

IOT Based Animal Health Parameter Monitoring System

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Abstract: Cattle health monitoring is very important as “prevention is better than cure”. It is important to monitor the health condition of cattle before loss as over 20.5 million people are dependent on livestock. In this research project, we propose a “IOT based cattle health parameter tracking device” which monitors basic parameters like heart rate, the saturation level of oxygen(spo2), and normal body temperature in comparison with the temperature during the insemination, and to detect the live location of cattle using Global positioning system. The technology we used to implement this module is the Internet of Things (IoT) using sensors and the data collected from the cattle and will store data in cloud for data analysis. If the health condition of the cattle is not in a normal state, we do cloud computing and will get an alert notification that the cattle is not in normal state. The intention of this research is to establish a platform or livestock monitoring and management system. The Internet of Things framework gives IOT solutions in a wider range of applications livestock, and the agricultural sector. In some cases of emergency, the veterinarian cannot observe them 24/7. This issues are the leading cause of death in said animals. The IOT solutions provide wide range of applications in farming, livestock, and the agricultural front. The problem of death can be controlled use of best controllers and sensors. Also this module store history data in cloud which helpful for future analysis.

Keywords: Cattle health, Cloud, GPS, Heart rate, Internet of things, Object temperature, sensors, Spo2.

I. INTRODUCTION

Monitoring the health condition of cattle is important as many cattle losing their lives because of communicable disease. As per UNDP i.e., United Nations Development Program, it has been declared that cattle population by 2050 will increase by 70% with respect to the present population. “The main scope of this project is to measure all basic parameters in the single module and on a particular single body part”. The aim of this paper is to establish a platform

or livestock monitoring and management system that keeps tracking the real-time data of sick animals. For a better understanding of this concept, we need to go back to our existing system. That the former health monitoring of the cattle is done through manual monitoring. In this system farmer unable to predict health early until disease reach its peak which lead high cost to cure or loss of animal. Also in manual monitoring leads to many manual errors which lead wrong disease predication. When disease reaches to maximum level and loss the animal it does not have historical data to analysis cause of disease for further preventions. Also as per UNDP reports wild animals count is reducing drastically and it will be difficult to tack them in forest. This module helps to tack wild animal’s location as well their health along with their historical moments and health parameters.

The main concept of this project is by being anywhere we can monitor the health condition of the cattle. Here we can monitor and measure some parameters they are Ruminantion, heart rate, temperature, blood pressure, and saturation level of oxygen in cattle. The goal of this research is to create a platform or system for monitoring and managing livestock. Using the Internet of Things (IoT) technology, we aim to develop solutions for various farming, livestock, agricultural applications and protection of wild animals. One significant problem we want to address is the high mortality rate among animals due to health issues. By using IoT technology, will connect different devices and sensors to collect data. These sensors will measure things like temperature, heart rate, and location of the animals. This data will be sent wirelessly to the cloud for processing and storage. With the collected data, will create a user interface or dashboard that shows the real-time health status of the animals. Farmers or veterinarians can access this interface remotely and receive alerts if any animal shows signs of illness or any unusual behavior. The system will also analyze the

data to identify patterns or trends that might indicate potential health risks for the animals.

II. LITERATURE SURVEY

There are many approaches towards monitoring the cattle health. Amongst them a device proposed by Rajshree S. Thakre et.al [1] which monitors the health of cattle using ZigBee. It is lower power consuming and can be connected to many nodes. This data can be accessed from the sensors here, the surrounding humidity, temperature and rumination is detected. This module does not have not used any cloud for its storage. And the data monitored and transferred to the PC is wired. So this can be improved using a cloud such as blynk which is open source and can be monitored data remotely. In the proposed system by B. C. Baker et. al [2] approached about the temperature monitoring by thermistor. Till now the thermometer is the only source which detects the correct temperature of cattle's when placed in the rectum part of the body of cattle. The thermistor may also detect and show the modules temperature as module on the cattle body is active for 24 hours so the contactless sensors can be used so that we can get the cattle's body temperature. In the proposed system by E. Lindgren et.al [3] it shows the Validation of rumination rate measurement device and its role in dairy cow. Focused on measuring the stress response in cattle in order to estimate the stress by using Rumination Act system. In this paper they have used MPU sensor for the detection of the acceleration and change in the axis of their movement. As the cattle is moving and changing its position it shows the reaching along x, y and z axis. The total body movement and activeness can be detected. As farmer cannot understand the reading and movement along axes of rumination and there is no algorithm that calculates the times of chewing of cud it becomes raw data. In proposed system by M. Janzekovic, P. Vindis et.al [4] use of a polar sport tester to measure the health rate of cattle. Research conducted by Hopster, Janzekovic, and Aerts suggests that changes in heart rate can be a significant factor when studying how animals respond to stress. Interestingly, similar findings have been observed in humans as well. using a polar sport tester may be helpful. These devices are originally designed to monitor heart rate during physical activities in humans, but they can potentially be adapted for cattle as well. By tracking the heart rate,

farmers can gain insights into the health condition and stress levels of their cattle. It's important to note that while the use of a polar sport tester can provide valuable information, it should be combined with other monitoring methods and veterinary expertise to ensure a comprehensive understanding of cattle health. Additionally, further research and development may be needed to optimize the use of such devices specifically for cattle monitoring. This is quite good idea and can be implemented. Seema Kumari et.al[5] Proposed A smart cattle health monitoring and control system based on IoT can provide real-time monitoring of parameters like, body temperature, heart rate, and rumination, along with surrounding temperature and humidity. The system utilizes various sensors mounted on the body of animals to gather information about their health status. Using a Raspberry Pi 3 as the core controller with built-in Wi-Fi is a suitable choice. The Raspberry Pi 3 can process the data sensed by the various sensors and display it on a monitor. Additionally, it can forward the collected data to the cloud for further analysis and storage. By leveraging the internet, users can easily access the animal health information from anywhere. An Android app can be developed to provide a user-friendly interface for accessing the data collected by the monitoring system. With the app, users can remotely monitor the health parameters of their animals in real time and receive notifications or alerts if any abnormalities are detected. This type of system has the potential to be valuable in various animal-related industries, such as agriculture, veterinary care, or animal research, as it allows for continuous monitoring and early detection of health issues. It can help improve animal welfare, enhance productivity, and facilitate timely intervention when necessary.

In our proposed system we are using blynk cloud for the store of data accessed by the sensors which are in contact with the jugular vein below the neck of cattle's. The main reason to use this cloud is it can be monitored remotely. Farmers can keep an eye on the health of their cattle's from being anywhere and instead of using GSM module for sending the notification i.e., alert messages we used WhatsApp bot that send messages to the registered mobile number. Also in future the project can be upgraded with the suggesting the solutions to the alert messages so that for initial times the farmers can try out the methods to save the lives of their cattle's in critical situation. We

are using inbuilt WIFI from the nodemcu that transmits our data from sensors to the cloud. Also we are using the contactless temperature sensor that gives accurate reading of cattle's temperature as well as the surrounding temperature.

Proposed system:

- ✓ The system consists of temperature sensor, heart rate sensor, and GPS to measure cattle body temperature, heart rate, oxygen level and track the location of the cattle.
- ✓ The collected data transfer to cloud to store data for analysis purpose.
- ✓ Then we do cloud computing for any abnormal condition of cattle we do send alert to farmer.
- ✓ We do use esp8266 Max3010 sensor, GPS, GY-906 sensor, blynk public cloud and some whatsapp API's.

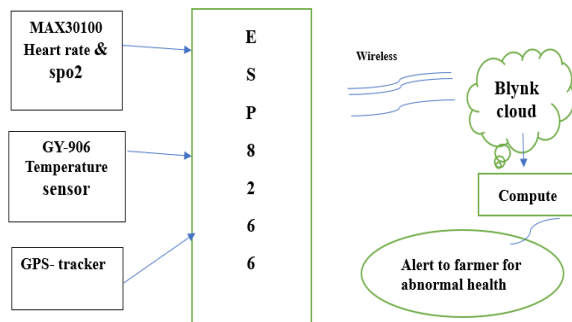


Fig.1 Block Diagram of module

III. ARCHITECTURE

Fig.1 shows block diagram or architecture of proposed module

Architecture of Proposed System

As shown in our architecture this proposed system consist of sensors, microcontroller, cloud and wireless data transmission system i.e. Wi-Fi.

a. MAX30100

It is an integrated pulse oximeter sensor. It monitors heart rate and spo2 level of cattle's. It uses an ultra-low shutdown current (0.7uA). it is the biometric sensor. It uses I2C based low-power biometric device. This sensor shines both lights on the finger, and earlobe, and also on the part of the skin where the skin is not too thick. Therefore, both lights can pass the tissue, measuring the amount of light that is reflected. Coming to heart rate, the oxygenated blood has the

feature of absorbing the IR-led light. When the heart pumps blood to the finger the IR led detects the changes in reflected light and creates a waveform at the output. Next Pulse oximeter, depending on the amount of oxygen in our blood red and IR light varies. Deoxygenated blood absorbs red light and oxygenated blood absorbs IR light. Based on pumping rate it calculates heart rate and oxygen level in cattle.

b.GY-906

It uses to monitor the both object and ambient temperature of the cattle. The range of this sensor is -70°C to +380°C and it will operate with accuracy of 0.5°C. This is infrared contactless sensor connected via I2C can be used any kind of micro controllers. This sensor can be integrated easily with any device and available for low cost. It measures temperature with 0.2°C resolution which more than enough to detect abnormality in animals. It also has feature of sleep mode which leads to low power consumption. This sensor gives output in three modes i.e PWM mode, Duty cycle and thermal switch mode can use any mode by changing I2C bus settings.

c. GPS tracker

Global Positioning System is satellite-based navigation and location system. GPS will communicate with 24 communication satellite that transmits signals around the globe. It will detect the movement in centimeters also and for its achieved in military specification receivers. With a GPS receiver, one can quickly and accurately determine the latitude, the longitude, and in most cases the altitude of a point on or above Earth's surface. Proposed system uses GY-GPS6MV2 module sensor to detect the location of cattle. This module has features of anti-jamming technology, 50 channels to receive signals with maximum navigation frequency rate of 5HZ. This module used where less space and power needed. It required 3V in order to detect latitude and longitude. It has operation temperature limit of -30°C to +85°C with gravity 4g, altitude of 50000m these conditions are suitable to track animals in any location on earth.

d. ESP8266:

Less cost less power Wi-Fi enabled device which have multi input and output pins. It operates TCP/IP networking software built by espressif systems. It has 32-bit RISC processor along with enough RAM,

ROM, EEPROM and flash memory for programming. The wireless fidelity with compatibility of IEEE802.11 standards which leads to interface any other board for wireless communication. It has many peripherals like I2C, GPIO, SPI, UART and DAC with all these features motivate us to choose this device for proposed system.

e. Blynk Cloud:

Public free cloud for some features which have both web applications and mobile application where can store huge amount of data and control any device from any location motivate us to choose this cloud among available many free clouds. It has best user friendly and ready to use code for some applications. Here proposed system store all animal health parameter data along with dash boards. Later part it helps computing abnormal conditions of animal health based on historical data.

f. WhatsApp applications:

To send alert to farmer proposed system uses WhatsApp messenger application as it have some free APIs to send alerts to users and maximum farmers uses WhatsApp application as well. GSM is also other option to send alert to users which required extra hardware and programming along with cost.

IV. COMPONENTS INTEGRATION AND PLACEMENT

Install the MAX30100, GY-906 and GPS components within the enclosure. Securely mount each component to prevent movement or damage. Connect the components using wires or cables, ensuring proper electrical connections and signal integrity. Follow the datasheets or provided documentation for each component to determine the appropriate wiring connections. Define the requirements and specifications for the cattle health monitoring device, including the desired functionality, data collection parameters, and user interface. Determine how the components will be integrated and communicate with each other. Plan the data flow and processing within the device. Decide on a suitable power source for the device, such as batteries or a rechargeable Battery. Consider power management options to optimize battery life. Connect the power source to the device, ensuring proper polarity and voltage requirements.

Power source used here is 5V rechargeable batteries which will be less cost and portable have better life time.

After connecting all these sensor devices in a single module as shown in Fig.2, we are going to tie it on neck of the cattle that to on the jugular vein. During connection the sensors should be in touch with animal skin. Connecting in jugular vein gives proper values of heart rate, oxygen level and temperature. Below are sample model and connecting to animal. Utilize the MAX30100 sensor to monitor the heart rate of the cattle. The sensor measures the changes in blood volume through the skin, allowing you to calculate the heart rate. Process the data from the sensor using suitable algorithms to extract the heart rate information.



Fig.2 Module and its placement

V. RESULT AND ANALYSIS

The device is connected to the jugular vein in cattle. Place the device nearer to the vein leads to get accurate values of health parameters. Will power on the device by providing 5v supply which activate all sensors which leads to functioning. The data that sensed is send to Blynk cloud will store complete data of health

parameters for every five minutes. This historical data will help doctors to analyses patterns of animals or cause of changing health parameters and disease predication in feature. This data also helps researches who are analyzing animal patterns. In order to help farmers who does not have idea about historical data we do cloud computing using machine learning algorithm to predict abnormal health parameters in animals. Any abnormal parameters sense by device leads to get alert message to famer who registered his mobile number which help early predication and cure of any disease. We compared health parameters that detected by proposed device with standard and present module papers with different conditions will received better results. Below are the features we tested using this module there was lot scope to test but selected important parameters for initial testing.

a. Heart rate and SPO2(oxygen) level

To decide the health condition of any livestock measuring the heart rate is important. The normal heart rate of cattle is 48-84BPM (beats per minute). Proposed module have tested on multiple cattle, that too in both rest condition and in roaming condition we got some accurate results. At present doctors also measuring the heart rate without any medical devices they just keep thehand on rumen of cattle, and by their experiences they will decide the heart rate of cattle and decide the condition of cattle. The predication of doctor’s heart rate and sensors output have nearer heart rate results. Below are the heart rate and oxygen level results that tested using proposed module. All these data measured with interval of five minutes and send to cloud.

WhatsApp alert message: Based on data stories in cloud when the heartrate and SPO2 level exceeds the normal value or goes below normal value WhatsApp

message will pop to the registered mobile number. In proposed system if heart rate and SPO2 level goes below 45 and 90 respectively and exceeds 85 and 100 users will get alert pop up to his registered WhatsApp application as shown in Fig.3.

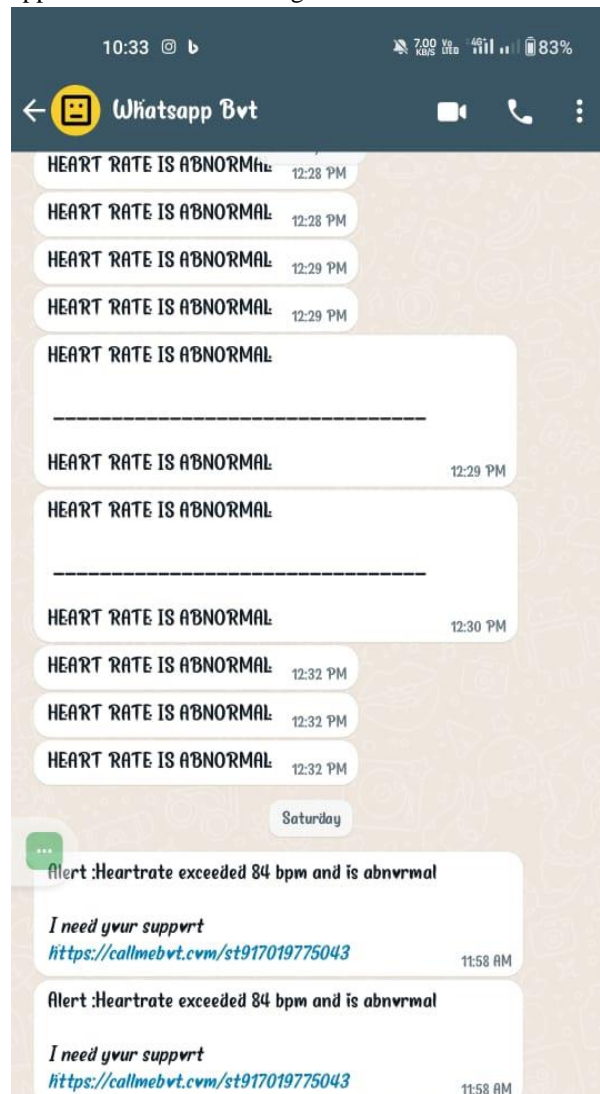


Fig.3 Sample what sup alert message

Table.1 Comparison of heart rate and oxygen levels

Heartrate reading (Normal)	Normal SPO2	Studies from other websites	project Output
Cattle-1 48-84 bpm []	90 & above	60-68bpm& 95% [35]	~64-89bpm & 97-95%
Cattle-2 48-84bpm	90 & above	29-48bpm & 94%[36]	~100bpm & 100%

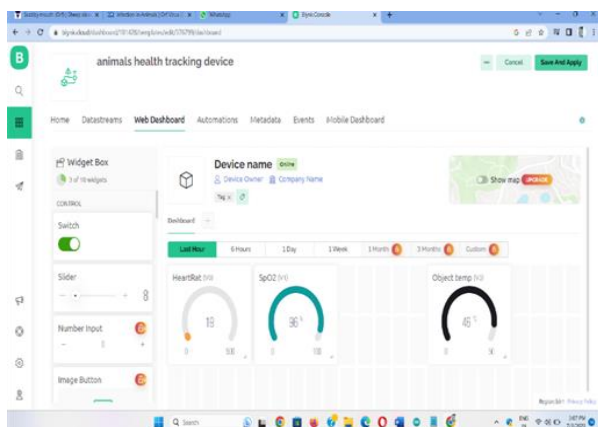


Fig.4 Parameter stored in Cloud

b. Temperature

To monitor and detect the body temperature of cattle's proposed system use GY-906 as mentioned above. This temperature sensor is contactless and also detects the object and surrounding temperature separately. The mean temperature of these cycling cows was maintained at about 101.4 to 101.5 ° F., during an eight- to 12-day period in mid-cycle. A few days prior to heat, the body temperature fell and reached a low point two days before the onset of estrus. The sensed data is transferred to Blynk cloud for storage as shown in Fig.4 and 5. The storage values can be exported to excel sheet for future analysis. As the normal body temperature is 36-38.5 degree Celsius. When the value exceeds the normal value in the second picture then user will get a WhatsApp alert. When the temperature is below or above 30 or 40 degree then WhatsApp alert will receive by user to register number as shown in Fig.6.

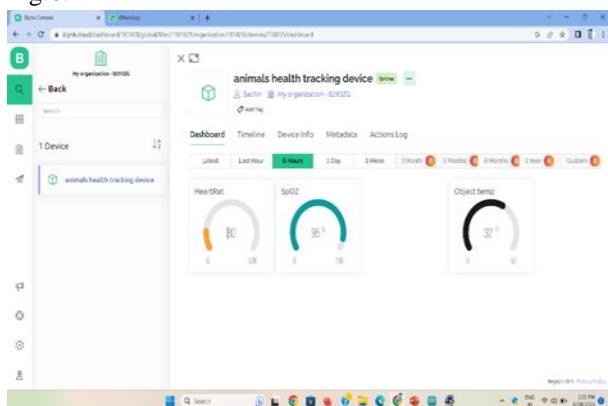


Fig.5 Parameter Dash board in Cloud

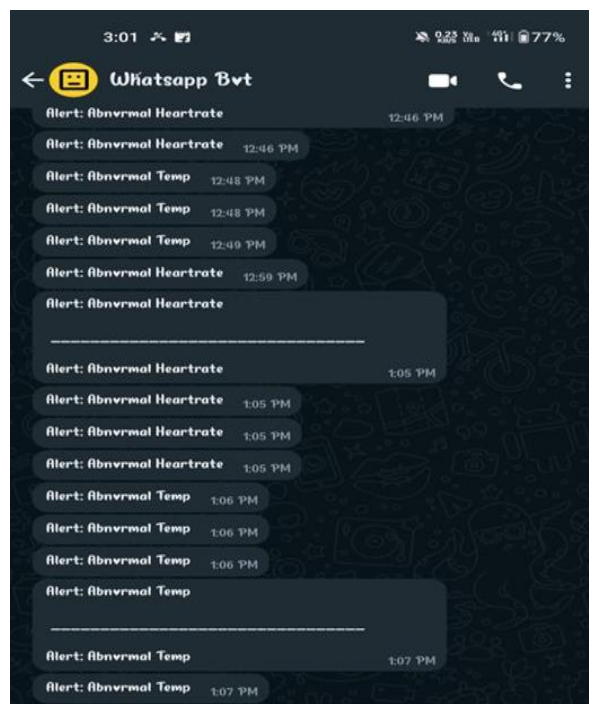


Fig.6 Alert Message for temperature abnormal

c. GPS location

The main aim of use of GPS is to track moments of animals during abnormal condition and different times in day or month. Tracking wild animal is very important has the count of wild animals reducing these days. The GPS device used by this module gives the output with the accuracy of ~100meters. This sensor gives us the output in the form of latitude, longitude, time and date which again stored in Blynk cloud for future analysis. Use of location tracker leads to control animal thrift as well. The result was displayed in fig.7.

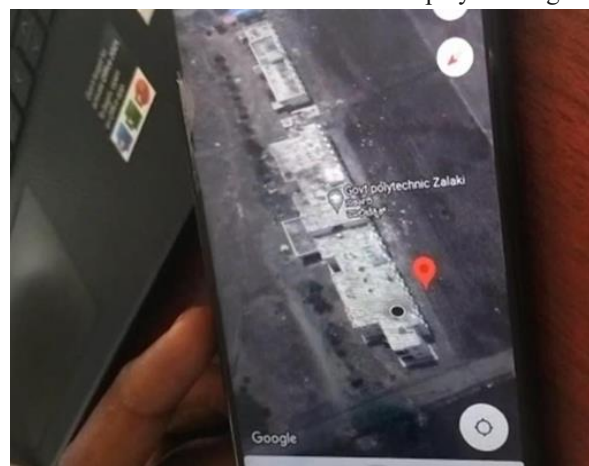


Fig.7 GPS location of cattle

VI. CONCLUSION

This research aims to use special sensors to keep track of the health of animals, particularly dairy cattle on automated farms. The demand for dairy products is high, so it's important to ensure that the cattle are healthy and producing well. By continuously monitoring their health, we can make sure they are fit and their well-being is taken care of. This is not only important for the consumers' health but also for the overall economy of the dairy farming industry. To make things easier for farmers, we have developed sensors that collect data and provide valuable information about the cattle. Instead of spending a lot of time and money on manual checks and labour to take care of the cattle, farmers can invest in this sensor module. With this technology, they can monitor their cattle remotely, using an online system. They can quickly take action if there are any problems or challenging situations. We have designed the module to be compact and all-in-one, meaning it includes multiple sensors in a single device. We have placed it near the jugular veins, which give accurate readings. This module has avoided using multiple sensors on different parts of the body, such as the tail, ear, chest, or legs, making it more convenient for the cattle. In this generation by changing time everyone is adapted to the present world. Everyone uses the smart phones and has the WhatsApp application. Therefore, to get alerts if abnormal temperature, heartrate and Spo2 to WhatsApp application.

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