Wireless Sensor Network based Smart Home Monitoring System using LoRa

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Abstract:**The aim is to design and develop a wireless sensor network (WSN) infrastructure for a smart home using the Internet of Things (IOT) which can be used to monitor different devices and to update the user with real-time data.It enables remote monitoring of conditions inside the home and creates an alert when any one of the values goes beyond the threshold value, and that is detected by unique buzzer sound, the sensor data are constantly monitored for each sensor node which are connected together by Lora Wireless module capable of long range transmission, It handles and supports low power consumption and multiple environment monitoring sensors. The LoRaWAN (Long Range Wide Area Network) module is used to connect sensors to the microcontroller which can be connected to the internet. It is mainly focused on monitoring Smoke, Humidity, Temperature environmental condition parameters.In this project, we have built a system for smart home using LoraWAN which is interfaced with a temperature sensor, a smoke sensor (MQ137 and MQ7), flame sensor and buzzer.**

Keywords— LoRaWAN, IOT, WSN, home automation

I. INTRODUCTION

The home-based Internet of Things is not completely fresh. In the initial, the general use of High-speed Internet and the held together Internet-based home net system quickly extended. The current overview of the home IoT is an allowance of the present raised by the growth of the wireless Internet surroundings and machine to machine (M2M) technology. Though the prevailing home net has restrictions in development in order to predominant use of the reinforced linkage, the existing home IoT can attach more varied procedures on justification of the progression of associated wired tools. [1]

Wireless sensor network (**WSN**) is a collection of disseminated and dedicated sensors for observing and documenting the status of the environment and organizing the collected data at a central location. WSNs evaluates environmental conditions like temperature, sound, pollution levels, humidity, wind and helps by alerting us. [2]

Home automation is constructingautomation for a home, called a **smart home** or **smart house**. A home automation method will monitor the surrounding parameters. It might also contain home safety such as access regulator and alarm methods. Once associated with the Internet, home-based policies are a significant essential of the Internet of Things.

A home based mechanization scheme characteristically links precise procedures to a "gateway". The customer interface for regulating the system customsone or the other wall-mounted workstations, desktop computers, an android application, or a Web interface, that may also be reachable off-site over the Internet.[3][16]

Though there are many works/research are done related to wireless sensor network based smart home monitoring system using IoT technologies and the protocols like ZigBee, XBee, etc., through WSN methods in order to collect the data and to determine the result. But the ideas were not able to implement in real time as there are many constraints and requirements.

The existing idea is based on ZigBee and XBee Using WS methods and the methods were not able to implement in real time and the determined results were not appropriate.

Meanwhile our project uses simpler components such as a PIC microcontroller, LoRa gateway, and sensors like DHT11, Flame sensor, MQ137 sensor, MQ7 sensor, and a buzzer for generating the alarm for the user.

II. DESCRIPTION OF PROPOSED SYSTEM COMPONENTS

The purpose of this system is to offer an architectural scheme for the smart home monitoring System. The nodes collects the data through the sensors and the data is passed to the thingspeak server through the LoRa gateway. Then the data's are monitored in order to prevent the causes by making the beep sound through the buzzer. It is programmed with C language.

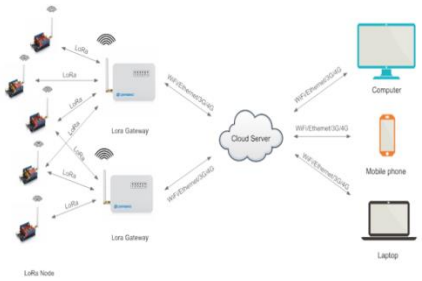

Fig 1: System Architecture

A. ARDUINO ATmega328

ATmega-328 is essentially an Advanced Virtual RISC (AVR) micro-controller. 8 bit data is supported. ATmega-328 has 32KB internal in-built memory storage. The micro-controller takes a lot of additionalfeatures. ATmega 328 has EEPROM. Even when there is no power supplied to the micro-controller the data is stored and that data could be retrieved once the power is supplied to the micro-controller. Furthermore, ATmega-328 has 2KB (SRAM). The ATmega 328 has become most popular device in market, as it has several different

characteristics. The characteristics contains the advanced RISC architecture, the performance of the system is good, the power consumed is less, 6 PWM pins, and programmable Serial USART, throughput up to 20 MIPS etc. ATmega-328 is typically used in Arduino.

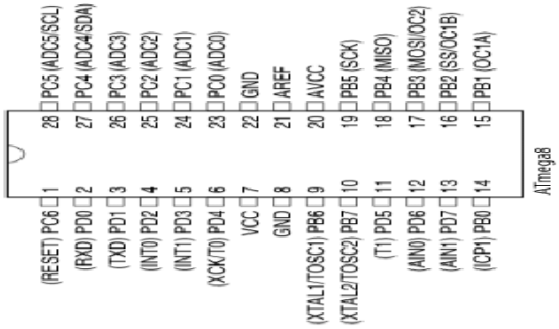

Fig 2: PIN diagram of ATmega 328

B. DHT11 SENSOR:

The DHT11 Temperature and Humidity Sensor topographies a standardized numerical indication production with the temperature and humidity sensor ability. It is combined with a high-performance 8-bit microcontroller. Its knowledge guarantees the high dependability and brilliant lasting constancy. This device comprises a resistive part and a device for wet NTC temperature computing strategies. It has brilliant excellence, fast response, anti-interference capability and high presentation.

Each DHT11 devices topographies tremendously precise standardization of humidity standardization chamber. The standardization constants stowed in the OTP package recollection, interior devices sense signs in the process. The creation is 4-pin solitary row pin package. Suitable linking, singular suites can be providing permitting to operators need.

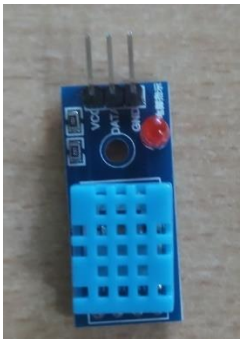
Fig 3: DHT11 Sensor

C. MQ-137 GAS SENSOR

The **MQ-137 Gas sensor** can notice or portion gasses like Ammonia (NH3) and Carbon Mono-oxide (CO). The component variety of this instrument derives with an Ordinal Bit which makes this device to function uniformly without a microcontroller and that originates in nearby once you are only annoying to notice one specific gas. Once it originates to calculating the gas in ppm the similarity bit has to be used, the analog pin is also TTL focused and workings on 5V and later can be used with greatest mutual microcontrollers.


Fig 4: MQ137 Gas Sensor

D. MQ-7 GAS SENSOR

SnO2 is the sensitive material of MQ-7 gas sensor, which has lesser conductivity towards air. It makesrecognition by technique of series high and low temperature, and notice CO when the temperature is low. As the gas concentration increases the senor's conductivity also increases. The other gases which are adsorbed under the low temperature, are cleaned when the temperature goes high. Carbon Monoxide is easily sensible by MQ-7 gas sensor. MQ-7 gas sensor can easily detect the different gases which contains CO, with low cost and it is suitable for different applications.

Fig 5: MQ7 Gas Sensor

E. FLAME SENSOR

The flame sensor can notice fire and infrared light bases with wavelengths fluctuating from 760 nm to 1100 nm. It practices the LM393 comparator chip, which stretches a sparkling, steady digital output gesture and pouring capability of 15 mA. This spark sensor that can be used in fire agitations and extra fire noticing strategies.


Fig 6: Flame Sensor

F. BUZZER

A buzzer is a small yet well-organized constituent to add complete landscapes to our project/system. It is very minor and dense 2-pin configuration later can be effortlessly used on breadboard. Board and smooth on PCBs which varieties this is an extensively used module in most automated uses.

There are two types are buzzers that are usually accessible. It is a simple buzzer which when motorized will make an unremitting Beeeeeeppp.... sound, the other type is called a convenient buzzer which will appear bulkier than this and will yield a Beep. Beep. Beep. Sound due to the inner wavering trail present inside it. But, the one used in this project is most generally used since it can be modified with assistance of additional paths to fit effortlessly in our application.

Fig 7: Buzzer

G. THINGSPEAK:

ThingSpeak is an exposed data stage for the Internet of Things. The device or an request can connect with ThingSpeak by means of a RESTful API, and the information could be made as isolated or community built on the worker. In adding, we use ThingSpeak to examine and act on the information. ThingSpeak delivers a connected text editor to do data examination and visualization using MATLAB. ThingSpeak is used for varied uses reaching from climate data collection and examination, to harmonizing the color of lights through the world.

The core of ThingSpeak is a time-series file. ThingSpeak delivers operators with free time-series data storing in stations. Each station can comprise up to eight data fields.

Fig 8: Thingspeak Cloud.

III. PROPOSED SYSTEM

This paper is based on the deployment of the LoRa Technology along with the WSN in order to build a real time application for monitoring the air quality. As the LoRa technology has many advantages when compared with other protocols it would be easy to build the system. The Thingspeak is used in order to store the data collected from the different WSN nodes and the buzzer will make a beep sound if sensor the data goes beyond the threshold value. Hence the user can take the appropriate measure in order to prevent the causes.

Advantages:

- Easy to build.
- It would be easy to add extra nodes.
- It provides the accurate result when compared to other methods.
- It is easy to store the data and to handle it.
- This is applied in real time application.

IV. METHODOLOGY

The purpose of this system is to offer an architectural scheme for the smart home monitoring system. The various WSN nodes collects the data through the sensors and the data is passed to the central thingspeak server through the LoRa gateway. Then the data's are monitored using a buzzer. The buzzer makes a beep sound when the sensor data goes beyond the threshold value. This smart home monitoring system is done in order to avoid the dangerous issues as fast as possible and the user can take the necessary actions based on the result. The result could be seen in desktop, Laptop and in Android phones.

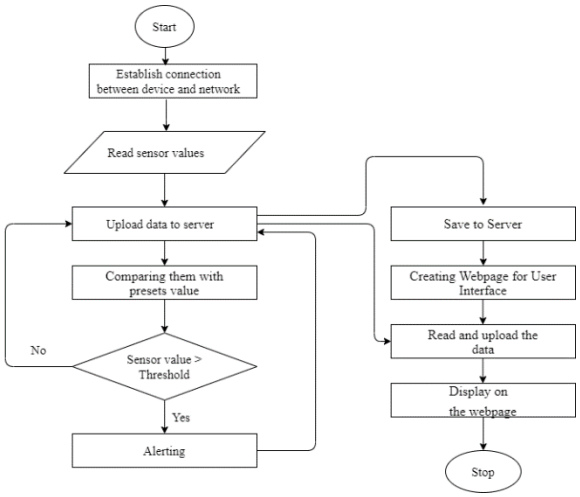

Fig 9: Flow chart of the WSN based smart home monitoring system using LoRa

V. RESULTS AND DISCUSSIONS

The WSN based smart home monitoring system using LoRa is designed with 4 WSN nodes and the snapshots of the project model are well-defined in the figures. By giving precise inputs the results are as per and predictable output. In this we have learnt a method to start with the LoRa module, design it, and check that here strength be correspondence set up among the unit and some additional device from arduino with a voltage divider to drop from 5v to 3.3v.

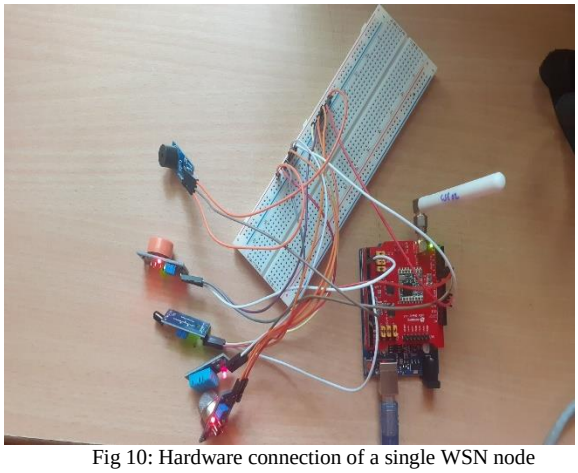

Fig 10: Hardware connection of a single WSN node

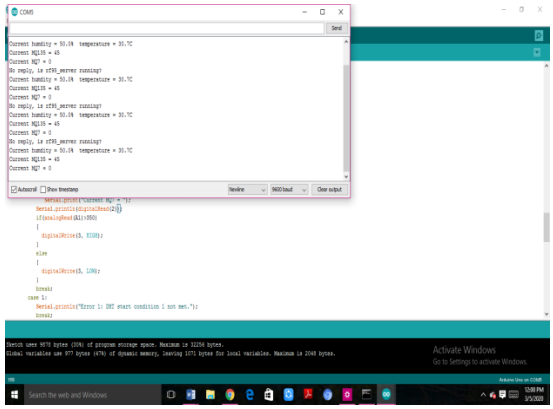

Fig 11: the output of different sensor in serial monitor after connecting to the server

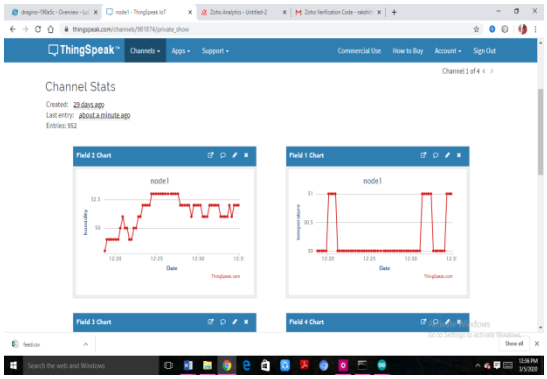

Fig 12: the graph of different sensor nodes in the Thingspeak server

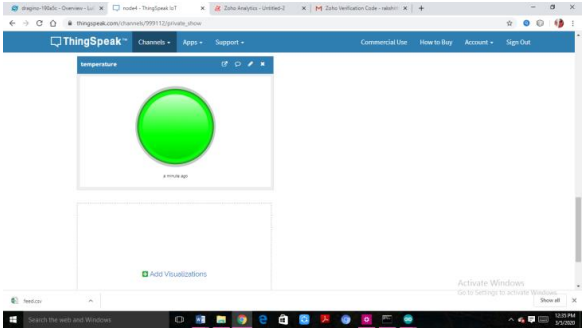

Fig 13: The widget can be used in Thingspeak Server where the bulb widget will turn on when the sensor data goes beyond the threshold value and gets off when the data of the sensor goes beneath the threshold value

VI. CONCLUSION

The component is useful and carries information reading from sensors, processing and spreading them to a central unit. The component is self-governing, takes an indigenous power source and communicates via LoRa gateway with a smartphone, tablet, laptop, etc. With the help of a smart phone via Bluetooth and Infrared communication we can switch the equipment in the locations climate. The central unit attaches to the Internet via WiFi, and over the devoted request installed on the mobile, we could see the data delivered by components, the consumption of power is lowletting the scheme to function for extendederas of period. The component can be enhanced by assigning sensors for gas detection, flame sensor in order to detect the flame, temperature level detection, humidity level detection etc.With this data we can create graphs on temperature, humidity and the other sensor data.

In future the android application could be developed.

VII. ACKNOWLEDGMENT

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