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AN INTEGRATED ANIMAL HUSBANDRY LIVESTOCK MANAGEMENT SYSTEM

K.Saravanan[1], S.Saranya[2]
[1]Department of Computer Science and Engineering, Anna University,
Regional Campus, Tirunelveli, INDIA
[1]saravanan.krishnan@auttvl.ac.in
[2] Department of Electrical and Electronics Engineering, Anna University,
Regional Campus, Tirunelveli, INDIA
[2]saraniyasenthil.s@gmail.com

ABSTRACT

Agriculture is the main source of income in countryside areas. Animals such as cow, buffalo, sheep and goat play an important role in rural living and source of income. Lot of farmers are now tormented from different animal diseases and increase in breeding cost. In modern era, compact wireless devices has made animal monitoring increasingly smart. However animal heat detection is still a complicated and inconvenient method. A complete integrated information and communication Technology is desired for animal monitoring system to identify the animal health, heat stress and fertility for artificial insemination during the livestock Monitoring. Here, wearable collar based device with sensors is placed in the neck of the animal helping the farmers to monitor the animal condition at remote distance via wireless communication and take timely actions in case of emergency. Cloud based framework has been proposed for livestock animal husbandry which will be beneficial in IoT healthcare solution.

Indexing terms/Keywords

Animal husbandry, Livestock, Animal Monitoring, Wearable Device, Wireless network, Internet of Things(IoT)

Academic Discipline And Sub-Disciplines

Engineering

SUBJECT CLASSIFICATION

Cloud based Monitoring

TYPE (METHOD/APPROACH)

Experimental

INTRODUCTION

Farming industry gives significant contribution to India's revenue growth. Animals in the farms are often affected by foot and mouth diseases such as anthrax, bovine mastitis, heat stress and infertility. It is important to deploy an animal monitoring application to follow individual animal as well as to identify the frequency of occurrence of animal diseases. e.g., to monitor the health condition of each animal the sensor can be mounted on the cow. Nowadays, internet is prevalent and its usage is growing exponentially by internet users worldwide, moved to 3.17 billion. Moreover, internet acts as a global platform to interconnect physical objects or things (IoT), shifts that internet can be used for interconnecting end user devices for communication among each other. Also it opens market opportunities for humans in multiple businesses such as e-commerce, e-health, finance, real time processing and reporting in industries, intelligent logistics and various others. Portable health monitoring which connect multiple sensors with the internet at anywhere, anytime is the viable solution for animal monitoring.

Food features are not only decided by the environment & regularities of the end product, but also by the animal welfares status by which the food is produced. The quality of food product, pathology and health conditions of the animal affect the production rate in farming industry.The quality and healthy of milk and its components are completely related to provision of sanitization and atmosphere in the livestock. Cows are homoeothermic and it is necessary to maintain consistent heat atmosphre. The different objectives to monitor the animal condition are listed below.

1. Animal health monitoring: Disease management is main part of the animal health monitoring. An animal can be easily affected by disease due to its environment conditions. Diseases are an abnormal condition of the animal where they are directly or indirectly affect the metabolism of the animal. According to the cause and symptoms, the diseases are classified into various types such as bacterial diseases, viral diseases, parasitic disease and many more.

2. Heat Stress: It causes undesirable effects on animal such as reduction in milk production, weight loss, feed intake, reproduction inefficiency and increase of susceptibility to diseases.Heat stress can be measured using non-invasive method through temperature and humidity index chart.

3. Recognize the right time for Artificial Insemination: It is the technique in which semen with living sperm is collected from the male animal and injected into female reproductive tract at proper time with the help of

instruments. Heat is symptoms of Artificial Insemination. This period of heat detection during estrus cycle is known as standing heat which extends from 14 to 16 hours in every 21 days/month.

In RF market trends, high speed wireless network LTE (Long Term Evolution) and Wi-Fi has been stretched and last low power wireless communication are being required strongly. Bluetooth smart, Zigbee or sub-GHz are also being introduced. The internet methodologies and their wireless solutions can be incorporated in embedded systems. The highest use case of 35% of course, is mobile communication, while 30% is general purpose application using Bluetooth smart, Wi-Fi and Zigbee. Figure 1 listed CARG (Compound Annual Growth Rate) wireless solution in which Bluetooth smart is estimated to have the highest growth potential due to the intermediate radio communication system.

RF	Frequency	Home appliance	Portable healthcare	Smart meter	Industry
Wi-Fi	2.4GHz	○	○		○
Bluetooth smart™	2.4GHz	△	◎		
ZigBee	2.4GHz	○		○	
Sub-GHz	920MHz (Japan) 915MHz (U.S.) 868MHz (EU) 865MHz (India)	○		○	

◎: Most, ○ Fair, △ Emerging

Figure 1. CARG Rate in Wireless Solutions

LITERATURE REVIEW

Jacky et al [1] designed a RFID-based Mobile Monitoring System (RFID-MMS) to manage the animals in efficient and user friendly way by using dynamic information retrieval, location identification and behavior analysis over a wireless network. Toshio et al [2] describes methods for detecting estruses and predicting calving-time in dairy cattle by employing wireless sensor network. It is identified that heart rate and core body temperature [3,4] are conventional crucial parameters for cattle health assessment, as they indicate symptoms for illness and disease.Wireless solutions greatly helps in reducing the operational cost and enhancement of animal health.

Ji-De et al [5] explained the gateway with an embedded system using IoT sensors. It is composed with an intelligent architecture which connects pool of sensing objects for monitoring purposes. Anuj et al [6] developed an Animal Health Monitoring System (AHMS) for monitoring the physiological parameters of the farm animals. Here, IEEE 802.15.4 & 1451.2 standards are used in the implementation of sensor module, Zigbee device and PIC18F4550 microcontroller. The graphical user interface (GUI) is implemented in Lab VIEW 9.0 according to the IEEE1451.1 standard. Smart mobiles can read & process the wearable sensor data [7] and display the heart rate on the move.

Rafael et al [8] described a Computational Intelligence based Automatic Body Conditioning System for cattle we have called Automatic Body Condition Assessment (ABiCA). Non-invasive wearable sensor system is implemented [9] for remote monitoring of animals for vital signs such as heart rate and respiration rate continuously.Mobile information system is used [10] to diagnosis and recommendation of therapeutic measures using Plant Asset Management(PAM).Livestock health records were recorded and reported using RFID based web application platform [11,12]. Sensor modules with three sensors such as temperature, heart rate and rumination [13] is developed for animal monitoring using Zigbee. Animal monitoring algorithm is proposed [14] to have the stray live in a good environment as well as to increase adoption rate. Low cost energy solutions with robustness and autonomy is implemented [15] to identify the animals in livestock. Sapna et al presents [16] a cloud based conceptual framework to benefit the healthcare industry by implementing IoT healthcare solutions.

PROPOSED SYSTEM

In our animal monitoring system, smart wearable collar device is proposed for livestock animals by using the wireless communication technology via Bluetooth and Wi-Fi. In Figure 2, architecture of the the animal monitoring system is depicted which consists of farm unit and data center unit. In farm unit, the data is collected from wearable smart collar animal monitoring device of the animal and then the data is transferred into gateway of wireless network via Wi-Fi. In the data center unit, data from the gateway of the farm unit is analysed and visualized in real time through the user authenticated hand held devices. In case of emergency, the user takes timely action regarding the data output. The real time data is stored in the cloud server database which is used for further retrieval and analysis of the animal condition in periodic interval of time. The animal monitoring system is designed to help users for better management and take care of the animals by real time information at anywhere, anytime over a wireless network. By using Bluetooth enabled smart phones, this system receives the real time data of the animals within short distances.

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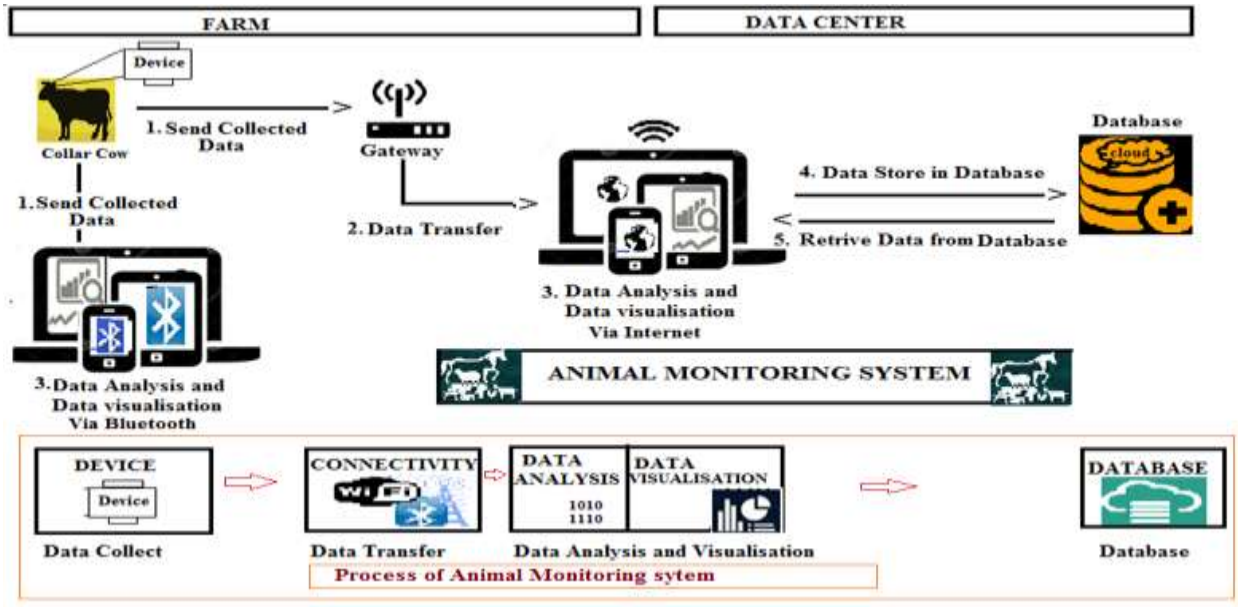

Figure 2. Architecture of Animal Monitoring System using Wireless Technology

MODULES

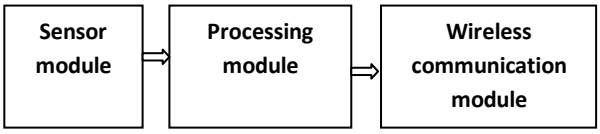

Figure 3. Wearable smart collar animal Monitoring Device

In sensor module, the sensor is used to sense the body temperature of the animal. Infrared thermometer sensor is used to measure the body temperature of the animal which is small size, low cost, accurate and used in many medical applications. In processing module, Ardunio Uno atmega 328p board is used as the processing module because of their flexibility, open source development tool, easy programming, and low cost, huge collection of application data. the sensor and wireless communication module are connected to Ardunio Uno atmega 328p board. Sensor collects the signal and sent the signal to Ardunio atmega 328p board for processing the signal. Then the processed signal is transmitting the information through the ESP8266 Wi fi module and Bluetooth module to authenticated the hand held device of the user. Ardunio 1.6.12 software was used to program the Ardunio Uno atmega 328p board. In wireless communication module, the ESP2866 Wi-Fi and smart Bluetooth module are used. The module approaches a complete and self-controlled Wi-Fi and Bluetooth interacting solution from devices to devices. putty software is used to configure the ESP2866 Wi-Fi module TX AND RX pin to USB TTL by using Attention command to connect the device through wireless network.

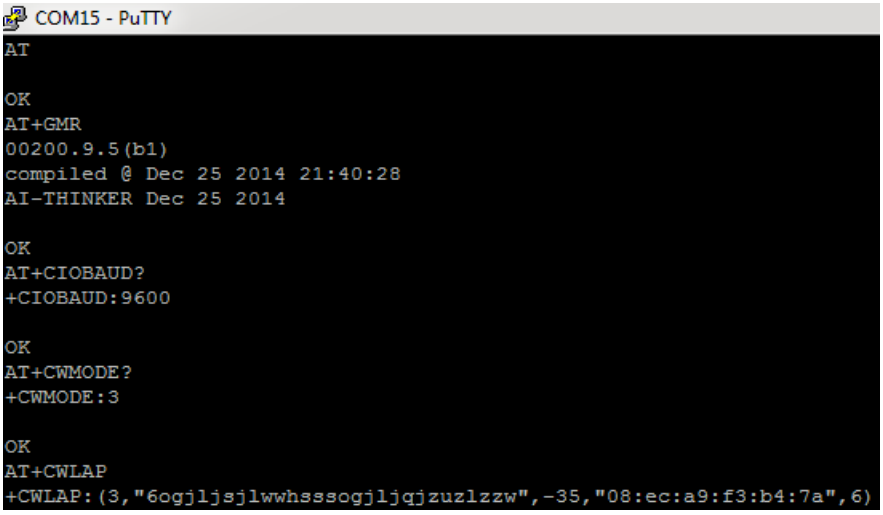

Figure 4. Configuration of ESP2866 Wi-Fi module using the putty software

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RESULTS ANALYSIS

1. Animal Health Monitoring

The average temperature of cow is 38.5° to 39.5° Celsius. When the temperature is below 38.5° Celsius, diseases such as indigestion, milk infections arise. When the temperature is above 41° Celsius, the disease arises are influenza and anthrax. When the temperature of the animal is very high , it cause the death of the animal.

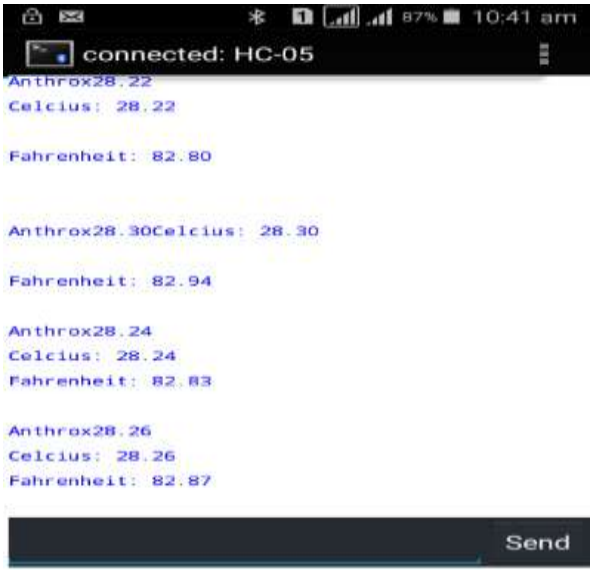

Figure 5. Animal health monitoring using smart phones

2. Heat Stress

Heat stress (HS) causes the cow to produce less milk with same nutritional input, which efficiently increase farmer's production cost. The temperature is classified into four types according to the temperature and humidity index chart, when the temperature excesses the 38° Celsius it indicates the animal is stress. When the temperature excesses the 39° Celsius it indicates the animal is in mild stress. When the temperature excesses the 40° Celsius it indicates the animal is in moderate stress. When the temperature excesses the 41° celsius it indicates the animal is in danger stress.

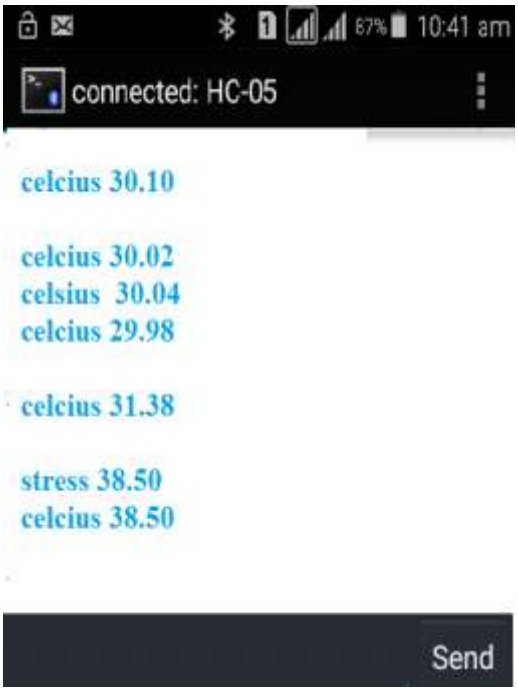

Figure 6. Screen shot for the heat stress using smart phones

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3. Fertility

Detecting Estrus (to give being "in heat" its technical name) begins is normally difficult. It lasts for just 12–18 hours every 21 days and typically occurs between 10pm and 8am. Animal monitoring device works by constantly monitoring the temperature a cow is taking the system knows that it is likely Estrus has begun. The system also knows that the optimum time for artificial insemination is 16 hours from the start of this period. If farmers inseminate their cows in the four hours before this optimum time, it is probable they will have a female calf, while if they carry out the procedure in the four hours afterwards; it is probable they will have a male calf.

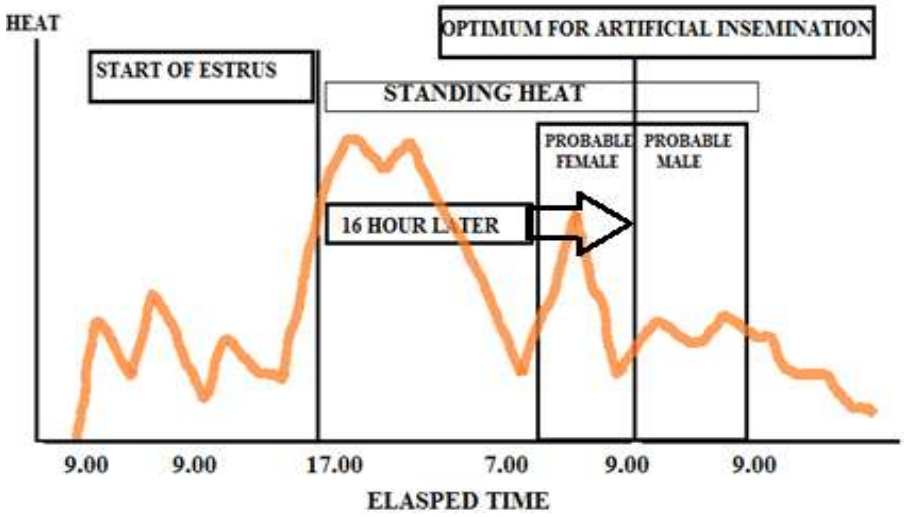

Figure 7. chart showing how system is able to accurately tell when a cow is in heat

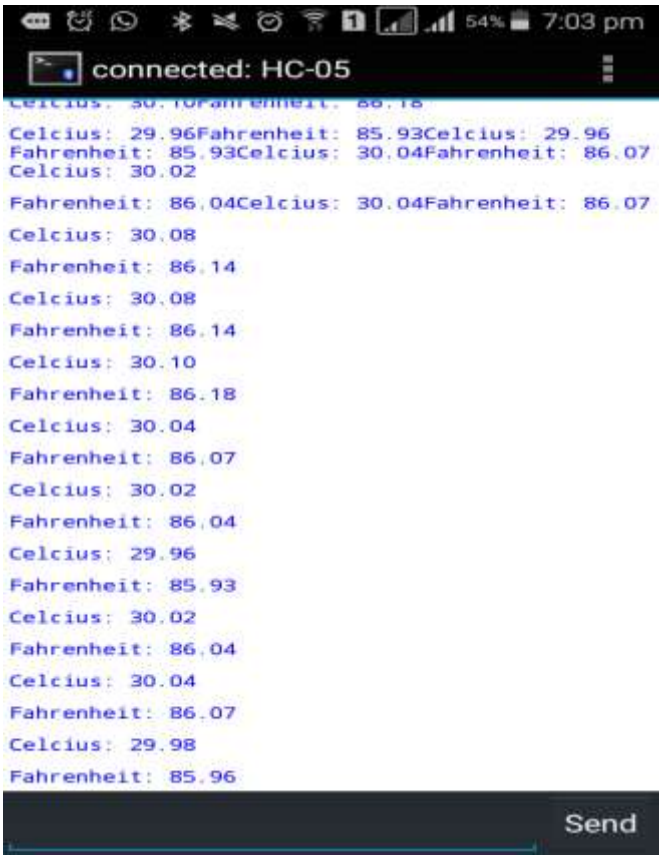

Figure 8. Screenshot for the fertility

In figure 9, ThinkSpeak, which is an internet of things based analysis software, is used to store the data. In animal monitoring system the wearable collar device is connected to the network via Wi-Fi and made a separate channel to monitor the animal temperature real time heat data in celsius.

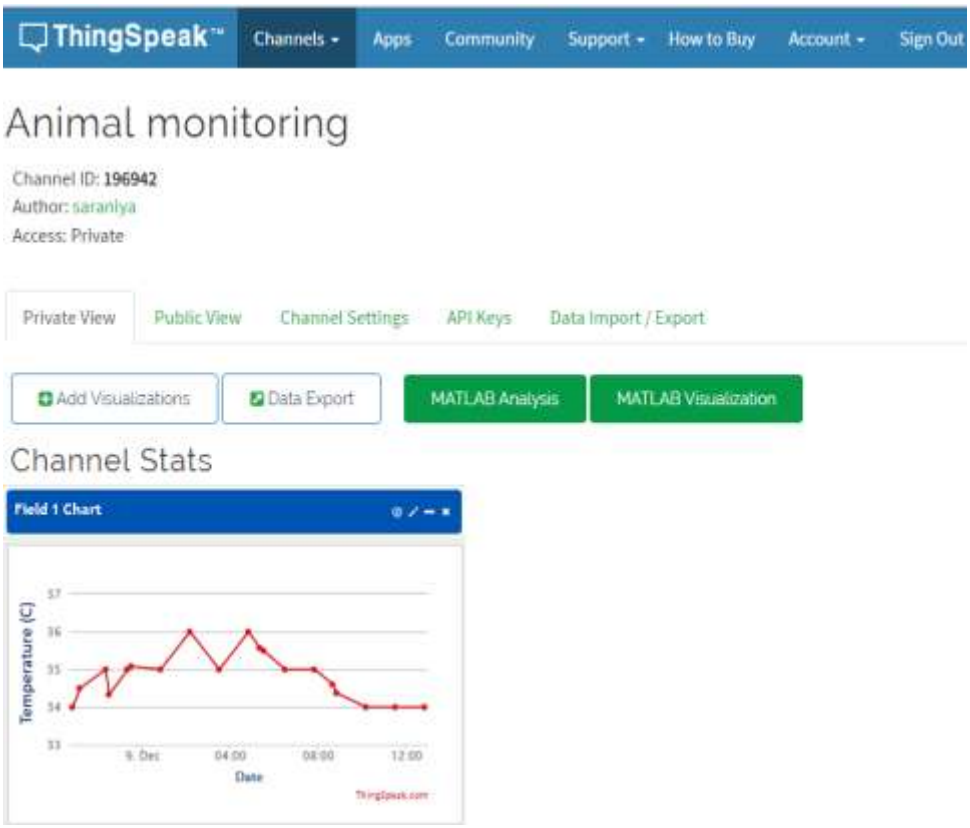

Figure 9. Screen shot for monitoring animal temperature via Wi-Fi technology

CONCLUSION

In this paper, we proposed an integrated approach for animal husbandry livestock management system to determine the health status, heat stress and fertility of the animal in livestock. The animal monitoring system is helpful to all kind of commercial farmers who can afford using a GSM based application to monitor their cattle. This system is developed using low cost, low power consumption wireless sensor for a cattle monitoring. Result shows that this system monitors the animals effectively as well as observes the heat values periodically. The animal monitoring system can be applied to other animals such cow, sheep and goat also.

REFERENCES

1. Jacky S. L. Tings, K. Kwok, W. B. Lee, Albert H. C. Tsang and Benny C. F. Cheung, 'A Dynamic RFID-Based Mobile Monitoring System in Animal Care Management Over a Wireless Network', International Conference on Wireless Communications, Networking and Mobile Computing,2007.
2. Toshio Watanabe, Atsushi Sakurai and Kouhei Kitzaki, 'Dairy cattle health monitoring using wireless acceleration-sensor networks', Sensors IEEE,2008.
3. Steve Warren, Angel Martinez, Timothy Sobering and Daniel Andresen, 'Electrocardiographic pill for cattle heart rate determination',30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society,2008.
4. Kae Hsiang Kwong, Konstantinos Sasloglou and Hock Guan Goh, 'Adaptation of wireless sensor network for farming industries Networked Sensing Systems (INSS)', IEEE Sixth International Conference, 2009.
5. Ji-De Huang and Han-ChuanHsieh, 'Design of Gateway for Monitoring System in IoT Networks',IEEE International Conference on and IEEE Cyber, Physical and Social Computing,2013.
6. Anuj Kumar and Gerhard P. Hancke, 'A Zigbee-Based Animal Health Monitoring System', IEEE Sensors Journal, 2013.
7. M.H.Ariff and I.Ismail, 'Livestock information system using Android SmartphoneSystems', Process & Control (ICSPC) IEEE Conference, 2013.

8. Rafael Tedín, J.A.Becerra, Richard J.Duro, and Fernando LopezPeña, 'Computational Intelligence based construction of a Body Condition Assessment system for cattle', IEEE International Conference on Computational Intelligence and Virtual Environments for Measurement Systems and Applications (CIVEMSA),2013.
9. Rita Brugarolas, James Dieffenderfer, Katherine Walker, Ashley Wagner, Barbara Sherman ,David Roberts, Alper Bozkurt,'Wearable wireless biophotonic and biopotential sensors for canine health monitoring', IEEE SENSORS,2014.
10. Jens Ziegler, Leon Urbas, Henning Lenz and Hermann Richter , 'App based System Diagnosis using Mobile Information Systems', IEEE Emerging Technology and Factory Automation (ETFA), 2014.
11. M. H. Ariff, I. Ismarani, N. Shamsuddin, 'RFID based systematic livestock health management system', Process and Control (ICSPC), IEEE Conference, 2014.
12. Yoshihiri Hayashi, Koichi Yahagi, Hisayasu Sato, Koichi Sato and Masamichi Muratani,'Easy-to-use RF-solutions for IoT applications',Radio-Frequency Integration Technology (RFIT), IEEE International Symposium,2014.
13. Anushka Patil, Chetana Pawar, Neha Patil, Rohini Tambe, 'Smart health monitoring system for animals', Green Computing and Internet of Things (ICGCIoT), International Conference, 2015
14. Chao HsiHuang, PinYin Shen, Yueh Cheng Huang,'IoT based physiological and environmental monitoring system in animal shelter' International Conference on Ubiquitous and Future Networks,2015.
15. Hugo Filipe Lopes and Nuno Borges Carvalho,'Livestock low power monitoring system', IEEE Topical Conference on Wireless Sensors and Sensor Networks (WiSNet),2016.
16. Sapna Tyagi, Amit Agarwal, Piyush Maheshwari, 'A conceptual framework for IoT based healthcare system', cloud computing International Conference - Cloud System and Big Data Engineering, 2016.

Author' biography with Photo

Dr.K.Saravanan, is working as an Assistant professor, Department of Computer Science & Engineering at Anna University, Regional Campus, Tirunelveli (Constituent college of Anna University) He received his master degree in M.E Software engineering in the year 2007 and B.E degree in Computer Science & Engineering. He has done doctoral degree on Cloud computing in Anna University, Chennai. His research interests include Cloud computing, Software engineering, Web Technology, Education Technology, Semantic Web and Big data analytics. He published papers in 12 international conferences and 16 international journals.

Ms.S.Saraniya received her Bachelor of Technology degree in the Department of Electronics and communication from Kalasalingam university, Krishnankovil on 2015. She is currently pursuing Master of Engineering (M.E) in the branch - Embedded system Technologies from Anna university Regional Campus-Tirunelveli.