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Agrotiz: Automated Analysis of Thermogram using Bot for Health Determination of Cattle's

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***Abstract*— Farmers perceived cattle diseases as one of the challenges in dairy farming. There is a difficulty in cognizing and monitoring of ailments in herds of livestock cattle such as hoof lesion and mastitis.**

Solution to the above problem is a thermogram on wheels. An autonomous bot which takes routine thermogram of different parts of cows focusing their hoofs and udder, analyzing those images for predicting the earlier signs of diseases and notifying the farmer about the result. It uses a reference line for navigation throughout the farm. An optical camera is for detecting cows and focusing different parts of the cow and a thermal camera is used to take thermogram of the parts. This image is then send directly to central computing unit via Wi-Fi network for processing. Disease is predicted based on the temperature difference.

Keywords- Raspberry Pi; image processing; infrared thermography

I. INTRODUCTION

A healthy diet represents a healthy nation. Milk, which contains calcium and several other nutrients constitutes complete food in our daily diet. The demand for dairy products is increasing day by day. In India's socioeconomic development, the diary sector plays a very important role . Dairy industry provides livelihood to millions of homes in villages, ensuring supply of quality milk and milk products to people in both urban and rural areas. Hence as an important segment in rural economy providers of dairy and dairy products should be taken care off.

Among the infectious diseases of dairy animals, mastitis is the main cause of economic losses in farmers. Mastitis etiological agents are usually bacteria, fungi and algae. In many cases the etiologic agent can escape of the immune system and multiply, resulting in mastitis. Several nonspecific antimicrobial factors are found in the mammary gland, such as lactoperoxidase–thiocyanate-hydrogenperoxide, lysozyme, lactoferrin, and complement system. Adaptive or acquired immunity can lead to an immediate response in repetitive exposure to the same microorganism. Two types of adaptive responses are described: humoral and cellular immunities.

This proposal is a non-invasive technique that uses an infrared camera that measures the emitted infrared radiation from an object and then uses this information to create images (thermograms). These thermograms are evaluated by a specially analyzing software program.

II. PROPOSED SYSTEM

Agrotiz is an autonomous robot that navigates inside a dairy farm and it monitors each and every cattle inside the farm. It navigates inside the farm with reference lines as guidance. It's equipped with an optical and thermal camera to monitor the cows.

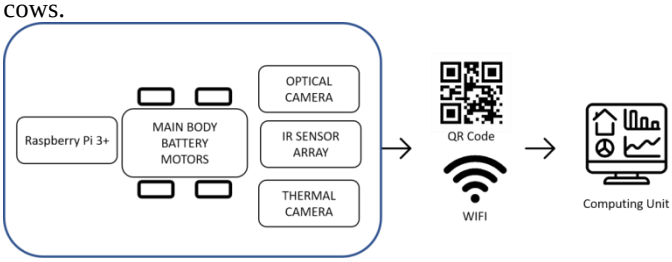

Figure 1:Block diagram of proposed system.

The main body consists of motor, motor drivers, batteries and a RFID receiver. Chassis is made of aluminium based frame which holds all the components f the bot. It act as the frame for holding components of the bot. Sensors, processor, wheels all are attached to the metal frame work. Meta frame provide good rigidity and strength to the bot so that it can be used in any extreme condition of a farm. Main body also constitutes of the control unit which controls every actions of the bot. The sensors unit are used to navigate and avoid any obstacles in the way. Control unit is the heart of the whole body. Raspberry Pi 4 is used as the main processor. It controls the movement of the bot and controls the camera and helps in detecting each parts of the cow to take the thermogram. The thermogram is send to computing unit via Wi-Fi. Raspberry PI is powerful processor which controls every actions of the bot. It controls the movement and navigation of the bot. It also controls the camera unit which helps to scan the QR code and also take the thermogram of each cattle in the farm. Its powered by a battery pack which powers the whole unit which is also chargeable. Thermal camera is used to take the thermogram of each parts of the cow. Thermal camera uses infrared light to calculate the temperature of the cattle. Thermal images are outputted as a spectrum of colors of the image to identify visually different temperature of the subject. A thermal image gives data which can be processed to find the temperature of a subject.Optical camera is used as a scanner to scan the QR code attached beside every cows shed so as to identify the details of the

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cow scanned. It works like taking a picture of QR code and decoding the data stored in the QR code using image processing and sends that data with the thermal image to the server.An array of ultrasonic sensors is used as the obstacle detection sensor. This is used to provide a clean path for the bot. It helps to navigate in rough condition in the dairy farm. Its obvious that during navigation the bot will encounter obstacles in its path. So to navigate around the obstacle its necessary to detect before collision.Ultra sound sensor does this job of detection of obstacle in the track and also prevents ant obstacle from above for example like stampede from cows in the farm. So these sensor prevents these from happening.It also consist of IR sensor array, Wifi unit, QRcode and computing unit.

III. SYSTEM DESIGN

The first phase of the project is the bot. The whole bot is designed with raspberry pi as its core controlling each and every part of the bot. The raspberry pi is powered by a 12v lipo battery. The input voltage for the raspberry pi is achieved with a 5V buck converter between the battery and the pi.

The pi runs with Rasbian OS as its operating system. The programming of the board in done by python programming language. Every peripheral is connected to it GPIO pins.

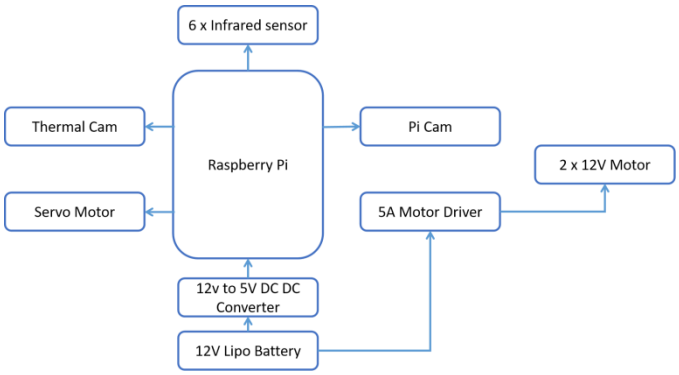

Figure 1 : Raspberry Connection

The images of the cattle is taken by a thermal camera mounted on top of the bot. The thermal camera is connected to the USB port of the pi, which gives the thermogram data to the pi to be transferred via Wi-Fi.

A Pi camera is also mounted adjacent to the thermal camera to scan the QR code in each stalls of the cattle shed to identify the cattle to be scanned. Pi cam is connected to the CSI camera port.

Other peripherals like the infrared sensor array for navigation , ultrasound sensor for obstacle detection is connected the GPIO pins of the pi. IR sensor detects the track laid on to the floor of the farm to navigate around the farm for the bot to navigate. The ultra sound sensor mounted on top of it is used to protect the bot from stampede or any obstacles in its path.

The 2 motors are powered through 10A motor driver which is controlled from the GPIO pins of the pi and it is powered directly from the 12V battery.

Second phase of the project is the processing of the thermal images in the server. Here a desktop is used as the server for the bot. Python code using open cv library is used for the processing of the thermal image and interface made using django frame work for displaying the output from the after the processing.

When the bot takes the thermal image it is directly send to the server with all the details of the cow. Inside the server python code runs which processes the image to identify any abnormal temperature in the image. Open CV library is used to detect the temperature from the thermal image. The output of the program is displayed in a interface where the the user can see the details of the output of each cow.

Python code maps each and every pixels of the thermal image and detects each colors and maps to respective temperature corresponding to each color range. Open CV library is used for the image processing. After the mapping, when the user sets the threshold temperature the code maps that specific temperature in the thermal image and marks it so that the user can understand the abnormality in the specific part of the cow.

IV EXPERIMENTAL RESULTS

By running the python code by giving a thermal image as input the code could successfully detect the hot spots or the above threshold regions in the thermal image. Software successfully detected the above threshold temperature given to it. Thus the thermal image was analyzed and a visual result is presented to the user to identify any abnormalities in there cattle's. Depending on the location of the hot spot primary evaluation of the disease can be determined.

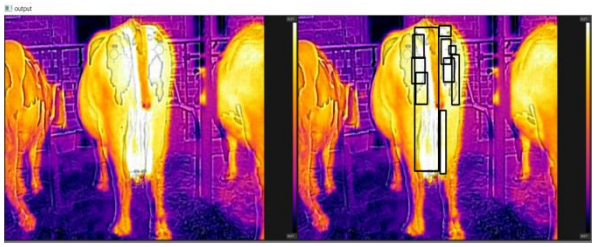

Figure 2 : Code Output

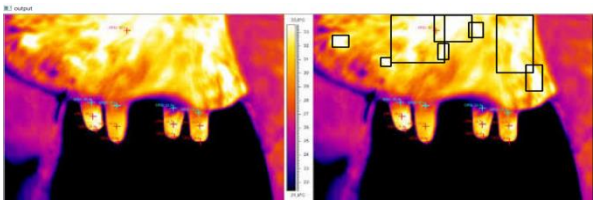

Figure 3 : Code Output symptom of mastitis

CONCLUSION

Dairy farms and cattle livestock are really important part of a growing economic nation. It's equally important to meet the huge rising demand of dairy products. Livestock cattle are a integral part of the growing healthy nation.

Its important to take care of the livestock and protect them from diseases and keep them healthy so that they can produce healthy milk and other products. This project deals with the monitoring of health of cows in a dairy farm.

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Using robotics and benefits of thermogram to predict the diseases in cows beforehand plays an important part to protect these livestock from diseases. Agrotiz provides an output showing the health condition of the cattle and thus taking preventive measures to protect them.

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