Design and Development of Smart Food Grain Management System

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Abstract- Agriculture is the backbone of any nation's economy and there is a dependency between agricultural growth and economic prosperity. As India is an Agriculture dependent country where 70% of the population is directly or indirectly involved in farming, the storage of grains plays a crucial role in national economy. As India lies on tropic of cancer, grain grown are seasonal so its important to restore and reuse. In the process of grain storage, temperature, humidity and carbon dioxide concentration (CO2) are major ecological factors that can influence directly on the quality of the grain. Capturing of images of food grains running on a conveyer belt. The neural network process these captured images accordingly and classifies them into three classes i.e. wheat, rice, and jowar. in Python language. The classification is on based color, shape and size. Hence, there is a necessity to monitor the vital parameters continuously during storage and communicate the status to the manger in real time which becomes challenging. The traditional method is base on manual temperature and humidity testing which is relatively backward since grain condition analysis is done without any proper means of processing and regulation; hence there is a need for smart grain management system with automation which can also avoid hidden security risks. The smart grain storage system is designed based on Raspberry pi 3, using temperature sensor, humidity sensor and ultrasonic sensor, which improves the level of grains storage procedure and reduces man-power and labor intensity. The smart food grain storage system proposed in system is real-time, easy to operate and site stability.
Keywords – Neural Network classifier, Raspberry pi3, temperature sensor, humidity sensor.

I. INTRODUCTION

India with a population of 125 crores, the storage of food grains to maintain its quality plays an important role. Due to the developments in the field of biotechnology the production of food grains has increased .But the due to the Lack of facilities and proper infrastructure the storage demands are not meeting the production. The storage of food grains is greatly influenced by the environmental factors such as temperature, humidity, light. Other factors such as time and purpose of storage, type of storage also play an important role in the storage of food grains. During the storage there is a loss in both quality and quantity of food grains due to pests, rodents, rats, fungal growth, mold growth and other microorganisms, the growth of which is influenced by the environmental factors . Due to this there is a loss of 15%-20% of food grains. Hence there is a great need for a system which monitors and controls the environmental factors so that the loss of food grains is reduced. Traditional storage systems require a lot of human interaction and hence it is not so efficient. So here an integrated system has been proposed to detect the type of food grain automatically and to monitor and control its temperature and humidity which mainly consists of wireless sensors and thereby reducing human activities. The table given below provides the moisture and temperature content thresholds to be maintained for the different food products.

Table 1: Threshold temperature and moisture content for various food grains

Food grain	Drying Temperature (C)	Max. Moisture Content (%)
Paddy	60	17
Wheat	65	14.5
Oats	60	14
Jowar	55	14.8
Maize	49	14
Flax	80	10
Peas	45	16

As temperature rises moisture holding capacity increases, so temperature has to be maintained .the optimum illumination is maintained around 50 lux to 90 lux.

Motivation: In most of countries Food grain storage are of primitive type i.e. analyzing temperature and humidity without proper processing of grain or their regulation. They use a lot of manpower and resources, older methods of drying, ventilation and pest controls are practiced. Technology used is hard-wired having lot nodes connected to hardware with long transmission lines, using lot of power and low yield. Due presence of most of long wired hardware requires lot of maintenance, this proposed implementation results in low accuracy, poor scalability and security risks. Therefore there is requirement of real-time monitoring and controlling Grain storage system.

II. DESIGN AND IMPLEMENTATION

The system designed is divided into two subsystems i.e. the first system being the image processing system which identifies the grain and tells its quality and the second being the monitoring system which tells us about the present temperature and humidity at which the grains are stored.

I. Image processing system: This system is mainly used to classify the food grains. It's the basic requirement in food industries. The process begins with the capturing of images of food grains running on a conveyer belt. The neural network processes these captured images accordingly and classifies them into three classes i.e. wheat, rice, jowar as shown in Figure 1. The display unit displays the type of grain and also their threshold temperatures and humidity based on the lookup table. This information is sent to the microcontroller through local host, where it sets the threshold temperature and humidity using the look up table [Table 1].

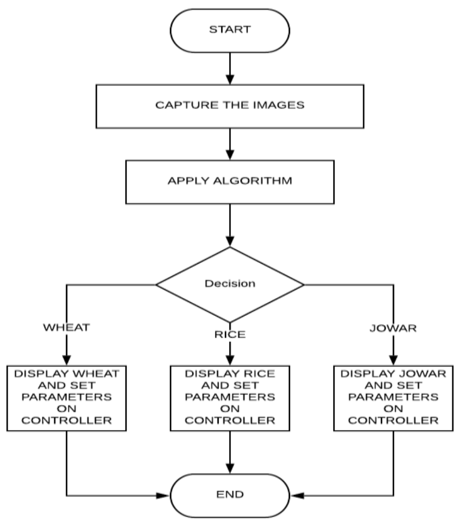


Figure 1: Flow chart for identification of the grain

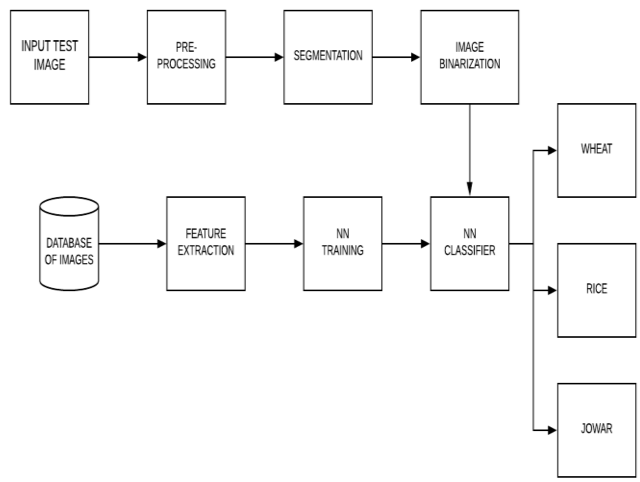


Figure 2: Image processing system flow

1. Image acquisition: The image of the grain sample is captured using a camera fitted at a fixed distance above the conveyer belt .These images acts as the inputs for the neural network.
2. Image conversion: The captured images are converted from RGB to a grey image.
3. Segmentation: Resizing of the captured images is done and the foreground i.e. the region of interest is extracted followed by thresholding where the region of interest is separated from the background.
4. Binarization: Images are converted to binary based on their contrast levels.
5. Image database: collection of image samples.
6. Feature extraction: The geometrical features such as area, major axis length, perimeter which gives the quality of the grains are extracted.
7. NN Training / Classifier: The neural network is trained using sample images and then it classifies the input images by comparing them with the trained images.

III. MONITORING SYSTEM

The general model proposed for grain storage framework comprised of two parts, one is the host PC which assembles Grain environment i.e. Sensor data, it procedure and forecast of grain circumstance, the other one lower level control terminal in the silo/depot with grain information obtaining. The principle reason for the framework is to get information from various sensors and transmits this information over Wireless Network.

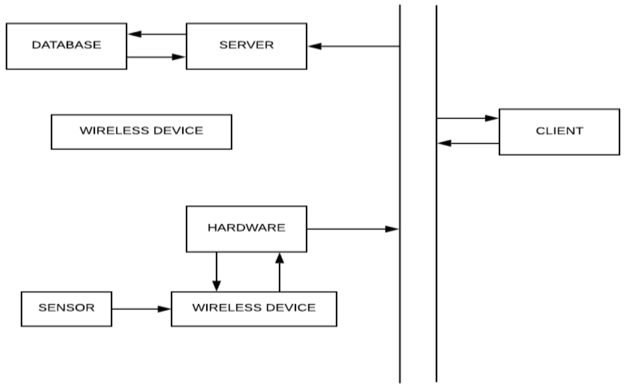


Figure 4: Overview of grain monitoring system

The architecture of proposed grain monitoring system is consisting of Hardware as well as Software components. The hardware part consists of DHT11 temperature and humidity sensor. The data acquired different sensor is amplified and A/D converted to feed into Raspberry pi 3.

The software part comprises of host computer or system located in control room. It consists of database which is created for storing of data of temperature for far access of data through internet.

DHT11: It is a sensor belonging to DHTXX series which measures both temperature and humidity. It can measure a humidity range of 20% -90% and a temperature range of 0-500C.it has a sampling period of 1 second.

Raspberry pi3: It is a small pocket sized computer compatible with windows OS.

The features of raspberry pi 3are:

It consists of a 64 bit quad core ARMv8 Processor which is clocked at 1.2GHz

Inbuilt WLAN (Wi-Fi) and Bluetooth (BLE) module

4 USB 2.0 Ports

Ethernet Port

General Purpose Input Output Pins and HDMI support

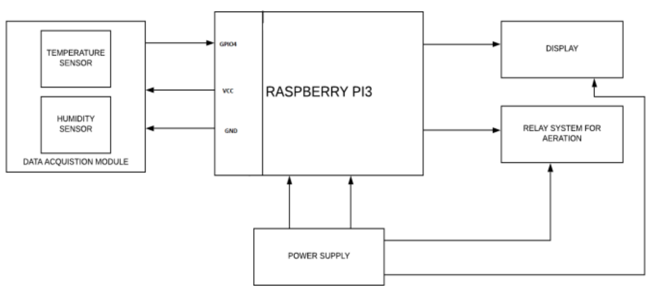


Figure 5: Architecture of food grain monitoring system

Monitoring System Implementation: Implementation part of grain system includes Hardware implementation and software realization. Each implementation part is described in the lower section.

The program source code is written in such a way that operations of the development board can be controlled. The PCB circuit design for the hardware used in the present work is done using Orcad design software. The software development kit python Anaconda supports pi controllers, with the help of this tool source code is written in python language and compiled to generate hex file. The hex code generated by the compiler is burned into Raspberry pi3. Flowchart for grain monitoring system model is shown in Figure 6.

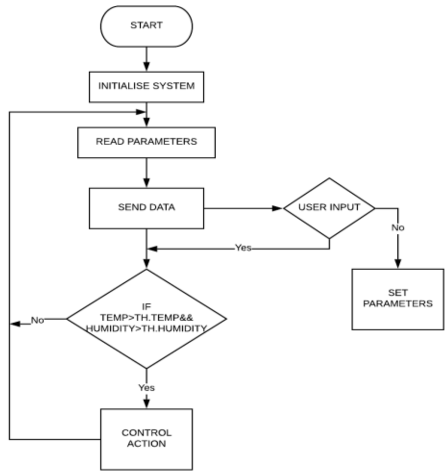


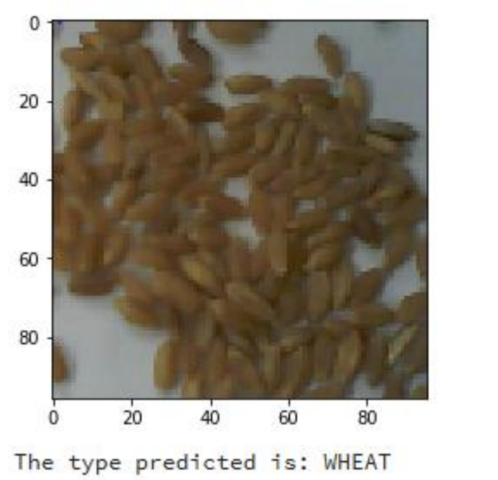
Figure 6: Flowchart for monitoring system control flow

Hardware implementation dealing with according to the application drawing the schematic on the plane paper, schematic of the design is tested over the breadboard using the many ICs to check whether the design meeting the objectives. Carrying out the Printed Circuit Board layout of the schematic tested on breadboard, lastly prepared the board and testing the hardware designed.

Image 1: Implementation

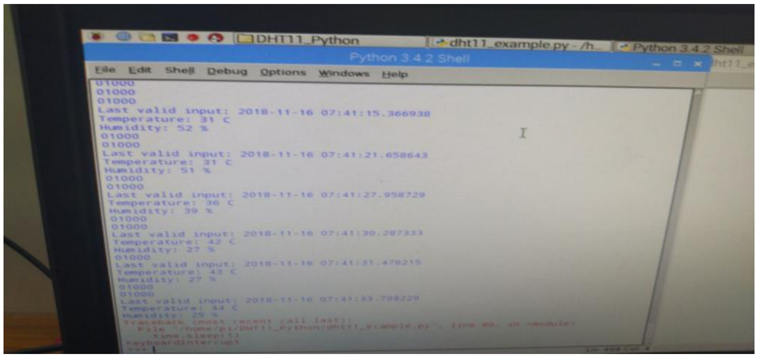
IV. RESULT AND DISCUSSIONS

Once the input image is captured by camera, it is processed by the neural network and then displaying the type of grain predicted.



Result 1: Grain type detection, identified as wheat

Through this detected type the further monitoring of System is carried out efficiently



Result 2: Display of real time temperature and Humidity

V. CONCLUSION

This system has been tested on jowar, rice and wheat samples to classify them and monitor their quality. The identification of grain is based on their size, shape and color. The neural network is trained using the database consisting of hundreds of images of each grain. It results wheat, rice and jowar. The Proposed system gives flexibility and reliability in data acquisition .It is real-time and fully automated. The control of humidity minimizes human labor and grain wastage in food depots. As system is real-time can used in any country with variable climate and atmosphere. The Smart food grain system provides accurate measurement and cost effective.

There are certain aspects in this work that can be investigated in future, such as Environmental factors influencing the Grain quality, we are considered only major factors Humidity, Temperature and CO2 concentration for early detection of deterioration of Grain and Good Control actions like Reducing Temperature in the Grain depot if Temperature is High i.e. keeping parameters at nominal level by an Automatic system irrespective of condition

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