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Design of Wireless Weather Parameters Monitoring System

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ABSTRACT

To develop weather parameters sensor networking and Monitoring System without human intervention using Wireless Zigbee technology. The project is mainly targeted towards reliability of monitoring. It Keeps track of temperature, humidity, wind direction, rainfall amount, Carbon gas detection system etc. The system displays these readings in real time on a display as well. Weather parameters are monitored by using sensors and through Zigbee the real time data is being sent to the remote PC and weathers parameters are being continuously monitored and monitoring data can also be stored in lod sessions for future reference.

Keywords— Zigbee, remote monitoring, wireless, networking, sensors

I. INTRODUCTION

In an industry during certain hazards it will be difficult to monitor the parameter through wires and analog devices such as transducers. To overcome the said problem we use wireless device to monitor the parameters so that certain steps can be taken in worst case. The main use of this module helps in an industry during the worst cases as analog devices may be damaged may be during the accidents but with the wireless transmission we do not have an accurate data but when compared to the analog failure the errors are very minimum so that we use wireless to monitor the parameter in industry where there is no means of the human operator to monitor these parameters. It leads to cheap wireless technology so that it can be used for the low rate data transfer. The Zigbee technology is widely used for the home and industrial automation.

Today, the winds, hazardous gases, pollution and other weather variables are of equal concern and can have an even greater impact on our modern, high-technology life style. Weather affects a wide range of human activities like agriculture, transportation and leisure time work. Modern weather monitoring systems and networks are designed to make these measurements necessary to track these movements in a cost effective manner. In weather monitoring systems parameters like the time and date, temperature, relative humidity, also dew point, wind direction and speed, rainfall amounts, and weather forecast are shown on the LCD display as required.

II. BACKGROUND

The nature of wireless sensor network (WSN) offers the several advantages on monitoring and controlling applications over the other traditional technologies including the self-healing, self-organization, and flexibility. Zigbee is an IEEE 802.15.4 standard for the data communication with business and consumer devices. The overall system development with the Zigbee specification is intended to be simpler and less expensive than WPAN, such as bluetooth and wifi. The main objective of this project is to derive statistical information about abnormal geological and atmospheric conditions through sensors and then send data to the weather stations for monitoring.

III. LITERATURE SURVEY

To develop sensor networking and Weather Station Monitoring Systems without human intervention using the Wireless ZigBee Technology. The project is mainly targeted towards the reliability of Pollution Monitoring system. A WMS keeps track of temperatures, humidity, wind speed and direction, rainfall amount. The system displays the readings in real time on display. It also keeps track of historical information on hourly and daily basis. The data can be displayed on LCD. Various techniques are used to monitor weather like satellites, radars, microcontrollers and many other simple instruments. Weather can also be monitored by using the remote wireless sensors. Zigbee is latest wireless weather monitoring technique approach which supports

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wireless data transfer over several meters. The existing monitoring systems are manual, we need human support for same. There are limitations for human to know about the exceeding hazardous parameters of environment. There are chances of some human errors. Like human calculations may not be precise sometimes, human may not cover large area. We need some smart systems which will automatically measure the parameters. In this application, Wireless sensor network can solve this problem, where parameters calculations and controlling will be very precise even over the larger area.

IV. MONITORING APPROACHES

4.1 Traditional Approach/ Manual Approach

There are many methods which are helpful to calculate the weather parameters. Manual methods need to take the readings at the place of the station by human being. This method of traditional approach is accurate and depends upon the person who takes the values. Before going for any method we must know the definitions and standard units of the weather parameters. A manual inventory system is relies heavily on the action of the people which increases the possibilities of human errors. With this people might forget to record the weather parameters or simply made mistake in writing any value. This can affect the systems integrity. The time taken for sensing using this types of analog instruments is more, hence it also cause the error. As far as the accuracy is concern these systems are less accurate than now day digital system.

Disadvantages of manual approaches:

1) Readings are needed to take manually by humans, causes errors.
2) Sensing time is very high.
3) High installation cost.
4) Complex installation.
5) Hard to replace any elements.

4.2 Modern Approach

Now a days wireless technology is rapidly increases and also used to monitor weather parameters remotely. Instead of analog instruments now day we can use with internally calibrated digital instruments and sensors. In addition with above all features sensing time is very less hence digital method is advantageous. The system design consist of transmitter as well as receiver. Transmitter section consist of different types of sensing units such as temperature measurement, Humidity measurement, Atmospheric pressure measurement, Air quality measurement, Rainfall measurement, Wind speed and wind direction measurement. The output can be shown on the either LCD or Computer Monitor. In case of the wired system output is usually displayed on the Liquid crystal display, while using wireless protocol output shown on the computer monitor at remote place.

V. PROPOSED SYSTEM

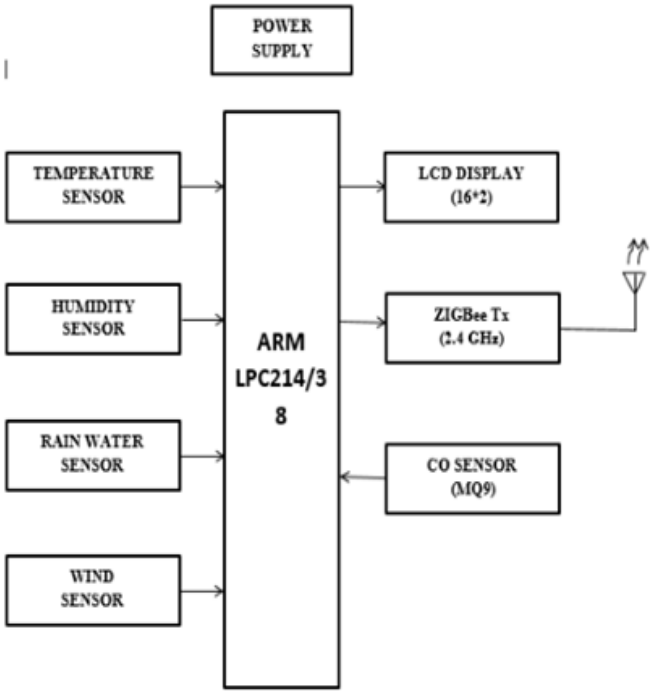


Figure 1. Block diagram

This project is to develop and reduce the work load of human being and to sense parameters like gas, temperature, humidity, rain and pressure. After sensing these parameters depending on scenario the ARM controller will take the appropriate action. The main modules in the project are Sensors (temperature Sensor DHT11, humidity Sensor, gas Sensor, rain detection Sensor and pressure Sensor), ARM controller unit with the LCD display and output device.

Figure 2. receiver block diagram

5.1. transmitter flowchart

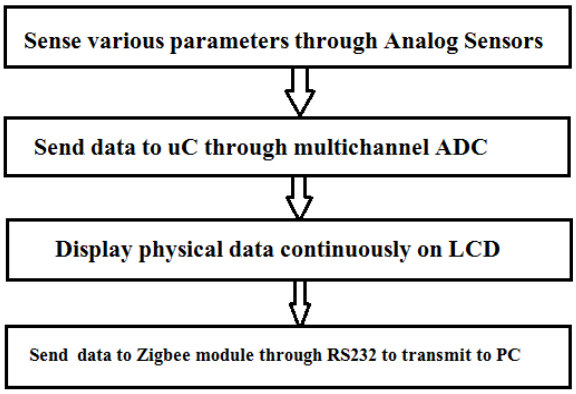


Figure. 3. transmitting flowchart

Transmission process is given into transmitter flowchart in figure given above. Transmitter senses various environmental parameters through analog sensors. It then sends this digital data of each sensors to the microcontroller through multichannel ADC.

It displays the sensors actual physical data continuously on the LCD board. It then sends the physical data to the zigbee module through MAX232 to transmit to the PC. It also uses HTML5 Webpage for continuous monitoring of data.

5.2 Receiver flowchart

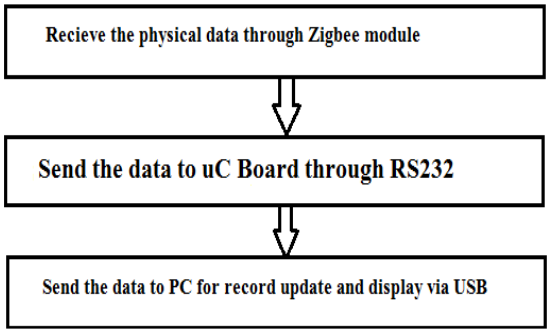


Figure.4. Receiver flowchart

Receiving Process is shown into Receiver Flowchart in the above figure. It Receive the physical data through zigbee module which is obtained from the sensors. It sends this data through microcontroller board through RS232 It sends this data to PC for record updating and display via USB. The desired result is displayed.

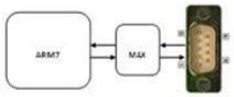
	UART DB-9 Connector	LPC2148 Processor Lines	Serial Port Section
UART0(P1)	TXD-0	P0.0	
ISP PGM	RXD-0	P0.1	
UART1	TXD-1	P0.8	
(P2)	RXD-1	P0.9	

Fig 5. port connections for programming

VI. HARDWARE DETAILS

6.1 LPC2148 Pro Development Board

LPC2148 development board is a powerful development platform based on LPC2148 ARM7TDMI microcontroller with 512K on-chip memory. This board is powered by USB port and does not need external power supply. It is ideal for developing embedded applications involving high speed wireless communication (Zigbee / Bluetooth / WiFi), USB based data logging, real time data monitoring and control, interactive control panels etc. The on-chip USB controller provides direct high speed interface to a PC/laptop with speeds up to 12Mb/s. The UART boot loader eliminates need of an additional programmer and allows you to pro-gram using serial port. The on board peripherals include SD/MMC card interface, USB2.0 interface, 4Kbit I2C EEPROM, Xbee / Bluetooth / WiFi wireless module interface, ULN2003 500mA current sinking driver, L293D DC motor controller, 16X2 character LCD and many more. The on-chip peripherals and the external hardware on the development board are interconnected using pin headers and jumpers. The I/O pins on the microcontroller can be accessed from a 50 pin male header. This direct access to I/O pins enables you to connect your own devices very easily to the processor. The board is made from double sided PTH PCB board to provide extra strength to the connector joints for increased reliability.

The LPC2148 microcontroller is based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed ash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications the alternative 16-bit Thumb mode reduces code by more than 30 percent with minimal performance penalty.

6.2 Power supply unit

In this project there is 9 volts transformer for continuous power supply. Why I am using this means to continuous power will come. Otherwise If I use a battery sometimes the total currents will loss so that way I am using A.C Transformer.

A.C transformer is giving the input to Bridge Rectifier. Bridge Rectifier converts A.C to D.C. After that we are using one capacitor 1000uf/25v electrolytic capacitor .We

connecting this capacitor in parallel section. The main purpose of this capacitor is if there is any alternate peaks we need to reduce that peaks. Nothing but that again pulls. After that we are using LM7805 Regulator Most digital logic circuits and processors need a 5 volt power supply. To use these parts we need to build a regulated 5 volt source. We make a 5 volt power supply, The LM7805 is simple to use. First connect the positive lead of our unregulated DC power supply Input pin, connect the negative lead to the Common pin and then when we turn on the power, we get a 5 volt supply from the Output pin. Here we are using one red color led to indicate the power.

6.3 Temperature Sensor LM35

LM35 is a precision IC temperature sensor with output proportional to the temperature (in degree C). The sensor circuitry is sealed and it is not subjected to oxidation and other processes. With DLM35, the temperature can be measured more accurately than with a thermistor. It also possess low self- heating temperature rise in still air. The operating temperature range is from -55°C to 150°C. The output voltage here varies by 10mV in response to every degree C rise/fall in ambient temperature.

6.4 CO sensor MQ9

The Grove - Gas Sensor (MQ9) module is useful for gas leakage detection (in home and industry). It is suitable for detecting LPG, CO, CH4. Due to its high sensitivity and fast response time, measurements can be taken as soon as possible. The sensitivity of the sensor can be adjusted by using the potentiometer.

6.5 Potentiometer for Wind Direction

We are using a potentiometer to simulate wind flow direction. By turning it to a certain degree it will show various directions. For eg. 0 degree to 90 degree It will Show North, 91 degree to 180 degree it will show East, 181 degree to 270 degree will show South, 271 degree to 360 degree will show West.

6.6 Rain drop detection

A rain sensor is a switching device activated by rainfall. It then sends a digital signal to the ARM controller.

6.7 Humidity Sensor HR202

HR202 is a new kind of humidity-sensitive resistor made from organic macro- molecule materials, it can be used in occasions like: hospitals, storage, workshop, textile industry, tobaccos, pharmaceutical and meteorology, etc. Excellent linearity, low power consumption, wide measurement range, quick response, anti- pollution, high stability, high performance-price ratio.

6.8 LCD

A 16X2 LCD Display is used to Show to Output the sensors detect. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two register, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

6.9 Serial Interface

Serial data is any data that is sent one bit at a time using a single electrical signal. In contrast, parallel data is sent 8, 16, 32, or even 64 bits at a time using a signal line for each bit. Data that is sent without the use of a master clock is said to be asynchronous serial data. Several communications standards exist for the transfer of asynchronous serial data. Common PC's transfer data using the EIA RS-232C (also known as V.28 or V.24). Updated versions of this standard include RS-232D and EIA/TIA-232E, but most literature still refers to the RS- 232C or RS-232 standard. The baud rate for a serial connection is the number of bits that are transmitted per second. It is specified in bits/second or baud. For example, a 110 baud serial link transfers 110 bits of data per second.The EIA RS-232C standard permits data rates up to 19200 bps and cable lengths up to 400 meters (but not both).MAX232 Since the RS232 is not compatible with today microprocessors and microcontrollers, we need a line driver (voltage convertor) to convert the RS232s signals to the TTL voltage levels that will be acceptable to the 8051s TxD and RxD pins. The MAX232 converts from RS232 voltage levels to TTL voltage levels, and vice versa. One advantage of the MAX232 chip is that it uses a +5 V power source which is the same as the source voltage for the 8051.

6.10 Zigbee

The IEEE 802.15.4-2003/ZigBee Protocol Stack. The IEEE 802.15.4-2003 standard describes the physical and MAC layer. ZigBee builds on the IEEE standard and define the network and application layer. The physical layer is responsible for Activation/Deactivation of transceiver. Channel selection, assessment. Transmission and reception of packets. Frequency bands: 2.4 GHz (world- wide), 868 MHz (EU), 916 MHz (US). The application layer provides the following services. Maintain tables for binding, Fragmentation, reassembly and reliable data transport Provide communication endpoints for the application, Discovering devices and application services. Initiating/responding to binding requests between endpoints. The lower level of the ZigBee protocol builds on the MAC layer of IEEE 802.15.4. Are Topology specific routing Security, new device configuration, Network startup, Joining/leaving a network, neighbor discovery Route, discovery reception control. Each ZigBee node has a unique 64 bit MAC address additionally the Coordinator maintains a table to map the 64 bit addresses to network-specific 16 bit addresses. Within each node, the application can define up to 240 application endpoints.

VII. PARAMETERS OF WEATHER STATION

7 . 1 Temperature

A temperature is an objective comparative measure of hot or cold. Temperature usually measure by the thermometer. Several scales and units are available for the temperature most common is Celsius (0C formally known as centigrade), also measures in Fahrenheit (0F) and Kelvin (0K) 1 K = 273+ 0C and 1 F= 32 + 9/50C.

7.2 Humidity

The amount of water vapor in the air is known as humidity. Water vapor is the gaseous state of water and is invisible Relative humidity measures in % Absolute humidity ΔH= mH2O/Vnet mH2O = mass of water vapor. Vnet =Volume of air and water vapor mixture.

7.3 Rainfall

Rain is the liquid water in the form of droplets that have condenses from atmospheric water vapor and the precipitated that is become heavy enough to fall under gravity. Raindrops have sizes of 0.1 to 9 mm diameter above which they tends to break up. Rainfall is measured in the millimeter/24 hours.

7.4Wind Direction

Simulating the direction of the wind using pressure resistance of the potentiometer eg. 0 degree – 90 degree North, 91 degree – 180 degree East, 181 degree – 270 degree South, 271 degree – 360 degree West.

VIII. RESULTS

Software Used For Logging Physical Quantity Putty:
www.putty.org
Extra Putty: http://www.extraputty.com

Both of the above software are freeware available on the above links.

Implementation:

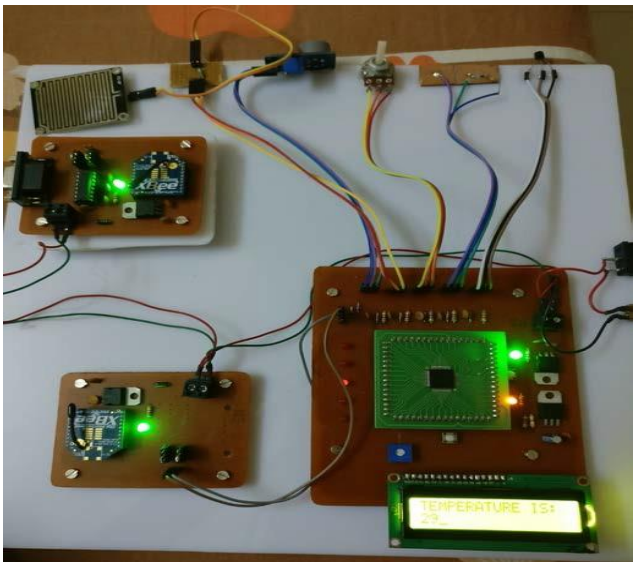


Figure 6. Real time working

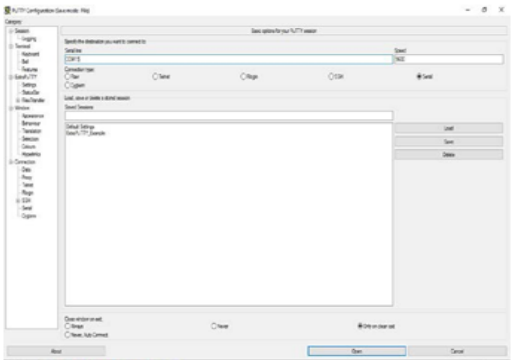


Figure 7: PUTTY MAIN CONFIGURATION WINDOW

PUTTY Result Logs

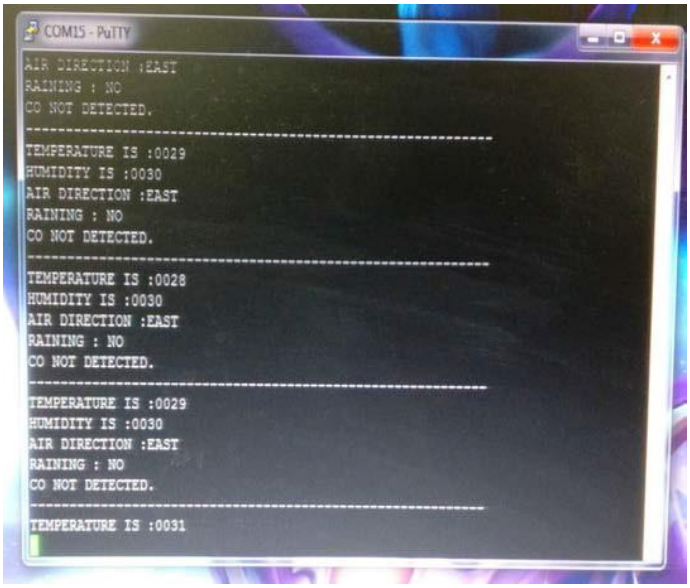


figure 7. putty output window

PUTTY log in real time:

=~=~=~=~=~=~=~=~=~=~=~=~=~= PuTTY log 2017.04.18 20:35:07 =~=~=~=~=~=~=~=~=~=~=~=~=~=
Event Log: Writing new session log (raw mode) to file: putty.log
Event Log: Opening serial device COM15
Event Log: Configuring baud rate 9600
Event Log: Configuring 8 data bits
Event Log: Configuring 1 data bits
Event Log: Configuring no parity
Event Log: Configuring XON/XOFF flow control
[18/04/17 - 20:35:09:373] CO NOT DETECTED.
[18/04/17 - 20:35:09:451]
[18/04/17 - 20:35:09:451] ----------
[18/04/17 - 20:35:09:498]

[18/04/17 - 20:35:11:557] TEMPERATURE IS :0028
[18/04/17 - 20:35:11:557]
[18/04/17 - 20:35:13:664] HUMIDITY IS :0031
[18/04/17 - 20:35:13:664]
[18/04/17 - 20:35:16:672] AIR DIRECTION :EAST
[18/04/17 - 20:35:16:688]
[18/04/17 - 20:35:17:860] RAINING :
NO [18/04/17 - 20:35:17:953]
[18/04/17 - 20:35:20:091] CO NOT DETECTED.
[18/04/17 - 20:35:20:232]
[18/04/17 - 20:35:20:232] ----------
[18/04/17 - 20:35:20:263]
[18/04/17 - 20:35:22:293] TEMPERATURE IS :0027
[18/04/17 - 20:35:22:293]
[18/04/17 - 20:35:24:386] HUMIDITY IS :0030
[18/04/17 - 20:35:24:386]
[18/04/17 - 20:35:26:498] AIR DIRECTION :EAST
[18/04/17 - 20:35:26:529]
[18/04/17 - 20:35:28:589] RAINING :
NO [18/04/17 - 20:35:28:652]

[18/04/17 - 20:35:33:676] CO NOT DETECTED.
[18/04/17 - 20:35:33:676]
[18/04/17 - 20:35:33:676] ----------
[18/04/17 - 20:35:33:676]
[18/04/17 - 20:35:33:676] TEMPERATURE IS :0026
[18/04/17 - 20:35:33:676]
[18/04/17 - 20:35:36:141] HUMIDITY IS :0031
[18/04/17 - 20:35:36:141]
[18/04/17 - 20:35:37:217] AIR DIRECTION :EAST
[18/04/17 - 20:35:37:264]
[18/04/17 - 20:35:39:326] RAINING : NO
[18/04/17 - 20:35:39:388]
[18/04/17 - 20:35:41:541] CO NOT DETECTED.
[18/04/17 - 20:35:41:635]
[18/04/17 - 20:35:41:635] ----------

We were successfully able to run the project and acquired Parameters in real time. Below is our Project Image and the results we got from sensors. Also the Putty software is able to get Parameters in real time. We have recorded real time log of project session and attached it accordingly. The system was working efficiently and responding quickly in real time, this makes project able to use in recording environment physical quantities. The Zigbee modules transmitted and received data quickly and displayed it on the monitor thus concluding our wireless transmission. Thus the implementation of our weather monitoring system was a success.

IX. CONCLUSION

This whole model can be placed anywhere. This model has five sensors as an input device to sense weather conditions and depending on parameter measured the controller will take appropriate actions. This module continuously monitors the weather conditions of the place where it is placed. If the temperature varies, gas detected, Rain fall detected, Humidity varies and pressure of the weather varies, then the ARM controller will activates the buzzer to convey information. This project can be implemented in Homes, Schools, Colleges, and Companies where we have to reduce work load of humans. This remote weather monitoring system using wireless zigbee technology is working efficiently and successfully tested. It is able to show the parameters in real time using software Putty which is free online. The data is collected in the form of serial com port on the computer and can be saved in the form of log file Thus we are able to keep an eye on the physical quantities of our surrounding and help regulate it as desired.

X. FUTURE SCOPE

Project can be further improved by adding the program code and using a software to retain the output parameters in excel format. If used in industry an alarm system can be implemented if the parameters exceed or deplete the regulated conditions. It can be used in Automation Industry to efficiently record statistics. Our Remote Weather Monitoring Station is simple to use thus can be implemented in remote places like agricultural , greenhouse, vineyards, etc, to regulate the conditions appropriately.

An easy to use tool with well implemented sensors and requires sufficient knowledge to work upon can be improved further by add more sensor nodes of required quantities or making the circuit smaller, it can be even made portable, thus exceeding its usefulness.

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