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ZigBee Based Irrigation System Using IoT

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Abstract: ***Agricultural domain can be transformed from the conventional manual, static to smart, intelligent and dynamic which will generate higher production with lesser human inclusion as well as hard work by utilizing automation of farm related activities. This project gives us a fully automated irrigation system which continuously observes, and maintains the desired soil moisture content through automatic irrigation of the field. The control unit is implemented by using a microcontroller on a PIC platform. This assembly utilizes soil moisture sensors in order to detect the correct moisture level in soil. So, an appropriate quantity of water can be supplied to the land by using this system such over/under irrigation can be avoided. IoT can be utilized to let the farmers be updated continuously about the status of sprinklers. Information from the different sensors like soil sensors, humidity sensors, temperature sensors, PIR sensors is detected and is continuously updated on a webpage and an android app using ZigBee module for the communication which a farmer can verify whether the water sprinklers are ON or OFF at any given time. This system will be designed consisting of slave nodes and a master station. The frames are forwarded to the master station via a ZigBee ad-hoc network. The master station contains an embedded fuzzy logic irrigation algorithm. This algorithm can help us to water the plants, grass and trees based on a set of pre-defined rules. Again, a home based server can be linked with the master station in order to have remote monitoring and accessibility.***

Keywords: IoT (Information of Technology), ZigBee, Microcontroller, Sensors, ad-hoc, fuzzy logic, Irrigation.

I. INTRODUCTION

The automated irrigation system is mainly targeted towards the optimization of the water utilization for the agricultural fields as well as the gardens. Distributed Wireless Sensor Networks were used to create the earlier technologies. In order to find the humidity that is present in the corps moisture sensors and the temperature sensors are situated at the root or the base of the plants or trees. This data from Temperature and moisture sensors is transferred to the web page by utilizing the GPRS technology. So, we can access and view the data.

We can also get an alert SMS that will be send to a particular mobile when these value's have exceeded particular threshold values. Nowadays, distributed wireless sensor network contributes a vital application in monitoring the agricultural production as well as mitigating the agony of people doing farming.

The rain water sensor along with pH sensor can be used in order to detect the weather conditions in rainy season. Sensor's data is detected or collected by using PIC microcontroller. In this desired system ZIGBEE module is utilized in order to transmit and receive the data without any physical medium. Photovoltaic cells power up the system over here.

Nowadays, few of the irrigation systems are operated by people manually, few are automatically monitored and operated. So, the present systems mostly depend on Computer based, Low and high technological principles as well as Real time based. These projects are not much cost effective or are not cost-centered. The weather conditions as far as the agriculture lands are considered, cannot be detected exactly by using the present techniques. They are not able to maintain the real time intervals.

The compatibility is also very much low while large scale systems are quite complex. The proposed project help the farmers in the real time monitoring of crops and also effective usage of water for irrigation by identifying the soil temperature and moisture.

This project also helps to water the plants from any remote places. In future we can also implement the mineral deficiency detection by capturing and analyzing the images of crops. Agricultural domain can be transformed from the conventional manual, static to smart, intelligent and dynamic which will generate higher production with lesser human intervention and intrusion as well as hard work by utilizing automation of farm and garden related activities.

Single-chip microcontrollers come provided with wireless transceivers area unit obtaining great quality in good field automation as well as the home automation.

This is because of their inherent resources, the low power consumption, size, affordability, sturdiness, efficiency and scalability. The Research and development professionals are trying to grab the chance and attention towards the style. They are trying to integrate a lot of functions and services for good field monitoring as well as home observance and moreover the management systems using such microcontrollers.

II. RELATED WORKS

Nowadays, few of the irrigation systems are operated by people manually, few are automatically monitored and operated. So, the present systems mostly depend on Computer based, Low and high technological principles as well as Real time based. These projects are not much cost effective or are not cost-centered. But still some of these techniques are really worth the time been given.

In paper[1], the analysis study referred to as "Automatic Irrigation System on Sensing Soil wet Content" is ready to create an automatic irrigation system that manages the motor pump ON and OFF when the detection of the wet content of the soil. Within the field of agriculture, usage of correct suggests that of irrigation is sort of usable and economical. The good thing about using these techniques is to decrease human interference and still certify acceptable irrigation. This machine-driven irrigation project brings into play an Arduino board ATmega328 micro-controller, is programmed to gather the signal of changeable wet circumstances of the world via wet moisture investigation system.

In paper[2] called "AUTOMATIC IRRIGATION SYSTEM" by Anitha K, the research study aims to create an automatic irrigation system which changes the motor pump ON or OFF on detecting the moisture content of the field. The benefit of using this system is to decrease human intrusion and again make sure that automatic irrigation is carried out. This system takes an 8051 series microcontroller which is programmed to get the incoming data of changing moisture states of the soil through the sensors assembly. This goal is reached by taking an OP-Amp as a comparator circuit which acts as an interface among the sensing assembly and the micro-controller. Once this arrangement gets this signal, it generates an output that starts a relay for operating the motor pump. An LCD display is interfaced to the microcontroller to show the condition of the soil and motor pump. The sensing assembly is prepared by using two stiff metallic conductor like rods deepen into the field at a distance. Readings from the metallic rods are interfaced to the main head unit.

In paper[3], in this project "AUTOMATED IRRIGATION SYSTEM BASED ON SOIL MOISTURE USING ARDUINO" by Arduino device and L293D module. This automatic irrigation system senses the wet content of the soil and mechanically switches the pump once the ability is on. A correct usage
of irrigation system is incredibly necessary as a result of the most reason is that the shortage of land reserved water, because of lack of rain, spontaneous use of water as a result massive amounts of water goes waste. For this reason, we have a tendency to use this automatic plant watering and soil moisture observation system. This technique is incredibly helpful in all weather conditions. Republic of India is that the agriculture based mostly country. Our most of people's square measure fully relied on the agricultural gathering. Agriculture may be a supply of employment of majority Indians and has nice impact on the economy of the country. In dry areas or just in case of lacking rain, irrigation becomes tough. So, it has to be machine- driven for correct watering a plant and handled remotely by farmer.

In paper[4], "Design And Implementation Of Automatic Irrigation System Using ARM7" **,** the Automatic Irrigation system is designed to optimize the water use for agriculture crop. The system has represented the wireless sensor network of soil-moisture, temperature and humidity sensor placed into root zone of the plant. The system is designed to find the exact field condition, to control the wastage of water in the field and to provide exact controlling of field by using the automatic irrigation and automating the agricultural environment by using the components and building the necessary hardware. This system includes the monitoring of the system using ZigBee and GSM.

In paper[5], "IOT based Smart Irrigation System (Srishti Rawal-2017)", this proposal discussed about how the water can be efficiently used for agriculture. According to this proposal Real Time Clock (RTC) is used to control the motor in the real time. First the ON time and OFF time of the motor is send from the android application via GPRS modem. Once the ON and OFF timings are reached the controller, the motor continuously starts and stops in that particular time interval in the by using RTC. Temperature and moisture values of the irrigation area are continuously monitored and the values are send to the android application via GPRS modem. If the temperature and moisture values are beyond the certain limit an alert SMS will be send to the farmer. If the farmer wish to control the motor remotely it is possible by pressing the ON and OFF button given in the android application.

III. PROPOSED WORK

The system planned in this project plans an automated soil irrigation system which will monitor and keep the required soil moisture content through an automatic irrigation. Microcontroller on PIC platform is utilized to design the control unit. The assembly utilizes soil moisture sensors which detect the correct moisture content in the field. This data makes the system to utilize proper required amount of water which prevents over/under watering of the field. IOT is utilized to make the farmers get updates related to the state of sprinklers.

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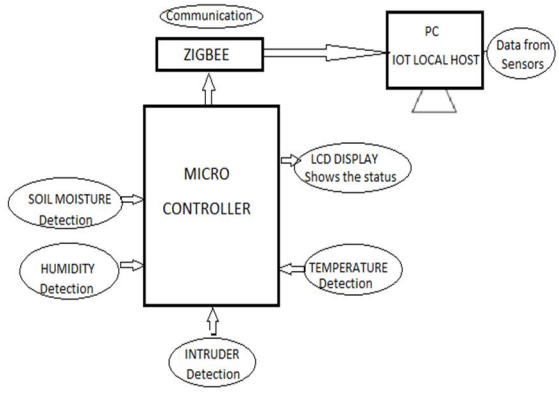
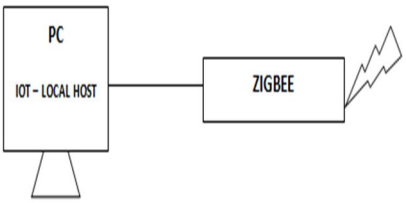


MONITORING UNIT:



FIELD UNIT:

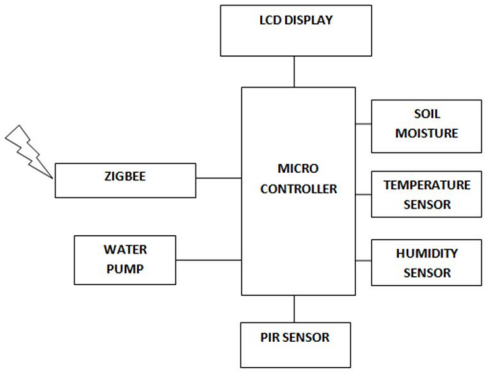


Fig.1. Architecture of the Proposed System

IV. METHODOLOGY

Information of Technology (IoT) can be utilized to let the farmers be updated continuously about the status of sprinklers. Information from the different sensors like soil sensors, humidity sensors, temperature sensors, PIR sensors is detected and is continuously updated on a webpage as well as an android app using ZigBee module for the communication which a farmer can verify whether the water sprinklers are ON or OFF at any given time. This wireless soil irrigation system can be integrated with existing smart control systems. This system will be designed consisting of slave nodes and a master station. The frames are forwarded to the master station via a ZigBee ad-hoc network. The master station contains an embedded fuzzy logic irrigation algorithm. This algorithm can help us to water the plants, grass and trees based on a set of pre-defined rules. In order to make the model work in appropriate manner, we have to follow the following steps: Step 0: Connect all of the sensors and all other required hardware in the assembly and connect them to system using ZigBee network.

Step 1: Begin the model.

Step 2: Starting power is supplied to the circuit.

Step 3: Now you can monitor the moisture level (smaller than or greater than). You can monitor humidity, temperature, and can also monitor if some intruder has entered your field or not.
Step 4: If theses value will be more than or smaller than a fixed threshold depending upon the parameter, there is no need to do irrigation.
Step 5: If these values are not up to the than a fixed threshold, begin the irrigation.
Step 6: Starting of the motor pump and sprinklers depending on the status.
Step 7: As the process gets over, this shifts to normal state.
Step 8: End the model.

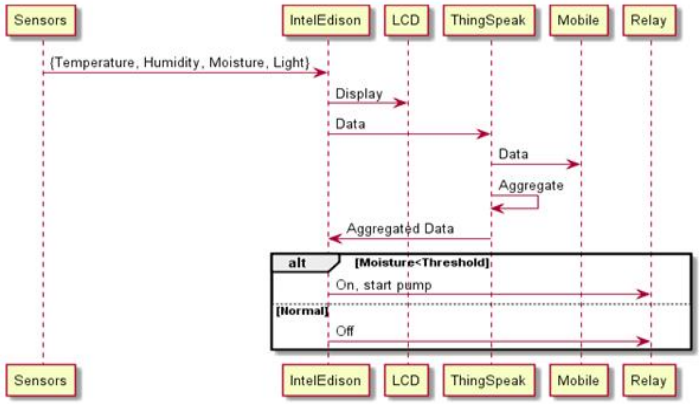


Fig.2. Sequence Diagram

You can monitor all of this detected data on the local host website or the android app that is designed for the same. This system will be designed consisting of slave nodes and a master station. The frames are forwarded to the master station via a ZigBee ad-hoc network. The master station contains an embedded fuzzy logic irrigation algorithm. This algorithm can help us to water the plants, grass and trees based on a set of pre-defined rules.

V. RESULT

The project completed and the goals that were estimated are achieved successfully. The sensor data can be viewed on the local host website like soil temperature, humidity, soil moisture, etc. The intruder detection part is also completed. The components are connected well and they are working fine. The range of the device is also quite long i.e.15-20m.The data from the sensors is accurately detected and displayed on the LCD display. The data is stored on the local server as well as online server. The data is accurately shown on the local host website and components can be managed from the website. The data is accurately shown on the android app and components can be managed from the android app. The motor can be automatically switched on or off depending upon the data provided by the sensors. So, this system can be used on a large scale to fully automate the soil irrigation system and effectively save the resources. The website and android application are for the effective use and reading of the data and in order to control the irrigation system automatically and manually too.

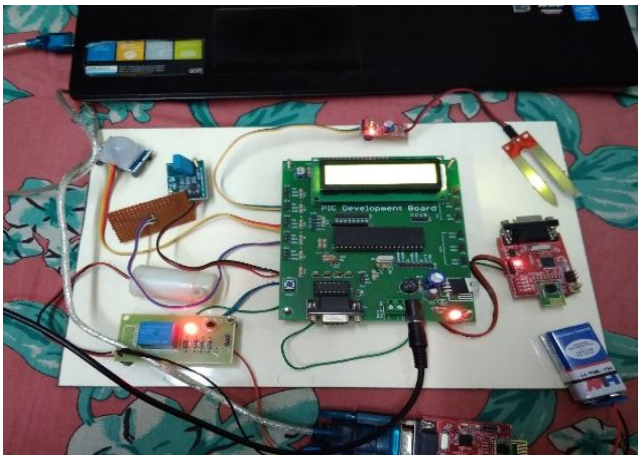


Fig.3. Project Circuitry

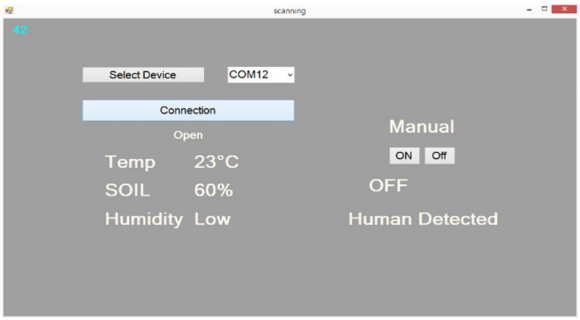


Fig.4. Scanning and Reading Hardware

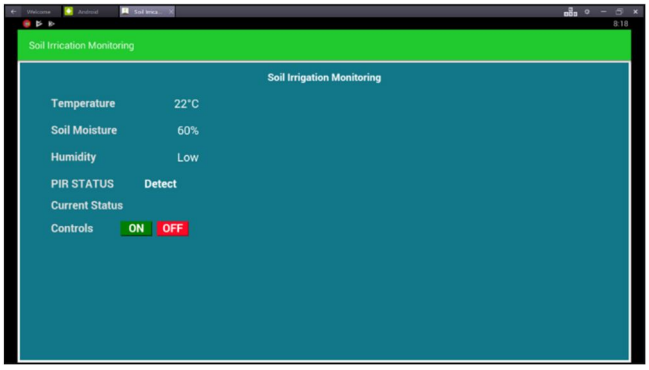
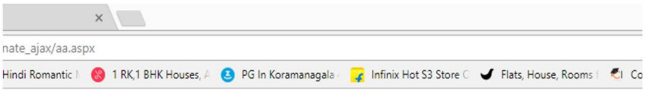


Fig.5. Android App



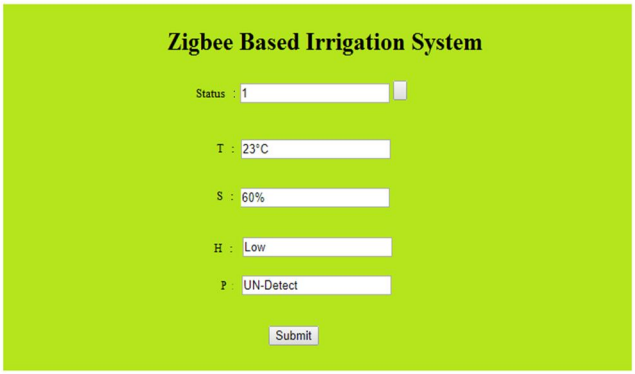


Fig.6. Local host Website

VI. CONCLUSION

In the conclusion part, we can discuss about the usability of the project. This project can read the data from the sensors effectively and that data can be stored effectively and effortlessly on the local server as well as some online server. This data then can be used in order to display the data from the sensors on some user interface like some local host website as well as some android application. The functionality of the soil irrigation system can be controlled from these interfaces. So, totally, it's a complete system that can be used to automate completely the irrigation system. As far as the limitations of this project are considered, the system has a range of nearly 15m. So, we have to use multiple systems in order to have effective monitoring of the irrigation system and the field. Again, we are sensors. Sensors are sometimes too delicate and can stop functioning partially or completely depending upon the hazardous factors in the nature. The ZigBee can stop working and communication can stop if it comes into contact with metallic substances for

a longer duration of time. Again, if we are trying to access the system from android app and if app is using the data from the online data server, then it can stop working if it loses the connection.

VII. FUTURE SCOPE

As far as any system is considered, there are always some flaws or there are always some modifications or advancements that can be made. I have listed above some of the limitations which can be taken care of. For the system that I have designed, we are here using the electric supply in order to start the hardware. We are using photovoltaic cells to power the ZigBee device up for the communication. But, instead of wasting the electricity, we can use the solar panels and generate the electricity from sun. We can use the wind energy to power up the system. In order to effectively generate the wind energy, we can use hybrid combination of vertical and horizontal blades. We can try to improve the intruder detection part also. Here, we can add some more sensors near the hardware kit all along the field. This system will be able to detect the intruders by showing the light signal as well as audio signals. When an intruder crosses the field during the night, it can switch the light sensors and hence, we can see the intruder clearly.

So, there are a lot of options and advancements that can be made in this project. This system can definitely help the farmers as well as the people who use irrigation systems for their home gardens. This system can also be implemented along with the security measures that are listed above such that field or garden remains safe from intruders like human beings as well as animals.

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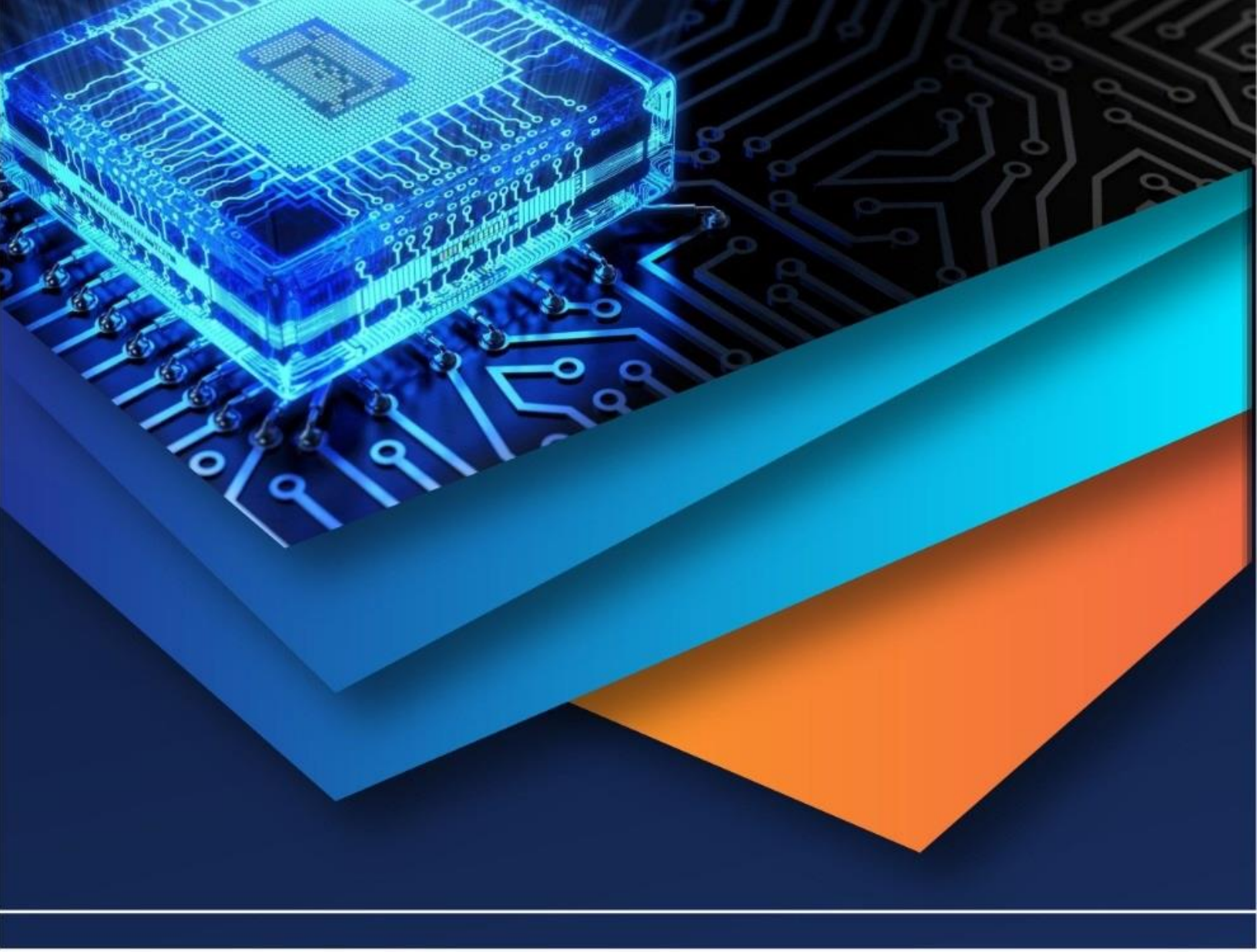

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