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IOT Based Forest Fire Detection And Early Warning System Using Raspberrry Pi And GSM

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Abstract

Forest fire causes greater havoc to forests and endangers wildlife. In this paper, an intelligent early warning fire detection system based on Image processing on IOT platform was proposed. A real time Flame detection algorithm that differentiates fire and fire colored objects is used to detect the true fire incident. Raspberry pi Microcontroller based IOT platform detects the forest fire as early as possible and takes speedy action before the fire spreads over large area. Sensors such as smoke sensors is connected with Raspberry Pi.GSM modem connected with Raspberry Pi alerts the forest monitoring control room.

Keywords-*Fire detection, GSM, IOT, Raspberry Pi, Sensors*

1.Introduction

Nearly 30% of world's land area has been covered by forest which accounts for nearly four billion hectares. Due to the dense nature of forest, unseen condition fire can spread over large area rapidly spoils the entire ecological system and endangers wild animal. This fire causes greater havoc in the environment. Recently forest fire occurs frequently due to the drought conditions.Fire in the world is increasing in recent times. This fire in the forests, farmlands and industries are owed to either natural or man-made disasters Forest fires results from natural causes such as lightening or manmade causes such as burning of unwanted materials results in a slow combustion of saw dust and leaves.

Every year the occurrence of forest fire has been increased enormously causes greater destruction to floras and faunas. Forest fire monitoring and detection system plays a significant role in preserving natural resources and safe guards humans. This attracted so many researchers to develop a significant solution to this problem. In order to sense fire at beginning and for early alarm automatic fire detection system has been proposed. But these techniques detects the fire at the scenario that it has spreaded over vast area makes it difficult to control and extinguish the fire completely. The outcome of such a scenario destructs the environment and atmosphere causes irremediable damage to the ecology. Further it has a negative impact on the pattern changes in weather and global warming. It is critical to perceive the fire and its location quickly and also alerting the fire units.

According to National Institute of Space Research (INPE) 76,000 fires were happened in Brazilian Amazon. During January-October 2019 nearly 906,000 hectares of land were burnt completely. Destruction had occurred within short interval of time. Due to the feeding of fuel by ignitable materials, the fire at the central spot has increased drastically and spreads faster over large areas. Therefore timely detection of forest fire is necessary before the fire spreads over large area. A cost effective fire fighting and monitoring system is essential.

IoT describes a system that uses wireless and wired Internet connections to interconnect different things in the physical world together with the sensors through the internet in which things in the physical world and sensors are connected to the Internet. Diverse local area networks like RFID, NFC, Wi-Fi, Bluetooth, and Zigbee can be exploited by these sensors [16] .Also sensors can be interconnected to GSM, GPRS, 3G, and LTE wide area networks. The Internet of Things will connect all physical objects with the living things [14]. The industrial equipment was interconnected with the internet of things in the earlier version. Now we can interconnect inanimate and living things with the help of IOT.Today, the vision of IoT vision has stretched that it has connected daily objects with industrial equipment. Location, vibration, motion and temperature conditions are monitored by sensors

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[15]. In IoT, understand the output signal from the sensors. Since the mobile networks supports the persistent connection of smart devices better quality of service offered to the customers will be achieved by IOT.

In this project, IOT based early warning fire detection framework senses the fire as quickly as possible and save valuable lives. Detection of fire based on color information results in false prediction. Here flame and flame colored objects were distinguished based on color and motion features. Raspberry Pi is used because of its high processing speed at low cost. Several sensors are used to collect the data and these data's were transferred to Raspberry Pi. GSM module alerts the fire monitoring station through SMS.

2. Related Work

Md Saifudaullah Bin Bahrudin et.al [1] presented a fire monitoring system that detects fire by the smoke that has generated by the fire. Camera is used to capture the fire image when a fire incident happens. The system remotely sends the image of the fired room on the web page and alerts the firefighter through SMS.

Sowah *et. al*. [3] implements fuzzy logic based fire detection system for vehicle .Temperature, flame and smoke sensors are used to sense fire. In this system air-conditioning system is used for extinguishing fire within 20 seconds when fire occurs.

Wen-bing Hang, Jim-wenpeg [10]-A novel method to identify the flame is proposed. The pixels in the Flame calculated using Hue Intensity Saturation color model.HSI rules were used for segmenting fire regions. Fire aliases can be avoided by seperating the pixels that have low intensity and low saturation in segmented fire regions. Degrees of fire flames have been measured by binary counter images results in false positive and false negatives. This method detects fire flames from test videos within a second.

K.Angayarkkani, N.Radhakrishnan [8] presented a system using Artificial Neural Intelligence to recognize the forest fire.RGB images are transformed to XYZ color space and anisotropic diffusion is used to identify fire zones. The pixel values of color space in segmented fire regions are using radial basis function neural network.

T.qiu, Y.Yan, G.Lu [12] several methods for edge detection have been used to access flame edge identification. Edges obtained from non trivial images do not resemble notable phenomenon.

Turgey,Hasan Demirel [11] – classified the pixels in the flame based on generic rule.YCbCr color space is used for flame pixel classification .this method segments the flame region yields 99.9% accurate flame pixel classification rate.

Zhao J, Zhang Z, Han S, Yuan Z [13] proposed a fire monitoring system using cameras. Features extracted from Gaussian mixture model were trained using Support Vector Machine (SVM) .False prediction occurs in case of red objects in analyzed image.

3. Methods and Material

In this proposed system Fig (1) first the camera captures continuous frames and sends to the controller. Fire is detected by an image processing based real time flame detection algorithm.

Step 1: Frame differential method is used take out running pixels and portions that are detected.

$$F(x, y, k) = \begin{cases} 1 & if \left(I(x,y,k) - I(x,y,k-1)\right) > L \\ 0 & otherwise \end{cases}$$

Step2: HIS color model is obtained and if it satisfies the condition

$$0 \leq H \leq 60$$

$$0 \leq S \leq 0.2$$

$$127 \leq I \leq 255$$

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Then the regions are taken as flame regions

Step3: The next step is foreground accumulation of images. In this step, time taken by the foreground images gives the value of pixels display in the same pixel portion at the time of succeeding time window is formed. Block image processing is helps to identify the flame motion features. Individual image of the video sequences is divided into 8X8 resolution blocks. Then sum of all pixel values such that the summed up values satisfies the condition H(x, y, t)>T.

Step 4: if half of whole pixel vales satisfies above condition then it is considered as flame block.

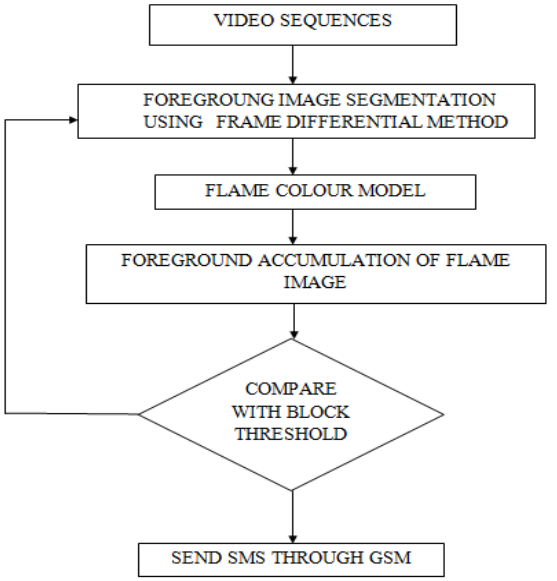

Fig 1. Steps of The Proposed Technique

Step 5: After the detection of flame, a mail is sent to the security and the nearest fire department with an attachment of the photo through GSM module.

Smoke sensors are employed to detect smoke that caused due to the fire incident.

Step 6: In final step after detection of fire the Sprinkler motor sprays the water to prevent the fire spreads over to the nearest area.

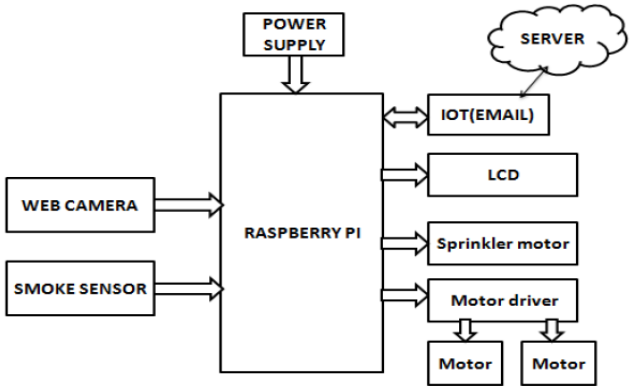

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Fig 2.Block Diagram of The New Method

Fig 3. Raspberry Pi

Fig 4. Smoke Sensor

PYTHON

Python is an elevated level programming language for broadly useful programming. Python is profoundly decipherable .It gives clear programming on both little and enormous scopes. Python includes a powerful kind framework and programmed memory the executives. It guides numerous including object arranged, basic, practical and procedural, and has an enormous and extensive standard library.

Python mediators are accessible for some OS.IDLE can be expand in a way such that Python's Integrated Development & Learning Environment. Coded in 100% Python, utilizing the GUI toolbox cross-stage works for the most part the equivalent on Windows, UNIX, and Mac OS X.

4. Results and Discussion

The algorithm is implemented using python language. This language executes each and every line present in the program & recognize the inputs from camera, sensors and creates the respective output according to the rules that are provided in the program.

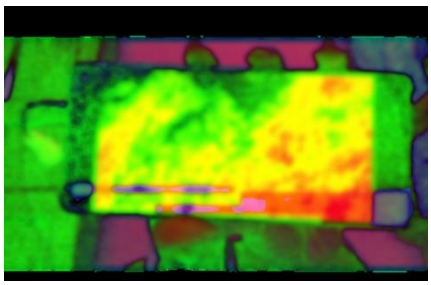

Fig. 5(A) Simulation Results

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Fig. 5(B) Simulation Result

Fig. 5(C) Output of the Project When Fire Is Detected

6. CONCLUSION

In this paper early warning and fire detection system for forest fire on IoT platform is presented to detect the fire at the early stage and prototype was developed. Furthermore the proposed platform also provides a very prompt and cheaper embedded system to detect true incident of fire.GSM module automatically sends SMS to alert the control room. In future work encryption of data for security purpose should be added.

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REFERENCES

1. Md Saifudaullah Bin Bahrudin, Rosni Abu Kassim. "Development of Fire Alarm System using Raspberry Pi and Arduino Uno," Electrical, Electronics and System Engineering (ICEESE), 2013 International Conference on. IEEE, 2013
2. Yu, Liyang, Neng Wang, and Xiaoqiao Meng "Real-time forest fire detection with wireless sensor networks," in Proceedings of International Conference on Wireless Communications, Networking and Mobile Computing, Vol. 2, 2005.
3. Sowah, Robert, et al., "Design and implementation of a fire detection and control system for automobiles using fuzzy logic," in Proceedings of Industry Applications Society Annual Meeting, 2016.
4. Chen, Thou-Ho, et al. "The smoke detection for early fire-alarming system base on video processing," in Proceedings of International Conference on Intelligent Information Hiding and Multimedia, 2006.
5. H.K. Merchant; D.D. Ahire.,"Design and implementation of Industrial Automation Using IOT with Raspberry Pi"[J]. 2017(17).
6. Luo Qian; Xie Min., "Temperature and Humidity detection system of communication system based on Raspberry Pi", Detection system, 2018.
7. Chunyu Yu, Zhibin Mei, Xi Zhang.," Real-Time Video Fire Flame and Smoke Detection Algorithm", Elsevier.2013, pp.891-898.
8. Angayarkkani K., Radhakrishnan N.,"An intelligent system for effective forest fire detection using spatial data, "International Journal of Computer Science and Information Security 2010.
9. Celia T., Demirel H., Ozkaramanli H.,"Automatic fire detection in video sequence", Proc. of European Signal Processing Conference. September 2006.
10. Hang W.B., Peg J.W.," A new image based real time flame detection method using color analysis," Proc. Of IEEE Network sensing and Control.2005.
11. Turgay, Demirel H.," Fire detection in video sequence using a generic color model", Fire Safety Journal. 2009, 4,147-158p.
12. Qiu T., Yan Y., Lu G.," An auto adaptive edge-detection algorithm for flame and fire image processing", IEEE Transactions on Instrumentation and Measurement. 2012.
13. Zhao J., Zhang Z., Han S., Yuan Z.,"SVM based forest fire detection using static and dynamic features", Computer Science and Information System.2011.
14. Subhasri.G,C.Jeyalakshmi.,"A study of IoT based Solar panel Tracking System", Advances in computational Sciences and Technology, Volume 11, Number 7 .2018 pp. 537-545.
15. S.Rajapriya, A.Abinaya, V.Subhashini, "IOT Based Dam Monitoring System", International Journal Of Advanced Research In Computer And Communication Engineering, 2019 Volume 8, Issue 6, Pages:73-75.
16. S .Shabina, "Smart Helmet Using RF and WSN Technology for Underground Mines Safety", Proceedings of International Conference on Intelligent Computing Applications, pp.305-309, 2014.

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