Forest Fire Detection and Wild Animal Health Monitoring

Shravya[1], Anushree k[2], Nischitha B[3], Spandana[4]
Dr. R Balakrishna[5], Dr. Neha Singhal[6]

UG Student, Dept. Information Science and Engineering, RRCE, Bangalore, Karnataka, India

UG Student, Dept. Information Science and Engineering, RRCE, Bangalore, Karnataka, India

UG Student, Dept. Information Science and Engineering, RRCE, Bangalore, Karnataka, India

UG Student, Dept. Information Science and Engineering, RRCE, Bangalore, Karnataka, India

Pricncipal, RRCE, Bangalore, Karnataka, India

HOD & Professor of Dept. Information Science and Engineering RRCE, Bangalore, Karnataka, India

ABSTRACT

Forest fires and animal health are major environmental concerns worldwide. Early detection of forest fires and monitoring the health of animals can prevent significant damage to ecosystems. In this paper, we propose a forest fire and animal monitoring system using an Arduino board and sensors. The system consists of temperature and smoke sensors, GPS modules, and a microcontroller board. The sensors collect real-time data on temperature and smoke levels, which can indicate the presence of a fire, and GPS modules track animal movement and habitat use. The system can be integrated with other systems for effective firefighting and preventing significant wildlife loss.

Keyword*- Internet of Things(IoT), Wireless Sensor Networks, Data Transmission, Temperature sensor and smoke sensor, Camera Trap.*

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1. INTRODUCTION

The development of the Internet has brought people closer together in a new way, but it has also enabled the connection of bias, creating a network of objects and effects with bedded intelligence and communication capabilities. This network, known as the Internet of effects(IoT), allows for flawless communication between bias and the gathering and analysis of data from the terrain. The IoT has surfaced as a result of a shift in the way the Internet is used, from connecting people to connecting bias. It involves billions of connected bias that are suitable to report their position, identity, and history over wireless connections. These biases interact with each other and with the mortal world through Internet norms and protocols for collecting and participating information. pall computing has made it possible to store and dissect the massive quantities of data generated by the IoT.

Communication between bias is automated, reducing the need for mortal intervention and saving time and trouble. In the history, wired communication systems were used for monitoring environmental parameters in diligence, but they were precious to install and delicate to maintain. To overcome these challenges, we propose an optimized system for timber fire discovery and wild beast monitoring using an Arduino board and detectors.

Temperature and bank detectors are stationed at specific locales in the timber to descry ignition and the range of carbon dioxide gas. These detectors shoot information to a microcontroller, which reacts automatically in the event of an exigency. still, this approach had some significant downsides. originally, the installation cost of a wired communication system can be veritably high, especially in large artificial installations. This is because cables need to be run throughout the structure to connect the detectors to the central garçon. also, the process of installing these cables can be time consuming and disruptive to the installation's operations. Secondly, wired communication systems can be complex to troubleshoot in the event of a fault. If a line becomes damaged or disconnected, it can be delicate to identify the position of the fault and form it. To overcome these challenges, wireless communication systems have come decreasingly popular for artificial monitoring operations. Wireless systems offer numerous benefits, including lower installation costs, lesser inflexibility in detector placement, and easier fault discovery and form. For illustration, the proposed timber fire discovery and beast monitoring system uses wireless communication between the detectors and the microcontroller, which eliminates the need for complex and precious wired connections. This approach not only reduces the cost of installation but also makes it easier to troubleshoot any issues that may arise in the system. This approach offers several advantages, including fast response times, one- time installation, and the capability to cover worker surroundings at any time. The use of IoT technology in timber fire discovery and beast monitoring has the implicit to ameliorate safety and effectiveness in these areas, while also minimizing the impact on the terrain.

2. RELATED STUDY

In this section we discuss our related study about early fire detection techniques, frameworks.

J. Gubbi, R. Buyya, S. Marusic, and M. Palaniswami, "Internet of Things (IoT): A vision, future directions and architectural elements," Cloud central inventiveness for cosmopolitan consummation of Internet of Things. The braid endow poultice domains and technologies which are promising to hurried IoT study in coming are finish. A Cloud law second-hand Aneka,that stipulate interaction of notorious and secluded sully is immediate. We arrive to an destruction on our IoT ken by expatiate the poverty for crossroads of WSN, diversified estimate and the Internet addressed at likeness of technological exploration.

Bello and S. Zeadally, "Communication issues in the IoT(Internet of Things)," in Next Generation Wireless Technologies: 4G and Beyond A musical applications supported on business IoT have been build and instrument in neoteric yonks. This paper discuss the present research of IoT, cue enabling technologies, major Industrial IoT applications, identifies research challenges and trends in an effort to understand the evolution of IoT in industries.

S. Yu and Y. Peng, "Research of routing protocol in Internet of Things which is based on RFID," Routing procedure of RFID-supported IoT are homogenetic to those of WSN as they both procedure of several-leap passing, but also have a multitude of variations along of the contention in might labor, contexts and practical environments. The concern examine this question, by intend a Tex.-conscious RFID march procedure which is count supported and show the strength study of this sample.

G. Fodor, N. Reider, E. Dahlman, G. Miklós, G. Mildh, Z. Turányi and S. Parkvall, "Design aspects in network assisted D2D (device-to-device In the distinct we occasion habit of the 3GPP Progression system as a sordid measure for D2D designate, dissect some of the force project problems, and refer to solutions that permit liquid devices and D2D impair to divide expedient of specter which expect to lengthen the spirit effectiveness and specter of old-fashioned loculose cobweb. Simulation terminate show.

B. Atakan and O. B. Akan, "Biologically-inspired spectrum distribution in cognitive radio networks," In this journal, a unspent BIOSS (Biologically-inhaled Spectrum Sharing) clockwork has been present that is supported on the ductile work placing plan in buzzard colonies. BIOSS sanction every unlicensed use to distributive terminate the correspondent sweal(s) that sustain in intercourse, without penury for any synchronicity between the unlicensed users. M. Belleschi, A. Abrardo, and G. Fodor, "Performance interpretation of a distributed D2D communications resource allocation scheme," We talk the quotation in combine degree, and dominion check liveliness as an optimization ne plus ultra in this papery that we first solution presuming the receptibility of a pivotal being. A diversified means disposition tactics and suboptimal quotation in combine custom has also been speak that we benchmark accordingly to the ideal resolution which is focused. We identify that diversified plant achieve more.

3. PROPOSED SYSTEM

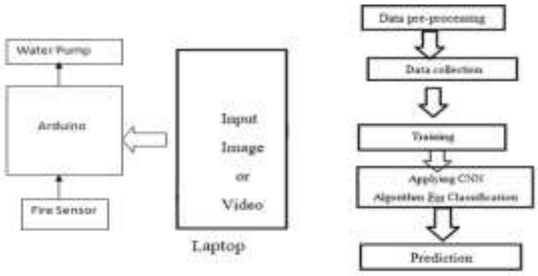

Fig 1. Proposed Scheme

3.1 Arduino UNO

Fig 2. Arduino UNO Board

The Arduino Uno board is a popular microcontroller board grounded on the ATmega328P microcontroller chip. It's extensively used in colorful systems and operations that bear interfacing with the physical world through detectors, selectors, and other factors. The Arduino Uno board features 14 digital input/ affair legs, of which 6 can be used as palpitation- range Modulation(PWM) labors. PWM is a fashion for bluffing analog affair using digital signals. It can be used to control the speed of motors, the brilliance of LEDs, and other analogous operations. The board also has 6 analog input legs, which can be used to read values from analog detectors similar as temperature detectors, light detectors, and potentiometers. The Uno board is designed to be easy to use and requires no external programming tackle. It can be programmed using the Arduino Integrated Development Environment (IDE) which is a software tool used for jotting and uploading law to the board. The IDE is available for free and can be downloaded from the Arduino website. Fire Sensor A fire detector is an essential element in fire alarm systems that are used to descry the presence of fire or bank in an area. The Arduino Uno board can be used to affiliate with a fire detector and produce a simple fire discovery system. The fire detector is grounded on the principle of detecting infrared radiation emitted by a fire. It consists of an infrared (IR) receiver that can descry radiation in the range of 700nm to 1000nm wavelength, which is generally emitted by a fire. The IR receiver converts the radiation intensity to a corresponding current value that can be reused by the Arduino board.

3.2 FIRE SENSOR

The fire detector also contains a comparator, specifically the LM393, which is a binary discriminational comparator. It compares the analog affair from the IR receiver with a threshold value set by a potentiometer to determine if a fire is present. The perceptivity of the detector can be acclimated by changing the potentiometer value. The fire detector can give both analog and digital labors. The analog affair can be read using the analog input legs on the Arduino board, while the digital affair can be read using the digital input legs. The digital affair provides a high signal when a fire is detected and a low signal when no fire is present. The fire detector has a discovery angle of 60 degrees in the forward direction. This means that it can descry a fire within a cone- shaped area of 60 degrees in front of the detector. The discovery range of the detector can be acclimated by changing the position and exposure of the detector. The fire detector can be powered using a voltage range of3.3 V to5.2 V. This makes it compatible with the power force range of the Arduino Uno board. In conclusion, the fire detector is an essential element in fire alarm systems, and the Arduino Uno board can be used to affiliate with the detector and produce a simple fire discovery system. By combining the fire detector with other factors and programming the Arduino board, it's possible to produce a sophisticated fire discovery and alarm system.

3.3 WATER PUMP

The Micro DC Submersible Pump is a great solution for DIY projects that require water circulation or for small fountain and garden applications. Its small size and low cost make it an attractive option for hobbyists and DIY enthusiasts.

The pump is designed to be operated from a 3 ~ 6V power supply, making it easy to power from a variety of sources such as batteries or a DC power supply. It has a low current consumption of only 220mA, which helps to conserve power and reduce operating costs.

The pump is capable of delivering up to 120 litres of water per hour, which is more than enough for most small-scale applications. To use the pump, simply connect a tube pipe to the motor outlet and submerge it in water. It's important to ensure that the water level is always higher than the motor to prevent damage due to dry running.

While the pump is durable and long-lasting, it's important to be mindful of its limitations. Overheating due to dry running can cause damage to the motor, and it's recommended to keep the pump submerged at all times to prevent this from occurring. Additionally, while the pump is relatively quiet, it may produce some noise during operation

3.4 POWER

The power force options available on the Arduino Uno board give inflexibility in powering up the board grounded on the requirements of the design. The board's power source can be named automatically, and it can be powered via USB connection or external power force. When using an external power force, it can either be an AC- to- DC appendage or a battery. However, it can be connected to the power jack using a 2, If using an appendage.1 mm centre-positive draw, while a battery can be connected to the Gnd and Vin pin heads of the POWER connector. It's important to note that the board can operate on an external force of 6 to 20 volts. still, if the voltage supplied is lower than 7V, the 5V leg may supply lower than five volts, and the board may come unstable. On the other hand, if the voltage supplied is further than 12V, the voltage controller may heat and damage the board. thus, it's recommended to use a power force within the range of 7 to 12 volts. The power legs on the Arduino Uno board include VIN, 5V, 3V3, and GND. The VIN leg is the input voltage to the board when using an external power source. It can be used to supply voltage directly to the board or penetrated through the leg when supplying voltage via the power jack. The 5V leg provides regulated power to the microcontroller and other factors on the board, and it can be supplied either by VIN through an on- board controller or USB or another regulated 5V force. The 3V3 leg generates a3.3- volt force through the on- board controller, and its maximum current draw is 50 mama. Eventually, the GND legs serve as the ground connection for the board.

3.5 BUZZER

The two wires of a buzzer or beeper are usually red and black, with the black wire being the ground or negative terminal. When an oscillating voltage is applied to the buzzer, the piezo element inside vibrates and produces a sound. The buzzer case is designed to support the piezo element and has a resonant cavity to amplify and direct the sound produced. Buzzers and beepers are commonly used in electronic devices for audio signalling purposes, such as to indicate an alarm or a warning message.

3.6 OpenCV

OpenCV-Python is a widely used computer vision library that provides a variety of algorithms and techniques for image and video processing. With its easy-to-use Python interface, it allows developers and researchers to quickly prototype and develop computer vision applications.

One of the main advantages of OpenCV-Python is its integration with NumPy, which provides a powerful array processing capability that allows for efficient processing of large datasets. This is especially useful for image processing applications where large datasets of images are common.

In addition to NumPy, OpenCV-Python also integrates with other popular scientific computing libraries such as SciPy and Matplotlib, which provides additional functionality for scientific computing and data visualization.

OpenCV-Python provides a wide range of functionality for computer vision, including image and video processing, feature detection, object detection and tracking, and machine learning. It supports a variety of platforms including Windows, Linux, and macOS, and has bindings for several programming languages including Python, C++, and Java.

Overall, OpenCV-Python is a powerful tool for developing computer vision applications with Python. Its simplicity, ease of use, and integration with other scientific computing libraries make it a popular choice for researchers and developers alike.

3.7 ARDUINO IDE

The Arduino software is easy- to- use for newcomers, yet flexible enough for advanced druggies. It runs on Mac, Windows, and Linux. preceptors and scholars use it to make low-cost scientific instruments, to prove chemistry and drugs principles, or to get started with programming and robotics. Contrivers and engineers make interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments. Makers, of course, use it to make numerous of the systems displayed at the Maker Faire, for illustration. Arduino is a crucial tool to learn new effects. Anyone- children, potterers, artists, programmers- can start tinkering just following the step by step instructions of a tackle, or participating ideas online with other members of the Arduino community

4. SYSTEM DESIGN

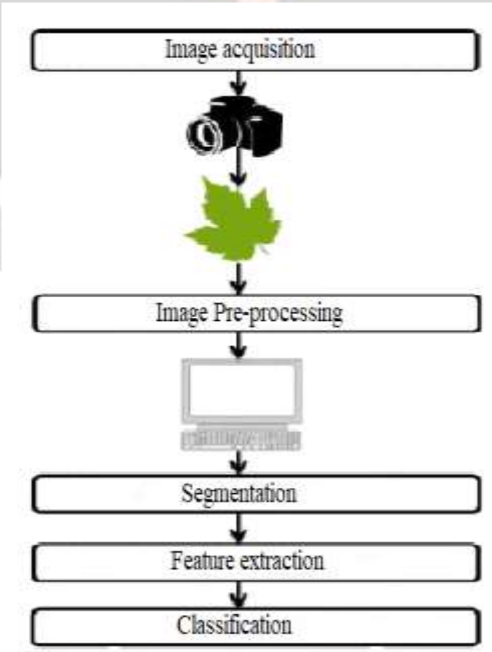

Fig 3. System Design

This proposed system seems to be focused on image analysis of animal samples. It involves five modules, starting with image acquisition using a digital camera. The next stage is image pre-processing, which aims to reduce the size and complexity of the image. The third stage is segmentation, which separates the rotten portion of the animal samples from the rest of the image. The fourth stage is feature extraction, where inherent features of the objects within the image are identified. Finally, the fifth stage is classification, which maps the data into specific groups or classes. Overall, the system seems to be aimed at identifying and separating rotten portions of animal samples using image analysis techniques

5. DATA MANAGEMENT

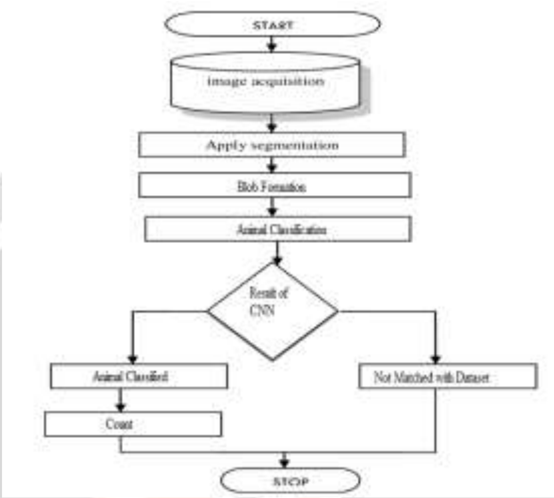

Fig 3. Data Flow Diagram Levels

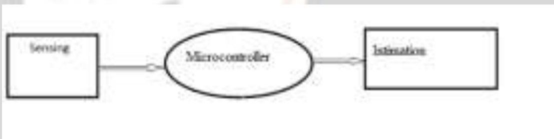

Fig 4. Fire Monitoring

A DFD consists of a set of symbols that represent processes, data stores, data flows, and external realities. Processes are the conduct or functions that transfigure the data. Data stores are depositories of data within the system. Data overflows are the paths through which the data moves from one element to another. External realities represent the sources or destinations of data outside the system, similar as druggies or other systems. DFDs are hierarchical in nature, with the top-position illustration representing the entire system and lower- position plates representing detailed views of individual processes. Each process in a DFD can be farther perished into its sub-processes to give a more detailed view of the system. DFDs are a useful tool for system analysis and design as they help to identify the inputs, labors, and processes needed to achieve the asked issues. They also help to identify areas where the system can be bettered, and to determine the data inflow between different factors of the system.

6. USE CASE DIAGRAM

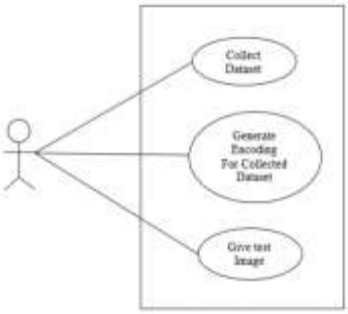

Fig 5. Use case Diagram

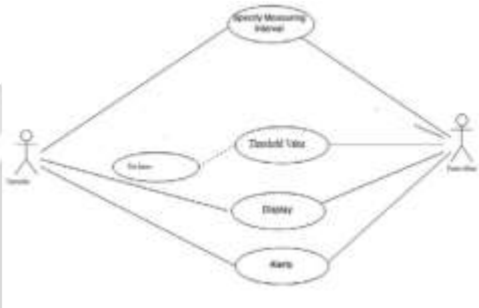

Fig 6. Fire Detection

A use case illustration at its simplest is a representation of a stoner's commerce with the system that shows the relationship between the stoner and the different use cases in which the stoner is involved. A use case illustration can identify the different types of druggies of a system and the different use cases and will frequently be accompanied by other types of plates as well. While a use case itself might drill into a lot of detail about every possibility, a use case illustration can help give a advanced- position view of the system. It has been said before that" Use case plates are the arrangements for your system". They give the simplified and graphical representation of what the system must actually do.

7. Future Scope

These are great suggestions for improving the system's accuracy, efficiency, and performance. Adding more precise sensors can definitely improve the quality of the data being collected, and using a sub-server unit can reduce the time it takes to alert forest officers. Upgrading the system with low-power elements and higher versions of Zigbee can also help increase efficiency and run-time.

Using portable computers like Raspberry Pi with better memory, processing speed, and networking capabilities can help improve the accuracy and performance of the system. Cooling systems like heatsinks can also be used to prevent the processor from overheating and undergoing thermal throttling, which can impact the system's performance.

Finally, INTERCONNECTING such systems with a central computer can help accumulate data, which can be used to train THE algorithm better and improve the performance of the entire network. These are great suggestions that can be considered for improving the system in the future.

8. CONCLUSION

Forest fires are a significant threat to natural resources, including forests, wildlife, and water supplies. Early detection of forest fires and monitoring the health of wild animals is critical to prevent significant damage to ecosystems. In recent years, researchers have developed several automated forest fire detection systems and wild animal health monitoring systems, which are effective and cost-efficient. These systems can be integrated with other systems for effective firefighting and preventing significant wildlife loss. The system uses machine learning algorithms to detect and count the livestock in the captured image. The system is trained using a dataset of images of different animals and their corresponding count. The system compares the captured image with the dataset to identify the animal and then uses object detection and counting techniques to count the number of animals present in the image. The system provides real-time results and can be used in various applications like wildlife monitoring, livestock production, and management. The system can be further improved by integrating more advanced sensors, upgrading the hardware, and enhancing the machine learning algorithms.

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