Supervisory Data Acquisition Of Temperature And Humidity In Oil Palm Tissue Culture Laboratory

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Abstract—**The tissue culture laboratory provides the oil palm industry with innovations for the production of improved planting materials and information on the molecular biology of tissue culture processes. Research has shown that factors such as temperature and humidity are critical in producing quality colonial materials using tissue culture process. Consequently, sensors are required to monitor and record the data in growth room using data acquisition monitoring system which can be real–time. Sensors will monitor critical parameters that focus on temperature and humidity that will be linked to the database and analysis software for storing and analyzing the monitored data. The sensor is low cost because it used local products and low power consumption and fabricated to suit the biological laboratory environment. The purpose of this sensor is to serve as an interface among user as the disturbance analysis program and an expert system in identifying the disturbance. The system could monitor via a wireless system and automatically display data and graph in Visual Basic and stored data in Database Access. Xbee as the automatic wireless identification method using radio waves, relying on storing and remotely retrieving data from the sensor. Eventually, this wireless (Xbee) technology system could improve the efficiency of inventory tracking and management for oil palm tissue culture growth.**

Keywords – ***Oil Palm, Temperature, Humidity, Visual Basic 6.0, Database Access, Xbee.***

I. INTRODUCTION

Malaysian Palm Oil Board is producing clonal planting materials by using tissue culture system. The tissue culture laboratory provides the oil palm industry with innovations for the production of improved planting materials and information on the molecular biology of tissue culture processes. Plant tissue culture relies on the fact that many plant cells have the ability to regenerate a whole plant (tot potency). Single cells, plant cells without cell walls (protoplasts), pieces of leaves, or (less commonly) roots can often be used to generate a new plant on culture media given the required nutrients and plant hormones [1].

Research has shown that factors such as temperature and humidity are critical in producing quality clonal materials using tissue culture process. Under physical condition, factors such as temperature and humidity should be set at certain standard for development of good cultures [2]. However the monitoring system to detect changes of temperature and humidity is not too efficient. Normally, the recording is done manually and this reduces the efficiency and reliability of the process [3]. The advantage of monitoring system on tissue culture laboratory is to obtain and analyze the data on factors that affect the growth of cultures. Then, the data will be analyzed and controlled by Visual Basic where the data result and graph will appear on the computer screen and the data automatically stored in database access. The data of temperature and humidity appear in real–time. This system commonly has been practiced on monitoring and controlling conditions such as room temperature and humidity of lab. Monitoring is employed in various applications including temperature and humidity [4].

A. *Oil palm Tissue Culture*

Oil palm is oil producing tropical plant. Oil palm tissue culture offers a potentially practical route to clonal propagation of high yielding palms. However, current tissue culture methods are laborious and costly, and the performance of the cultures can be difficult to describe quantitatively. Computer control of bioreactor processes increases reproducibility and permits quantitative description of the growth of oil palm cultures [1]. Tissue culture-derived plants of oil palm (*Elaeis guineensis* Jacq.) can develop abnormal flowers in which stamen primordia are converted into carpel-like tissues (mantled fruit). This abnormality can be heritable; individual palms may show variation in mantling and reversion to the normal phenotype over time has been observed [5].

B. SHT11

The SHT11 is single chip relative humidity (RH) and temperature multi sensor modules comprising a calibrated digital output [6]. SHT11 use it to measure ambient temperature and RH values without using individual sensors. The sensors integrate sensor elements plus signal processing on a tiny foot print and provide a fully calibrated digital output. A unique capacitive sensor element is used for measuring relative humidity while temperature is measured by a band-gap sensor. The applied CMOSens® technology guarantees excellent reliability and long term stability. Both sensors are seamlessly coupled to a 14bit analog to digital converter and a serial interface circuit. This results in superior signal quality, a fast response time and insensitivity to external disturbances (EMC) [7].

C. Xbee Wireless

XBee and XBee-PRO 802.15.4 OEM RF modules are embedded solutions providing wireless end-point connectivity to devices. These modules use the IEEE 802.15.4 networking protocol for fast point-to-multipoint or peer-to-peer networking. They are designed for high-throughput applications requiring low latency and predictable communication timing. The XBee/XBee-PRO OEM RF Modules interface to a host device through a logic-level asynchro-nous serial port. Through its serial port, the module can communicate with any logic and voltage compatible UART; or through a level translator to any serial device (For example: RS-232/485/ 422 or USB interface board) [8].

D. Microsoft Visual Basic 6.0

Microsoft Visual Basic 6.0 is a language rapid application development environment that gives fast, easy, and intuitive tools to quickly develop windows application. Using Visual Basic, also can develop simple utilities or sophisticated applications. Data access features allow creating databases, front-end applications, and scalable server-side components for most popular database formats [9].

The “Visual” parts refer to the method used to create the graphical user interface (GUI). The “Basic” part refers to the BASIC (Beginners All-Purpose Symbolic Instruction Code) language. In visual basic, the form is the container for all the controls that makes up the user interface. A form may fill entire screen or have other forms within it. It may be a custom dialog box. When a Visual basic application is executing, each window it displays on the Desktop is Form [10].

E. Database Access

A *database* is a repository of information. A relational database stores data in tables which comprise rows and columns. Access also includes a query interface, forms to display and enter data, and reports for printing. Microsoft Access offers several ways to secure the application while allowing users to remain productive. Data Access Objects are most commonly used to manipulate data in an existing database. Running queries updating records and performing database maintenance are DAO’s bread and butter [11].

This paper will discuss the display and develop database Access with Visual Basic 6.0 of temperature and humidity. Visual basic as a controller which is receiving the data of temperature and humidity by MS Comm control from serial port. The process of sending the data will be continuously display on the computer. All the data will stored in database Access. Results are provided to demonstrate successful implementation of the design.

II. METHODOLOGY

This project consists of hardware and software but for this paper will discuss last part (software) that is Database Access with Visual basic 6.0. The function of the receiver is to gather the data process and display it on the computer. For the receiver’s part, the microcontroller is not being used because the computer can be used as a processor instead of microcontroller. Figure 1 show the flow chart for microcontroller’s program.

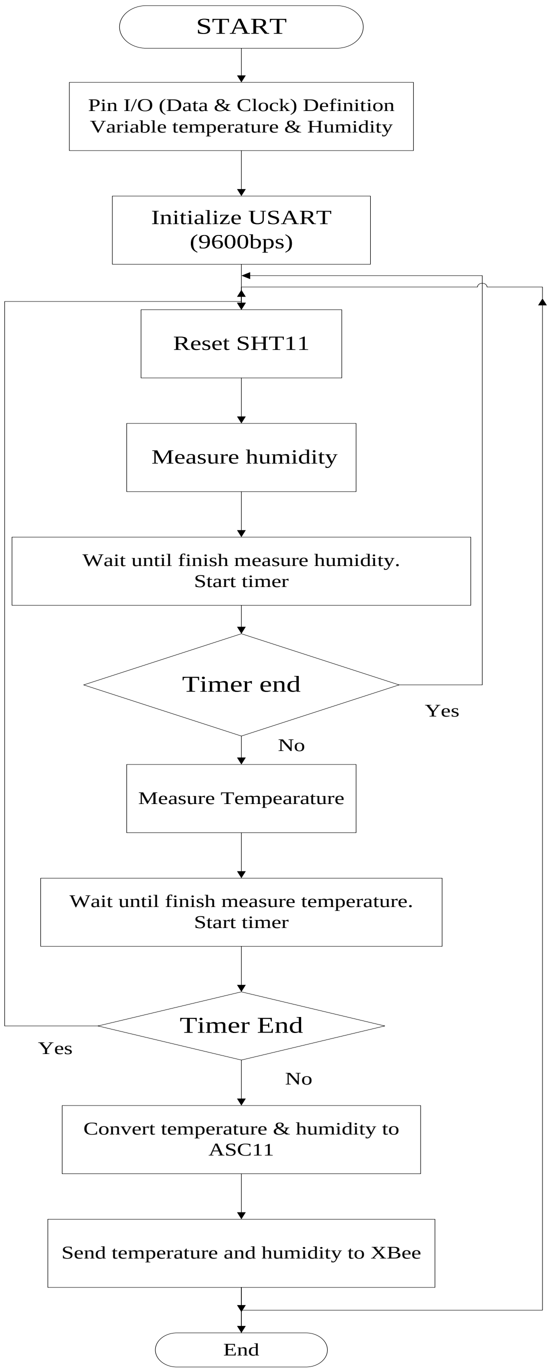

Figure 1: Flow chart microcontroller’s program

First, the process performed to determine the definition of pin I/O (Data & Clock) for serial two wire communication and temperature and humidity variable declarations in place to accommodate the temperature and humidity measurement data then do initialization USART Serial communication that is baudrate 9600bps, data bits, no parity bit, one stop bit. After reset SHT11, it will measure humidity and if timer end until two second, it will reset back otherwise it will proceed to measure temperature. After that, the microcontroller send temperature and humidity to zigbee and reset SHT11 back until the process finish.

The Flow Chart of this system for monitoring the data (temperature and humidity) and stored in Database Access is shows in Figure 2.

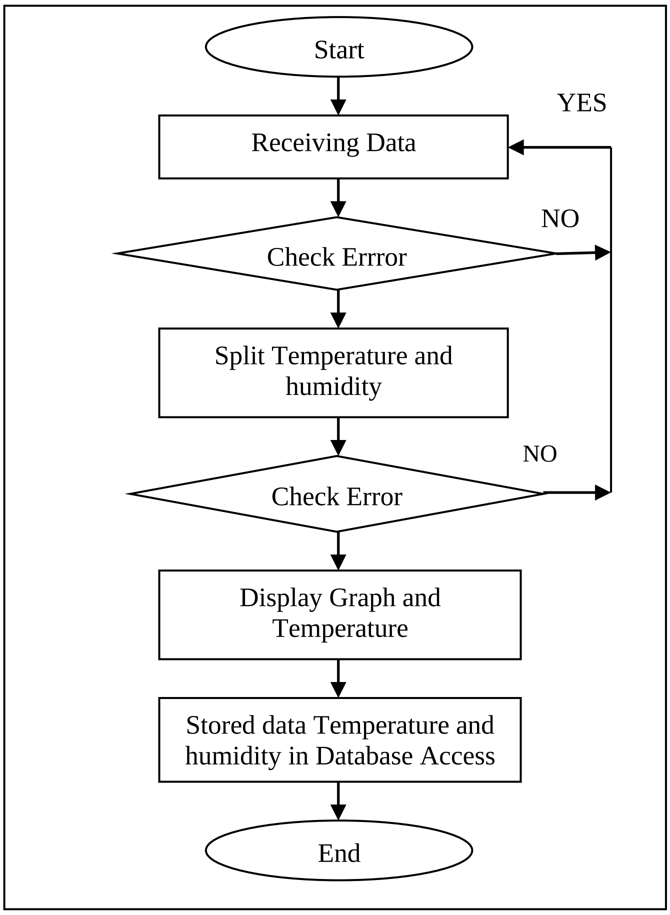

Figure 2: Flow chart for monitoring the data (Temperature and Humidity) and stored in Database Access

The entire program controlled by Visual basic 6.0. The data of temperature and humidity receiving using MS Comm control from serial port. In this program use comm. Port 5. When comm port 5 open, will start receiving data that are detected from sensor SHT11. If the sensor not detected, PIC will send error. Then receiving data start again, the data of temperature and humidity will split. After that, check error again whether the data correct or not. If the data is correct, data of temperature and humidity display with the graph. It will display synchronous and continuously with every 100 seconds. Timer also use in Visual Basic 6.0 to count the time and directly stored the data of temperature and humidity in Database Access.

All the data of temperature and humidity will stored in Database Access automatically. In database Access will store the value of temperature and humidity, date and time. All data was taken in real time. The purpose all data stored in database as reference and for review future. Button *Previous Record* provided to check previous data of temperature and humidity by selected date. It is easier to check and fast to get the previous data of temperature and humidity.

III. RESULT AND DISCUSSION

Tissue Culture Lab at Malaysia Palm oil Board (MPOB) Bangi consist 2 types of rooms for young oil palm growth. There are dim room and light room. Dim room at growth room 1 and 2 wherever bright room at growth room 3 and 4. Figure 3 shows the growth room 4 at Tissue Culture Lab at Malaysia Palm oil Board (MPOB) Bangi.

Figure 3: Growth room 4

The wide of growth room 4 is 7.3m x 7.4 m while growth room 3 is 4.8 m x 7.4 m are shows in Figure 3.

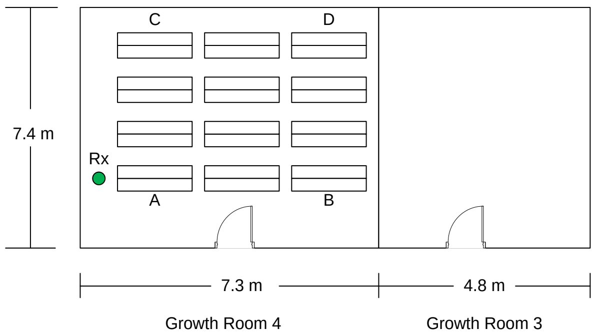

Figure 4: Layout for growth room 4 and 3

From figure 4 in growth room 4, there are four different distances that was taken from receiver. From figure 5 shown that shelf a = 2.4 m, shelf b = 4.4 m, shelf c = 5 m and shelf d = 9 m from receiver. Each shelve have 5 levels and high for each level is 0.18 m.

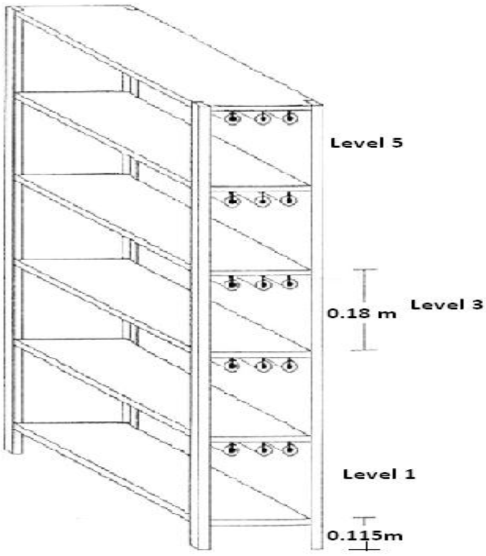

Figure 5: Shelves

Comparison temperature (° C) and humidity (%) were taken from 3 vessels. Figure 6 shows the vessel 1. Inside this vessel have many leaves, many shoots ready for rooting and more perspiration process. Tissue cultures inside this vessel 1 about 12 months

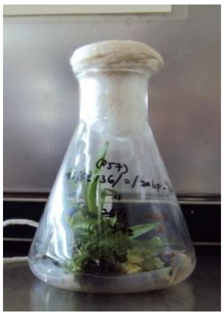

Figure 6: Vessel

Figure 7 shows that acquired data of each temperature were averaged from vessel 1, vessel 2 and vessel 3for distance 2.4m and 4.4m. This distance is first row from the transmitter as shown in Figure 4.The temperature in vessel 2 higher than vessel 1 and 3 between different distances. It because tissue cultures inside this vessel 2 is about 10 months which is through embryo process. In this process, the temperature is about 26.5 ºC until 30 ºC higher than other vessels. At 4.4 m, temperature between three vessels is higher than other distance. It is because the vessel placed near the fluorescent lamp. Vessel 2 at 4.4 m, the temperature is about 29.367 ºC higher than other vessels and distances. It because of many shoots ready for rooting, the leaves less and less perspiration process.

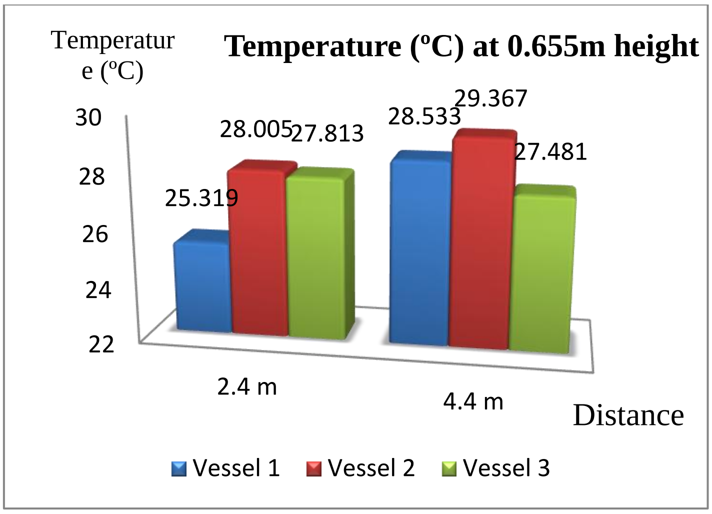

Figure 7: Temperature at 0.655m height between Two Distance (2.4m and 4.4m) and Different Vessels

Figure 8 shows that acquired data of each temperature were averaged from vessel 1, vessel 2 and vessel 3 for distance 5m and 9m. This distance is fourth row from the transmitter as shown in Figure 4. Temperature between three vessels at 9m is higher than at distance 5m. It because the vessels place far from air condition and near with the fluorescent lamp compared with distance 5m. The temperature at 5m is lower than at 9m because of one of fluorescent lamp was burn. So that can affect the value of temperature. The more far distances, increasingly the value of temperature.

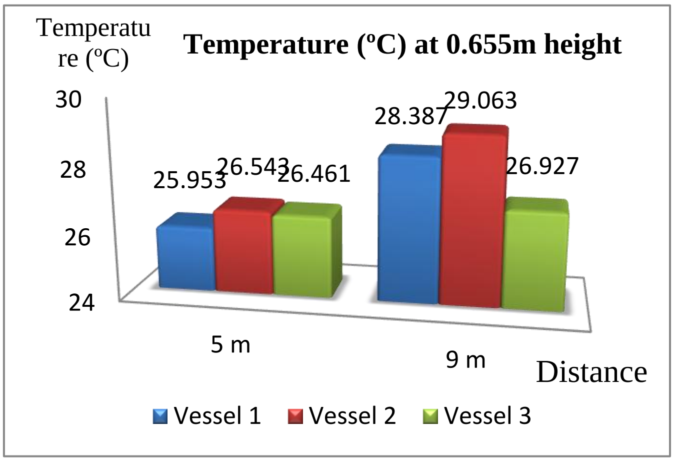

Figure 8: Temperature at 0.655m height between Two Distance (5m and 9m) and Different Vessels

Figure 9 shows the humidity between three vessels and distance. The different distance between 2.4m and 4.4 m. Humidity in vessel 1 at 2.4 m higher compare with vessel at 4.4m. It is about 98.821%. It is because the sensor place near the leaves of tissue culture in vessel and near the air condition. The value of humidity will effect when the leaves moisture.

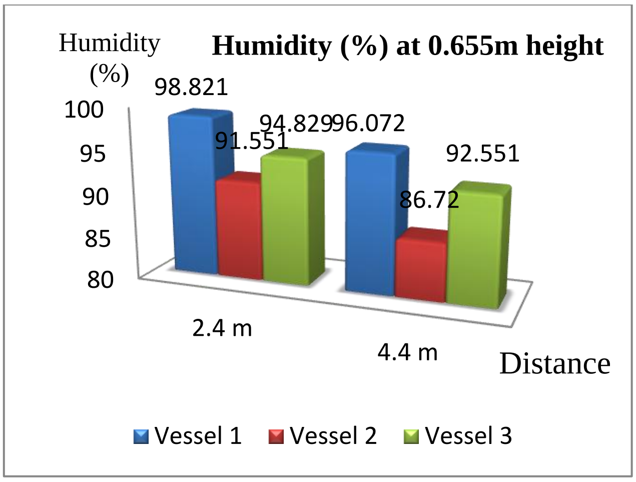

Figure 9: Humidity at 0.655m height between Different Vessels at distance 2.4m and 4.4m

The value of humidity in vessel 3 at 9m is 99.147 % which is higher than other vessels as shown in Figure 4.11. This is because of more perspiration process. Beside that, at the wall inside the vessel have water.

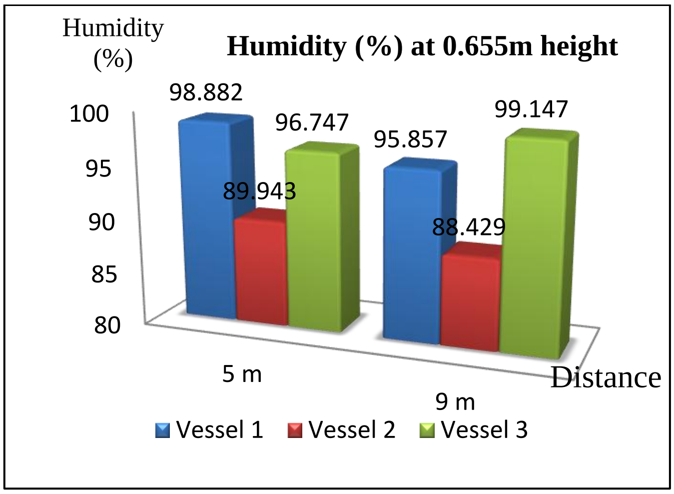

Figure 10: Humidity at 0.655m height between Different Vessels at distance 5m and 9m

Figure 11 shows that temperature and humidity at 1.015 m height. The humidity inside the vessel is higher than outside the vessel between 2.4m and 4.4m. It because have light at outside and near the fluorescent lamp compare between inside the vessel. Inside the vessel have water at wall of vessels, leaves, breathing oil palm and rooting and transplanting. The value of temperature and humidity decrease when putting the sensor SHT11 outside the vessel.

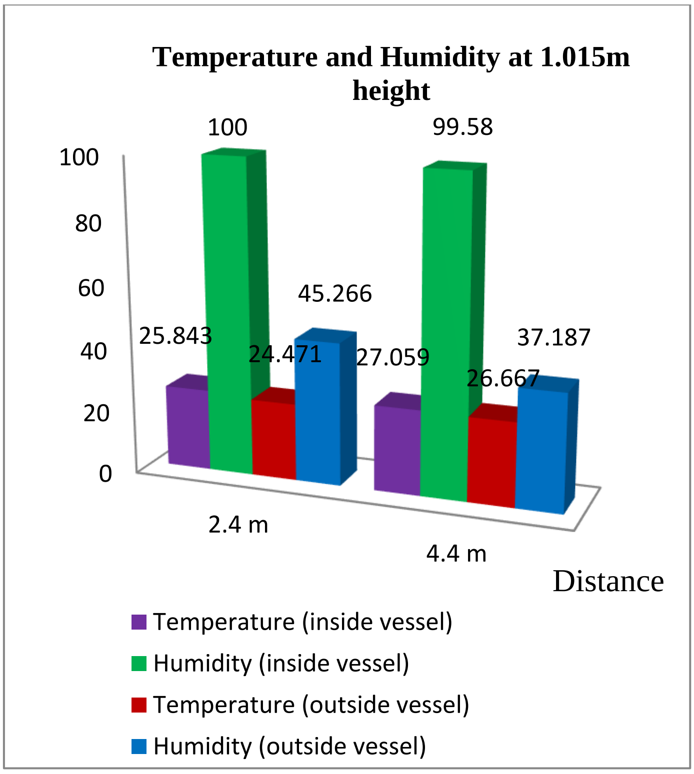

Figure 11: Temperature and Humidity at 1.015 heights between 2.4m and 4.4m

Figure 12 also shows that temperature and humidity at 1.015m height between 5m and 9m. The humidity inside the vessel decrease when the distance far from the transmitter. It because at the wall inside the vessel have water, more leaves, breathing oil palm and rooting and transplanting. The value of temperature decrease when putting the sensor SHT11 outside the vessel. The temperature increase when distance increase.

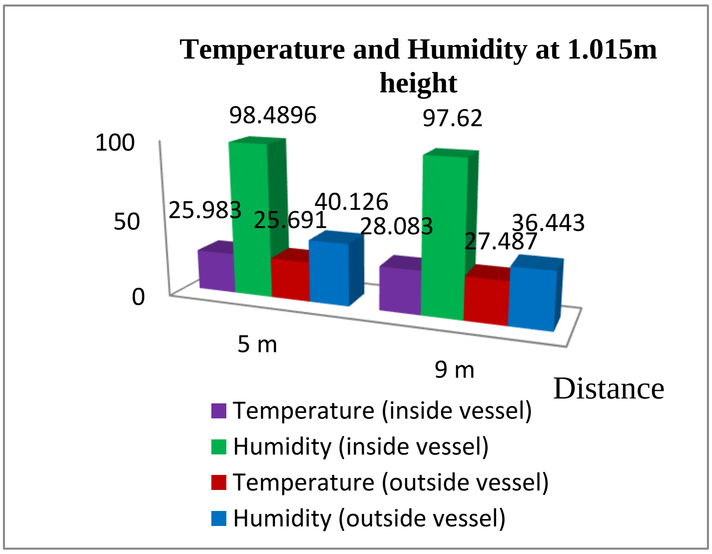

Figure 12: Temperature and Humidity at 1.015 heights between 5m and 9m

Figure 13 show that the temperature between two rooms like same and humidity at room 4 higher than room 3. From the graph shows a little fluctuation temperature and humidity among three vessels and room temperature. The temperature at room 4 is between 25.319 ºC until 28.929 ºC. It because of the room temperature and environment between two rooms is same. The humidity in room 4 higher than room 3 because the sensor place near the wall of vessel which is have water at that surface. The air condition in room 4 is cold than room 3. Humidity at vessel 2 is lower than other vessels. It because of less perspiration process compared with vessel 1 and vessel 2.

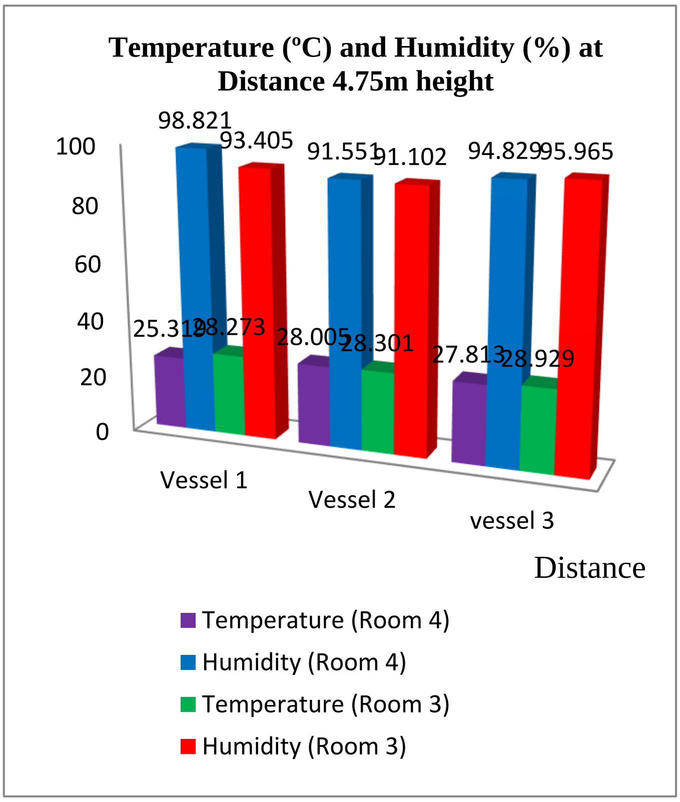

Figure 13: Temperature and humidity at distance 4.75m height

Figure 14 shows the different line of sight of temperature and humidity. The humidity and temperature at nursery (indoor) higher than at building (indoor) because on that day was rain and cold. So the humidity and temperature at nursery (indoor) is higher. The signal at indoor using wireless system is about 34.2 m and 25.2 m. It is the maximum range that already tested between two different of indoor environment. It achieved the range using Xbee which is up to 30 m. The signal at outdoor using wireless system is about 70.8 m. it is the maximum range for outdoor. The range wireless Xbee of outdoor is up to 100 m. From testing, the range closes to 100 m.

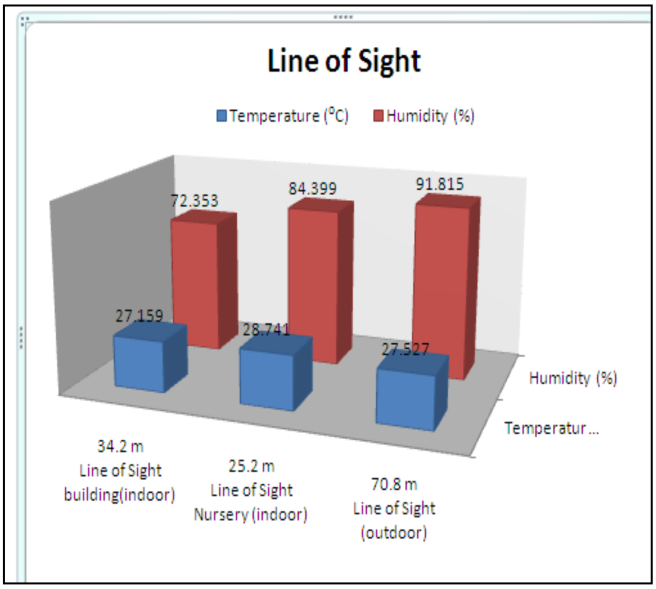

Figure 14: Line of Sight of Temperature and Humidity

The reading temperature from hygrometer is 28.2 ºC and Humidity consist of 89 % at line of sight (outdoor) as shown in Figure 4.16. The reading is close same compare using wireless which is the reading from line of sight (outdoor).

Figure 15 shows that the data receive from transmitter and receiver. The data received in real time. The graph displays synchronous with the display data.

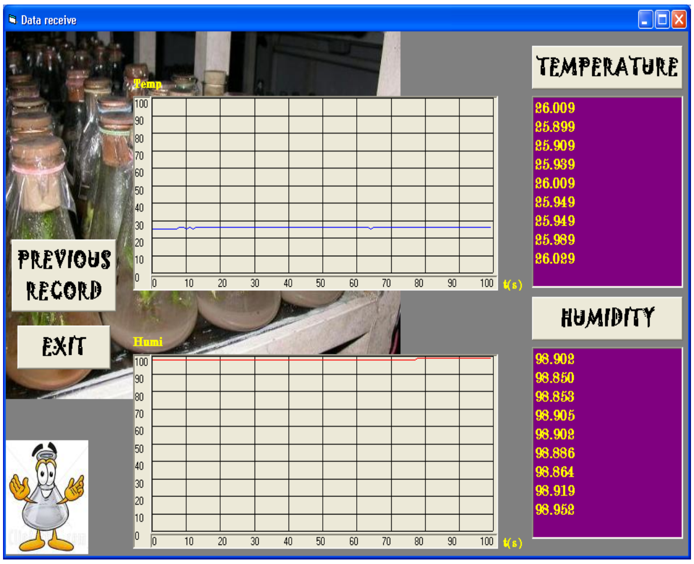

Figure 15: Line of sight of temperature and humidity

Table 1: Temperature and humidity stored in database

March01			
Masa	**Tarikh**	**Temp**	**Humi**
105834	100410	26.009	98.902
105836	100410	25.899	98.850
105837	100410	25.909	98.853
105838	100410	25.939	98.905
105840	100410	26.009	98.902
105841	100410	25.949	98.886
105842	100410	25.949	98.864
105844	100410	25.989	98.919
105845	100410	26.029	98.952

Table 1 show that temperature and humidity stored in Database Access. The data stored automatically when received the signal. In database consist of date, time, value of temperature and humidity. All the data stored in real time.

IV. CONCLUSION

The data acquisition of temperature and humidity using wireless system developed in this project was used to study the factors affecting temperature and humidity in the tissue culture vessels. The factors that can effects are distance, height, places of sensor in vessel, temperature air condition in room, shoots for rooting, number of leaves, and growth of tissue culture. Beside that, weather can effect the temperature and humidity at outdoor.

The primary motivations for choosing a wireless network over a wired approach are the flexibility and the cost-savings associated with eliminating cables and wires. User can easily observe, monitoring and record the temperature and humidity for the future analysis. It is also able to develop a system that can transfer and store data automatically. The data will transmit and receive in real time via wireless system.

The sensors data are linked to database and analysis software via wireless system that will be designed to store and analyze monitored data.

The use of wireless equipment such as this system can be easily justified by the savings achieved through prevention that can cause damage to the tissue culture under unacceptable storage temperatures and humidity and also by the elimination of the time consuming by doing the data collected manually [12].

V. FUTURE DEVELOPMENT

For future development, this project can implement in others tissue culture like orchid, plantations like rubber plantation and in other agriculture.

Beside that, this system must be upgrade so that it can use for human body like in hospitals and clinics. This system is more convenience to users, easier for doctor or nurse to get the data, reduce employee and time and more innovation. It just monitoring from the computer or laptop. It also can enhance alert system that can get from mobile.

In the future this system also need to consider the type of security that will need to be applied to the database if it is important that user access to the application and it's data is required. A database management program to store data in a more or less organized way with the possibility to make relations between several elements of your information. For example can a database of your media and divide it in books, audio CD's, CD-ROM's and DVD's.

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