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A Smart Gadget to Analyse the Weather Changes Using SenseHat Sensor and Internet of Things(IoT)

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Abstract

Objectives: In present days, as the technology improves day by day, every one seems to automate most of the possible things to take advantage in providing ease in life. The main objective of this paper is to develop project which monitors the weather with temperature, pressure and humidity values. **Method:** The proposed method is to build our very own weather dashboard, using Raspberry pi SenseHat and wifiusb nano adapter which captures the weather inside and outside of house over time and sends the data to ThingSpeak. **Findings:** The code used for the proposed method is developed in python language, which is a default programming language provided by Raspberry Pi and Store's the results in new channel API Thing speak key, which is an IoT application. **Improvements:** The reliability of the proposed work can be further improved by using Wireless Sensor Nodes at different places.

Keywords: API Key, Raspberry Pi, SenseHat, Thing Speak, Wi-fi Adapter

1. Introduction

Weather changes occurs in continuous motion in troposphere of the atmosphere, which is closest to earth of approximately 10 kilometres in depth which is below the stratosphere. With increased in height temperature is varied in different layers[1]. It is defined as the conditions of the atmosphere at a given time and place noted on day to day basis to observe the patterns of temperature, pressure, humidity etc., which helps in daily decisions about it. Nearly all the weather forecasts take place in the lower atmosphere. There are various weather forecast techniques which are used with the help of human intervention[2]. This problem can be overcome by using automatic weather monitoring station. An automated weather station is an instrument that measures and records meteorological parameters using sensors without intervention of humans[3,4].

1.1 About Internet of Thing

Mark Weiser introduced the concept of Internet of Things (IoT) forward in the early 1990's. The term Internet of Things was popularized by Auto-ID centre at MIT in 1999. It had begun to design and propagate RFID infrastructure. In 2002, its co-founder and former head Kevin Ashton was quoted by Forbes as saying, "We need an Internet of Things, a standardized way for computers to understand the real world". While many devices had network capability to connect to another[5]. The focus on IoT is in the configuration, control networking via internet of devices or "things" that are not affiliated to internet.It is one of the most hyped concept in today's technology world. Internet of things has unique identities of everything around us and can be connected to internet The identity can be anything-a vehicle, machinery, airport, city, people, phone or even a shoe. Today in this digital world technology IoT is no exception. With over 100+ vendors providing 100+ devices, services and platforms to build IoT applications. Experts forecast that by the year 2020 there will be a total of 50 billion devices/ things will be connected to the internet[5,6].

A practical micro weather station, which can sense temperature, relative humidity, pressure which is portable in size. By using Micro-Electro-Mechanical Systems

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(MEMS) technology, the process is used to calculate values in this process is simple[6]. Design and Implementation of monitoring the underground aquatic life by using Temperature sensor Tmp106 and pressure sensor MPL115A1 and display these parameters for defence and scientific applications[7]. The proposed design for interactive home automation by using raspberry pi interfaced with camera and developed the code on python software for capturing image then alerting client using smart phones and social networking sites which is economical and smart in today's world for providing better security and privacy[8,9]. Thehome weather station uses a PC to control and for data visualisation is done by the code written in c# with communication via USB or RS232 it is low in price due to absence of display elements and controls. Thus automatic weather station is used to update the various parameters related to weather and displays the values. In automatic weather station parameters would update automatically without the help of human intervention[10,11]. The pollution in the surrounding environment is increasing rapidly to overcome we can use sensors and the collected data can be shared among the sensors for environment usage by using Mobile Ad hoc NET works (MANET's) for low range communication[12]. A method for environment monitoring in large areas placing the sensors in different places and communicating with each other using mobile adhoc networks for sharing data. The monitoring of Patient health condition would be made easy by using raspberry pi attached with temperature and pressure sensor and information is shared by using wi-fi in the limited area and can be transferred to webpage visible for users[13]. The environmental monitoring system was designed by using single board i.e., Raspberry pi attached with Temperature, humidity sensors which senses the values and automatically sends the data to Internet of Things without the help of human intervention which is designed with the help of Python language[14].

2. Proposed Method

The proposed system is Raspberrry pi SenseHat based weather dashboard using Internet of Things(IoT). The objective is to design the automatic weather monitoring station. In this model Raspberry pi and Add on board SenseHat is used. To know about SenseHat i.e., found that in SenseHathas various sensors included, i.e., temperature, pressure, humidity, Inertial Measurement Units (IMU) sensors (accelerometer, gyroscope, magnetometer), joystick and 8x8 led matrix. In this proposed system temperature, pressure, humidity sensor are used and the values sensed data is sent through wi-fi adapter to web service i.e., ThingSpeak as per the program written in the python runtime environment in software implementation. The proposed work is implemented in two steps i.e., in Hard ware implementation and software implementation which is discussed below.

2.1 Hardware Implementation

The block diagram of proposed system is indicated in Figure 1, which depicts the model of smart weather station. The detailed information about the hardware components is provided in section 3.1.1,3.1.2,3.1.3,3.1.4.,3.1.5.

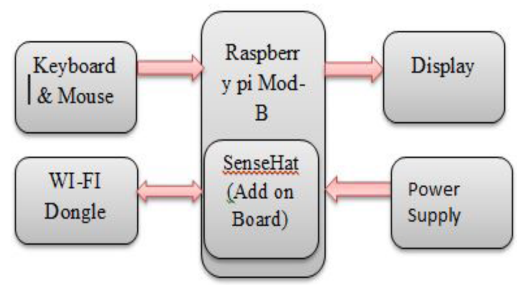

Figure 1. Block diagram of proposed system.

The system consists of Raspberrypi, SenseHat, Wi-fiadapter, power supply. The flowchart of the proposed method is indicatedin Figure 2 which describes clearly the working procedure of the module. First of all we have to create account in the ThingSpeak which is an webservice for IoT application. Then create the channel fields depend on application and give latitude and longitude for channel location. Attach the SenseHat Add-on-Board on top of the Raspberry pi B+ model then run the program written on python runtime environment which is default language provided by Raspberry Pi foundation. run the code and sense the values of Temperature, Humidity and Pressure in SenseHat ThingSpeak is easy to communicate the people and things by internet access of current status anyplace in the world, and visualize the parameters through graphical charts.

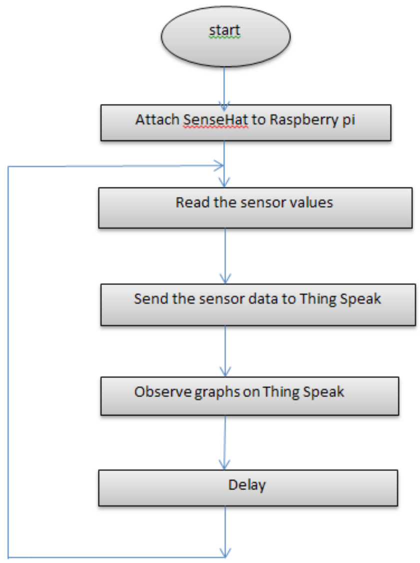

Figure 2. Flowchart of proposed system.

2.2 Raspberry pi Mod-B+

The Raspberry pi mod b+ is used in our model is a single board computer with Raspbianos or other small operating systems. It was developed by Raspberry Pi foundation in UK for the use of computer science education. The second version of the Raspberry Pi is used in this project is indicated in Figure 3. Which consists of an Broadcom BCM2835 ARMv6 Soc with full HD multimedia application Processor Chipset, which runs at Single Core @700 MHz clock speed, 512MB SDRAM@ 400 MHz, 4 USB port, one video and audio output, one HDMI output. It also has 40 pins. The Raspberry Pi needs an external Secure Digital (SD) card to store its operating system and also all the user data. Hence by such powerful microcontroller it can be used as alternative to CPU by interfacing external devices like mouse, keyboard, monitor. It is a capable to learn python and scratch language which is also capable of playing high definition videos and spreadsheet services, various web services[14].

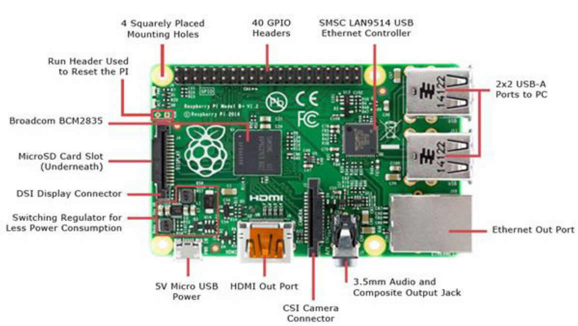

Figure 3. Raspberry pi B+ model.

2.3 Sense Hat

The Raspberry Pi Sense Hat is attached on top of the Raspberry Pi via the 40 GPIO pins (which provide the data and power interface) to create an 'Astro Pi' can be seen in Figure4. The Sense 'Hat' has several integrated circuit based sensors that you can use for many different types of experiments, applications, and even games.

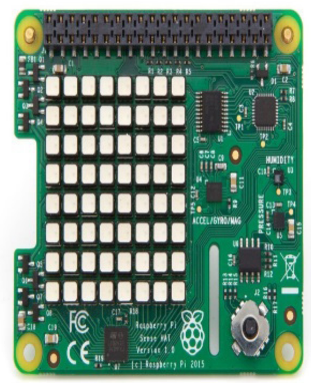

Figure 4. Diagram of SenseHat.

Technical Specification

- Gyroscope – angular rate sensor: ±245/500/2000dps
- Accelerometer - Linear acceleration sensor: ±2/4/8/16 g
- Magnetometer - Magnetic Sensor: ±4/8/12/16 gauss
- Barometer: 260 – 1260 hPa absolute range (accuracy depends on the temperature and pressure, ±0.1 hPa under normal conditions)
- Temperature sensor (Temperature accurate to ± 2° C in the 0-65° C range)
- Relative Humidity sensor (accurate to ±4.5% in the 20-80%rH range, accurate to ± 0.5° C in 15-40° C range)
- 8x8 LED matrix display
- Small 5 button joystick[15].

2.4 Power Supply

The power supply system driven by Raspberry Pi is very simple. It uses a Micro USB connection to power itself. The power source used for the device is a 9000mAh external battery for smart phones and tablets.

2.4 Steps to Install Raspbianos

- First step is to download Raspberry pi Supported Raspbainos.
- Install "Win32Disk Imager" application on your windows system.

- Insert SD card adapter into your system.
- Burn os into SD card using Win32 Disk Imager which can be seen from Figure 5.

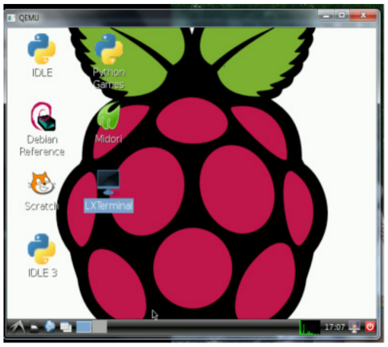

Figure 5. Installed raspbianos.

The hardware setup that is being used in this weather station model is dependent upon the software implementation. To utilize any of the hardware, we actually need to configure. The major hardware that is being used is Raspberry Pi SenseHat. This add-on-board is comprised of many sensors out of them only temperature, pressure and humidity are being utilised.

In the proposed model, the first part is to understand and utilise the hardware that can be properly used in the implementation process. The card sized minicomputer i.e., raspberry pi in this model is driven using python.The detailed information about software implementation is provided below.

3. Software Implementation

To start with SenseHat, it is required to update the kernel which is indicated in Figure 6. It is also required to initialise its library files as such the data can be retrieved from the hardware. The Raspberry pi is provided with UNIX kernel and to support the features of add-on-board SenseHat, the syntax below specified is used to update the kernel services of Raspberry pi.

sudo apt-get update

After updating of the kernel services, it is quite important to install the SenseHat package that is available to ensure the kernel is up-to-date, indicated in Figure 7 and to install the necessary libraries and programs in Raspberry pi can be. To perform this update it nearly

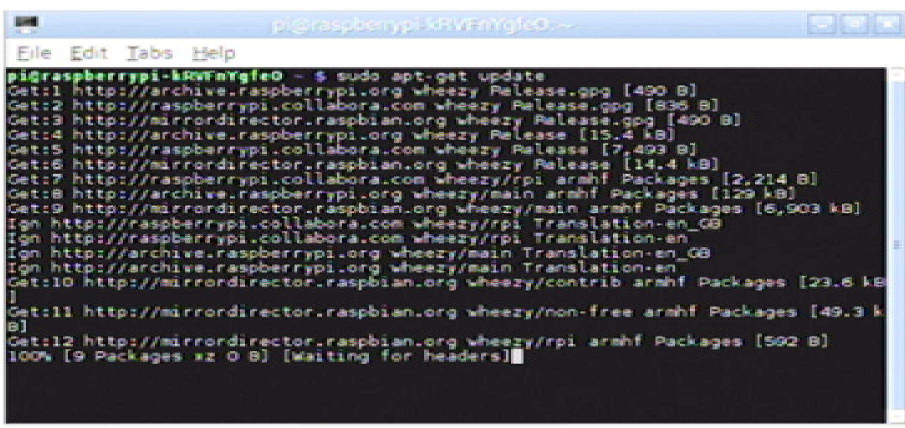

Figure 6. Installing the Raspbian updates.

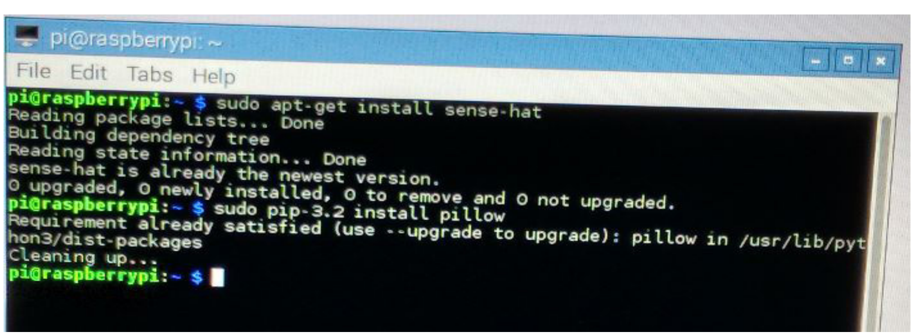

Figure 7. Installed SenseHat library.

2minutes of time. The syntax below is used to update SenseHat package

sudo apt-get install sense-hat

The final step is to reboot the raspberry pi.The reboot is performed to ensure that the updating process can make necessary changes in the kernel according to packages installed. To perform the rebooting operation the following syntax is used,

sudo reboot

4. ThingSpeak

The ThingSpeak Application Programming Interface (API) is an open source interface which listens to incoming data, timestamps it, and outputs it for both human users (through visual graphs) and machines (through easily parse able code). The SenseHat sends data to ThingSpeakStores in it and displays in the form of chart.

5. Experimental Results

The proposed system is defining itself as different from the existing system by updating the weather changes on web services using IoT, which helps to monitor the changes in the weather. The sensor values of temperature, pressure, Humidity obtained are shown in graphs.

The graph in Figure8 shows the variation of temperature from 36 to 37.5^{0} C periodically such as compact model can be utilised for various applications, where a keen observations in temperature changes are required to be updated.In the same manner the humidity and pressure changes periodically are plotted in Figure 9 and 10. These variations are being recorded automatically from the sensor Raspberry PiSenseHat.

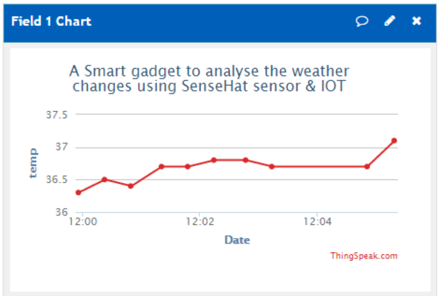

Figure 8. Temperature values in ThingSpeak.

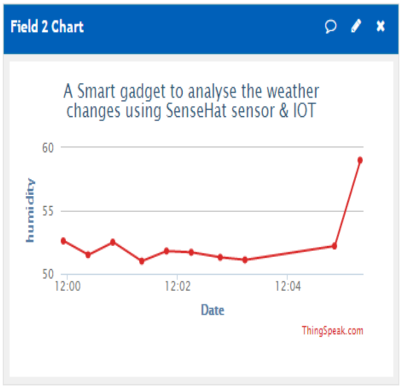

Figure 9. Humidity values in ThingSpeak.

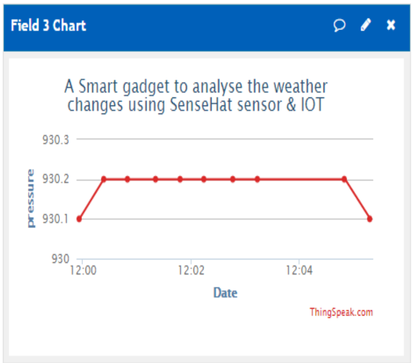

Figure 10. Pressure values in ThingSpeak.

At different monitoring points by removing the wired connections. This mode has outperformed the other models in its compact design and reliability. Thus it is to state that this smart weather monitoring system can be part of future generation's gadgets to monitor the changes from any location using IoT.

6. Conclusion and Future Scope

This paper proposes the development of a portable weather system to measure temperature, pressure and Humidity. Its importance is that it provides a reliable and practical tool to measure the parameters with a very simple device. The core component of the system which is newly available in market, SenseHat which is an Add-on-Board is utilised. In the present work this sensor values obtained are updated continuously from the point of observation to the point of monitoring using ThingSpeakIoT webservices. The main feature of the model is its compact design & continuous monitoring of temperature, pressure, humidity values. The reliability of the proposed work can be further improved by using Wireless Sensor Nodes at different places.

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