iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** IV **Month of publication:** April 2018

DOI: http://doi.org/10.22214/ijraset.2018.4028

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

I.O.T and A.I. Enabled Fire Detecting Moving BOT

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Abstract: Internet of things is an interconnections of physical devices embedded with electronics, software, sensor which is capable of collecting data from the surrounding and sending data over internet is IOT. The fire detection gathers all of the techniques and processes that contribute to early detection of fire. We identify three main categories: Smoke detection, Flame detection and Temperature detection. Automatic fire detection system provides real-time surveillance, monitoring and automatic alert. Now-a-days there are many problems related to fire in the forests and in isolated areas , so to keep check or surveillance on such areas and to alert the people and the system administrator when there are chances of fire or when the fire has started. We are designing a system-- a moving bot (Drone) ; which will be keeping surveillance of the entire area and it will be detecting smoke, fire and rise in temperature. Our system will be sending locations as well as pictures of the area in which our bot is monitoring in different time intervals with the help of micro-controller unit (MCU ESP8266) to the cloud where whole database and sensor dashboard will be maintained. Whenever sensor detects smoke , fire or rise in temperature it will be sent to the cloud with its current location and pictures of that area and through cloud some alerts and alarms will generated to warn the administrator ; so that he can control the fire in that area before it starts to spread. The system administrator can also keep check on the whole system using cloud irrespective of where the administrator is. Our main objective to design such a system is to detect fire in forests and in isolated areas before it spreads and destroys the whole area.

Keywords: Fire detection, sensor, alarm, surveillance, micro-controller, cloud, database.

I. INTRODUCTION

A wildfire or a forest fire is a fire in an area of combustible vegetation that occurs in country side or rural areas. Depending upon the type of vegetation where it occurs , a wildfire can be classified more specifically as a brush fire ,bush fire , desert fire , forest fire , grass fire , hill fire , vegetation fire or veld fire. Wild fire can be characterized in the terms of the cause of ignition , their physical properties , their combustible materials and effect of the weather on fire. Strategies of wildfire or forest fire prevention , detection and suppression have varied over the years. Fire lookout towers were used in the United States in the early 20th century and fires were reported using telephones, carrier pigeons, and heliographs. Aerial and land photography using instant cameras were used in the 1950s until infrared scanning was developed for fire detection in the 1960s. However, information analysis and delivery was often delayed by limitations in communication technology.

Early satellite-derived fire analyses were hand-drawn on maps at a remote site and sent via overnight mail to the fire manager. During the Yellowstone fires of 1988, a data station was established in West Yellowstone, permitting the delivery of satellite-based fire information in approximately four hours. An integrated approach of multiple systems can be used to merge satellite data, aerial imagery, and personnel position via Global Positioning System (GPS) into a collective whole for near-realtime use by wireless Incident Command Centers.

Fire detectors sense one or more of the products or phenomena resulting from fire, such as smoke, heat, infrared and/or ultraviolet light radiation, or gas. Sensors used in fire detection devices nowadays include a large variety of sensors due to very different applications, cost levels, detection coverage and so on. Optical fire detectors as an example are the most commonly used ones in industrial applications since several decades and in private homes since some years. Nevertheless severe drawbacks (sensitivity to phenomena like nuisance aerosols usually leading to false alarms) existed since optical smoke detectors are on the market.

Recently several methods (multi-angle, multi-wavelengths) have been reported and implemented showing how to improve the optical scattering sensors for more robust operation. Other sensors like CO gas sensors aim at completely reducing these problems but the long-term stability and cross-sensitivities have to be considered.

Our system totally focuses on detecting fire through sensor and sending location using GPS through the microcontroller to the cloud ; and through cloud the administrator will receive various alerts regarding the fire . This whole system works on wireless network. Using IOT(Internet of things) the whole system is established.

In this paper our system is presented that can minimize the hazardous effects caused by fire by detecting the fire as early as possible and alarming the area administrator right away , so that he can take appropriate actions on right time.

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II. LITERATURE SURVEY

A. CCTV (Closed Circuit Television) technology [1]

It has great advantage for use on sensing and monitoring a fire. Compared with other types of fire detectors, the video cameras cannot be fooled by visible, or emissions from common background sources, eliminating such false alarm problems. It is processes multiple spectral images in real time to reliably detect a small fire or smoke at greater distances in very short times, and at the same time, it can identify the location of a fire, track its growth and monitor fire suppression. It can be trained for very rapid response, making it suitable for explosion suppression .

B. Fire detection using image processing and sensors [3]

It uses a camera along with sensors. The camera keeps on capturing images every 30 seconds and sensors keep on sensing the environment parameter. Whenever a picture is capture which contains red, yellow or orange color in specific pattern image processing is done. The RGB image is converted into grey image which is further converted to binary value. When specific pattern indicating fire is found, value of sensor is also checked at that moment. If pattern of fire is found in grey image and if reading are also corresponding to the fire condition then fire detected. It rings alarm, or generate some voice to inform others about the fire.

C. Safe From Fire [2]

It is an algorithm which is used for fire detection. The technique which uses this algorithm is known as Safe From Fire technique. In this technique three sensors are used which are flame sensors, gas sensors and temperature sensors. Arduino is a microcontroller which is used for collecting data from the sensors. The technique consists of two parts that are software module and hardware module. The software part consists of webpage through which user will login in the system and the sensors along with Arduino will start working. The reading of sensors is passed to the Arduino to through which it is stored in the database. Database maintains record of all the readings of sensor whenever fluctuation occurs in the reading at least any two sensors then automatically alarm rings. Which detect that fire has been occurred.

D. Fourier Transform Infrared (FTIR) spectrometers for fire detection [1]

FTIR can examine the entire spectrum from about 2.5 m to 25 m, and quantify the presence of multiple species of interest to provide early fire warning with low false alarms. FTIR measurement also provided significant amounts of additional data prior to ignition and during early stage of combustion, including monomeric species, unburned fuel, oxygenates, olefins, and pyrolysis products. Commercial FTIR instruments are now available, and have the potential to sense CO, HCN, HCl, CO2, H2O, and miscellaneous hydrocarbons. Their measurements for CO, CO2 and total hydrocarbons were found to follow similar trends as the measurements of single parameter instruments. However, advanced data analysis scheme for the FTIR-based fire detection system must be developed to quantify the gas and smoke concentrations and to determine if a fire condition is present. In addition, a wide range of applications of FTIR-based fire detection systems is limited by high initial costs and maintenance requirement.

E. System Description

Since it is shown in the previous section that there are no accurate or proper detection and alarming or alerting techniques. Compared to the other systems our system provides detailed view of location and runtime alerting when the fire is detected using wireless sensor network . This reduces the effects of the fire as it can be controlled before it starts spreading. Our moving BOT on which the whole system is installed will be monitoring the different areas of the forests which will reduce the workload of humans and is more efficient than human beings.

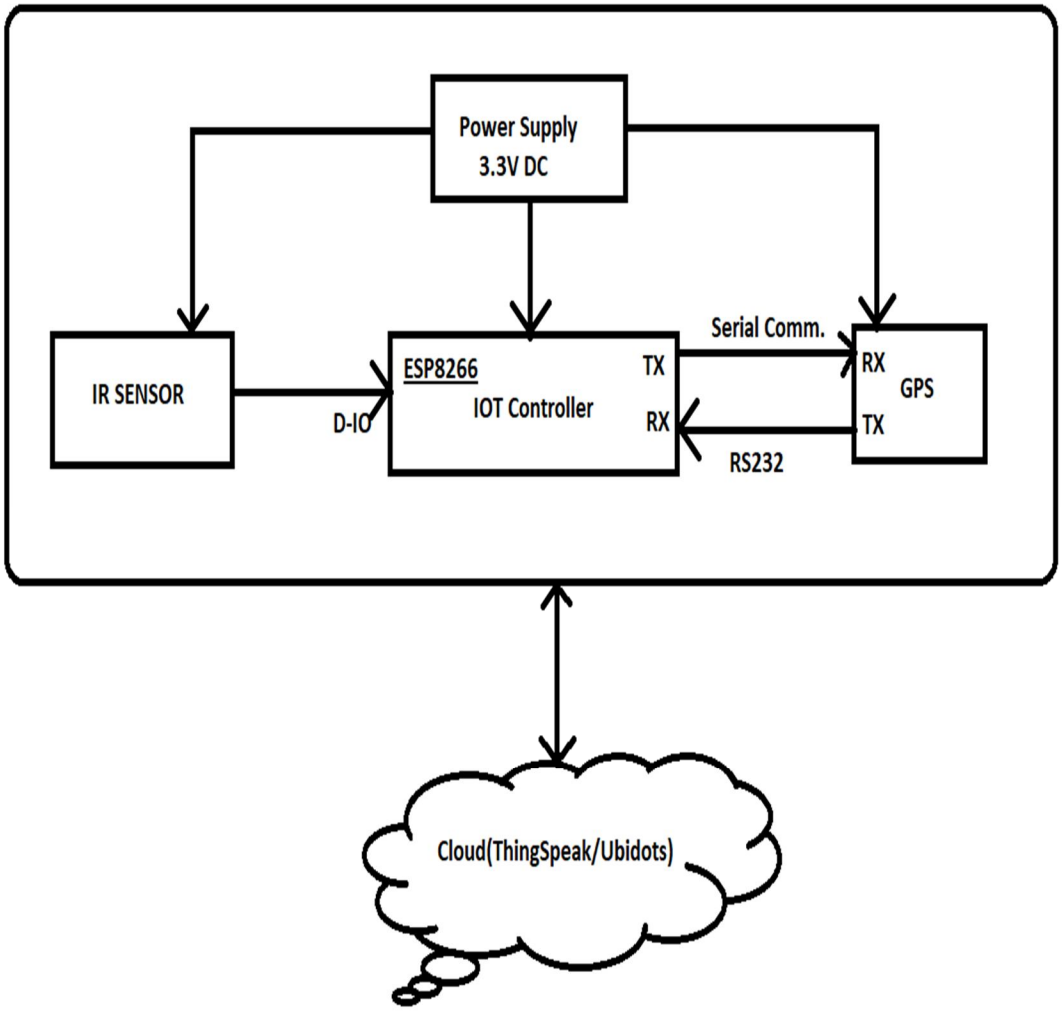
F. The whole system includes 4 main modules. They are as follows:

1) Micro-controller(Node MCU ESP-8266)
2) GPS
3) IR sensor
4) Cloud

These four modules are integrated together to form our whole system. The following table tells the detail description of the modules of our system.

Module No.	Module Name
1.	Project Component Shortlist as per required specifications.
2.	Component Purchase and Exploration.
3.	Getting Started with Node MCU - Software Installation, driver Installation, Hardware connectivity etc.
4.	Digital & Analog I/O Exploration.
5.	Sensor Integration and debugging.
6.	GPS Sensor Testing and Interfacing.
7.	Fireflame sensor interfacing.
8.	IoT Cloud Exploration.
9.	IoT Cloud Registration and Understanding Cloud API.
10.	Integration of IoT Hardware with Cloud.
11.	Data Visualization.
12.	IoT Events Execution.
13.	Testing And Debugging Final Code.
14.	Installing the whole system on the moving BOT.

Block Diagram

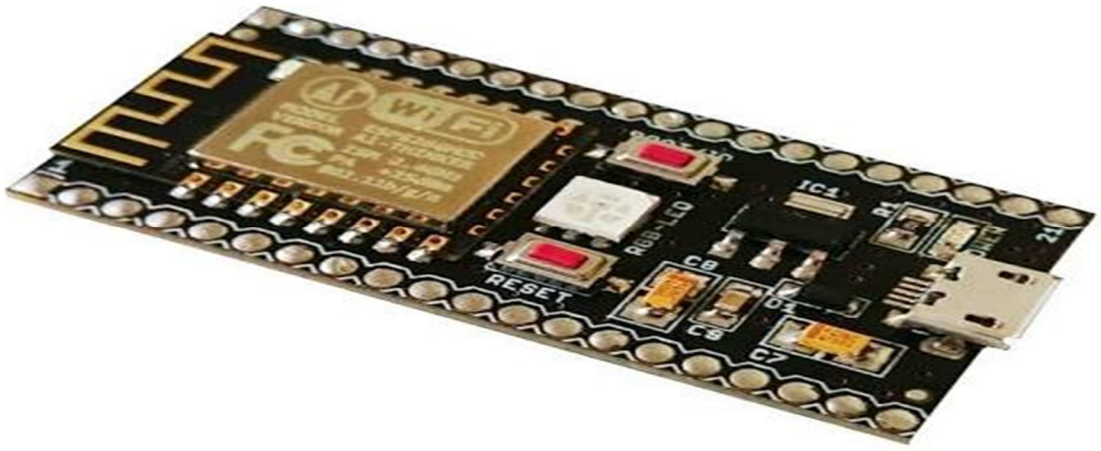


G. System Epquipments And Methodology

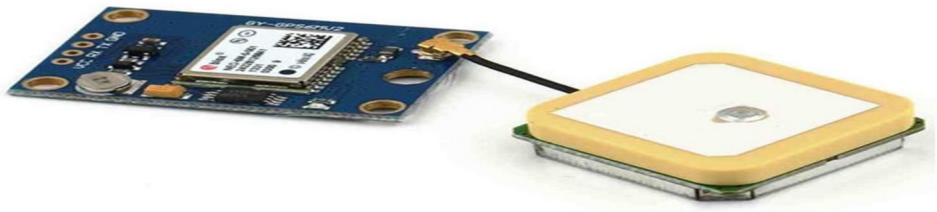
Our system is incorporated with various modules attached to the micro-controller Node MCU ESP-8266 circuit board. . Node MCU ESP-8266 has been chosen for our system development and hardware prototype design.

1) *ESP8266 (Micro-controller):* Our main brain of the system is micro-controller. This microcontroller is integrated with the GPS module and the Fire sensor module. The microcontroller is the main module of our system. It is also interfaced with the cloud (Ubidots) through wireless network. The main purpose of ESP8266 is to get the data from GPS and Sensor and send it to the cloud ; whenever the fire is detected through cloud some events will be triggered which will be the alerts for the system administrator which will be sent to him via cloud as a message, notification on social networking site and e-mail.

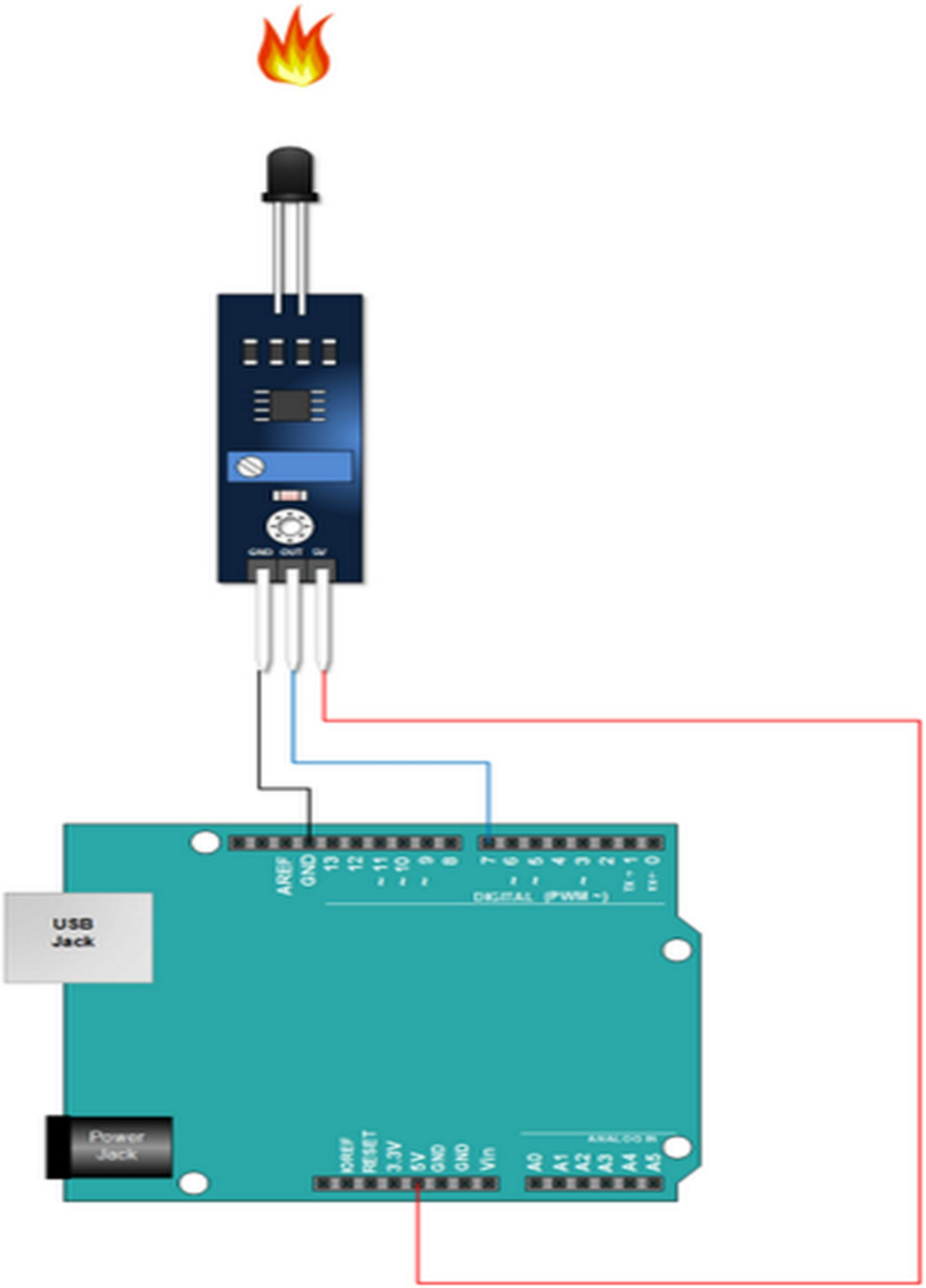
The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability.



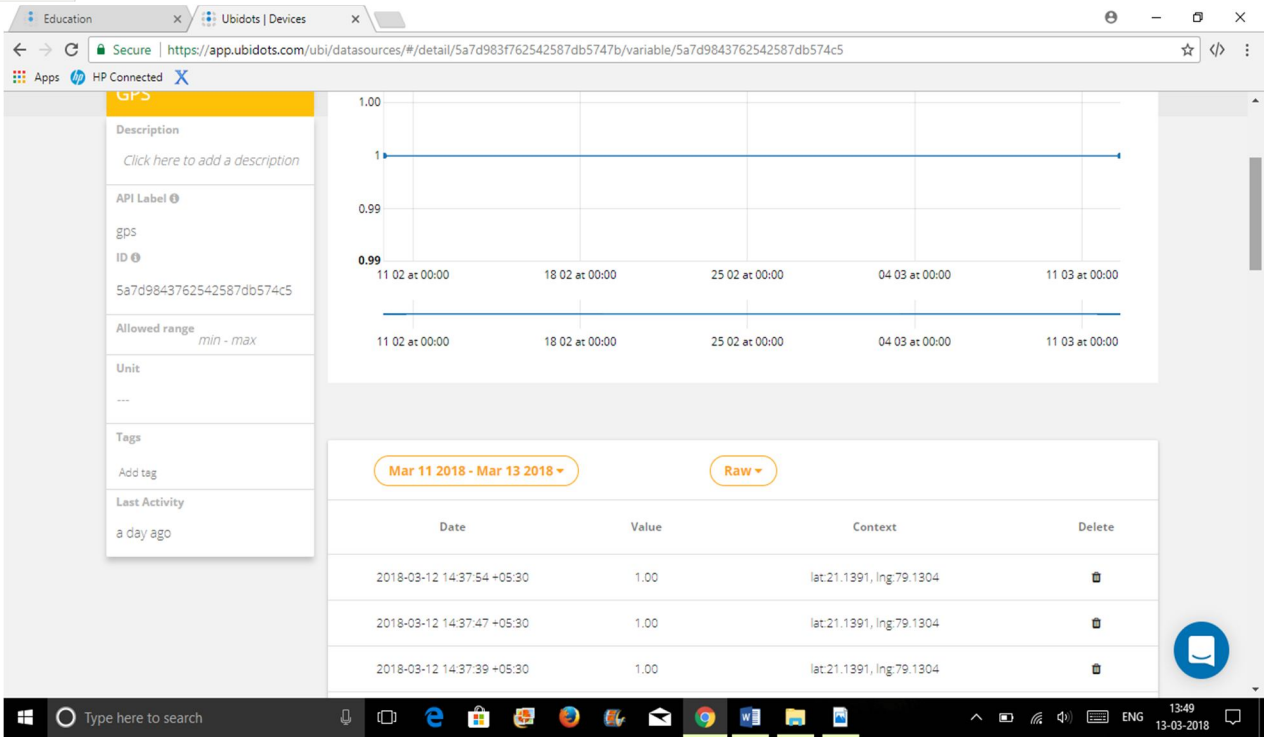
2) *GPS (Ublox):* is a global navigation satellite system that provides geo location and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. Obstacles such as mountains and buildings block the relatively weak GPS signals. This GPS module is integrated with the ESP8266 and will send the latitude and the longitude of the current location of our system. The GPS will send the location in certain interval of time to the ESP8266 . This location can be viewed in the Google maps. The locations sent by the ESP8266 will be maintained in the dashboard of the cloud. The GPS is integrated with the RX pin(D6) and TX pin(D7) of the microcontroller.

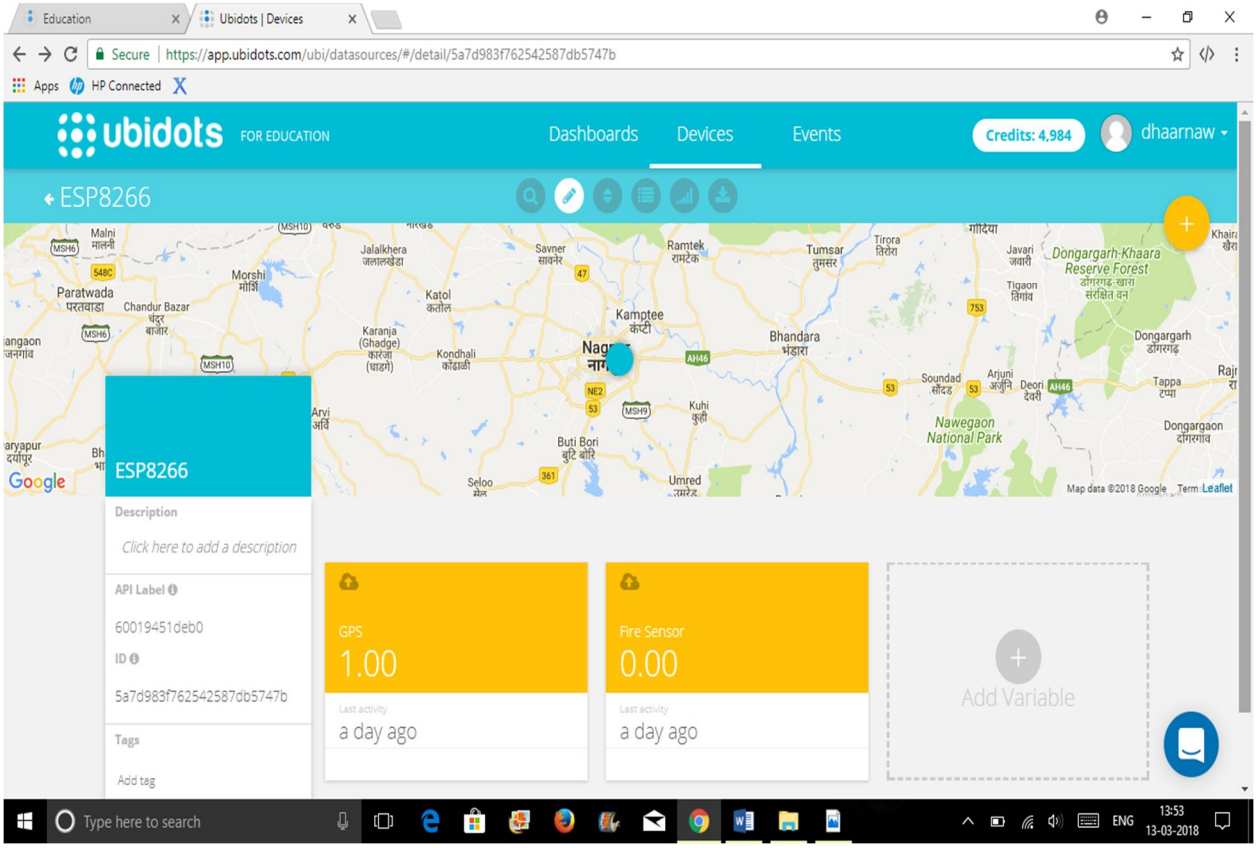


3) *Fire Flame Sensor(IR Sensor):* flame detector is a sensor designed to detect and respond to the presence of a flame or fire, allowing flame detection. Responses to a detected flame depend on the installation, but can include sounding an alarm, deactivating a fuel line (such as a propane or a natural gas line), and activating a fire suppression system. A flame detector can often respond faster and more accurately than a smoke or heat detector due to the mechanisms it uses to detect the flame. This IR sensor is integrated with the ESP8266 via D0 pin. The IR sensor will send a binary 0 or 1 only when the fire is detected, to the ESP8266.

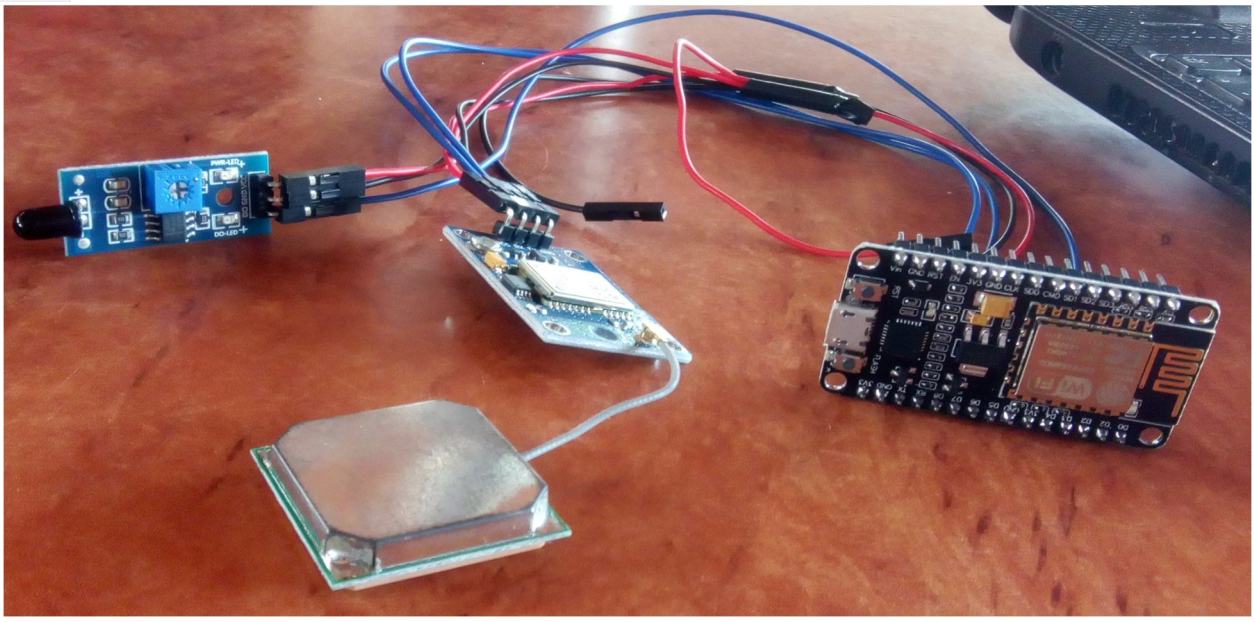


4) *Cloud (UBIDOTS):* For maintaining dashboards and data we are using UBIDOTS . The main purpose of using cloud is to trigger events when there is fire. Triggers here refer to alerts or alarms for the System administrator. The administrator will receive message , call, email, and notification on social networking sites.





The whole system integration is done using Ardunio Sketch. Ardunio Sketch is a platform which is used to for coding of various electronic devices. The ESP8266 and UBDOTS are integrated together using Ardunio Sketch and wireless network.



Integrated circuit

III. CONCLUSION

There is an immense need of implementation of automatic fire detecting system to protect lives and assets from fire hazards. Use of real-time control via the Internet or wireless network will extend the monitoring and control of fire safety systems inside the forest. The status of the fire detecting moving bot monitored at any time and from anywhere via the Internet or wireless network will be very helpful for timely measures and security.

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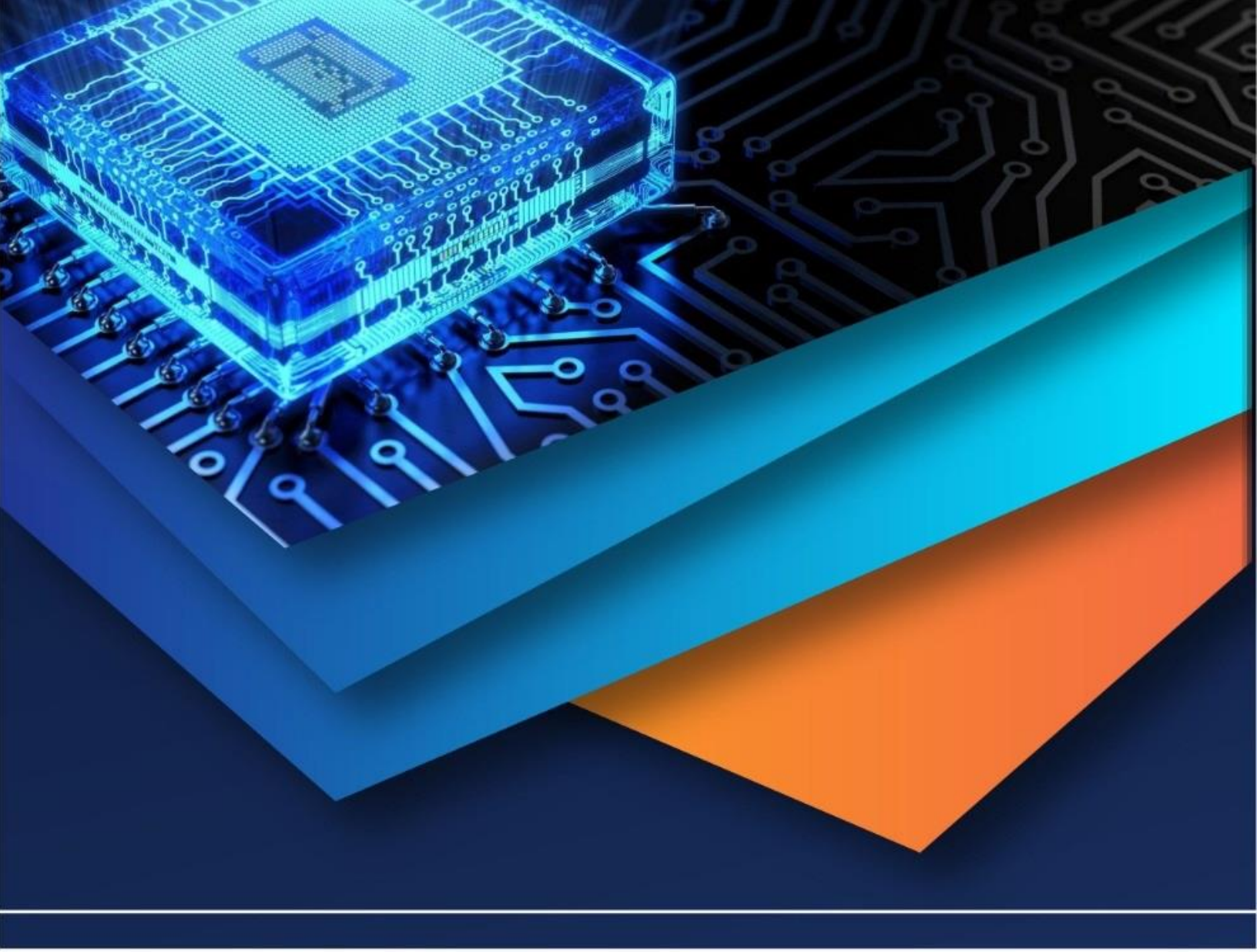

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