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Advanced Cold Storage System Using Raspberry Pi-3

M A. Venkatakrishnan, Vinayak Shreekant Hegde, Yogesh Kumar Singh, Praveen Kumar YN, Kalaiselvi S

UG Student, Dept. of I.S.E., The Oxford College of Engineering, VTU, Bangalore, Karnataka, India

UG Student, Dept. of I.S.E., The Oxford College of Engineering, VTU, Bangalore, Karnataka, India

UG Student, Dept. of I.S.E., The Oxford College of Engineering, VTU, Bangalore, Karnataka, India

UG Student, Dept. of I.S.E., The Oxford College of Engineering, VTU, Bangalore, Karnataka, India

Assistant Professor, Dept. of I.S.E., The Oxford College of Engineering, VTU, Bangalore, Karnataka, India

ABSTRACT: Advanced Cold Storage System is the one widely practiced method for bulk handling of the perishables between production and marketing processing. It is one of the methods of reserving perishable commodities in fresh and whole some state for a longer period by controlling temperature and humidity with in the storage system. Maintaining adequately low temperature is critical, as otherwise it will cause chilling injury to the produce. Also, relative humidity of the store room should be kept as high as 80-90% for most of the perishables, below (or) above which his detrimental effect on the keeping quality of the produce. Most fruits and vegetables have a very limited life after harvest if held at normal harvesting temperatures. Postharvest cooling rapidly removes field heat, allowing longer storage periods. Proper postharvest cooling can Reduce respiratory activity and degradation by enzymes, reduce internal water loss and wilting, Slow or inhibit the growth of decay-producing microorganisms, Reduce the production of the natural ripening agent, ethylene. In addition to helping maintain quality, postharvest cooling and by leveraging the latest supply chain technology and the IOT, which will serve as a hub to improve the efficiency and speedup the process throughout the entire supply chain. This proto type incorporates an IOT based Advanced cold storage system that interacts with the items stored within, collects the information about them and process this information into relevant data. The objects placed inside the Advanced cold storage system will be detected and identified using a web camera. Load cell with HX711 IC driver is used to calculate the Weight of the objects. Raspberry Pi-3 B+ collects data from the ARDUINO and analyse the data using python programming and transmit the stock information to the users through mobile application. It gives an alert to the users to place an order if the weight falls below the threshold value, i.e. If there is any shortage or out of stock of the objects. LM35 IC Temperature sensor is used to monitor the Temperature of the storage system. This proto type will reduce the use of manual labor increasing speed and shipping accuracy, and offer retailers an opportunity to obtain unparalleled visibility into inventory and supply chains.

KEYWORDS: Raspberry Pi-3 B+, Arduino, HX711 IC driver, LM35 IC Temperature sensor

I. INTRODUCTION

According to FAO (Food and Agriculture Organization), 1.3 billion of tons per year food loss is reported which represents 33% of the total production. The food demand is continuously increasing and could reach about 150-170% of the current demand by 2050. Moreover, according to an estimate of World Health Organization (WHO), approximately 1.7 million deaths per year around the globe are associated with low intake of FVs. The WHO recommends a minimum intake of 400g FVs per day. which helps to reduce risk of diseases such as diabetes, certain cancer, respiratory conditions and cardiovascular disease (CVD) [4]. While the loss rate of FVs (45%) is high among all other foods including meat (20%), oil seeds (20%), diary (20%), cereals (30%), fish and sea-food (35%) The loss of FVs which occur at storage stage is 10% that is higher than all other stages. Includes harvesting, storage, processing and distribution of post-harvest life cycle These convincing evidences indicate that a critical measure should be immediately taken to reduce the loss of perishable products like FVs. Smart cold storage has the ability to connect to the internet through Wi-Fi to provide special features. It is a smart way of dealing with the stock or items present in the storage. It includes internal cameras, more flexible user-controlled cooling options, and the ability for to interact with its features using smart phone or tablet. This proto type has the ability to know the quantity of items present. It will provide notifications to the user and the dealer or shopkeeper, if they are out of stock, Notifications include

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temperature, as well as information about the goods. This prototype uses a webcam to detect the presence of objects. ARDUINO is used as weight scale controller and Raspberry Pi3 as a home server. The controller will collect all information and send them to Raspberry Pi-3. Using python programming the weight of the object when placed the storage box is identified.

II. SIGNIFICANCE OF THE STUDY

The cold storage facilities available are mostly for a single commodity like potato, oranges, apple, flowers etc. which results in poor capacity utilization. The existing cold storage system lacks storage capacity of fruits and vegetables partially responsible for the non-availability of seasonal fruits and vegetables. A cold storage unit incorporates a refrigeration system but cannot store for a longer time. To maintain the quality of perishable products from production to consumption, cold storage is used as an effective strategy. Here, our main concern is to perform real time monitoring of environmental parameters inside cold storage to reduce the loss of perishable product like FVs and also intimate personnel. Our proposed System It includes internal cameras, more flexible user-controlled cooling options, and the ability for to interact with its features using smart phone or tablet. This proto type has the ability to know the quantity of items present. It will provide notifications to the user and the dealer or shopkeeper, if they are out of stock, Notifications include temperature, as well as information about the goods.

III. REVIEW OF RELATED STUDIES

Aurel-Dorian Floarea (2016): Conducted a study on Smart Refrigerator to determine the around the core concept of product identification based on RFID technology. In their study they found Firstly, the manufacturers will easily track their products from the assembly line, transportation route and finally to the store shelf, giving them more information about assembly and transportation costs
along with information about product visibility in the store itself. Secondly, the consumer will be able to easily access the above information, in time, for himself, information that is not easily or at all accessible to this day.

Nikhil Kakade, Prof. (Dr) S. D. Lokhande: Conducted a study on IoT based intelligent home using smart devices and, in their project, they proposed a design aims to implement a smart refrigerator system, which is easy to use and economical for the user. It is capable of notifying the owner about their activities going on inside it via wireless system on the mobile phone. The Internet of things-based systems where they will be able to see the condition of the number of milk packets kept inside the refrigerator.

Soundhar Ganesh S, Venkatesh S, Vidyasagara P, Maragatharaj S: Conducted a study on "Raspberry Pi Based Interactive Home Automation System through Internet of Things. And they proposed system for security purpose and to monitor the flow of water basically consists of raspberry pi module, sensor and MSP430 microcontroller.

III. OBJECTIVE OF THE STUDY

a. To prevent the quality loss of crop yields in order to help the farmers.
b. To monitor the maintenance of the crop yields and reduce the time management for FAO (Food and Agricultural Organization).
c. Cold chain management system will increase crop availability throughout the seasons.
d. To Increase the heterogeneity of yield and easily available to farmers at low cost in field of an agriculture.
e. To enhance the revenue of both farmers and the government.
f. Farmer can use the low-cost technology to preserve their yields.

The farmer and organization can review the status of crop yield and time span of the food products is extended for a longer period.

III. METHODOLOGY

a. Raspberry PI consists of in built WIFI along with LAN connection. An SD card will be inserted in raspberry pi by installing an operating system called Raspbian OS.

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b. It also has a camera module to which the Webcam is connected. The ARDUINO is connected to the GPIO of the Raspberry pi.

c. Weight scales attached with the load cell are connected to HX711IC. HX711IC acts as a driver for storing analog output weight. The analog electrical output is given to HX711IC and output of HX711IC is given to ARDUINO. The temperature sensor LM35 is also connected to ARDUINO. The temperature sensor LM35 detects temperature inside the storage box.

d. ARDUINO acts as an interface between analog output from weight scales, temperature sensor and digital input of raspberry pi.

e. Raspberry is programmed in such a way that it captures 50 samples of each product using webcam. The samples of the product taken are stored in the database. This process is known as training. Weight scales are placed inside the storage box.

f. Whenever a product is kept in the storage box, the image of it is captured using Pi camera. The captured image is detected using python programming.

g. This electrical output given to Arduino, Arduino consists of data regarding temperature and weight of the products inside the storage box.

h. Arduino is programmed so that the data present in it is given to raspberry pi. Using python programming the raspberry pi analyses the data. An app is created to notify the user.

IV. SAMPLE DATASET

- **Storage Box:**

1. 6L Capacity
2. 15 to 25 Degree Celsius
3. 48W to 65W Colling Power and 30W to 55W Heating Power

- **Captures 50 samples of each product.**
- **Weight scales are placed inside the storage box.**
- **HX711IC:**

1. 2 no. Of Channels
2. 5V Supply Voltage
3. 40mV Differential Input Voltage
4. 24-bit Precision
5. Less than 10mA Operating Current
6. 2.7V to 5V DC Operating Voltage
7. 24 x 16 Size

V. TECHNIQUES USED IN STOCK NOTIFICATION

- **Object Detection**: the input to the proto type will be an image, which is captured by a webcam. A webcam will detect the object and tracks it continuously. Each sample that is specified in the python script is detected when placed in the storage area using webcam. Each detection is reported with information like name or ID of the object.

- **Object Recognition:** It is the process of recognizing the product. The Raspberry Pi identifies the number of the sample matched with the detected image. The numbering of each sample is linked to specifications the product. Specifications consist of name of the product. Using these parameters and the detection of the object the product placed is recognized along with its identity.

- **Weight Identification:** Weight identification involves identifying the weight of the object which is recognized in the process of object recognition. Each sample saved is specified with number, name and threshold value. These parameters are used in the weight identification.

- **Temperature Identification:** The temperature inside the storage box is also notified to the user through app. So as to make the user know regarding the temperature in the box. LM35 temperature sensor is used. It gives linear relationship between output voltage and Celsius temperature. Raspberry Pi is programmed to send notification to the user using app.

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- **Notifications:** After the identification of the data regarding the weight of the products and temperature inside the storage box the user is notified through an app. An app named all things maker is created and linked to the program using its ID. Using this mobile application, the image of the product identified and the weight of it is updated in the app.

VI. CONCLUSION

In this paper we proposed and developed a proto type of an efficient, cost effective and accurate smart cold storage system using Raspberry Pi-3 model B+. Our smart cold storage system is more accurate and is capable of notifying the details about the contents of the storage and their weights to the user and the product supplier, when the contents are running out of stock. Temperature inside the storage system will also be indicated in the specified app through the user's smart phone. Thus, details of the stock in the storage can be easily tracked and refilling of the items can be done by the user. Even though our smart cold storage system is more efficient, the camera coverage area is limited. So, the camera capturing range has to be increased. By using more advanced algorithms for detection and recognition, irrespective of the position of the products the system should be able to detect and recognize them accurately. The processing speed can be improved.

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