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SURVEY ON FOREST FIRE DETECTION PROCESS IN WIRELESS SENSOR NETWORK

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ABSTRACT-Forest and rural fires are one of the main causes of environmental degradation in Mediterranean countries. Existing fire detection systems only focus on detection, but not on the verification of the fire. However, almost all of them are just simulations, and very few implementations can be found. Every year, thousands of forest fires across the world occurs and cause disasters in the environment system including losses huge spaces of green area , thus, there is a realistic need for finding a solution to eliminate the impact of the forest fires. Many applications and techniques/method used to identify forest fire in early stage. This paper surveys the Forest Fire detection techniques, method and algorithms.

Keywords- [Forest Fire, Wireless Sensor Network, Detection Process.]

1. INTRODUCTION

In Wireless Sensor Networks (WSNs), the nodes are deployed and left unattended to monitor an application. These nodes need to operate with minimal human intervention. Furthermore, it is infeasible to replace their batteries especially when they are deployed in a hostile environment. Therefore, special considerations need to be in place in order to efficiently utilize the limited battery power of the nodes. In these networks, most of the energy is consumed in data transmission as compared to data processing. Therefore, energy-efficient routing protocols need to be carefully designed to maximize the lifetime of these networks. Furthermore, the hostile deployed environment poses further threats to these networks. As a result, the designed routing protocols need not only be energy efficient but secure as well. Energy conservation is one of the key issues requiring proper consideration. The need for energy-efficient routing protocols to prolong the lifetime of these networks is very much required. Moreover, the operation of sensor nodes in an intimidating environment and the presence of error-prone communication links expose these networks to various security breaches. As a result, any designed routing protocol need to be robust and secure against one or more malicious attacks. The selection of an optimal percentage of cluster heads reduces the energy consumption, enhances the quality of delivered data and prolongs the lifetime of a network. Apart from an optimal cluster head selection, energy consumption can also be reduced using efficient congestion detection and mitigation schemes.

Technological advances in wireless communication paved way to the development of tiny low-cost, low-power and multifunctional sensor nodes in wireless sensor networks. Wireless Networks are becoming popular due to the concept of “3 any”- any

person, anywhere and anytime. The design of sensor network is influenced by factors like scalability, energy consumption, environment etc. and depends on the application. Of the three activities: sensing, processing and communication, most of the energy is spent on communication purposes. Energy conservation is thus a dominant factor in wireless sensor networks. Routing strategy selection is very important for proper delivery of packets. Ongoing research aims in extending network lifetime by designing protocols that requires less energy during communication. An energy harvesting wireless sensor networks is a solution against the drainage of energy in battery powered networks since renewal of energy is too expensive. Energy harvesting make use of nodes that are able to harvest energy from the environment. Wireless Sensor Networks are becoming a need for the mankind due to the advancement in Micro-Electro-Mechanical Systems (MEMS) technology. A processing device, sensor or motes in wireless sensor networks can gather data, process it and transmit it to another device. Other device aggregate the data obtained in such a way that it is comprehensible to the humans. Wireless Sensor Networks (WSNs) is defined as a composition of a large number of sensor nodes which are densely deployed either inside a physical phenomenon or very close to it. Sensors are tiny devices which monitor various conditions like temperature, humidity, pressure etc. and later convert it into electrical signal. These sensor devices communicate either directly to the Base Station (BS) or among each other. Each node hence requires a power source which can give a node maximum life in spite of its small size. The self-organizing capability of sensor nodes provides several challenges among researchers for designing the network protocols.

2. LITERATURE SURVEY

[1]. Anupam Mittal, Geetika Sharma, RuchiAggarwal (2016) proposed a two level sensor fusion based event detection technique for the WSN. This two layer fusion based technique provides extra support for dynamic nature of the network, physical failure of the nodes. Every field of human endeavor is affected by these issues; therefore a few examples will suffice. In bioinformatics, there are opportunities to use information about the human genome to design more effective medications, information from medical records to track drug side-effects or emerging diseases, and information from medical imaging to understand the structure and function of the brain and other organs. In robotics, major challenges lie in making use of visual and other sensed information to allow a robot to adapt flexibly to its environment. In the domain of e-commerce, all but the simplest artificial agents designed to gather information and act on behalf of human users will have to be equipped with the ability to adapt their behavior successfully to unexpected conditions. The very large number of documents and databases available on the web has fostered the development of tools for abstracting, extracting, and combining sources in a variety of ways to make the information more usable to humans. SVM's are an alternative training method for polynomial, radial basis function and multi-layer perception classifiers in which the weights of the network are found by solving a quadratic programming problem with linear constraints, rather than by solving a non-convex, unconstrained minimization problem as in standard neural network training. ANN is a nonlinear dynamic system and work pattern of human brain. The Artificial neural networks are kind of learning based algorithms. The models of ANN compose of many neurons that are similar in function and structure. These neurons connect forming a net, and use parallel processing algorithm. ANN is a system that has the ability of learning by itself and learning is an adaptive process. Decision tree is a form of multiple variable analyses. They allow predicting, explaining, and classifying an outcome. Feed-forward networks can be seen as cascaded squashed linear functions. The inputs feed into a layer of hidden units, which can feed into layers of more hidden units, which eventually feed into the output layer. Forest fires generally occur in wild areas due to human activities and change in environment. They cause threats to the ecosystem and may result in human and animal deaths. In Future

this technology can provide real-time monitoring, where it can provide information at the ignition instance or at very small delays, depending on the node used in wakeup/sleep schedule.

[2]. Dr.M.PSivaram Kumar, Shyamala.R, Priyanka.G, Sneha. R (2016) proposed forest fires represent a constant threat to ecological systems, infrastructure and human lives. Past has witnessed multiple instances of forest and wild land fires. Traditional fire protection methods use mechanical devices or humans to monitor the surroundings. The most frequently used fire detection techniques are usually based on particle sampling, temperature sampling, and air transparency testing. An alarm is not raised unless the particles reach the sensors and activate them. So we are going to capture the images through satellite and will give the captured image as a input to the software, this system will give the output as whether the fire is present or not. If fire is present then it will display the status of the fire like mild stage, severe stage or no fire stage. Initially the process which is going to takes place is preprocessing .In pre-processing, there are three steps, such as grayscale conversion, resize the image to fixed size, and filter the image. Grayscale conversion is used to reduce the brightness effect and it also reduce the memory requirement. Then the image is converted into fixed size to simplify the calculations and filtering an image process will takes place to remove the noise in the image. Forest fire is a important issue now a days. It destroys the valuable resources of the forest like woods, etc and they can create great environmental problems for Nature. When a wildfire burns out of control, the size of the losses can be almost immeasurable. More than that forest is one of the reason for rain. A number of early forest fire detection methods have been proposed using various remote sensing systems based on infrared thermal camera imaging, airborne or ground-based Lidar , Satellite-based Synthetic Aperture Radar (SAR) imaging techniques, radio – acoustic based sounding system, and fire detection based. Currently many institutions are trying to develop reliable and efficient methods to forecast the fire disasters, which may induce heavy property loss as well as serious social impact. The traditional method to detect fire is employing some people as inspectors, but human resource is expensive and such approach has very low efficiency. Fire sensors have already been used as another method to detect the particles generated by smoke or fire, temperature, relative humidity, etcs. Fortunately, computer vision based fire detection brings us a new kind of method which can overcome the key deficiencies of the aforementioned methods. The detection of fire through the usage of photographed data of forest area followed by computer processing of the data. A method for reading information, pre-processing of an image color components, the segmentation and data classification using SVM is proposed. The method is working very fast and can be used for online calculations and decision making. The efficiency of the proposed procedures is shown: 95 % detection ration and 5 % false detection is shown. The proposed method can be used in the monitoring systems of the area to detect fire.

[3]. VIKTOR TUBA, ROMANA CAPOR-HROSIK, EVA TUBA (2017) proposed a method for fire detection in digital images based on the color features. In order to identify if a pixel is fire or not several rules have been established and in order to classify pixel as fire all rules need to be satisfied. Forest fires are one of the big ecological catastrophes. Every year thousands of people die as result of forest fire. Enormous material damages are made and immeasurable impact on ecosystems is made. There are predictions that forest fires (natural and intentional fire clearings) will burn around half of the all forests in the world by year 2030. In Europe alone, around 10.000km2 of forests is burnt every year. Estimates are that over 20% of carbon-monoxide emissions in the whole world is made as result of forest fires. That fact combined with global warming is making forest fires a serious problem that needs to be tackled on large scale. Image processing can introduce new techniques for forest fire detection. Today digital cameras are very cheap and can be connected directly to the computer and captured images can be

processed in real time. Using some sort of detection algorithm can automate and speed up traditional fire detection systems. For example, forest services can place hundreds or thousands of wireless digital cameras throughout area they monitor and connect those cameras to central computer in base that will process live feed and raise alarm if fire is detected on some of the camera feeds without need for human supervision. Human based detection systems. These are constituted, usually, from watch towers and on foot or vehicles patrols, where humans visually search for forest fires. Sensor networks constitutes of wireless sensors spread over large areas that detect changes in temperature or some other parameter that can indicate that forest fire has started. Areal or satellite surveillance. These systems can with relative ease cover huge areas of forest but there is limitation. Low quality of images mean that only bigger fires can be detected. Also atmospheric conditions can limit this method greatly.

[4]. George Suciu, Ramona Ciuciuc, Adrian Pasat, and Andrei Scheianu (2017) proposed system, the sensors placed in the forest are collecting information, and then sending them to their respective cluster nodes, hence forming a neural network. The neural network is processing the received data and then providing a weather index, which measures the probability of a fire to be caused by the weather. Remote sensing solutions are usually based on a solid architecture which contains a wireless sensor network of ground sensors, a central server, radio and wire communi-cations and a layer of intelligence information system. propose three innovative components for a remote sensing system: energy efficiency in forest environments for increasing the lifetime of the sensor network, a statistical model for forestry risk factors and threats for the prediction and confirmation of an event, collaborative automation of system resources and intervention services in case certain events. The proposed framework is intended to be an efficient way of rapidly detecting the fires with small energy usage. In normal conditions, the system sends various meas-ured data but in the case of a fire, it switches to an alert mode and it will act much faster, the information will be transmitted at higher speed. Therefore, in normal conditions, the sensors are consuming a small quantity of energy. Also, the approach is flexible, the system being able to adapt to different scenarios (season, terrain etc.). The authors desire to achieve an efficient forest fire detection system considering the following: energy efficiency, early detection and accurate localization, forecast capability, adapting to harsh environments. After the proposed system was tested in terms of effectiveness and energy consumption, it was observed that there can be obtained accurate results with no drastic effects of the small amount of energy consumed. Analyzed the constraints and proposed a software workbench to implement and integrate different types of sensors and WSN for monitoring at acoustic level and warning in case of events with potential destructive effects on the forest environment.

[5]. Mahadev A. Bandi, Dr. Mrs. V. V. Patil (2013) proposed methods to conduct the fire detection and also propose new techniques to implement in parallel. It gives more optimized results in detection of flame. In developing the system the following stages are involved. Fire detection system are base on sensors to make decision. Most of the available sensors used such as smoke detector, flame detector, heat detector are take time to response as well as they cannot analyze or visualize the damage. These sensors are to be carefully placed in various positions but these sensors are not suitable for exposed places. Due to speedy development in this technology and video processing techniques, the new conventional fire detection technique is going to be replaced by computer vision based systems. Conventional point smoke and fire detectors are widely used in buildings. Smoke and fire detectors are typically detect the presence of certain particles generated by smoke and fire by ionization or photometry. Unless particles reach the sensors to activate them alarm is not issued. Therefore, they cannot be used in open spaces and large covered areas. By using video in fire detection makes it possible to serve large and open place. In addition, closed circuit

television (CCTV) surveillance systems are currently installed in various public places monitoring indoors and outdoors applications. Such systems may gain an early fire detection capability with the use of fire detection. This fire detection is done by using software processing the outputs of CCTV cameras in real time. Current vision systems are based on color clues, motion in fire and edge detection of flame. Fire detection scheme can be made more robust by identifying the gray cycle pixels nearby to the flame and measuring flame area dispersion. The purpose of this is to develop an optimized system to detect an occurrence of fire based on video images. In this project use the previously proposed methods to conduct the fire detection and also propose new techniques to implement in parallel. It gives more optimized results in detection of flame. In developing the system the following stages are involved. The proposed optimized flame detection system can be used more conveniently for the detection of flame in a live video stream sequences. It has shown that the proposed flame detection system performs well in both smaller and larger or open area flame regions in video sequences. With this advances the system can be used more conveniently in houses, school and colleges, industrial areas, and large open areas and even in the forest or farms fire detection.

[6]. K. Nanthini, D.Prabhakaran, C.Ramkumar (2015) proposedImage processing and Fuzzy C-Means clustering techniques were utilized in the design of the present system. Anisotropic diffusion is employed for segmentation process and Fuzzy C-means is employed for fire detection process. The images are converted from RGB into L*a*b color space and segmentation is performed. Fire is a dynamic combustion process, instability and continuous development, so fire flame always keeps flickering and beating, and its visual characteristics are mainly embodied in the edge of the flame image. This phenomenon such as Edge jitter, generating sharp corners and the irregular beating of the numbers of the sharp corners, will both lead to the overall flame height, area and other corresponding changes, whose change law not only have direct contact with the flame flickersing frequency, but also have a great difference with interference source. A low-level image processing task image segmentation is used for splitting an image into identical regions. Using the segmentation results the regions of interest and objects in the scene that is very advantageous to the consequent Image Analysis can be identified. Color image segmentation is more monotonousthan the grey image segmentation owing to the reason that the inherent multi features contain nonlinear relation individually and encompass inter-feature dependency between R, G and B. a filter approach method, which chooses more informative features according to their probability density function (pdf) using the non-parametric of Gaussian Kernel Density Estimation relations. This method does not use the class label of each pattern (document), thus being suited for unsupervised learning problems. The main idea of the this method is firstly approximating the Probability Density function using Gaussian Kernel Density Estimation of each feature independently in an unsupervised manner and then removing those features which their probability density functions have higher covering areas with the pdfs of other features which are termed as redundant features. Forest fires cause noteworthy environmental dimidiation while menacing human lives. The explosive growth of spatial data and wide spread use of spatial databases emphasize the need for the automated discovery of spatial knowledge fire plays a vital role in a majority of the forest eco-systems. The proposed system made use of image processing and Feature selection Using Gaussian Kernel Density Estimation. The images utilized by the presented system are used for the detection of forest fires.

[7]. D.Velmurugan, Elango, Kamalakkannan, Mohandass, S.Prakash (2017) proposed method hardware implementation is validated under Lab view and information exchange through the transmitter and receiver implemented with MYRIO PROTOCOL. Fire alarm to be

enclosed with receiver to alert. Forest resources are important resources for all living things in the world. Around 1/3 rd of the world‟s land areas is forest. Forests are provides renewable resources for this earth. Covering the earth like a green blanket these forests not only produce innumerable material goods, but also provide several environmental services which are essential for life. Forested watersheds act like giant sponges, absorbing the rainfall, slowing down the run off and slowly releasing the water for recharge of springs. Increasing demands for fuel wood by the growing population in India alone has shooted up to 300-500 million tones in 2001 as compared to just 65 million tones during independence, thereby increasing the pressure on forests. Wood for making boxes, furniture, railway-sleepers, plywood, match-boxes, pulp for paper industry etc., have exerted tremendous pressure on forests. Forests are the homes of millions of wild animals and plants. About 7 million species are found in the tropical forests alone. About 50-80% of the moisture in the air above tropical forests comes from their transpiration which helps in bringing rains. It can absorb many toxic gases can help in keeping the air pure. They have also been reported to absorb noise and thus help in preventing air and noise pollution. The term forest fire refers to drastic elimination of forest resources due to many natural and man- made activities. The total forest area of the world in 1900 was estimated to be 7,000 million hectares which was reduced to 2890 million hectares by 2000. The Block Diagram of Proposed Method. The Block Diagram Consists of two Sections one is Forest Area and another one is monitoring Area. In Forest Area Solar panel, Charge Controller, Battery, MYRIO, GPS, Flame Sensor are connected in transmitter channel. Solar Panel gets Maximum power through Sun using MPPT Algorithm. The output of the solar Panel is 20V. The Output voltage is stored using a Battery with the help of charge controller. Charge controller used to maintain the voltage level 12V. Hardware implementation of forest fire detection using LabVIEW with wireless sensor networks based myRIO and flames sensor performance is validated using LabVIEW. This method is better optimization for comparing the other forest fire detection techniques. In hardware implementation solar panel 21V is given to controller circuit. Charge Controller circuit which provides the constant voltage 12V and stored into battery. Flame sensor and GPS based location monitoring is Connected through myRIO. The output from the flame sensor and gps is received by the myRIO. The labview program with led indication turns ON when fire occur in the forest.

[8]. R. Chandrasekharan, Ashiq M.I, Dr. V. Prakash (2011) proposed forest fire detection algorithm considers static and dynamic features subsequently. Color based segmentation including 3D color model with GMM and colors labeling with new flame pattern definition are provided. The algorithm of consecutive frames subtraction, transient change of image can be detected, but the overlapping region of two consecutive frames can be mistakenly taken as background. In the algorithm of background subtraction, intact target region can be extracted because of the static state of the background image, but the extracted target may be vague and inaccurate if the background image cannot be updated in time. For segmentation of possible flame regions, color values of each pixel in an image are checked with a pre-determined color distribution, which represents the range of possible fire colors in a color model such as RGB space. Color based segmentation, after GMM construction from sample pixels and segmentation of candidate fire regions, we define the specific forest flame pattern and then label three types of colors including whiteyellow, orange and red. The labeling introduces a novel feature of forest fire, i.e. color distribution, which is very helpful for further classification. The segmented results from single frame, SVM trained on 11 static features is applied to filter out the false regions, and only the remained regions continue with the following steps. In this way, computational expense is saved obviously.The sole target, but multiple candidate fire regions are tracked by shape based matching among the consecutive frames. With our defined overlapping degree and varying degree, the matching algorithm can also detect complex fire behaviors, e.g. one

fire region slowly breaks into several small parts, or the small fires burn into one region. To compute the fire flickering frequency based on region contour, the temporal wavelet is used to analyze Fourier descriptors representing the variation of flame contour in a short period. Our approach avoids explicitly setting the threshold value in the existing FFT methods, while detects forest fire more accurately than the methods using wavelet transformation only. A total of 27 dynamic features are considered for SVM based final classification, and the features are computed from every 20 consecutive video frames. Therefore, except for accuracy, the detection algorithm can perform and give alarms in real time.

[9]. Ahmad AA Alkhatib, proposed and developed based on to make decisions by tracking the fire propagation and check the logic behind it. This concept relies solely on the node behaviour to alert of crises possibility using simple node components to provide detection and information on whether this is a peaceful fire, or the beginning of wild fire. This research objective is to build a network through distributed wireless sensors randomly spread in the forest and to create a self-organized and robust network between the sensors to cover large areas in the forests that may be prone to/or in threat of fire damage at any time. As the sensors are provided with small wireless range transmitters the data will be transmitted from sensor to sensor until the signal reaches the sink. When the sink receives the data it will start a processing routine and check if the fire clearly represents danger through a measure of the rate with which the fire spreads. If the result of processing is affirmative and real danger exists, then the sink determines the position of the fire. Then the sink will send an alarm signal to the fire department to include information about the exact location of the fire, the temperature, fire spread speed to understand the fire behaviour. Based on the information received, the fire department will then be able to assess the extent and gravity of the situation to arrive at an optimal decision. In case of real danger, subsequent preventative work can then commence to mitigate the situation through appropriate action before the fire becomes uncontrollable. a wireless sensor network (WSN) can be defined as “a network of devices, denoted as nodes, which can sense the environment and communicate the information gathered from the monitored field (e.g., an area or volume) through wireless links. The data is forwarded, possibly via multiple hops, to a sink (sometimes denoted as controller or monitor) that can use it locally or is connected to other networks (e.g., the Internet) through a gateway. The nodes can be stationary or moving. They can be aware of their location or not. They can be homogeneous or not”. The main advantage of this is: No need for complicated gas boards and specialized devices or connect the network to data basses and applying complicated models to detect fires. Only simple cheap temperature sensor required on each node. Helps in decision making by distinguishing between peaceful fire, fault alarms and potential danger require immediate reaction. Low possibility of false alarms. Provide some information about the fire behaviour for fire fighters to help in team work organising.

[10]. Ganesh Sharma and DipanjanBhattacharjee, proposed and developed based on a selection of temperature sensor for forest fire detection system. A selection of an appropriate temperature sensor for forest fire detection system is done based on real time experiment. Another important aspect of this system is the network for transmission of sensed data to base station for analysis. Temperature is one of most important parameter that determines the occurrence of fire. Hence temperature sensor is vital in case of forest fire detection system. This research basically describes about the advantage of zigbee over other WLAN technology like Bluetooth. It also states that other WLAN technology has larger power dissipation, shorter range, higher complexity compared to zigbee. This research describes the use of AHP for selecting the best temperature sensor. It describes the whole process of AHP for selecting the best sensor among various commercially available sensor based on various parameters to be taken under consideration. Three temperature sensors

namely MLX90614, BMP085 and DS18B20 were taken into consideration. From the real time experiment it can be concluded that among these three sensors, MLX90614 is suitable for above application because of its capability to measure the temperature from distance and its faster response towards change in temperature. This paper also deals with selection of wireless network for forest fire detection system based on WSN using AHP. Three suitable networks for above application were taken into consideration namely Zigbee, Wifi and Bluetooth. Considering three network criteria namely power consumption, range and data rate, zigbee was found suitable after analyzing using AHP. It was concluded that zigbee was preferred over wifi and Bluetooth for this application due to its lower power consumption which enhance the lifetime of sensor node.

CONCLUSION

The design, development and the performance test of a Wireless Sensor Network for rural and forest environments fire detection and verification. This paper exposed the various techniques, methods, algorithms also. Each one of these techniques has advantage and disadvantage in term of the cost, energy and performance.

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