

Integration of Computer Vision with Raspberry Pi in Surveillance Robotics

Shalini Sahay*, Aayushi Rajput, Sapna Kushwaha, Sumit Giri, Swati Meena

Abstract

An enhanced method for tracking the weather at a specific location and having the data viewable from anywhere in the world is the system described in this study. The technology behind this is the Internet of Things (IoT), a state-of-the-art and efficient way to connect devices to the internet and connect everything in the world in a network. Things like electronic devices, sensors, and vehicle electronics could be found here. Temperature, relative humidity, and CO level are just a few of the environmental variables that the system monitors and controls via sensors. After that, it sends the information to a web page, where graphical statistics are plotted using the sensor data. Through the internet, anyone can access the most recent data from the established system from anywhere in the globe.

Keywords: Unmanned aerial vehicles (UAVs), raspberry Pi, robots, Internet of Things

INTRODUCTION

Unmanned aerial vehicles (UAVs) have advanced quickly in the last several years and have a wide range of applications in the commercial, private, and academic domains. UAV use has increased significantly in a number of areas, including security, agriculture, and the environment, because of technological advancements in computer hardware and navigation software. Based on Dronell's estimate, their value is predicted to reach USD 42.8 billion by 2025. These UAVs have demonstrated the ability to gather substantial volumes of data in comparatively short amounts of time, enabling more rapid and accurate analysis. Their developments have made research in the geosciences, archeology, and spatial ecology easier. Volcano surveillance was one of the primary goals of research projects linked to environmental monitoring (PIGR 21-01, PIM 21-01), which is where the fundamental purpose of this study originated. UAVs operating in these conditions need to incorporate accurate and energy-efficient onboard technologies to optimize flight duration, improve mapping characterization, interpretation, surveillance, and risk assessment, and open up new research directions. Moreover, using UAVs for monitoring in environmental risk management plans is a great way to lower operating costs and achieve wider coverage in developing nations like Ecuador, where environmental risk is high, according to a 2020 European Commission report [10]. The autopilot is notable since a UAV is made up of parts that allow for control and maneuverability. It is an electrical component of the control subsystem that decodes signals from a ground control station or remote control and sends out the right signals to direct the aircraft to the intended spot and trajectory. The Pixhawk, one of the most well-known autopilots available, has a suite of position, orientation, and acceleration sensors that make it easier to handle and steer UAVs. Nevertheless, in order to facilitate actions like landing or obstacle avoidance, its autonomous navigation system needs

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extra equipment. It can even carry out duties for particular applications. Border security has long been a primary concern for everyone on the planet, not just India. It speaks of guarding the nation's borders from the unauthorized movement of people, goods, drugs, and weapons. It is necessary to protect against terrorism, maintain international trade, and permit lawful movement. This supports the preservation of a nation's freedom, safety, and economy. The instruments used to monitor activities near borders and identify any suspicious activity are border surveillance systems. If something occurs that raises suspicions, a set of predetermined actions are taken. It can entail notifying the relevant authorities or triggering other systems, like a combat or warning system, in reaction. The use of Intruder Detection Systems (IDS) in border monitoring is essential.

They are built to function in a hostile environment, continuously monitoring, identifying, and tracking intruders (moving targets). Intruders for this specific study might include drug dealers, human traffickers, terrorists, and espionage agents. An intrusion detection system (IDS) that can send out automated notifications might be extremely helpful, considering how tiring it is for individuals to watch and monitor the live video streaming continuously. The suggested Smart Border Surveillance System uses wireless sensor network (WSN) technologies to detect border infiltration. A microprocessor and a series of motors are arranged on top of the security camera [1]. Infrared sensors installed on the border fence send signals to the microcontroller in order to identify intruders. The signal is in charge of directing security cameras in the direction of any detected intrusions.

The motors can be instructed by the CPU to move the camera in both vertical and horizontal planes. The two motors serve as actuators and are in charge of the vertical and horizontal movement as well as the exact placement of the surveillance camera. The angle of the camera allows it to record the intruder's actions and movements while it is in its field of view. Determining if the movement is being caused by an animal or a human is also crucial. Alert messages are sent to the central control room as soon as it is determined that the intruder is human. These notifications compel the controller to take a closer look at the recorded video and assess if the activity necessitates a reaction. The controller is thus left with the task of determining the proper course of action in the current scenario. He or she can forward the information to higher authorities and set off automated processes to deal with the trespasser.

Movement in the monitored area is detected using pyroelectric infrared (PIR) sensors. These sensors are inexpensive, need little power, and work well in low light. Additionally, step motors are inexpensive and incredibly dependable.

They communicate with a Raspberry Pi to regulate their precise placement in addition to their forward and backward motion [2].

Robots are actually electromechanical systems with sensors to monitor and manipulate their surroundings, processing units to interpret the data from these sensors and generate outputs, and motion mechanisms to move the outcome of the process from the process.

Mobile and non-mobile robots are the two primary categories of robotics; a robot is classified as non-mobile if its working volume remains stationary with respect to a reference coordinate system, and as mobile if it changes.

Mobile robots have a wide range of applications, including the cleanup of radioactive and toxic wastes, the disposal of explosives, the transportation of biological wastes, cleaning the outside windows of tall buildings, finding, removing, and transporting mines, building space stations, underwater search and rescue, human rescue during earthquakes, and part transportation in factory production lines [3].

Applications for mobile robots in security and monitoring of interior spaces, such manufacturing facilities, airports, and warehouses, are also very significant. In these kinds of uses, the mobile robot

can communicate with people and other robots to keep an eye on the surroundings and sound an alert when something unusual happens.

We provide an Internet-based intelligent weather reporting system. We have implemented a system that enables online reporting of weather parameters. It eliminates the need for weather predicting agencies by enabling individuals to monitor the current weather conditions immediately online. The system tracks temperature, humidity, and precipitation along with a humidity sensor to offer real-time weather statistics reporting. Using temperature and humidity sensors, the system continuously checks for rain and temperature. **Weather The** task of a weather monitoring system is to identify and collect a variety of meteorological parameters at multiple sites so that they can be analyzed or utilized for weather forecasting. Information from the Internet-connected device may be effortlessly moved to the cloud, and from the cloud to the end user. A significant practical application of the Internet of Things concept is weather monitoring, which entails sensing and collecting numerous weather parameters and using them for long-term study as well as alerts, notifications, and appliance adjustments. Furthermore, we will attempt to use graphical representation to find and show trends in the parameters. The gadgets employed for this function gather, arrange, and present data.

RESEARCH PAPERS' OVERVIEW

The following list comprises the research papers that served as sources for our Virtual Telepresence Robot project:

1. *An Internet of things (IoT)-based weather monitoring system* is implemented in the survey [1]. This research paper's author describes how weather monitoring can be done with IoT technology.
2. *The questionnaire [3]*: It provides an output that is both accurate and efficient, and the swarm method is employed to further improve accuracy. Therefore, the author's objective in this project is to build a weather monitoring system using IoT.
3. *L. NaveenThe author of the paper [4]* wants to use the Internet of Things to create a weather monitoring system. Because this project uses both software and hardware, it is easy to implement. In the project, the author uses a different sensor to collect climate data, which is then stored in the cloud.
4. *The survey [5]* uses an API key to transfer the entire meteorological data set to an Android mobile application after extracting it from the cloud storage space. Rain sensors are devices that can identify drops of precipitation. When the plague appears, the voltage is calculated based on the raindrops that appear on the strips.
5. *In the study [6]*, R. Rangnath [It provides an output that is both accurate and efficient, and the swarm method is employed to further improve accuracy.

BLOCK DIAGRAM

The block diagram for the weather monitoring project is shown in Figure 1.

Turn on the supply or start the power bank module for Raspberry Pi 3 B+. The camera module rotates with the assistance of a motor and is attached to the Raspberry Pi module. With the aid of Wi-Fi, we were able to see the directions and live TV streaming on screen. The motor driver is connected to the raspberry pi. Here, an Android app that is connected to a Raspberry Pi is used to control the robot. Using an Android app, we can easily rotate the camera angle. Block diagram of flow of information is shown in Figure 1.

Hardware Requirements

Raspberry Pi 3 model B+

A single printed circuit board, as shown in Figure 2, serves as the foundation for the Raspberry Pi line of tiny single-board computers, which function similarly to desktop, laptop, or smartphone computers. It contains an integrated 802.11ac/n wireless LAN, 4GB RAM, gigabit Ethernet, a 1.4 GHz 64-bit quad-core Arm Cortex-A53 CPU, and Bluetooth 4.2 [7].

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Node MCU

The open-source Node MCU firmware, hardware, and software development environment was first created for the LUA-based Node MCU ESP8266 Wi-fi SoC chip [8].

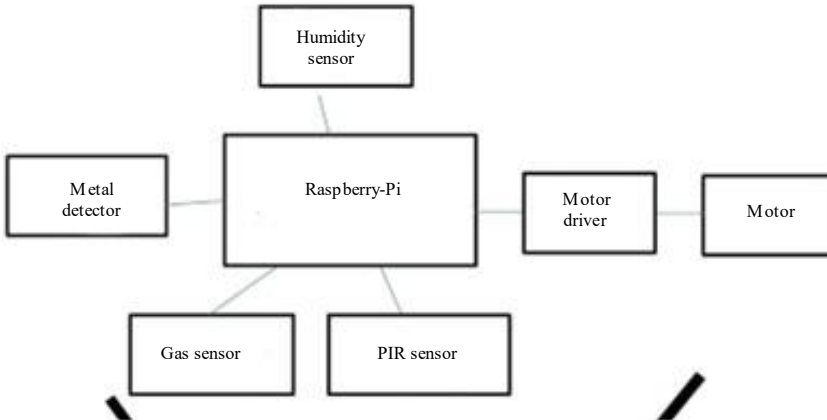


Figure 1. Block diagram of flow of information.

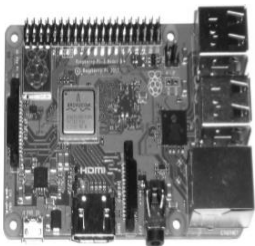


Figure 2. Single printed circuit board.

BMP 180 with Raspberry

The absolute pressure of the air surrounding barometric pressure sensors is measured. The weather and altitude both affect this pressure. Depending on how you analyze the information, you can track meteorological changes, determine height, or perform any other.

Humidity and Temperature (DHT11)

The thermistor and capacitive humidity sensor comprise the DHT11 sensor, which is depicted in Figure 3. The humidity detecting capacitor consists of two electrodes separated by a substrate that can retain moisture as a dielectric [9].



Figure 3. DHT11 sensor.

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Software requirements

The important programming language and software are used as follows:

- C language.
- Arduino IDE and

CONSTRUCTION

A modular or component weather station, whether it is installed on a tripod, pole, or tower, can resemble an odd skeleton with different boxes, panels, and bizarre devices dangling off in strange ways. Every gadget is only used for one or two measurements or functions. These various parts are united in a central box with a data gathering or processing device inside. Circuit Diagram of 2D model is shown in Figure 4.

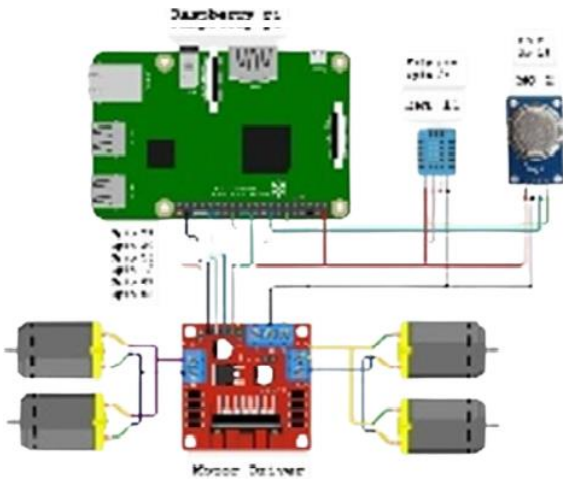


Figure 4. Circuit diagram 2D model

RESULT

Numerous parameters, including temperature, humidity, air pressure, wind direction and speed, rainfall, soil moisture, UV radiation, and more, can be observed by an Arduino-powered weather monitoring system.

CONCLUSION

In summary, the system has been designed and tested in multiple schools, and both teachers and students there are really happy with it. Deep research into its efficacy is still pending, though. The indicator and methodology would be the most crucial factors to consider while assessing the efficacy of WMS. We shall give the task of assessing WMS effectiveness top importance.

In this work, we provide a novel method to weather monitoring systems (WMSs) that gathers, stores, and transmits weather data using a portable, low-cost Raspberry Pi fitted with gas and weather sensors. Compared to the majority of previously created WMS, WMS is more accessible thanks to the usage of these widely used, low-cost technologies. WMS offers an online application that displays real-time meteorological data in addition to taking availability into account.

REAL TIME IMAGE

Experiment real time image captured at the time of evaluation is shown in Figure 5.

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