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Detection of Lumpy Skin Disease in Cattle using IOT & Deep Learning

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ABSTRACT

Lumpy Skin Disease (LSD) is a transmissible disease in cattle set on by a virus from the Poxviridae family's virus Capripoxvirus genus. The virus is believed to spread through biological forms of vectors such as flies, ticks, mosquitos, and direct contact. This virus is to be blamed for series economic aliment that results in crucial losses in fertility, milk production, trade tariffs, and some instances livestock animal death. Furthermore, the LSD Virus was deducted in the pusand ocular secretion of cattle infected.

Sectors like agriculture and livestock experiencing major shift as a result of Web of Things and smart gadgets. It is extremely tough for us to fathom a world without the Internet of Things where majority of things are connected to one and other around us. The cattle business has undergone a revolution thanks to the Internet of Things. Farmers can now keep collection of data of their livestock without having to haul them around everywhere with the help of battery powered sensors and smart devices. In this paper, we present a device that enable farmers to deduct and compare current health parameters enabling them to deduct any decline in the cattle's health. Critical parameters affecting cattle health, such as body temperature, hyper salivation, ulcers, lacrimation and lumps on the skin, are continuously monitored in our Wireless Sensor Based cattle health monitoring system. Requirements for our project are Arduino Board ATMEGA328,Temperature Sensor, Wet Sensor and GPS Tracker.

Keywords: *LSD, Capripoxyvirus, Poxviridae, Cattle, Arduino UNO, Sensors, IOT,Smart Device*

INTRODUCTION

The fatal livestock illness Lumpy Skin Disease(LSD) has a massive impact. Fever, nodules spanning the entire body, including the mucus membranes and internal organs, as well as extensive lymphadenopathy are all linked with it. Infected cattle may also suffer lameness and oedema inflammation in their limbs. Since the virus may cause long term skin problems in infected cattle, it has an economic impact on their market value.

Furthermore, this disease results in long term impairment, lowered milk production, stunted growth, sterility, abortion and in some circumstances death. Nearly after one week virus infection fever begins to develop.

Initially, this fever can reach 41 degrees Celsius and linger for approximately a week.The swelling at this period affects all the lymphoid follicles. A week to twenty days following virus inoculation, the disease's recognizable lumps start to form. When the lumps start to show, mucus discharge from eyes and nose also appears. The nodular lumps affect both the skin and epidermis and may even spread to the

muscle. The body might develop these lumps whenever (but arelikely common on neck, head, udder, scrotum, vulva and perineum), can be well restrained or join together to form a single mass or whole.
When the nodules first appear, they are pale grey to white in color and may discharge fluid when cut. Within the nodules, a cylinder shaped central cavity of dead material may appear after about two weeks. Furthermore,lumps on the mucosal surfaces of the mouth, eyes, udder, rectum, nose, and genitalia also ulcerate rapidly, assisting in the spread of virus. The focus of the application will concentrate on cattle. As a result, the researchers suggest creating a software platform to detect and keep an eye on the temperatures, pulse rate and heart beats. If the heart rate is abnormal, it is safeto assume that the animal is in danger. They can also provide information to veterinarians or hospital. When anomalies are reported, the veterinary doctors may be able to assist on time, potentially saving their lives.

Fig.1:-*Nodular lesions of LSD affected Cattle*

We aim to prepare a device that aims at the detection of LSD in the cattle. Our device incorporates hardware components consisting of the Arduino Board ATMEGA328, LM35 Temperature Sensor, Wet Sensor, ESP8266 WiFi Module, GPS Tracker, a buzzer and an LCD Display. This device works on the software implementation of primarily Image Processing technology with Deep Learning playing out as the domain. Open CV is the image processing tool used in our project and ThingSpeak is the software cloud which used to upload and store data. This device can be used in various forms of portable, user-friendly collar tags or a smart band or a ear tag. The Algorithm which operates our device is the Convolutional Neural Network (CNN). It plays out in three main processes: Preprocessing, Segmentation and Classification.
(1) In Preprocessing- Our three main objectives are; (i)Resize image: Converting bigger or smaller size images into one target size, resizing of images is done to train our model of images is done to train our model. (ii)Reshape image: While resizing an image noise is created which is being eliminated by reshaping the image. (iii) RGB to Gray scale:since in our project, we only require image features and not the color, we ignore the color. Further the Gray Scale image is sent into segmentation process.

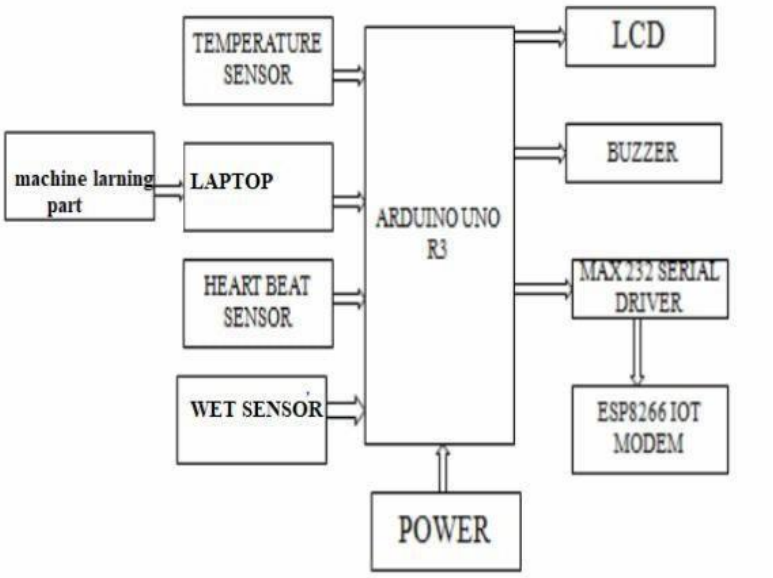

Fig.2:-*Block Diagram*

(2) In Segmentation- A visual image is divided into segments to prepare analysis of the (3) image easier. This process takes place in two steps:

(i) Feature Selection: Highlights the featuresand objects from the images.

(ii) Feature Extraction: Extracting the highlighted features from the image and is next sent to classification process.

(4) In Classification- It will utilize all the fivelayers of CNN Algorithm for whatever data set and features have been extracted and willbe converted into binary value, that value will be sorted in a training model. There will be two classes one is lumpy skin disease is detected and another is Healthy/Normal cow. This will create models for each and every data set into two types, hence model training is done.

A WiFi sensor network is a system composed of sensor nodes in a huge number, each of which is with a sensor capable of detecting physical sensations for instances such as temperature, stress, light, and so on. The sensor node is an essential component of aWSN, the sensor is a wireless network node that provides the environment and tool status. Which are then transferred to the microcontroller.

In this paper, the Arduino UNO receives the sensor's content and develops it accordingly. The Wi-Fi ESP 8266 module will shift the content, allowing for the physical completion of the interaction Wireless sensor networks will be a major technology for IoT. To monitor the health of cattle, two sensors are used: body temperature, hypersalivation, and lacrimation proposed by J.Tamilselvan M.E et. al[1].

Their way of life is heavily reliant on the health of the cattle, as most people rely on dairy products for a living, as do farmers who cannot afford advanced agricultural machinery and must rely on cattle. A detailed explanation of the devices and sensors used is provided in the paper proposed by Kunja Bihari et. al[2].

The LSD virus (type variant, Neethling), along with the sheep and goat poxviruses, is a member of the capripoxvirus genus in the poxviridae family and is respansible for the deadly cattle condition known as lumpy skin disease. Large skin lumps that cover

the full body, enlarged lymph nodes, fever, sinus drainage and lacrimation are distinguishing features of the illness, however the intensity of medical symptoms varies widely. LSD results in huge financial damage because it permanently harms the skin [3].

LITERATURE SURVEY

The paper published by J.Tamilselvan M.E et.al. [1] proposed a technique where today'speople find it impossible to envision their lives without technology. Diverse technology that are all around us are enabling individuals to live their lives more comfortably.

Many projects from this time period have been improved and developed, including the Advanced Cattle Health Monitoring System using Arduino and IOT. Critical elements impacting cattle health, such as body temperature, respiration, humidity, heartbeat, and rumination, are continually monitored in the wireless sensor-based cattle health monitoring system. The parameters and behaviour of animals are all sensedin this framework using an Arduino UNOmicrocontroller.

This study looks at livestock health, environmental sensing, and locating. We recommend assembling on farmlands an IOT-based livestock health and environment monitoring system to gather economic and environmental parameters, farmers worldwide to oversee the animals from outside the farm. The farmer will be informed via Short message service should any irregularities are learned in the cattle.
The data obtained by the sensing devices is monitored closely on the online platform. As a matter of fact, observing the activities of animals is exhausting and incredibly hard. The presented system can detect the welfare of the animals without human assistance. When there is a concern with the wellbeing of cattle, remedies can be offered quickly.

The paper issued by Kunja Bihari Swain et.al.
[2] proposed farmers who endure recurrent hardship owing to the ill health of their cattle and the lack of competent veterinarians nearby may benefit from effective online cattle health monitoring. In this survey, we reveal a tool that permits farmers to monitor, control and compare the current health parameters of cattle with the quintessential reference healthy criteria, having allowed them to pinpoint any declining trend in the cattle's wellness. To establish such a sensor for real-time use, Arduino Board, Esp8266, an Xbee module, and a wide range of sensors have been used. This paper is primarily concerned with the body's heat, respiratory rate, rumination, and moisture content.

The paper published by Fatemeh Namazi et.al. [3] proposed that, cattle and water buffalo can get acute or subacute sickness from lumpy skin disease (LSD), a serious threat to stockbreeding (Givens, 2018; Tuppurainen, Venter, et al., 2017). Cattle of all ages and types are impacted, although young animals and those lactating at their peak are particularly vulnerable (Tuppurainen et al., 2011). Due of its potential for rapid spread and considerable economic losses, the World Organization for Animal Health (OIE) has listed this transboundary disease as a notifiable disease (Tuppurainen & Oura, 2012). Given that the disease has recently expanded to previously disease-free nations, controlling and eradicating the sickness is crucial (Sprygin et al., 2019).

The paper produced by Mohamed Hassan Tageldin et.al. [4] proposed that The Lumpy Skin Disease (LSD) virus (type strain: Neethling), along with the sheep and goat poxviruses, make up the Capripoxvirus genus of the Poxviridae family. LSD is a devastating illness that affects cattle. Large skin nodules covering the entire body, fever, enlarged lymph

nodes, nasal discharge, and lachrymation are all symptoms of the condition, however the severity of these symptoms varies greatly from patient to patient. LSD damages hides permanently, which results in enormous economic losses. Cows and bulls may become infertile temporarily or permanently.
It results in decreased milk production and, occasionally, fatal secondary bacterial infections. Additionally, it impedes the export of cattle and cattle products from nations where LSD is prevalent.

Fig.3:-*Affected Cattle in Separation*

The paper issued by Samuel Kipruto Kiplagat et.al. [5] proposed a new ailment of cattle called Lumpy Skin Disease (LSD) significantly reduces an area's economic output. The impact on the farmers as well as the favour

transmission in the field are not well qualified . The study examined Lumpy Skin Disease is variables and the financial affect of the outbreak on cattle ranches in Nakuru, Kenya. It was a retrospective case – control investigation. Data was gathered via questionaries that were given out during in – person interview. The information gathered covered herd sizes, age and sex compositions, breed, source of replacement stock, grazing methods and cost (indirect and direct) associated with LSD epidemic.

The paper published by Md. Hakimul Haque et.al. [6] proposed that Lumpy skin disease (LSD) is a potentially contagious viral disease in cattle that is brought on by the LSDV, a member of the Poxviridae family of viruses. Indirect contact and biological vectors like mosquitoes, flies, ticks and other insects are thought to be the main ways the virus spreads. It is a serious economic disease brought on by a virus that significantly reduces milk production, fertility, abortions, import restrictions, and, in some cases, livestock animal deaths. In several farms in Bangladesh'snorth-western region, this study set out to evaluate the current state of LSD and its management.
Female cattle were found to be the most vulnerable to LSD infection, and the majority of cow owners (91.17%) do not use mosquito nets at night in their cattle houses. Culling all affected animals, however, will not be enough to stop the disease from spreading.

The paper published by M.Giasuddin et.al.[7] proposed that cattle are susceptible to the disease Lumpy Skin Disease(LSD), which is bought on by the virus (LSDV). It is a DNA virus that is a member of the family of Poxviridae and the genus Capripoxvirus (Buller et.al., 2005; Douglas et.al., 2019).

Other members of this genus include the sheeppox and goatpox viruses. The LSDV

was first noted in Zambia in 1929, and from there it is migrated north to Sudan and south to countries in southern Africa (Umberto et.al., 2018).

This disease, which has been going around in Africa for a while, has a big impact on the economy for cattle business there. Currently, the illness is rapidly spreading throughout Asia, including Bangladesh.

The paper published by Ehsanallah Afshari S et.al. [8] proposed that this study's goal was to evaluate how well some machine learning algorithms could predict the likelihood of LSDV infection based on geographical and meteorological characteristics. In the beginning, the Extra Trees Classifier algorithm was used to pick the most crucial predictive qualities from among meteorological, animal population density, dominant land cover, and elevation parameters in order to forecast the occurrence of disease in unseen (test) data. In test data, several machine learning techniques showed up to 97% accuracy in predicting the presence of LSDV.

Finally, several machine learning techniques, like as ANN, could presumably used to aptly predict the onset of LSDV infection based upon certain geographic information systems and weather patterns parameters. This initiative could be incredibly beneficial in areas within which LSDV infestation is a serious risk for incorporating surveillance and awareness programmes, in addition to reasonably precautions such as vaccine candidatures.

The paper published by Ayesha Anwar et.al. [9] proposed that the global cattle business is significantly impacted by the crucial transboundary disease known as LSD.

The goals of this study were to identify patterns and important turning points as wellas to predict the phenomenon. We used binary segmentation to identify statistically significant data change points. For each continent, four key turning points were noted. The interval with the elevated average of the total LSD reports in the African data was in the middle of 2016-2019.
The expected LSD outbreaks in Europe is said to remain consistent over the next five years.

The paper proposed by K.A. Al-Salihi. [10] proposed that reports an infectious, eruptive, and seldom deadly condition of cattle known as LSD is characterized by nodules on the skin. The only afflicted animal species are cattle and water buffalo, both of which have high rates of

illness but relatively low rates of mortality—although calf mortality is generally greater. LSD results in decreased milk and beef production, female abortions and male infertility. The origins of LSD date back to 1929 and come from Zambia.
On the African continent, LSD is thought to be an endemic disease. However, in 1984, the disease was brought outside of Africa. In Madagascar and a few Middle Eastern and Arab Gulf countries, it has been documented. This review essay will explore LSD in light of the recent events that have people worried
about the spread of disease.

The paper published by Farazi Muhammad Yasir Hasib et.al. [11] proposed that Lumpy Skin Disease (LSD), an essential viral infection caused the commercial lifestock industry a lot of money. In various regions of Bangladesh, particularly the Chattogram division, there was an LSD outbreak among the cattle population that was identified in the middle of 2019 between August 2019 to December 2019, a cross- sectional surveillance study was carried out to examine the prevalence and risk factors for LSD in livestock in the

Chattogram district.
In conclusion the current study evaluated the LSDV infection in Bangladeshi commercial farms, revealing the diseases general clinical prevalence and risk variables.
The paper proposed by Sumon Sarkar et.al. [12] proposed that an acute infectious viral disease of cattle with significant morbidity and low death, a Lumpy Skin Disease (LSD) is primarily common African countries (Davies 1991). Similarly, to how LSD continues to spread throughout the Middle East, it now poses a grave threat to the rest of Asia and Europe (Abutarbush, 2015).
Currently, this disease has a substantial influence on cattle farming, particularly small – scale farming where the farmer faces financial loses that reduce their standard of living and deter farming in our nation. Lumpy Skin Disease Virus (LSDV), a double- stranded DNA virus belonging to the genus Capripoxvirus and family Poxviridae, is the culprit behind LSD (Babiuk et.al., 2008)(Woods 1988).

PROPOSED SOLUTION

WHAT IS DEEP LEARNING?

Deep learning is a class of a wider set of machine learning approaches built on object recognition and neural nets. Learning can occur unsupervised, semi-supervised, orsupervised.

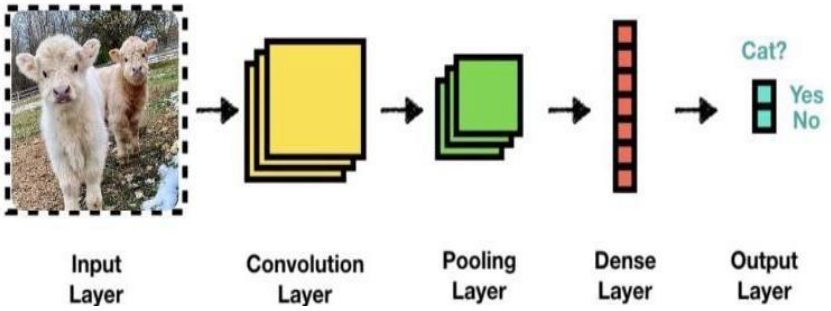

Fig.4:- *CNN Layers*

In addition for these neural network models to "train" from such a large volume of data it may emulate how well the human brain works. Models are built using a massive range of datasets and multiple layer artificialneural topologies

We are using the Convolutional Neural Network (CNN) Algorithm CNN's usually abbreviated as Convolutional Neural Networks or Convnets are an element of Machine Learning. It is a subgroup of diverse artificial neural network models that are used for different datasets and purposes. A different kind of neural network called a CNN may find important information in both time series and image data. This makes it very beneficial for applications involving images, such as pattern recognition, object classification, and picture identification. A CNN makes use of linear algebraic concepts, including matrix multiplication, to find patterns in an image. CNNs may categorize audio and signal data as well.

CNN Algorithm is carried out in 3 main processes

(1) Pre-processing: The availability of largedata sets and training examples across a variety of areas, as well as improvements in computing power and effective parallel hardware, are the primary causes of the advent of machine learning.
Image scaling: After making sure that

every image is square (or has a specific proposition), it is required to scale every image properly.

Normalizing image inputs: Data normalization is a crucial step in making sure that each input parameter—in this case, a pixel—has a comparable data distribution.

Dimensionality reduction: We can choose to combine the RGB channels into a single gray- scale channel to reduce the dimensions.

(2) Segmentation: The technique of assigning each pixel in a picture to a certain category is known as image segmentation. Although there are many other types of picture segmentation techniques, when it comes to the field of deep learning, there are two basic forms of segmentation:

1. Semantic
2. Instance

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(3) Classification: For feature extraction, convolution and max-pooling layers are employed. Major pooling layers are intended for feature selection, whereas CNN layers are purposeful for feature detection. When a CNN's output with smaller area retrieved is necessary after running a down sampling process on the raw data, or when a image shouldn't need all of the elevated information max pooling layers are used. The convolution and pooling layers feed input to the fully connected layers which classifies the data using it.

(4)

The different layers are:

- The convolutional layer
- The ReLU correction layer
- The pooling layer
- The padding layer
- The fully-connected layer

These are the five different types of layers that make up the CNN

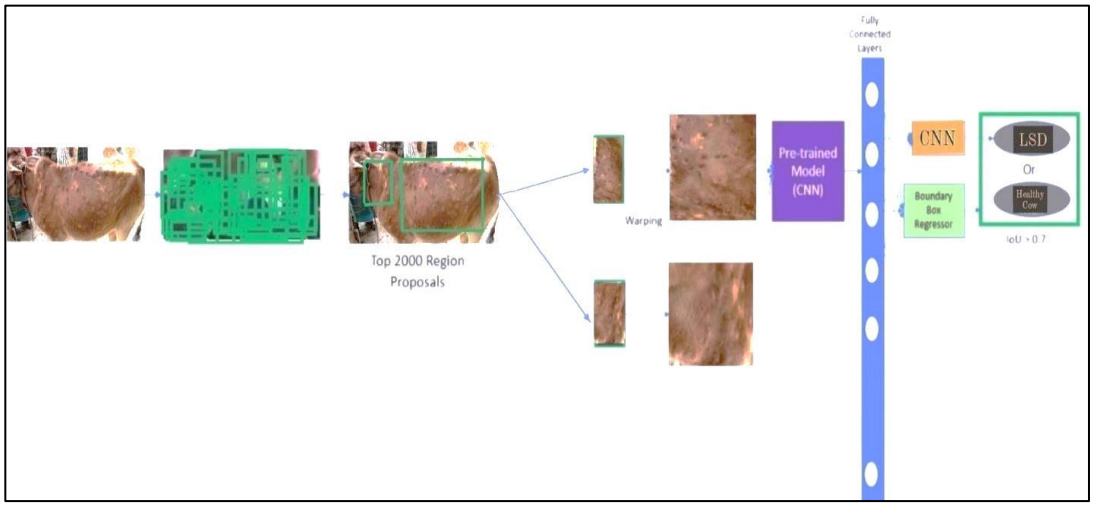

Fig.5:-*Classification Training Model in CNN*

SOFTWARE TOOLS

The technology used in our research and project is Image Processing. Our domain is Deep Learning, which is a subset of Machine Learning. We are coding our project using python. Open cv is tool we are using for image processing.

SYSTEM REQUIREMENTS

Hardware Requirements:

- Arduino UNO ATMEGA328

- LM35 Temperature Sensor
- Wet Sensor using PPM
- GPS Tracker
- ESP8266 IOT Modem WiFi module
- Buzzer
- Power Supply Unit
- 16*2 LCD display

Software Requirements:

- Embedded C
- OpenCV
- Python
- Arduino Software

CONCLUSION

The identification of Lumpy skin illness and the classification of the condition as Severe, Mild, and Normal skin are generally improved by this study. The creation of the Lumpy Skin Disease Image dataset and thedevelopment of the Lumpy Skin Disease Using a model of image classification and a method, local data can be used to determine theprevalence of an animal epidemic disease. Theabsence of Lumpy skin illness Image data state for experiment and noises for appropriately detecting the region of interest pose the keyobstacle in this investigation.

The disease's recent expansion into formerly disease-free regions is evidence of its epidemiological and economic significance. Animal movements between Middle Eastern nations should be carefullyregulated by veterinary authorities due to the large borders of these nations.

Additionally, careful study of the disease's transmission and epidemiology as well as the application of efficient preventative interventions like immunization may lead to improved disease control. As a result, it is strongly advised that accurate and prompt diagnosis in endemic areas, vaccination with the homologous strain of the LSDV, vector control, animal movement restrictions, and LSDV testing of bulls used for mating be employed as tools to stop further spread.

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