel Institute of Technology and Design, Panaji, INDIA
[4]Computer Engineering, Agnel Institute of Technology and Design, Panaji, INDIA
[5]Computer Engineering, Agnel Institute of Technology and Design, Panaji, INDIA

[1]Corresponding Author: ksa@aitdgoa.edu.in

Received: 15-07-2023 Revised: 03-08-2023 Accepted: 25-08-2023

**ABSTRACT**

**Complexity in the food-related Supply chains also introduces economic inefficiency at every point of transaction, be it a poultry farmer or a distributor. Therefore, a system is required that tracks every point of Poultry transaction with an intuitive rather than minimal technology medium that can trace bird disease and maximize efficiency in operations at every level, from Poultry farm to Chicken Butcher/seller. A solution for farm-to-butcher/seller chicken tracker that rapidly traces bird flu while also providing a platform to maximize operational efficiency. To make the chain effective the proposed system needs enrolment at every level (Farmers, Distributors, Sellers) where poultry transactions can be recorded, and hence, our solution maximizes platform enrolment by cutting down the distributors' labor costs by providing access to accounting and management tools and providing a one-stop marketplace to both distributors and farmers. With the ease of use of the RFID tagged system for distributors and sellers to tap and add batches to their inventory for easy supply chain management. The same data will also help in flu detection.**

***Keywords***-- H5N1, Influenza, Tracking, Poultry

## I. INTRODUCTION

### *1.1 Overview*

H5N1 influenza is a virus that primarily infects birds and also has a chance of eventually infecting humans upon consumption. Usually, in a poultry supply chain there are 3 major stakeholders who participate in the transport of poultry and likely the spread of H5N1 influenza, the first stakeholder is the Poultry farm which is the root of the supply chain followed by the distributors, at the end the sellers of the poultry which can be any poultry shops, supermarkets, etc.

There has to be a system that efficiently tracks and detects bird flu in your nearby locality so that the spread of bird flu can be controlled by simply detecting and red-flagging the respective stakeholders of the supply chain as infected in a particular scenario. In this paper, we propose a platform that detects bird flu right from the seller shops from where usually poultry is bought, to the poultry farm which is mainly the source of the virus.

### *1.2 Application*

1. Early detection and warning: By monitoring and analyzing data on bird flu outbreaks in real time, the platform can help identify potential outbreaks early and issue warnings to relevant authorities andstakeholders.
2. Disease surveillance: The platform can be used to track the spread of the disease, monitor its evolution, and identify potential risk factors.
3. Control and eradication: By providing real-time data on the location and spread of the disease, the platform can assist with the development of effective control and eradication strategies.
4. Vaccination and biosecurity: The platform can also be used to identify key areas for vaccination and biosecurity interventions, and to monitor their effectiveness.
5. Communication: The platform can be used to communicate with authorities and stakeholders and provide them with the information they need to respond effectively to bird flu outbreaks.
6. Research: The platform can be used to support research into the causes, transmission, and control of bird flu, which can help to improve our understanding of the disease and develop new strategies for preventing its spread.

### *1.3 Scope of the Research*

The objective of this project is to build a bird flu tracking system that efficiently tracks and controls the further spread of bird flu. This project aims towards providing a platform where all the 3 stakeholders of the poultry supply chain to provide their sales data which will help the app in tracking and in return will help them to get some additional features such as management tools etc. This project predicts whether a farm has been affected by H5N1 influenza by using a classification algorithm based on the symptoms shown by some sample chickens from the poultry. The project also aims to provide additional features such as management tools, analytical charts to monitor their sale, a reporting platform for users which will allow the application to detect the potential sources of the virus spread, and a map-based page that will show the infected sellers and poultry farms. In conclusion, the application has a wider scope in controlling the spread of H5N1 Influenza or bird flu and potentially avoiding a pandemic.

***1.4 Research Goal***

The goal of this research is to reduce the incidence of H5N1 influenza in both animals and humans. H5N1 influenza is a contagious disease caused by a variety of influenza viruses that birds carry, and it can be contracted by humans through contact with infected birds, their droppings, or other secretions. To prevent the spread of H5N1 influenza, it is important to detect the disease as early as possible. This can be done through surveillance programs that monitor wild birds for any signs of the virus and humans can report if they have contracted it, if they show any symptoms regarding the same. Moreover, effective public health and communication initiatives should be employed to raise awareness about the risks and spread of H5N1 influenza and how to reduce the risk of contracting it. Our proposed system aims to solve this problem by making all the stakeholders aware of the possible and real-time spread of this contagious disease and helps to take early informed decisions to efficiently control its spread. Overall, the goal of solving bird flu detection and preventing its spread is to protect public health and reduce the overall impact caused by this contagious disease.

## II. LITERATURE SURVEY

***2.1 The Bird Flu: A New Emerging Pandemic Threat and its Pharmacological Intervention***

According to the above paper "Bird flu is an infection caused by avian influenza viruses, which are of different types A, B, and C. Type A avian influenza viruses are the most frequently associated with avian influenza epidemics and pandemics. There are 16 hemagglutinin (H1 to H16) and 9 neuraminidase types (N1 to N9) identified till date. A peculiar characteristic of influenza A virus is their propensity for genetic change by two main processes: antigenic drift (small, gradual changes) and antigenic shift (abrupt, major change producing a novel influenza A virus subtype)" [2]

The above paper puts forward various modes of transmission of the virus along with some of the most alarming concerns about the impact of H5N1 Avian Influenza virus on infants and young children.

***2.2 Avian Influenza (H5N1) Expert System using Dempster-Shafer Theory***

The above paper puts forward an expert system considering five major symptoms such as depression, combs, wattle, bluish face region, swollen face region, narrowness of eyes, and balance disorders in chickens[1]. It works on the basis of Dempster-Shafer's theory to combine beliefs under conditions of uncertainty and ignorance, and allows quantitative measurement of the belief and plausibility in our identification result. Based on the provided symptoms shown with chickens and results the probability of having been infected by the H5N1 Avian Influenza Virus.

***2.3 RFID Applications: An Introductory and Exploratory Study***

RFID has been used for decades in animal farms, the military, airline, library, security, healthcare, sports, animal farms and other areas[3]. Industries use RFID for various applications such as equipment tracking, store security, fast food establishment, logistics, etc. The focus of the above paper is to explore the main RFID components i.e. the tag, antenna, and reader and it gets a general understanding of RFID technology.

***2.4 RFID: A Technical Overview and its Application to the Enterprise***

The above article provides a brief overview of what RFID is and how it works, including some of the applications of RFID that can and are being used in various industries and projects worldwide such as supply chain management, security, movement tracking[4]. It also provides us with some understanding of what are the challenges and problems faced during RFID technology implementation, and how some organizations implemented RFID.

***2.5 A Framework for the Risk Prediction of Avian Influenza Occurrence: An Indonesian Case Study***

In this study, a framework for the prediction of the occurrence and spread of avian influenza events in a geographical area was proposed. The application of the proposed framework was examined in an Indonesian case study.

"To combine disparate sources, data rows were scaled to a temporal scale of 1 week and a spatial scale of 1-degree × 1-degree cells. Given the constructed datasets, underlying patterns in rules explaining the risk of occurrence and spread of avian influenza were discovered. The created rules were combined and ordered based on their importance and then stored in a knowledge base." [5]

***2.6 Smart Monitoring and Controlling of Pandemic Influenza A (H1N1) using Social Network Analysis and Cloud Computing***

The above paper puts forward an effective cloud computing architecture which predicts H1N1 infected patients and provides preventions to control infection rate. It consists of four processing components along with secure cloud storage medical database. The random decision tree is used to initially assess the infection in any patient depending on his/her symptoms. Social Network Analysis (SNA) is used to present the state of the outbreak.[6] According to the authors the proposed architecture is tested on synthetic data generated for two million users. The key point of the paper is the use of SNA graphs to calculate role of an infected user in spreading the outbreak known as Outbreak Role Index (ORI). It will help government agencies and healthcare departments to present, analyze and prevent outbreak effectively.[6]

***2.7 Risk Factors and Clusters of Highly Pathogenic Avian Influenza H5N1 Outbreaks in Bangladesh***

This study analyzed the temporal and spatial patterns of HPAI H5N1 outbreaks and quantified the relationship between several spatial risk factors and HPAI outbreaks in sub-districts in Bangladesh. According to the authors they, assessed spatial autocorrelation and spatial dependence, and identified clustering sub-districts with disease statistically similar to or dissimilar from their neighbors. The distinct clusters of HPAI outbreaks and risk factors identified could assist the Government of Bangladesh to target surveillance and to concentrate response efforts in areas where disease is likely to occur.[7]

***2.8 A Decision Support Framework for Prediction of Avian Influenza***

This research proposes the development of a framework that comprises of three main parts, including (1) Data management for acquiring, pre-processing and integrating of data; (2) Knowledge management for building a knowledge base by extracting rules and facts from data; and (3) User interface for creating reports for questions that users can inquire about the risk of avian inuenza in dierent geo-graphical scales. According to the authors the framework combines patterns from two main approaches. In the rst approach, the Twitter disease-related data was used to identify the date, severity and virus subtypes of ocial outbreak reports. In the second approach, several covariates data sources were combined to build a spatiotemporal dataset. Then, underlying patterns explaining the risk of introduction and spread of avian in-uenza were discovered. They propose that the novelty of the present study lies in utilizing several data sources which could contribute to the timeliness and accuracy of extracted patterns.[8]

***2.9 Avian Influenza Surveillance System in Poultry Farms using Wireless Sensor Network***

This article discusses the development of a wireless sensor network for avian influenza surveillance in poultry farms. The authors evaluate the effectiveness of using a wireless sensor node with temperature and accelerometer sensors to detect chickens infected with highly pathogenic avian influenza (HPAI) viruses at an early stage. They propose a detection method using body temperature and acceleration data and demonstrate the basic operation of a wireless sensor node with a small button battery. The study concludes by evaluating the surveillance system using the wireless sensor node for chickeninfection detection. [9]

***2.10 To Report or Not to Report: A Psychosocial Investigation Aimed At Improving Early Detection of Avian Influenza Outbreaks***

This study explores the difficulties and barriers to reporting avian influenza outbreaks and suggests incentives for reporting. Interviews and surveys were conducted with policy-makers, veterinary practitioners, and poultry farmers. The study identifies six major barriers to reporting, including lack of knowledge and uncertainty about clinical signs, guilt and shame, negative opinions of control measures, dissatisfaction with post-reporting procedures, lack of trust in veterinary authorities, and uncertainty about the notification process. The study also highlights differences in attitudes towards reporting between farmers and veterinarians. Recommendations for improving early detection of avian influenza outbreaks are discussed, including improving communication, providing free testing, and building trust between farmers and authorities. [10]

## III. PROPOSED SYSTEM

***3.1 Research Concept***

While the Poultry supply chain becomes more complex, the Rapid Tracing of bird diseases like bird flu becomes near to impossible, in most cases it takes months!

A bird flu tracking system aims towards keeping a record of the supply of poultry between the poultry farm and from the distributor to the seller or poultry retail stores.

***3.2 Research Statement***

Delaying in tracing of bird flu leads to

1. Delay in containment
2. And above all increase in disease transmission both in humans and birds.
3. Complexity in the food-related Supply chains also introduces economic inefficiency at every point of transaction, be it a poultry farmer or a distributor.

So, there has to be a system that can track the route of the poultry supply chain right from the poultry farm to the sellers from which customers buy poultry.

**3.3 Solution**

Our solution to this problem is summaries below

1. Keep a record of every batch delivered from the poultry farm to the retail store.
2. Every batch that is generated in a poultry farm will have an RFID reader, on which the distributor will tap his RFID card.

Once the batch is delivered to the retail store, the store owner also needs to tap his RFID card on the distributor's RFID reader machine which will create a chain-like **Poultry Farm -> Distributor -> Seller** So, if any of the retail stores has been found to be infected then the system can track the route to the poultry farm and in-turn calculate which of the other stores have been infected.

***3.4 Block Diagram***

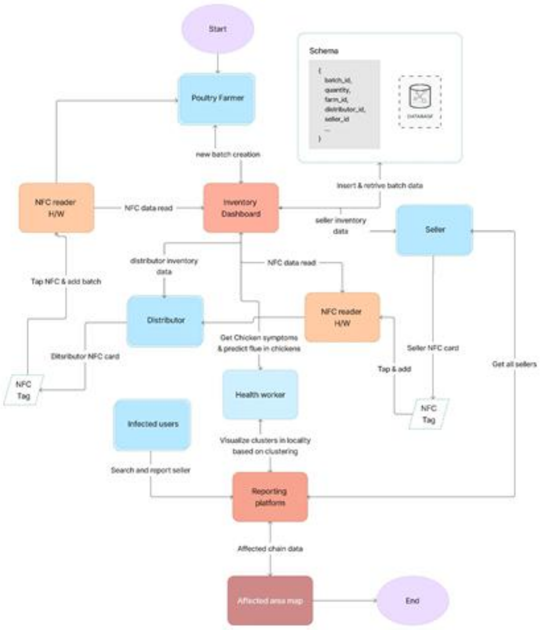


**Figure 1:** Application block diagram

## IV. DESIGN

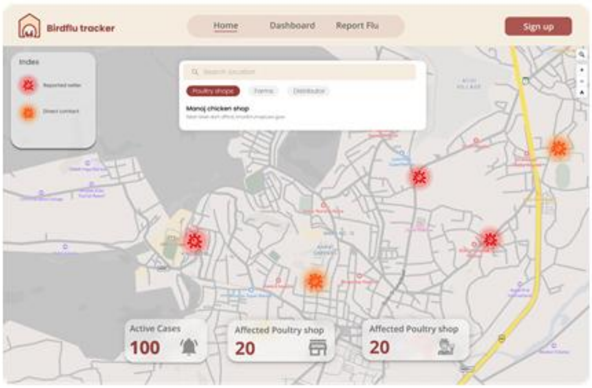


**Figure 2:** Dashboard home page

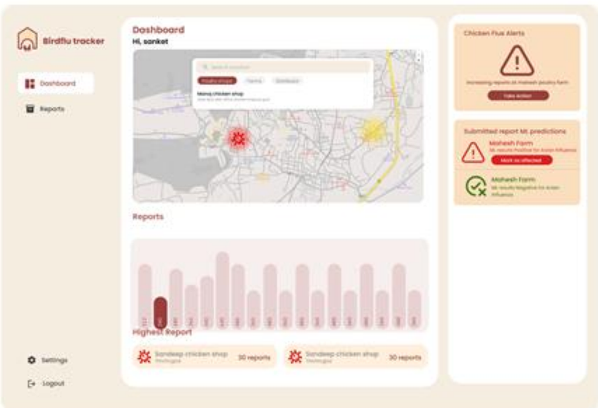


**Figure 2:** Healthworker dashboard


**Figure 2:** Farmer dashboard

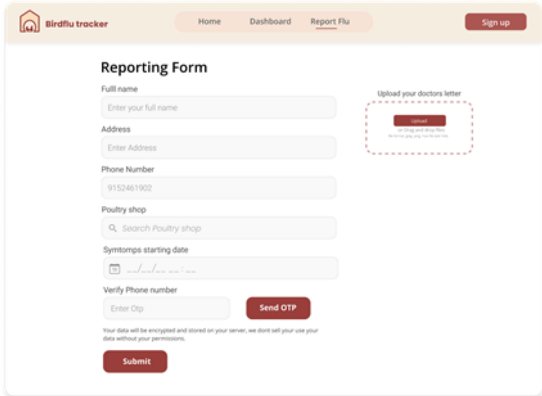


**Figure 2:** Reporting form

### *4.1 System Design Overview*

#### *4.1.1 System Architecture Diagram*

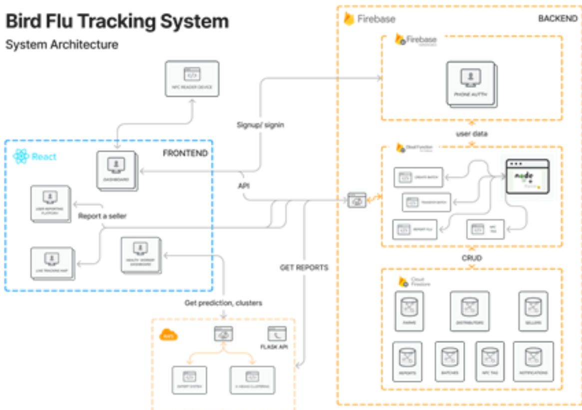


**Figure 3:** System architecture diagram of the bird flu tracking system

International Journal of Engineering and Management Research
e-ISSN: 2250-0758 | p-ISSN: 2394-6962
https://ijemr.vandanapublications.com
Peer Reviewed & Refereed Journal
Volume-13, Issue-4 (August 2023)
ttps://doi.org/10.31033/ijemr.13.4.19

***4.2 H5N1 Influenza Detection in Chicken Based on Symptoms Using Machine Learning***

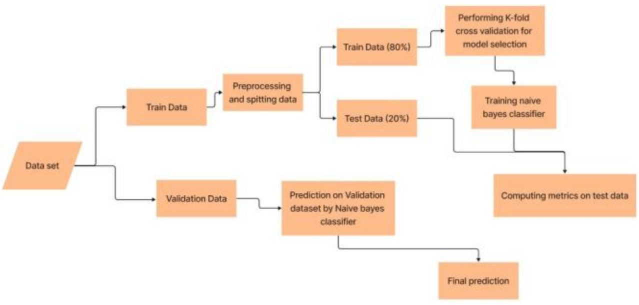


**Figure 4:** State transition diagram for prediction

***Naïve Bayes Model***

It is a conditional probability model for classification purposes. The goal is to find a way to predict the class variable (Y) using a vector of independent Variables. In termsof probability, the goal is to find the probability of Y belonging to a certain class X ie. $P(Y|X)$

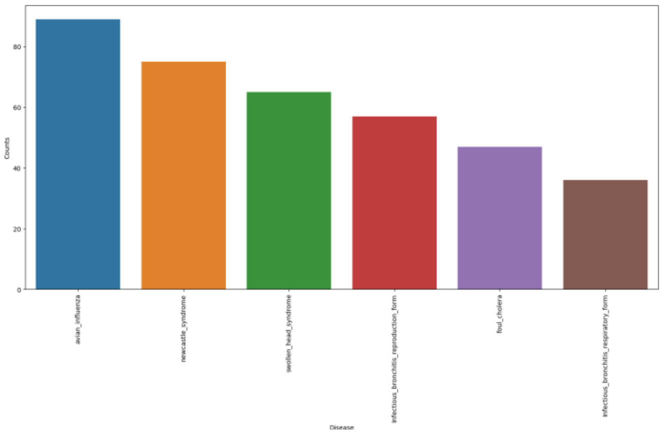

**Figure 5:** Bar Plot for Naive Bayes Classifier

**Prediction**
**Input**: ['Depression', 'Combs Wattle Blush Face', 'SwollenFace Region']
**Prediction** : avian_influenza

***4.3 DB-SCAN Clustering Algorithm***

Unlike K-means clustering and k-medoids, the desired number of clusters(k) is not given as input. Rather DBSCAN determines dense clusters from data points.

Density is defined as the minimum number of points within a certain distance from each other. Based on the concept of minimum points (min pts) and threshold value eps.

DBSCAN divides the data points into 3 types:

1. ***Core point:***
   A point is said to be a core point if there are at least minPts number of points, (including its point) in its surrounding area with eps.
2. ***Border point:***
   A point is a border point if it is reachable from a core point and there are fewer minPts within its surrounding area.
3. ***Noise/Outlier point:***
   A point is an outlier point if it is not a core point and not reachable from any core points.

***4.4 K-Means Clustering Algorithm***

K-Means is an unsupervised learning algorithm wherein, given a data set of items that contain certain features and values for these features, the algorithm will categorize the items into K groups or clusters of similarity. The similarity can be calculated by finding out the distance between the cluster centroids and data points using Euclidean distance, Manhattan distance, Hamming distance, or Cosine distance formula.

***4.5 Comparing DB-SCAN Clustering Algorithm vs K-means Clustering Algorithm***

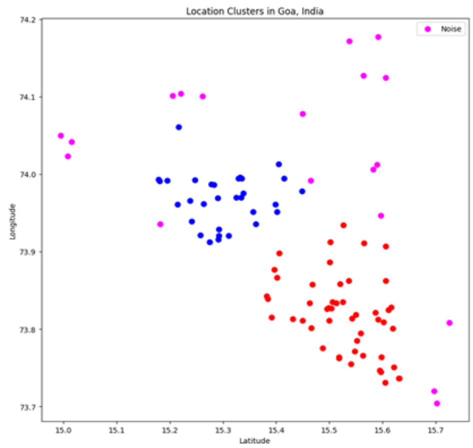


**Figure 6:** DBSCAN

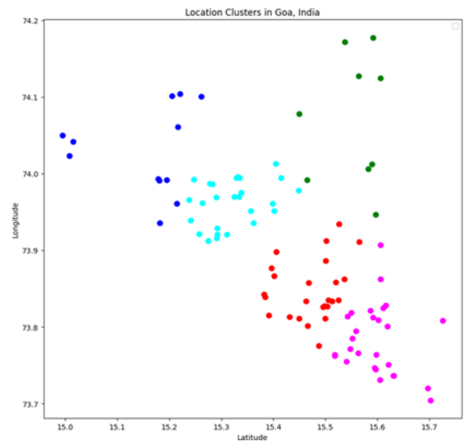


**Figure 7:** K-MEANS

Our requirement being density based spatial clustering, we analyzed performance of K-Means vs DB-Scan using. It was found that we were able to better identify false or spam reports.

In the above scatter plot comparison we can see that DB-Scan can handle larger dataset with greater cluster accuracy which are of multiple sizes and is not influenced by noise or outliers whereas k-means has difficulty with clusters of multiple sizes.

***4.5 Hardware Design and Modules***

NodeMCU is justified for the bird flu tracking system due to its cost-effectiveness, built-in Wi-Fi connectivity, sufficient GPIO pins, open-source platform, programming flexibility, compact size, and low power consumption. It enables real-time data transmission and communication, easy integration with sensors, and customization. With these features, NodeMCU proves to be an ideal microcontroller for efficiently implementing the proposed system to trace bird flu in the poultry supply chain and enhance operational efficiency.

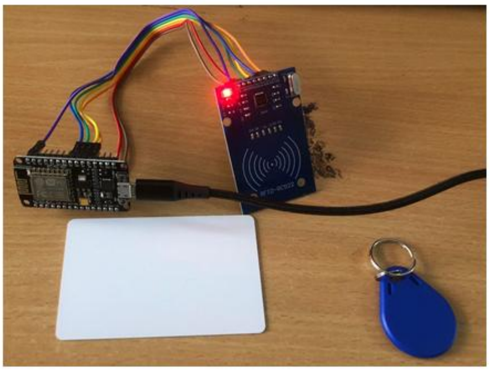

**Figure 9:** Hardware components. ESP8266 and RC522


**Figure 10:** Hardware Module with RFID tags

## V. CONCLUSION

After conducting a comprehensive literature survey we were able to define our problem definition with greater clarity. We are also able to identify the main objectives required to build our proposed system. Various techniques to realize these goals were also discovered and explored. Our tracking system aims towards fast and easy tracking of bird flu and supply chain management through the use of modern technology and collaboration between different stakeholders, the Bird Flu Tracking System offers a comprehensive approach to mitigating the impact of avian influenza on both animal and human populations.

## REFERENCES

[1] Maseleno, Andino & Md Mahmud Hasan. (2012). Avian influenza (H5N1) expert system using Dempster-Shafer theory. *International Journal of Information and Communication Technology, 4*(2-4), 227-241.

[2] Mittal, Niti & Bikash Medhi. (2007). The bird flu: a new emerging pandemic threat and its pharmacological intervention. *International Journal of Health Sciences, 1*(2), 277.

[3] Ahsan, Kamran, Hanifa Shah & Paul Kingston. (2010). RFID applications: An introductory and exploratory study. *arXiv preprint arXiv*, 1002.1179.

[4] Weinstein, Ron. (2005). RFID: a technical overview and its application to the enterprise. *IT Professional, 7*(3), 27-33.

[5] Yousefinaghani, Samira, Rozita Dara, Zvonimir Poljak, Fei Song & Shayan Sharif. (2021). A framework for the risk prediction of avian influenza occurrence: An Indonesian case study. *PloS One, 16*(1), e0245116.

[6] Sandhu, Rajinder, Harsuminder K. Gill & Sandeep K. Sood. (2016). Smart monitoring and controlling of Pandemic Influenza A (H1N1) using Social Network Analysis and cloud computing. *Journal of Computational Science, 12*, 11-22.

[7] Loth, Leo, Marius Gilbert, Mozaffar G. Osmani, Abul M. Kalam & Xiangming Xiao. (2010). Risk factors and clusters of highly pathogenic avian influenza H5N1 outbreaks in Bangladesh. *Preventive Veterinary Medicine, 96*(1-2), 104-113.

[8] Yousefinaghani, Samira, Rozita A. Dara, Zvonimir Poljak & Shayan Sharif. (2020). A decision support framework for prediction of avian influenza. Scientific Reports, 10(1), 19011.

[9] Okada, Hironao, Koutarou Suzuki, Tsukamoto Kenji & Toshihiro Itoh. (2010). Avian influenza surveillance system in poultry farms using wireless sensor network. In: *Symposium on Design Test Integration and Packaging of MEMS/MOEMS (DTIP)*, pp. 253-258. IEEE.

[10] Elbers, A. R. W., Marjan Gorgievski, Kiumars Zarafshani & Guus Koch. (2010). To report or not to report: a psychosocial investigation aimed at improving early detection of avian influenza outbreaks. *OIE Revue Scientifique Et Technique, 29*(3), 435-449.