

# DESIGN OF REAL-TIME WEATHER MONITORING SYSTEM BASED ON MOBILE APPLICATION USING ESP8266

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**ABSTRACT**--Environmental factors influence the deterioration of human health, causing various diseases and depend on prolonged exposure in environmental environments where these factors are found in extremely harmful indexes for people. In recent years, the most worrisome environmental factors are air pollution due to the different concentrations of polluting gases and the high rates of ultraviolet radiation. If the time of exposure to the factors is greater, then the damage to health will be harmful. It is estimated that 24% of annual deaths worldwide and 33% of diseases in children under 5 years of age are due to exposure to risks due to environmental factors that could be prevented. For this reason, a measurement system was implemented to evaluate environmental factors and prevent existing diseases. The research project uses the Node MCU ESP8266 platform for the development of the Internet of Things (IOT), which will allow sending the data to the server using the internet technology of things, where the data acquired by measuring the electrochemical sensors (MQ), temperature LM35 and humidity. This system works using a server allowing monitoring the data in real time.

**Keywords**—*Environmental factors, air pollution, ultraviolet radiation, Internet of Things.*

## I. INTRODUCTION

Environmental factors have a considerable impact on the health of people, causing skin infections and diseases due to Prolonged exposure to extremely high rates in unhealthy places such as beaches, main avenues and other areas that put health at risk. According to the World Health Organization (WHO), 23% of deaths worldwide are caused by environmental factors that could be avoided, also mentions that the most affected are children from 0 to 5 years with high rates of diseases and deaths from these factors. It is estimated that annually 3.8 million deaths in Asia and 847 thousand deaths in America; they are due to the prolonged exposure of people to these environmental factors. Ultraviolet radiation is the first environmental factor influencing the health of people by the deterioration caused to the skin when the rates established by the WHO are exceeded, and even more depends on the exposure time of the person. Peru is considered the country with the highest rates of ultraviolet radiation worldwide, meaning this condition a risk to the health of people, even more in the skin causing different lesions and dermatological diseases.

In the market, there are commercial products such as the company Pasco, which incorporates various measurement systems with multiple sensors of environmental parameters in order to analyse various environments and perform specific studies. However, the characteristics of these products have been established for specific uses at the hardware and software level, and their cost is high. In Spain, UV cameras have been developed that allow through image processing for indication of sunspots and other skin lesions that are not perceived by people. The objective of the research is to obtain a reliable and low-cost product that measures the parameters of the main environmental factors

in various areas through the use of environmental sensors applying the internet platform of things, in addition to working with the data obtained for the prevention of existing diseases by these environmental factors.

## II. INTERNET OF THINGS

Internet of things (IOT), is another advance technology in IT sector, provides internetworking for numerous of devices such as sensors, actuators, PLCs and other electronic embedded smart devices and controls, and various software's and provides systems network configuration and connectivity, which enables communication between these numerous devices for information exchanging.

As IOT provides interconnectivity among various real-time sensing sensors and PLC and other intelligent devices, therefore this technology will be an entity indicated for the more advance cyber-systems encircling the significant developments, "such as smart grid, smart vehicle systems, smart medical systems, smart cities, and others smart systems." In early future, IOT has striven to provide advance or smart connectivity for variety of electronic and intelligent equipment's or devices, IT-based systems and the more advanced services through deploying of various traditional and real-time protocols, networks domains, and system software/hardware applications, which will be an work followed by machine-to-machine technological concept.

Through interconnection of various devices and managing of 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. In 2013 the Global Standards Initiative

on Internet of Things (IOT-GSI) defined the IOT as "the infrastructure of the information society. 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.

When IOT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. Experts estimate that the IOT will consist of almost 50 billion objects by 2020.

**III. THE DESIGN OF SYSTEM STRUCTURE AND NETWORK**

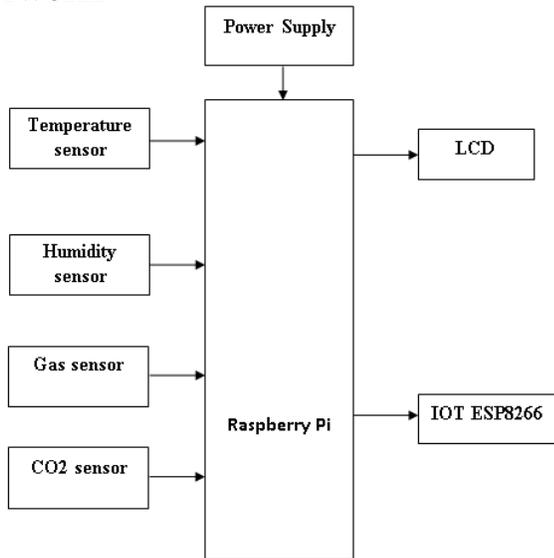


Fig. 1. Block Diagram

**A. THE MAIN STRUCTURE OF SYSTEM, FUNCTION AND TECHNICAL SPECIFICATIONS**

The Raspberry Pi is a series of credit card-sized single-board computers developed in the United Kingdom by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools and developing countries.

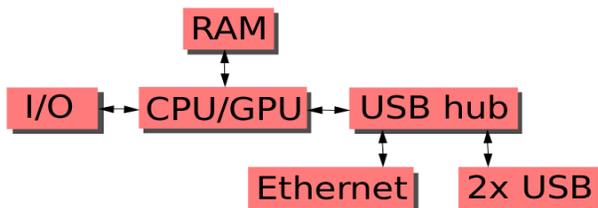


Fig.2. R Pi Block Diagram

This block diagram depicts models A, B, A+, and B+. Model A and A+ and Zero lack the Ethernet and USB hub components. The Ethernet adapter is connected to an additional USB port. In model A and A+ the USB port is connected directly to the SoC. On model B+ the chip contains a five-point USB hub, of which four ports are available, while model B only provides two. On the model Zero, the USB port is also connected directly to the SoC, but it uses a micro USB (OTG) port.

1) Processor / SoC (System on Chip)

The Raspberry Pi has a Broadcom BCM2835 System on Chip module. It has a ARM1176JZF-S processor. The Broadcom SoC used in the Raspberry Pi is equivalent to a chip used in an old Smartphone (Android or iPhone).

2) SD Card

The Raspberry Pi does not have any onboard storage available. The operating system is loaded on a SD card which is inserted on the SD card slot on the Raspberry Pi. The operating system can be loaded on the card using a card reader on any computer.

3) GPIO – General Purpose Input Output

General-purpose input/output (GPIO) is a generic pin on an integrated circuit whose behavior, including whether it is an input or output pin, can be controlled by the user at run time. GPIO pins have no special purpose defined, and go unused by default.

The production Raspberry Pi board has a 26-pin 2.54 mm (100 mil) expansion header, marked as P1, arranged in a 2x13 strip. They provide 8 GPIO pins plus access to I<sup>2</sup>C, SPI, UART), as well as +3.3 V, +5 V and GND supply lines. Pin one is the pin in the first column and on the bottom row.

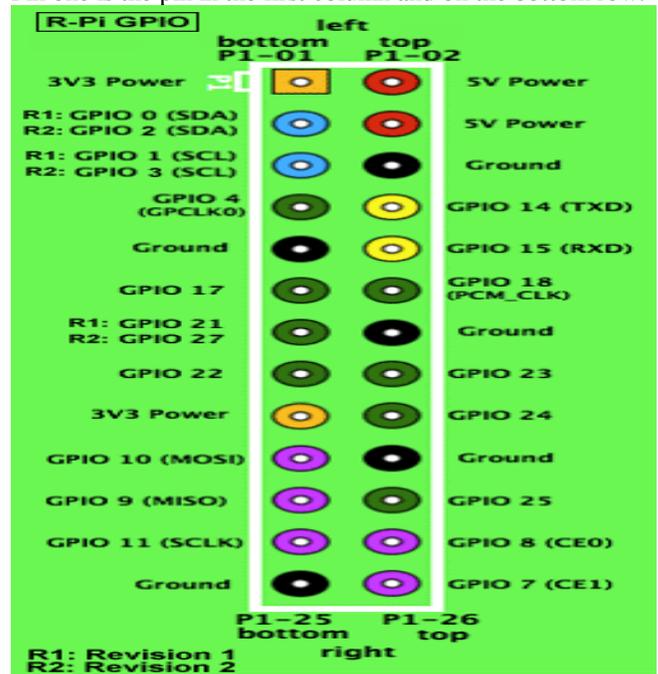


Fig.3. R Pi Pindigram

1) DSI Connector

The Display Serial Interface (DSI) is a specification by the Mobile Industry Processor Interface (MIPI) Alliance aimed at reducing the cost of display controllers in a mobile device. It is commonly targeted at LCD and similar display technologies.

2) RCA Video

RCA Video outputs (PAL and NTSC) are available on all models of Raspberry Pi. Any television or screen with a RCA jack can be connected with the RPi.

3) Audio Jack

A standard 3.5 mm TRS connector is available on the RPi for stereo audio output. Any headphone or 3.5mm audio cable can be connected directly. Although this jack cannot be used for taking audio input, USB mics or USB sound cards can be used.

4) Status LEDs

There are 5 status LEDs on the RPi that show the status of various activities as follows:

“OK” - SD Card Access (via GPIO16) - labelled as "OK" on Model B Rev1.0 boards and "ACT" on Model B Rev2.0 and Model A boards

“POWER” - 3.3 V Power - labelled as "PWR" on all boards

“FDX” - Full Duplex (LAN) (**Model B**) - labelled as "FDX" on all boards

“LNK” - Link/Activity (LAN) (**Model B**) - labelled as "LNK" on all boards

“10M/100” - 10/100Mbit (LAN) (**Model B**) - labelled (incorrectly) as "10M" on Model B

5) USB 2.0 Port

USB 2.0 ports are the means to connect accessories such as mouse or keyboard to the Raspberry Pi. There is 1 port on Model A, 2 on Model B and 4 on Model B+. The number of ports can be increased by using an external powered USB hub which is available as a standard Pi accessory.

6) Ethernet

Ethernet port is available on Model B and B+. It can be connected to a network or internet using a standard LAN cable on the Ethernet port. The Ethernet ports are controlled by Microchip LAN9512 LAN controller chip.

7) CSI connector

CSI – Camera Serial Interface is a serial interface designed by MIPI (Mobile Industry Processor Interface) alliance aimed at interfacing digital cameras with a mobile processor. The RPi foundation provides a camera specially made for the Pi which can be connected with the Pi using the CSI connector.

8) JTAG headers

JTAG is an acronym for 'Joint Test Action Group', an organization that started back in the mid 1980's to address test point access issues on PCB with surface mount devices. The organization devised a method of access to device pins via a serial port that became known as the TAP (Test Access Port). In 1990 the method became a recognized international standard (IEEE Std 1149.1). Many thousands of devices now include this standardized port as a feature to allow test and design engineers to access pins.

9) HDMI

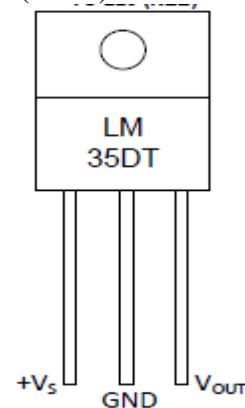
HDMI – High Definition Multimedia Interface  
HDMI 1.3 a type A port is provided on the RPi to connect with HDMI screens.

**Temperature sensor**

Temperature is the most-measured process variable in industrial automation. Most commonly, a temperature sensor is used to convert temperature value to an electrical value. Temperature Sensors are the key to read temperatures correctly and to control temperature in industrial applications.

A large distinction can be made between temperature sensor types. Sensors differ a lot in properties such as contact-way, temperature range, calibrating method and sensing element. The temperature sensors contain a sensing element enclosed in housings of plastic or metal. With the help of conditioning circuits, the sensor will reflect the change of environmental temperature.

**Temperature sensor (LM35)**



**Fig.4. Temperature Sensor**

**Pin Definition**

The definition of gray-scale sensor pin is

1. Signal Output
2. GND
3. Power

**Features of Temperature Sensor**

- Calibrated directly in Celsius (centigrade)
- 0.5° C Ensured accuracy (at +25° C)
- Suitable for remote applications
- Operate from 4 to 30 V
- Low cost due to wafer-level trimming

**Specifications**

- Type: Analog
- Sensitivity: 10mV per degree Celcius
- Functional range: 0 degree Celsius to 100 degree Celsius

**HUMIDITY SENSOR**

Humidity sensor is an instrument used for measuring the moisture content in the environment. Humidity measurement instruments usually rely on measurements of some other quantity such as temperature, pressure, mass or a mechanical or electrical change in a substance as moisture is absorbed. By calibration and calculation, these measured quantities can lead to a measurement of humidity.

**Features**

- Relative humidity sensor
- Two point calibrated with capacitor type sensor, excellent performance
- Frequency output type, can be easily integrated with user application system
- Very low power consumption
- No extra components needed



Fig.5. Humidity Sensor

**GAS SENSOR**

A gas detector is a device which detects the presence of various gases within an area, usually as part of a safety system. This type of equipment is used to detect a gas leak and interface with a control system so a process can be automatically shut down. A gas detector can also sound an alarm to operators in the area where the leak is occurring, giving them the opportunity to leave the area. This type of device is important because there are many gases that can be harmful to organic life, such as humans or animals.



Fig.6. GAS Sensor

In current technology scenario, monitoring of gases produced is very important. From home appliances such as

air conditioners to electric chimneys and safety systems at industries monitoring of gases is very crucial.

**LIQUID CRYSTAL DISPLAY (LCD)**

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

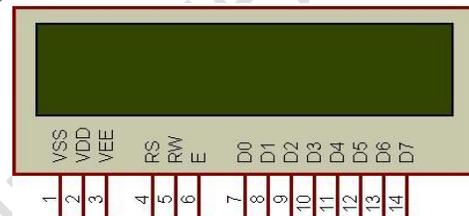


Fig.7. Alphanumeric LCD 16X2

**ESP8266 WIFI IOT MODULE**

**Specifications:**

- 802.11 b/g/n
- Serial/UART baud rate: 115200 bps
- Integrated TCP/IP protocol stack
- Input power: 3.3V (see "Recommended Accessories" below for 3.3V power options)
- I/O voltage tolerance: 3.6V Max (see "Recommended Accessories" below for level converters to connect to higher voltage devices (i.e. Arduino) )
- Regular operation current draw: ~70mA
- Peak operating current draw: ~300mA
- Power down leakage current: <10µA
- +19.5dBm output in 802.11b mode
- Flash Memory Size: 1MB (8Mbit)
- WiFi security modes: WPA, WPA2
- Module's dimensions: 24.75mm x 14.5mm (0.974" x 0.571")

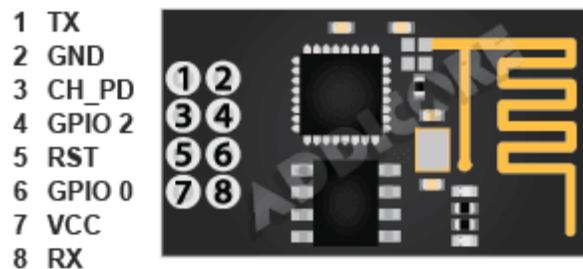


Fig.8. IOT Module ESP8266

#### **IV. SOFTWARE TOOL**

##### **RASPBERRY PI SOFTWARE**

###### **A. OPERATING SYSTEM**

- The Raspberry Pi essentially utilizes Linux piece based working frameworks. The ARM11 depends on variant 6 of the ARM which is never again upheld by a few well-known adaptations of Linux, including Ubuntu. The introduce administrator for Raspberry Pi is NOOBS. The OSs included with NOOBS are:
  - Arch Linux ARM
  - Open ELEC
  - Pidora (Fedora Remix)
  - Rasp mc and the XBM Copen source advanced media focus
- RISCOS – The working arrangement of the primary ARM-based PC
- Raspbian (recommended) – Maintained self-sufficiently of the Foundation; in light of ARM hard-float (arm hf)-Debian 7 'Wheezy' designing port, that was expected fora more cutting-edgeARMv7 processor whose sets would not tackle the Raspberry Pi, yet Raspbian is accumulated for the ARMv6 direction set of the Raspberry Pi making it work anyway with slower execution. It gives some available deb programming packs, pre-orchestrated programming gatherings. A base size of 2 GB SD card is required, anyway a 4 GB SD card or above is endorsed. There is a Pi Store for exchanging programs. The 'Raspbian Server Edition (RSEv2.4)', is a stripped adjustment with other programming groups bundled when stood out from the run of the mill PC orchestrated Raspbian.

#### **V. CONCLUSION AND FUTURE WORK**

It was demonstrated with the research carried out the problems that exist with the risk due to the main environmental factors such as ultraviolet radiation and air pollution are found in high indexes, and the risks in the health of the person if the presence of both factors exists. In addition, this platform will allow people to know the permissible and harmful environments for health, thus helping to prevent existing diseases. The difference with other technologies is that the system has been implemented with materials of less cost and is open hardware, so it would allow the use of more parameters.

In the future, it is expected to make an electronic bracelet that allows people to measure the environmental conditions of their environment, as well as send alerts when environmental conditions put at risk the health of people who travel daily. Additionally, more sensors will be adapted so that the system allows greater environmental parameters to be obtained. It is also expected to use the data obtained using Machine Learning to prevent future diseases in different places. This will allow working with national organizations to contribute with the support and care of the environment.

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