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Texture Analysis of Smoke for A Review on Early Forest Fire Analysis

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Abstract: *The environmental challenges facing the planet today haven't been greater or more complex. Global areas covered by forest and concrete woodlands are threatened by natural disasters that have increased considerably over the past decades, both in terms of frequency and magnitude. Large-scale fires are one of the most damaging natural hazards affecting global climate change and life around the world. To minimize their impact on people and nature, it is necessary to adopt effective methods of prevention, warning and response, strategically and closely coordinated. This paper presents an outline of optical remote sensing technologies used in early fire warning systems and supplies an in-depth survey on both flame and smoke detection algorithms employed by each technology. This project gives the prevention of using Temperature detector LM35 and Gas sensor. After the fire is detected, the device makes an alarm sound and automatically turns on the buzzer.*

Keywords: Forest Fire, Gas Sensor, Arduino, GSM, Temperature Detector LM35 Sensor, IoT, Buzzer, Pump Motor, etc.

I. INTRODUCTION

Wildfire detection systems receive a lot of attention due to the continuing threats fires pose to assets and public safety. Hundreds of millions of hectares are destroyed by fire each year and more than 200,000 fires occur each year worldwide. Forest fires destroy a total area of 3.5 to 4.5 million km^2 the proliferation of forest fires in the world's forested areas has increased the motivation to develop fire alarm systems for early detection of forest fires. Sensor technology is widely used in fire detection and is generally based on the detection of physical parameters such as pressure, humidity and temperature changes and chemical parameters such as carbon dioxide, carbon monoxide and nitrogen dioxide. However, there are a variety of reasons such as high cost, power consumption by the sensors, and the necessary proximity of the sensor to the focus for accurate detection, resulting in physical damage to the sensors. Also, sensor methods have a high rate of false alarms and their response time is quite high. There are a number of factors that motivate the use of an image-based fire detection method. The first factor is the rapid development of digital cameras and digital CCD or CMOS technology. Cameras, resulting in a rapid increase in image quality and a reduction camera costs.

The second issue is that digital cameras will cowl massive areas with glorious results. Third, the latency of image process models is healthier than that of existing device models. Finally, the general price of image processing systems is under existing systems. Recent advantages from machine vision, machine learning and remote sensing technologies give new tools for hearth detection and observation development of recent materials and electronics has allowed sensors to be additional effective at distinctive active forest fires. in contrast to different fire detection review articles that have centered on numerous detection technologies. betting on the extent of acquisition, three broad classes of wide used systems will discover or monitor of active hearths or real-time/near-time smoke incidents are known and discussed, notably land, air and satellite. These models rely upon knowledge assortment throughout wildfires, simulations, and laboratory experiments to specify and predict fire growth in several regions.

Recently, simulation tools have been used to predict forest fires, but the simulation tools have encountered some problems such as the accuracy of input data and simulation tool execution time Machine learning is a sub-branch of Artificial Intelligence (AI) to learn computers aspect. Machine learning can be divided into two classes: supervised, unsupervised is existed to give insight into the learning algorithm on how wrong or right a decision or action is.

II. LITERATURE REVIEW

1. Time-Varying modelling of Land Cover Change Dynamics Due to Forest Fires, Ayan Banerjee
   Seasonal versions in land cowl are normally represented the usage of a consistent frequency cosine version with time-various parameters. As frequency represents the usage of a consistent frequency cosine version represents the consistent annual flora boom cycle, the version isn't always good enough to symbolize dynamics together with unexpected adjustments withinside the flora boom cycle and locate abrupt adjustments in land cowl because of wooded area fires.

2. An improved Forest Fire Monitoring Algorithm with Three-Dimensional Otsu, Zhao Deng.
   Forest Fires will injury many thousands of acres of land at shockingly speedy speeds. The ground hearthplace issue's identity set of rules is that the most important step withinside the woodland hearthplace pursuit process. Most typical woodland hearthplace watching techniques use constant thresholds, ignoring heritage pixels, and have low quality rates, that would cause several problems, inclusive of pretend coverage and occasional popularity rate. This paper proposes and examines a collection of accommodative forest factor identity rules mistreatment Himawari-8 data.

3. Bi-Objective scheduling of Fire Engines for Fighting Forest Fires: New Optimization Approaches, Peng Wu.
   This paper investigates a bi-goal rescue car scheduling hassle for multi-factor wooded area fires, which goals to optimally dispatch a constrained variety of hearthplace engines to extinguish fires. The goals are to decrease the overall hearthplace-extinguishing time and the variety of dispatched hearthplace engines. For this hassle, we first broaden an integer software this is a progressed and simplified model of an present one. After exploring a few houses of hassle, let's develop a precise set of dynamic programming rules and a heuristic method for quick understanding. The goals are to decrease the overall hearthplace-extinguishing time and the variety of dispatched hearthplace engines.

4. Prediction of Forest Fire using Neural Network based on Extreme Learning Machines (ELM), Farhanna Mar'I
   To save you wooded area fires, predictions want to be made to discover regions of land which have the ability to burn primarily based totally on meteorological situations acquired from the sensor, in order that it's miles predicted to lessen the unfold of hearthplace earlier than the hearthplace spreads. Meteorological situations used on this examine to are expecting regions of land on the way to be laid low with wooded area fires are temperature, wind, humidity, and rainfall. The approach used in this study is a neural community with an ELM (Learning Machine) schooling model.

III. IMAGE PROCESSING

Image processing is converting the font of a photograph with the intention of
1. Improving its illustrated statistics for human interpretation,
2. Render it greater appropriate for self-sustaining system perception.

We will be worried with virtual photograph processing, which entails the usage of a pc to extrude the character of a virtual photograph. It is essential to recognize that these components are separate but equally critical components of photographic processing. A process that satisfies the condition,
1. A process that increases the appearance of a photograph may be the worst process for pleasing conditions
2. Human like their photos to be sharp, clean and distinctive system select their photos to be easy and understand

The intention of pre-processing is a development of the photograph information that suppresses unwilling distortions or complements a few photograph capabilities critical for similarly processing, despite the fact that geometric variations of photos (e.g., rotation, scaling, translation) are labeled amongst pre-processing strategies right here on the grounds that comparable strategies are used.

Median Filter

The median filter out may be a nonlinear virtual filtering approach usually accustomed do away with noise. Such noise discount is a regular pre-processing step to reinforce the outcomes of post-processing (e.g., aspect detection in associate photograph). Median filtering is generally utilized in virtual photograph process because it preserves edges and eliminates noise beneath Neath certain conditions.

Figure 1: After Applying Median Filter

Gaussian Filter

Gaussian smoothing is additionally used as a preprocessing step in portable computer vision algorithms to try and do this. Reinforce image structures at completely different scales, see scaled space illustration and scaled area implementation. MaK: thematically, applying a scientist blur to an image is that a similar as convolving image with a Gaussian function. This will also be known as the two-dimensional Weierstrass transform.

Figure 2: After Applying Gaussian Filter

IV. SYSTEM ARCHITECTURE
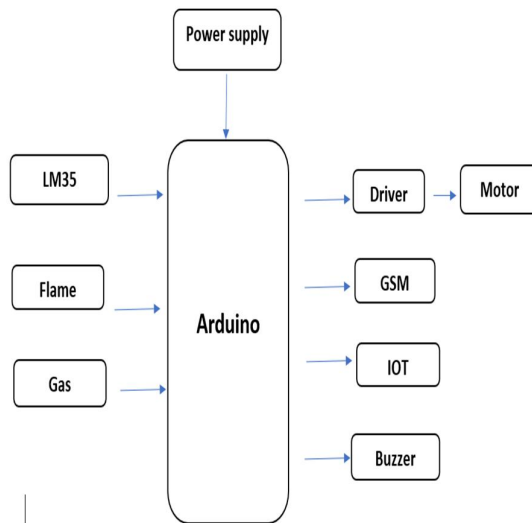
Figure 3: Architecture Diagram

The Arduino was connected through fire device, gas sensor, buzzer, IoT board, GSM electronic equipment and LM35 (temperature detector). Once the fireplace has been detected, the Arduino can facilitate activate the buzzer and send a sign to the GSM to send the message to the desired mobile number, and therefore the pump motor will begin operating mechanically and water will flow to cut back the fire. The temperature detector (LM35) sends a message when it reaches the most of physicist or Celsius. Gas sensor that detects the smoke and sends the message to the amount provided. IoT stores the data that features when the fireplace was detected and therefore the time and date.

V. METHODOLOGY

A. Fire Detection

The Fire or Flame detector Module will defect flames within the 760 – 1100 micromillimetre wavelength range. little flames sort of a lighter flame will be detected at roughly 0.8m. The detection angle is roughly sixty degrees and also the sensor is especially sensitive to the flame spectrum. associate on-board LM393 op-amp is employed as a comparator to regulate the sensitivity level. The Sensor has a virtual and analogue output and sensitivity may be adjusted thru the blue potentiometer. This Flame Sensor Module is used to come across fire/flame supply or different mild resets of the wavelength with inside the variety of 760 nm – 1100 nm. It is primarily based totally at the YG1006 sensor that is a excessive pace and excessive touchy NPN silicon to infrared radiation.

Figure 4: Fire Sensor

B. Temperature detection

A hardware device referred to as the LM35 is employed to discover temperature in our model. If the temperature rises on the far side thirty-five degrees, it's thought-about abnormal, and also the individual isn't allowed to enter the realm wherever our system is installed.

LM35 Sensor

A temperature sensor could be a device that measures temperature via associate electrical signal, usually a thermocouple junction or RTD. A thermocouple (T/C) is a device created of 2 dissimilar metals that produces an electrical voltage in direct proportion to temperature variations. Associate RTD (Resistance Temperature Detector) is a rheostat that adjusts its impedance in a very precise, repeatable, and nearly linear manner in response to temperature variations.

Temperature sensor that measures temperatures outside the sensor exploitation an external diode-connected electronic transistor because the sensor (for example, on a board or on the die of a CPU). It's producing a digital output in most cases.
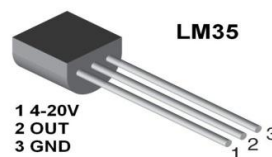

Figure 5: LM35 Sensor

C. Smoke Detection
Gas Sensor

A gas detector could be a technological instrument that detects/senses a signal, a physical situation, or chemical substances. By detective work these voltages, the sensor can determine gases. this discharge within the gizmo will be

accustomed determine the gas concentration. The gas sensor runs on 5V DC and consumes regarding 800mW. it's a detection vary of two hundred to 10000ppm for LPG, Smoke, Alcohol, Propane, Hydrogen, Methane, and Carbon Monoxide. By sterilization the resistance of the fabric inside the sensor, the sensor provides a corresponding electric potential supported the gas concentration, which may be measured because the output voltage.
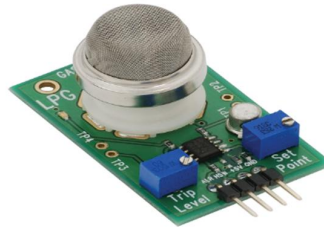
Figure 1: Gas Sensor

D. GSM Modem

A GSM (Global System for Mobile Communication) Modem is a wi-fi modem that works with a GSM wi-fi Network. A wi-fi modem behaves like a dial-up modem. The most important distinction among them is that a dial-up modem sends and gets statistics via a hard and fast Telephone line even as modem sends and gets statistics via radio waves. A GSM modem may be an outside tool or a PC card / PCMCIA card. Typically, an outside GSM Modem is hooked up to a pc via a serial cable or USB cable. A GSM modem withinside the shape of a PC Card / PCMCIA Card is designed to be used with a computer pc.
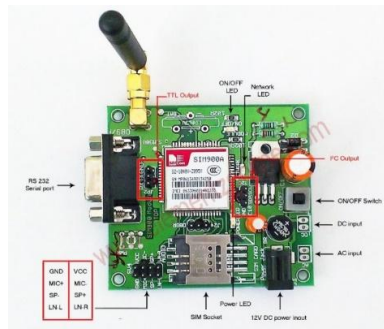
Figure 7: GSM Modem

Both GSM modem and dial-up modems help a not unusual place set of widespread AT instructions. You can use a GSM modem as a dial-up Modem. In addition to the same old AT instructions, GSM modems help a prolonged set of AT instructions. These prolonged AT instructions are described withinside the GSM standards. With the following

- Reading, writing and deleting SMS messages
- Sending SMS messages
- Sign strength monitoring
- Monitoring the charging fame and charger degree of the battery
- Reading, writing and looking telecall smartphone ee-e book entries. The quantity of SMS messages that may be procedures via way of means of a GSM modem in keeping with minute may be very low-best approximately six to 10 SMS messages in keeping with minute.

E. IoT Board

The Internet of Things (IoT) is an environment in which gadgets, animals, or humans are equipped with specific element identifiers and the cap potential to switch records over a community without requiring human-human or human-pc interaction. IoT allows far-flung sensing and/or management of gadgets via the present community infrastructure, growing possibilities for extra direct integration of the bodily global into pc structures and ensuing in advanced efficiency.
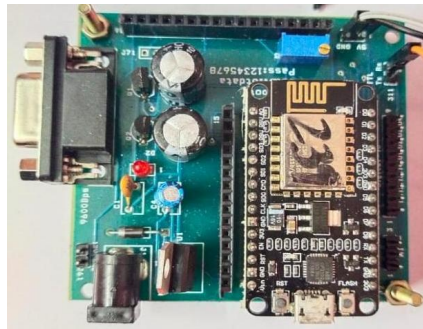
Figure 8: IoT Board

F. Pump Motor

Micro submersible pump DC 36V Mini water pump for fountain garden Mini water circulation system DIY project. This is a low-cost, small-length submersible Pump Motor That may be operated from a 3-6 V electricity supply. It can soak up to a hundred and twenty liters according to hour with a completely low present day draw of 220mA.
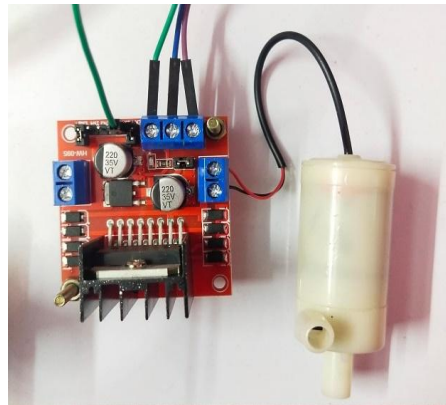
Figure 9: Pump Motor Connected with Driver

Motor Driver

This L298 Based Motor Driver Module is a high-energy motor driving force best for riding DC vehicles and Stepper motors. It uses the famous L298 motor power chip and has an onboard 5V regulator that could power an external circuit. It can manipulate as many as four DC vehicles or 2 DC vehicles with path and pace manipulation. This motor driving force is best for robotics and mechatronics tasks and best for riding DC and stepper vehicles for micro mice, line-following robots, robot arms, etc.

G. Arduino (ATMega328) Microprocessor

There are 20 digital input/output pins on this board. A USB connector, a power jack, an ICSP header, and a reset button are among the features. ATmega328 microcontroller, 5 V operating voltage, 7-12 V input voltage (recommended). 6-20 V input voltage (limits), 14 digital I/O pins (of which 6 provide PWM output) 6 analogue input pins, 40 mA DC current per I/O pin, 50 Ma DC current for 3.3V pin, 32 KB flash memory, 0.5 KB consumed by a bootloader. Arduino is a programming language that allows you to create computers that can sense and control more of the physical environment than your typical desktop computer. It's an open-source physical computing platform that includes a development environment for building software for the board and a simple microcontroller board. Arduino may be used to create interactive devices that accept input from various switches or sensors and operate lights, motors, and other physical outputs.

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Figure 10: Arduino (ATMega328) Microprocessor

Arduino initiatives may be self-contained or talk with software program set up in your computer. Forums can be assembled by hand or pre-assembled and the open supply IDE can be downloaded for free. The Arduino programming language is primarily based totally at the Processing multimedia programming surroundings and is an implementation of Wiring, a comparable bodily computing platform. The Arduino is a system that connects all of our sensors to embedded c programming and presentations the outcomes on a buzzer.

Figure 11: Buzzer
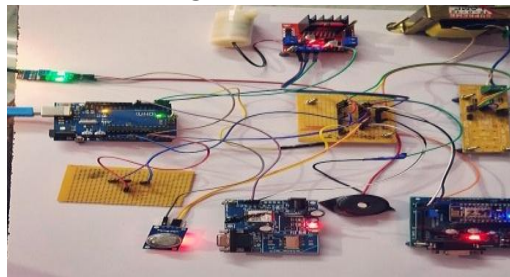
Figure 12: Arduino Connected with All Sensors

VI. RESULTS

OUTPUT FOR FIRE DETECTION
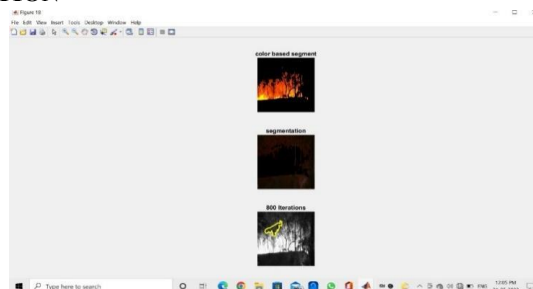
Figure 13: Output for Fire Detection (Highlights the fire Detected Area)

When a hearthplace takes place withinside the segmentation process, it's been detected via way of means of its segmentation primarily based totally on colorations and generation level. The image provided suggests how focus is detected
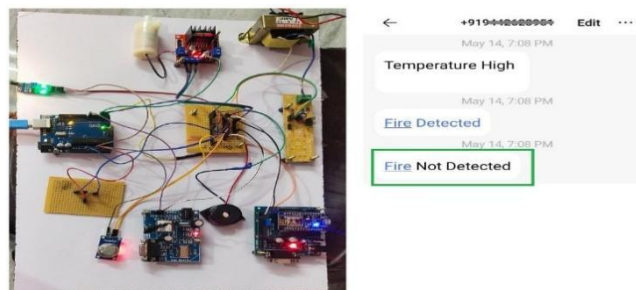
OUTPUT FOR FIRE DETECTION
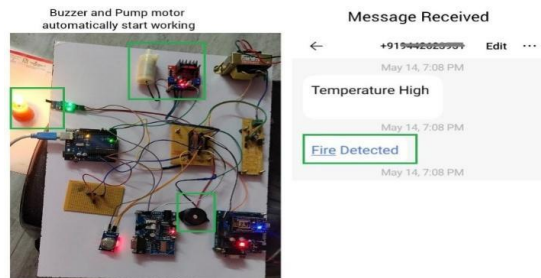
Figure 14: Output for Fire Detection (Using Fire sensor)

When the fire is detected, the buzzer will start working and the pump motor will start working automatically, sending the message to the specified number
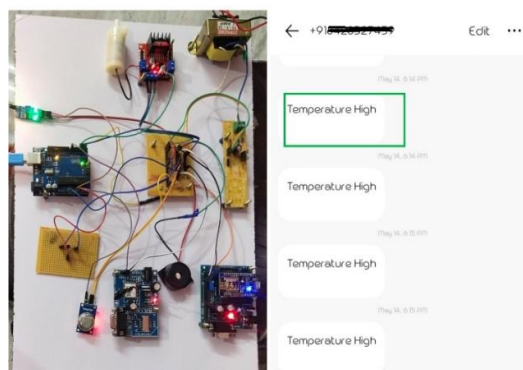
OUTPUT FOR FIRE NOT DETECTED

Figure 15: Output for Fire Not Detection

When the hearthplace isn't detected, the buzzer and pump will now no longer begin running automatically, sending the message to the required variety that the hearthplace isn't detected.

OUTPUT FOR TEMPERATURE DETECTION
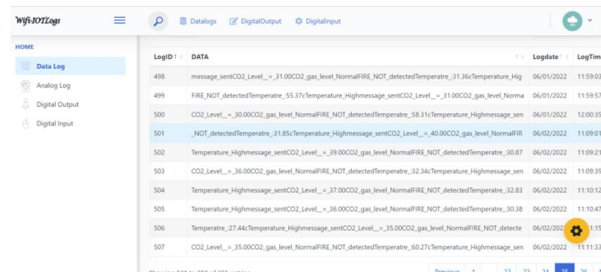
Figure 16: Output for Temperature Detection

In temperature detection, the temperature detector (LM35) will send a message when it reaches the maximum of Fahrenheit or Celsius.

OUTPUT FOR INFORMATION STORES USING IOT

Figure 17: Output for Database

Whilst the fire, temperature and fuel line become detected the message dispatched and by the point date might be saved as database the usage of IoT board. The above given photo indicates how become records saved

VII. CONCLUSION

To reduce the detection of forest fires, a system of emergency pumps is used in conjunction with a reservoir in the forest canopies filled with water. Their future efforts in fire/smoke detection research should focus less on real deep learning architectures/methods and more on real dataset gathering and duration process, ensuring that the dataset better represents how fires start, brood, and spread in images of natural scenes.

FUTURE SCOPE

We are going to construct a Fire Alarm System the usage of Arduino, LM35 Temperature sensor and GSM module. Applications of SMS primarily based totally Fire detection gadget the usage of Smoke and Temperature sensor: This assignment may be utilized in Industries, shopping malls, Office. Survey of forest hearths. The use of MATLAB rather than the conventional Arduino software program made the method much less bulky and left scope for destiny improvements. Cutting side AI analytics provide exquisite overall performance in range phrases, detection FOREST FIRE DETECTION SYSTEM (FFDS) It is nicely known, there could be big variations/boom in temperature from the everyday temperature every time wooded area hearthplace occurs. Wireless Sensor Network-primarily based totally Forest Fire Detection Systems that were carried out to start with after Satellite-primarily based totally Fire Detection Systems made out of simple Radio Frequency modules and a everyday Solar Energy Harvesting System. In out proposed method, we're aiming to stumble on the presence of fires the usage of temperature and humidity sensors. Through this assignment, you're going to construct for a completely unique hearthplace safety gadget for the Homes and business buildings. Design, set up, and renovation of the gadget. ANALYTICAL PROCEDURE, we use an Arduino Uno to test if a sensor is triggered.

REFERENCES

[1] R. Baker, ''Forest history: International studies on socioeconomic and forest ecosystem change,'' Forest Ecol. Manage., vol. 159, no. 3, p. 293, 2002, doi: 10.1016/S0378-1127(01)00441-8

[2] L. Shu, X. Tian, and X. Kou, ''The focus and progress on forest fire research,'' World Forestry Res., vol. 16, no. 3, pp. 37–40, 2003, doi: 10.3969/j.issn.1001-4241.2003.04.007

[3] D. J. Rasbash, ''Effects of fire on items which may have helped cause the fire,'' Fire Saf. J., vol. 7, no. 3, pp. 293–294, 1984, doi: 10.1016/0379- 7112(84)90027-4.

[4] A. Sekizawa, ''Fire risk analysis: Its validity and potential for application in fire safety,'' presented at the 8th Int. Symp. Fire Saf. Sci., Beijing, China, Sep. 2005, pp. 85–100. http://www.iafss.org/publications/fss/8/85/view/fss_8-85.pdf

[5] B. M. Wotton, D. L. Martell, and K. A. Logan, ''Climate change and people-caused forest fire occurrence in Ontario,'' Climatic Change, vol. 60, pp. 275–295, Oct. 2003, doi: 10.1023/A.1026075919710.

[6] J. Marchal, S. G. Cumming, and E. J. B. Mcintire, ''Exploiting Poisson additivity to predict fire frequency from maps of fire weather and land cover in boreal forests of Québec, Canada,'' Ecography, vol. 40, no. 1, pp. 200–209, 2017, doi: 10.1111/ecog.01849.

[7] M. P. Plucinski, W. L. Mccaw, J. S. Gould, and B. M. Wotton, ''Predicting the number of daily human-caused bushfires to assist suppression planning in south-west Western Australia,'' Int. J. Wildland Fire, vol. 23, pp. 520–531, Jul. 2014, doi: 10.1071/WF13090.

[8] A. C. Alencar, L. A. Solórzano, and D. C. Nepstad, ''Modeling Forest understory fires in an eastern Amazonian landscape,'' Ecol. Appl., vol. 14, pp. 139–149, Aug. 2014, doi: 10.1890/01-6029

[9] M. G. Rollins, P. Morgan, and T. Swetnam, ''Landscape-scale controls over 20th century fire occurrence in two large Rocky Mountain (USA) wilderness areas,'' Landscape Ecol., vol. 17, pp. 537–557, Aug. 2002, doi: 10.1023/A:1021584519109.]

[10] J. P. Prestemon, M. L. Chas-Amil, J. M. Touza, and S. L. Goodrick, ''Forecasting intentional wildfires using temporal and spatiotemporal autocorrelations,'' Int. J. Wildland Fire, vol. 21, pp. 743–754, Oct. 2012, doi: 10.1071/WF11049.