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IMPLEMENTATION INTERNET OF THINGS PLATFORM AT GREENHOUSE OTOMATION SYSTEM

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Abstract : Greenhouse is a building that serves to protect plants from adverse climatic conditions for plant growth. Now, many greenhouses are developed with automation systems to control climate and regulate fertigation systems. Internet of Things (IoT) technology has also been implemented to support the greenhouse automation system so that control and observation of greenhouse automation instruments can be accessed via the internet. SaaS technology is a cloud product designed to serve the needs of online applications so that greenhouse owners can use applications easily without developing applications independently. This research was conducted to implementing a greenhouse automation with SaaS-based applications and implemented using the Node-Red application. The testing method is carried out by measuring service speed in automation system applications in two types of services. telemetry data sensor services and instructions for running an actuator. The results of this study indicate that automation systems with saas platforms can functionally function like local automation systems. Internet connection latency time is one variable that affects the speed of data services.

1. INTRODUCTION

the various advantages of using greenhouse facilities for agriculture have been demonstrated. Easier planting schedule, zero problems with the weather and easy to manage scheduling of the plant maintenance process will certainly increase crop productivity, crop quality and also in the harvest. this is a part of the added value of a greenhouse.

Automation technology applied to greenhouses has been implemented in many types, with local control technology [1], using logic control devices [2] and using Internet of Things technology [3]. Internet of Things Technology in the Agricultural Industry has been implemented [6]. In the previous research, a greenhouse automation model was developed that has a sensor data acquisition system integrated with node-red software as a service. Node-red application implemented cloud technology. for data communication in data acquisition process in this research using MQTT. MQTT protocol is protocol specifically for telemetry data. the results of this research have shown the feasibility to be implemented in the actual environment.

In this study, a greenhouse automation model was developed with a modification of the application model where node-red is only assigned to supply system logic. Development of the user interface is made in a framework-based web application. Result of application then implemented in an actual environment where the automation model adjusts to the user's wishes.

2. POLIJE HORTICULTURE GREENHOUSE

one of the development units in the state polytechnic of jember is Flagship technology program "Horticultural crop production" one project in this unit is a greenhouse that has several features. the first is that there are several models of planting media namely water media or known as Hydroponics, coconut powder media and soil media. each planting model has a different watering method. secondly, the greenhouse is also equipped with a weather controller in the form of a fan and cooling pads for temperature control and a misting system to control humidity. This greenhouse control system uses mechanical switches to power devices. for measuring the temperature and humidity used

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a separate measuring instrument installed inside the greenhouse. Based on these conditions the internet of things application is very appropriate to be implemented in this greenhouse

3. Internet Of Things Platform for Greenhouse

a. User Requirement

Jember State polytechnic (polije) have a flagship program to build smart greenhouse. spesification of the greenhouse that was built in polije can be seen in teh picture 1

Figure 1. Greenhouse otomation in jember state polytechnic

Based on analysis with greenhouse users, automation design can be integrated into the features of the greenhouse existing. There are several control systems needed. the first is to control the weather by controlling temperature and humidity. a method used for temperature control by acquiring temperature sensor data where for minimum and maximum temperatures will be activate and stop the exhaust fan and colling pad. while moisture data acquisition will be used to activate and stop the misting process. Fertilization system is made by arranging a fertilizer schedule which will automatically carry out fertilization with the specified quantity. Light radiation data acquisition can be an additional decision-making process for fertilization. another system requirement is that a manual control process is still needed so manual mode or automatic mode must be made. the last specification is that the whole process can be monitored and controlled through the internet. an overview of the design of an automation system based on user desires is shown in the block diagram below.

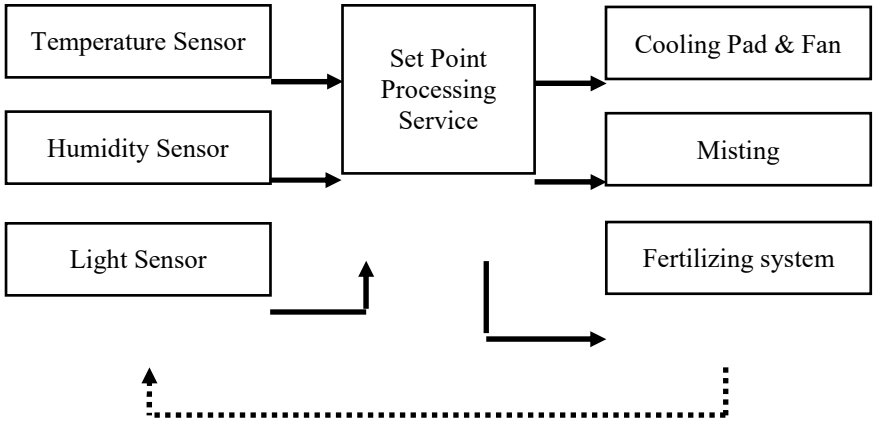

Figure 1. Greenhouse otomation system block diagram

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b. Design Internet of things Platform

Implementation of an internet of things platform can be done with a sensor device that can send data periodically or an actuator device that can receive data through the internet network either through a

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wireless or wired connection. The following is a design drawing of the IOT application layer model developed in this study

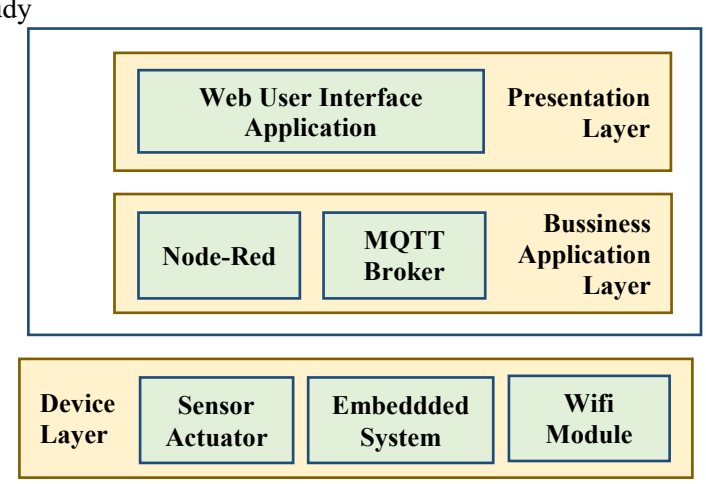

Figure 2. Design Platform internet of things

There are three layers developed in this research. The lowest layer is the device layer that is outside the cloud. in this layer sensors and actuators are developed as devices that will supply data or receive data. The sensor is assembled together with a WiFi module and a microcontroller which contains a program to translate the sensor into data that can be sent via the WiFi module. in this greenhouse the sensors made are temperature, humidity and actuator to turn on or turn off the exhaust fan and cooling pad and activate the pump for misting. the embedded program in this device layer using arduino language. hardware package in wifi module and micro system have been bundled in wemos d1 mini. . the platform layer consists of two parts that are developed separately, namely the business application layer and the presentation layer. The business layer application layer have functions to process data like the business process automation system that has been designed. The presentation layer is application development interface for users. Technically the business layer was developed through a node-red application to make the logic system and MQTT broker is open source application that just needs to be installed and use it.

c. Application development stages

temperature, humidity and light sensors are built with the same steps, the sensor already has a driver circuit and connected to the "wemos d1mini". program was create with arduino language and embed in Wemos D1 Mini. this program work is taking data every second from sensor and sending to MQTT broker. the next step is install MQTT broker and Node-Red application on the cloud server. All the latest sensor and actuator data from the device layer stored to MQTT broker. logic program also develop in Node-Red application. every request data form web application make Node Red subscribe MQTT broker to get last state data in all device, after that node-red will processing data and sending data to client. The figure 3 show the IoT work process developed in this study. and figure 4 showing node red logic program.

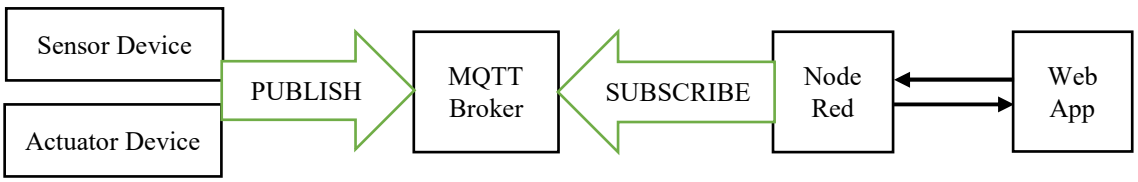

Figure 3. work flow of communication data betwen sensor and client

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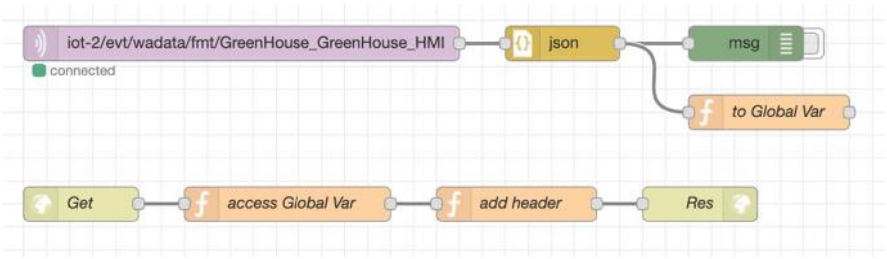
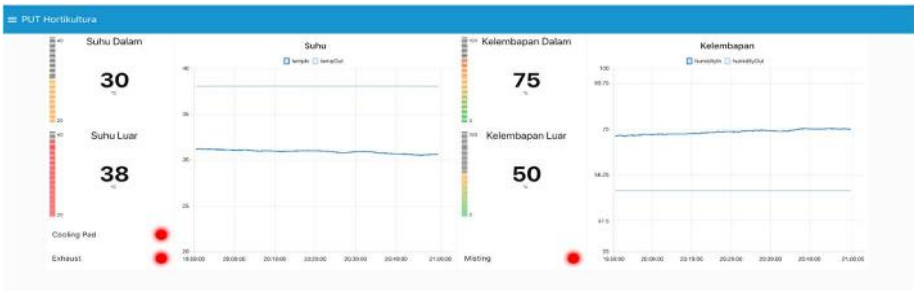


Figure 4. Logic flow from Node-Red Application

on figure 4 shows if program starting with connection between node-red and mqtt broker. function generating a subscribe data to MQTT broker and when have data flow continue to convert data to JSON format and save as global variable. Node red also generate flow to serve client. when client request data using GET function, node-red will be serve with sending data to client with rest methode. in figure 5 show display in web application.



c. Functional test

Functional test doing by changing the time request data from the client computer that accesses the web application. The resulting latency showed response time less than 1 second. technically the data displayed is not realtime data but with reasonable delay this application is feasible to implement. for the record, client computer device specifications have influence on latency time.

4. CONCLUSION

Node-red application is very powerfull for developing logic system for service data client and subsribe MQTT Broker. the business process layer becomes the most important part to make application working optimum, Technically the design of sensor and actuator devices must be equipped with data communication specifications related to the mqtt protocol. and last result is separating business layer and presentation layer makes the application more lighter

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