MECHATRONICS for Advanced Mini Rice Mill Optimization using VLSI Based Microcontroller

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Abstract— This paper presents how MECHATRONICS develop an innovative idea about the automation of Rice mill. The heart of this project is the Microcontroller which is mechatronics system that controls the entire operation in grain extraction and also this preserves the proteins in the rice grain.

This project impacts on illuminating the drawbacks in the existing rice milling process such as breakage of rice grain during extraction, improves the quality and quantity at low cost, low power by using automation techniques of VLSI based Microcontroller programming.

I. INTRODUCTION

Rice is the staple food for 65% of the population in India. It is the largest consumed calorie source among the food grains. With a per capita availability of 73.8 kg it meets 31% of the total calorie requirement of the population. India is the second largest producer of rice in the market next to China. The all India area, production, and yield of rice in the year 2001-02 was 44.62 million hectares, 93.08 million tones and 2086 kg/ha respectively[1]. In India paddy occupies the first place both in area and production. The crop occupies about 37 % of the total cropped area and 44% (2001-02 position) of total production of food grains in India. West Bengal is the leading producer of paddy in the country. It account for 16.39% of the total production, and the other leading states are Uttar Pradesh (13.38%), Andhra Pradesh (12.24%), Punjab (9.47%), Orissa (7.68%) and Tamil Nadu (7.38%); the remaining states account for 33.45% of the production.

India is also one of the leading exporters of rice in the world market. India's export of rice stood at 23.89 lakh MT in 1997-98. The corresponding value of foreign exchange earned was to the tune of Rs. 3371.00 crore in 1997-98. Indian Basmati Rice has been a favorite among international rice buyers. Following liberalization of international trade after World Trade Agreement, Indian rice will become highly competitive and has been identified as one of the major commodities for export. This provides us with ample opportunity for development of rice based value-added products for earning more foreign exchange. Apart from rice milling, processing of rice bran for oil extraction is also an important agro processing activity for value addition, income and employment generation.

Many of the rice processing units are of the traditional huller type and are inefficient. VLSI Based Advanced Mini Rice Mill is Modern rice mills are having high capacity and are capital intensive, although efficient. Small modern rice mills have been developed and are available in the market but the lack of information is a bottleneck in its adoption by the prospective entrepreneur. The present model will go a long way in bridging the information gap. This modern rice mill is based on VLSI technology provide controllability of mill using Microcontroller programming features.

II. DESCRIPTION OF RICE MILLING OPERATION

Paddy in its raw form cannot be consumed by human beings. It needs to be suitably processed for obtaining rice. Rice milling is the process which helps in removal of hulls and barns from paddy grains to produce polished rice. Rice forms the basic primary processed product obtained from paddy and this is further processed for obtaining various secondary and tertiary products.

2.1 PROCESS DEFINITION

- Pre Cleaning: Removing all impurities and unfilled grains from paddy
- De-stoning: Separating small stones from paddy
- Parboiling (Optional): Helps in improving the nutritional quality by gelatinization of starch inside the rice grain. It improves the milling recovery percent during deshelling and polishing / whitening operation
- Husking: Removing husk from paddy
I.  Husk Aspiration: Separating the husk from brown rice/ unhusked paddy
II. Paddy Separation: Separating the unhusked paddy from brown rice
III. Whitening: Removing all or part of the bran layer and germ from brown rice
IV. Polishing: Improving the appearance of milled rice by removing the remaining bran particles and by polishing the exterior of the milled kernel
V. Length Grading: Separating small and large broken from head rice
VI. Blending: Mixing head rice with predetermined amount of broken, as required by the customer
VII. Weighing and bagging: Preparing the milled rice for transport to the customer

2.2 Rice Grain Structure

From the following figure 1, A Kernel of rice consists of a hull and a brand coat, both of which are removed on polishing “white” rice. In general, each rice kernel is composed of the following layer:
- Rice shell, Hull or Husk: encloses the brown rice consists mainly of embryo and endosperm.
- Bran Coat (layer): a very thin layer of differentiated tissues. Thai layer contains fiber, vitamin B, protein and fat. The most nutritious part of rice resides in this layer.
- Embryo: The innermost part of rice consisting mainly of starch called amylase and amylopectin. The mixture of these two starches determines the cooking texture of rice.

Figure 1. Structure of rice grain

III. PROBLEM STATEMENT

The recovery of whole grains in a traditional rice mill using steel hullers for dehusking is around 52-54%. There is excessive loss in the form of coarse and fine broken. Further loss of large portion of endosperm layers during the dehusking operation further accentuates the problem against it; the recovery percent of whole grains in modern rice mills using rubber roll shellers for dehusking operation is around 62-64%. The whole grain recovery percent further increases to 66-68% in case of milling of parboiled paddy. Thus it can be seen that there is an overall improvement of recovery of whole grains by about 10-14% if one uses rubber roll shellers for rice milling operations. The conversion ratio (i.e. recovery % of various final product and byproduct for every 100 kg feed of raw paddy) for these improved rice mills can be as follows:
1. Percent of milled rice: 62-68%
2. Percent of rice bran: 4-5%
3. Percent of rice husk: 25%
4. Percent of germ wastages: 2%-8%

It has been observed that dehusking using rubber roll shellers reduces the risk of breaking the grain because husk is pulled off almost at once and pressure is applied by means of resilient surfaces across the width of the grain, where kernels, generally are much more uniform than they are by length. Moreover, the process does not remove the internal epidermis of the husk. Thus the deshelled grains with their silver skin envelope are protected against scratches and keep longer and better while the silver skin and the germ increases the quantity of bran which is produced while whitening. The improved rice mills have a better husk and rice bran aspiration system. The same prevents mixing of fine broken with rice bran. Therefore the quality of rice bran obtained is better.

It has also been observed that the location of rice mills are confined to a few selected production centers. Their development as a village level agro processing unit is yet to take a proper shape. In the absence of village level rice milling unit, the farmers have to travel great distances for milling the rice. This leads to increased transportation and handling losses. Thus there is a need to develop improved rice mills as a village level agro processing unit for bringing about technical up gradation and development of the sector. Value addition and generation of gainful and sustainable employment opportunities are the other possible benefits arising out of this agro processing industry.

IV. MOTOR USED AND POWER CONSUMPTION

The details of plant and machinery for the rice milling unit are as follows:
1. Paddy cleaner
2. Rubber Roll Paddy Shellers
3. Paddy Separators
4. Blowers, Husk and Barn Aspirators
5. Paddy Polishers
6. Rice grader/ aspirator
7. Bucket Elevators
5. ELECTRICAL AND OTHER ITEMS
The tentative power requirement for various equipment for the rice milling unit is as follows:

**Power:**
The total power requirement for the model project will to the tune of 75 KW. The essential power requirement of the unit is about 90 HP and accordingly suitable standby generator provision is made.

### Sr. No. | Equipment | Electric Motor (HP)
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1 | Paddy cleaner | 5
2 | Rubber Roll Paddy Shellers | 15
3 | Paddy Separators | 5
4 | Blowers, Husk and Barn Aspirators | 7.5
5 | Paddy Polishers (3 nos. in series each with 15 Hp motor) | 45
6 | Rice grader/aspirator | 5
7 | Bucket Elevators | 7.5
8 | Internals | 10
9 | Subtotal | 100

6. BLOCK DIAGRAM [4],[5]

REFERENCEs