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# Using Android Mobile Application for Controlling Green House

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**Abstract** - The existing system has the ability to yet lack the ability to control indoor humidity. Green House Monitoring and Controlling is a complete system designed to monitor and control the humidity inside a green house. This software uses an Android mobile phone, connected using Wifi to a central server which connects via serial communication to a microcontroller and humidity sensor. The result shows that thecondition specified in sensor's datasheet and system in reality is appropriate. The achieved test result concludes that the system is working properly.

**Keyword:** green house, arduino uno, wireless network, embedded system, SHT 11 sensor, stepper motor, SPC driver, flowchart design

## I. Introduction

Green house farmers cannot precisely detect level of level of humidity inside the green house. They only know the condition inside the green house manually and by feel it by themselves. Ultimately, experiences play a bigger part on their daily operations. If the condition is too dry, they will give water to the plants or soil, but if it is too humid, they will open the rooftop of the green house, especially in the daylight.

In designing this device, there is limitation to problems, to see how far this system can do its tasks. This limitation according to the situation where this system will be used later. The limitation is the system can detect the humidity of air in the building. When the humidity sensor reach a certain threshold, the humidity sensor will send a signal to microcontroller which will then process the signal, to be sent into connected computer. Computer functions as a server which connects to the android platform.

There are 3 kinds of activity that are designed in the system. First, monitor the humidity level in the green house. Secondly, if the green house is too dry, the water sprayer can be activated, to increase the humidity level. It also can deactivated water sprayer. Third, if the green house is too humid, the rooftop can be opened to lower the humidity level. The third function can be use to open or close the rooftop based on the needs.

## II. Design of Green House Monitoring and controlling system

This embedded system for monitoring and controlling the green house is based on measuring the humidity and temperature by sensor that located at different places. The monitoring and controlling is conducted through Android Smartphone.

### *A. Hardware Description*

Design of hardware for green house monitoring and controlling are used to control the environment condition of green house to get a good condition. The parameters are humidity and temperature in the greenhouse. The monitoring and controlling of greenhouse component consists of sensor for the humidity, Arduino UNO microcontroller, serial communication, wireless connection, LED module change for water

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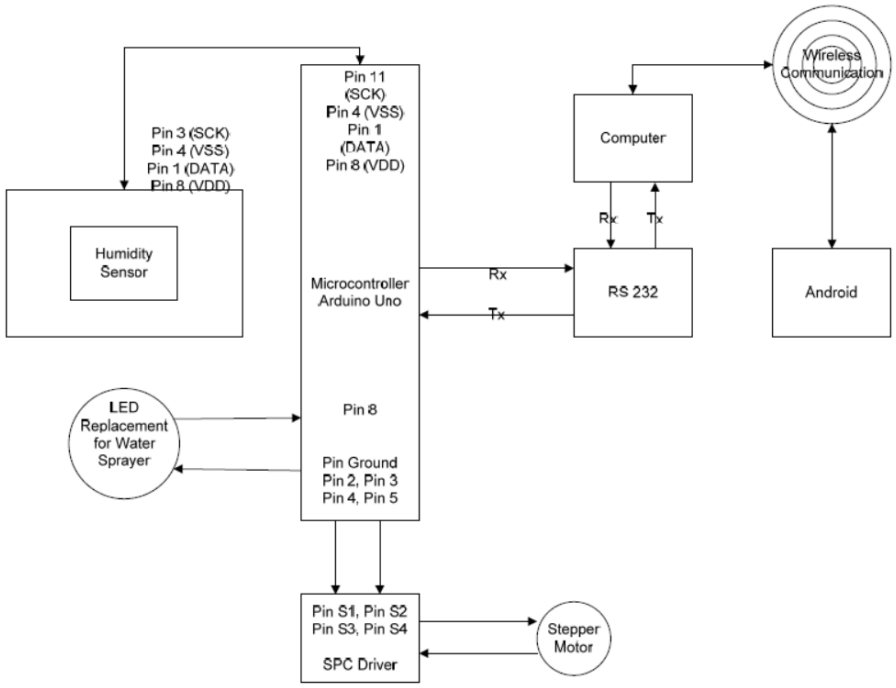
sprayer, stepper motor, model of greenhouse, personal computer as server, and power supply unit. The output for the sensor become an input to microcontroller and sent to computer through serial communication. The task of the computer is to transfer the data through wireless communication to application software at Android martphone. The task of the Android Smartphone to control the microcontroller and the components, such as, LED module and stepper motor, sent to the computer.




The microcontroller will read the sensor periodically and updates the value of sensor to android. Figure 1 show the schematic diagram of greenhouse monitoring and controlling system.

### *B. Software Description*

The software is designed to process the humidity value, monitoring and controlling the green house. The software includes the various measurements of the sensor, analog to digital converters, send humidity value from sensor to microcontroller. Then continue to display the value in application at Android, control the microcontroller from the application in Android and update to user by sending the value of sensor for monitoring the green house.

The microcontroller Arduino UNO is to convert analog to digital, send the value of sensor through serial communication to PC, control the stepper motor, water sprayer, and updating the user. The program is written in Arduino 1.0.1 IDE.The server used to process the value from the sensor, serial, and wireless communication by PHP serial programming and PHPmyadmin to transfer and receive the input for controlling and output for monitoring.

## III. Hardware System

The hardware system is divided into 3 part. There are microcontroller arduino, a sensor, and IEEE wireless 802.11g. The microcontroller arduino used for monitoring and controlling the green house. It is used to read the measurement value of sensor, write an input to control the stepper motor and LED module, analog-digital converter and serial communication for the flow of value from sensor. First, microcontroller get the analog voltage signal from the sensor and convert it to digital signal. After microcontroller receive the digital signal, microcontroller send the value from sensor to the Android via computer through serial communication and wireless connection.

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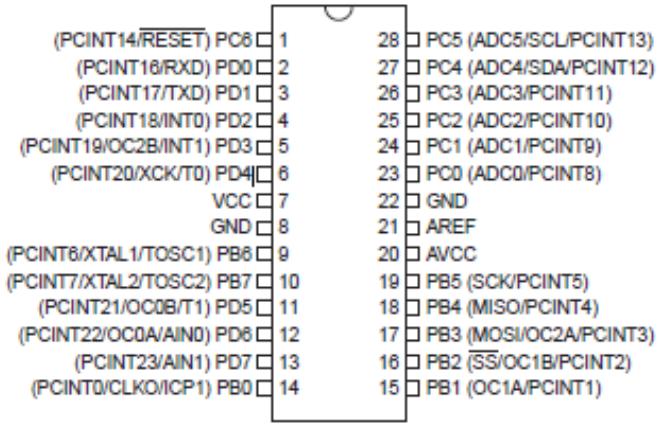


**Figure 2.** Architecture of AT MEGA 328 for Microcontroller Arduino

The reading program, the converter and also program to controlling is done in C Language for Arduino. The value from read the sensor, analog to digital converter, and for controlling is done in Microcontroller Arduino that use AT MEGA 328. Figure 2 shows the architecture of AT MEGA 328.

For sensor we use SHT 11 to measure humidity and temperature. This sensor is interfaced to the stamp over two I/O pins. Through a two-wire serial interface, both temperature and humidity can be read with excellent response time and accuracy. Figure 3 shows the module of SHT 11 sensor:

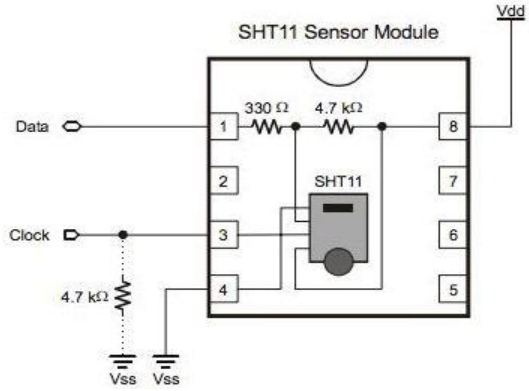


**Figure 3**. SHT 11 Sensor Module

Each SHT 11 is invidually calibrated in a precision humidity chamber from the manufacturer. The calibration coefficients are programmed into an OTP memory on the chip. These coefficients are used to internally calibrate the signals from the sensors. The 2 wire serial interface and internal voltage regulation allows for easy and fast system integration. SHT 11, for which datasheet appliesfeatures a version 4 Silicon sensor chip. Besides the humidity and temperature sensors the chip contains an amplifier, A/D converter, OTP memory and a digital interface. Dimensions in mm (1mm = 0,39 inch). The type of sensor is SHT 11 and contacts are assigned as follows: 1.GND, 2:DATA, 3:SCK, 4:VDD.[5]

The features of SHT 11 sensor are:

- Temperature range: -40º Fahrenheit (-40º to +254,9ºF (123,8ºC)
- Temperature accuracy: +/- 0,5ºC - 25ºC
- Humidity Range: 0 to 100 %RH
- Low power consumption (typically 30W)

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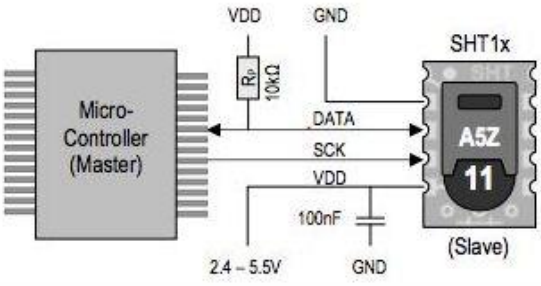


Figure 4. Schematic of SHT 11 Wire to Microcontroller

Because the sensor built in resistors, the pins that should be connected,

- SHT-11 PIN 3 (SCK) -> Arduino PIN 11 (SCK)
- SHT-11 PIN 4 (VSS) -> Arduino's Ground
- SHT-11 PIN 1 (DATA) -> Arduino PIN 9 (data)
- SHT-11 PIN 8 (VDD) -> Arduino +5V

Arduino is process signal from this sensor, where the result will take in the right value. In this sensor, there is a LED to show whether the sensor is on or off.

For wireless transfer, we use IEEE 802.11g-2003 or 802.11g or Wireless G is an amendment to the IEEE 802.11 specification that extended throughput to up to 54 Mbit/s using the same 2.4 GHz band as 802.11b. This specification under the marketing name of Wi-Fi has been implemented all over the world. 802.11g is the third modulation standard for wireless LANs. It works in the 2.4 GHz band (like 802.11b) but operates at a maximum raw data rate of 54 Mbit/s, or about 19 Mbit/s net throughput (identical to 802.11a core, except for some additional legacy overhead for backward compatibility). 802.11g hardware is fully backwards compatible with the 802.11b hardware. Details of making b and g work well together occupied much of the lingering technical process. In an 802.11g network, however, the presence of a legacy 802.11b participant will significantly reduce the speed of the overall 802.11g network. Wireless G is used in our system as a communication path from Android to server and vice versa.

## IV. Android Application System

In developing the software, Eclipse Indigo. The method that used is created to make monitoring activity. It is called *kosong.java* with *layout_kosong.xml*, controlling activity that called MainActivity.java with activity_main.xml, main menu window that called MainMenu.java with *layout_mainmenu.xml*, timer activity that needed to update data that received from database that called *MyTimerTask.java*.

| Class Name | Methods | Description |
|---|---|---|
| kosong.java | DefaultHttpClient getThreadSafeClient() | Used to connecting & receiving data from android to PHP |
| | onBackPressed() | Used to disconnecting the update that received from PHP if we change to another window |
| MainActivity.java | setOnCheckedChangeListener(new CompoundButton.OnCheckedChangeListener() | Used to make what need to do with toggle button |

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| | | |
|---|---|---|
| | sendDataSpray() | Used to sending data water sprayer from android to PHP |
| | sendDataRooftop() | Used to sending data rooftop from android to PHP |
| MainMenu.java | setOnClickListener(new OnClickListener() | Used to change the window in main menu layout |
| MyTimerTask.java | MyTimerTask extends TimerTask{} | Used to handling timer that used for updating data that received from PHP |

In the system, Kosong.java used to receiving data from PHP that has delay every three seconds. It will be shown in TextView on android window. MainActivity.java is the main class for controlling microcontroller. It send data from toggle button into database. Then it will get the string if the data get to database. If it doesn't get string, it will not receive any string because it is not connected to database that will send an echo into android. On MainMenu.java it is used to choose which window, whether it is monitoring or controlling. For MyTimerTask.java it is used to run the timer to control for updating data that received from PHP.

## V. Implementation Of Greenhouse Monitoring And Controlling System

### *A. Hardware Implementation*

In the hardware implementation, it has wired components sensor to microcontroler arduino by jumper cable and use protoboard as a board for the components like stepper motor and LED module in the hardware. The 5V DC power is provided for microcontroller arduino UNO, stepper motor and also the sensor. Then, the connection between for microcontroller arduino, sensor circuit, stepper motor, water sprayer replace by LED module are made through serial communication and computer as a server. The computer as a path for receive and transfer value from sensor for monitoring and input for controlling.

### *B. Software Implementation*

For software implementation, Figure 6 shows the flow of the software in monitoring and controlling the green house. C program for arduino to measure humidity, send the value to computer then to Android Smartphone through serial communication. Next receive input from Android Smartphone then control the stepper motor and LED module. PHP code use for communication path. Last, Modules for application in android are written in C program.

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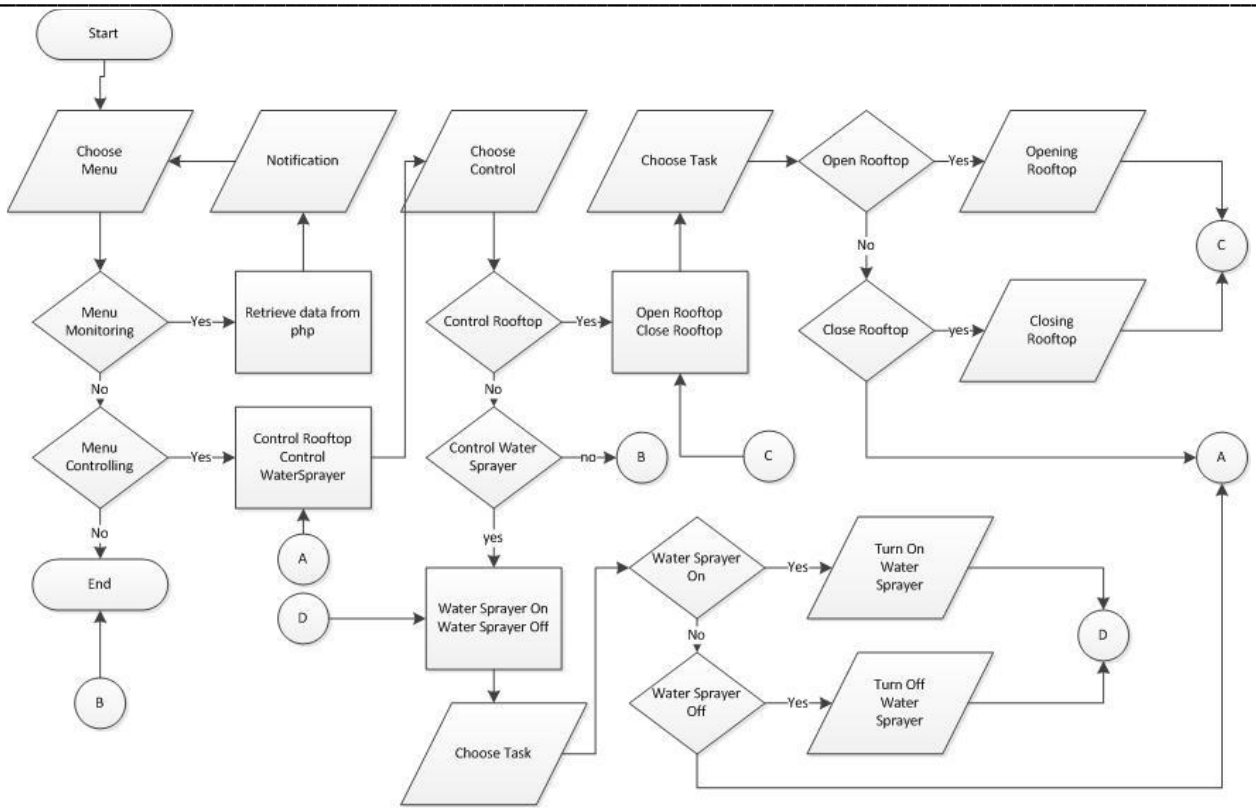


**Figure 6**. Software Flowchart Design

## VI. Analysis

Based on datasheet, sensor works stable within recommended normal range (see Figure 10). Long term exposures to conditions outside normal range, especially at humidity >80%RH. After return to normal range it will slowly return towards calibration state by itself. Prolonged exposure to extreme conditions may accelerate ageing.

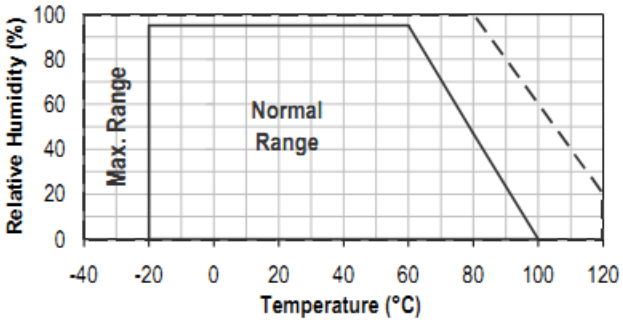


Figure 10. Operating Condition of SHT 11 Sensor

In testing of work characteristic sensor, it used heat from GPU core of a computer through GPU ventilation to increase the temperature in environment. This test used a closed box to put the computer and sensor.

Figure 11 shows the graphic of sensor working characteristic in this system (shown in red) compared to ideal sensor characteristic (shown in blue), where the comparison between temperature and humidity is in normal range SHT 11 sensor. In the red line, the tests are from 30oC until 70oC. In conclusion, sensor works fine and fit with the value in datasheet. The system shows that the sensor works properly.

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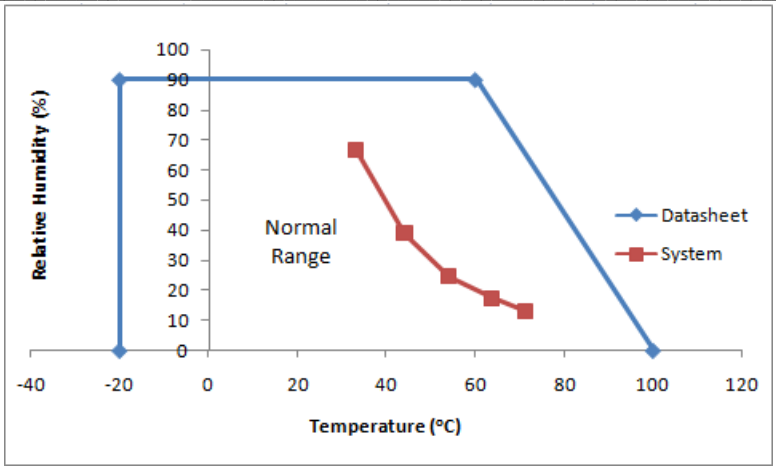


**Figure 11**. Comparison of Sensor Work

Characteristic with Datasheet In the test, the system is tested whether it is working properly or not. Table 2 shows that system is running properly.

**Table 2**. Technology Acceptance Modeling

| № | Parameter | Yes | No |
|---|---|---|---|
| | Android received humidity data from sensor | √ | |
| | Android send data and received in PHP | √ | |
| | Android send data for water sprayer to microcontroller and water sprayer's indicator is turned on | √ | |
| | Android send data for motor stepper to microcontroller and motor stepper work | √ | |
| | There is no error in the whole application | √ | |
| | There is no error in the whole system | √ | |

## VII. Conclusion

The prototype of the system is successfully built and run in reality based on Technology Acceptance Modeling that shows in Table 2. The output for the given analog input values are visualized in android application system. The analog value given by the sensor changes it into a digital value.

The android software is already working properly and appropriate with the purpose in the beginning, that is to get humidity value from green house and give input to control components in green house.

After development is finished, test for sensor's work is done and device is working properly.

The testing that has done shows that condition in datasheet of sensor and in system is appropriate. The test result shows in temperature 30°C to 70°C, humidity is still in normal range area. If temperature gets higher and more, relative humidity will be decrease and goes near to zero.

Looking into the Table 2 about Technology Acceptance Modeling, it can be conclude that the whole system, which are software and hardware is working fine.

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