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# IoT Smart Environmental Monitoring System

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**Abstract:** This paper proposes an approach to building a cost-effective standardized environmental monitoring device using the Raspberry-Pi (R-Pi) single-board computer. The system was designed using Python Programming language and can be controlled and accessed remotely through an Internet of Things platform. It takes information about the surrounding environment through sensors and uploads it directly to the internet, where it can be accessed anytime and anywhere through internet. Experimental results demonstrated that the system is able to accurately measure: temperature, humidity, light level and concentrations of the carbon monoxide harmful air pollutant. It's also designed to detect earthquakes through an assembled seismic sensor.

**Keywords:** GPIO, IoT Monitoring, Raspberry-Pi, Sensor.

## I. INTRODUCTION

Tracking the environmental parameters' variation is essential in order to determine the quality of our environment. The collected data encompass important details for a variety of organizations and agencies. Outside the governments and other organizations, the information is used by many people, because of the weather's effect on a wide range of human activities. Internet of Things (IoT) is a concept and a paradigm that considers the presence in the environment of a variety of things/objects that through wireless and wired connections and unique addressing schemes are able to interact with each other and cooperate with other things/objects to create new applications.

## II. BLOCK DIAGRAM

The sensors like LDR, Rain Sensor, Temperature and Humidity sensors are connected to the MCP 3208 the A/D converter as these sensors are in analog form. The MCP 3208 is connected to the Raspberry Pi. The remaining sensors like MEMS Sensor and CO (Smoke sensor) are connected to Raspberry Pi. By giving a power supply as shown in Fig.1 the sensors are connected to the Raspberry Pi, through wifi, the data is the data is shown in the web page display.

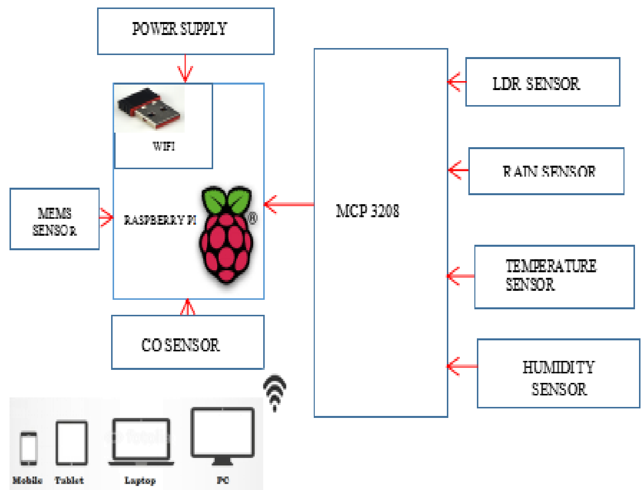


**Fig.1. Block Diagram.**

## III. METHODOLOGY

The system is comprised of several subsystems; each will be explained in detail in this section.

### A. Sensing

The purpose of this unit is to detect (sense) all the parameters desired using a collection of sensors that were chosen carefully to achieve the best performance.

### B. Weather

**Temperature:** The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-Proportional to the Centigrade temperature.

**Humidity:** A humidity sensor also called a hygrometer, measures and regularly reports the relative humidity in the air. This means that it measures both air temperature and moisture. The most common type of humidity sensor uses what is called "capacitive measurement."

**Light level (LDR):** A Light Dependent Resistor (LDR) or a photoresistor is a device whose resistivity is a function of the incident electromagnetic radiation. A light dependent resistor works on the principle of photoconductivity.

**MEMS Sensor:** The MMA7660FC is a ±1.5 g 3-Axis Accelerometer with Digital Output (I2C). It is a very low power, low profile capacitive MEMS sensor featuring a low pass filter; compensation for 0g offset and gain errors.

**Rain Sensor:** This module allows you measure moisture via analog output pins and it provides a digital output when a threshold of moisture is exceeded. It includes the electronics module and a printed circuit board that “collects” the raindrops.

**CO Sensor:** Sensitive material of MQ-5gas sensor is $SnO_2$, which with lower conductivity in clean air. The MQ-5 sensor has high sensitivity to butane, propane, methane, and can detect both methane and propane at the same time.

**MCP 3208:** The Microchip Technology Inc. MCP3204/ 3208devices are successive approximation 12-bit Analog-to-Digital (A/D) Converters with onboard sample and circuitry.

## IV. IMPLEMENTATION

### A. Computer Processing (Raspberry Pi)

This is the most important unit and the core of the system. It receives the sensing information, processes it, returns the corresponding values, and generates the necessary controls to guide the data to the desired destination.

**Serial Protocols:** There are several serial protocols shown in the pin descriptions that the chip uses to deal with the peripherals (sensors) connected to it. These protocols are: Serial Peripheral Interface (SPI), Inter-Integrated Circuit interface or $I^2C$ and standard Universal Asynchronous Receiver Transmitter (UART).

**Connect to Sensors:** Each of the system's sensors is connected to the R-Pi's GPIO pins. The main concept of the wiring is that digital sensors are connected directly to the R-Pi's GPIO, while analog sensors are connected to an analog to digital converter, which in turn is directly connected to the R- Pi.

**Software Design:** Before writing the code for the system, several software dependencies must be installed. These dependencies add more functionality to the use of Python on the R-Pi and make the software design process easier.

**Uploading:** HTML is a protocol implemented for sharing sensor data between remote environments, both physical and virtual. Additionally, it can be used to facilitate direct connections between any two environments.

### B. Flowchart

Once the project setup is done we can start initializing the sensors. After initialization we can read the sensor valves. The temperature, humidity, LDR sensors valves are collected and send these data to the MCP 3208 A/D converter. In the rain sensor it checks the whether it is a heavy, moderate or no rain and displays the output. Next for the MEMS Sensor, the output varies according to the disturbance occurred. By using these sensors it collects the data and sends the data to the Raspberry pi. The Raspberry pi processes and collects the data send by the sensors as shown in Fig.2. Here by using HTML we are creating a web page and PHP general purpose scripting language especially suited for web development and can be embedded into HTML. So the data which is collected is send through an in-built wifi which is present in the Raspberry pi as shown in Fig.3.

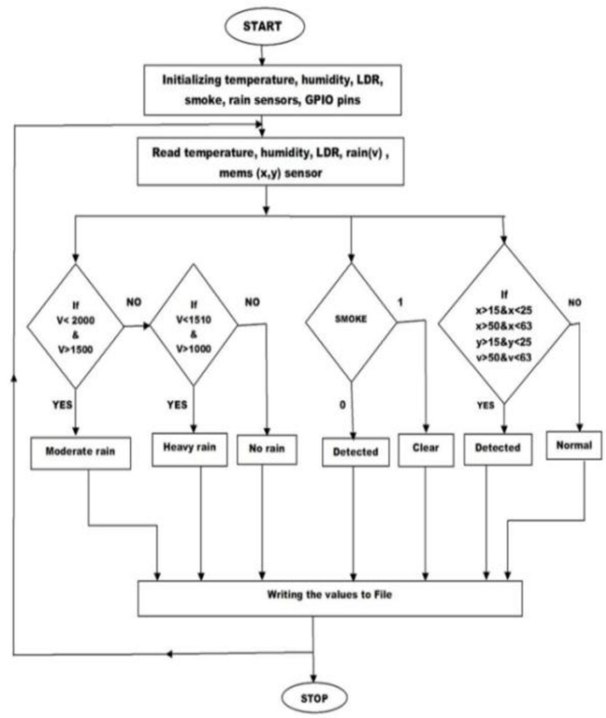


**Fig.2. Flowchart.**

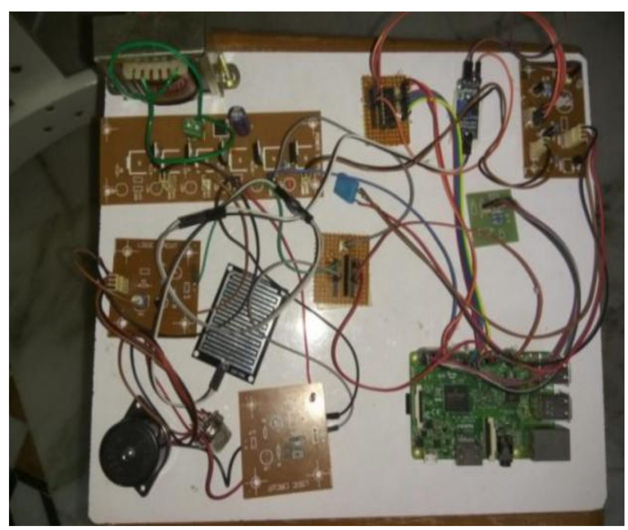

**Fig.3. Hardware Model.**

## V. RESULTS

### Case -1: Temperature Sensor

In case-1, the Temperature sensor readings are taken by surrounding area and displayed on the web page as shown in Fig.4.

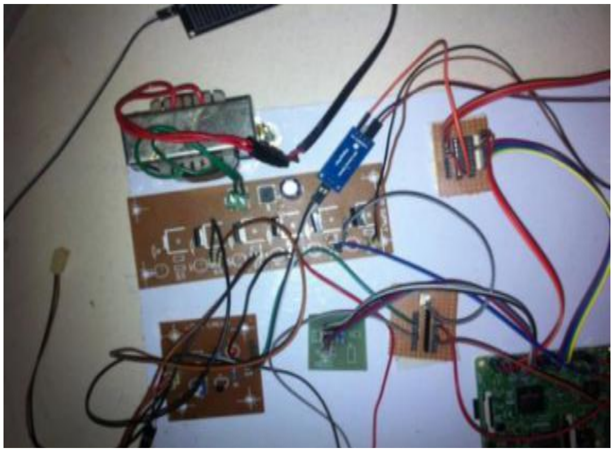

**Fig.4. Temperature Sensor.**

**Case – 2: LDR Sensor**

In case-2, the LDR sensor readings are taken by surrounding area and displayed on the web page as shown in Fig.5.

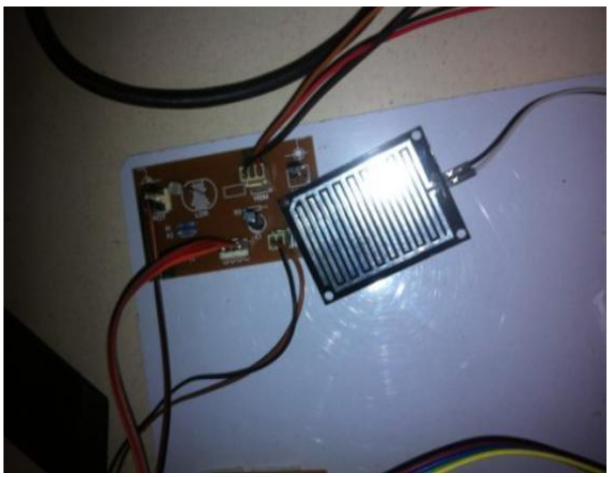

**Fig.5. LDR Sensor.**

**Case- 3: Humidity Sensor**

In case-3, the Humidity sensor readings are taken by surrounding area and displayed on the web page as shown in Figs.6 and 7.

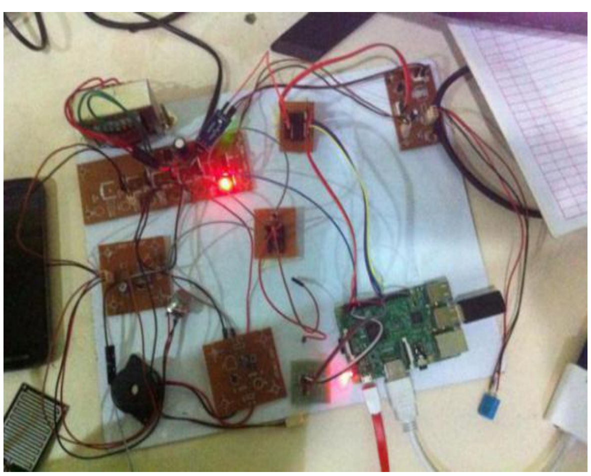

**Fig.6. Humidity Sensor.**

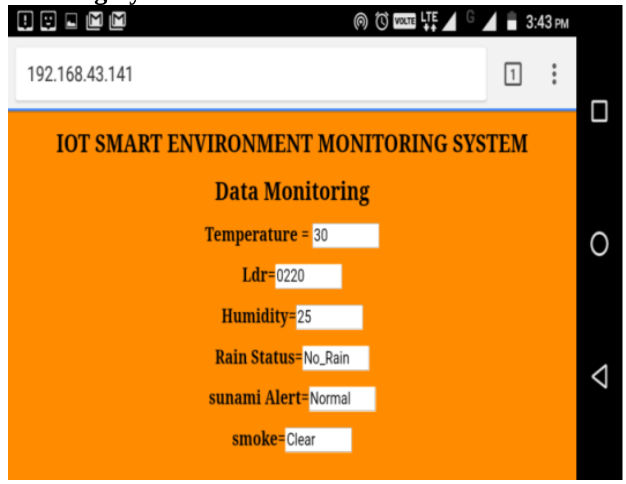


**Fig.7. Web Page Display.**

**Case- 4: Rain Sensor (Moderate, Heavy Rain)**

In case-4, the Rain sensor readings are taken by amount of water fall on the circuit and displayed on the web page as shown in Figs.8 and 9.

**Fig.8. Rain Sensor.**

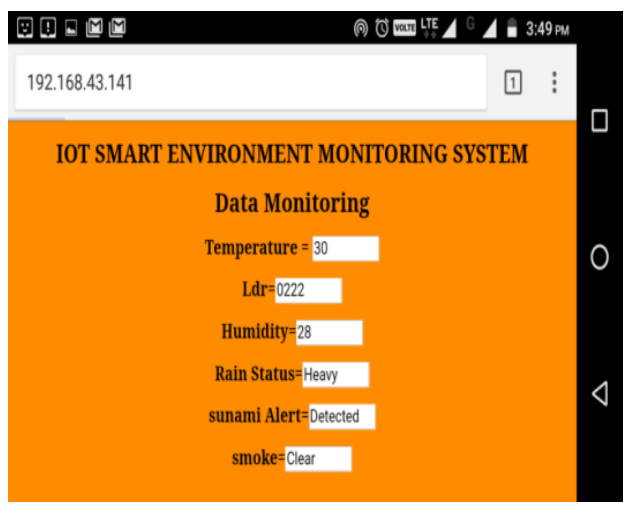


**Fig.9.Web page of rain sensor.**

**Case – 5: Smoke Sensor**

In case-5, the Smoke sensor readings are taken by surrounding area and displayed on the web page as shown in Figs.10 and 11.

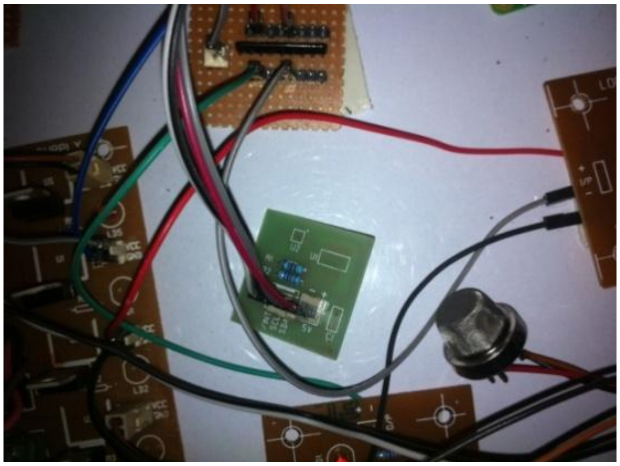

**Fig.10. Smoke Sensor Circuit.**

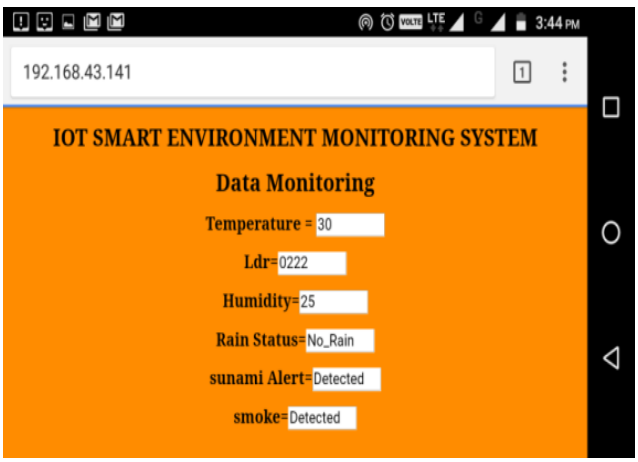


**Fig.11. Web page display of smoke sensor.**

**CASE – 6: MEMS Sensor**

In case-6, the MEMS sensor readings are taken by the disturbance made on the circuit and displayed on the web page as shown in Figs.12 and 13.

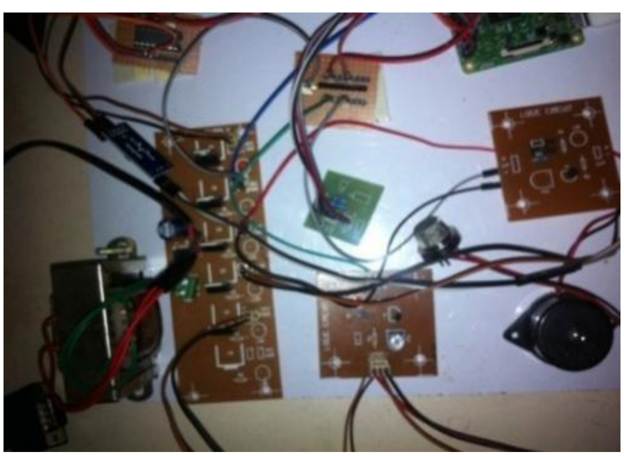

**Fig.12. MEMS Sensor Circuit.**

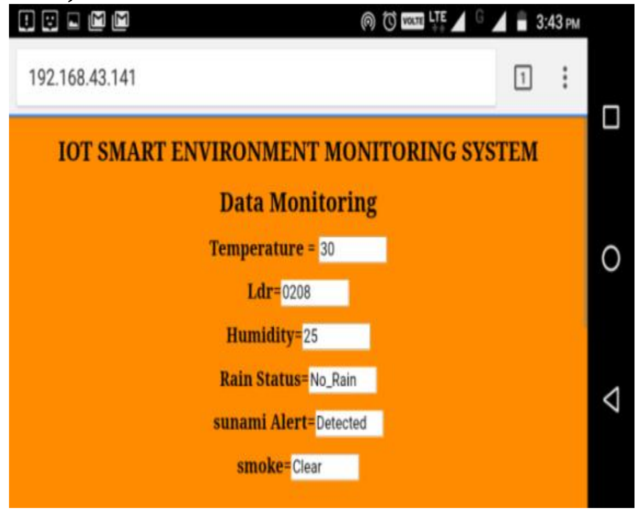


**Fig.13. Web page display of MEMS sensor.**

## VI. CONCLUSION

The environmental monitoring system might offer several potential benefits. It provides monitoring services for remote areas and for ad-hoc applications that are normally not available from larger monitoring systems owned by governments and big agencies. Its' earthquake detection capability can help saving millions of lives. It can be used to predict the onset of bad weather using signs such as changing temperature and humidity. Raising the awareness of how society is affected the region's environmental policies and have the knowledge basis to push for the change.

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