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IB-SAEMACS: IoT Based Smart Autonomous Environment Monitoring and Control System

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ABSTRACT**:** The core objective of this project is to design a multipurpose system that acts as a weather station, a home security system, a fire detection system, water management system and essentially a smart home using the Internet of Things. We are making our home smart, as the devices in our home will interact with each other, forming a closed loop control system. Thus it makes our home reliable, secure, safe and more energy efficient. The data is securely transferred via the internet between the Thingspeak API and Ubidots and microcontroller.

KEYWORDS: Internet of Things, Gmail, twitter, SMS, Thingspeak, Ubidots, microcontroller, API.

I. INTRODUCTION

Home is a place where we like to feel cherished. We always care about ourselves and our family's safety. It's the only place where we really like to spend time either with our family or with ourselves. All our homes are mostly inefficient. We are wasting a lot of resources, especially electricity and water. Most of our devices and appliances are switched on without purpose. We may forget to switch it off while going for work. As a result, we are losing energy and money. And because of global warming and climate change, it has become really improbable to change our home manually depending on climate and environment. It's quiet essential that we need to act right now to prevent global warming. While we are away from our home, our mind is filled with uncertainty. We are also wasting a lot of water for watering plants without even checking the weather report and moisture content in the garden. We are in need to conserve water because it's necessary because more than 500 million doesn't have access to pure water. The biggest threat that everyone concerning about is the home security.

We need to make our homes smart so that we can prevent any potential invasion. We also need to know whether someone is at our door or someone is inside our house. We need secure environment where safety thrives so that kids can enjoy. We can also know the weather report in real time such as temperature, humidity, atmospheric pressure, UV intensity, light intensity and rainfall. We can detect fire immediately using flame sensor and prevent potential fire hazard by measuring combustible substance content in air. We can also measure the air quality. That's were our IB-SAEMACS comes into play. We can know our home like the back of our hand and also feel our home's condition from being anywhere in the world by Internet of Things. We can monitor our home and control our home either manually or autonomously. So we have a lot of space in our mind due to the elimination of uncertainty, so we can focus our work. We can see the status even in Gmail, Twitter [9], SMS, phone call, Thingspeak [7] and Ubidots [8]. We also can control our devices using commands which are executed in the microcontroller itself. It is made possible by the use of relays. It is also controlled by using Blynk [12] and Cayenne app.

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II. DETAILS ABOUT THE PROJECT

A. HIGHLIGHTS

The environmental parameters can be monitored from anywhere in the world. The home will have good protection against intruders, fire and fuel leakage. The usage of water can be monitored to reduce water consumption. This makes the house energy efficient by knowing the environmental parameters and weather and adapting to it. The user can know the status of the house in Twitter [9], Gmail, Thingspeak [7] API and in mobile app Blynk [12].

B. LAYOUT

The system uses two Arduino megas' and two NodeMcus' which connected to the internet [5]. The system collects data from 36 sensors and uploads into the cloud. The system uses sensor data from the cloud [3] to control the actuators. The sensor data will be uploaded to the cloud for every 15 seconds. The data can be downloaded in .CSV format and fed as input to the Deep learning model. The users will receive push notifications via email [10], SMS, twitter [9] and phone call. Deep learning model can be created for predicting the future values based on past and present data.

III. INTERCONNECTED SYSTEMS

The Arduino mega will be integrated with Ethernet shield and bridged with Wi-Fi [4]. The NodeMcu will be directly connected to the Wi-Fi. DHCP should be enabled. The system can be divided into 4 sub-systems. They are water management system, weather monitoring system, fire alarm and home intrusion detection system.

A.WATER MANAGEMENT SYSTEM

The role of Water management system is to reduce the wastage of water. The water management system comprises of various sensors such as water flow sensor, soil moisture sensor [6], rain drop sensor and water level sensor. The data from sensors are collected by the microcontroller which is connected to the internet. The sensor data is uploaded to the cloud service such as Thingspeak [7] and Ubidots [8]. The sensor data will be updated for every 15 seconds. The user can view the raw data as well as processed information using visual tools like charts, graphs, gauges, etc.

B.WEATHER MONITORING SYSTEM

The Weather monitoring system [1] is used to improve the users experience with respect to the current weather conditions and also to reduce the energy consumption based on weather conditions. The Weather monitoring system consists of sensors such as Temperature Sensor, humidity sensor, barometric pressure sensor, rain drop sensor, UV intensity sensor, light dependant resistor, air quality sensor and altitude sensor. The sensor data is uploaded to the cloud service such as Thingspeak [7] [7] and Ubidots [8]. The sensor data will be updated for every 15 seconds. The user can view the raw data as well as processed information using visual tools like charts, graphs, gauges, etc.

C.FIRE ALARM SYSTEM

The fire alarm system is used for alerting the users about fire detection and conditions where there is possibility of fire hazard. This system uses various sensors such as flame sensor, temperature sensor, humidity sensor, smoke sensor and combustible substance sensor. On detection, the buzzer will be activated and also the display screen. The sensor data is uploaded to the cloud service such as Thingspeak [7] [7] and Ubidots [8]. Here also the sensor data will be updated for every 15 seconds. The user can view the raw data as well as processed information using visual tools like charts, graphs, gauges, etc.

D.HOME INTRUSION PREVENTION SYSTEM

The home intrusion detection systems' primary role is to sense any potential intrusions. The intrusion detection system uses sensors such as Passive Infrared Sensor, Infrared sensor, ultrasonic sensor, digital sound sensor, tilt sensor, vibration sensor, accelerometer and gyroscope sensor. On detection, the buzzer will be activated and also the display screen. The sensor data is uploaded to the cloud service such as Thingspeak [7] and Ubidots [8]. Here also the sensor data will be updated for every 15 seconds. The user can view the raw data as well as processed information using visual tools like charts, graphs, etc

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IV. METHODOLOGY

The following section deals with methodology of our system. We made it a wee bit cost effective [2]. The fig 1 shows our basic block diagram. It consists of sensors, actuators, display devices and power sources. The project will continue to work until it's manually powered down.

A. BLOCK DIAGRAM

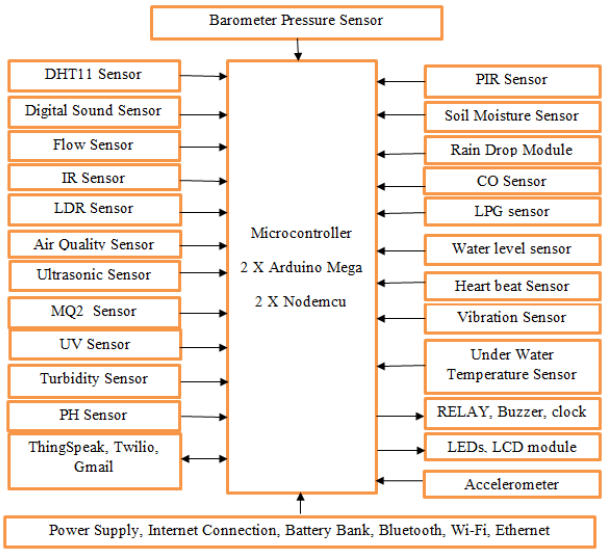

Fig 1 Block Diagram

From the Fig 1, we can see that the various sensors will gather the data and will send it to the microcontroller. Then the microcontroller will send the data to the cloud and process the data. With the processed data, it'll take certain decisions and will give command to the actuators such as relays, LCD display, buzzer and electrical loads.

B. COMPONENTS

The microcontrollers that we use are [5] Arduino mega along with Ethernet shield W5100 and NodeMcu ESP8266.

Fig 2 Arduino Mega

The Fig 2 shows the orginal image of Arduino Mega that we are using. It has 54 Digital I/O pins and 16 Analog I/O pins. It is programmed using Arduino IDE. It is powered by 5V DC supply.

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Fig 3 Ethernet Shield

The Fig 3 shows Arduino connected with Ethernet shield. The Ethernet port is connected with computer's Ethernet port using Ethernet cable.

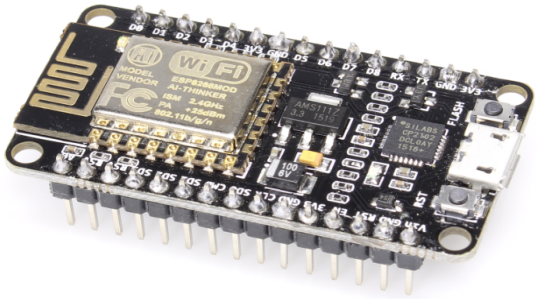

Fig 4 NodeMcu ESP8266

The NodeMcu is shown in the Fig 4. It has 9 Digital I/O pins and various other special purpose pins. It is powered by 3.3V DC supply.

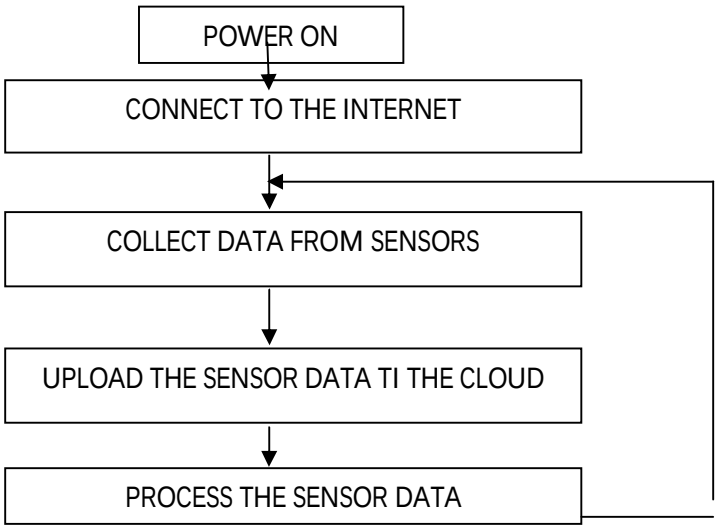

Fig 5 Flow chart

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The Fig 5 shows the flow chart of our project. It has only five steps and a loop. Once powered on and connected to the internet, it'll continuously collect and upload the sensor data to the cloud and it will be processed there.

C. OPERATION

The data is collected from various sensors and will be uploaded to the cloud. The raw data will be processed into valuable information. Threshold value will be set for all the sensors. If any one sensor is triggered and output goes out of threshold zone, then push notifications such as SMS, email [10], tweet and also phone call will notify the user. The cloud will be fed with sensor data for every 15 seconds. The user can see the raw data and also the visuals such as graphs, charts, etc. The user can immediately be alerted. By using relays, automation is made possible. Whenever the certain sensor data meets certain condition, then certain action will happen with or without the relays. The user can also switch on and switch off manually using both voice and touch.

V. RESULTS AND OUTPUT

The output is shown below in the following images.

A.THINGSPEAK

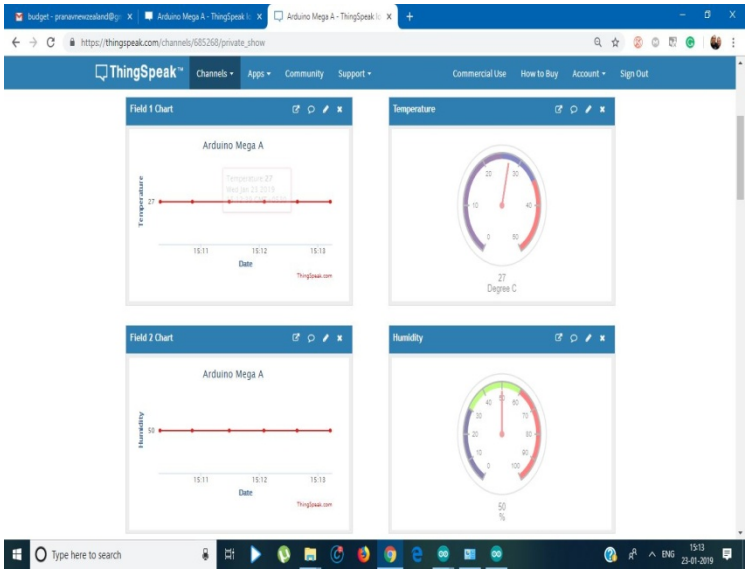

Fig 6 Thingspeak Output

The Fig.6 shows the output that we obtained in thingspeak [7] cloud service. By using the data from thingspeak [7], we can do a lot of processes such as Reactor Time-control.

B. UBIDOTS

The Fig 7 shows the output that we obtained by using Ubidots [8] cloud services. We can know the status of our home in with a delay of 10 seconds. If we used a Real Time Operating System and paid cloud services, then we can eliminate the delay and make it real time. We can do much analysis on the data from both the cloud services. We can use charts, graphs, gauges and etc.

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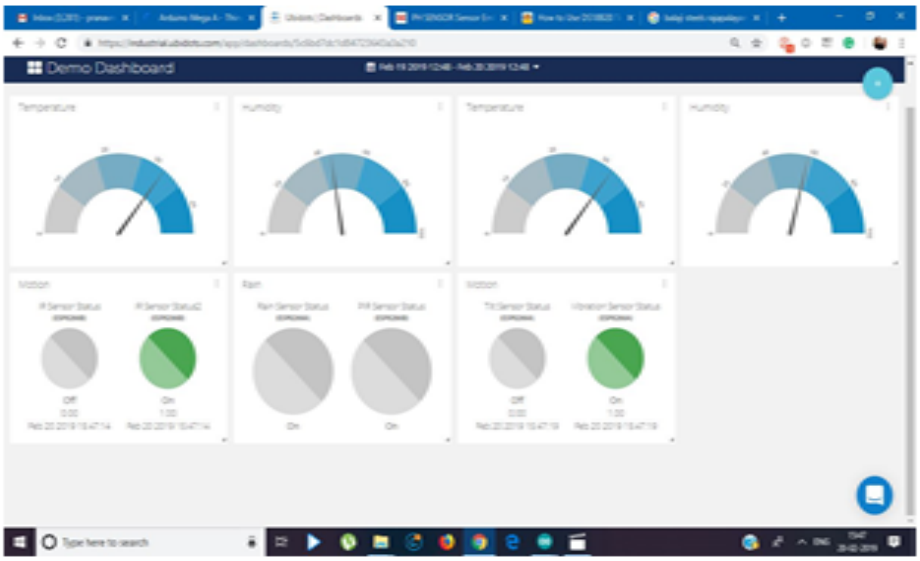

Fig 7 Ubidots Output

We can download the data in .csv format and can be used to feed the Deep learning models. By using certain conditions, we can get push notifications such as SMS, Email [10], tweet and phone call. We can also see the output in thingview android mobile application.

C. TWITTER

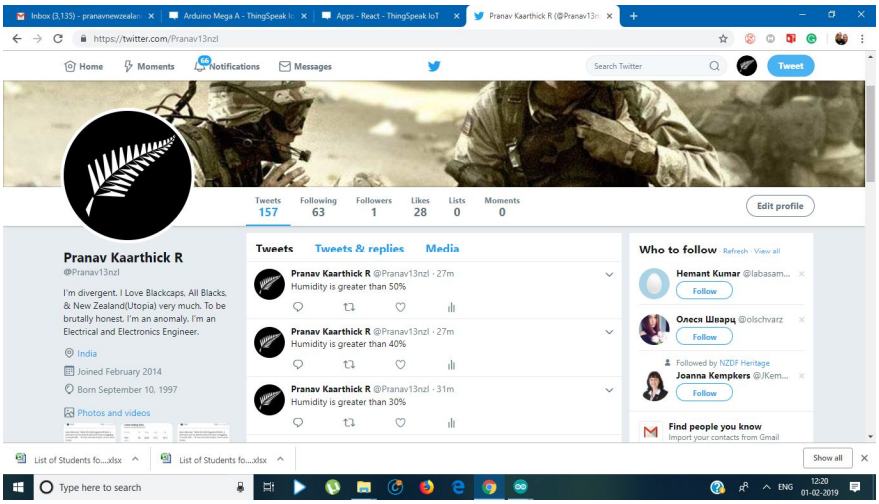

Fig 8 Twitter Output

The Fig.8 shows the output that we obtained in twitter [9] by using thingspeak [7] cloud service. We will be giving certain predetermined conditions, and if the sensor data goes out of the threshold range, the tweet will be generated.

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D. GMAIL

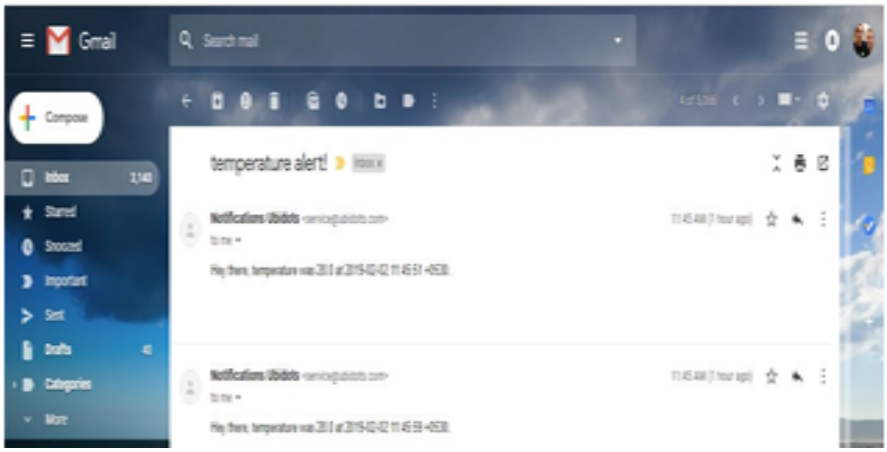

Fig 9 Email Output

The Fig 9 shows the output that we obtained in email [10] by using Ubidots [8] cloud services. Its operation is similar to that of tweet.

VI. CONCLUSION

The output of the sensors can be downloaded from the cloud service in .CSV format. It can be fed to Deep Learning model as data set. The model can be trained and made to predict future values and also detect the failures that occur in sensor or any anomalies. There is the biggest concern about IoT is security and privacy. By using Edge Computing or Fog computing, we can have local data servers where data will be processed instead of the Central Neural Network. As per 2019, 8% of the business in the world will fall without IoT [11]. And also 95% of the IoT users are feeling positive about their industry [11]. This is the golden age of IoT, where engineering drives innovation and productivity, and where the big ideas are born every day, and the new technologies are perfected, and where the every sunrise inspires the extraordinary and where the impossible becomes reality.

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