Comparative Study of Cattle Health Monitoring Systems

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Abstract: Major issue in rural India is unavailability of good veterinary in the society. And due to this farmers are facing severe problems of their cattle's health monitoring and diagnosis. In this paper comparative study about cattle heath is presented and proposed certain solutions to this through cattle health monitoring system. The proposed system is an easy solution for the farmers to monitor the cattle health parameters for farmers. A system is prepared which compares the present health parameters with standard reference parameters. Different types of sensors, Node MCU, and IoT based platforms are used for experimentation. Obtained results are found useful for identification of the disease in early stages and the system can be useful for the farmers by providing advance technical support to the traditional business of cattle's farm.

Index Terms: IOT, Temperature, Humidity, Rumination Node MCU, Foot Step Counter.

I. INTRODUCTION

In the developing country like India, most of the people in rural areas depend on cattle farming as their major source of income. There is a huge population of cattle in the country which means there is a huge chance of the cattle falling prey to various diseases. The Government of India is putting up major efforts for the treatment of the cattle. But it's not possible for some farmers to travel long distances. Cattle health monitoring system using Arduino and Lab VIEW for early detection of diseases [1], distant biometry in cattle farm using wireless sensor network. It is difficult for farmers to monitor and compare the present health parameters with the standard reference healthy parameters with such comparison farmers would be able to spot any health issues in the cattle's health. There are various advanced technologies coming up to solve these problems. Some of available systems which are used to monitor health of cattle's by Cattle Heart Rate Determination using Electrocardiographic Pill [2].To prepare such a system for real time application, very few researchers are working through use of Node MCU, Node MCU is an open source IoT platform. In this paper we are going to give the brief introduction to some of such system with their advantages and disadvantage to identify a best system for cattle health monitoring. For the experimentation we have considered the biological parameter as Temperature, humidity footsteps & rumination. Milk production is affected by heat stress when THI values are higher than 72, which corresponds to 22 ° C at 100% humidity, 25 ° C at 50% humidity. Johnson (1980). This paper focuses on study and investigate the need of modern healthcare solutions for cattle health monitoring such system using different technologies. This paper is organized as follows. Section 2 discusses the related work in this field. The proposed system model is presented in Section 3. In Sect. 4 experimentation and results are analysed. Finally, the work is concluded in Sect.5.

II.RELATED WORK

For better results parameters such as counting of footstep, temperature, rumination and humidity of cattle should be monitored. Different technologies can be used for implementation of such system. Some of such system is as follows Mr. Steve Warren & Angel Martinez has given an idea about Health monitoring system using wired communication in his paper "Electrocardiographic Pill for Cattle Heart Rate Determination" published in IEEE EMBS Conference Vancouver, British Columbia, Canada. As per result HMS system is promising but having loophole of wired medium. This system design for health monitoring of cattle was based on wired system in that they only monitor the parameter like heart rate and temperature of cattle's. In this technique an ingestible pill is fed to the cattle to obtain heart rate by an electrocardiographic sensor. A wearable cattle health monitoring system is used along with this pill. This entire system seeks to record many cattle health parameters. Everytime whenever an animal is around this system it sends data to a veterinary information network. The collected health records are further used for epidemiological research. This paper presented prototype hardware and early data for an electrocardiographic pill that will allow continuous acquisition of cattle heart rate and other cardiopulmonary parameters. But the system has some disadvantages as this system is able to monitor core body temperature and heart rate only, it is wired system and the system is complicated.

Mr. Kunja Bihari Swain and Satyasopan Mahato has given an idea about Health monitoring system using zigbee module in his paper "Cattle health monitoring system using Arduino and LabVIEW for early detection of diseases" LabVIEW is a graphically-based programming language developed by National Instruments. Its graphical nature makes it ideal for test and measurement (T&M), automation, instrument control, data acquisition, and data analysis applications [18]. Kunja et.al published the detail system in 2017 IEEE 3rd International Conference on Sensing, Signal Processing and Security (ICSSS).This system was designed to overcome the problems which was in previous system. The first system was using wire and now the new system has overcome this drawback. New system design was wireless system using zigbee module. In this paper, a device which provides an opportunity to the farmers to monitor and compare the present health parameters of the cattle with the standard reference healthy parameters, by which they would be able to spot any deterioration in the cattle's health. For real time application of such a device different types of sensors for monitoring the body parameters are been used.

Online cattle health monitoring system provides accurate and real time health parameters of the cattle which are incredibly helpful in monitoring the health condition and detecting any change in behaviour and health problems. system has advantages as mention above but some of disadvantages are Use of zigbee modules the system becomes bulky, zigbee module range is short, only one cattle can be monitored at a time and Cost of Lab view may not be economical to farmers. Lab VIEW is also called system design platform and development environment for a visual programming language [3].

Health monitoring system using ARM7 microcontroller and biological parameter was suggested by Mr. S. Jegadeesan & Dr. G. K. D. Prasanna Venkatesan his paper "Distant Biometry In Cattle Farm Using Wireless Sensor Networks" published in 2017.In this measure biological parameters such as temperature, ph value, and wound indication. These parameters are measured using wireless sensors, which are attached on the cattle's body. All these sensors form Wireless Body Sensor Network (WBSN). The wireless sensors are coordinated by a microcontroller. The sensors sense the parameters and transmit them to a monitoring system. To reduce power consumption, whenever there is abnormal change in temperature, it enables the other two sensors, which means that the temperature sensor acts as a wake up devices. In the monitoring system, all three values are viewed, and if any value seems to exceed the default value, an alarm will be produced. Here, ph value of cattle's urine is noted, because when the acidity in the cattle's urine increases, liver may gets damaged. The RGB sensor is used to identify starting stage wound, by identifying the changes in colour. The RGB sensor with temperature sensor is used to identify foot mouth disease. The microcontroller that we used here is ARM7 Microcontroller. Thus, the parameters are sensed and transmitted to the monitoring system, from which health status is monitored. To implement a health monitoring system for cattle in the cattle farm using the wireless technology, the parameters like temperature; pH value of the cattle is noted [10], [11], and [12]. Health monitoring system using ARM7 microcontroller has advantages as stated [19] but parallel it has some disadvantages as Cost is high, Complex instruction set, Complicated to designs because number of pin is more [5] [20]. GSM technology can also be used to transmit data through wireless networks. [19]

III. SYSTEM MODEL

Based on above review it is now easy to clear the actual requirements of system for cattle health monitoring that system for monitoring the health of cattle's should be simple to implement and cost effective. The system will be more efficient if it is implemented using IOT technology. IOT based system is one of the best technique for implementation of cattle health monitoring system as it overcome all drawbacks of systems design using Electrocardiographic Pill, Arduino, and Lab VIEW and Wireless Sensor Networks, IOT based system can be implemented using node MCU. Node MCU is used to monitor health of many cattle's at a time through Wi-Fi module. It is less complicated as Wi-Fi module is inbuilt in node MCU. To design such a system for real time application, Node MCU, pedometer and different types of sensors are required for monitoring the cattle body parameters. This system focuses mainly on the parameters like counting foot step, temperature, rumination and body humidity of the cattle.
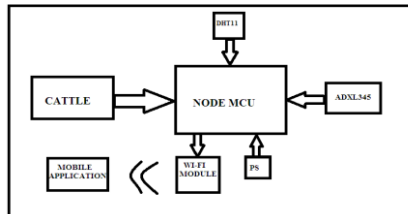

Fig. 1: IOT Based system block diagram.

This whole system has been divided into two sections one is a transmission section and the other is a receiver section. Power supply, Node MCU, Wi-fi module and different sensors fall in the category of transmission section whereas mobile is considered as receivers. Node MCU is used for the interfacing of the sensors and the Wi-fi module is used for reading and transmission of signals .The rumination sensor is placed on the side of the mouth. The back of the cattle has been placed with a DHT11 sensor. Now when the data is sent from the transmission section it is received by the second Wi-fi module in the receiver section and then is processed through Node MCU and displayed in the mobile.

A. **Humidity and temperature sensor:**

Determination of heat stress on the production of milk can be done with the temperature humidity index (THI). For this the DHT11 sensor is used which helps to monitor the temperature and humidity parameter of the cattle.

B. **Rumination sensor:**

Chewing process is very common among cattle. This is also known as rumination. Cattles are said to be ruminating 400-500 times a day. A three axis gyro accelerometer which represent x,y,z axis is used for this purpose. But in this case only two axis x and y are considered.

IV. EXPERIMENTATION AND RESULTS

As a part of experimentation we have taken cattle with an average age 9 years under consideration and with the help of implemented system we have collected the results of different parameter at different conditions and time. SIt is also expected that the system will be able to give the values of all the parameters by comparing with the reference values. Following results are obtained after experimentation. During experimentation we have taken care that our experimentation should not harmfully in any aspect.

In very first part of experimentation we have tie our system to one of the cattle (cattle A) and with the help of thing speak application all the parameter ware noted such as temperature, humidity, rumination and step count.

Fig.2: Experimentation on Cattle A

A. Time vs. Temperature, Time vs. Humidity, Time vs. Rumination

Figure shows the change in body temperature, Humidity and Rumination of cattle as recorded during 12:04 To 12:54 PM.

Fig.3: Graph a- Time vs. Temperature, Graph b- Time vs. Humidity, Graph c- Time vs. Rumination

B. Graph of accelerometer readings on x, y and z axis

Fig.4: Graph of accelerometer readings on x, y and z axis

In above figure the figure 3 Showa the Graph of Time vs. Temperature, Time vs. Humidity, and Time vs. Rumination   whereas figure 3 shows the Graph of accelerometer readings on x, y and z axis As per standard reference healthy parameters system must give the comparative analyses of actual footsteps per day, body temperature, humidity index (THI). Milk production is affected by heat stress when THI values are higher than 72, which corresponds to 22 ° C at 100% humidity, 25 ° C at 50% humidity, 28 ° C at 20% humidity. Johnson (1980) reported that when THI reaches 72, milk production as feed intake begins to decrease. The standard body temperature of a healthy cow is 101.5 ° F (38.6 °C) [1] [13] [14]. The cattle

generally ruminate 400 to 500 minutes per day [15]. From system we are also expecting the primary precautions if any parameter cross its threshold value.

In second part of experimentation we have evaluated system comparing actual footsteps and steps counted by CHMS and results are shown in below table.

Table: 1 Actual foot steps Vs. Counted steps by counter

Cattle	Height (cm)	Age	Time (slot)	Step reading in Pedometer	Original steps taken
Cattle A	172	15	120 Sec (1)	95	98
Cattle A	172	15	120 Sec (2)	94	94
Cattle A	172	15	120 Sec (3)	85	82
Cattle A	172	15	120 Sec (4)	83	82

V. CONCLUSION

In this paper we have given a brief comparative literature review of different systems implemented for cattle health monitoring through their used techniques and advantages. In the presented comparative analysis in very first system using Electrocardiographic Pill for Cattle Heart Rate Determination it is design to monitor only for heart rate and core body temperature. Also the said system is wired system hence it is somewhat complicated to implement. Whereas system implemented through Arduino and Lab VIEW is more convenient but cost of Lab view may not be affordable to farmers. This drawback can be overcome by the system design with the help of Distant Biometry. In which Wireless Sensor Networks is used to monitor cattle's health. This system is design using ARM 7 and it is necessary to have computer system to monitoring parameters. On above review we have concluded that system for monitoring the health of cattle's should be simple to implement and cost effective. System or device should be portable so that it can be tie up with cattle and parameter con be monitor on mobile application through internet connectivity and the entire requirement can be fulfil, if system is developed by IOT concept. The experimentation was carried out for around 20 different cattle's to calculate accuracy of system and it is concluded that it give accuracy around 92 % which is good percentage for such types of system. Hence IOT based cattle's health monitoring system is more prominent in above conditions.

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