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Remote Monitoring System for Cold Storage Warehouse using IOT

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Abstract: *This paper outlines a remote monitoring system of temperature, humidity, gas and light control for cold storage warehouses. In these warehouses, it is significant that homestead produces should stay fresh. Lamentably when an administrator goes out from the cold storage, the temperature and other ecological factors like humidity, gas and light could be changed because of the different reasons, for an instance a valve of cooler is broken. This temperature change can bring about a major issue about the nature of farm produce.*

To overcome this issue, the owner needs to look to the present condition of the temperature and different ecological factors of the cold storage, even when he is far away. In this way, a monitoring system is required to display and control the ecological factors, for instance, temperature, humidity, gas and light when the owner is not present in the warehouse. Hence, this paper depicts the remote checking of warehouse, where this monitoring system is put on line follower robot setup to ensure complete tracking of the environmental condition of the warehouse. The owner of the cold storage warehouse will get a SMS alert. This SMS alert is based on the preset threshold data values fetched by the sensors, as the data value goes beyond the threshold a SMS is prompted. The proposed system is designed upon to support the cold storage warehouse, and maintain the quality of food item stored in it.

I. INTRODUCTION

Food safety is necessary to forestall the food wastage as food is the basic necessity of all living beings. Cold storage of fruits and vegetables was used extensively by our ancestors to keep food safe after the harvest season [1]. Often excess fruits and vegetables are kept in food industry, which cannot be consumed immediately but could store well [5]. So, in order to prevent food from wastage, the nature of the food should be checked and it must be kept from spoiling and degrading by the environment variables like temperature, humidity, gas and light. In this way, it is needed to implement quality observing devices at cold storage warehouses. These checking devices keep a watch on the natural factors that cause or accelerate rot of the food. Afterward, the ecological elements can be constrained by refrigeration, vacuum stockpiling and so on.

This paper focuses on designing of a similar cold storage monitoring system that will keep a watch on natural factors like temperature, humidity, alcohol gases and light. The objective of the paper is to monitor parameters like temperature and relative humidity in cold storage warehouses, so that stored products would not get contaminated due to surrounding conditions [2]. Here the monitoring node is Raspberry pi. Programming language used for Raspberry pi is python [3]. Raspberry Pi 3 is a little however full- included PC on a solitary board. The Raspberry Pi board is interfaced with different sensors these sensors are DHT11, MQ3 and LDR. DHT-11 sensor is used to screen temperature and humidity, MQ3 sensor is used to determine alcohol contents and LDR sensor is used to determine intensity of light. This monitoring system is placed on the line follower robot setup to ensure complete tracking of the environmental conditions of the cold storage [7-12].

This is an IOT (Internet of Things) based device. IOT is the cutting-edge technology that has the capacity to communicate from anything, anyplace and anywhere. This device sends the deliberate sensor information to an IOT platform. This data will be posted onto network using inbuilt Wi-Fi of Raspberry Pi. However, whenever a condition comes like temperature gets too high or concentration of gases increases or humidity parameters change then in this case owner of the cold storage warehouse will get a SMS alert.

This SMS alert is based on the preset threshold data values fetched by the sensors, as the data values goes beyond the threshold a SMS is prompted. With the strength of Internet of Things, the natural elements influencing the cold storage warehouse can be remotely checked.

II. COMPONENTS REQUIRED

- 1) *Raspberry pi*: It is a compact size full-featured computer on a single chip.
- 2) *DHT11 Sensor Module*: It used to sense the temperature and humidity.
- 3) *LDR Sensor Module*: It is a Light Dependent Resistor and is used to sense the intensity of light.
- 4) *MQ3 Sensor*: It is a gas sensor, used to detect the presence of ethanol gases.
- 5) *ADS1115*: It is analog to digital converter comprising of four channel board.
- 6) *IR Sensor*: It is an electronic device used to detect obstacles. It also functions as a proximity sensor.
- 7) *DC Gear Motor*: It is used to direct the robot to the desired directions.
- 8) *L293D Motor Driver*: It is a 16 pin IC used to guide a DC Motor in either direction.
- 9) *Li-ION Battery*: It is used to power the motors sensor and the raspberry pi.
- 10) *Voltage Regulator (LM2596)*: It is used to regulate the voltage at 5V.
- 11) *Jumper Wire*: It is used to connect the components.

III. PROPOSED MODEL

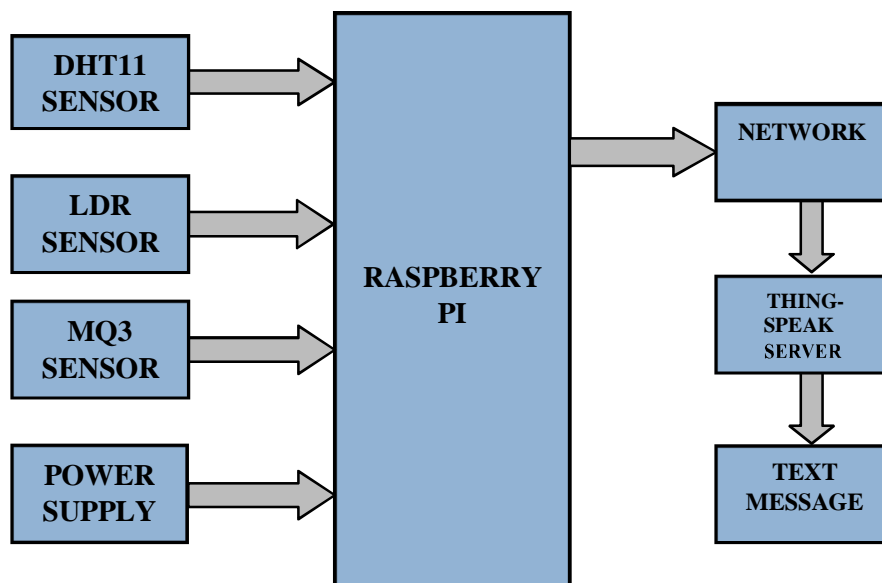


Fig.1 Block diagram of cold storage monitoring system

A. Raspberry PI

- 1) It is a credit-card size tiny computer on a single board. It is a 64-bit processor having a CPU frequency of about 1.2GHz.
- 2) It is used for education purpose *i.e.* to learn programming languages, to make electronic projects to explore computing and also in industrial applications.

B. DHT11 Sensor

- 1) It is a type of sensor which is used to sense temperature in the range of 0°C to 50°C and humidity in the range of 20% to 90%.
- 2) It works on the principle of Negative Temperature Coefficient.
- 3) It has four pins these are VCC, Data, NC, and GND.

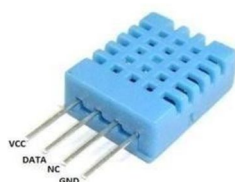


Fig.2 DHT11 Sensor

C. MQ3 Sensor

- 1) It is a sensor which is used for the detection of concentration of alcohol gases in the range of 0.05mg/L to 10mg/L.
- 2) It works on the principle that when the concentration of gas increases the conductivity of sensor increases.
- 3) It has four pins VCC, GND, DO and AO.



Fig.3 MQ3 Sensor

D. LDR Sensor

- 1) It is a Light Dependent resistor which is used to detect the intensity of light.
- 2) It works on the principle of photoconductivity i.e. when the intensity of light on LDR increases the resistance of LDR decreases.
- 3) It has four pins VCC, GND, AO and DO.



Fig.4 LDR Sensor

E. Internet of Things

- 1) Internet of Things (IOT) is a cutting-edge technology that has the capacity to communicate between any devices at any place and at any time.
- 2) It provides the facility in which all the things that are having a unique identity to connect to a network and share data and information.

IV. WORKING OF COLD STORAGE MONITORING SYSTEM

Fig. 5 shows the schematics of proposed cold storage monitoring system. This device ought to be installed in a cold storage warehouse. When the installation is done and powered on, it links with the internet by means of inbuilt Wi-Fi module and begins to fetch information from the interfaced sensors which are DHT-11, MQ3 and LDR sensors. DHT11 is a sensor comprising of inbuilt capacitive humidity component for measuring humidity and thermistor for measuring temperature. It reads an ongoing temperature and humidity reading at regular intervals. This sensor works on 3.5 to 5.5 Volts power supply and can measure temperature in the range of 0° C to 50° C and relative humidity in the range of 20% to 90%.

The standard library for DHT11 sensor is accessible to the raspberry pi. The read11() method from the DHT class is called to read the data from the sensor. The LDR sensor is associated in a potential divider circuit and intakes a voltage at the analog input pin of the controller. The in-built ADC channel is used to read and digitalized the voltage.

The MQ3 sensor is used to detect the outflow of ethanol gases. The ethanol sorts of gases are emanated when the food/organic product get ruined. The MQ3 yields an analog voltage relative to the concentration of the gas. The in-built ADC converts the analog output passed to the analog pin of the raspberry pi into digital output.

The Raspberry Pi gathers information from all the sensors and the inbuilt Wi-Fi of the Raspberry Pi will transfer this information to Thing-Speak Server. Instant messages will be incited by the platform dependent on the standards characterized by the client; same will be received by the client. This monitoring system is set on the line follower robot setup to ensure complete monitoring of the environmental condition of the cold storage warehouse. With the strength of Internet of Things, the natural components influencing the cold storage warehouse can be checked from anyplace.

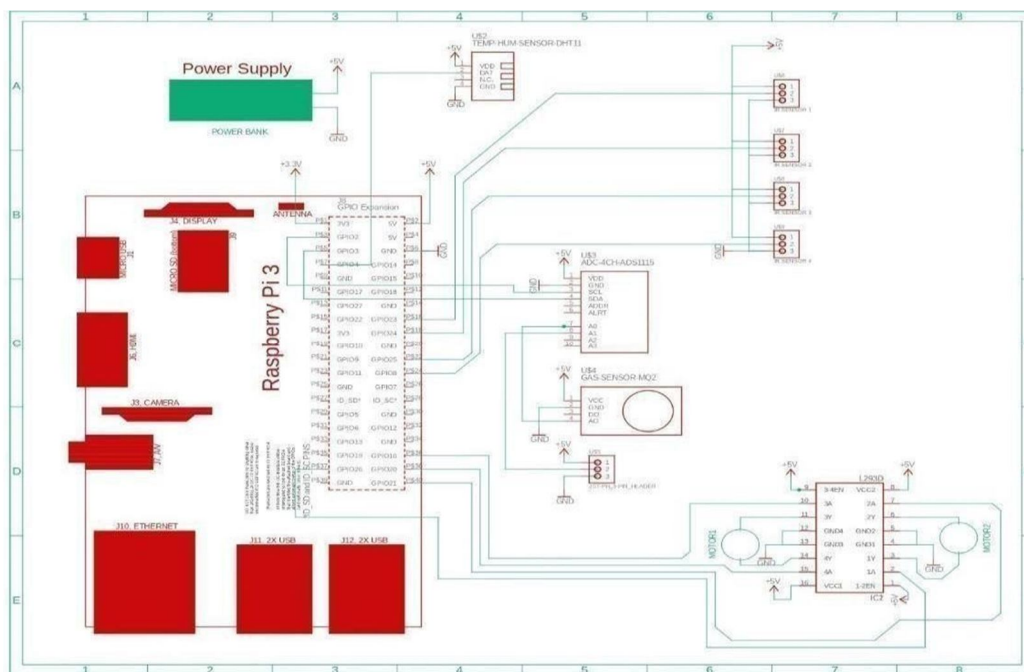


Fig.5 Schematic of Cold storage monitoring system

V. WORKING OF LINE FOLLOWER ROBOT

Line Follower Robot is a type of robot which follows a particular path. The movement of this robot is autonomous. This movement depends on white line on black surface or black line on white surface. It is able to follow the particular line with the use of motors and IR sensors. This IR sensor comprises of two parts IR receiver and IR transmitter, the IR transmitter transmits the light, and when this light is reflected by the surface it is absorbed by the IR receiver. Although, all surfaces do not reflect light only white surface reflects light whereas on the other hand dark surface fully absorb this light and hence, this property is used by line follower robot to find its path.

If the robot goes out of path then the motors are utilized to get them back to the path. These motors should allow movement in two opposite directions and also requires excessive current as a result we are utilizing L293D motor driver. A controlling device like Raspberry pi is also needed to control these motors, based on the data fetched by the IR sensors.

The two IR sensors are positioned on both side of line.

- A. The Raspberry pi directs the motor to move forward, if none of the sensors are detecting a blackline.
- B. The Raspberry pi directs the robot to turn left by rotating the right wheel, if the left sensor comes on blackline.
- C. The Raspberry pi directs the robot to turn right by rotating the left wheel, if the right sensor comes on blackline.
- D. Robot stops, if both the sensors come on black line. Hence, in this manner the robot is able to follow the required path.

VI. CONCLUSION

This protocol model is planned for checking the environmental conditions of cold storage warehouses. Management of these warehouses is simplified by the use of Internet of Things. These warehouses are consistently monitored in real time by the owner. Wireless monitoring has casted a huge impact on the evolution of new standards and technology in this era of automation. Hence the cold storage monitoring system forestalls the food item stored in it from getting decayed. Automation of schedules is vital for all food safety related task.

VII. ACKNOWLEDGEMENT

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