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Environment Monitoring System using IoT and Wireless Sensor network

Dr. G. Senthil Kumar
Associate Professor, Department of ECE, Sri Chandrasekharendra Saraswathi Viswa MahaVidyalaya

Abstract: ***The wired sensor networks for green environmental monitoring are facing the difficulties to place the sensors and facing the other difficulties like wiring and cable aging and corrosion. The IoT technology is preferred to build a wireless sensor network for monitoring humidity, temperature, light energy, level of carbon dioxide. Each node is mainly designed for low-power usage. The RS-485 bus is developed based on the Modbus protocol, to achieve the communication between a numbers of sensor networks and host. The system offers low power consumption, easy sensors placement and maintenance and low cost.***
Keywords: Sensors, IoT, PIC microcontroller, environmental parameters, MP Lab.

I. INTRODUCTION

The energy saving and wireless technology are considered recently for green environmental monitoring. This avoids the issues related to wiring and cabling installation and maintenance. The IoT technology is preferred to support many wireless terminal along with wireless technology. The wireless sensor networks are promising technology for monitoring the environment parameters. The system with wireless sensor network and embedded system offers low power design and fast processing. This integrated system joins with RS-485 bus to provide the communication between a sensors and host.

II. RELATED WORKS

The environment of crops is the most important factor that affects the growth and yield of plants. In most of the greenhouse environment monitoring, wired sensor networks are being used [1-3]. These methods are currently being followed in the greenhouse. In existing greenhouse monitoring systems, the wired sensor networks are being used which have some issues, for example, complicated wiring, inflexible sensor location, cable soften and corrosion and so on [4-6]. It is not user-friendly due to its complexity. The enhancement are required to improve the performance. It is difficult to perform any operation in the manual mode of operation wherever the human cannot access the environment. The operations can be performed by the devices and hence only limited operations can be performed [7-9].

In the proposed system, the monitoring can be performed by both automatic and the manual processing. Therefore, majority of operations can be performed by mixed mode. The automation, wireless and intelligence technologies can be applied to avoid flooding of field.

III.PROPOSED SYSTEM

This paper presents a monitoring and control system for environmental monitoring through wireless network. The proposed system will monitor the various environmental conditions such as humidity, lighting level, temperature, presence of rain, etc., as shown in fig. 1. If any condition crosses threshold limits, a alert message will be sent to control section. The microcontroller will automatically turn on the motor if the soil moisture is less than a threshold value. A rain sensor will sense the rain fall or not.

All information stores in host through IoT. The internet of things (IoT) is the network of physical devices, vehicles, buildings and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data.

The IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems and resulting in improved efficiency, accuracy and economic benefit. The processed data are displayed on the LCD display as well as updated and uploaded using the IoT. This data can be used effectively to monitor, conserve the power using sensor placement with low power nodes.

The PIC microcontroller PIC16F877A is very convenient to use and easy programming for the various tasks. One of the main advantages is that it can be write-erase as many times as possible because it use FLASH memory technology.

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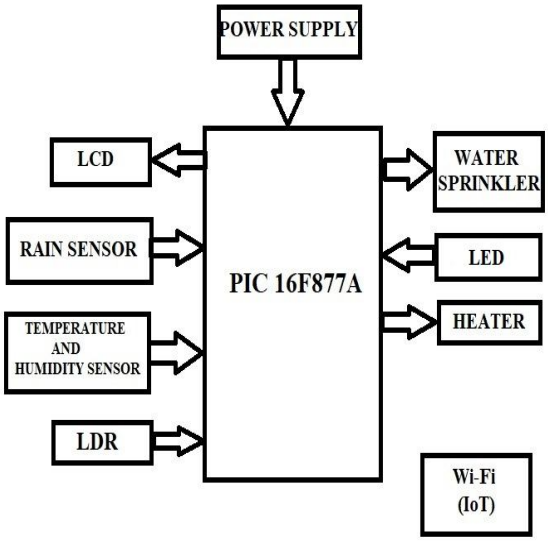


Fig. 1 Block diagram of the proposed system

IV. IMPLEMENTATION DETAILS

A. Hardware Description

1) Microchip PIC16F877A: The microcontroller is implemented using microchip PIC16F877A PIC microcontroller as shown in fig. 2. The specifications are,

a) Operating speed: 20 MHz, 200 ns instruction cycle
b) Operating voltage: 4.0-5.5V
c) Industrial temperature range (-40° to +85°C)
d) 15 Interrupt Sources
e) 35 single-word instructions
f) All single-cycle instructions except for program branches (two-cycle)
g) Flash Memory: 14.3 Kbytes (8192 words)
h) Data SRAM: 368 bytes
i) Data EEPROM: 256 bytes
j) Self-reprogrammable under software control
k) In-Circuit Serial Programming via two pins (5V)
l) Watchdog Timer with on-chip RC oscillator
m) Programmable code protection
n) Power-saving Sleep mode
o) Selectable oscillator options
p) In-Circuit Debug via two pins

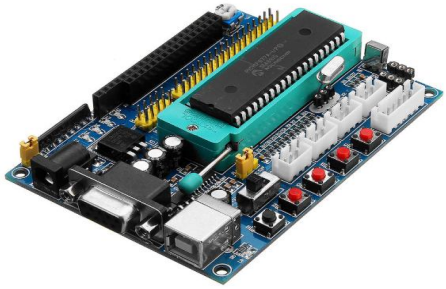


Fig. 2 PIC Microcontroller



Fig. 3 LCD

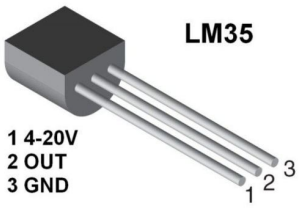


Fig. 4 Temperature sensor

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2) *LCD:* The Liquid Crystal Display (LCD) is used for microcontroller board as shown in fig. 3. The display of size 16x2 displays two rows of characters, 16 characters per row and pixel of 5x7 matrix. The command instructions can be used to configure the LCD for various task like clear screen, initialize, reset, position setting, and control the display, etc. The data of ASCII characters can be displayed using the data register.
3) *Temperature sensor:* The LM35 is an IC temperature and humidity sensor which can be used for measuring the temperature and produces the output in electrical voltage as shown in fig. 4. The performance is better than the thermistors. The specifications are scale factor of .01 V/ºC, an accuracy of +/-0.4 ºC at ambient Celsius temperature. It possess the low self-heating capability and consumes 60 uA current.
4) *Rain Sensor:* The rain sensor is used as switch for detecting the rainfall and intensity of raindrop falls as shown in fig. 5. The board is constructed with a potentiometer for sensitivity adjustments and LED for indication. It seeks the variation in beam intensity and gives the analog voltage corresponding to the size of drop. The LED is configured to indicate intensity of rain drop.

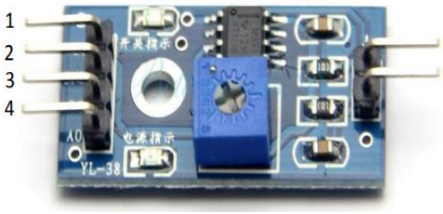


Fig. 5 Rain sensor


Fig. 6 LDR


Fig. 7 LED

5) *LDR:* A Light Dependent Resistor (LDR) is a photoconductor device which produce the resistive change for the variation of light intensity as shown in fig. 6. It can be used for controlling the electronic gadgets remotely. The specifications are the resistance of 1MOhm for full darkness and in the range of 10-20 KOhm for light conditions.
6) *LED:* A Light Emitting Diode (LED) emits the coloured light as per the specified semiconductor material for the given electrical voltage as shown in fig. 7. This special PN junction diode releases the photon energy as electron and holes recombine within the device.
7) *Water Sprinkler:* The Model B-1 Upright and Pendent foam-water sprinklers manufactured by Johnson Controls used for foam-water deluge systems as shown in fig. 8. The foam is applied to sprinkle for flammable risks. These sprinklers are developed for fire protection purpose as per safety rules.

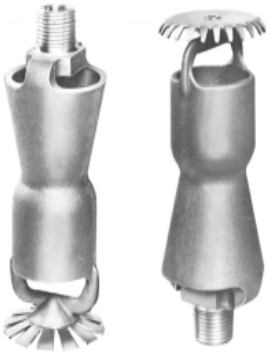

Fig. 8 Water Sprinkler



Fig. 9 Wi-Fi Module

8) *Wi-Fi Module:* The ESP 8266 Wi-Fi module is a low cost wirelessly networkable microcontroller module as it performs the IoT operation as shown in fig. 9. It is basically a System on Chip (SoC). The Smart Connectivity Platform (ESCP) is a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers [10]. It provides unsurpassed ability to embed WiFi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement The feature include 802.11 b/g/n, integrated low power 32-bit MCU, integrated 10-bit ADC, integrated TCP/IP protocol stack, Wi-Fi 2.4 GHz, support WPA/WPA2.

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B. Software Description

1) *Embedded C:* The embedded system is the key for all recent applications such as medical electronics, domestic systems, military and defence systems. The various devices are mainly based on microcontrollers for low budget domestic applications such as televisions, video players, washing machines, etc. These systems does not require complex embedded operating system using Windows or Linux or real-time operating system because it requires small amount of memory to configure small embedded systems using monitor program. This type of operating systems is programmed using embedded C and supported using simple assemblers. The executable software are created using embedded C for execution of the proposed system.
2) *MP Lab:* Microchip has a collection of software and hardware development tools integrated within one software package called MPLAB Integrated Development Environment (IDE). MPLAB IDE is used for embedded applications and combined with Microchip's PIC and dsPIC microcontrollers platforms. Also, it IDE provides a single integrated environment to develop code for embedded microcontrollers. MPLAB IDE supports Windows platform and related applications. Also, it supports debugging and application development in GUI environment.

V. RESULTS AND DISCUSSION

This paper describes the proposed system for monitoring the environment parameters using wireless sensor network. The IoT technology supports a wireless sensor network for monitoring humidity, temperature, light intensity, carbon dioxide level. Each node is mainly designed for low-power usage. The RS-485 bus is developed based on the Modbus protocol for achieving the communication between a number of sensor networks and host. An experiment is done to record the temperature, humidity, and light intensity readings in greenhouse. The reason for this experiment is to make sure that the proposed system is functioning correctly and recording the data correctly. This is safest and no manpower is required. This design is very useful to all-climatic conditions and economic feasible. The following fig. 10 shows the snap of the sample result using MP Lab for the proposed system.

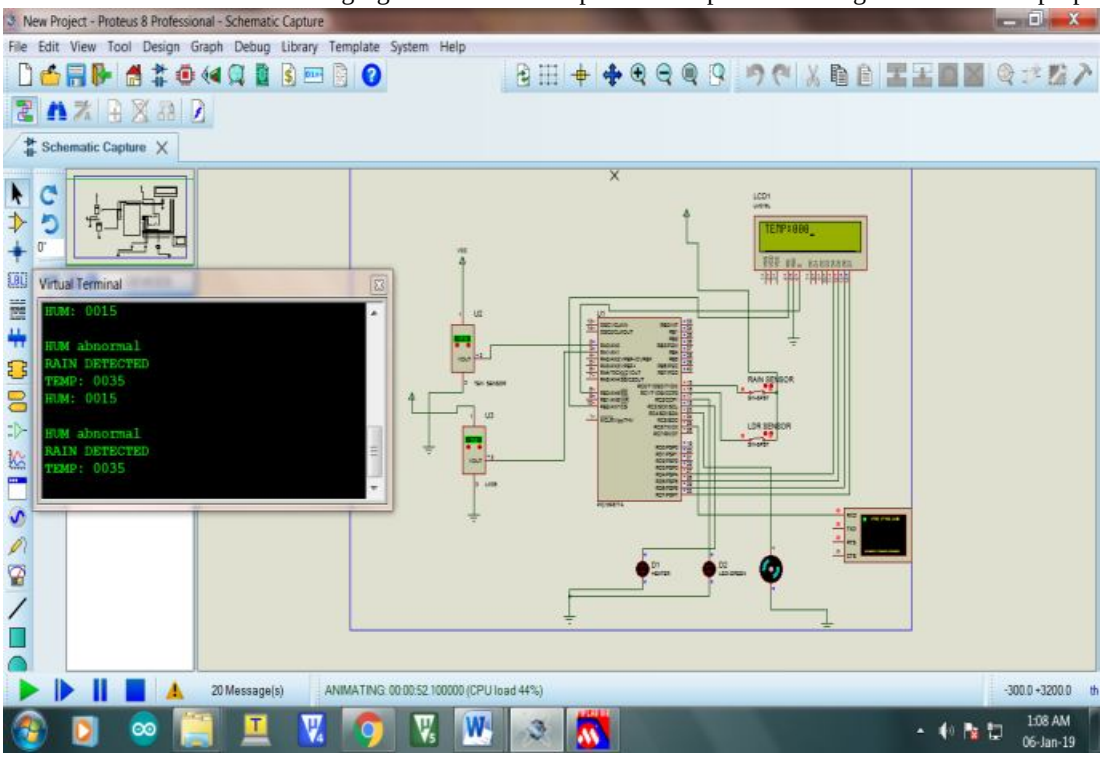


Fig. 10 Snap of the sample result using MP Lab

VI. CONCLUSION

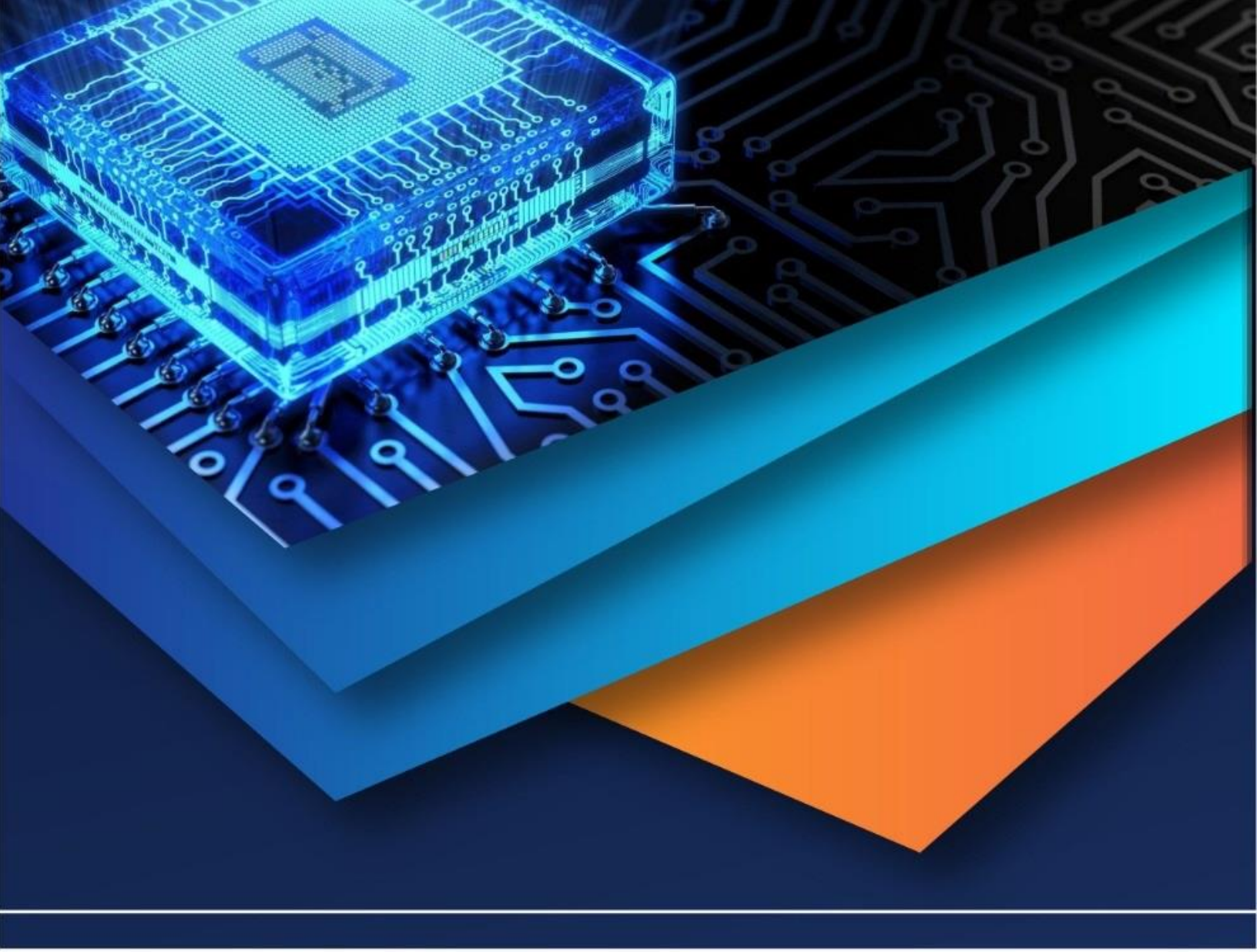
Thus, a design for environment monitoring is developed using wireless system network. The IOT module has been used for wireless data transmission, from which the various parameters are monitored from remote places. The proposed system offers flexible sensors placement and maintenance and low power consumption. Implementing the wireless system for monitoring weather would be a breakthrough in future.

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