Design and Implementation of Smart Farm Data Logging and Monitoring System

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Abstract

In the advent of technology, everything is getting automated. Many of the designers and engineers have been implemented such systems that will help the need of the tedious manpower. Agriculture is very viable because it provides the needs and necessity of the human life. Agriculture is correlated to the technology which is the source of every system that is being implemented. There are lots of parameters that affects the growth and quality of the crops. In this study, the proponents will design and implement a system that will log data parameters monitored by different sensors. These four parameters, which needs to be observed, include temperature, humidity, soil moisture content, and acidity of the soil as well. The sensors to be used are DHT11, soil moisture sensor and PH sensor. The logged data will be integrated by the proponents into a single system, which will cover effective monitoring of plant growth. This system will be simulated and executed using microcontroller specifically Arduino ATMega 2560, which serves as the main control unit that is suitable for integrating the said sensor for monitoring the data parameters. The sensed data will be sent to the main computer which include VB.Net that will be used as a programming language for monitoring and logging the data values of temperature, humidity, and soil moisture and soil acidity. The Excel which serve as a database is also included to the main system where the data is being logged and will have its graphical representation. Lastly, the LCD monitor which is connected to the main system will fetch all the data gathered to display the information. This module of SMART farm system helps in monitoring data parameters and determining possible abnormalities over specified period of time.

Keywords*: SMART Farm; Data Logging; Monitoring; Arduino; VB.Net; LCD; DHT11, VH400, DS7911*

1. Introduction

This chapter aims to discuss the justification and achievements of the study. It includes the background of the study and the statement of the problem. A list of the project goals and coverage of the project are cited as well with emphasis on its significance. This section would serve as a basis to determine the functionality and importance of the study.

1.1 Background of the Study

Agriculture is one of the most vital perspectives in human exercises around the world [1]. Agriculture is about the art of farming that contains growing of the crops through soil cultivating and providing foods, fleece and different products. Ever since the agriculture was born, farmers have been experienced such different problems in their everyday lives. Farmers are facing new challenges on how they will retain their crops and animals to be healthy. Agriculture is highly dependent on the conditions of the climate. The state of the atmosphere is truly matter for the farmers to produce a healthy crops. Furthermore, the technological development has a gigantic effect to the improvement of agriculture. With the advent of technology, there are lot of new ideas and more-effective devices that can be integrated as a whole to implement a system. Innovation is the way to accomplish long haul destinations and guarantee the logging and

monitoring of data within specified set of time. We are in a world that everything is being automated. Automatic systems are ideal nowadays because it provides an energy efficiency and minimizes the need for tedious physical work/labor [2]. Smart farming is gradually used by the agriculturist to make agricultural production more intelligent. This kind of technology is also called precision agriculture where the idea is about how will observe, measure and respond to inter and intra-field variability of crops. With the use of sensors, at the earliest moment, the proponents will easily detect and monitor the possible abnormalities over specified period of time.

The changes in temperature, humidity, content of the soil moisture, the acidity of the soil could have significant impacts on crop yields. The crops may rapidly grow if the temperature is warmer, there is a possibility that the yields can lessen if the temperature is warmer. Crops have the tendency to grow faster in warmer conditions. Nonetheless, for some yields (such as grains), the time measure can decrease if the crops will grow faster [3]. The suitable temperature in any specific crop for its growth and propagation leads to the higher temperature [4]. The issues facing of every farmers particularly in planting are clods and crusting that leads to the low quality of seed beds. This means that the soil are not cultivated properly, improper watering and not in the correct moisture content. In addition, when the weather is changing, it is not good for the crops if the temperature, humidity, the speed of wind and direction of the wind are changing. These are the common issues that can be solve if there is a system that will help the farmers to monitor the planting process and store the data gathered from the sensors that will detect the atmospheric temperature, humidity, soil acidity and determine the content of the soil moisture. It is difficult to measure and control the soil moisture content as well as to maintain the growth and health of the plants. The purpose of monitoring and observing the soil moisture content is about getting enough waters of the plants. It is the measurement of the water level and the availability of its roots. Data logging is generally used as part of checking data where it helps the human to gather the data electronically [5]. In the realm of agriculture, it is indeed that the agricultural production was more diverse than today. There are lots of new technologies are used by the farmers to sustain more people and helps to lessen the manpower in the farm. Through biotechnology and genetic engineering, it is possible to grow crops in drought conditions. In the past years, technology in the industry of agriculture are getting improve and differ because of the equipment and its functionality, examples are electronic components and altering the biotechnology.

In due course, the proponents designed and implemented a system that will help farmers to monitor and log all data gathered by the sensors. The information that will be observed by the utilized of sensors are the atmospheric temperature, humidity, soil moisture and soil acidity of the wind that have a big effect to the growth of the plants. This system have a big contribution for the farmers because it will lessen their work and will give an efficient way to produce an accurate and precise information. In this Smart Farm Data

Logging and Monitoring System, the farmers will have an effective solution for recording the data over specified time, can observe and checks if there are unusual parameters that can affect to the growth of the plants. This data logging and monitoring system will use smart farming to integrate the three sensors that will monitor data parameters.

1.1 Objectives of the Study

The proponents' main objective is to design and implement a smart farm data logging and monitoring system.

Specifically, this system aims the following:

- to observe the temperature and humidity, soil moisture content and acidity of the soil that affects the growth and quality of crops through sensors (DHT11, Soil moisture sensor and PH Sensor)
- to gather, log and update all the data parameters given by the sensors over specified period of time using Visual Basic.Net
- to create a database and provide the graphical representation for data values gathered
- to test the functionality and accuracy of the sensors by monitoring the collected values of data parameters within the farm
- to fetch the data values gathered by the system and display to the LCD Monitor

1.2 Significance of the Study

This system will be a significant endeavour for the farmers because it will lessen the labour hour of the farmers and speed up the logging of data parameters. The system will have a main computer where there is a database that is connected to the Visual Basic.Net to log the data parameters gathered through specified sensors. The temperature, humidity, soil moisture content and soil acidity will be displayed in LCD. The administrator/farmer will be the one to control when will the system work. Hence, the farmers will not manually monitor the parameters that can effect on the plants and they can easily identify if there is a problem exist. This system will help the farmers to decide and provide data analysis about their crops.

The advantages of data logging and monitoring are: Readings are accurate because there is no human error involve. It automatically gives report to the user. This system will have a big contribution for the development in agriculture technology. With the help of smart farming data logging and monitoring system, it will help the agricultural production to increase the quality and quantity of the plants. Using this technology, farms can make more intelligent. This technology is gradually used and it can be utilized to collect vast of data from the parameters mention [6] [7].

Moreover, the proponents benefited in this system because it can be a source of knowledge and enormously understanding of the programming languages that will be used. This will be a training ground for the

researchers to improve and enhance their capability in the chosen field. This study is different in any related system because it has a lot of parameters needs to consider and the methodology that will be use is differ in any related systems**.**

1.3 Scope and Limitation

This study aims to design and to develop a smart farm data logging and monitoring system. It covers the monitoring of the plants and saves the data and information in Microsoft Excel by the use of sensors. The complete reports and collects data on a specified set of time basis from the plants is safely stored inside the system.

The proposed smart farm data logging and monitoring system is expected to gather data that covers the temperature and humidity, soil moisture content, and soil acidity of the plant by the use of sensor. DHT11 which have a measurement range of 20-90%RH (0-50℃), humidity accuracy of ±5％RH, the temperature accuracy of ±2℃ and the response time is 6s to 30s [8]. The soil moisture sensor has a power input of +5V DC and has a current limit of approximately 8mA. The soil moisture sensitivity can be adjustable and this sensor can be used in digital and analog because it has both connection pins. The PH Sensor is for detecting the acidity of the soil. The PH sensor has a power of 5V, and its size is 43x32mm. The range capacity of PH sensor is 0 to 14 pH and its accuracy is ± 0.1pH (25 ℃). These sensors are capable to provide an accurate, precise and reliable data. The proponents will have an experimentation for placing the sensors strategically in order to monitor the data values of the said parameters to provide more accurate and precise information. With these, the proponents can integrate and implement a system for SMART Farm specifically in logging and monitoring the data which are the parameters given [9] [10].

The study is limited only on monitoring, reports on the system and logging all the data observed by the sensors. The logged data will be integrated by the proponents into a single system, which will cover effective monitoring of plant growth. This system will be simulated and executed using Arduino microcontroller, which serves as the main control unit. The sensed data will be sent to the main computer and the VB.Net will be used for data monitoring. Lastly, the data gathered will be displayed through LCD. This system helps in monitoring data parameters and determining possible abnormalities over specified period of time.

2. Review of Related Literature

This chapter deals with the related research and synthesis of the study. The proponents seek related literature that would help them to know more about their study. These research contributes a lot to widen the views, ideas and knowledge of the proponents that would benefited to their study.

Based on the review of related literature, the data logging and monitoring the data parameters within the field can be summarized as a common solution for the agricultural production. There are lots of

different technology and methodology that can be used to monitor and log the data such as Wireless Sensor Network (WSN) technology, Smart Sensors Field Programmable Gate Array (FPGA)- based, Zigbee protocol microcontroller, Graphical User Interface, Remote control through WSN, Wireless monitoring with USB and transceiver chip, Zigbee protocol Arduino Microcontroller-based with Global System for Mobile Communications, ASP.NET and SQL technologies using C# programming language, peer-to-peer technology QoS-based multi-objective optimization and PID Controllers, GPRS and TinyOS. Most of the technology and/or methodology used in different studies that gathered by the proponents are the Wireless Sensor Network. The WSN are typically used to monitor the conditions of environment that is why it is the in demand technology. The studies are not just focuses on the monitoring but also in the management of the data. The uniqueness of this study is that the system only covers the monitoring of the different parameters that have an effect to the quality and growth of the plants. In this system, the proponents focused to the monitoring and logging the data monitored by the sensors while in the related studies, the authors has a big coverage of their systems' functionality.

In synthesizing the overall related studies, the proponents did not encountered such system which monitors, collect the data and logged all the information gathered through sensors that is connected in Arduino Microcontroller with combined of VB.Net for data logging purposes which transmitted to the Excel to provide a graphical representation.

3. Conceptual and Theoretical Framework

This chapter introduces and explains how the study was conducted. Also, it contains conceptual framework, theoretical framework and the proposed design of the study. Furthermore, this chapter represents the paradigm of the study which illustrates the parameters needed and shows how the proponents come up with the design and implementation of smart farm data logging and monitoring system. The proponents provide a general to detailed explanations of the study.

3.1 Conceptual Framework

The proponents aimed to design and implement smart farm data logging and monitoring system. In this study, the proponents provides different paradigm of the system that will help to understand and analyse the goal of the study and how the system will work. Furthermore, the proponents explains the general concept of the study in a comprehensive way.

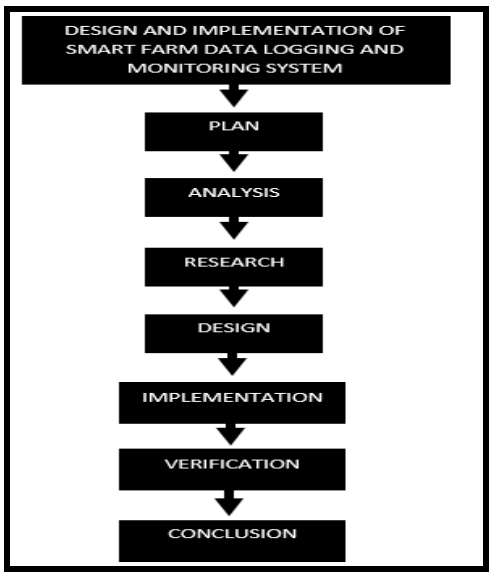


Figure 1: Research Methodology

The Figure 1 is the research methodology of the proponents which includes the planning, analysis, research, design, implementation, verification, and conclusion. The planning section covers the time, cost and scope of the study to be able to identify what the parameters are, what software and hardware to be used, cost estimation and how long the system will implement. In analysis section, the proponents analyse the parameters that affect the growth and quality of the crops such as chili, tomato and bell pepper. The research section where the proponents gathered data and information related to the study which helps them to decide what software and hardware are applicable to implement the system. After identifying the suitable software and hardware tools, the design section includes the system architecture, the flow of the data parameters, and the concept of the system. In implementation, the proponents are able to identify the programming language to be used which is the Visual Basic.Net. Lastly, the verification which includes the unit testing and system testing to determine the accuracy and functionality of the system.

Table 1. Conceptual Framework

INPUTS	PROCESS	OUTPUTS
• Values of temperature and humidity, soil moisture, soil acidity from the Farm	• Detect and gather the values of data parameters through sensors • Send a data signal to the microcontroller • Transmit the data values to the system • Perform the program language to log and plot the data values in the Excel Database • LCD fetch the data values gathered by the system	• Smart Farm Data Logging and Monitoring System

Table 1 illustrates the general concept of the system. It is the framework which explains the flow of the system. The inputs are the data parameters which are temperature and humidity, soil moisture, soil acidity to be used by the proponent that will detect and gather through sensors. The sensors will send the data signal to the microcontroller and the microcontroller will transmit the data values to the system. The system have used the VisualBasic.Net for the programming language and provide a graphical user-friendly interface, this will perform to log the data values and get its graphical representation to the excel database. The LCD monitor will fetch the data gathered by the system and will display the information. This will come up to the Smart farm data logging and monitoring system.

3.1.1 Block Diagram of the System

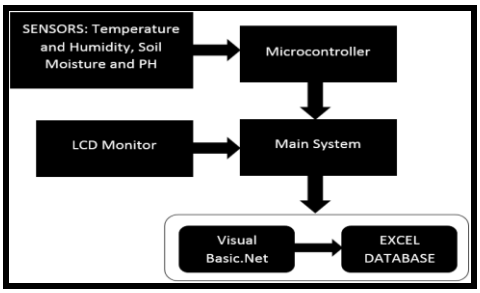


Figure 2: Block Diagram of the Smart Farm Data Logging and Monitoring System

In Figure 2, the block diagram illustrate the general concept of the system which includes sensors, microcontroller and the main system which includes the Visual Basic.Net and Excel database. These are the hardware and software tools that will be used by the proponents for able to implement a system that will log and monitor the data parameters which are temperature, humidity, soil moisture content and soil acidity as well. The sensors performs its functionality which is detecting the values of data parameters. The sensors are connected to microcontroller which is the central part of the system. The microcontroller is connected to the main system where the programming language is placed which is the VisualBasic.Net and the database which is the Excel. The VisualBasic.Net where the graphical user interface will implement for the users understand how to use the system easily. The LCD Monitor is connected to the main system to fetch the data values of parameters gathered

3.1.2 Data Flow Diagram of the System

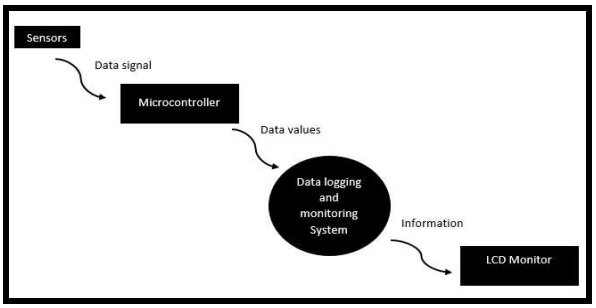


Figure 3: Level 0 Data Flow Diagram of the System

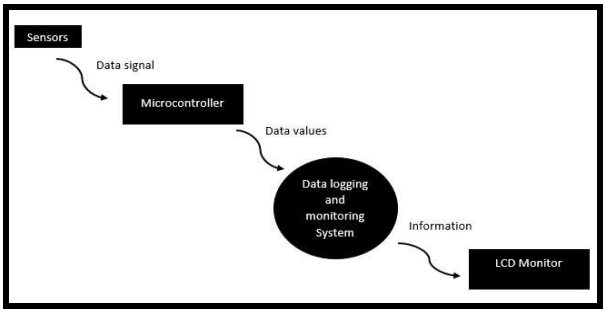


Figure 4: Level 1 Data Flow Diagram of the System

Figure 3 and 4 are the flow of the data parameters. The Figure 3 illustrates the general functionality of the entire system. It includes the modules of the system and explains the relationship between software and hardware tools in terms of external view. The Figure 4 is the detailed flow of data that explains how the data is being monitored, gathered, displayed and logged with the used of software and hardware tools. This is the specific representation of level 0 in terms of internal view.

3.2 Theoretical Framework

3.2.1 Sensors

Sensors are commonly used for detection of parameters and respond to any of electronic controller to collect information. The

result of information gathered by sensor are usually a data signal and is converted to human readable display. This is also a type of input from the physical environment [11] [12]. The discovery of sensor have a big help for the manufacturers and businessmen which driven different applications. Sensors functionality are very crucial in monitoring the environment with integrity. Furthermore, sensors used to easily detect the chemicals that may be hazardous [13].

A. Functions of Sensors

The sensors covers limited range. If the data exceeds within the range, the sensor will automatically detect only the minimum and maximum value of information. The measured property determine the full scale range of the sensor [14]. Drift (telecommunication), is a changes of bit by bit in output signal. Using the drift in long term leads to the moderate degradation of the properties of sensors [14].

B. Types of Sensors

In our everyday life sensors are already used and classified as analog and/or digital sensors. The sensors have different types and the temperature and humidity sensor, soil moisture sensor, speed and wind direction sensor are the most commonly used for monitoring the environment. Analog sensors provides continuous analog output signal which is proportional to the measurand. It can assume any values that ranges between 0 and 5volts. Digital signals are the generated digital sensors. This means that the values resulted are in range but the values should gradually increase. The values between any, previous and/or following values have a known relationship. The signal produced or reflected by the sensor is binary it is between 0's and 1's. It can be only ON and OFF [15]. There are different types of sensor that will be used by the proponents are the following:

a. Temperature and humidity Sensor

The DHT11 is a type of sensor that will be used to monitor the temperature and humidity within the SMART Farm. This sensor used by the proponents because it is ideal for the SMART Farm Data Logging and Monitoring System, it provides a long term stability and high reliability. Also, it provides the high cost performances advantage, quick result and a satisfaction of quality. In addition, this sensor can monitor the humidity because it highlights an accurate calibration of humidity calibration chamber [8].

b. Soil Moisture Sensor

This sensor used to evaluate the content of soil water level in volume unit. Due to the plant uptake and evaporation which leads to the loss of moisture, this sensor is capable in measuring its value. Also it can analyse the desired soil moisture contents for various species of crops. It can enhance the soil moisture content by monitoring and controlling the irrigation in greenhouses [16]. The soil moisture sensor will be used by the proponents. This is the specific sensor that will detect the water level within the soil. It provides a low cost yet gives an accurate

information of soil water content [9]. This sensor can observe the moisture of the soil up to 10 meters above the ground.

c. PH Sensor

PH Sensor measures the soil acidity. The PH sensor is ideal in this system because it has a specifications that fits the standard of the proponents to monitor acidity of the soil. This sensor will provide reliable and precise information. It can be use in a long term basis. Also, it has a high quality because of its specification which is a compatible with Arduino and can be used for long term solidity. This sensor has been verified to determine the accuracy and range of its specifications.

3.2.2 Arduino Microcontroller

Arduino is ideal for implementing electronic projects because the programmer can freely made their own program. Arduino includes hardware and software tools such as a microcontroller where is dedicated to perform the circuits' functionality and IDE (Integrated Development Environment) which the coding process is implemented [17]. Arduino Microcontroller is the programmable circuit board of the Arduino. By observing, the board contains USB, Analog Pins, Digital Pins, LCD display, LED, Power and Ground Pins. Arduino is built by hand that is why it can be bought or preassembled. Moreover, it can be re-used by the users for their other projects to be implemented [18]. The Arduino ATmega 2560 is the type of Arduino microcontroller that the proponents choose to use because it has 54 digital input pins which is very suitable for integrating with the sensors to fetch the data values needed to monitor and log.

3.2.3 LCD (Liquid crystal display)

The LCD are commonly used in the panel and laptop monitors because of its features that is super thin. It is formed by inserting between two electrodes to provide images in electronically based. The color of this substance can be transformed by increasing or decreasing the electrical current. They use up much less power because LCD are based on the source of blocking light [19]. The LCD will be used by the proponents because it is ideal in displaying the information gathered and is suitable for easily monitoring the transmitted data values of parameters in a set period of time.

3.2.4 Visual Basic.Net (VB.Net)

The VB.Net will used by the proponents in implementing the system code. This programming language is much applicable to the design and implementation of the system because it has a best common language for improving the applications of windows [20].

3.3 Proposed Design

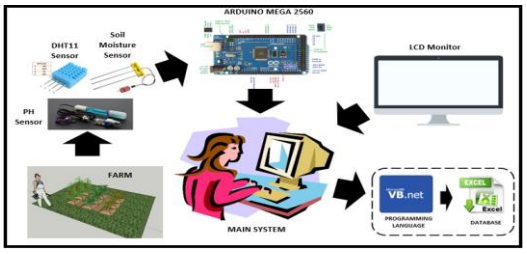


Figure 5: Proposed Design of the System

In this study, the design and implementation of smart farm data logging and monitoring system evaluates the parameters needed in order to produce a healthy crops. This system monitors the temperature, humidity, soil moisture content, and soil acidity as well. These parameters set by the proponents because it has tremendous effects to the growth of the crops such as chili, bell pepper and tomato. The farm where the data values will monitor through sensors. The sensors are the DHT11, Soil Moisture sensor and PH sensor which monitors and detect the said parameters. The sensors which are DHT11, Soil Moisture sensor and PH Sensor are connected to the microcontroller to perform their task and the microcontroller is connected to the main system. The main system includes VisualBasic.Net where the proponents will make the graphical user interface of the system which is easy to use and understand, and the Excel workbook that will serve as a database of the system. Furthermore, the data values of temperature and humidity, soil moisture and soil acidity will have a graphical representation to determine the possible abnormalities in a period of time.

3.3.1 Sample Output Designs

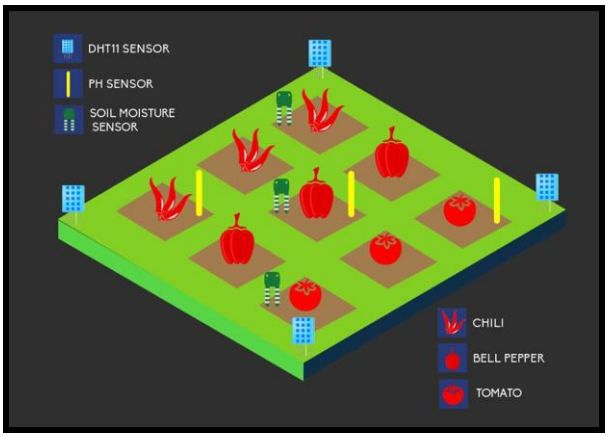


Figure 6: Sensor Location

The Figure 6 illustrates where the sensors will locate to monitor the parameters. The DHT11 will be placed at the edge of the farm to monitor the temperature and humidity. Each of the crops such as chili, tomato and bell pepper will have its own soil moisture sensor and PH sensor which placed diagonally to detect the water level and acidity of the soil. However, the proponents will have an experimentation on placing the sensors strategically. The sensors will test its functionality by scrutinizing the placement of the sensor which are located at the top, first, second or third column horizontally/vertically.

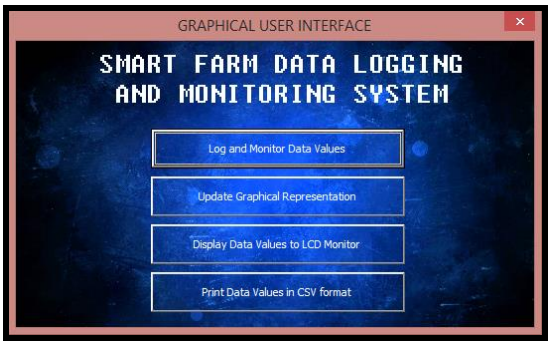
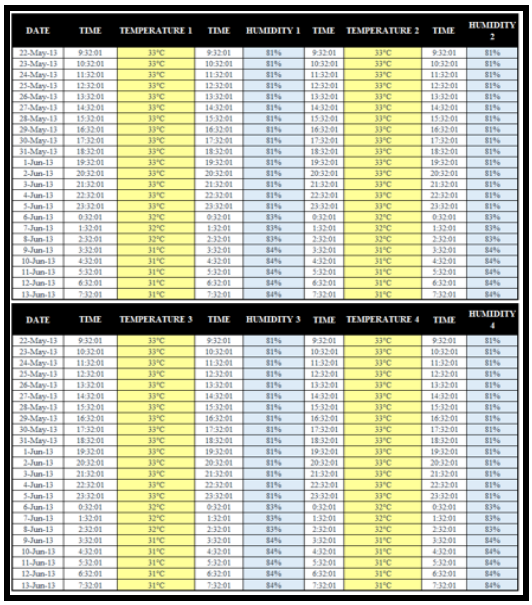


Figure 7: Graphical User Interface

The Figure 7 illustrates the sample of graphical userform created in Visual Basic.Net. This userform will be the farmers interface to

the system that has four command buttons which consists of Log and Monitor Data Values, Update Graphical Representation, Display Data Values to LCD Monitor and Print Data Values in CSV Format. The Log and Monitor Data Values button as the name implies, it will automatically store the data to the excel database and monitor as well. The Update Graphical Representation, the data values will plot to easily determine the abnormalities of the data values over specified time. The Display Data Values command is for displaying the data values of temperature and humidity, soil moisture, and soil acidity to the LCD monitor for the user can see it in a clear and complex form. Lastly, the Print Data Values button is for automatically provide the hard copy of the monitored values of data parameters in a CSV format.



DATE	TIME	TEMPERATURE 1	TIME	HUMIDITY 1	TIME	TEMPERATURE 2	TIME	HUMIDITY 2
22-May-13	9:32:01	33°C	9:32:01	81%	9:32:01	33°C	9:32:01	81%
23-May-13	10:32:01	33°C	10:32:01	81%	10:32:01	33°C	10:32:01	81%
24-May-13	11:32:01	33°C	11:32:01	81%	11:32:01	33°C	11:32:01	81%
25-May-13	12:32:01	33°C	12:32:01	81%	12:32:01	33°C	12:32:01	81%
26-May-13	13:32:01	33°C	13:32:01	81%	13:32:01	33°C	13:32:01	81%
27-May-13	14:32:01	33°C	14:32:01	81%	14:32:01	33°C	14:32:01	81%
28-May-13	15:32:01	33°C	15:32:01	81%	15:32:01	33°C	15:32:01	81%
29-May-13	16:32:01	33°C	16:32:01	81%	16:32:01	33°C	16:32:01	81%
30-May-13	17:32:01	33°C	17:32:01	81%	17:32:01	33°C	17:32:01	81%
31-May-13	18:32:01	33°C	18:32:01	81%	18:32:01	33°C	18:32:01	81%
1-Jun-13	19:32:01	33°C	19:32:01	81%	19:32:01	33°C	19:32:01	81%
2-Jun-13	20:32:01	33°C	20:32:01	81%	20:32:01	33°C	20:32:01	81%
3-Jun-13	21:32:01	33°C	21:32:01	81%	21:32:01	33°C	21:32:01	81%
4-Jun-13	22:32:01	33°C	22:32:01	81%	22:32:01	33°C	22:32:01	81%
5-Jun-13	23:32:01	33°C	23:32:01	81%	23:32:01	33°C	23:32:01	81%
6-Jun-13	0:32:01	32°C	0:32:01	83%	0:32:01	32°C	0:32:01	83%
7-Jun-13	1:32:01	32°C	1:32:01	83%	1:32:01	32°C	1:32:01	83%
8-Jun-13	2:32:01	32°C	2:32:01	83%	2:32:01	32°C	2:32:01	83%
9-Jun-13	3:32:01	31°C	3:32:01	84%	3:32:01	31°C	3:32:01	84%
10-Jun-13	4:32:01	31°C	4:32:01	84%	4:32:01	31°C	4:32:01	84%
11-Jun-13	5:32:01	31°C	5:32:01	84%	5:32:01	31°C	5:32:01	84%
12-Jun-13	6:32:01	31°C	6:32:01	84%	6:32:01	31°C	6:32:01	84%
13-Jun-13	7:32:01	31°C	7:32:01	84%	7:32:01	31°C	7:32:01	84%

DATE	TIME	TEMPERATURE 3	TIME	HUMIDITY 3	TIME	TEMPERATURE 4	TIME	HUMIDITY 4
22-May-13	9:32:01	33°C	9:32:01	81%	9:32:01	33°C	9:32:01	81%
23-May-13	10:32:01	33°C	10:32:01	81%	10:32:01	33°C	10:32:01	81%
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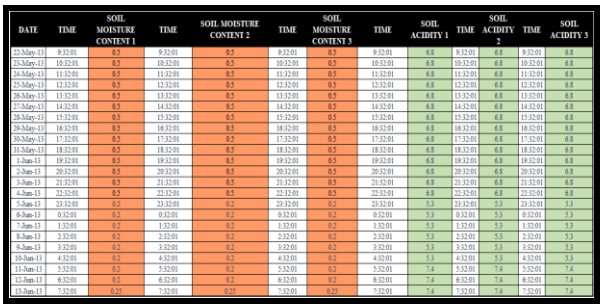
29-May-13	16:32:01	33°C	16:32:01	81%	16:32:01	33°C	16:32:01	81%
30-May-13	17:32:01	33°C	17:32:01	81%	17:32:01	33°C	17:32:01	81%
31-May-13	18:32:01	33°C	18:32:01	81%	18:32:01	33°C	18:32:01	81%
1-Jun-13	19:32:01	33°C	19:32:01	81%	19:32:01	33°C	19:32:01	81%
2-Jun-13	20:32:01	33°C	20:32:01	81%	20:32:01	33°C	20:32:01	81%
3-Jun-13	21:32:01	33°C	21:32:01	81%	21:32:01	33°C	21:32:01	81%
4-Jun-13	22:32:01	33°C	22:32:01	81%	22:32:01	33°C	22:32:01	81%
5-Jun-13	23:32:01	33°C	23:32:01	81%	23:32:01	33°C	23:32:01	81%
6-Jun-13	0:32:01	32°C	0:32:01	83%	0:32:01	32°C	0:32:01	83%
7-Jun-13	1:32:01	32°C	1:32:01	83%	1:32:01	32°C	1:32:01	83%
8-Jun-13	2:32:01	32°C	2:32:01	83%	2:32:01	32°C	2:32:01	83%
9-Jun-13	3:32:01	31°C	3:32:01	84%	3:32:01	31°C	3:32:01	84%
10-Jun-13	4:32:01	31°C	4:32:01	84%	4:32:01	31°C	4:32:01	84%
11-Jun-13	5:32:01	31°C	5:32:01	84%	5:32:01	31°C	5:32:01	84%
12-Jun-13	6:32:01	31°C	6:32:01	84%	6:32:01	31°C	6:32:01	84%
13-Jun-13	7:32:01	31°C	7:32:01	84%	7:32:01	31°C	7:32:01	84%

Figure 8: Temperature and Humidity Data Values



DATE	TIME	SOIL MOISTURE CONTENT 1	TIME	SOIL MOISTURE CONTENT 2	TIME	SOIL MOISTURE CONTENT 3	TIME	SOIL ACIDITY 1	TIME	SOIL ACIDITY 2	TIME	SOIL ACIDITY 3
22-May-13	9:32:01	0.5	9:32:01	0.5	9:32:01	0.5	9:32:01	6.8	9:32:01	6.8	9:32:01	6.8
23-May-13	10:32:01	0.5	10:32:01	0.5	10:32:01	0.5	10:32:01	6.8	10:32:01	6.8	10:32:01	6.8
24-May-13	11:32:01	0.5	11:32:01	0.5	11:32:01	0.5	11:32:01	6.8	11:32:01	6.8	11:32:01	6.8
25-May-13	12:32:01	0.5	12:32:01	0.5	12:32:01	0.5	12:32:01	6.8	12:32:01	6.8	12:32:01	6.8
26-May-13	13:32:01	0.5	13:32:01	0.5	13:32:01	0.5	13:32:01	6.8	13:32:01	6.8	13:32:01	6.8
27-May-13	14:32:01	0.5	14:32:01	0.5	14:32:01	0.5	14:32:01	6.8	14:32:01	6.8	14:32:01	6.8
28-May-13	15:32:01	0.5	15:32:01	0.5	15:32:01	0.5	15:32:01	6.8	15:32:01	6.8	15:32:01	6.8
29-May-13	16:32:01	0.5	16:32:01	0.5	16:32:01	0.5	16:32:01	6.8	16:32:01	6.8	16:32:01	6.8
30-May-13	17:32:01	0.5	17:32:01	0.5	17:32:01	0.5	17:32:01	6.8	17:32:01	6.8	17:32:01	6.8
31-May-13	18:32:01	0.5	18:32:01	0.5	18:32:01	0.5	18:32:01	6.8	18:32:01	6.8	18:32:01	6.8
1-Jun-13	19:32:01	0.5	19:32:01	0.5	19:32:01	0.5	19:32:01	6.8	19:32:01	6.8	19:32:01	6.8
2-Jun-13	20:32:01	0.5	20:32:01	0.5	20:32:01	0.5	20:32:01	6.8	20:32:01	6.8	20:32:01	6.8
3-Jun-13	21:32:01	0.5	21:32:01	0.5	21:32:01	0.5	21:32:01	6.8	21:32:01	6.8	21:32:01	6.8
4-Jun-13	22:32:01	0.5	22:32:01	0.5	22:32:01	0.5	22:32:01	6.8	22:32:01	6.8	22:32:01	6.8
5-Jun-13	23:32:01	0.2	23:32:01	0.2	23:32:01	0.2	23:32:01	5.3	23:32:01	5.3	23:32:01	5.3
6-Jun-13	0:32:01	0.2	0:32:01	0.2	0:32:01	0.2	0:32:01	5.3	0:32:01	5.3	0:32:01	5.3
7-Jun-13	1:32:01	0.2	1:32:01	0.2	1:32:01	0.2	1:32:01	5.3	1:32:01	5.3	1:32:01	5.3
8-Jun-13	2:32:01	0.2	2:32:01	0.2	2:32:01	0.2	2:32:01	5.3	2:32:01	5.3	2:32:01	5.3
9-Jun-13	3:32:01	0.2	3:32:01	0.2	3:32:01	0.2	3:32:01	5.3	3:32:01	5.3	3:32:01	5.3
10-Jun-13	4:32:01	0.2	4:32:01	0.2	4:32:01	0.2	4:32:01	5.3	4:32:01	5.3	4:32:01	5.3
11-Jun-13	5:32:01	0.2	5:32:01	0.2	5:32:01	0.2	5:32:01	7.4	5:32:01	7.4	5:32:01	7.4
12-Jun-13	6:32:01	0.2	6:32:01	0.2	6:32:01	0.2	6:32:01	7.4	6:32:01	7.4	6:32:01	7.4
13-Jun-13	7:32:01	0.25	7:32:01	0.25	7:32:01	0.25	7:32:01	7.4	7:32:01	7.4	7:32:01	7.4

Figure 9: Soil Moisture and Soil Acidity Data Values

The Figure 8 and Figure 9 are the sample of data values for temperature, humidity, soil moisture and soil acidity. This illustrates how the data values is being logged to the excel database with respect to time and date. With this, the user can monitor the data gathered and will easily identify how data values changes. This data values gathered will be manage and analyse by the other module of smart farm system if there are abnormalities encountered and will notify the farmers.

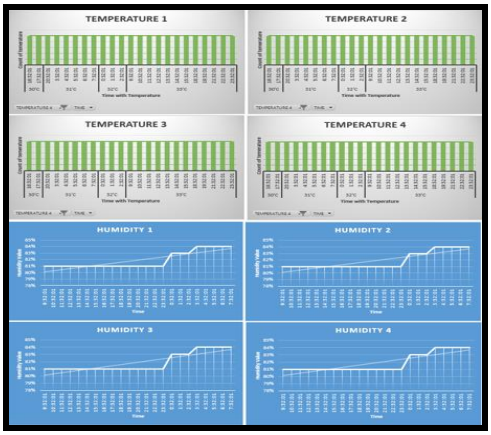


Figure 10: Graphical Representation of Temperature and Humidity

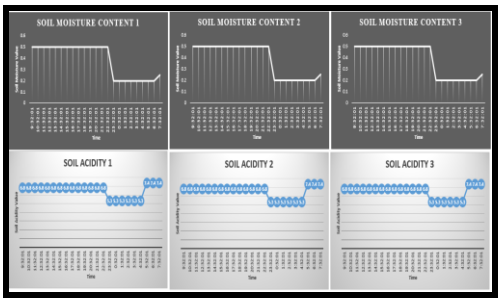


Figure 11: Graphical Representation of Soil Moisture and Soil Acidity

Figure 10 and 11 are the graphical representation for temperature, humidity, soil moisture and soil acidity. This paper will help to determine the abnormalities monitored by the system with that it can easily know the possible solution that needs to perform.

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