EXPLORING SMART SENSING TECHNOLOGY FOR BROODING

Joy G. Bea, Alvin R. Malicdem

Abstract: Brooding is the most critical period in the life of a chicken. During brooding period, day old broiler chicks do not have the capability to warm themselves, and if not properly monitored chicks would die because of the change in weather. This would mean a big loss to the poultry farmer or owner. So to be able to address this issue, this study aimed to explore smart sensing during brooding period. This process could help monitor the temperature and humidity of the chicken coop easily during brooding period and notify the farmer immediately. The researcher developed a prototype using DHT22 sensor with Arduino Microcontroller and GSM Module. The prototype was tested and evaluated in terms of reliability.

Index Terms: Arduino Microcontroller, Brooding, DHT22 sensor, GSM Module, Smart Sensing

1 INTRODUCTION

THe Brooding is the most crucial period in the life of a broiler chicken. This period is when the systems are still in the development stage and the immune system is still delicate and cannot fight diseases. The feathers are not yet fully grown and the chicks are still learning to eat and drink [1]. Since day old chicks do not still have the capabilities to keep their body warm. They are very vulnerable to the environmental conditions like temperature and humidity level [2]. It could lead to sickness and worst death of the chicks if they are exposed to colder temperature. If this happens, this could mean a big loss to the poultry farmer or owner. Usually, small scale farmers set up brooding by using cluster rule. If the chicks clustered away from the lamp it means the heat is too hot. If the chicks clustered under the lamp it means the heat is not enough to warm the chicks. The chicks should be comfortably moving around the coop this means the heat is enough for the chicks [2]. The suggested temperature in the chicken coop for the 0-7 day's old chicks is 95°F. Chicks are not advisable to stay outside the chicken coop because of their sensitivity to weather. Week 2 is 90°F and chicks start to fly so lamp should be ensured that chicks cannot reach it [6]. Further, other poultry farmers place the chicks in a partitioned barn for supplementary heat from the other chicks during brooding. This period continues up to 11 days until the full area of the barn can accommodate the chicken when they grow[10]. Meanwhile, relative humidity is also very important to the broiler chicks during brooding. During the first week of brooding, relative humidity should be monitored daily to avoid dehydration and respiratory diseases and it should not be below 50% [7]. The recommended relative humidity for brooding period is from 50%-70%. However, a very high relative humidity has bad effects to chicks. It may increase the growth of microbial organisms that could be harmful for the health and survival of the chicks [8]. So poultry farmers need to ensure that the chicken coop relative humidity and temperature is properly monitored to prevent diseases and promote good growth that leads to higher profit in the poultry. This is also to make sure that the chicks are always comfortable [9]. To do this, smart sensing was explored for brooding. This could help in monitoring the temperature and relative humidity without always checking the chicken coop all the time. This could reduce the time in spending in the chicken coop just to check the environmental condition of the chicken coop. Smart sensing is now a trend now a day. With the use of the different sensors and microcontrollers, it becomes easier to monitor the different activities or environmental conditions. Just like in a poultry farm, smart sensing can also be used. Using Arduino Microcontroller, DHT 22 sensor and GMS Module. This would be a big help in monitoring the temperature and humidity in the chicken coop. This smart sensing is very helpful to monitor the temperature and humidity in the chicken coop so that respiratory diseases and other infections could be prevented [3]. Temperature and humidity is very important environment parameter with regard to poultry farming. It weakens the immune system and brings heat stress to chickens [4]. Since chicken do not sweat, their life depends on the environmental parameter such as humidity and temperature. Usually change in weather is very delicate to chicks. Especially during rainy season, chicks need extra heat to survive against the cold weather. Else, chicks might die because of cold weather. Further, during brooding period. The temperature and humidity level should be monitored at all times to ensure the survival rate of the chicks. It needs immediate action if there are problem in the temperature and humidity level. So the poultry farmer or owner needs to check the chicken coop from time to time. These issues prompted the researchers to develop a low cost smart sensing prototype that could monitor the temperature and humidity level of the chicken coop. Whatever data can be detected would be texted to the poultry farmer or owner so that the manual monitoring of the chicken coop could be lessen and this could improve the production of broiler chicken meat. With the use of the GSM Module, the farmer would be updated of the temperature and humidity level of the chicken coop. This study aimed to explore the smart sensing technology in brooding period then evaluate the reliability of the said prototype.

2 MATERIALS AND PROCEDURES

2.1 Materials

The developed prototype is composed of the following: Arduino Uno Microcontroller

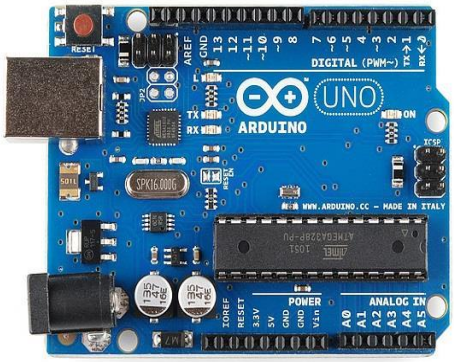

Fig. 1. *Arduino Uno Microcontroller. The Arduino is the main controller of the developed prototype. All the data detected from the DHT22 sensor is process by the microcontroller.*

- DHT22 sensor

DHT22 pins	
1	VCC
2	DATA
3	NC
4	GND

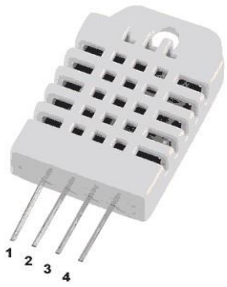

Fig. 2. *DHT22 sensor. The DHT22 sensor is use to detect temperature and humidity. This sensor is part of the developed prototype to detect the temperature and humidity level at the chicken coop. The data detected is sent to the Arduino Uno for processing.*

- GSM Module

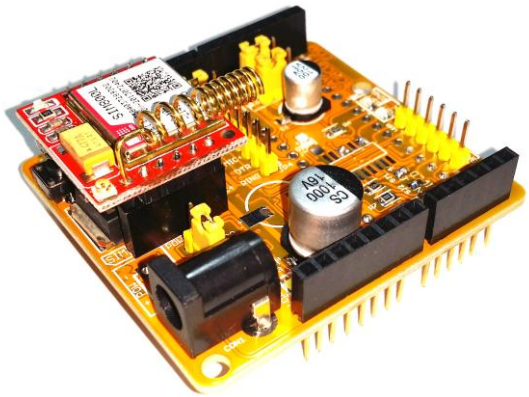

Fig. 3. *GSM Module. The GSM Module is connected to the Arduino Microcontroller. Through the GSM Module, the information about the temperature level and humidity level is sent to the mobile phone of the poultry farmer through a text message.*

2.2 Procedures

The researcher designed a system architecture framework that serves as the bird's eye view of the entire prototype. The Fig. 4 shows the architectural framework of the entire system. It consists of Arduino Microcontroller, DHT22 sensor and GSM Module. After designing the System Architecture framework, the researcher develops the prototype guided by the Rapid Application Model. The said model was adopted from the study of [5]. It used from the development, testing and evaluation. After the development, the developed prototype was placed inside the chicken coop to be tested. Afterwards, it was evaluated by poultry farmers as the respondents of the research.

3 RESULTS AND DISCUSSION

The Fig. 4 shows the system architecture of the entire system. It consists of Arduino Microcontroller, DHT22 sensor and GSM Module. The materials are low cost and efficient so that small scale farmers can afford the said device. The DHT22 detects temperature and humidity level and send the data to the Arduino Microcontroller. The microcontroller processes it and a text message is sent to the mobile phone of the poultry farmer containing the temperature and humidity level in the chicken coop. A threshold for temperature and humidity level is set that suited for the chicks brooding period. So, if there are changes in the temperature and humidity level beyond the set threshold a text message is sent to the poultry farmer. This process helps the poultry farmer to monitor the chicken coop without going to the chicken coop in person. This early detection also helpful to apply immediate action in case the temperature and humidity level goes beyond the threshold value.

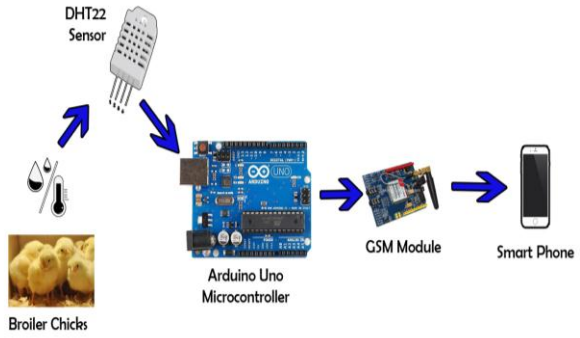

Fig. 4. *System Architecture Framework.*

The Table 1 shows the DHT22 sensor technical detail:

TABLE 1 *DHT 22 Technical Details*

	Specification
Power:	3-5V
Max Current:	2.5 mA
Humidity:	0-100%,2-5% accuracy
Temperature Range:	-40 to 80°C,±0.5°C accuracy
Humidity Range:	0% to 100%
Output:	Serial data
Resolution:	Temperature and Humidity both are 16-bit
Accuracy:	±0.5°C and ±1%
Operating current:	0.3mA (measuring) 60uA (standby)

The Table 2 shows the SIM900/SIM900A GSM/GPRS technical detail:

TABLE 2
SIM900/SIM900A GSM/GPRS

Specification
Quad-Band 850/900/1800/1900 MHz
Dual-Band 900/1900 MHz
GPRS multi Slot class 10/8 GPRS mobile station class B
Compliant to GSM phase 2/2+ Class 4(2W @850/900 MHz)
Class 1 (1 W @ 1800/1900MHz
Control via AT commands (GSM 07.07, 07.05 and SIMCOM Enhanced AT Commands
Low power consumption : 1.5A(sleep mode)
Operation temperature: -40°C to +85°C

The Table 3 shows the Arduino Uno Microcontroller technical detail.

TABLE 3
Arduino Uno Microcontroller

	Specification
Microcontroller:	ATmega328
Operating Voltage:	5V
Input Voltage: (recommended)	7-12V
Input Voltage(limit):	6-20V
Digital I/O Pins:	14 (of which 6 provide PWM output)
Analog Input Pins:	6
DC Current per I/O Pin:	40mA
DC Current for 3.3V Pin:	50mA
Flash Memory:	32KB of which .5KB used by bootloader
SRAM:	2KB
EEPROM:	1KB
Clock Speed:	16MHz

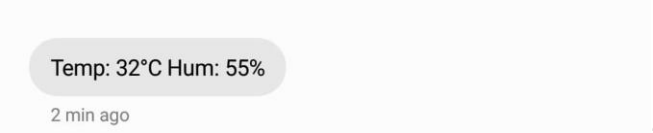

Fig. 5*. Screen Shot of the sample SMS received by the Poultry Farmer through the Smart Phone*.

Smart Phone of the Farmer. It shows the detected temperature and relative humidity by the prototype. After the development of the prototype it was tested for its reliability test. There are 10 respondents poultry farmers who evaluated the prototype. Purposive Sampling was used to determine the number of respondents. The survey questionnaire used was designed and validated by poultry farmers. All respondents strongly agreed that the developed prototype is very highly reliable based from the grand mean rating of 4.75. This finding implies that the developed prototype is indeed reliable because it is consistently detects the temperature and humidity level of the chicken coop.

4 CONCLUSION

Brooding is the most sensitive and crucial stage of the life of the chicken. Continuous monitoring of temperature and humidity level should be applied to ensure the survival of the broiler chicks. So to aid the farmers to monitor the temperature and humidity level, the researcher aimed to explore the smart sensing technology in brooding period then evaluate the reliability of the said prototype. Based from the result, through smart sensing technology it is indeed helpful since the prototype is very reliable and effective in detecting the temperature and humidity level. Through smart sensing, the farmers can easily monitor the temperature and humidity level of the chicken coop without manually monitoring the environmental condition. This is very helpful especially during rainy days with cold weather since chicks are vulnerable during cold weather. Further, the said prototype is also low cost so that it is affordable for the poultry farmers. Thus, the developed prototype is indeed very helpful and reliable especially for small scale poultry farmers.

5 RECOMMENDATIONS

This study can be upgrade by adding other sensors like MQ135 to monitor also ammonia level since ammonia level affects the health of the chicks and people around the farm.

Acknowledgment

This study is not possible without the help of the family of the researcher.

References

[1] Ali,M,(2008). The most crucial period of a chick's life – brooding.Retrieved on May 10, 2019 from https://en.engormix.com/poultry-industry/articles/the-most-crucial-period-t34143.htm

[2] Strawn,H.(2016).Your Complete Guide To Brooding Chicks. Retrieved on May 2, 2019 from https://www.hobbyfarms.com /your-complete-guide-to-brooding-chicks/

[3] Esmail,S.(2017). Focus on basic management factors improves flock production. Retrieved on April 21, 2019 from https://www.poultryworld.net/Meat/Articles/2017/3/Focus-on-basic-management-factors-improves-flock-production-108781E/

[4] Adriano,J. & Djamessi,F.(2017). Climate stress cuts poultry Production.Retrieved on June 26, 2019 from https://www.scidev.net/asia-pacific/livestock/news/climate-stress-cuts-poultry-production.html

[5] Dellosa, R. (2014). Development of an Anti-Theft Device using Motion Detection and Body Temperature. Asia Pacific Journal of Multidisciplinary Research. P-ISSN 2350-7756 .E-ISSN 2350-8442.Volume 2, No. 6

[6] Ames,M.(2019)., How Long Do Chicks Need a Heat Lamp? Heat Lamps: For Chicks, They're Not Optional! Retrieved on June 2, 2019 from https://backyardpoultry.iamcountryside.com/feed-health/how-long-do-chicks-need-a-heat-lamp/

[7] XIONG Y., MENG Q., GAO J., TANG, X., ZHANG H. (2017). Effects of relative humidity on animal health and welfare. Journal of Integrative Agriculture 2017, 16(8): 1653–1658

[8] Simiyo, M.(2015). Temperature Profiles In A Floor Heated Brooder. Retrieved on April 19, 2019 from http://erepository.uonbi.ac.ke/bitstream/handle/11295/90963/Simiyu_Temperature%20profiles%20in%20a%20floor%20heated%20brooderL.pdf?sequence=1&isAllowed=y

[9] Hartigh, W.(2015). Tips for better chicken house heating and ventilation. Retrieved May 4, 2019 from

https://www.farmersweekly.co.za/animals/poultry/tips-for-better-chicken-house-heating-ventilation/

[10] Hamilton,J., Negnevitsky,M., Wang, X.(2016). Thermal analysis of a single-storey livestock barn. Retrieved June 8, 2019 from https://journals.sagepub.com/doi/full/10.1177/1687814016643456