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Wireless Sensor Network (WSN) based weather monitoring in flood disaster management by using IOT

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***Abstract*— WSN is a self configured and infrastructure less wireless network to monitor physical and environmental condition. IOT provides internetworking of physical devices, building, vehicles and other components like sensors and actuators. This paper present the real time monitoring of different environmental parameters, detect and forecast threatening flood disaster using IOT and WSN. WSN is preferred due to its cost effectiveness, faster transfer of data and accurate computation of required parameter for weather monitoring in flood disaster. WSNs are integrated into the "IoT", where sensor nodes join the Internet dynamically, and use it to collaborate and accomplish their tasks. Wireless sensor networks (WSN) are well suited for long-term environmental data acquisition for IoT representation. Weather monitoring are made by collecting quantitative data about the current state of the atmosphere in a given place and use scientific understanding of atmospheric processes to project how the atmosphere will evolve on that place.**

***Index Terms*— WSN, IOT, sensors, Ardunio microcontroller, LCD.**

I. INTRODUCTION

A. Wireless Sensor Network (WSN)

Wireless Sensor Network (WSN) is a wireless network consisting of spatially distributed autonomous devices using sensors to monitor physical or environmental conditions. A WSN system incorporates a gateway that provides wireless connectivity back to the wired world and distributed nodes. Wireless Sensor Networks (WSNs) can be characterized as a self-designed and framework less remote systems to screen physical or natural conditions, for example, temperature, sound, vibration, weight, movement or contaminations and to agreeably give their information through the system to a principle area or sink where the information can be watched and examined. A sink or base station acts like an interface amongst clients and the system. One can recover required data from the system by infusing inquiries and social affair comes about because of the sink.

The term sensor network refers to a heterogeneous system combining tiny sensors and actuators with general purpose computing elements. Sensor networks may consist of hundreds or thousands of low-power, low-cost nodes, possibly mobile but more likely at fixed locations, deployed en masse to monitor and affect the environment. Sensor networks often have one or more points of centralized control called base stations. A base station is typically a gateway to another network, a powerful data processing or storage center, or an access point for human interface. They can be used as a nexus to disseminate control information into the network or extract data from it. In some previous work on sensor network routing protocols, base stations have also been referred to as sinks.

Regularly a remote sensor contains a huge number of sensor hubs. The sensor hubs can convey among themselves utilizing radio signs. A remote sensor hub is furnished with detecting and processing gadgets, radio handsets and power parts. The individual hubs in a remote sensor organize (WSN) are naturally asset obliged; they have constrained handling speed, stockpiling limit, and correspondence transmission capacity. After the sensor hubs are sent, they are in charge of self-sorting out a suitable system framework frequently with multi-jump correspondence with them. At that point the locally available sensors begin gathering data of intrigue. Remote sensor gadgets likewise react to inquiries sent from a "control site" to perform particular directions or give detecting tests. The working method of the sensor hubs might be either ceaseless or occasion driven. Worldwide Positioning System (GPS) and nearby situating calculations can be utilized to get area and situating data. Remote sensor gadgets can be outfitted with actuators to "act" upon specific conditions. These systems are in some cases all the more particularly alluded as Wireless Sensor and Actuator.

A wireless sensor node is equipped with sensing and computing devices, radio transceivers and power components. The individual nodes in a wireless sensor network (WSN) are inherently resource constrained; they have limited processing speed, storage capacity, and communication bandwidth. After the sensor nodes are deployed, they are responsible for self-organizing an appropriate network infrastructure often with multi-hop communication with them. Then the onboard sensors start collecting information of interest. Wireless sensor devices also respond to queries sent from a "control site" to perform specific instructions or provide sensing samples. The working mode of the sensor nodes may be either continuous or event driven. Global Positioning System (GPS) and local positioning algorithms can be used to obtain location and

positioning information. Wireless sensor devices can be equipped with actuators to "act" upon certain conditions. These networks are sometimes more specifically referred as Wireless Sensor and Actuators.

B. IoT means Internet of Things:

Internet of Things is a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual "things" have identities, physical attributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the information network, often communicate data associated with users and their environments. IoT refers to physical and virtual objects that have unique identities and are connected to the internet to facilitate intelligent applications that make energy, logistics, industrial control, retail, agriculture and many other domains "smarter" [1]. It provides inter-networking of physical devices, buildings, vehicles and other components like sensors and actuators. By giving network connectivity to systems embedded with electronics, software, sensors and actuators; these objects are able to collect and exchange data. By using IoT objects to be sensed or controlled remotely through existing network. It gives opportunity to connect physical world with computer-based systems. IoT improves efficiency, accuracy, economic benefits along with reduced manpower. IoT frameworks help for the interaction between "things". It also supports for more complex structures like distributed computing and development of distributed applications. Now a days most of IoT frameworks seem to focus on real-time data logging solutions. By utilizing IoT articles to be detected or controlled remotely through existing system. It offers chance to interface physical world with PC based frameworks. IoT enhances proficiency, precision, financial advantages alongside decreased labor. IoT structures help for the cooperation between "things". Additionally underpins for more mind boggling structures like circulated processing and improvement of conveyed applications. Fig 1.1 reviews that with the internet of things, anything's will able to communicate to the internet at any time from any place to provide any services by any network to anyone. this concept will create a new types of applications can involve such as smart vehicle and the smart home, to provide many services such as notifications, security, energy saving, automation, communication, computers and entertainment.

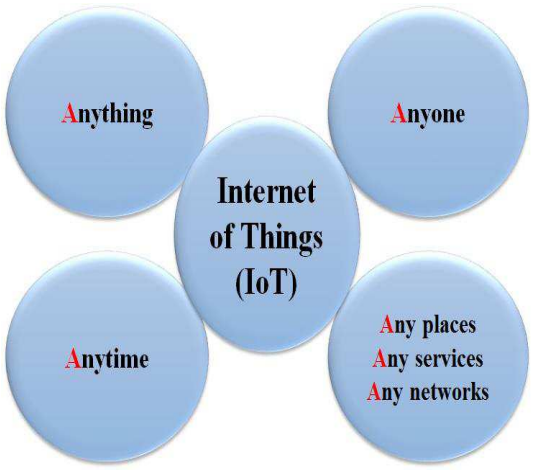

Fig 1.1 Internet of things Concept

C. Arduino microcontroller:

Arduino, is a single board microcontroller to make using electronics and acting as data logger process the converted output of sensors from analog to digital. The logged data can then be transferred to a desktop or any other monitor has GUI for further analysis. By using easily obtained components and less complicated circuitry powerful weather station can be build. Ardunio Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins, 6 analog inputs, a USB connection, a power jack, an ICSP header and a rest button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or battery to get started. It runs with Ardunio software 1.0.

II. LITERATURE SURVEY

2.1 K C Gouda1, Preetham V R and M N Shanmukha Swamy [2] proposed a system for microcontroller based real time weather monitoring device with GSM. A device for real time weather monitoring is presented in this paper to monitor the real time temperature, atmospheric pressure, relative humidity and temperature of the atmosphere via GSM network, using analog and digital components. The analog outputs of the sensors are connected to a microcontroller through an ADC for digital signal conversion. An LCD display is also connected to the microcontroller to display the measurements. For analysis and archiving purposes, the data can be transferred over GSM and receiver section is connected to PC. Received data is further processed to generate graphical display using weather modeling algorithms. The device has many advantages compared to other weather monitoring systems in terms of its smaller size, on-device display, low cost, portable and robust.

2.2 Arko Djajad et al. [3] have presented their system for ambient environmental quality monitoring using IoT sensor network. In this system sensors are connected to Net Client via serial interfaces such as Modbus or I2C. Data collection is then sent to Fog net by TCP/IP. Data from all environmental sensors act as input to Arduino ATMega2560 board. This board needs Wi-Fi module to connect to Wi-Fi router. This result can be sent to the web-server to achieve online

monitoring purpose. Result can be accessed by electronic devices such as laptop or hand phone as long as it is connected to internet. Sensors used are ambient light sensor, DHT11 for temperature and humidity sensor, sound sensor, sensor MG811 for carbon dioxide, sensor MQ7 for carbon monoxide, sensor MQ6 for LPG and sensor MQ3 for alcohol. All environmental sensors used are analog sensors. Hence, these sensors can be connected to analog pin of Arduino. In this research two communications are used, Serial for communication between Arduino and PC, and Serial1 for communication between Arduino and ESP8266. The Wi-Fi connection allows for data transmission from the Arduino node directly to web servers using standard HTTP protocol. They can be local servers or global external servers, such as free IoT server thingspeak.com in this case. Outputs can be seen in graphical form.

2.3 Nikhil Ugale et al. [4] have proposed the system based on IoT for environmental condition monitoring in homes. The proposed system use different sensors light, temperature, level and humidity to collect the data to monitor the environmental conditions and also to detect any fault in devices. PIC microcontroller is used to control and monitor all the sensors connected to it. Different sensors are placed against different devices to check the functionality of the devices. Once device turn on sensor will sense the functionality of the device if it is not working properly then automatically e-mail or SMS will send to the service provider as well as user. Also one more functionality is added that device can turn on and off through cell phone as well as to get full functionality details of device through SMS. This system has successfully demonstrated a new IoT architecture that lets existing embedded systems be integrated into the IoT network. “Internet of Things” is very effective for home automation and effective utilization of home appliances. Using this Low-cost system device can be connected easily and corresponding information can be globally accessible.

2.4 Indira Priyadarshinee, Kabita Sahoo, Chandrakant Mallick [5] proposed a system flood prediction and prevention through wireless sensor networking. This system is used for traffic monitoring, predicting and preventing natural climates like flooding, earth quake etc. it consist of three different type of nodes, they are sensing node to read the data like water level and water speed, computational node for transferring the sensed data, intermediate node for providing interaction between the nodes and water is managed to predict and prevent flood at barrage. Two types of computational nodes are used. (i)local computational node and (ii) managing computational load. The rate of flushing is computed at managing node and send to local office. If the local computational load fails to transfer the data to the managing computational load then the intermediate node helps in transferring the data. In this way flood could be prevented due to sudden flushing of huge amount of water from barrage at a time.

2.5 Kondamudi Siva Sai Ram, A.N.P.S Gupta [6] proposed a system IOT based data logger system for weather monitoring using wireless sensor network. It is used to monitoring the weather condition at a particular place and makes the information visible anywhere in the world. The system deals with monitoring and controlling the environmental conditions like temperature, humidity, light intensity using sensors and send the information to the web page and then plot the sensor data as graphical statistics. The data updated from the implemented system can be accessible in the internet from anywhere in the world. It is a less expensive solution due to usage of low power wireless sensors.

2.6 Adil Hamid Malik, Aaqib Jalal, Bilal Ahmed Parray, Meena Kohli [7] proposed a system of smart city IOT based weather monitoring system. This system provides weather station that is very helpful for smart city challenges. This weather station is based on IOT. It is equipped with raspberry pi2 and environmental sensors used to capture distributed meteorological measurements at any particular place and report them in real time cloud. It will also give the graphical representation of weather parameters that will help the user to compare the weather stastics of different instants of time and fro this graphical representation the user can predict the weather of that particular place. This is used to provide the view of building smart city by giving the weather update of any particular place like a particular office or room.

2.7 Edward N. Udo, Etebong B. Isong [8] proposed a system of flood monitoring and detecting system using wireless sensor network. Flood is one of the main problems in many countries. This may be attributed to climate change which causes high rate of rainfall, placing the cities at increased risk of flooding. We have presented this system using relative humidity, temperature, waterlevel and amount of rainfall as a flood indicators whose values are gathered by sensors. The system monitors and know the development of floods and then send notification SMS to the inhabitant of such zones for necessary action. The developed systems are robust and give timely alert of flood occurrences.

2.8 M V S S Babu, M Jyothi Priyanka, J Sai Cherisma, G Y S Adithya [9] proposed a system IOT based floods alerting system. This system was developed based on a programmable electronic board, where some electrical resistors were connected to three heights into water container, the raising water levels covering the resistance so that cause variations in the impedance, this fact indicates what is the water level, and so on for the three different heights. This information was transmitted to a web server via wi-fi. After this information can be accessed by mobile devices, users can graphically see the data, these data show the values of water levels. Hence people can be opportunely informed when rising river levels, so inhabitants can make a decision and start preparing to evacuate their homes if necessary. So we use really warning system to alert residents of low lying areas about changes in rivers.

2.9 Cholatip Yawut and Sathapath kilaso [10] proposed a system wireless sensor network for weather and disaster alarm system. This system is used to prevent enormous damage from natural disasters. In this system, a wireless sensor network based on Zigbee/IEEE802.15.4 standard is utilized as a weather station network sending weather information and disaster alerts. It uses ardunio microcontroller and Xbee wireless module based on Zigbee standards. This system take advantages of wireless sensor networks which can send signal over far distance by using mesh topology, this transfers the data and also consumes low power. The system includes (i)

display weather information (ii) alert when weather conditions match using decision tree technique and (iii) keep weather information statistics. The system can alert when the weather information matches with specified conditions.

III. PROPOSED SYSTEM

Many things affect the weather and weather also affects on most of living as well as non-living things. At Weather station study of different environmental parameters using some instruments and equipments has been done. So to meet the goal of weather monitoring and flood disaster we have designed IoT based real-time, low-cost, portable and high speed weather station by using Arduino microcontroller. Present innovations in technology mainly focus on monitoring of different activities. These are increasingly emerging to reach the human needs. Most of this technology is focused on efficient monitoring of different activities. An efficient environmental monitoring system is required to monitor and assess the conditions in case of exceeding the prescribed level of parameters.

Proposed system is used to monitor the different parameters like temperature, humidity, and light intensity. Theses parameters are monitored by different sensors like, LM35 which is used to access the information about temperature. Moisture sensors are used to collect the data about the humidity. Light Dependent sensor is used to access the data about the light intensity. In this system, we collect the data about different condition by using different sensors and collected data are sending to the Arduino microcontroller, then use these data which are compared against the predefined threshold value. If the collected data value is greater than the threshold value, then system sends the message to the end-users using android application and result is displayed by using Liquid Crystal Display. After getting the message, the system uses relay switch, fan and water pump to monitor the environmental condition during flood disaster.

A. *System design*

Design is a creative process; a good design is the key to effective system. System architecture is the conceptual design that defines the structure and behavior of a system. An architecture description is a formal description of a system, organized in a way that supports reasoning about the structural properties of the system.

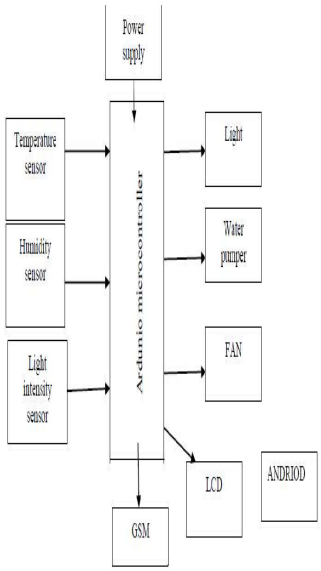

Fig 3.1 weather monitoring system architecture

In figure 3.1, Ardunio microcontroller is the heart of the system, located at the centre of the block diagram and controls all the operations of the system. An LCD is used to display all the operations going on inside the microcontroller For the weather monitoring wireless sensors are used to measure various parameters like Temperature sensor (T), humidity level (H), light intensity(l). All sensors are connected on the microcontroller and the status of the sensors is sent to the control section periodically every 3 minutes. The data transmission is done by wireless communication GSM. The received data is updated on to Android application. The parameter values can be updated on internet or can be displayed locally. These parameters can be used as inputs to certain mathematical models to predict about the possibility of floods. These data are displayed by using liquid crystal display and send to end user mobiles by using android system. After predicting the weather condition we use relay light, relay bulb and water pump to monitor the weather condition.

B. *Flow Chart*

Flow chart is a graphical representation of a computer program in relation to its sequence of functions. Flow chart is a formalized graphic representation of a logic sequence, work or manufacturing process, organization chart, or similar formalized structure.

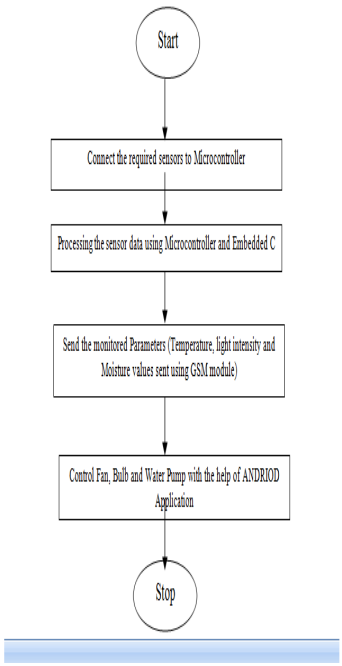

Fig 3.2: Flow chart of weather monitoring system

Flow chart for Weather monitoring system is shown in figure 3.2, In this system different weather parameters are accessed by using different sensors, these sensors are connected to Arduino microcontroller. Ardunio act as an analog to digital converter that converts the sensor data into digital value. These sensor data are processed by using microcontroller and Embedded C and these parameters are sending to the end user through GSM. After receiving the message the end user monitor the environmental condition by using control fan, Bulb, and water Pump with the help of android application.

IV. IMPLEMENTATION

In this paper it contains two modules. They are,

- Main module
- Deployment module

Main Module

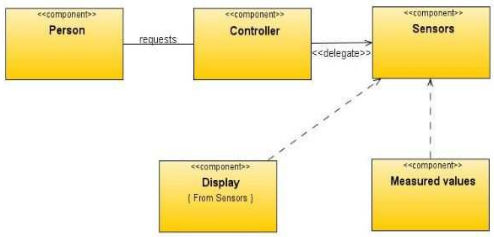

Fig 4.1 Main module for monitoring system

In fig 4.1 each component is provided for a purpose. The person component specifies time and date which is given to the controller. The controller internally does many activities to check whether the person is valid or not. The controller delegates the sensors. The sensors component is initiated by the controller. They in turn measure temperature, pressure, humidity etc. The values which are produced by the sensors are displayed.

Deplyoment module

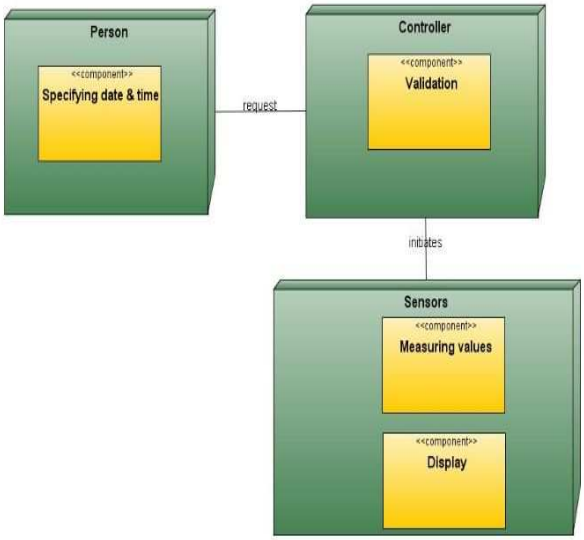

Fig 4.2 Deployment module

In fig 4.2 some components are enclosed under a node. Here Person, Controller and Sensor are the nodes used. Under the Person node, the component used is specifying time and date. The person requests the controller. Under the controller node, validation component is used .This component is meant for validation of the user. The final node contains 2 components. The first component is meant for measuring the values and the second component is meant for displaying the values.

V. CONCLUSION

This IoT based system gives real-time monitoring of environmental parameters. This system monitors temperature, humidity, pressure, altitude, light intensity and rain water level. Data can be seen from anywhere in the world using sensors. By using this system the client can continuously monitor different environmental parameters without any interaction with additional server. In the existing systems, they use Ardunio, Raspberry pi, Raspberry pi3 microcontrollers for monitoring the environmental parameters. This weather monitoring system is designed using these microcontroller which are low cost, small size, low power consumption but this system has some limitations, it do not have built-in Wi-Fi and built-in Real Time Clock. For networking, direct internet connection has to be given. As well as all sensors has to be connected directly to the GPIO header. For future development, Arduino microcontroller can be used. More sensors can be added to expand the system also for remote location monitoring.

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