DESIGN AND IMPLEMENTATION OF IOT NETWORK FOR WHEATHER REPORT

T.L.AMRUTHA VARSHINI
M.Tech Scholar
Department of Embedded Systems
Indira Institute of Technology And Sciences::Markapur,Prakasam(Dist),A.P.

V.MADHURI
Asst. professor
Department of Embedded Systems
Indira Institute of Technology And Sciences::Markapur,Prakasam(Dist),A.P

***Abstract*—** The Internet of Things (IOT) depicts the intercon-nection of gadgets and individuals through the conventional web and informal communities for different everyday applications like climate observing, social insurance frameworks, savvy urban areas, water system field, and keen way of life. IOT is the new unrest of the present web world which screens live spilling of the whole world's status like temperature, moistness, rainstorm, quake, floods and so forth that can amaze a caution to human life. This paper proposes a minimal effort climate observing framework which recovers the climate state of any area from the cloud database the board framework and demonstrates the yield on an OLED show. The proposed framework utilizes an ESP8266-EX microcontroller based Wemos D1 board and it is executed on Arduino stage which is utilized to recover the information from the cloud. The primary target of this paper is to see climate states of any area and permits to get to the present information of any station.

I. INTRODUCTION

Weather forecasting is a prediction of what the weather will be like in the near future. In the online world, weather forecasting is important for a number of reasons like it saves lives and it helps when things like natural disaster occurs such as floods, tornadoes, hurricanes etc. Weather forecasting can predict when those natural disasters are imminent. The more warning people have the better they can prepare for the upcoming disasters. The weather can affect our daily lives, if we didnt know about weather in right time, we would be in serious trouble. It can affect in sports, outside activities, farming, navigation, transportation etc. The weather is important to farmers also to plant the seeds in the right type of climate. From the seedlings to take the grains to home it is very important for farmers to observe the climatic conditions throughout. Well actually, predicting the weather is majorly important for sailors, pilots and the people who are in business of transportation. They should know the weather conditions prior to their fly, sail, or ride in any other way. Weather monitoring has become an essential aspect in a variety of field. To fetch the accurate information of climate from the site is a major challenge. In order to satisfy the requirement this weather station is design in such a way that it will measure different atmospheric conditions as well as will be realized. According to the IBM concept, smarter planet is built on the following set of three pillars called the Three Is which is illustrated in fig:1. The first I stands for Instrumented which means through the use of remote sensor information is captured wherever it exists. The second I stand for Interconnected that means collected information is moved from one point to the other where it is useful. The third I stands for Intelligent which means information is processed, analyzed, and acted upon it to get the knowledge [14].

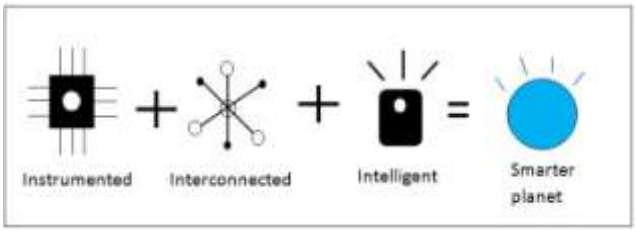


Fig. 1. The three pillars of the smarter planet

In the proposed system a live weather station is developed by connecting an IOT device Wemos D1 to an internet from the various cloud services like Wunderground and Thingspeak to retrieve data and display

on an OLED the weather condi- tions. The cloud service wunderground generate an unique api key for a particular location which give the real time weather information and it can access by anyone from anywhere. Thingspeak is an open source data platform for the internet of things that works on HTTP protocol which enables you to allow to collect, retrieve, visualize, analyze, store and allows to plot live charts on its channels. Every Thingspeak user can create its private or public channel which consist of eight fields and each channel have its own channel ID, channel name, API key, and description. Nowadays, there are various weather station cloud services are available comparison among few of them is shown in table:1 [15]. and time. The emerging concept of Internet of things (IOT) is a critical foundation on which the vision for a smarter planet Based on the above valuescore equation, the value score chart has been prepared which is shown in Fig. 2

TABLE I
COMPARISON OF WEATHER STATION SERVICES

Performance and service provided	Wunderground	Weather Bug	Yahoo!	Wheather Channel
Pollen frecast	No	Yes	No	Yes
Crowdsourced Whether	Yes	No	No	Yes
Shows infographic information	Yes	No	No	Yes
Provides satellite image	Yes	No	Yes	No
Informs about the risk of thunder-storm	Yes	Yes	No	No
Live webscam	Yes	Yes	No	No
Provides exact hour of rain	No	Yes	No	Yes
Includes videos or news	No	Yes	No	Yes
UV forecast	No	No	Yes	Yes

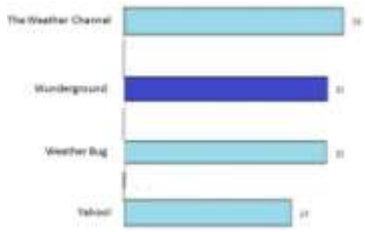


Fig. 2. Value Score Charts for Weather Cloud Services

II. LITERATURE SURVEY

In todays era weather monitoring is becoming heap and heap and one of the challenging task to get the accurate data in right place and right time. Farmers and our agriculture fields are severely affected by the climatic conditions and struggling to cope with this tough weather conditions. In India, a survey was conducted to observe the various weather parameters through analog devices during weather hazards [1]. In this approach a wireless sensor network based on Zigbee/IEEE802.15.4 is design in order to send the weather information and guidelines to the farmers for better growth of crops.

Weather forecasting is an application of science and technology which collects the quantitative data of current state of atmospheric weather and predict the future state by analyzing the past and present conditions. After, reviewing many articles one such proposed system is discussed in this paper [2]. The main aim of this article is to develop an arduino based weather

monitoring system which automatically collects the data of temperature and humidity that store in the database management system. In the recent years many sensors are deployed to measure the temperature, humidity, rainfall, wind direction which is very tough task. This study [3] proposes a wireless remote weather monitoring system based on Micro-Electro-Mechanical Systems (MEMS) and wireless sensor network (WSN) technologies comprising of sensors for measuring of weather condition.

Internet of things (IOT) is a network of interconnected devices with local intelligence that share access to push and pull the information or status from the networked world [4]. In this approach the weather information is collected from the environment and is displayed on the webpage using LPC1768 microcontroller and GSM network.

An intelligent weather station is designed in a small scale which can deliver the real time weather conditions of the surrounding environment [5]. This system uses Free scale Dragon12-plus2 board with three sensor wind speed sensor, wind direction sensor, and temperature sensor and LCD to display the output.

In the evolving generation of wireless technology the concept of smart cities and IOT has given a new remark in the world. One such remark leads towards the Online smart weather station system [6]. It is developed for presenting online the weather data collected over a period of time.

Traffic management in real time has become a complex task as the adverse weather condition affects the driving conditions badly and it has a big impact on road accidents rates. This paper [7] present a new autonomous system which give the real-time weather conditions in a short time and informs the driver the upcoming weather situation to avoid the fatal crashes.

Fetching the weather data accurately from the site is the most challenging task today. Sometimes having the weather information for a particular region isnt sufficient as the weather changes are brisk. Zone specific weather monitoring system using crowdsourcing and telecom infrastructure [8] proposes a group of service provider which can aid in easy retrieval of weather parameters. This approach provides a provision for getting region specific weather information instead of getting single weather conditions for entire city.

In large city, weather conditions vary from region to region and for this zone-specific information is needed [9]. This paper describes the low cost weather monitoring system that connects online for logging and visualization of data. In this approach an Ethernet wired connection is used for reliability and stability of data transmission.

Due to Earths tilt weather changes every season when it revolves around the sun [10]. In this paper an embedded system is designed to monitor temperature, pressure, and humidity by using a hydrogen balloon in which the sensors

are mounted in it. Radio frequency signals are used for communication and transmission of measured data to the ground station.

A case study has been done for constructing an automatic Weather station in emergency time [11]. In this study they show how to install an automatic weather station (AWS) in real time.

III. DESIGN AND IMPLEMENTATION

The overview architecture of the proposed system for live weather monitoring system is shown in Fig. 3:

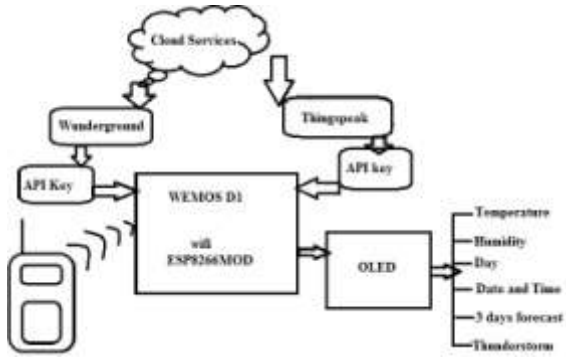


Fig. 3. Architecture of weather monitoring system

A. *Wemos D1 Board:*

The Wemos D1 is a mini wifi internet of Things (IOT) module based on ESP-8266EX microcontroller and provides 4MB flash. Its nine GPIO pins makes this board suitable for large IOT target audience. It is an excellent MCU that can be programmed with both Arduino IDE or Nodemcu. It has micro USB for auto programming and it can also be programmed using OTA. One side of the board features ESP8266 module and other side have CH340 serial to USB chip, and a reset button and a PCB antenna. It is even compatible with Android and iPhone. It has the ability to use external Antenna and a CP2104 USB to UART IC.

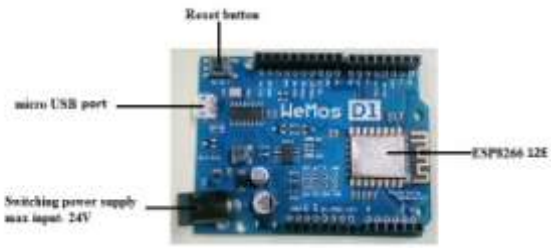


Fig. 4. Wemos D1 board

The technical specification of this module is shown in below table-2. In this proposed system the wifi module of wemos board is connected to the station having a ssid and password which will access the cloud services wunderground and thingspeak and retrieve the data and display on OLED. This system is cost effective as it is not using any kind of sensor for retrieving data. Length and width of this OLED display is 34.2mm and 25.6mm respectively. It weighs around 2.5gm.

TABLE
II
TECHNICAL
SPECIFICATION OF WEMOS

Microcontroller	ESP8266-FX
Operating Voltage	3.3 Volts
Digital I/O Pins	11
Analog Inputs Pins	1
Clock Speed	80MHz/160MHz
Flash	16M bytes

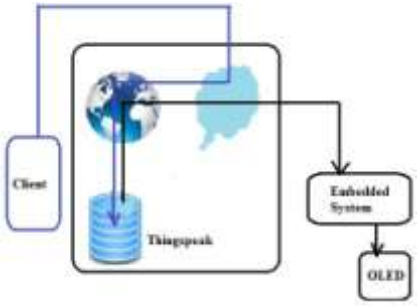
B. *OLED Display*

An Organic Light Emitting Diode (OLED) is a Light Emitting Diode (LED) which is lightweight, low power, simple and easy to use via I2C protocol. I2C is a serial protocol for two-wire interface that provides communication 899link between integrated circuits. It has two I2C signals serial data (SDA) and serial clock (SCL) which is connected to the GPIO pins of Wemos board. OLED display includes driver IC of SSD1306 and it has a resolution of 128*64. In this proposed system this OLED is used to display the retrieve data which is collected from the cloud database that includes temperature, humidity, current day and time, three days weather forecasting, and thunderstorm status.

Fig. 5. OLED Display

C. *Cloud Services*

In order to display up-to-date weather information we need to call a few services from the cloud. Wunderground is a commercial weather website that provides real-time online weather information like temperature, pressure, humidity, wind gust, etc whenever or wherever we want. It provides the information collected from various services, including over 180,000 personal weather stations (PWS) [16]. Wunderground service is based on simple HTTP GET protocol where it sends the request to the stations, user and sensor information. It has its API, to get our own API key an account has to be created which is very quick and free. Similarly, Thingspeak is an open source internet



of things (IOT) platform or application uses HTTP protocol to store or retrieve the data from devices via the internet. It generates an API key for individual user and channels consisting of eight fields for storing the data and creates charts or graphs with those fields. A channel can be public or private for reading and writing the data. Thus the data is highly secure in this cloud services websites.

HTTP and MQTT are the two most widely used and available protocol as both are based on TCP/IP, and almost all computing devices have a TCP/IP stack with it. Table-3 gives the clear comparison between these two protocols, to help the developers choose the most suitable messaging protocol for applications [14].

TABLE III HTTP VS MQTT

PARAMETERS	HTTP	MQTT
Design orientation	Document centric	Data centric
Pattern	Request/Response	Publish/Subscribe
Message size	Larger, partly be-cause status detail is text based	Small, with a com- pact binary header just two bytes in size
Complexity	More complex	Simple
Extra libraries	Depends on the application (JSON, XML), but typically not small	Libraries for C (30KB) and JAVA (100KB)
Services levels	All messages get the same level of service	Three quality of ser- vice settings
Data distribution	1 to 1 only	Supports 1 to 0, 1 to 1, and 1 to n

VCC is positive power supply voltage and GND stands for ground, whereas SDA and SCL are the data lines of the I2C protocol. Pins connections of OLED with Wemos board are shown in fig:7. VCC and GND pins of OLED are connected to the 3V3 and GND pins of wemos D1 board respectively. Serial data (SDA) and serial clock (SCL) pins of OLED are connected to GPIO4 and GPIO5 pins of wemos board respectively. A micro USB cable is used in wemos for power supply. In the given figure we used four male-to-female jumper wires for connecting the components and they come with the weather station kit.

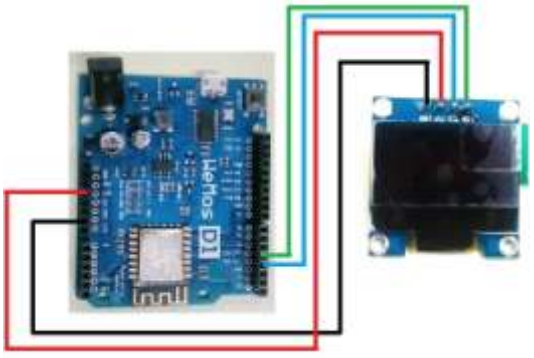


Fig. 7. Schematic diagram of the system

V. SOFTWARE REALIATION

Now, we have all the setup done and we are ready to post our climate data on to the cloud. In this proposed system we are using an Arduino code written in arduino IDE to update and retrieve the data to and from the cloud services. For configuration of weather station we need to set following section in the arduino code:

1. For wifi setting we need to set the ssid name of our wifi network and password with its own password.
2. In Time client setting section we need to adjust our local time zone offset compared to UTC time zone.
3. In the wunderground section the API key needs to be set which we received from the cloud database and also the name of country and city of the place we want to display.
4. In Thingspeak section its read API key and channel ID needs to be updated.

After setting of the code and flashing on the board we can successfully store and retrieve the climate data on our tiny OLED display.

Fig. 6. Simple service architecture of Thingspeak

IV. HARDWARE AND IMPLEMENTATION

Live weather monitoring system is realized using Wemos D1 board having an ESP8266 wifi module mounted on it and an OLED display. OLED display which has four connectors

VI. TESTING AND RESULTS

The complete hardware and software setup have been done in hardware and software realization section. A wifi network is created by client to get access the cloud services and microcon- troller. After flashing and updating the proposed system, the OLED display will start configuring the wifi connection and after updating the data to the thingspeak and wunderground it will display on an OLED, the climatic condition of the location mentioned in the arduino code. This system is cost effective as we are not using any DHT sensor which reduces the cost to a greater extent. As we have tested for the weather condition of warangal city we got following results in our OLED display.

Fig. 8. Display of current day, date and time

Fig. 9. Display of temperature

Fig. 10. Display of 3 days weather forecasting

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