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OUTLIER DETECTION IN SMART IRRIGATION SYSTEM USING MACHINE LEARNING

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Abstract: IoT is an emerging technology that is used in all the areas such as agriculture, medicine, industries, banking, etc… In smart irrigation systems, the sensors like moisture sensor and DHT11 are sending data to the raspberry pi. If the moisture level comes down based on the required level, then the water pump will switch on. The problem with this system is, that if the moisture sensor does not work properly then the corps will spoil. The proposed system will check the data received from the sensors to find the outliers. If an outlier is detected then we can check and solve the issues in the smart irrigation systems. The local outlier factor algorithm is used to detect the outliers in the sensor data.

Key terms: Outlier detection, local outlier factor, smart irrigation

I. INTRODUCTION

Internet of Things connects all the devices and sends the data to the cloud and allows all the devices to communicate with them. Internet of Things allows devices to connect to the internet. The internet of things improves productivity in industries and reduces human labor. The Internet of Things has four major components: sensors, connectivity, data processing, and interface. The Internet of things is used for cost reduction, efficiency and productivity, business opportunity, smart house, and smart cities.

In smart irrigation systems, the moisture sensor senses the moisture level of the soil and sends information to the raspberry pi. The Raspberry Pi will switch on the motor based on the moisture level. The humidity sensor senses the humidity and temperature of the atmosphere and sends the data to the raspberry pi. If any problem happened in the sensors, then we can not find the fault in the system. The machine learning algorithm is used to find the outlier in the sensor's data. If sensors provide unusual data, then the machine learning algorithm will find out.

II. PROPOSED SYSTEM

The block diagram of the proposed system is shown in Figure 1. The raspberry pi collects the sensor data from DHT11 and moisture sensor. All data are stored in the system as xlsx format. This data is input for the machine learning algorithm. The machine learning algorithm will find the outliers in the data.

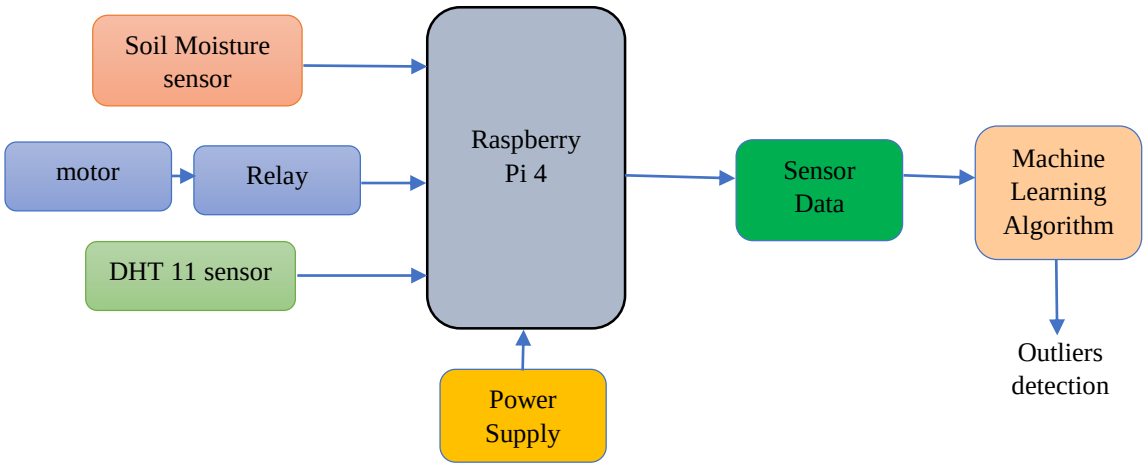

Figure 2.1: Proposed System

2.1 Raspberry Pi

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. It supports programming languages like scratch, python, c, etc… Like a desktop computer, we can do browsing the internet, play high-definition videos, make spreadsheets, do word processing, and play games. Raspberry Pi OS (formerly Raspbian) is a free operating system based on Debian, optimized for the Raspberry Pi hardware. It is a 32-bit Operating System. And now, the Beta version of the 64-bit Operating System is available.

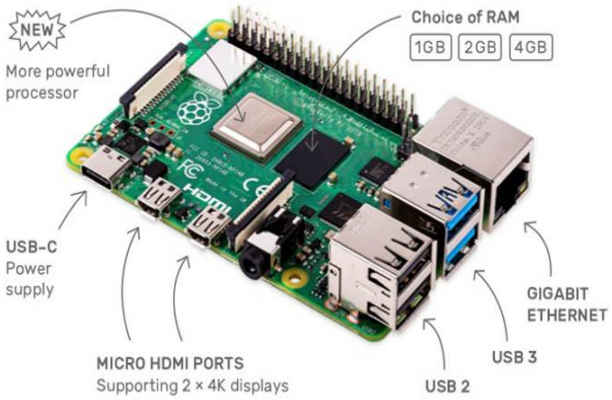

Figure 2.2: Raspberry Pi

2.2 Soil moisture sensor

Soil moisture sensors measure or estimate the amount of water in the soil. These sensors can be stationary or portable such as handheld probes. Stationary sensors are placed at predetermined locations and depths in the field, whereas portable soil moisture probes can measure soil moisture at several locations. [1] Soil moisture sensors do not measure water in the soil directly. Instead, they measure changes in some other soil property that is related to water content in a predictable way.[2] The measurement of moisture level is very important to supply water to the plants. This sensor measures the moisture level and sends information to Raspberry Pi. The Raspberry pi will switch on the water pump based on the moisture level.

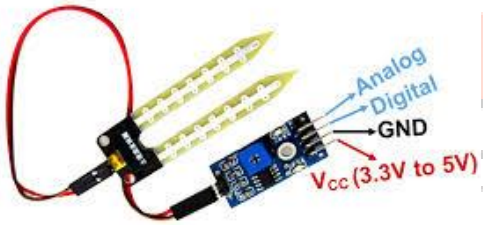

Figure 2.3: Soil Moisture sensor

2.3 DHT11 sensor

The DHT-11 Digital Temperature and Humidity Sensor is a basic, ultra-low-cost digital temperature and humidity sensor. 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). Its fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so in your code please use sensor reading interval at 2 seconds or more. Compared to the DHT22, this sensor is less precise, less accurate, and works in a smaller range of temperature/humidity. [3] This sensor will measure the temperature and humidity of the environment. Based on the temperature and humidity we can switch on the water pump.

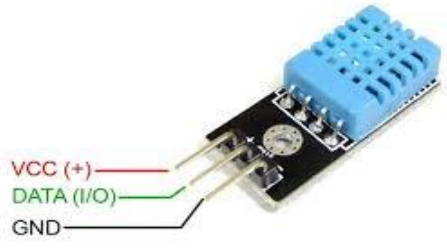

Figure 2.4: DHT11 sensor

2.4 DC water pump

A DC water pump is an electric pump with low voltage. They are quiet and use little power. They are used for many applications, including automotive, household, and water wells. DC water pumps are small pumps powered by a battery, dc power supply, or solar panel. Their primary use is to circulate, pressurize, and emulsify liquids. They are particularly useful in environments where water is in short supply.[4] The water pump will switch on when the moisture level goes down. Sometimes based on the temperature and humidity, we can switch on the water pump.

2.5 Local outlier factor

Local outlier factor (LOF) is an algorithm used for Unsupervised outlier detection. It produces an anomaly score that represents data points which are outliers in the data set. It does this by measuring the local density deviation of a given data point with respect to the data points near it. Working of LOF: Local density is determined by estimating distances between data points that are neighbors (k-nearest neighbors). So for each data point, local density can be calculated. By comparing these we can check which data points have similar densities and which have a lesser density than its neighbors. The ones with the lesser densities are considered as the outliers. Firstly, k-distances are distances between points that are calculated for each point to determine their k-nearest neighbors. The 2nd closest point is said to be the 2nd nearest neighbor to the point.[5] If any of the sensor does not work, then we can easily find out based on outlier detection. All sensor's data are stored in excel sheet. This excel sheet is input for the local outlier factor algorithm.

III. RESULTS AND DISCUSSION

The proposed system monitors and stores the data in the Excel sheet. The sensors send the data to the Raspberry Pi. The Raspberry pi stores the information in Excel sheet as data logger. The data logger sheet will be input to the machine learning algorithm. The algorithm will detect the outlier if any. If any outlier detected then we can check the sensor and can find the fault.

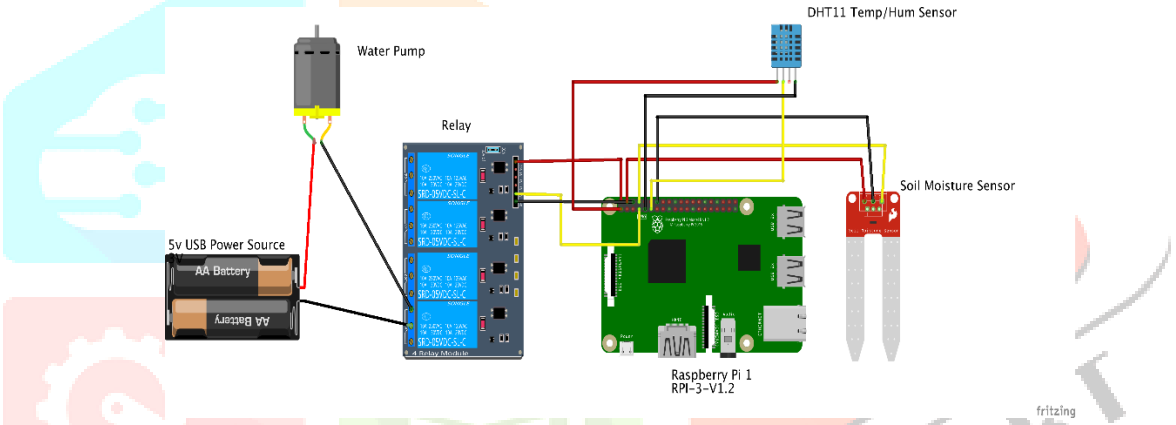

Figure3.1 Circuit Diagram of proposed system

IV CONCLUSION

The proposed system is used to detect the problem in smart irrigation system. The data received by raspberry pi will be analysed and outlier will be detected. Based on the outlier we can detect the problem in the sensors like DHT11 and soil moisture sensor. This proposed system is used to increase the corps productivity.

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