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To cite this article: A Sumarudin et al 2016 IOP Conf. Ser.: Mater. Sci. Eng. 128 012044

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Implementation monitoring temperature, humidity and moisture soil based on wireless sensor network for e-agriculture technology

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Abstract. Indonesian agriculture has great potential for development. Agriculture a lot yet based on data collection for soil or plant, data soil can use for analys soil fertility. We propose e-agriculture system for monitoring soil. This system can monitoring soil status. Monitoring system based on wireless sensor mote that sensing soil status. Sensor monitoring utilize soil moisture, humidity and temperature. System monitoring design with mote based on microcontroller and xbee connection. Data sensing send to gateway with star topology with one gateway. Gateway utilize with mini personal computer and connect to xbee coordinator mode. On gateway, gateway include apache server for store data based on My-SQL. System web base with YII framework. System done implementation and can show soil status real time. Result the system can connection other mote 40 meters and mote lifetime 7 hours and minimum voltage 7 volt. The system can help famer for monitoring soil and farmer can making decision for treatment soil based on data. It can improve the quality in agricultural production and would decrease the management and farming costs.

Keywords: e-agriculture, monitoring soil, sensing, temperature, moisture, humidity.

1. Introduction
We propose e-agriculture system for monitoring soil. This system can monitoring soil status. The experimental setup and the preliminary results of the application used for data measurement and data collection as well as initial concepts for improving the monitoring system. The proposed architecture is designed in order to improve the quality in agricultural production and would decrease the management and farming costs. The environmental parameters such as temperature, humidity and moisture should be continually monitored and controlled in order to monitoring plant conditions.

Monitoring system based on wireless sensor mote that sensing soil status. This sensor for monitoring utilize soil moisture, humidity and temperature. System monitoring design with mote based on microcontroller and xbee connection. Data sensing send to gateway with star topology with 1 gateway. Gateway utilize with mini personal computer and connect to xbee coordinator mode. On gateway, gateway include apache server for store data based on My-SQL. System web base with YII framework. System done implementation and can show soil status real time.

2. The Design System E-agriculture
2.1. System Design
The design of the system is an overview of the literature that has been studied and then presented to the timetable for implementation in the manufacturing process. In designing this system will be addressed needs that must be met to be able to operate the system in accordance with the plan that is as sender wireless media sensor data using XBee module.

![Monitoring System Design](image1)

**Figure 1. Monitoring System Design**

3. The Method Design Implementation
For implementation the system, we development with microcontroller for data collection and controller, xbee connection utilize for communication mote end device to gateway system. The step implementation can show on figure 2.

In the working system is divided into two design, namely at the time of data transmission and storage of data and view data collection for sensor on web base interface, the figure 3 shows the phases that exist in both the current process is running.

![Flowchart of Data Delivery](image2)

**Figure 2. Flowchart of Data Delivery**
4. Result and Discussion
This research produced a way to monitor the temperature and ambient temperature, also on a soil moisture levels. This device can facilitate in monitoring environmental conditions, because it does not have to come directly to check the environmental conditions. This device can also store the data of temperature or ambient temperature also soil moisture during the period desired, and from data stored tersbut be displayed into a website in the form of a line chart and table format with a full day or 24 hours.
4.1. Working Principle Transmitter Device
This monitoring system requires data obtained by the sensors are embedded. The sensors will transmit temperature and humidity data obtained from the surrounding environment and sends it to a server PC wirelessly using a wireless module for 1 hour. This system is capable of running by getting resources from a 7.4V battery with capacity of 1300mAh.

4.2. Working Principle Receiver Devices
The data has been sent by the transmitter system will be accepted by the receiver system and then be converted into the form of a data string for the next stage will be processed into a database.

4.3. Test Result
Tests carried one by one from the start of testing the communication between the XBee, temperature sensors and temperature (SHT), the humidity sensor (Soil Moisture), and testing to all monitoring tools, testing conducted on the ability of XBee communication and power required to run the transmitter, and the results tests outlined in the table below as follows:

<table>
<thead>
<tr>
<th>No</th>
<th>distance</th>
<th>transmitter system position</th>
<th>Receiver System Position</th>
<th>there barrier</th>
<th>Data Sent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40m</td>
<td>Outdoor</td>
<td>Indoor</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>40m</td>
<td>Indoor</td>
<td>Indoor</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>40m</td>
<td>Outdoor</td>
<td>Indoor</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>10m</td>
<td>Indoor</td>
<td>Indoor</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>10m</td>
<td>Outdoor</td>
<td>Indoor</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

From the table above it can be concluded that the maximum distance to communicate with each other XBee is 40 meters without any obstacle, when the author of more than 40 meters to test the XBee can not communicate. Besides the barrier also interfere with communication between the XBee, XBee only able to communicate at a distance of no more than 10 meters when the two XBee blocked a doorway and surrounded by walls.

<table>
<thead>
<tr>
<th>No</th>
<th>Battery Time</th>
<th>Data Sent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7 Volt</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>6 Volt</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>5 Volt</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>4 Volt</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>3 Volt</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
<td>2 Volt</td>
<td>No</td>
</tr>
<tr>
<td>7</td>
<td>1 Volt</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 1. Table testing distance

Table 2. Table testing battery power 7,4v
From table 4.3 can be authors conclude that the minimum power needed for XBee able to send the data is equal to 4V. The author tested using li - po battery 1300mAh 7,4V assisted a ubec capable of generating an output of 5V. The result is a system of the sender is able to work for ± 7 hours with the intensity of shipping 1 time for 1 hour, the system stops sending when the remaining battery is less than 4V or approximately 3,24V.

Table 3. Testing battery with 12 volt

<table>
<thead>
<tr>
<th>No</th>
<th>Battery Time</th>
<th>Data Sent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12 Volt</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>11 Volt</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>10 Volt</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>9 Volt</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>8 Volt</td>
<td>Yes</td>
</tr>
<tr>
<td>6</td>
<td>7 Volt</td>
<td>Yes</td>
</tr>
<tr>
<td>7</td>
<td>6 Volt</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>5 Volt</td>
<td>No</td>
</tr>
<tr>
<td>9</td>
<td>4 Volt</td>
<td>No</td>
</tr>
<tr>
<td>10</td>
<td>3 Volt</td>
<td>Tidak</td>
</tr>
<tr>
<td>11</td>
<td>2 Volt</td>
<td>No</td>
</tr>
<tr>
<td>12</td>
<td>1 Volt</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 3 is the result of a second experiment by using li - po battery 12V without using ubec, which at this second trial the sender system is only able to work for ± 4 hours with shipping intensity is the same as the first experiment.

Figure 5. Application image link

Figure 2.4 is a picture which time the receiver receives the data, the application will download the user detection receiver port select along boudratenya. After the start button is pressed the data received will be converted into a string and stored into the database.
5. Conclusion

Based on the above results obtained some conclusions from the manufacture of temperature monitoring system:

1. From the testing that has been done, it can be concluded that the design and implementation of monitoring temperature using the ambient temperature and XBee arduino media has been successful in terms of the accuracy of the sensor with the actual conditions, both when displaying the temperature and the temperature as well as at the time of data transmission.

2. The device temperature and ambient temperature monitoring is enabled and used to the environment temperature and the temperature must be monitored in real-time such as smart-home, smart-garden or server room.

3. Data that has been saved is displayed into a website in the form of line charts and tables, the data is displayed every hour for a total of 24 hours or a full day.
4. The process of monitoring the temperature and the ambient temperature is more efficient, in the
setting of the time we can change the delay of delivery every 1 or 2 hours and so on, without
spending time and can also monitor outcomes temperature changes and temperature in real-time so
that we can know the temperature change that happened.

References
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