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REALTIME URBAN MICRO CLIMATE IMPLEMENTATION BY USING IOT

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ABSTRACT: Real-time environment monitoring and analysis is an important research area of Internet of Things (IoT). Understanding the behaviour of the complex ecosystem requires analysis of detailed observations of an environment over a range of different conditions. One such example in urban areas includes the study of tree canopy cover over the microclimate environment using heterogeneous sensor data. There are several challenges that need to be addressed, such as obtaining reliable and detailed observations over monitoring area, detecting unusual events from data, and visualizing events in real-time in a way that is easily understandable by the end users (e.g., City Councils). In this regard, we propose an integrated geo visualization framework, built for real-time wireless sensor network data on the synergy of computational intelligence and visual methods, to analyze complex patterns of urban micro climate. ABayesianmaximumentropy based method and a hyperellipsoidal model based algorithm have been build in our integrated framework to address above challenges. The proposed integrated framework was verified using the dataset from an indoor and two outdoor network of IoT devices deployed at two strategically selected locations in Melbourne, Australia. The data from these deployments are used for evaluation and demonstration of these components' functionality along with the designed interactive visualization components.

Index Terms—Internet of Things (IoT), Smart City, Urban Microclimate, Anomaly Detection, Spatio-temporal Estimation, Geovisualization.

I.INTRODUCTION

Real-time environment monitoring and analysis is an important research area of Internet of Things (IoT). Understanding the behaviour of the complex ecosystem requires analysis of detailed observations of an environment over a range of different conditions. One such example in urban areas includes the study of tree canopy cover over the microclimate environment using heterogeneous sensor data. There are several challenges that need to beaddressed, such as observations over monitoring area, detecting unusual events from data, and visualizing events in real-time in away by the end users (e.g., City Councils). In this regard, we propose an integrated geo visualization framework, built for real-time wireless sensor network data on the synergy of computational intelligence and visual methods, to analyze complex patterns of urban microclimate. A Bayes ian maximu mentropy based method and a hyperellipsoidal model based algorithm have been build in our integrated framework to address above challenges. The proposed integrated framework was verified using the dataset from an indoor and two outdoor network of IoT devices deployed at two strategically selected locations in Melbourne, Australia. The data from these deployments are used for evaluation and demonstration of these components' functionality along with the designed interactive visualization components. Index Terms—Internet of Things (IoT), Smart City, Urban Microclimate, Anomaly Detection, Spatio-temporal Estimation, Geovisualization.

II. LITERATURE REVIEW

Many researchers did their work on Urban Climate monitoring system using IOT.M. Wcislik et al [2] monitors patient's body temperature, Smoke, Humidity wave and variours global position using AR cortex M4F micro controller. Android app is created for monitor these values. Bluetooth connection is used for connecting microcontroller and Android phone. In my project monitor temperature, Humidity rate, heat and Global movements using Raspberry Pi board and sensors. Android app is support only android phones.

Bluetooth is very short distance for communication. It supports only within 100 meters. In my project webpage is created. Using IP address anybody can monitor urban status anywhere in the world. Amir-Mohammad Rahmani et al [3] monitor Pollution wave using panda board. Ethernet connection is used for connecting internet to the panda board. In my project monitor body temperature, Respiration rate, heart rate and body movements using Raspberry Pi board. Panda board is very difficult to operate compare to Raspberry Pi board. Ethernet connection is also very short distance. So i use USB modem for connecting internet to the Raspberry Pi board. Hoi Yan Tung [3] et al monitors using DRZHG micro controller.

III. DESIGN OF HARDWARE

This chapter briefly explains about the hardware implementation of health monitoring systems using iot and Arduino UNO. It discusses the circuit diagram of each module in detail. For implementing the health diagnosis system, there is a need of essential components that are suitable and manipulate health problems.

3.1. Temperature Sensor-LM35

It is an IC sensor that is used to measure temperature with an output voltage linearly proportional to the Centigrade temperature. The LM35 sensor has an advantage over linear temperature sensor, as the user has not to make the conversion of Kelvin to Centigrade. This is major significance of LM-35 that it calibrates directly in Celsius and it is also suitable for remote applications. It has better efficiency than thermistor.

Temperature is one of the most commonly measured parameter in the world. They are used in your daily household devices from Microwave,fridges, AC to all fields of engineering. Temperature sensor basically measures the heat/cold generated by an object to which it is connected. It then provides a proportional resistance, current or voltage output which is then measured or processed as per our application. Temperature sensor are basically classified into two types

- Non Contact Temperature Sensors: These temperature sensors use convection & radiation to monitor temperature
- Contact Temperature Sensors: Contact temperature sensors arethen further sub divided into three type

3.1.1 Features of LM35 Temperature Sensor

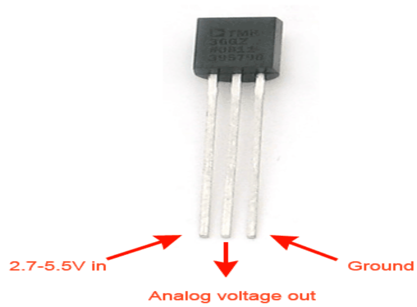

Fig 4.1: Pin diagram of LM35

3.2 ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode.Arduino board has the following new features:

- 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that use the AVR, which operate with 5V and with the Arduino Due that operate with 3.3V. The second one is a not connected pin, that is reserved for future purposes.
- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino boards.

Fig: ARDUINO UNO

3.3. POWER SUPPLY:

The power supplies are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can by broken down into a series of blocks,

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each of which performs a particular function. A d.c power supply which maintains the output voltage constant irrespective of a.c mains fluctuations or load variations is known as “Regulated D.C Power Supply”.

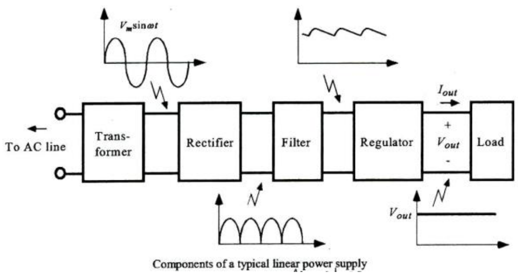


Fig:4.7. Block Diagram of Power Supply

3.4 ESP8266 WIFI

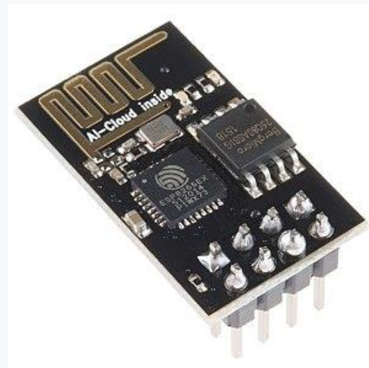
The **ESP8266** is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Espressif Systems.[1]

The chip first came to the attention of western makers in August 2014 with the **ESP-01** module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted.[2] The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation.[3]

The **ESP8285** is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.[4]

The successor to these microcontroller chips is the ESP32.

ESP8266



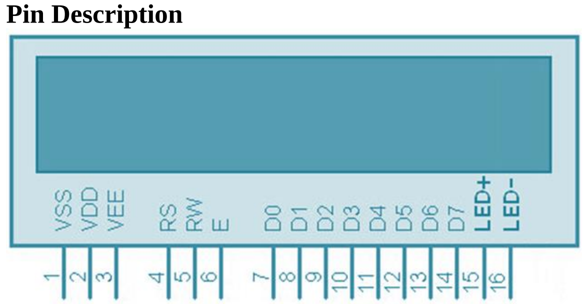
ESP-01 module by Ai-Thinker

Manufacturer	Espressif Systems
Type	32-bit microcontroller
CPU	@ 80 MHz (default) or 160 MHz
Memory	32 KiB instruction, 80 KiB user data
Input	16 GPIO pins
Power	3.3 V DC

3.5.LCD DISPLAY

Liquid Crystal Display also called as LCD is very helpful in providing user interface as well as for debugging purpose. The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. The most commonly used LCDs found in the market today are 1 Line, 2 Line or 4 Line LCDs which have only 1 controller and support at most of 80 characters, whereas LCDs supporting more than 80 characters make use of 2 HD44780 controllers.

Pin Description



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3.6.CO2 Sensor

MQ2 flammable gas and smoke sensor detects the concentrations of combustible gas in the air and outputs its reading as an analog voltage. The sensor can measure concentrations of flammable gas of 300 to 10,000 ppm. The sensor can operate at temperatures from -20 to 50°C and consumes less than 150 mA at 5 V.

Connecting five volts across the heating (H) pins keeps the sensor hot enough to function correctly. Connecting five volts at either the A or B pins causes the sensor to emit an analog voltage on the other pins. A resistive load between the output pins and ground sets the sensitivity of the detector. Please note that the picture in the datasheet for the top configuration is wrong. Both configurations have the same pin out consistent with the bottom configuration. The resistive load should be calibrated for your particular application using the equations in the datasheet, but a good starting value for the resistor is 20 kΩ.

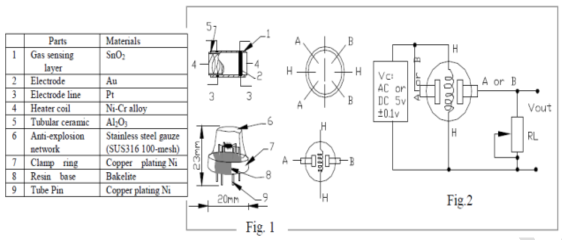
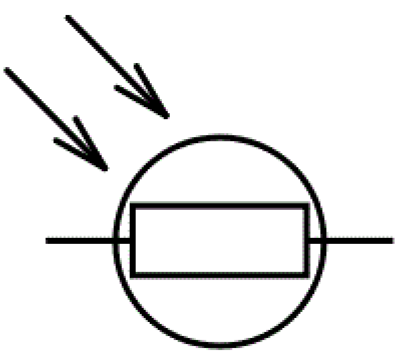


Fig 4.9 alcohol sensor pin description

3.7.LIGHT SENSOR

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance. There are many different symbols used to indicate a LDR, one of the most commonly used symbol is shown in the figure below. The arrow indicates light falling on it.



IV. PROJECT DESCRIPTION

This chapter deals with working and circuits of "**Real time Urban Micro Climate Analysis**". It can be simply understood by its block diagram &circuit diagram.

4.1. BLOCK DIAGRAM:

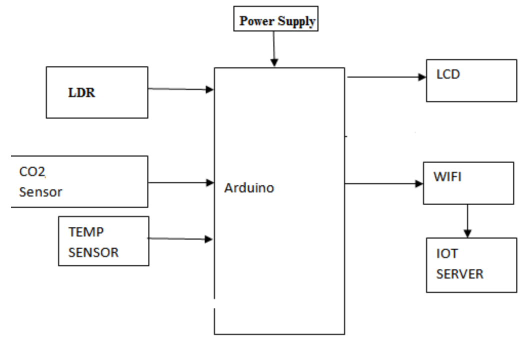


Fig 6.1 block diagram

4.2. SOFTWARE REQUIREMENTS:

- Arduino IDE

4.3. HARDWARE REQUIREMENTS:

- Power supply
- Arduino UNO
- LDR
- LCD
- CO2 Sensor
- LM35
- Wifi Module

4.4. WORKING:

In this Project, we propose an integrated geovisualization framework, built for real-time wireless sensor network data on the synergy of computational intelligence and visual methods, to analyze complex patterns of urbanmicroclimate.ABayesianmaximumentropybased method and a hyperellipsoidal model based algorithm have been build in our integrated framework to address above challenges. The proposed integrated framework was verified using the dataset from an indoor and two outdoor network of IoT devices deployed at two strategically selected locations in Melbourne, Australia. The data from these deployments are used for evaluation and demonstration of these components' functionality along with the designed interactive visualization components. Index Terms—Internet of Things (IoT), Smart City, Urban Microclimate, Anomaly Detection, Spatio-temporal Estimation, Geovisualization.

V.CONCLUSION

In this paper, we present an integrated framework with detailed implementation of an IoT platform that aids in creating actionable knowledge. BME based spatio-temporal estimation and hyperellipsoid based anomaly detection algorithm were used as backbone in our framework to address the three main challenges in urban microclimate analysis. Since, these challenges are same for many Smart City applications, the proposed framework can also be used to analyze other parameters of interest in a Smart City environment. The proposed framework also includes development of an interactive geovisualization tool to visualize spatio-temporal data with integrated algorithm outputs. On micro-level, the visualization assists in observing urban microclimate for different urban canopies under different daylight conditions. Our experimental results on IoT data reveal that, even using the measurements of a few low-cost sensors and a high precision sensor (weather station), the BME based estimation method can achieve reasonably good estimation accuracy. Therefore, a mix of several inexpensive low-cost sensors with a few high precision sensors can be used in IoT deployment for reliable monitoring in a cost-effective manner. Various interesting patterns have been identified using anomaly detection algorithm, which provide useful information for the urban forest team of Melbourne Council to perform in-depth analysis.

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