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CAUSES AND PREVENTIVE MEASURES OF FIRE OUTBREAK IN AFRICA: REVIEW

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Abstract

Fire is a visible effect of the process of combustion as a special type of chemical reaction which occurs when oxygen in the atmosphere reacts with some sort of fuel to bring out flame.This review research extensively detailed the causes, preventive and protective measure to be taken to curb fire outbreak in the society. This showed that the best way to avoid fire outbreak is by adopting preventive and protective measure which includes avoidance of using phone in the kitchen,fueling generator when it is ON, smoking in flammable prone zone, gas leakage and so on. This paper will guide home users and fire preventive software designers to be aware of the things to be incurred or put in consideration when managing/designing/ implementing a device that can prevent or control fire outbreak. This research review will be of important to the world as it serves as a guide on fire outbreak causes and simple ways to prevent it both manually and automatically.

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Introduction:-

Safety is one of the crucial aspects of life and it should be taken care of first before any other activities. One of the disastrous outbreak that many have experienced in life is fire outbreak and its control is always difficult. fire is the state of combustion in which inflammable material burns, producing heat, flames, and often smoke. Fire outbreak is a sudden and unplanned increase of fire in an enclosed or open arena. Fire outbreak is also described assudden unplanned eruption or an outburst of flame, light and heat which is produced when something burns. This fire outbreak can be caused by many factors such faulty home appliances, bad house wiring, careless use of gas cooker and container, careless use of candle, explosion of gas cylinder or tanker, use of cell phones at filling or gas station, smoking and so on.

However, such fire outbreak sometimes escalates to highest level simply because safe measures weren't put in place or there is less or no monitoring at all. Hence, several projects have been built in the past to ensure that the issue of abrupt fire outbreaks in schools and other places were eradicated or curbed to the barest minimum.

Many researchers have placed some curbing measures to ensure that such incident were reduced to ensure lives and properties weren't lost in this process. In 1999, R.A Carter presented a fire safety and security system in schools which had the security and smoke detection alarm system combined with an automatic sprinkler system [1]. In 2005 some group of researcher researched about School Safety Interventions: Best Practices and Programs where they involved school social workers because of their influence to stop school violence [2].In 2006, researchers also proposed an efficient monitoring system for early fire automatic detection using the Arduino mega and other main components used to design a fire alarm. The system had the ability to remotely send an alert to the authorities by using a GSM module whenever a fire is detected [3]. The quest to eradicate fire outbreak by researchers kept on evolving and in 2010 they came up with a fire fighting robot that had to control fire through a robotic vehicle. Moreover, With the advancement in the field of Robotics, human intervention is becoming less every day and robots are used widely for purpose of safety [4].A WiFi Based Home Automation System that supports a wide range of home automation devices like power management components, and security components like fire detectors were designed to still curb fire outbreak in our various home and offices [5].In 2013, the development of Fire Alarm System using Raspberry Pi and Arduino Uno that could detect the presence of smoke in the air due to fire and captures images via a camera installed inside a room when a fire occurs [6].

A Local Data Fusion Algorithm for Fire Detection through Mobile Robot was developed where a local data fusion algorithm based on luminosity, temperature and flame for fire detection was presented. The data fusion approach was embedded in a low-cost mobile robot [7].

An Intelligent Fire Detection and Mitigation System Safe from Fire (SFF) was developed and implemented. The developed system has the ability of taking in input signals from various sensors placed in different position of the monitored area and fuzzy logic was integrated on it to identify fire breakout locations and severity [8].

A controlled Robot for Fire Detection and Extinguish to Closed Areas Based on Arduino was design and implemented for effective fire outbreak control. The basic idea of fire detection and treatment robot was based on detection of the fire by the wireless camera and flame sensor and control the fire outbreak by sending a programmable command to the mobile phone through Bluetooth connection to turn ON water pump to extinguish the fire [9].

An IOT fire detection system using temperature sensor (flame sensor) and Arduino device was developed to detect fire outbreak and measure the amount of heat intensity as well as the specific location of the house, offices was designed in 2019 by [10]. This developed device help to detect and measure the specific location at where the fire outbreak happened and proffer solution to it immediately by signaling the specific and designed authority on the happenings.

An early fire detection system based on fuzzy logic using multisensory was developed and implemented by [11] in 2020. The system consisted of a multisensory to detect fire, smoke and temperature in the room. The multisensory used in the design were: KY-026 sensor as fire detection sensor, MQ-9 sensor as smoke detection sensor and DS18b20 sensor as temperature detector sensor were combined together for effective and efficient fire outbreak detection [11].

A fire detection model based on power-aware scheduling for IoT-sensors in smart cities with partial coverage was developed [12]. In the proposed model, the sleep scheduling approach used for saving sensors energy. The approach was anticipated to significantly help in saving consumed energy and retrieve the excess to avoid wastage and use it to fight fire outbreak [12].

In Uganda, a number of school dormitories have been prone to fire outbreak that has taken many lives which would have been curtailed if all the necessary fire outbreak proactive measures were taken. The fire outbreak incident of April 2008 in a girls' dormitory at Buddo Junior School took lives of 20 pupils which would have been secured. Another bad scenario of fire outbreak in Uganda that killed not less than 30 people happened at Bishop Ruhindi High School in Rukungiri District, Bukoyo Secondary School in Iganga District, St Mary's College in Buikwe District, Kawempe Muslim SS, Merryland High School, Kibibi Junior School, Light College Katikamu, Moyo SS and St Leo's Junior School and finally at St John Bosco Primary School, Katende were a live was lost. Furthermore, In November 12, 2018, a school in Rakai district caught fire and killed 10 SS3 students and left 50 students critically injured [13].

It is also very important to note that there is a need to install solar photovoltaic panels in the monitoring environment in case of power failure. There many review work done in the field of photovoltaic installation, fabrications and optimizations that will help in installation of solar photovoltaics in the designated zone of monitoring to avoid fire outbreak [14-18]. There is also study in the development and fabrications of photovoltaic panels that will help the research to know how to develop, optimize, fabricate and install a sizable solar panel in the monitoring environment with less cost [16] [19-25]

There are other designs and implementations of microcontroller and Arduino based research works that explicitly highlighted on the Arduino connections with ATmega322P microcontroller for smart surveillance security system, automated hybrid smart door control system, an improved automatic DC motor speed control systems using microcontroller, An industrial heat detector and cooling system using raspberry Pi [18][19] [26-28].

Theoretical Review of fire outbreak

Fire:Fire is the visible effect of the process of combustionas special type of chemical reaction. It occurs between oxygen in the air and some sort of fuel when they react to bring out flame. The products from the chemical reaction are completely different from the starting material.The fuel must be heated to its ignition temperature for combustion to occur. The reaction will keep going as long as there is enough heat, fuel and oxygen. The diagram in figure 1 is the components that made up fire.

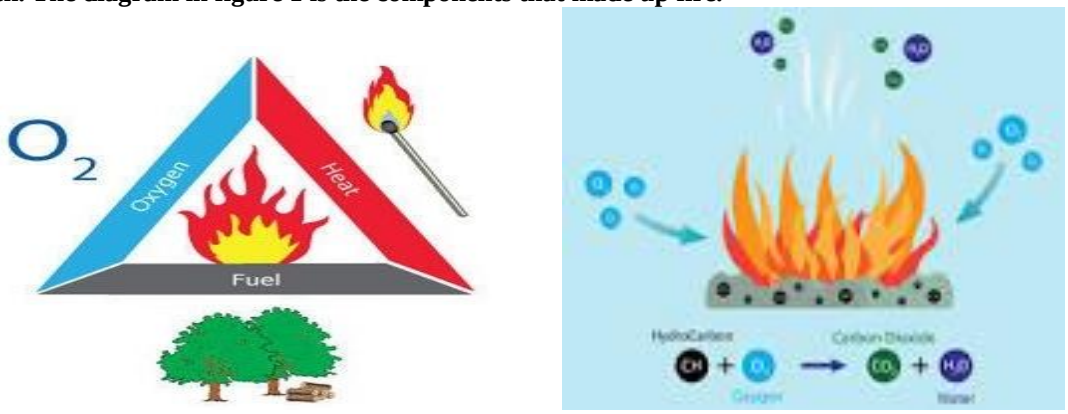

Figure1:- Components of Fire.

Combustion is a chemical process in which a substance reacts rapidly with oxygen and gives off heat. The original substance is called the fuel, and the source of oxygen is called the oxidizer.

Impacts of fire.

Fire has both positive and negative impact in the society depending on the degree at which it burns. The negative effects are always disastrous and hazardous, in some cases it results to deaths, widespread damage of properties. Positively fire is used for cooking foods and to do other essential things like welding, metallurgical process for the production of steals and so on.

The risk of wildfires increases is extreme during dry season where there is drought, harmattan with a very heavy wind. Wildfires can disrupt transportation, communications, power and gas services, and water supply. They also lead to a deterioration of the air quality, and loss of property, crops, resources, animals some essential economic trees.

Wildfires and volcanic activities as shown in figure 2, has affected about 6.2 million people between 1998-2017 with 2400 attributable deaths worldwide from suffocation, injuries, and burns, but the size and frequency of wildfires are growing due to climate change. Hotter and drier conditions are drying out ecosystems and increasing the risk of wildfires. Wildfires also simultaneously impact weather and the climate by releasing large quantities of carbon dioxide, carbon monoxide and fine particulate matter into the atmosphere. The contaminated air pollution caused by the wildfire can cause a range of health issues, including respiratory and cardiovascular problems.

Figure 2:- Wildfire Burning.

Causes of fire outbreak

House fires has continuously been a leading cause of death and property loss across the country. Data from the National Fire Protection Association (NFPA) statistically showed that about 490,500 residential homein the United States in 2020 were affected by fire outbreak. However, the most common causes of house fires in the society are outlines as follow:

1. Electrical Appliances and Equipment: Any device that generates heat (stoves, clothes dryers, heaters) or overheated up when used extensively (computers, fans) is a potential fire hazard. Cooking vessels that are left unattended to are avoidably one of the causesof fires outbreak.

2. **Candles**: this can cause fire outbreak in a house whenever it is left carelessly unattended to in an enclosure that has materials that can easily catch fire example wooden table, chairs, foams.

3. Smoking: Among the most common causes of house fires is the consequence of negligent smoking habits. People sometimes fall asleep while smoking. In doing so, they can set their bed, chair or couch on fire, which can easily result in a fatality. Another avoidable hazard is discarding still-hot ashes into a trash can where they can ignite.

4. Chemicals and Gasses: Home fires can easily be caused by sources of natural gas or propane gas. An errant spark combined with a small leak can create a combustible situation. Improperly mixed household chemicals can also trigger combustion and that's why it is more advisable to perform such activities outside the room.

5. Lightning: Lightning fires most commonly occur during raining season where the thunders blow. It mainly affects houses that don't have thunder protection. Lighting can cause fire outbreak more especially when electrical gargets were plugged in the connected electrical socket. Homes in heavily wooded areas are extremely vulnerable to lightning strikes because they can easily set the surrounding landscape on fire.

6.Gas leakage: This can easily cause fire outbreak. When the gas leakages are highly concentrated within the room any metallic object that comes in contact within that gas filled area catches fire.

Preventions of fire outbreak

1. Turn off your appliances while not in use: Since the nation's power supply cannot be trusted and predicted, it is very important that you turn off your appliances no matter how small they might be before heading out. Even while at home, appliances that are not in use should be disconnected. Just a little spark when there is a voltage surge can cause a great fire outbreak. Also, being sensitive and conscious while using some appliances is very important [29]

2. Avoid using your phone in the kitchen: Several warnings have been made to ensure that people stop receiving calls in the kitchen. This is because using your phone with some kitchen appliances can be very dangerous. The radiation that comes from a cell phone can be so dangerous at times, especially when you have gas in your kitchen. Apart from this, you might get distracted and not attend to your food being cooked on the cooker or gas as soon as you should.

3. Avoid fueling your generator while it is ON: A lot of Nigerians take this risk every day. Some get so lucky to get away with this and some don't. Try as much as possible to put off your generator and allow it to cool down before refueling it.

4. Be careful while lighting your gas cooker: Gas explosions have been one of the major causes of fire outbreaks. A lot of Nigerians put on their gas cookers in the wrong way, forgetting that gases move faster when released. While putting on your gas cooker, be careful to keep flammable materials or chemicals far away from you.

5. Use rechargeable lamps instead of candles: The advent of rechargeable lamps has made life easier and has reduced the rate of fire outbreaks. Using candles on tables and flammable objects can be so dangerous and risky. It may fall off while no one is around, burn the objects around it and cause a great fire.

6. Avoid smoking in sensitive areas: This cannot be overemphasized. A lot of organizations put up indications like "smoking is prohibited here." This is to ensure safety and prevent fires from exploding. Smokers shouldn't be allowed in a highly flammable environment.

7. Ensure proper wiring connections: **Naked wires and improper connections should be attended to as soon as possible. Improper wiring connections can cause a spark. You can properly cover the naked wires with tape when there is no power supply while you wait for an electrical technician.**

8. Avoid trying to fix electrical faults yourself: **Try as much as possible not to fix electric faults yourself without the skills. You might be violating some electrical laws, which could lead to a spark.**

9. Avoid overloading electrical sockets: **Excess loads on electrical sockets can be so dangerous and can easily cause fire outbreak**

10. Ensure your gas cylinder and cooker are properly fixed: **Gas is highly flammable and travels fast. Try as much as possible to pay attention to your gas cylinders from time to time. Even just a little hole in the pipes that connect your gas and your cookers together can cause a fire hazard. It is advisable to attend to flames while cooking to prevent fire accidents.**

11. Avoid shaking your gas cylinders:**Shaking your gas cylinders to check the amount of gas remaining is very dangerous. It would only enhance explosion and fire hazards.**

Conclusion:-

This review showed that fire outbreak cannot completely be eradicated in the society but can be manually and automatically reduced to its barest minimum by using some of the tips and preventive methods reviewed in this paper. This research paper reviewed the possible causes of fire outbreak in the society and its preventive solutions. From this paper it was observed that adoption of the preventive methods/tips will help in reducing fire outbreaks and keep properties and lives of individuals in the society safe.

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