Software Requirements Specification

for

Forest Ecology and Green Cover Monitoring System.

Version 1.0

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Revision History

Name	Date	Reason For Changes	Version

1. Introduction

1.1 Purpose

Forests are the precious natural resources which provide us wood, timber tree, human living essentials and it is the place where flora and fauna live. It helps in balancing the eco system. But the greedy mankind destroys this natural resource legally and illegally there by eco system gets unbalanced. The prime of the way of exploiting these forest resources is cutting the trees. Along with this, the global warming and the frequent forest fires are the greatest evils, that is happening to the world today. They are key motivation factor in development of systems for an early prevention and detection of forest fires and monitoring green level.The proposed IoT enabled system is the solution to this problem.In this project, we have built fire detector using Arduino Uno which is interfaced with a temperature and humidity sensor, smoke sensor and proximity sensor,where asRaspberry pi is interfaced with IR sensor and pi camera for image processing to monitor green cover.At whatever point a fire happens, the framework naturally faculties and alarms the client by sending an alarm to an application introduced on user's Android portable or page open through web. System will capture the image and compares it with the previous. By this process we can know the ups and downs in green level of the forest.

1.2 Product Scope

FEGCMS is an IOT system, in which Image Processing is used for the detection of green level in the forest and Arduino Uno along with some sensors to detect forest fire. After detection of the fire, analert message has been sent to the forest officer. To achieve this, a simultaneous graph will be plotted by the system. If result goes beyond the threshold an alarm will be given. On the other side, it uses machine learning to train the data for Image processing. Green level will be compared and updated on a daily basis. Hence, this system can be used as a substitute for humans for monitoring the forest ecology. The progression of this paper is as follows, in the 1st portion of the methodology, Machine Learning approach for the detection of the tree is explained. Which includes the description of the object detection using Image processing.In the 2nd portion of the methodology, functioning of sensors for finding the forest fireare described. This location is sent to the client using MQTT which is explained in the section-3.

References

1. https://arxiv.org/ftp/arxiv/papers/1908/1908.05849.pdf
2. https://science.howstuffworks.com/robot2.htm
3. https://www.geeksforgeeks.org/image-classifier-using-cnn/
4. https://medium.com/@ariesiitr/image-processing-with-opencv-45c3a5cefd10
5. https://www.ijraset.com/fileserve.php?FID=14058

2. Methodology

2.1 Machine Learning

There are multiple traditional ways in which our system can get the green level of the forest in the image, but all these methods are not robust and don't have accuracy anywhere near to the humans. To get an accuracy that is what the humans have achieved, our system needs to use Machine Learning approach. These approaches have already reached to near human accuracy, and some have also surpassed humans.

2.2 Object Detection

For detecting trees from the image, FEGCMSuses Image processing.Object detection refers to identifying instances of objects of a particular class (such as trees, humanetc) in images and videos in digital format. FEGCMSuses object detection for classifying the trees with the rest of the objects in the image. To make an object detection algorithm forFEGCMS, pre-traineddata model is used and letting FEGCMSin detecting the objects. Live streamed data is transferred to Raspberry pifor further calculation of green rate.

2.3 Sensor Working

The Temperature and Humidity sensor detects the warmth and Smoke sensor detects any smoke produced because of consuming or fire. Proximity sensor will sense the near by obstacles. Camera sensor is used to capturing images and recording. IR sensor detects the objects during night. LoRaWANa smallwifi module allows microcontrollers to connect to a Wi-Fi network and make simple connections with the server.

2.4 Alarming

At whatever point a fire happens, the framework naturally faculties and alarms the client by sending an alarm to an application introduced on user’s Android portable or page open through web. Even if the tree count or green level goes down, system will send an alarm.

2.5 Assumptions and Dependencies

- User should be able to connect to the device.
- A wired connection has to be made between RPI, Arduino and the wifi module.
- Active internet connection is required.
- RPI and Arduino should have the installed libraries.
- Continuous power supply is required for the monitoring.
- Object detection should be done accurately by the device.
- The user must have a device where he can receive alert message and monitoring results.
- The device should be placed in appropriate place and condition.

3. System Requirements

3.1 Hardware Requirements:

Arduino Uno Microcontroller-The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansionboards (shields) and other circuits.[1] The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by the USB cable or by an external 9-voltbattery, though it accepts voltages between 7 and 20 volts.

Raspberry pi Microcontroller-The Raspberry Pi is a series of small single-board computers with CPU: 32-bit and contains a SOC (System On Chip – Has multicore processor, GPU, ROM, I/O Peripherals inside it.), DDR RAM memory, Ethernet port, USB host, micro HDMI on it. The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse.

Breadboard - A breadboard is a solderless device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate.

LoRaWAN-LoRaWAN, also known as LPWAN, stands for low power, wide area network. It is the global de-factor standard for the Internet of Things (IoT). LoRaWAN is the foundation of the LoRa Alliance.

Proximity sensor-A proximitysensor is a sensor able to detect the presence of nearby objects without any physical contact. A proximitysensor often emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal.

Gas sensor-Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion.

Temperature and Humidity Sensor-A Temperature and Humidity sensor senses, measures and reports both moisture and air temperature. DHT11 is used for the purpose. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed).

IR sensor- An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion.These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor.

Pi-Camera-The Raspberry Pi camera module can be used to take high-definition video, as well as stills photographs. The camera consists of a small (25mm by 20mm by 9mm) circuit board, which connects to the Raspberry Pi's Camera Serial Interface (CSI) bus connector via a flexible ribbon cable. The camera's image sensor has a native resolution of five megapixels and has a fixed focus lens

GPS- It is a global navigation satellite system (GNSS) that provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. Obstacles such as mountains and buildings block the relatively weak GPS signals.

Memory Card-A memory card is an electronic flash memory data storage device used for storing digital information. These are commonly used in portable electronic devices, such as digital cameras, mobile phones, laptop computers, tablets etc.

3.1 Software Requirements:

Arduino IDE: Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

C++ Programming: C++ is a statically-typed, free-form, (usually) compiled, multi-paradigm, intermediate-level general-purpose middle-level programming language." In simple terms, C++ is a sophisticated, efficient and a general-purpose programming language based on C.

Image Processing using open cv: Visual information is the most important type of information perceived, processed and interpreted by the human brain. Image processing is a method to perform some operations on an image, in order to extract some useful information from it. An image is nothing more than a two dimensional matrix (3-D in case of coloured images) which is defined by the mathematical function f(x,y) where x and y are the two co-ordinates horizontally and vertically. The value of f(x,y) at any point is gives the pixel value at that point of an image, the pixel value describes how bright that pixel is, and/or what color it should be.

Python Programming-Python is a widely used high-level programming language for general purpose programming. Python features a dynamic type system and automatic memory management and supports multiple programming.

4. System Features

A conceptual design to develop an IOT based forest monitoring system is discussed here. The proposed system would have a number of features to overcome the limitations of the traditional forest fire detection system. The features may include the following:
1) The Temperature and Humidity sensor as well as gas sensor are capable of sensing the forest fire.
2) At whatever point a fire happens, the framework naturally faculties and alarms the client by sending an alarm to an application introduced on user's Android portable or page open through web.
3) Using Image processing, system can get the green level of the forest.
4) Live streamed images from the processed data will be displayed on the UI.

5. Working of the device

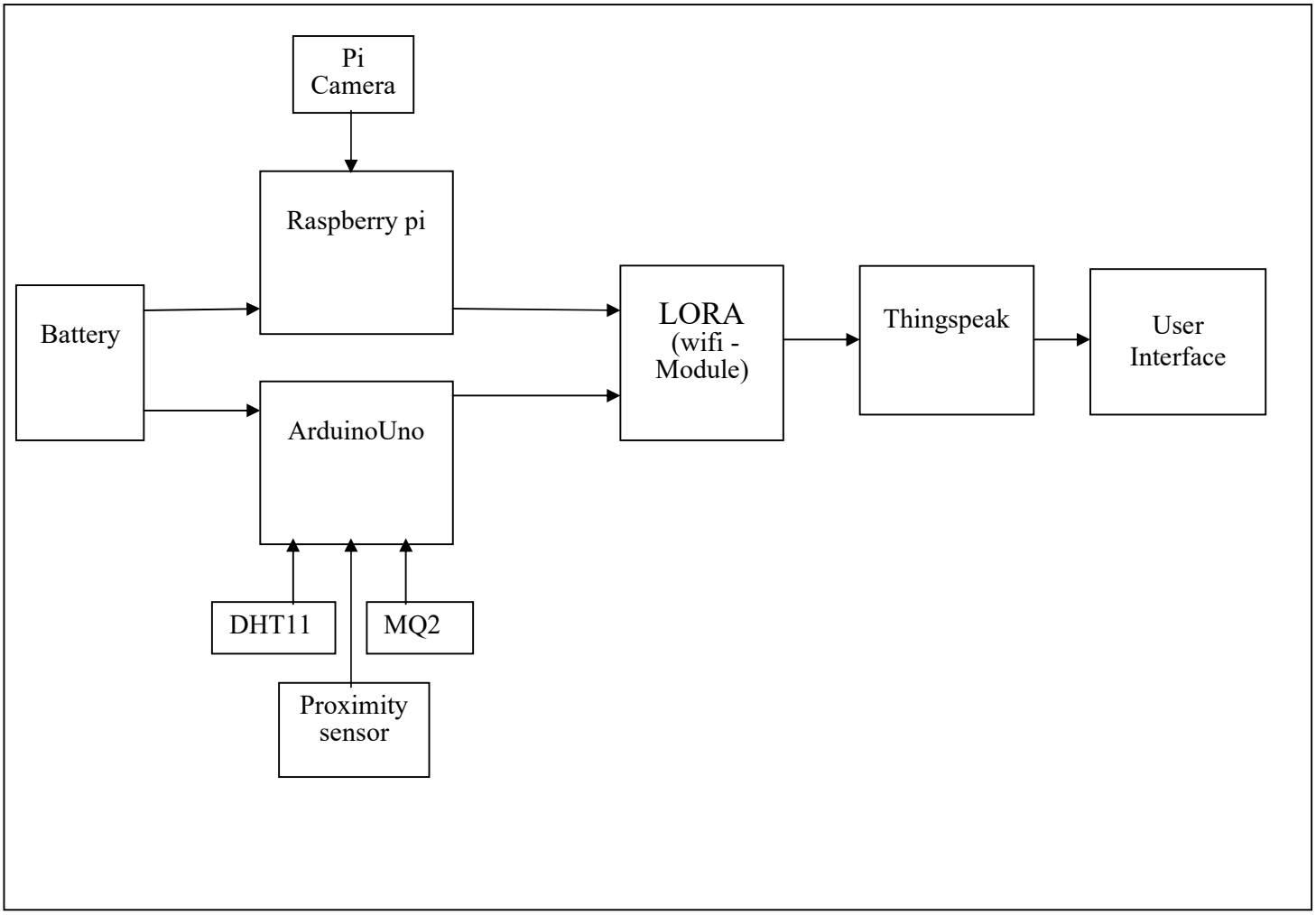
The System is mainly based on Arduino UnoandRaspberry Pi whichworks on C++ and python programming respectively. Arduinouno controls sensors like Temperature and humidity sensor, proximity sensorand gas sensor while Raspberry Pi controls IR sensor and Pi camera. When it comes to green level monitoring, Image processing will do its task. For image processing purpose python programming is used.Image processing is coupled with Raspberry pi and forest fire detection is coupled with Arduino. Forest Monitoring is an IoTproject which mainly focus on the forest fire detection and green level monitoring. Green level monitoring is done by capturing of the images and updating it on daily basis which works on the principle of image processing. The acquisition of the image is done by PI Camera. At whatever point fire activated, it consumes protests adjacent and produces smoke. A fire caution can likewise be activated because of little smoke from candlelight or oil lights utilized as a part of a family. Likewise, at whatever point warm force is high then additionally the alert goes on. Bell or alert is killed at whatever point the temperature goes to ordinary room temperature and smoke level decreases.LoRaWAN provides the required network for updating data to the server which can be accessed by the user.

Image Classifier using CNN algorithm
A) We will create an image classifier algorithm that can identify saw and human depending upon the fed data.
B) To achieve our goal, we will use one of the famous machine learning algorithms out there which is used for Image Classification i.e. Convolutional Neural Network(or CNN).
C) For the data-set we are using two sets of data, i.e, Test data-set and Train data-set.
D) Now after getting the data set, we preprocess the data a bit and provide labels to each of the image given there during training the data set.
E) Libraries Required :

1) **numpy** – To process the image matrices
2) **open-cv** – To process the image like converting them to grayscale and etc.
3) **os** – To access the file system to read the image from the train and test directory from our machines
4) **random** – To shuffle the data to overcome the biasing
5) **matplotlib** – To display the result of our predictive outcome.
6) **tensorflow** – Just to use the tensorboard to compare the loss and adam curve our result data or obtained log.
F) **TRAIN_DIR** and **TEST_DIR** should be set according to the user convenience and play with the basic hyperparameters like epoch, learning rate, etc to improve the accuracy. The images are converted to Grey Scale for fast processing.

6. Analysis Model

6.1 Block Diagram:



7. CONCLUSION

In this paper, an IOT based forest fire detection was implemented using the Arduino. So when the temperatureand the flame gets increased alarm will be activated.We have designed a system for Forest Fire Detection which overcomes the limitation of the Existing technologies of Forest Fire Detection. In this work, we have developed a system which can reduce catastrophic events caused due to fire. This system detects the Wildfire as early as possible before the fire spreads over a large area and prevents poaching. We also proposed IOT based forest green level monitoring using image processing implemented by Raspberry pi. Continuous monitoring of green level tells us about the health of the forest .