**Grain Counting based on IoT and Image Processing**

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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# APPROVAL

This Project titled "**Grain Counting based on IoT and Image Processing**", submitted by **Koushik Majumder, Nayan Das, Tajul Islam & Ijaz Ahmed** to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on **12/7/2020**.

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# DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Mohammod Jahangir Alam, Lecturer, Department of CSE,** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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## Abstract

This project aims to build a machine that would help the researchers of our country while they are developing any new seed, as they need to count number of grains produced using the SEED in an area and check its quality. Grain counting is very important for breeding. Main purpose of this project is to give the researchers a device that would help them with the counting and quality check process. This device will speed up the research greatly as counting and quality check would be done from an image. This will also greatly reduce the cost of their research as they won't need to go to a place and hire people to count & check quality of grains. This project is a 50-50 combo of hardware and software. Without hardware, software won't work and without software, hardware won't work. We used MATLAB as software and Raspberry Pie, Camera Module, battery etc. as hardware. An easy and user comfortable GUI is made via MATLAB & used as a software for capturing image and processing the image. Camera module is used to capture the image. The camera captures images and sends into a computer folder named "Counting". Raspberry Pie is used as the CPU for the capturing part. Battery is used as the power source of Raspberry Pie and Camera Module.

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# Chapter One
# INTRODUCTION

## 1.1 Introduction

We are living in an era where almost everything is based on science. Thus, many things in our country are getting done in old ways. One example of this is that researchers in Rice institute of our country hires people to do some their work which can be done using a low-cost device. So, we are going to develop a device that will the researchers with their research.

## 1.2 Motivation

Bangladesh is an Agricultural Country.63% people of our country does Agriculture for their livelihood and almost every people of our country eats “Rice” and 3.5 billion people of world eats rice. Rice institute (IRRI, BRRI, CRRI, RRDI, CNRRI) Researchers doing their best to make good production from any type of “Paddy”. For this they need to check many paddy fields and count and check quality of a minimum of thousand paddy. Counting thousand paddies by hand is tough. To decrease some their work load we decided to make a counting and quality check machine based on IoT and Image Processing.

## 1.3 Objectives

The main intention of doing this research is that it will fasten up the quality check and counting process of paddy for the Crop Researchers of the world as they need to check a minimum of thousand paddy to ensure a good production. For this we are going to make an IoT and Image Processing based machine that will count and check the quality of paddy.

- Faster the rice research techniques
- Quality check
- Decrease transport cost.
- Decrease workload of researchers
- Ensure good production via accurate data.
- Universal monitoring via web server.
- Easy to use.

## 1.4 Expected Outcome

A machine that will count and check quality of paddy from an image and store data in a web server.

# Chapter Two

# Description

## Hardware

There is some hardware we need to build the machine. List of hardware are given below:

1. Motor
2. Camera
3. Tray
4. Battery
5. Wire

## Software

There is some software needed to complete this project.

List of software:

1. A desktop application to take picture.

2. MATLAB GUI (For Object counting).

3.ImageJ (for image preprocessing)

4. A desktop application to send data into database.

# Chapter Three

# Background Study

## 3.1 Related Works

Image processing is one the hot topics of research world. Image processing is study and touching of a digitized image, in order to get corrected image or to solution any helpful information from it. It is an arrange homogeneous characteristics with input and output perchance image and with that image in which is signal processing. Image processing technique already arrange signal processing while includes two dimensional signals. In image processing system there are two kinds of framework one is Analogue image and other is digital image processing. The hard copies are used in the analogue image processing like photographs and printouts. The visual method uses in various fundamentals of interpretation of the image analysts. At the hand of using computers promote in deception of the digital image by the method of digital image processing. Computer algorithms are use of digital image processing system, in order to essence some helpful information. Digital image processing is more helpful from analogue image processing because it has many advantages. In the output data it allows to useful a very wider range of algorithms. In future the image processing system will have lot of research and also include new intelligent for research and job opportunities.

IoT is mainly a link between sensors, actuators and physical objects through wire and wireless networks. This term 'IoT was invented first in 1999. IoT was started to be popular since 2010 worldwide. Those days IoT was used as vocabulary to describe the phenomenon. Internet of things started growing in mass market in 2014. Nowadays there are a lot of scopes to develop and a wide research is going on based on IoT. IoT is growing on the concept of connecting devices to internet and makes things easier to access. German government finds the largest scope of IoT in industrial sector and set the goal of next industrial revolution based on IoT.

Image processing is used in software part in this project. Embeded Systems and IoT is used in hardware part of this project. Embeded system is a combination of hardware and software which is designed to do a specific job at a time. In this project Embeded system is used to capture the image of grains and IoT is used to send data into a web server.

For the IoT part Java is used to make a desktop app. Java is used because Java is one of the most used programming languages in the tech world. More than 3 billion devices are running using Java. It is easy to develop an app using Java as there are so many tutorials about Java.

Above are background study for the device.

## 3.2 Literature Review

We also did some study for the research method means how the counting will be done, how the image erosion can be decreased, which software will be best for image pre-processing and post-processing. Here is a summary of research study. In this summary, there will be some researcher name (who did the research), title (what he/she did), algorithm (how he/she did) that we studied.

Till now many researchers did many researches using image processing and IoT. A are quite a few numbers of researches on grain counting using IoT and image Processing. Zhao ping et al. [1] used vibration to spread the seed to remove overlapping then took a picture and counted the objects using MATLAB. Qing Yao et al. [2] converted the RGB picture to binary and searched for the corners of objects and counted the corner pairs. Bhagyashree Mahale et al. [7] also used corner detection but used the corner to measure the length of seed. Rahul Birla et al. [8] used machine vision to count normal seeds. Bhupinder Verma el at. [4] used image processing to grade and classify rice grains. Jagdeep Singh el at. [5] also used image processing to grade grains. Bhavesh B. Prajapati el at. [12] used image processing to classify Indian basmati rice as per the export rules. E. H. Van den Berg P, N. S. Shashidhar, Shatadal, D. S. Jayas, C. Ni, Q. Li el at. [16,17,18,20] used image processing to sperate and classify touching grains. Kanchana Wan, Y–N el at. [3,6] used image processing to check physical quality of grains.

There are many algorithms for counting objects from image. We studied the algorithms related to our research. We tried some of these and used one theses algorithm. The algorithm consists some steps. We used MATLAB as software. We needed to learn MATLAB's basic function first. We also learnt Embeded systems for hardware part.

We faced many problems while working on these algorithms as we are new to MATLAB. As per the algorithm, an image is captured via a camera, then the image is loaded into MATLAB. The loaded image is an RGB image which has too many details to count.

Therefore, we converted the picture to gray scale picture to reduce the details then threshold the image for further reduce the intensity of the image and lastly transformed the image into binary image for object counting.

After counting the objects, a desktop application will be used to send the data into an online database from where anyone can see the data.

## 3.3 Scope of the Problem

The problem or project is about counting various kinds seeds and check the quality of these seeds from an image. After this project there will be a device that will count objects from image and check quality of these objects.

## 3.4 Challenges

Challenges for this project are,

How much accurately the device can count objects from an image.

Can the device detect the moisture of the grains?

Can the device measure weight and length?

# Chapter Four

# Research Methodology

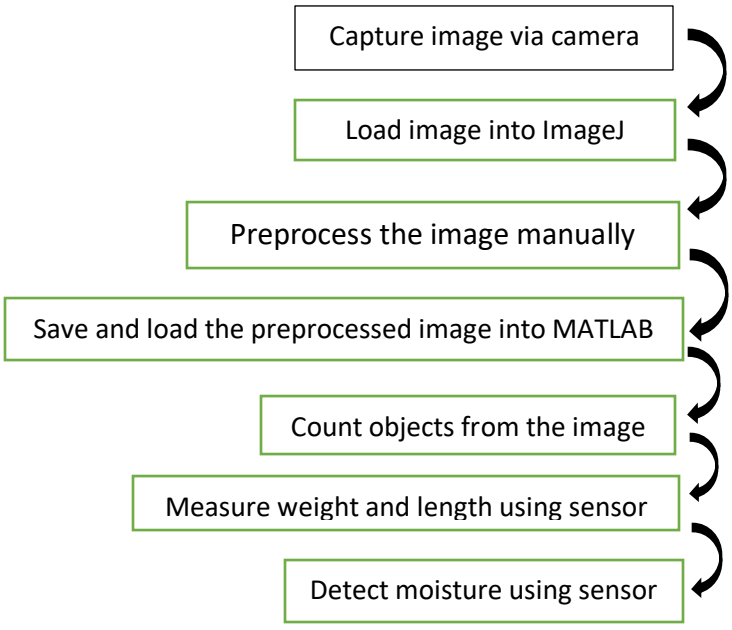
## 4.1 Introduction

This project is based on IoT and image processing. After being completed, this device will count grains from image, check average weight and length of grains, detect moisture of grains. We will use MATLAB and ImageJ as software for image processing & Arduino, camera will be used to capture image.

## 4.2 Algorithm

The main objective of this research is counting object from image. For this, we used Image processing techniques. There are many research papers about image processing. So, there is many algorithms for counting object from image. We tried some these algorithms and selected one the algorithms.

The algorithm we will be using goes like this,



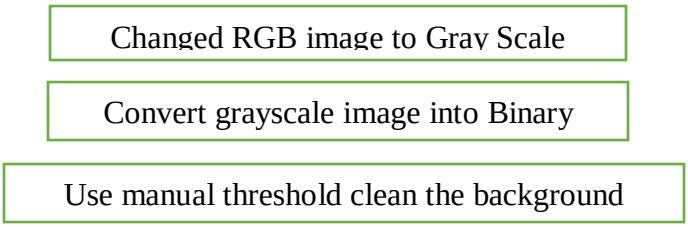
The device is made using Embeded System. Embeded System is a combination of hardware and software which is design to do a specific job at a time. Our device is going capture image of grains on a tray. The device is made of Raspberry Pi, camera which will be initially powered from our computer but it can be powered from 3 9v batteries. For weight and moisture two sensors will be used later. And length of grains will be measured using MATLAB GUI.

After the grains are counted, the data will be saved into an online database using a desktop application. For the application Java language is used. The app is connected with MySQL database.

## 4.3 Implementation of algorithms

Now we will explain how the image processing is done using the algorithm.

We used a vibrator to shake the tray containing the grains to clear up the overlaps. Then we used the camera to capture a clear image of the grains. Initially the image is saved on the computer directly. But in future we will upload it into web. Then, we used ImageJ (a software made by US government health department) to preprocess the image. The preprocessing goes like this,




first the image is loaded into ImageJ. The loaded image is an RGB image. We all know that RGB images contains very much details. So, if we use this RGB image to count object it will show a huge number. Because of that problem we converted the RGB image into gray scale image. But Gray image also contain much details. In this way, we further handled the picture and changed over it into a binary picture. The binary picture has just two hues Black and White. The items are dark and the foundation is White.

It removed almost all the black background from the image. Then we saved the image locally. Then the preprocessed image is loading into a MATLAB GUI made by us specially for this project. The GUI has two buttons. One is to load the image and one is to count the objects from the image. When we press the count button, the background program will be initiated and count the number of objects from the image. And show it in a label.

The desktop application which is being used to send data into an online database is made using Java Language. As we are building the device for researchers for rice institute, they need to save record of production from a new seed. Here, the production means how much rice is being produced in a particular area. So, the app will send data about the area (production area), how much grains are produced (counted grains), who counted the grains. The app can only be accessed by institute officials. So, there is signup and sign in options for users. There will be admin privileges for security.

The whole preprocess via ImageJ is shown in bellow images:

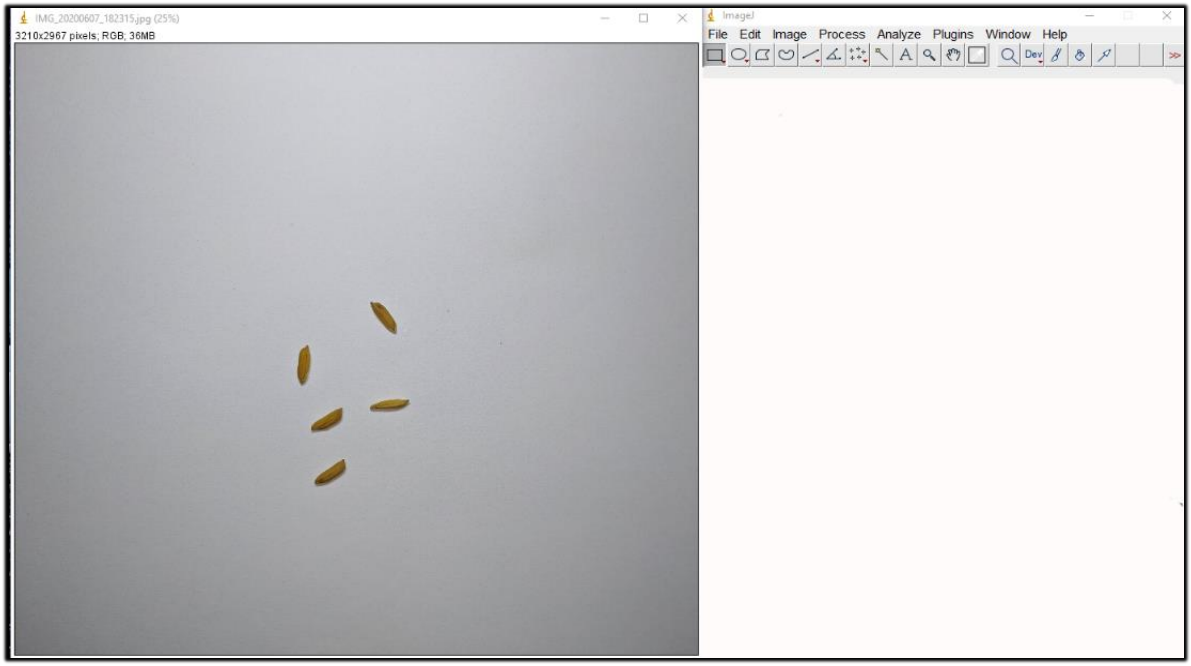



Fig 4.3.1: Image loaded into ImageJ

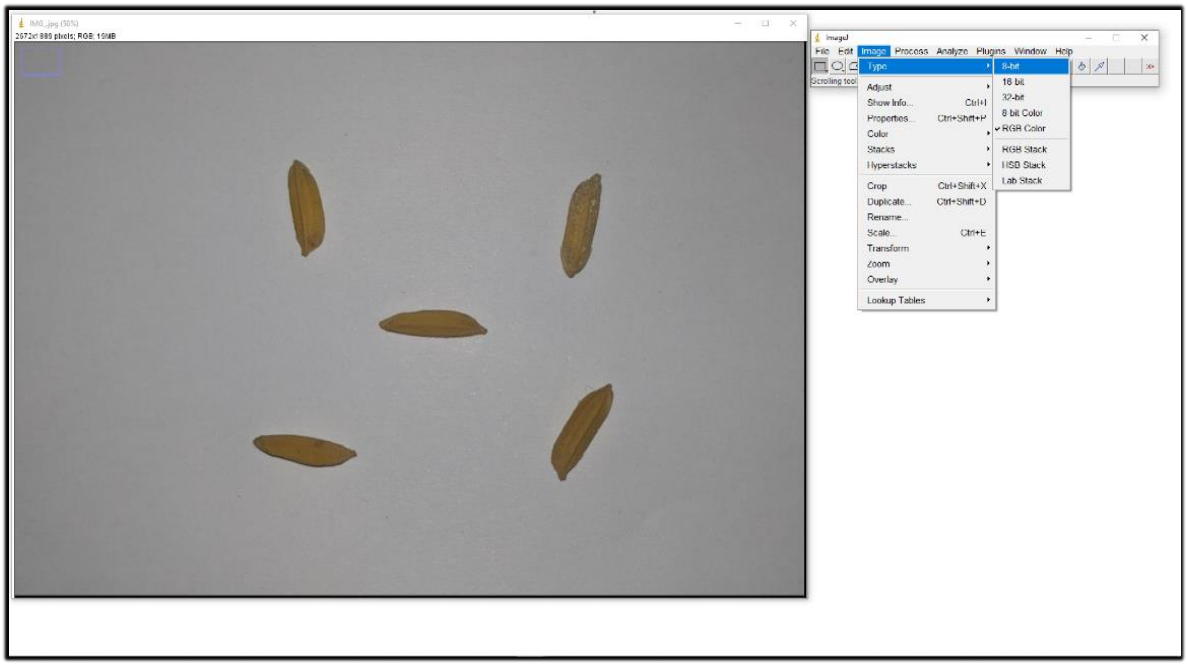



Fig 4.3.2: Converting RGB into gray scale image (8-bit image)

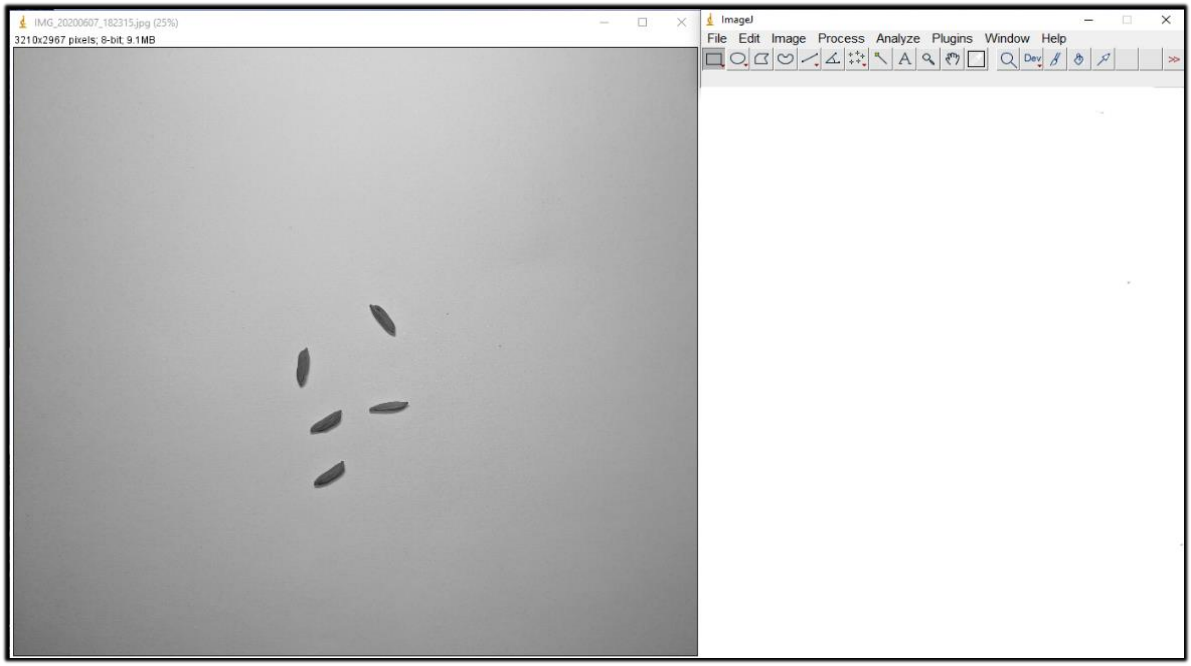



Fig 4.3.3: Converted into gray scale image

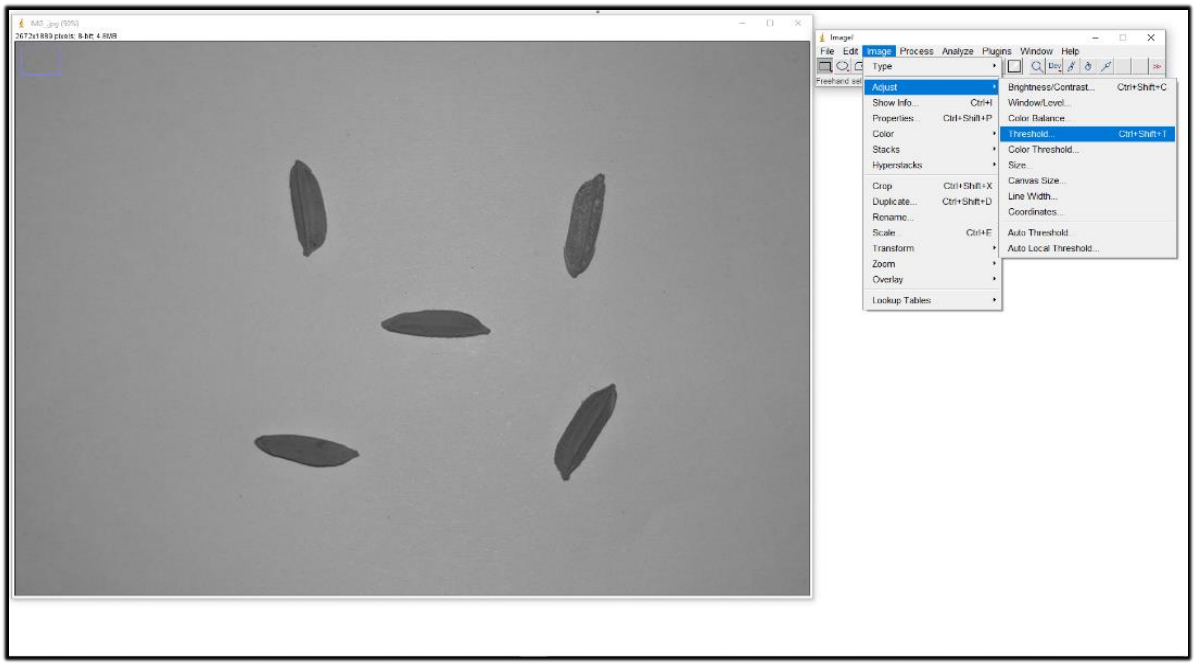



Fig 4.3.4: Manual thresholding

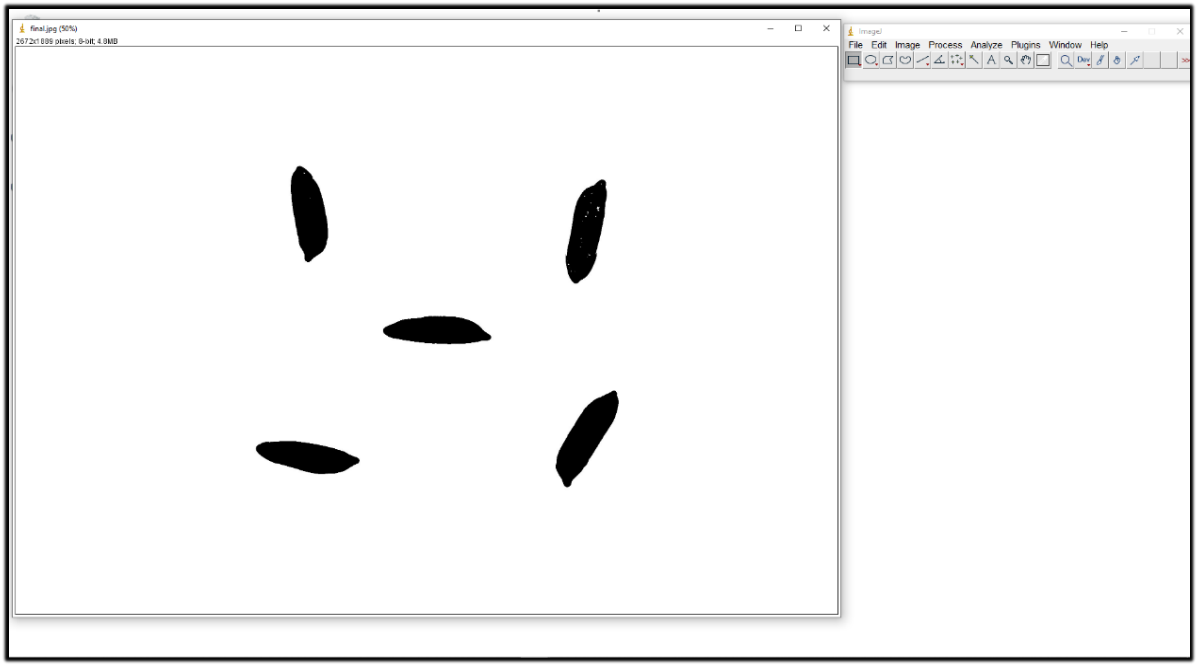


Fig 4.3.5: Filling holes after converted into binary image

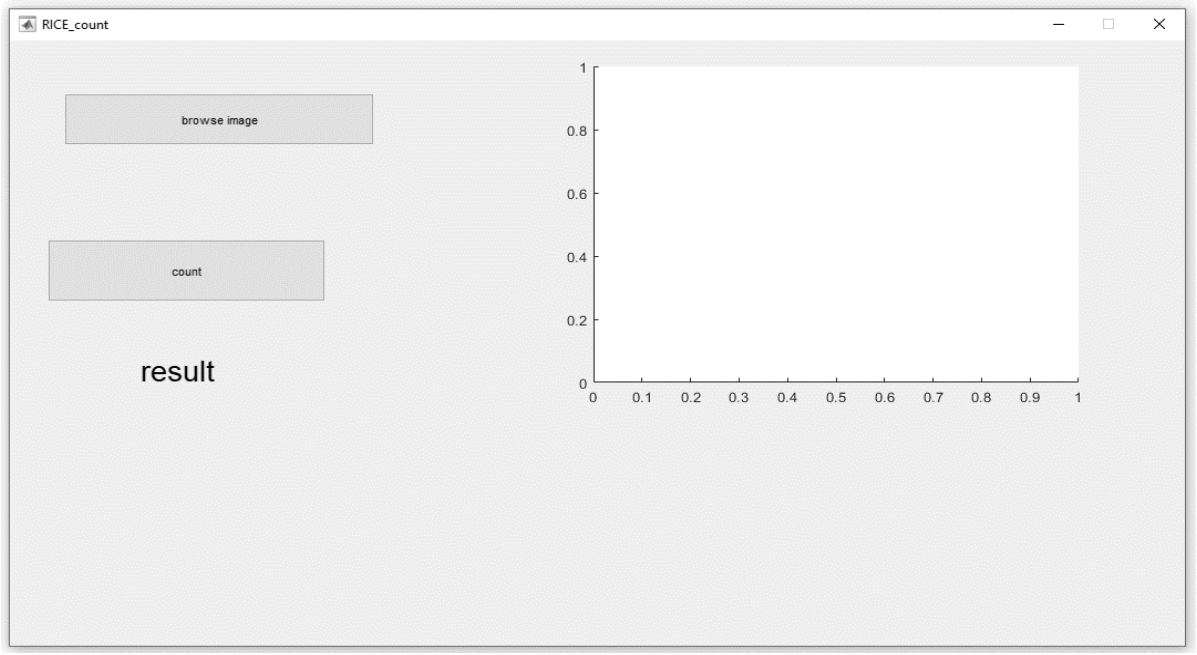



Fig 4.3.6: MATLAB GUI made by us


Fig 4.3.7: Result of counting objects from a preprocessed image

Now, components of the device in shown below:

Fig 4.3.8: Raspberry Pi

Fig4.3.9: Camera

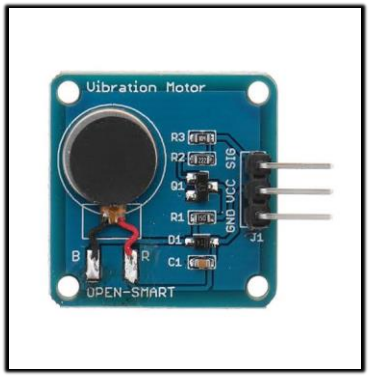



Fig 4.3.10: Vibrator

Fig 4.3.11: Weight Sensor

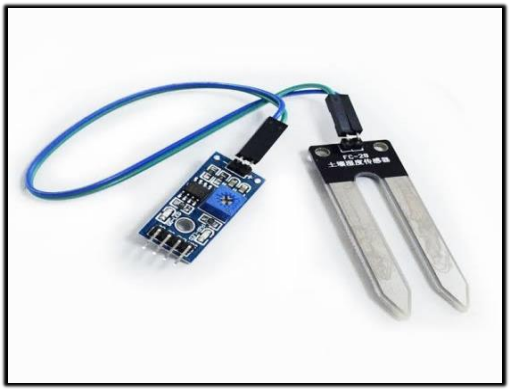


Fig 4.3.12: Soil Humidity Sensor

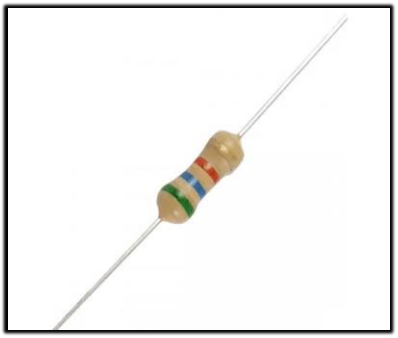


Fig 4.3.13: Resistor 1

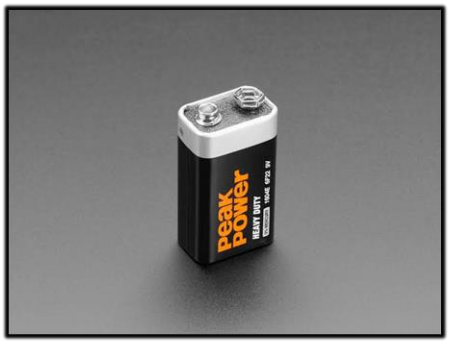



Fig 4.3.14: 9v Battery

This is our device, till now this device only captures image to count but in future this device can be sued to measure length, detect moisture, send data into web server automatically.

Fig 4.3.15: Final Device

# Chapter Five

# Experimental Results

## 5.1 Introduction

Nothing is perfect in this world. So, our device isn't perfect. Every device need testing before showing it others. So, we did some experimenting with our device.

## 5.2 Experiments

1.Take an image in low light and try to count object from the image.

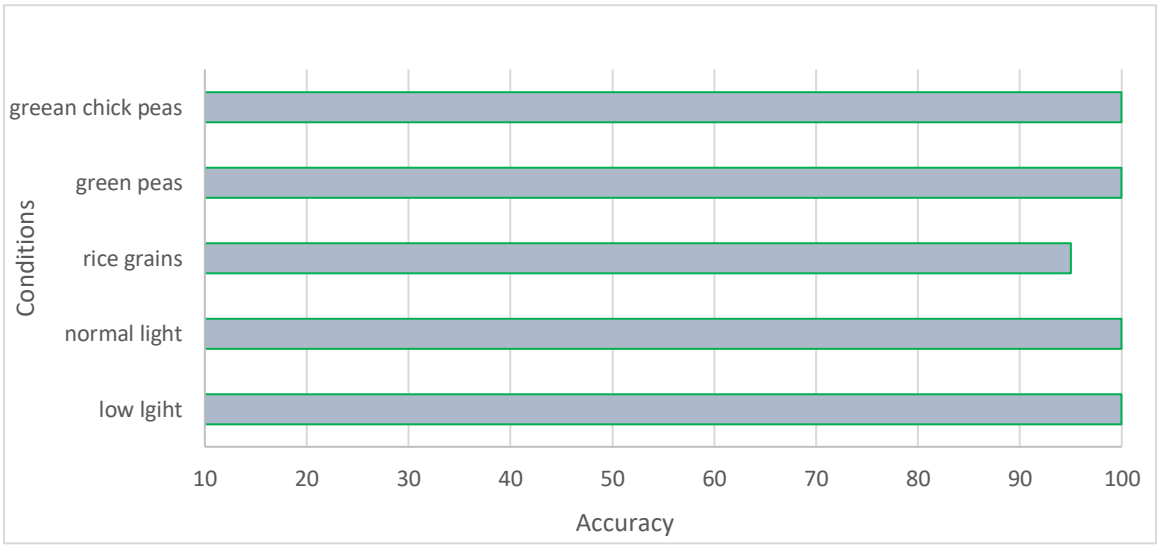
2.Take an image in normal light and try to count object from the image.

3.Use rice grains as objects

4.Use green peas as object

5.Use green chick peas as object

## 5.3 Result of Experiments



## 5.4 Descriptive Analysis

In the first experiment, we took a picture in low light using the camera. Then loaded the image into ImageJ. Then preprocessed the image then saved the image locally and then loaded into MATLAB GUI.

Then counted the objects and it showed exact number of objects.

Then in the second experiment, we did same as the first experiment and it showed exact number of objects.

But when we used rice grains as object and loaded the image into ImageJ, we found some holes in the grains. We tried to fill the holes but couldn't fill fully. Because of that, the counting process showing some extra objects. These holes appeared because rice grains don't have smooth edges.

The green and green chick peas also showed exact number.

## 5.5 Summary

From the experiments we have seen that almost every environment (low light, normal light) this device works well if the objects have smooth edges. But if the objects don't have smooth edges some holes appear and the counting part counts these holes and show more than the actual number objects.

# Chapter Six

# Conclusion

## 6.1 Summary of the Study

This project is about counting number grains from an image, measuring weight & length and detecting moisture. This project needs both hardware and software.

This project is a combination of development and research. For this project, we need to study about Image Processing, IoT and Embeded systems. Image processing has too many research papers, so we read many of them to get idea how to do image processing. We also needed to learn MATLAB and ImageJ. For MATLAB we had to see many tutorials as there is no proper documentation available. To complete this complete this project any one would need professional level skills in MATLAB and a very good idea in image processing.

After studying about image processing we need to learn about Embeded systems. Embeded systems is a combination of hardware and software which is designed to do a specific job at a time.

This device captures image via a camera and saves locally. Then the image is loaded into ImageJ for preprocessing. And the preprocessed image is loaded into MATLAB GUI for counting. Then, the length is measured from image the image and weight is measured using a sensor. Moisture of the grains is also detected by a sensor.

## 6.2 Conclusion

This task depends on Image processing and IoT. Image preparing dependent on MATLAB is a productive method to check grains from picture. Normally, grains are counted using human, which is a costly and takes so much time. Instead of that, this project can be proposed. This project saves cost and time of traveling to the field, hire human to count etc. After experimenting, we found that size of grains matters very much when counting the objects. We can say that bigger grains have better accuracy. Lighting condition also matter when counting the grains. Sometimes accuracy maybe a bit off as grain's edges

aren’t smooth. To make this device almost perfect anyone need to have a good idea of image processing and Embeded Systems.

## 6.3 Future Scope

We made a device which can only count. But our proposed system has weight, length measuring, moisture detection. This are primary level ideas. In the future, using this project we can identify the type of seed also as every seed are different from one another.

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