FOREST FIRE DETECTION USING PCB

A MINOR PROJECT - IV REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this **18ECP106L - Minor Project - IV** report "**FOREST FIRE DETECTION USING PCB"** is the bonafide work of **SHARATH C (927621BEC196), YOGESHWARAN(927621BEC246), YUVANSANKARRAJA (927621BEC250), SRIVELAN M(927621BEC209)**who carried out the project work under my supervision in the academic year **2023 -2024 - EVEN SEMESTER**.

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PROJECT COORDINATOR

INSTITUTION VISION AND MISSION

Vision

To emerge as a leader among the top institutions in the field of technical education.

Mission

M1: Produce smart technocrats with empirical knowledge who can surmount the global challenges.

M2: Create a diverse, fully -engaged, learner -centric campus environment to provide quality education to the students.

M3: Maintain mutually beneficial partnerships with our alumni, industry and professional associations

DEPARTMENT VISION, MISSION, PEO, PO AND PSO

Vision

To empower the Electronics and Communication Engineering students with emerging technologies, professionalism, innovative research and social responsibility.

Mission

M1: Attain the academic excellence through innovative teaching learning process, research areas & laboratories and Consultancy projects.

M2: Inculcate the students in problem solving and lifelong learning ability.

M3: Provide entrepreneurial skills and leadership qualities.

M4: Render the technical knowledge and skills of faculty members.

Program Educational Objectives

PEO1: **Core Competence:** Graduates will have a successful career in academia or industry associated with Electronics and Communication Engineering

PEO2: **Professionalism:** Graduates will provide feasible solutions for the challenging problems through comprehensive research and innovation in the allied areas of Electronics and Communication Engineering.

PEO3: **Lifelong Learning:** Graduates will contribute to the social needs through lifelong learning, practicing professional ethics and leadership quality

Program Outcomes

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1: Applying knowledge in various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of Engineering application.

PSO2: Able to solve complex problems in Electronics and Communication Engineering with analytical and managerial skills either independently or in team using latest hardware and software tools to fulfil the industrial expectations.

Abstract	Matching with POs, PSOs
AUTOMATIC CAR PARKING SLOT	**PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12, PSO1, PSO2**

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ABSTRACT

The primary goal of this project is to develop of a fire detection system that does not rely on traditional physical sensors, but instead utilizes image processing and machine learning techniques to identify fire and smoke in real-time from visual data. The system aims to provide an innovative, cost-effective, and scalable solution for early fire detection in various environments such as residential, commercial and industrial settings. Traditional fire detection systems primarily rely on physical sensors such as smoke detectors, heat detectors. These systems, while effective have limitations in terms of installation, maintenance, cost and sometimes, delayed in large or open spaces. To overcome these limitations, there is a need for an alternative approach that can quickly and accurately detect fires using existing infrastructure such as surveillance cameras.

Objectives:

1. To develop a real time fire detection system that uses image processing techniques to analyze video feeds from cameras.
2. To implement machine learning algorithms that can accurately distinguish between fire, smoke, and other similar visual distrubances.

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LIST OF ABBREVIATIONS

ACRONM		ABBREVIATION
ICSP	-	In-Circuit Serial Programming
IDE	-	Integrated Development Environment
IR	-	Infrared Receiver
LCD	-	Liquid Crystal Display
PCB	-	Printed Circuit Board

CHAPTER 1

INTRODUCTION

1.1 Introduction:

Economic growth in modern industrialized societies has resulted in factories, complex office buildings, and dense apartment blocks located in metropolitan areas. Associated gas stations and oil reservoirs, which are all vulnerable to fire due to the flammable substances they house, are also found in these areas. When a fire occurs in such places, firefighting is hindered by the mazes of crowded buildings, high temperatures, smoke, and the danger of explosions Current firefighting systems are based on humans using deluge guns and chemical fire repression systems. However, in environments where humans cannot work effectively, it is desirable to extinguish a fire quickly using fire-fighting robots. Recently, in order to cope with catastrophic fire related accidents, research on fire-fighting robots has advanced in many countries.

Nowadays, emergency situations involve huge losses, both material and personal. Adverse natural events and atmospheric pollution caused by human activities become disasters when they exceed a limit of normality and cause damages to the ecosystems and various diseases for the population. The effects of these events can be amplified due to poor planning of resources, such as lack of security or control steps, emergency plans and alert systems that can increase the options for predicting their occurrence or controlling their progress once they have occurred. The existence and combination of certain atmospheric conditions in addition to unusual and excessive presence of pollutant gases (carbon monoxide and carbon dioxide) can anticipate the occurrence of an increasingly frequent natural disaster: forest fires. Generally, these kinds of events usually result in serious emergency situations that cause the need of mobilization of different emergency management agencies and services. The land topography, different types of vegetation in the area and weather conditions are the main factors that affect forest fires generation and progress. The control and monitoring of atmospheric variables (temperature, relative humidity and atmospheric pressure) in addition to the concentration levels of certain pollutant gases (such as CO2 and CO) can favors the detection of fire generation and the monitoring of their progress. The main problem with this manual system is the loss of time and the search for optimal parking for the vehicle. Sometimes vehicle users can search in another parking area and the slot has no vehicle availability Therefore, this causes a fuel management problem and traffic can also occur. But using Arduino based car parking system it will help the driver to display the parking slot if available and if the parking slot is full the message will display on the screen “Sorry no parking space ’and the barrier gate will not open .this will save the time of the driver to search parking in other location.

PRELIMINARIES

In the field of IOT applications for the control of forest fires, several kinds of systems can be used for the warning, prevention and monitoring of these natural disasters. For example, this is the case of the application Forest Fire Danger Meter [2] available for Android. It stands out mainly because it is a calculator to find the fire hazard according to the classification of McArthur Forest Fire Danger Index [3], taking as reference the following parameters: temperature, relative humidity, wind speed, dryness factor, vegetation and pending. In the same field, IncendiosCyL [4] beta application is under development. The Eleventh International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies Another important element in the area of emergency situations and forest fires management is how Geographic Information Systems (GIS) [5] have become very relevant in the forest fires prevention and control. GIS allows real time access to data in the area, creating strategies to evacuate affected people, performing simulations, establishing health care points and redefining transport routes depending on the affected areas among other aspects. In fact, this system has been used recently by organizations such as the Civil Guard during the work of extinguishing the last fire in La

Palma Island in 2016 and in other cases, such as a Portugal forest fire in The system Find& Rescue offers a global online vision of emergency teams through a specific device carried by each emergency team member. Several IOT applications are based on the deployment from helicopters of different kinds of sensors, which could register environmental data: temperature, gases, etc. In the MERIS project, a real time application allows accessing the information of the status of recoverable victims through devices and sensors that control vital signs. The management of emergency tactics is done using sensor technologies, such as LIDAR and the Esphera platform: helicopter tracking through a 3D environment, integration of video from different resources and others aspects . I Safety is a comprehensive emergency management system, which allows the integration of smart sensors and other applications to realize a real time emergency situation control.

System model:

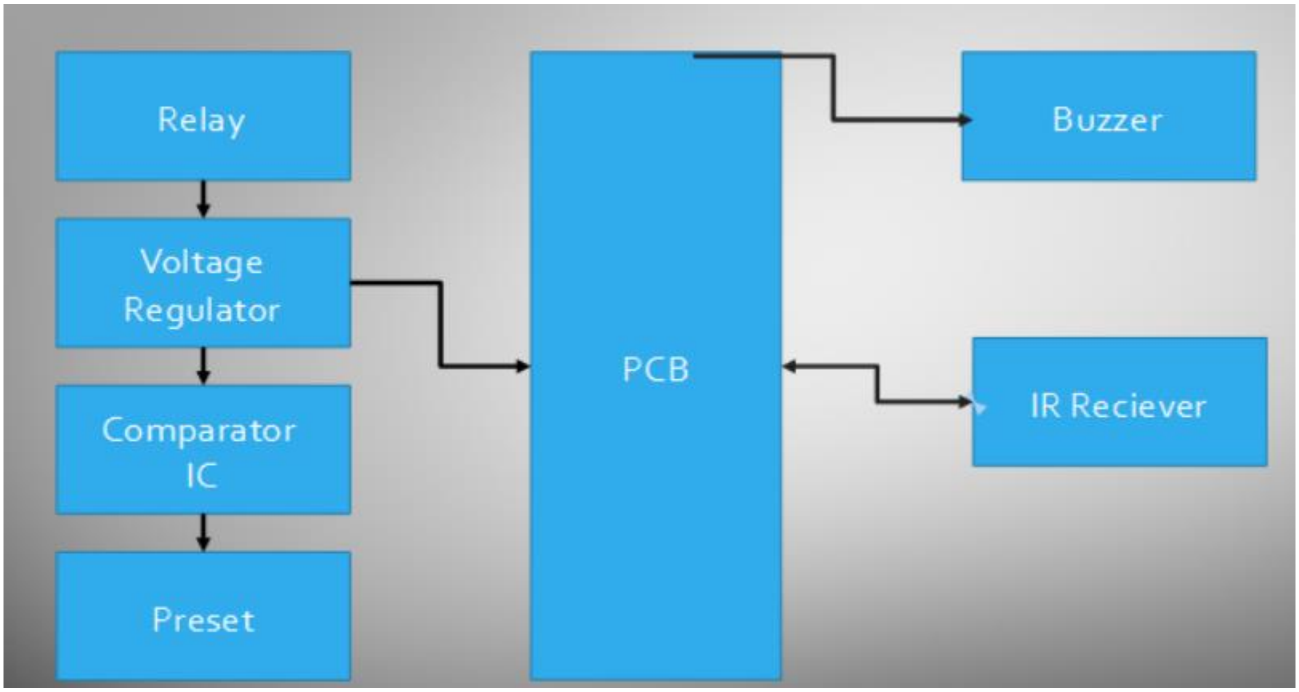


Figure 1.1 Block diagram of the system

THE OBJECTIVES:

To main S&T objectives of FIRESENSE are the following:

Identification of user requirements and system design

Extensive survey of state-of-the-art algorithms, technologies and systems related to

- Sensor Polling
- Video-based Fire Detection
- Data Fusion
- Prediction of Fire Propagation
- 3D GIS
- IR –based Fire Detection
- Weather Data Processing
- External Weather
- Forecast
- Area Fuel Mode

Smoke and fire detection based on cameras and WSN sensors

Development of novel algorithms for fire and smoke detection based on visible cameras. Development of novel techniques for thermal data processing using infrared cameras at different wavebands. Development of low-cost pyroelectric infrared (PIR) sensor based system for indoor fire detection Collection and analysis of weather data from local weather stations and official sources. Definition of WSN architecture and related communication protocols; definition of constraints and requirements for the network topology and the network node/gateway hardware/software. Hardware and software design, development and integration of sensor nodes, WSN gateways and housing. Design and development of communication protocols, routing algorithms and network topology for maximizing the lifetime of the WSN.

Multi-sensor data fusion

Development of novel data fusion techniques for the combination of data from multiple sensors to detect fire and smoke. Provision of different alarm levels for cases of temperature rise, detection of smoke or fire, extreme weather conditions, etc. based on the result of multi-sensor data fusion.

Estimation and visualization of fire propagation

Estimation of vegetation distribution and relevant fuel model parameters in monitored areas based on satellite images, pre-existing land cover information or ground surveys. Estimation of fire propagation based on the semi-empirical BEHAVE model and examination of physical and hybrid models for fire spread calculations. Development of user friendly GIS-based platform for 2D/3D visualization of the estimated fire propagation.

Development of FIRESENSE Control Centre

The control Centre will provide various functionalities to the end users such as visual and acoustic alarms in case of fire/smoke detection and extreme weather conditions, easy access to camera streams and sensor measurements, manipulation of cameras and sensors, video on demand, maps for location and visualization, visualization of fire propagation estimation, etc. through a user friendly interface.

System evaluation

Development of methodological framework for assessing the performance of the proposed system, in terms of covering the user requirements and expectations. Laboratory testing of system components and functionalities. Organization of real fire experiments for data collection and system evaluation. Evaluation of.

CHAPTER 2
LITERATURE SURVEY

The main S&T result of WP3 is the development of algorithms and software for fire and smoke detection based on optical and IR cameras. The developed software enables early detection of fires in large open areas and can be used for the protection of forests and cultural heritage areas, as well as for the detection of fires in landfills, industrial areas (chemical fires, warehouses) and military training areas. Computer vision based flame detection Optical cameras and video-based algorithms provide an effective and low cost solution for the detection of flames at an early stage. However, video-based flame detection systems are affected by several limitations that challenge their performance such as the presence of sun reflections, car lights, bad lighting conditions, poor image quality, movements of fire-like colored objects, etc. To overcome the aforementioned drawbacks, partners focused on improving existing algorithms and developing three new techniques for flame detection. The developed algorithms offer increased detection rates and lower false positive ratios compared to the literature. BILKENT developed a covariance matrix based fire detection method for video sequences. The algorithm divides the video into spatiotemporal blocks and uses covariance-based features extracted from these blocks to detect fire. Both the spatial and the temporal characteristics of flame colored regions are exploited. Unlike other algorithms used for similar tasks, the proposed method does not use background subtraction, which means that it does not require a stationary camera for the detection of moving flame regions and can, therefore, be also used with moving cameras. This is an important advantage because fixed cameras may sway because of the wind or a PTZ camera can slowly pan an area of interest to detect fire.

CERTH's flame detection

Algorithm results: 1) input video frame, 2) estimated foreground i.e. detected moving objects, Result of color analysis (detection of regions with fire-like color), 4) result of spatial analysis, 5) result of temporal analysis (flame flickering detection), 6) result of feature fusion, i.e. detected flames. Red rectangles indicate the regions of the image where flame detected. Detected flame blobs are illustrated as colored regions. CERTH developed a video based flame detection algorithm, which initially applies background subtraction and color analysis to identify candidate flame regions on the video frames and subsequently distinguishes between fire and non-fire objects based on a set of five extracted features including color probability, spatial variation, temporal variation (flickering), spatiotemporal variance and contour variability of candidate blob regions. Classification is based either on classifiers trained with fire and non-fire video frames or on a rule-based approach. Finally, SUPCOM developed a real-time flame detection system for video sequences captured by both fixed and moving (PTZ) cameras. First, moving objects are detected in each frame. Then, a set of flame characteristics including color, temporal intensity variance, spatial intensity variance, shape variation and shape complexity are extracted and classified as flame or non-flame using a set of fuzzy Context Independent Variable Behavior (CIVB) classifiers.

Computer vision based smoke detection

Smoke observed from a long distance and smoke observed from up close have different spatial and temporal characteristics. Wildfire smoke appears to move very slowly after a couple of hundred meters and it does not exhibit turbulent behavior when monitored by a video camera. Based on this observation, BILKENT developed two different algorithms for close range and long range (wildfire) smoke detection. The close range smoke detection algorithm first detects regions with smoke-like color (grey/white) to decrease the search area in the frame. Then, the video is divided into spatiotemporal blocks and a set of covariance descriptors is extracted for blocks with smoke-like color. The long-range smoke detection algorithm consists of three main sub-algorithms: (i) slow moving object detection, (ii) smoke-coloured region detection, and (iii) correlation based classification. Both algorithms obtain high detection rates while exhibiting increased robustness to false positives due to the presense of clouds, fog or moving objects. Smoke detection results using BILKENT's algorithms for close range (first two images) and long range (last two images) fires. BILKENT also developed an Entropy functional based Online Adaptive Decision Fusion (EADF) framework for image analysis and computer vision applications and improved former smoke detection results. In this framework, sub-algorithms of the smoke detection module are combined with weights, which are adjusted online according to the changing light and environmental conditions. In this way, it is possible to fuse the results of several smoke detection algorithms analyzing the scene in parallel. Improved performance was achieved for wildfire smoke detection at an early stage. Finally, SUPCOM investigated the possibility to embed an early smoke detector into the camera in order to send a quick alert to the monitoring center immediately after video acquisition. Generally, the two video compression standards MJPEG and MPEG2 are commonly available in most cameras. They both involve a block wise Discrete Cosine Transform (DCT). SUPCOM's first contribution for designing such smart camera functionality consists of exploiting the local fractal feature of smoke areas based on the DCT coefficients. The second novelty relies in refining the estimation of the fractal feature by considering larger blocks of coefficients to increase detection accuracy without Page 11 of 97 increasing the complexity. This technique could be very useful in low bit-rate transmission applications. Figure 7: Smoke detection results using the EADF framework in wildfire video sequences. IR camera based fire detection .Three prototype multispectral cameras were developed by XENICS. Meerkat Fusion consists of three cameras at different wavebands: visible, SWIR and LWIR. Meerkat PTZ consists of two cameras at visible and LWIR spectrums. Finally, Meerkat Fix consists of a LWIR and a SWIR camera. The cameras are capable of recording videos simultaneously and transmit the videos to a computer through Ethernet. Figure 8: Meerkat Fusion, Meerkat PTZ and Meerkat Fix cameras developed by XENICS. Figure 9: Images from field tests performed in Antalya, Turkey in May 2011 using the Meerkat Fusion multispectral camera: a) visible image, b) SWIR image and c) LWIR image of the same scene. Page 12 of 97 XENICS made an in-depth analysis for infrared data processing. Each aspect of the infrared radiation was studied:

2.2 International Journal of Innovative Research in Science, Engineering and Technology

Forest is considered as one of the most important and indispensable resource, furthermore, as the protector of the Earth's ecological balance. However, forest fire, affected by some human uncontrolled behavior in social activities and abnormal natural factors, occurs occasionally. Forest fire was considered as one of the severest disasters. In forest fire detection, it is essential to know how fire affects the soil mantle, stems and treetops, as well as how to detect underground fires. The sensor network must cover large areas, distributing high amount of sensing nodes, inexpensive sensors are needed to achieve cost reduction. Video cameras sensitive in visible spectrum based on smoke recognition during the day and fire flame recognition during the night, Infrared thermal imaging cameras based on detection of heat flux from the fire, IR spectrometer which identifies the spectral characteristics of smoke gases, and "Light detection and ranging" system which measures laser light backscattered by smoke particles. Infrared and laser-based systems have higher accuracy than the other systems a forest is basically a place for various types of trees and wildlife. The first thing that comes to our mind when we think about forest is trees. Forest is a home for varieties of plants and animals. The main source of oxygen is plants; it inhales carbon dioxide and other greenhouse gases and exhales oxygen. Since all are aware of the types of pollutions, air pollution has become more and more due to industries and wide use of vehicles these days. Only way to purify toxic air is growing trees and protecting forest. Forest fire causes huge damage to the world. Forest fires are can't be noticed easily and it spreads quickly damaging many plants and killing wild animals We have many incidents on forest fire which have taken place in all over the world. The major cause of the forest fire is mainly due to natural or man-made faults. Forest fire spreads quickly so the model should be designed in such a way that detects while the incident is happening and to notify within seconds. The forest fire spreads quickly and if it is not identified and measures are not taken properly it spreads so fast causing damage to the ecosystem. Forest is a home for all the wild animals and trees. There are many incidents which prove the damage caused by forest fires one such example is Bandipur. Bandipur incident took place in February 2019, it burnt down about 10,920 acres of forest land .Bandipur forest is a home for several animals and about 250 species of birds and huge range of vegetation . In many monitoring stations the authorities do not have any pre warning system or a device which sends mess. While the incident is taking place. So, the life of the forest guards would be in danger. In this project we have designed and developed a hardware model which helps in detecting forest fire at its earlier stage itself. This device helps to detect the fire and prevent loss to the government by indicating about the incident and also takes necessary actions to prevent the forest fire. The hardware model consists of sensor’s like gas/smoke sensor and temperature sensor. A buzzer is also provided which helps to alert while the incident is taking place.

CHAPTER 3
PROPOSED WORK

SYSTEM DESIGN:

The issue with timberland fires is that woodlands are generally remote, unmanaged domains stacked with trees, and dry wood and leaf litter that go about as fuel sources. These pieces are especially ignitable materials and address the ideal setting for impacts. Flame start can be polished by human activities like smoking or fire cooks, or by regular causes, for example, high temperatures on a mid year's day. Right when start begins, by then the burnable materials may effectively fuel the flame. The flame by then breezes up continuously basic and reasonably clearing.

DISADVANTAGES:

Difficult to screen all the woodlands zones in light of the fact that here we are using model we won't have much partition to cover certain area.

OBJECTIVE:

The objective is to detect the forest fire as early as possible by measuring the level of temperature and carbon dioxide level. Apart from the preventive measures, early detection and suppression of the fire is the only way to maintain the damage and casualties. IOT-based forest fire detection system is proposed to detect the fire by monitoring the values of carbon dioxide level and temperature. Existing system they are used Robots for Extinguish fire robot is interfaced with several sensors Unmanned Ariel Vehicle (UAV) – For monitoring Forest fire Unmanned Ground Vehicle (UGV) – For extinguish fire Both Vehicles are communicating through Radio Frequency Communication if UAV.

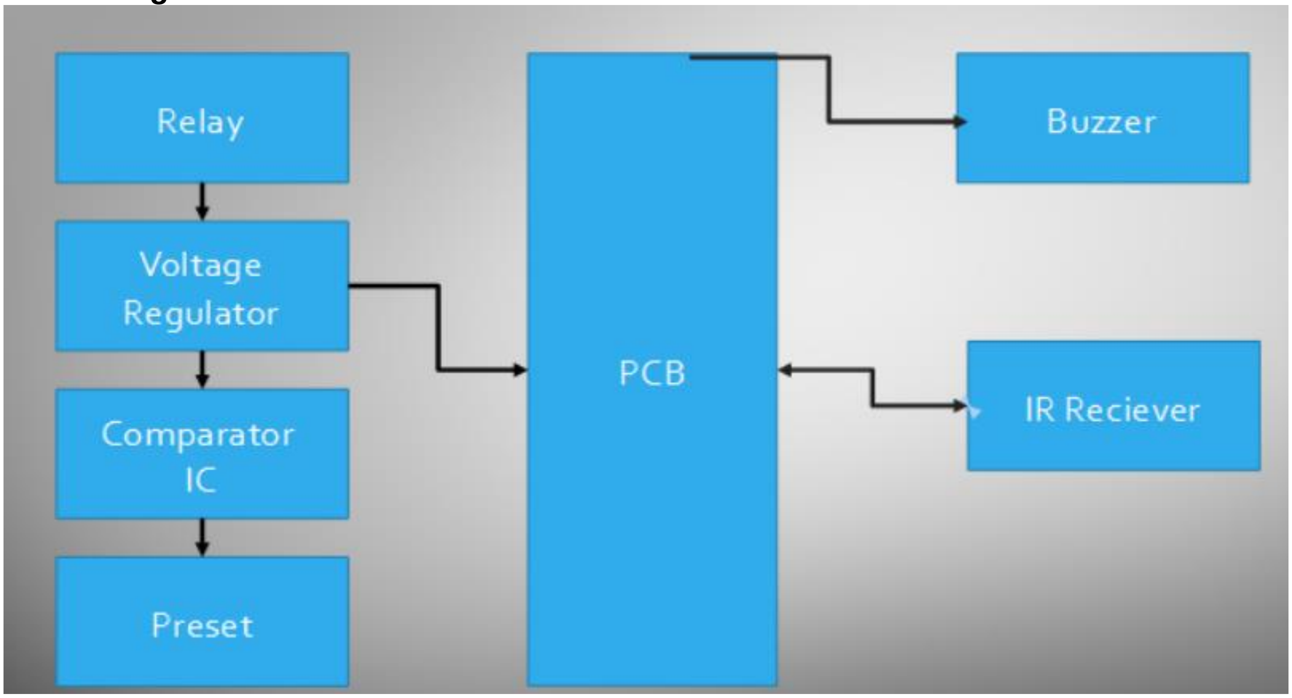
PROPOSED WORK:

Nowadays their area unit numerous occurrences regarding the pirating of trees like sandal, Sag wan and then forth. These trees area unit high-ticket and pitiful. They're utilized within the medicinal sciences, beautifying agents. To limit their sneaking and to spare woodlands around the world some preventive estimates ought to be sent. The wave got designed up a framework that may be utilized to limit sneaking. The structure framework utilizes 3 sensors tilt sensor to acknowledge the tendency of the tree once it's being cut, temperature sensor to determine timberland fires, a sound sensor for the successful discovery of unlawful work for instance so, even the sounds created whereas chopping out the tree area unit in addition detected. Information created from these sensors is consistently observed with the page. As for the sensors, their yield gadgets area unit initiated through a hand-off switch. For a tilt sensor and sound sensor, a ringer is enacted and for the temperature sensor, the water siphon is actuated.

PROPOSED SYSTEM

Effectiveness and response time in emergency situations management are key factors that directly influence the number of victims. The analysis of environmental conditions in real time (such as weather events and polluting gases) could provide relevant data on the environment that could help prevent or detect an emergency situation. Nowadays, IOT (Internet of Things) devices and sensors allow the monitoring of different environmental variables, such as temperature, humidity, pressure and concentrations of pollutant gases, such as carbon monoxide and carbon dioxide. Radical changes and combinations of these variables could indicate the occurrence of adverse weather events that could cause a natural disaster, such as a forest fire. Thus, the developed system integrates IOT devices and sensors that can perform a real time control of different atmosphere variables and polluting gases. In order to activate alerts when pollution levels increase excessively or when detection Climatic events. These events can favour the occurrence of fires and other emergency situations. Particular attention has been paid to the communication security among IOT devices, Web service and mobile devices. Moreover, a secure data transmission protocol, a block cipher algorithm and a secure authentication scheme have been implemented. In existing system, they use robots to extinguish the fire accidents but robots have its own advantages and disadvantages in this system we go for detection and Monitoring of forest fires through several sensors and send to IOT cloud. Depending upon the sensor values in the cloud if it is greater than the preset values it will send mail to the user. Continuous monitoring and uploading values to Ubidots cloud can be achieved.

Block Diagram



BLOCK DIAGRAM EXPLANATION:

The developed system is based on a sensor network and distributed Wireless IOT devices able to obtain data from the environment and process it in real time. The main goal is to provide information to the systems responsible for the management and strategic planning in emergency situations generated mainly due to forest fires. In this sense, the system consists of gathering data of magnitudes and atmospheric variables that determine the meteorological conditions and the presence of polluting gases in each zone to transform it into useful information that could be visualized through interactive elements (maps, graphs, statistics and gauges) .Atmospheric variables and pollutant gases control and monitoring can favour forest fires prevention in different ways. Firstly, it helps to prevent and determine possible risk areas for forest fires. Taking into account values collected by IOT devices and ”the rule of 30”, temperature measurements that exceed 30°C and humidity values below 30% in a same zone could implicate a preventive management process through alerts activation. The main reason is the existence of meteorological conditions that are favorable to forest fires generation. In addition to these factors, the pressure value is relevant in the field of early detection of periods of storms or anticyclones that can improve or aggravate the weather conditions in case of fire. Secondly, the control and monitoring of atmospheric variables and pollutant gases can also favor the early forest fires detection (when values and measurements provided by the IoT devices imply unusual meteorological conditions in the area, such as an abrupt rise of temperature values, decrease of humidity in the area or periods of anticyclone). In addition, an excessive increase of the CO_2 and CO concentrations could indicate an evidence of biomass combustion. Thirdly, the control and monitoring of atmospheric variables and pollutant gases can also favor the control of the forest fires progress. The monitoring of the commented variables in the surroundings of the burned zone allows to control the fire progress through detection of progressive increases of temperature, humidity, and CO_2 or CO concentrations. In this way, it is possible to realize a real time management of the area occupied by forest fire. The developed information system is Composed of three important parts.

HARDWARE REQUIREMENTS

- Arduino
- Node MCU

SOFTWARE REQUIREMENTS

- Arduino IDE
- Embedded C Programming

APPLICATIONS

- Remote forest fire detection
- Remote forest fire prevention
- Automated fire department

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop28 computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can be communicate with software running on your computer. The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.

Overview

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources. This guide covers the Arduino Uno board (Spark fun DEV-09950, $29.95), a good choice for students and educators. With the Arduino board, you can write programs and create interface circuits to read switches and other sensors, and to control motors and lights with very little effort.

This is what the Arduino board looks like.

The Duemilanove board features an Atmel ATmega328 microcontroller operating at 5 V with 2 Kb of RAM, 32 Kb of flash memory for storing programs and 1 Kb of EEPROM for storing parameters. The clock speed is 16 MHz, which translates to about executing about 300,000 lines of C source code per second. The board has 14 digital I/O pins and 6 analog input pins. There is a USB connector for talking to the host computer and a DC power jack for connecting an external 6-20 V power source, for example a 9 V battery, when running a program while not connected to the host

computer. Headers are provided for interfacing to the I/O pins using 22 g solid wire or header connectors. The Arduino programming language is a simplified version of C/C++. If you know C, programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions.
An important feature of the Arduino is that you can create a control program on the host PC, download it to the Arduino and it30will run automatically. Remove the USB cable connection to the PC, and the program will still run from the top each time you push the reset button. Remove the battery and put the Arduino board in a closet for six months. When you reconnect the battery, the last program you stored will run. This means that you connect the board to the host PC to develop and debug your program, but once that is done, you no longer need the PC to run the program. The Arduino Uno is a microcontroller board based on the ATmega328.It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Summary:

- Microcontroller ATmega328
- Operating Voltage 5V
- Input Voltage (recommended) 7-12V
- Input Voltage (limits) 6-20V
- Digital I/O Pins 14 (of which 6 provide PWM output)
- Analog Input Pins 6
- Clock Speed 16 MHz

Pin Configuration

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall- wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

The input voltage to the Arduino board when it's using an external power source (asopposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin **5V** this pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board **3V3.** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50mA.This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.

Memory:

- The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM.

Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode(), digital Write( ), and digital Read( ) functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull- up resistor (disconnected by default) of 20-50 kohm's. In addition, some pins have specialized functions:

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and Transmit (TX) TTL serial data.

These pins are connected to the corresponding pins of the ATmega8U2 USB-to- TTL Serial chip.

External Interrupts: 2 and 3: These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt () function for details.

PWM: 3, 5, 6, 9, 10, and 11: Provide 8-bit PWM output with the analog Write () function.

SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.

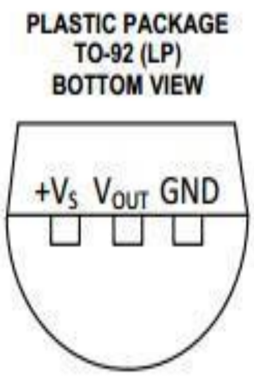
LED: 13. There is a built- in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off. The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analog Reference () function. Additionally, some pins have specialized functionality: AREF Reference voltage for the analog inputs. Used with analog reference ()reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

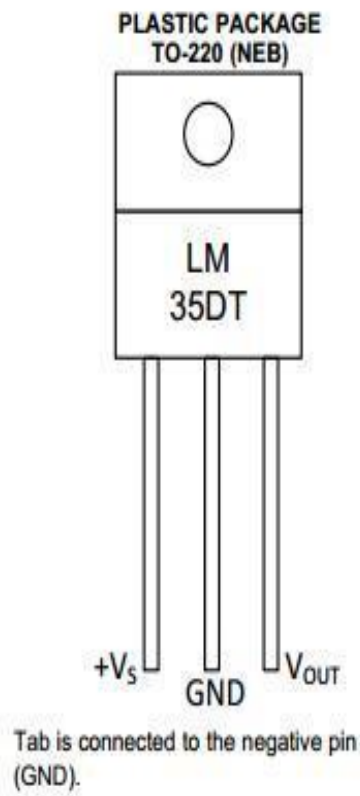
Communication

Microcontrollers depend on a host computer for developing and compiling programs. The software used on the host computer is known as an integrated development environment, or IDE. For the Arduino, the development environment is based on the open source Processing platform (www.processing.org) which is described by its creators as a “programming language and environment for people who want to program images, animation, and interactions.“ The Arduino programming language leverages an open source project known as Wiring (wiring.org.co). The Arduino language is based on good old- fashioned C. If you are unfamiliar with this language, don’t worry; it’s not hard to learn, and the Arduino IDE provides some feedback when you make mistakes in your programs. The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a in file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins(0 and 1).

DESCRIPTION:

The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the centigrade temperature. Thus the LM35 has an Advantage of over linear temperature calibrated in kelvin, as the user is not subtract a large constant voltage from the output to obtain convenient centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The low output impedance, linear output, and precise inherent calibration of the LM35 make interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 draws only 60 µA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 is rated to operate over a −55°C to +150°C temperature range, while the LM35C is rated for a −40°C to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic TO transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35Dis also available in an 8-lead surface-mount small outline package and a plastic TO-220 package.



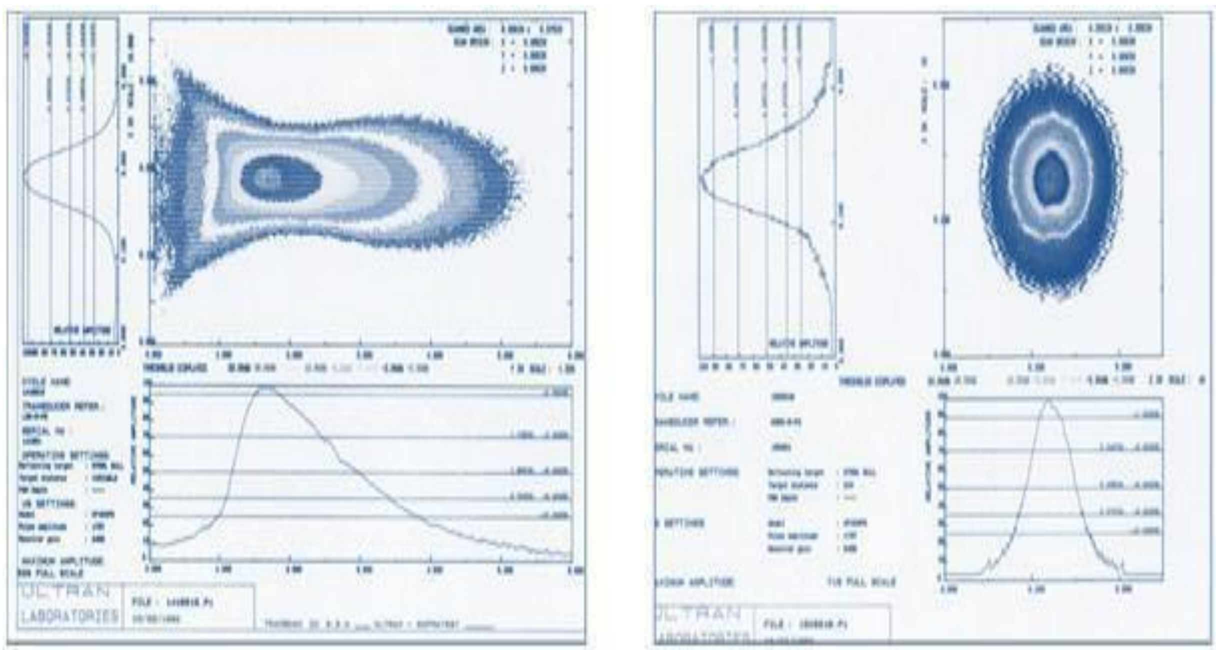


Micro-electromechanical systems (MEMS)

Micro-electromechanical systems (MEMS) is a technology that combines computers with tiny mechanical devices such as sensors, valves, gears, mirrors, and actuators embedded in semiconductor chips. MEMS or what he calls analogy computing will be "the foundational technology of the next decade." MEMS is also sometimes called smart matter.

Generating Ultrasonic Waves

For the generation of such mechanical waves, movement of some surface like a diaphragm is required which can then induce the motion to the medium in front of it in the form of compression and rarefaction. Piezoelectric materials operating in the motor mode and magnetostrictive materials have been widely employed in the generation of ultrasonic waves at frequency ranges of 1-20 MHz and 20-40 kHz respectively. The sensors employ piezoelectric ceramic transducers which flex when an electric signal is applied to them. These are connected to an electronic oscillator whose output generates the oscillating voltages at the required frequency. Materials like Lead Zirconate Titanate are popular piezoelectric materials used in medical ultrasound imaging. For best results, the frequency of the applied oscillations must be equal to the natural frequency of the ceramic, which produces oscillations readily through resonance. It offers maximum sensitivity and efficiency when operated at resonance. Piezoelectricity being a reversible phenomenon produces electrical voltages when ultrasonic waves reflect back from the target and impinge upon the ceramic structure. In this way, a transducer may work both as a transmitter and a receiver in pulsed mode. When continuous measurement of distances is required, separate transducers may be used for transmission and reception. The sensors when used in industry are generally employed in arrays which may be mechanical arrays consisting of oscillating or rotating sensors, or electronic arrays which may be linear, curved or phased. To visualize the output of an ultrasonic sensor, displays of different kind are used whose shape depends on the type of transducer array used and the function. A sectored Field of View is produced by mechanical arrays and curved and phased electronic arrays, while a linear field is generated by linear arrays. The display modes may be linear graphical plotting with amplitude on y-axis and time on x-axis called Amplitude mode or A-mode, or intensity modulated B-scans where the brightness of a spot indicates the amplitude of reflected waves. Other modes include M-mode, Doppler (D) Mode etc.



Axial and Cross Sectional beam profiles

Applications

The applications of ultrasonic sensors can be classified on the basis of the property that they exploit. These can be summarized as: Research has been going on to overcome the problems of ultrasonic sensors, particularly in medical imaging where it is known as ultrasound. The artifacts of ultrasonic sensors like Acoustic shadowing and Acoustic Enhancement are being exploited to characterize tissues which allow the differentiation solid and cystic tissues. The industry too has reaped the benefits from ultrasonic in application like plastic welding, jewelry cleaning, remote sensing and telemetry, assisted parking system etc.

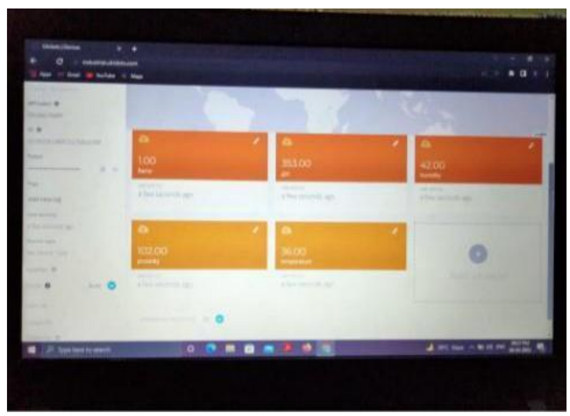
CHAPTER 4
RESULTS AND DISCUSION

In this paper we discuss how the circuit is designed and implemented. We have conducted this experiment in various stages in order to check the working of various sensors and to make the system fault tolerant. We have also performed this experiment at places where the speed of the internet / Wi-Fi is significantly low to make sure that the data is being transmitted even at low data rates. the experimented results and values for all the sensors, the data transmitted to cloud and also the image or video which was displayed in the webpage we created for monitoring are listed below. Explains the live streaming of video footage to webpage and how we can remotely control the devices connected to the system**.**

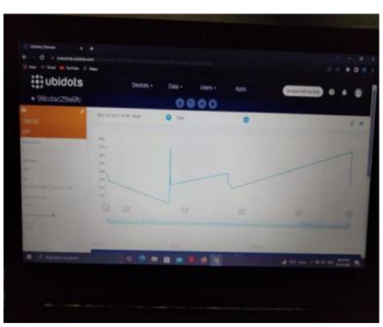
OUTPUT PICTURES

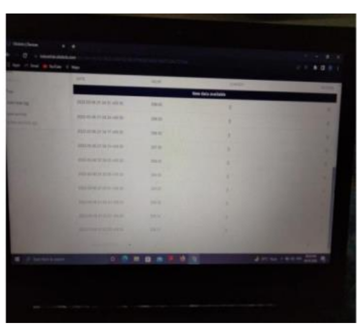
Sensor testing

Software ubidots



Software ubidots





CHAPTER V

CONCLUSION

The proposal presented in this paper describes a new information system that has been developed taking into account innovative technologies, IOT devices and the use of sensors with the aim of helping to improve the management of emergencies. Specifically, devices based on Arduino have been used. During the development of this solution, multiple challenges, such as the use of data transmission protocols (4G), interaction with hardware devices, integration of sensors and the transformation of registered data into useful information for the visualization of users have been solved. Furthermore, the integration of different technologies (mobile devices, Web service and IOT devices), the synchronization of all system data among different platforms (new alerts, measurements, etc.) and more considerations have been done. Given the importance of confidentiality and authenticity, the system has been provided with security services. Specifically, OWASP guidelines and AES CBC encryption have been applied. This proposal is a work in progress, so several lines of work are still open. First, we will try to incorporate new sensors in the system that allow to control new environment variables, in order to improve prevention, detection and management of emergency situations. Secondly, we will try to increase interaction possibilities with emergency teams and workforce that are situated in the zone affected by forest fire, in order to gather more data as multimedia real time information. Finally, we will try to introduce and combine more layers and content types in the system for improving development of action protocols and forest fires extinction.

FUTURESCOPE:

In this work, the system is designed and tested for its reliability and scalability due to improved sensor technology. The new technology can help to mitigate serious accidents caused by fire We can also add more sensors and train this system to detect animal movements, loggers and hunters in restricted areas of forest.

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