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An Effective Remote Monitoring System for Atmospheric Parameters Using Internet of Things (IoT)

Anurag S. Pingalkar[1]

[1]Dapartment of Electronics and Telecommunication, PDEA's College of Engineering, Manjari (Bk). Pune, Maharashtra, India.

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Abstract –

The system proposed in this paper is an advanced solution for keeping track of the weather conditions at a specific location and make the statistics visible globally. Internet of Things (IoT) is adding value to products and applications in the recent years. The technology behind this is Internet of Things (IoT), which is an advanced and systematic solution for connecting the things to the internet and connect the entire world of things in a network. The connectivity of the IoT devices over the network has widely reduced the power consumption, robustness and connectivity to access data over the network. IoT is powering many frontiers of industries and is seen as a promising technology to take Big Data Analytics to a level higher. The system deals with monitoring and keeps track of temperature, humidity, wind speed and direction, rainfall amount etc. The system displays these readings in real time on a display. It also keeps track of historical information on an hourly and daily basis. The data updated from the implemented system can be accessible in the internet from anywhere in the world.

Keywords- Internet of Things; GPRS Module; Sensors.

I. INTRODUCTION

The importance of weather monitoring is existed in many aspects. The weather conditions should be monitored to maintain the healthy growth in crops, to ensure the safe working environment in industries, etc. The primary motivation behind taking up this project is the large utility of the wireless weather monitoring in various areas ranging from agricultural growth and development to industrial development. The weather conditions of a field can be monitored from a distant place by farmers and will not require them to be physically present in order to know the climatic behavior at the location by using wireless communication. Due to technological growth, the process of reading the environmental parameters become easier compared to the past days. The sensors are the miniaturized electronic devices used to measure the physical and environmental parameters. By using the sensors for monitoring the weather conditions, the results will be accurate and the entire system will be faster and less power consuming. The system proposed in this paper describes the implemented flow of the weather monitoring station. Sensors are essential components in many applications, not only in the industries for process control but also in daily life for buildings safety and security monitoring, traffic low measuring, weather condition monitoring, etc. The advancement in technology has made these small and reliable electronic sensors capable of monitoring environmental parameters more favorably.

The system monitors the weather conditions and updates the information to the webpage. The reason behind sending the data to the webpage is to maintain the weather conditions of a particular place can be known anywhere in the world. The weather condition is also displayed on the system LCD. The system consist of Temperature and Humidity sensor combined which is Hygroclip, wind direction sensor, which is Potentiometric wind vane, wind speed sensor which is Three Cup Chopper Anemometer and rain quantity sensor which is Rain Gauge. These are standard sensors used in IMD (India Meteorological Department) for weather forecasting. The system is intended to be used at hill station, large residential buildings, airports, manufacturing industries, etc. The system contains a microcontroller to process all the operations of the sensors and other peripherals. The wireless communication standard was chosen in my system by analyzing the requirements of the application, that the weather conditions should be monitored and updated all the time continuously. There are many local area network standards for communication, but they are all standalone communication processes and completely localized communication. In my application, I have to make the weather condition of a particular place can be informative anywhere worldwide. The other communication technologies like ZigBee, RF Link can make the communication nearly in the same range of Wi-Fi but they can't broadcast the information as they can only communicate peer to peer therefore I am using GPRS module as my communication device of system. The World Wide Web (www) needs to have one client – server configuration for communication. Its client needs to be connected to the server with its IP address, which can be universally accessible. The GPRS module at certain period updates the information to the webpage through the server. The system is equipped with all sensor devices should acts as client to send the data to the web server. For establishing a connection between the sensor network and internet, I used a GPRS module as an additional communication interface controlled by the microcontroller. A GPRS module requires a source of internet connection with the help of SIM card. After configuration of the GPRS module with an internet source, it acts as client and sends the sensor data retrieved by the microcontroller and I can access it from anywhere using internet. The idea of connecting all the sensors to the internet is Internet of Things (IoT).

<u>Internet of Things (IoT)</u>:

It is the future technology of connecting the entire world at one place. All the objects, things and sensors can be connected to share the data obtained in various locations and processes/analyses that data for coordinating the applications like traffic signaling, mobile health monitoring in medical applications and industrial safety ensuring methods, etc. IoT offers a wide range of connectivity of devices with various protocols and various properties of applications for obtaining the complete machine-to-machine interaction.

The traditional technologies like home automation, wireless sensor networks and control systems will become more efficient and smarter due to involvement of IoT. IoT is

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having a wide range of application areas, such as Medical applications for monitoring the health of a patient, etc. The present developing Wearable instrumentation is also based on IoT. The example wearable instrumentation is Smart wristbands, navigation pills, etc. All these methods require an internet interface to update the health information or to control the device with a smart phone. The IoT also plays a vital role in media applications for advertising and exchanging the information worldwide. The manufacturing processes also require IoT for supply chain management, digital control systems for monitoring the manufacturing processes. The space requirements of IoT technology, the geographical specifications are always important in case of tracking applications. The geographical dimensions of objects is also important while obtaining the data from the objects. IoT in automobile applications and traffic maintenance became a most using area of automation. The automated devices in a vehicle should be connected to a cloud to update the car health within a period. By connecting the vehicles and traffic signaling systems to the internet, people can easily find the shortest path for their destination from the traffic monitoring systems and can navigate automatically by checking all other directions.

II. LITERATURE SURVEY

The survey has firstly done on standard technologies to establish a standard sensor network. Study went on choosing the suitable standard sensors. It should be suitable in all aspects like economic and technological. The primary concern I have to make while choosing the communication method is range of communication. Here I have chosen SIM900A GPRS module. When I give an internet source, the data can be exchanged anywhere in the world through its IP address. The further study has done on selecting the microcontroller. The system implementation is contained with a hidden goal of achieving low power consumable solution. The microcontroller should be also low power consuming alongside all the remaining sensors. I chose LPC2138, which is low power microcontroller and works with only 2.0V to 5.5V.

The next study went for the system to store the output data of sensors. The data collected from the sensors is mostly in the form of integer values representing the value of environmental parameter. After storing the data in the SD card, then with the help of IoT, the data of SD card is stored on the web page. SD card is my temporary storage on system. The web page displaying the data of sensors directly will not make a simpler impression for the users. It should be in a graphical representation for easy understanding of the users. The data hosted on an own webpage will be more expensive and have to pay for it in a rental basis. To make the system less expensive, I preferred some free data hosting websites who provides a cloud space for my sensor data to make it universal and makes the system less expensive.

III. PROPOSED ARCHITRCTURE

The implemented system consists of a microcontroller (LPC2138) as a main processing unit for the entire system and all the sensor and devices can be connected with the microcontroller. The microcontroller to retrieve the data from them can operate the sensors and it processes the analysis with the sensor data and updates it to the internet through GPRS module connected to it. In the above block diagram, there it is showing the main elements in the proposed system.

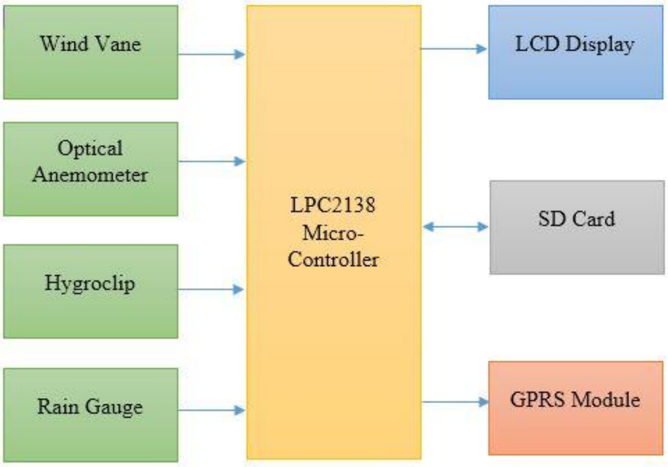

Fig. 1: Block Diagram

LPC2138:

A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30% with minimal performance penalty.

GPRS Module:

SIM900A Modem can work with any GSM network operator SIM card just like a mobile phone with its own unique phone number. The SIM900A is a complete Quad-band GSM/GPRS solution in a SMT module, which can be embedded in the customer applications. Featuring an industry-standard interface, the SIM900A delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power Consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM900 can fit almost all the space requirements in your M2M application, especially for slim and compact demand of design. SIM900A modem uses AT commands to work with supported features. SIM900 is designed with a very powerful single-chip processor by integrating AMR926EJ-S core. SIM900A GSM/GPRS modem is plug and play modem with RS232 serial communication supported.

Sensors:

The system consists of Hygroclip: temperature and humidity sensor, Potentiometric Wind Vane: wind direction sensor, wind speed sensor and rain quantity sensor.

1) Hygroclip: Hygroclip is a combined sensor for both temperature and relative humidity. The basic sensor for relative humidity is a thin polymer, which is having the property to absorb moisture from the air, and changes its electrical permittivity in proportion to the relative humidity. Hygroclip requires +12V dc power at field. It has a measuring range of 0-100% for relative humidity and -40°C to 60°C for temperature. Its output is 0-1000mV.

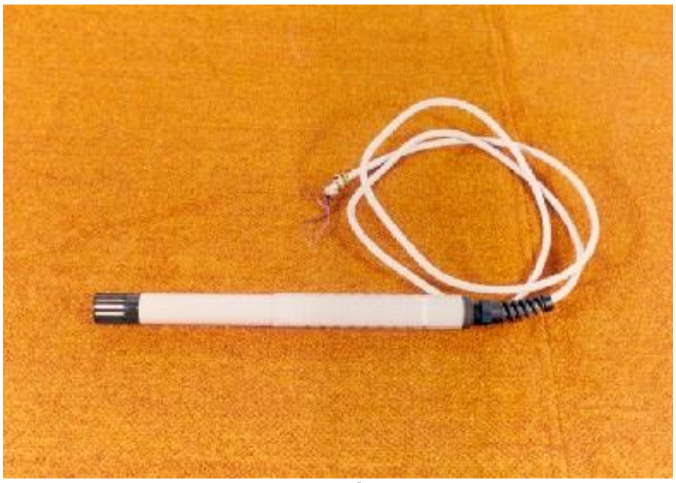

Fig. 2: Hygroclip Sensor

2) Potentiometric Wind Vane: The sensor used for measurement of wind direction is an IMD-make potentiometric wind vane. The potentiometer in the wind vane is a servo-micro torque potentiometer and has a maximum resistance of 10 kilo-ohms over an end gap of about 4 degrees. The variation of 0-360 degree corresponds to 0 to 10 KΩ.

Direction	Resistance
North	0KΩ
East	2.5KΩ
South	5KΩ
West	7.5KΩ

Table 1: Reading of Wind vane

Fig. 3: Potentiometric wind vane

3) Three-Cup chopper anemometer: The sensor used for wind speed measurement is the IMD make three-cup anemometer. The sensor chops IR beam using chopper tooth. System uses an opto coupler for this purpose. No. of chopped electric pulses per min is proportional to the Wind speed. The square pulses are maintained at 0 to 5Volts using Schmitt trigger IC. Later sent to Micro controller which directly gives value of Wind Speed in RS232 format (Data bits: 8, Parity: None, Stop Bits: 1, Baud rate: 4800). Chopper anemometer is automatically calibrated in Wind Tunnel by using standard alcohol manometer. At least 10 readings are taken on wind tunnel by generating different wind speeds, difference in chopper anemometer reading and standard wind speed computed from Manometer is entered in the memory unit of Chopper anemometer thorough same RS232 port, so that anemometer gives wind speed with an accuracy of ±2% of true wind speed up to 100Knots after completion of calibration. A Digital to Analog convertor IC used in the Anemometer to give directly 0 to 4Volts DC for 0 to 100Knots Wind Speed.

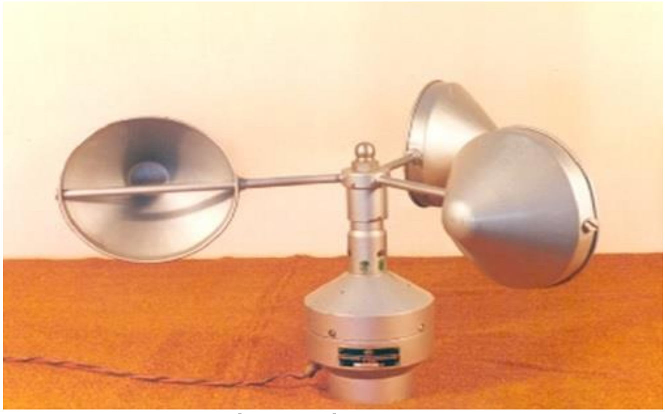

Fig. 4: Three-Cup chopper anemometer

4) Rain Gauge*:* The Tipping Bucket Rain Gauge (TBRG) consists of a funnel that collects and channels the precipitation into a small seesaw-like container. After a pre-set amount of precipitation falls, the lever tips, dumping the collected water and sending an electrical signal. An old-style recording device may consist of a pen mounted on an arm attached to a geared wheel that moves once with each signal sent from the collector. In this design, the wheel turns the pen arm moves either up or down leaving a trace on the graph and at the same time making a loud click. Each jump of the arm sometimes referred to as a 'click' in reference to the noise. The chart is measured in 10-minute periods (vertical lines) and 0.4 mm (0.015 in) (horizontal lines), rotates once every 24 hours and powered by a clockwork motor that must be manually wound.

Fig. 5: Rain Gauge

IV. SYSTEM FUNCTIONALITY

The system functionality includes the working process of the entire system after integrating all the peripherals along with software. The system works in three phases, one is reading the data from the sensors, and another one the data stored in SD card and finally sends the data to the server (webpage). The output of sensors some of them are analog and some are directly gives the digital output. The analog output data of sensors provided to the analog to digital convertor (ADC) to be converted into digital form. This part of process done by the data acquisition block of my system. Gathering all this data in SD card through microcontroller.

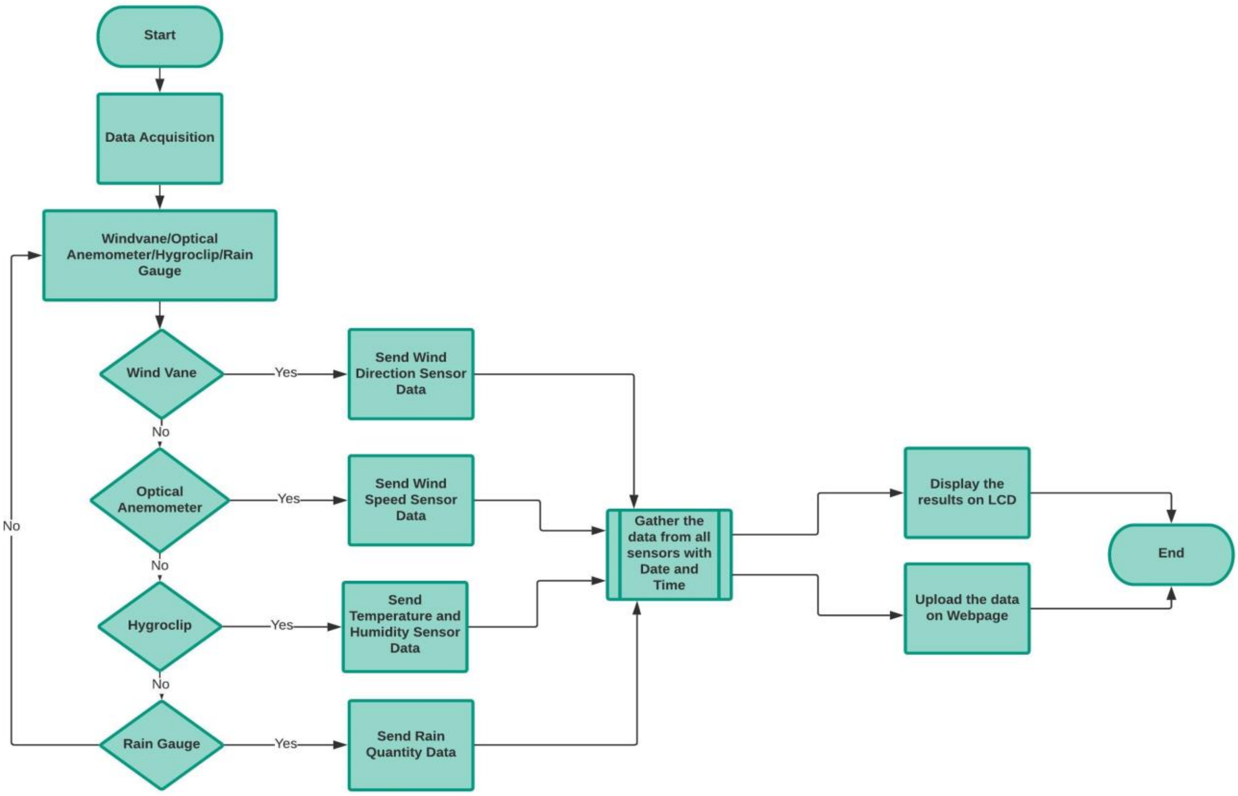

Fig. 6: Flow Diagram

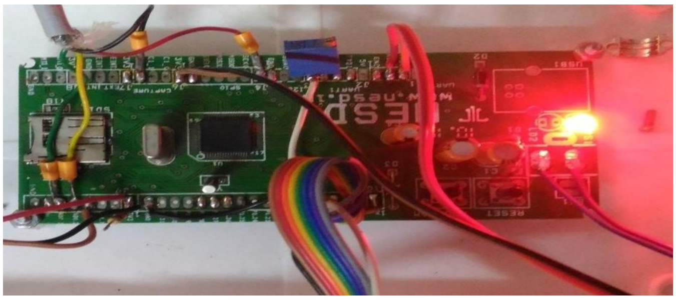

Fig. 7: Circuit Diagram

The Microcontroller gathers the data sensed by the sensors and evaluates the values. The obtained sensor values will be displayed on LCD and sent to the server and a plot can be drawn in the channel by considering the given sensor values as Y-axis and time and date as X-axis. The only limitation in updating the values is on webpage can be updated once for 10 minutes.

V. CONCLUSION

The research and implementation of a system for monitoring the environmental parameters using IoT scenario is accomplished. To implement this need to deploy the sensor devices in the environment for collecting the data and analysis. The system provides a low power solution for establishing a weather station. The system is tested in an indoor environment and it is successfully updated the weather conditions from sensor data. It is also a less expensive solution due to usage of low power wired sensors and SoC contained GPRS module. This data will be helpful for future analysis and it can be easily shared to other end users.

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