# Hybrid Automation Importance on Internet of Things (IoT) Smart Farming System

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**Abstract**

Automatic control and monitoring of plants in Smart Farming must be carried out to keep plants growing and developing good harvests. A poor internet network connection on the Internet of things Smart farming system results in poor automation being carried out. Hybrid automation is needed to overcome this. Combining online and offline automation using NodeMCU and Arduino Mega to build hybrid automation. The research results show that Hybrid Automation in the Internet of Things Smart Farming System is very important and must exist. Control and monitoring of plants in the smart farming system can continue to be carried out whether the internet network connection is good or bad.

**Keywords** : *Farming, IoT, hybrid, Automation.*

## I Introduction

The increasing population and increasingly narrow agricultural land as well as increasing food needs require researchers to be more innovative and creative to overcome the above problems. Researchers have several ways, including the integration of automation and the Internet of Things (IoT) in the agricultural sector or what is known as Smart Farming or urban farming if in urban areas by utilizing narrow land [1] and the introduction of information technology to farmers [2]. However, the problem that exists in the integration of automation and IoT is the sustainability of the system when it is on or online. In order for an IoT system to be able to perform tasks automatically, it must load or upload data from and into a database located in a particular cloud or domain. The tasks of this automatic system include watering, fertilizing and cooling on a schedule or based on sensor data parameters. If there is no internet problem, the automatic system will work fine, but if there is a problem, the system will be turned off or offline and such a situation will be very dangerous for the plants. This is the basis for this research, namely the addition of an offline automation system to maintain the sustainability of the system in monitoring and controlling plants.

A microprocessor in the microcontroller of the WiFi module is the main module of the IoT system that starts its operations from initialization followed by connection and iteration process. Internet connections are generally only carried out in the connection process, then activities will be carried out in the iteration process. The iteration process no longer reconnects from the WiFi module to the internet network. The system will start from the initial activity if there is a manual reset. Control and automation research to determine optimal temperature and air humidity values results in good system control [3]–[5].

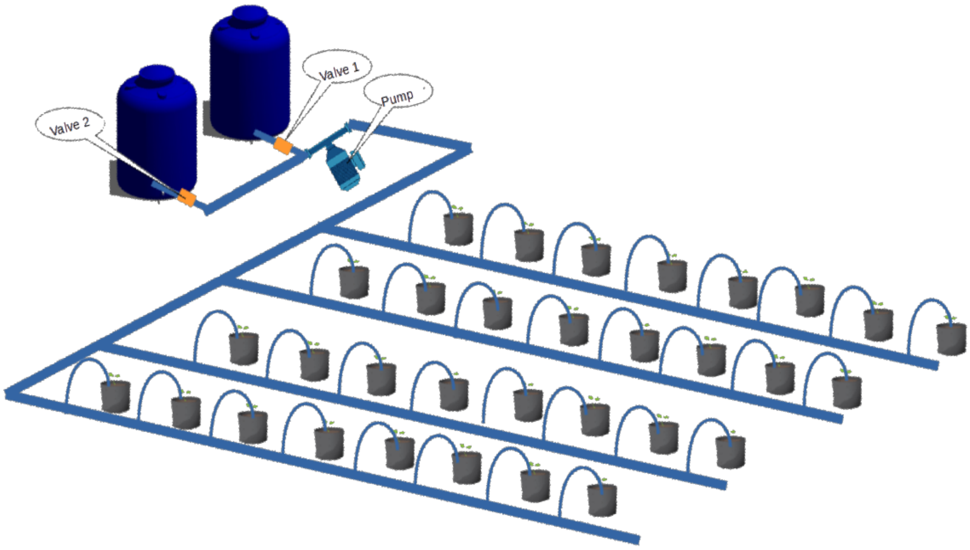


Figure 1 Irrigation system

Irrigation and plant nutrition systems use pipes or hoses to distribute water or fertilizer to each plant so it will really depend on the conditions of the system, both hydroponic and aeroponic [6]–[8]. The volume of water in the reservoir can be monitored using the MW22B water level detector [9], [10]. IoT systems can achieve efficiency of 46% [11], 16.93% [12] for water use in properly scheduled irrigation processes [13]–[15] and reduce the information error value by 2.3% [16]. The system is able to control salt levels in the range of 160-210, and pH 6.5-7.5 [17].

The use of this IoT system has also been proven to increase plant growth and produce more accurate, efficient, effective control and increased agricultural production [18]–[20] as well as in the use of pesticides in pest control [21], [22] and even the accuracy of planting recommendations reaches 99% [23]. The IoT system conditions the temperature and humidity of the soil for Chrysanthemum plants well and the harvesting process can be carried out 7 days faster than conventionally grown plants [24], [25]. The studies above have not paid attention to and taken into account internet network connectivity and to answer one of the research gaps in research for adding offline automation systems [26].

## II Proposed Methodology

To find out the importance of an offline automation system in an IoT Smart Farming system, this research uses a NodeMCU ESP8266 wifi module, an Arduino Mega and a router. The research steps are as follows: Create a flowchart or algorithm design on the NodeMCU and Arduino Mega. The two algorithms can be seen in Figure 1 as follows:

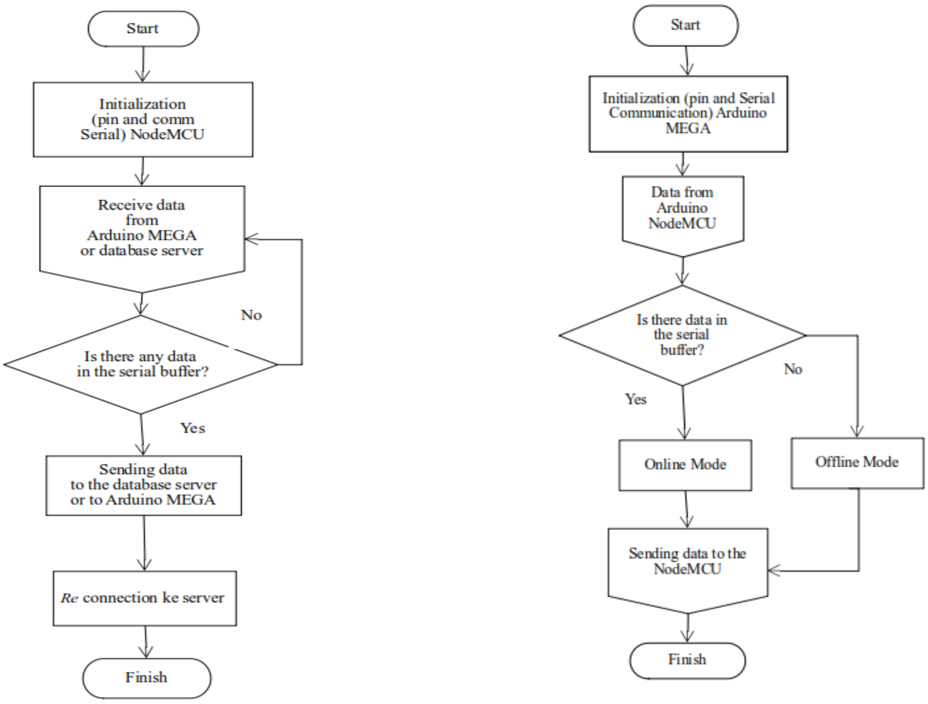


Figure 2 NodeMCU A and Arduino Mega algorithm.

Next, write the program code and upload it to the NodeMCU and Arduino Mega and connect to the internet network via a router. To determine internet network connectivity, NodeMCU and Arduino Mega connection status data is sent to the computer via two USB ports. NodeMCU and Arduino Mega communicate serially. NodeMCU reconnects to the server to maintain the system always online and sends data to the results of the connection to Arduino Mega. If an internet connection cannot be made, the offline automation mode will be run by the Arduino Mega. As seen in Figure 2 as follows:

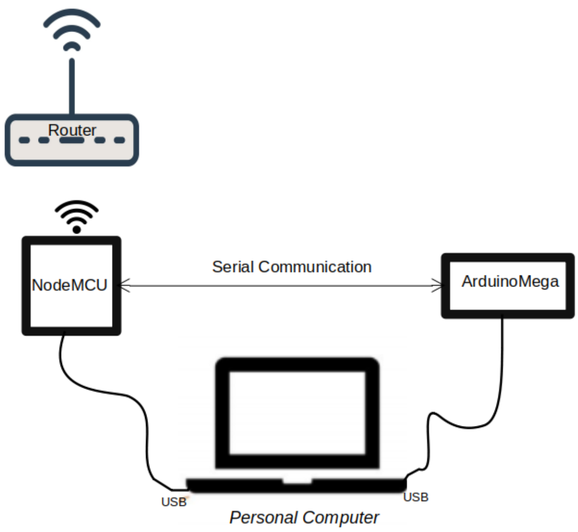


Figure 3 Test Design

The router connects to a specific domain for NodeMCU. Test the connectivity of the NodeMCU with the router and domain by periodically turning off the router every five minutes for one and sixty minutes to analyze the reconnection of the IoT system as well as the role of offline automation when the

IoT system is offline and display in graphical form a comparison of sustainability between the NodeMCU and Arduino Mega in offline automation.

There are two ways for device communication on nodes, namely with the Message Queue Telemetry Transport (MQTT) model [27] as in green monitoring system research [28] and Hypertext Transfer Protocol (HTTP) [29]. This research will focus on HTTP communication with POST and GET instructions. The POST instruction sends data from the NodeMCU A device to the cloud, while the GET instruction requests data from the cloud. The server or cloud will respond with a decimal value of 200 if the POST or GET instruction is successful and the data is stored in the database. This value will be used to state whether the NodeMCU is online or offline.

## III Results and Discussion

The NodeMCU and Arduino Mega are powered on together and communicate with each other. When the NodeMCU carries out a POST instruction to send data to the server and receives a server response with a decimal value of 200 when the server successfully enters data from the NodeMCU into the database. The decimal value is -1 when the data does not enter the server or experiences other network problems on the server. These two conditions are used to set the Smart Farming system in online or offline automation mode. If the response is 200, the smart farming automation system will be fully controlled by NodeMCU to carry out watering, fertilization and temperature control using data in the database. However, if the server response is -1 then the NodeMCU will instruct the Arduino Mega to carry out automation offline.

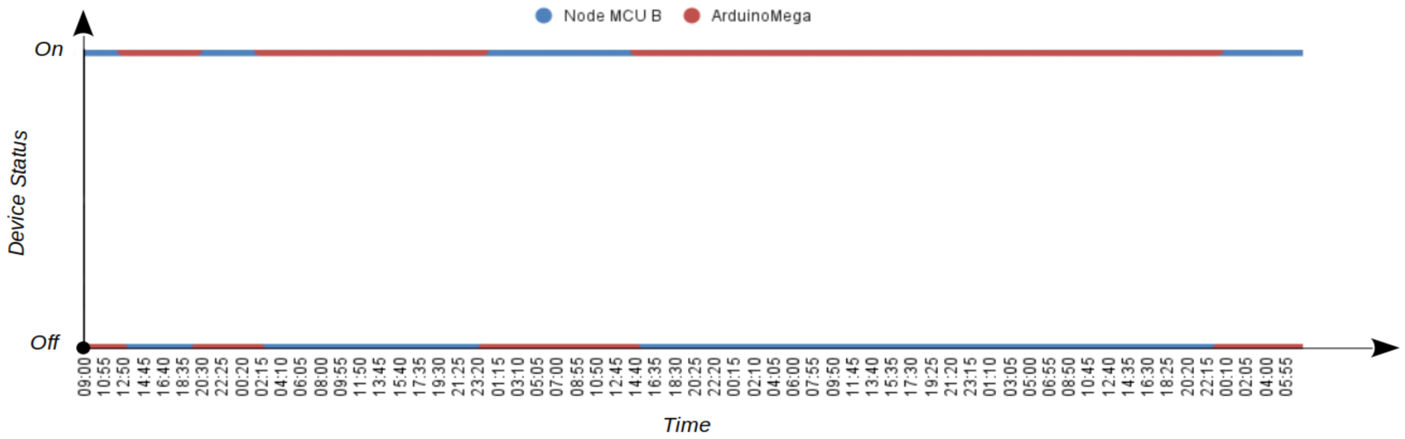


Figure 4 Automation system alternately both online and offline

Figure 3 shows the results of the automation system alternately both online and offline between NodeMCU and Arduino Mega. NodeMCU will control the automation system (on) at the start of 09:00 when the internet network connection is good and the Arduino Mega does not control the automation system (off). However, when there was a problem with the internet network connection at 12:50, the Arduino Mega was (on) controlling the automation system and the NodeMCU was (off). Monitoring of parameters in the Smart Farming system such as sensor data for soil moisture, air temperature, air humidity and soil nutrient levels will be carried out offline by the Arduino Mega as well as controlling watering, fertilizing and cooling. Control can be carried out based on minimum and maximum parameter values or based on real time using a Real Time Clock (RTC) device.

## IV Conclusion

The research results that have been obtained show the importance of a hybrid automation system in an Internet of things Smart Farming system. Control and monitoring of plants in the smart farming system can continue to be carried out whether the internet connection is good or bad. Online and offline automation alternates from 09:00 to 05:00 the following day, thus giving good hope for both plant growth and agricultural results that will be obtained.

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