FABRICATION OF SUGARCANE NODE CUTTING MACHINE

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ABSTRACT

Sugarcane (Saccharum sp.) is a clonally propagated grass of the Gramineae family characterized by a high degree of polyploidy and is a crop of major importance providing about 65% of the world sugar. Reproductive tissue is harvested as the economic product in nearly all field crops but this is not the case in sugarcane. In sugarcane, the stalks are the harvested tissue and stalk size has a major influence on yield. There has been virtually some research reported on the variation in size of individual stalk internodes with position on the stalk and with crop growth.

Sugarcane planting with traditional methods is costly, time-consuming and necessary compression of buds in the field is not achieved easily because of stalk planting in sugarcane. In traditional planting method, great human force and high volume of sugarcane stalk in hectare is required. To solve this problem and mechanizing of sugarcane planting, the application of machine vision system and image processing methods to identify nodes from sugarcane and to plant it as a seed by planting machines is suggested in this work.

The number of applications using machine vision and digital image processing techniques in the agricultural sector is increasing rapidly. These applications include land/aerial remote sensing of crops, detection and recognition of pathological stress conditions, shape and color characterization of fruits, among many other topics. The presented work is an application of image processing for the purpose of sugarcane node cutting at appropriate intervals. A complete frame with conveyor, blade, camera is fabricated for the purpose.

Keyword: -Sugarcane node, image processing, machine vision, stalk,, automation

1. INTRODUCTION

Sugarcane (Saccharum sp.) is a clonally propagated grass providing about 65% of the world sugar. Sugarcane planting with traditional methods is costly, time-consuming and necessary compression of buds in the field is not achieved easily because of stalk planting in sugarcane. In traditional planting method, great human force and high volume of sugarcane stalk is required.

In order to provide a solution to this problem, we tried to mechanize the node cutting process necessary for planting of new sugarcane crop. The mechanized means for node cutting saves considerable human efforts and also prevents damage to the node. Prevention of damages to node also results in good propagation ratio along with reduction in time and efforts.

Application of machine vision system and image processing methods is suggested to identify nodes from sugarcane and cut it at proper interval to plant it as a seed by planting machines. The complete setup is installed on metal framework. A camera is installed and image processing is done to identify the nodes. A belt conveyor is used to support and carry the sugarcane stalk. A cutter blade attached to a pneumatic cylinder is used to cut the nodes at desired point. The nodes are collected in a bin and transferred for plantation. A model is fabricated and demonstrates this application.

2. LITERATURE REVIEW

Rohit J Masute, et.al. identified the need for faster rate of production of agricultural products. Indian economy highly depends on agriculture. Shortage of labours and increased wages is a big challenge for farmers in India. Labour shortage and increasing demand of agriculture products are the two contradicting issues. Manual sugar cane harvesting is a very labour intensive activity in which workers usually become fatigued after manually

cutting the cane for a few hours. They need frequent pauses for rest, and they experience sustained injuries from excessive stress on the joints and muscles of the body. And also today's world need faster rate of production of agricultural products. The author contributed towards analyzing sugarcane harvester machine aspects for economical harvesting which will help to minimize the working fatigue and to reduce labour cost.

E Mever and L J Feawick, presented that the South African sugar industry harvests about 20 million tons of sugarcane annually. More than 90% of this tonnage is currently being harvested manually. During 2002, the South African Sugar Association Experiment Station's Agricultural Engineering Department conducted a comprehensive cane cutter survey throughout the South African and Swaziland sugar industries. The primary objective was to identify the productivity ranges for manual cane cutters across various harvesting systems, in both green and burnt cane. Factors impacting on cane cutter performance were also investigated. A small number of time and motion studies were also conducted to identify the time utilization of the various cane cutter tasks. Results indicate that cane cutter performances vary widely between cutters, farms and regions, and average output is greatly dependent on harvesting systems.

Teshar N Khilosial, L M Rola reported that bamboo sticks are the major raw materials used in the Agarbatti industry. The Agarbatti production generally involves the strips cut from the bamboo sticks. Earlier these processes was carried out by tribal people who make strips and sticks by conventional methods of using knives which is very tedious, time-consuming and risky. After that the hydraulic splitter machine came into existence which can produce the stick within a Single machine. But in that machine two different dies were used so the stick could not be cut in a single operation. Hence to avoid this problem one mechanism has been suggested which could cut the stick in a single operation. Furthermore the selection procedure for the pneumatic drive is also mentioned in this paper.

D. V. Siva Prasad, et.al. described design and analysis of Spur gear. In their work, it is proposed to substitute the metallic gear of sugarcane juice machine with plastic gears to reduce the weight and noise. For this purpose two different types of plastic materials were considered namely Nylon and Polycarbonate and their viability are checked with their counterpart metallic gear (Cast iron). Based on the static analysis, the best plastic material is recommended for the purpose. Static analysis of a 3-D model has been performed using ANSYS 10.0. Compared to Cast iron spur gears, Nylon gears are suitable for the application of sugarcane juice machine application under limited load conditions. To find the suitable design gears with less weight and less cost, corrosion resistance, frictionless also. With less cost, neat and clean hygienic juice.

E. P. G. Mehar, Dr. A. V. Vanalkar, Dr. S. S. Khandare Bamboos are a unique group of giant arborescent grasses in which the woody culms arise from underground rhizomes. They are shrubs and have tree-like habit. Their culms are erect and sometimes climbing. It is the fastest growing plant on this planet. Bamboos are characterized by wood), mostly hollow culms with internodes and branches at the culms nodes. India is the second richest country in terms of Bamboo genetic diversity with a total of 136 species under 75 genera. It encompasses about 8.96 million hectares of forest area, which is equivalent to 12.8 per cent of the total forest cover of the country. Generally different types of machines are use in different industries like bamboo cross cutting machine, bamboo splitting machine, knot removing machine, bamboo slicing machine, bamboo stick making machine, bamboo stick sizing machine, bamboo stick policing machine.

3. PROBLEM STATEMENT

The Sugarcane planting with traditional method is costly, time-consuming, requires great human force and high volume of sugarcane stalk per hectares. Also the existing (traditional) tools used for bud chipping of sugar cane

are unsafe, messy and need skill and training. The risk of injury is also too high. This necessitates the development of a node cutting machine for sugar cane. Now a day's sugarcane planting machines are used to reduce the human force and time. However, these machines do not have control on cutting location. In uncontrolled cutting process 3 to 6 buds set may get planted instead of single bud. This ultimately results into more population of sugarcane stalk which affects the yield. Sometimes, cut may appear on the bud as well, which results into no germination of the bud and we lose the seed. In addition to proper controlled cutting of stalk, it is necessary to identify any disease in the node as it affects the yield and quality of the sugarcane. Unfortunately the traditional sugarcane planting machines do not have any such facility. This paper presents application of image processing for node cutting at appropriate position in a mechanized manner which reduces the human risk factor as well as loss due to wastage of stalks.

4. METHODOLOGY

Proposed methodology starts with assumption that the sugarcane node is said to be normal if the difference between two consecutive nodes is less than 30 % and there is no crack on stalk. The system consists of following important components 1. Personal Computer (PC), 2. Charged Coupled Device (CCD) camera and Lighting system, 3. Control system and Cutter, 4. Conveyor belt drive system.

Parts of Sugarcane Node Cutting Machine:

1. Metal Frame
2. Belt conveyor with frame support
3. Pneumatic cylinder
4. Rollers and bearings for belt conveyor
5. Cutting Blade
6. Image processing system (camera and hardware)

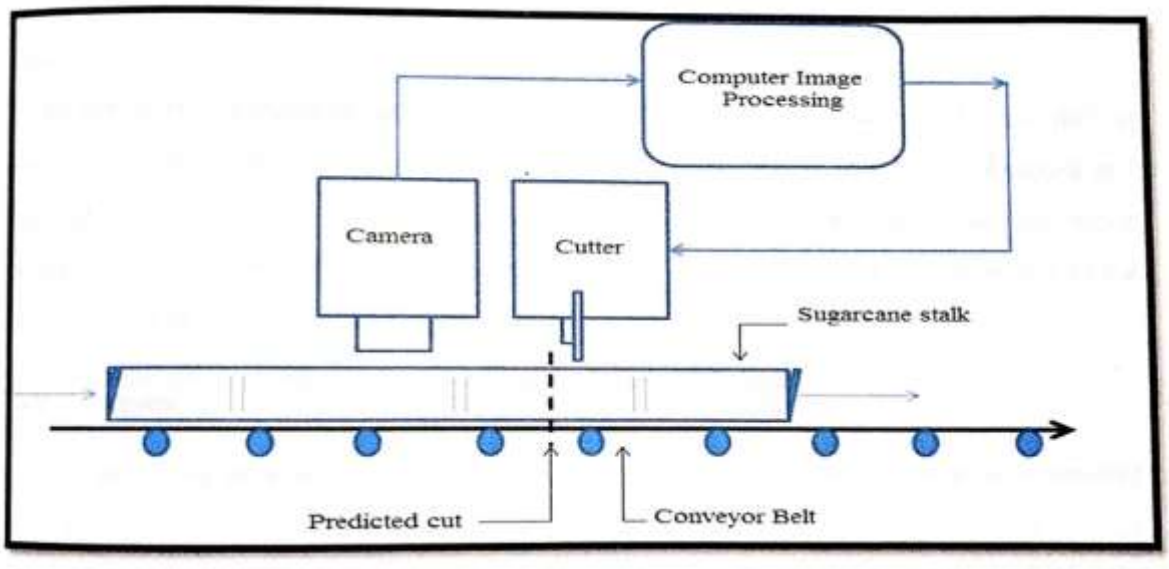

Fig 1- Proposed System for Node Selection

4.1 Fabrication of proposed machine

A CAD model was initially created in order to have a clear view of the proposed machine. This helped in checking the feasibility of the fabrication, checking of interferences, etc. Image below represents the CAD model.

Starting with actual fabrication, the metal frame was initially fabricated using MS angles. Dimensions were identified considering average length of sugarcane stock. Necessary provisions were made in order to support the belt, to mount the rollers for belt drive, to attach the pneumatic cylinder and also the camera to capture images.

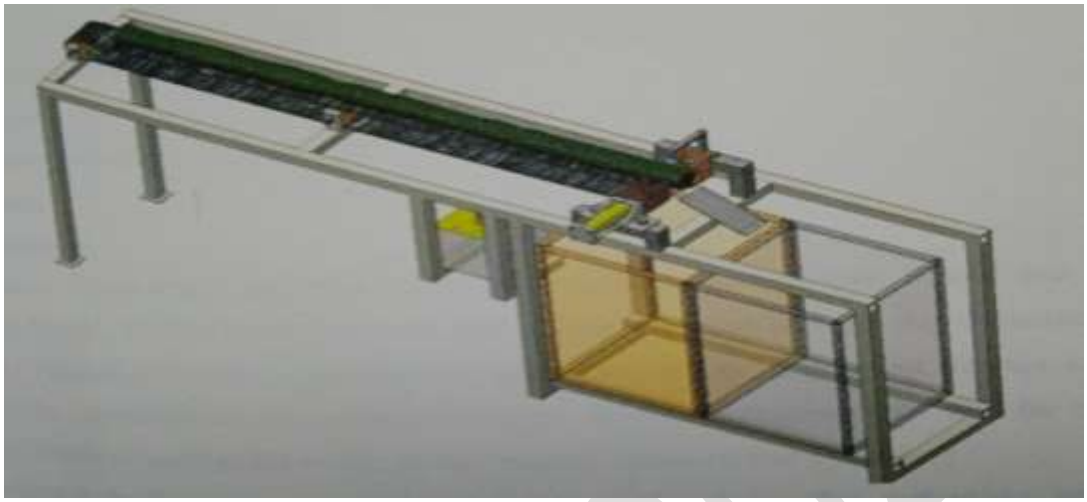

Fig 2- CAD Model (Isometric View)

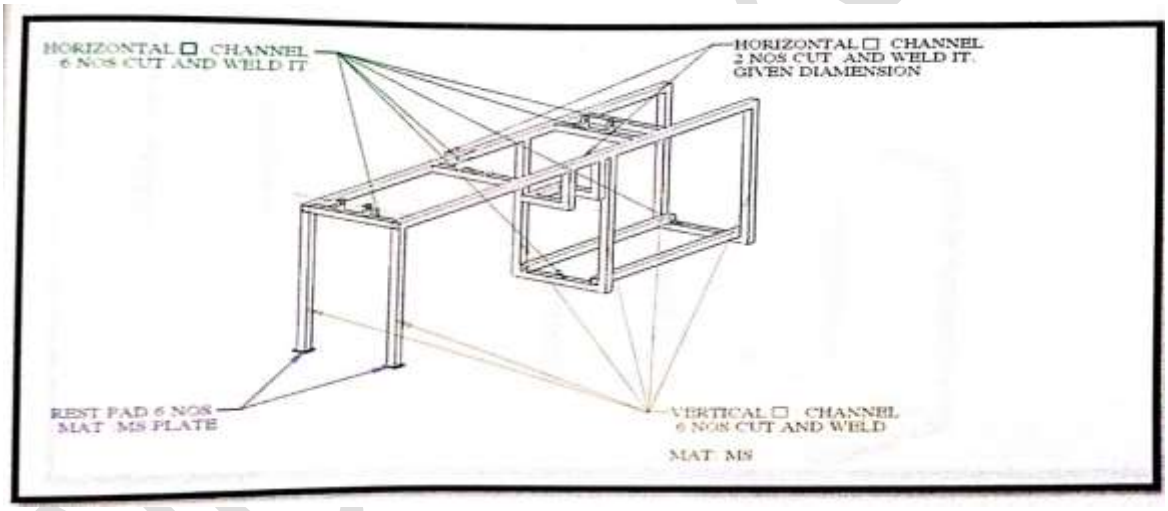

Fig 3- Fabrication of Base Frame

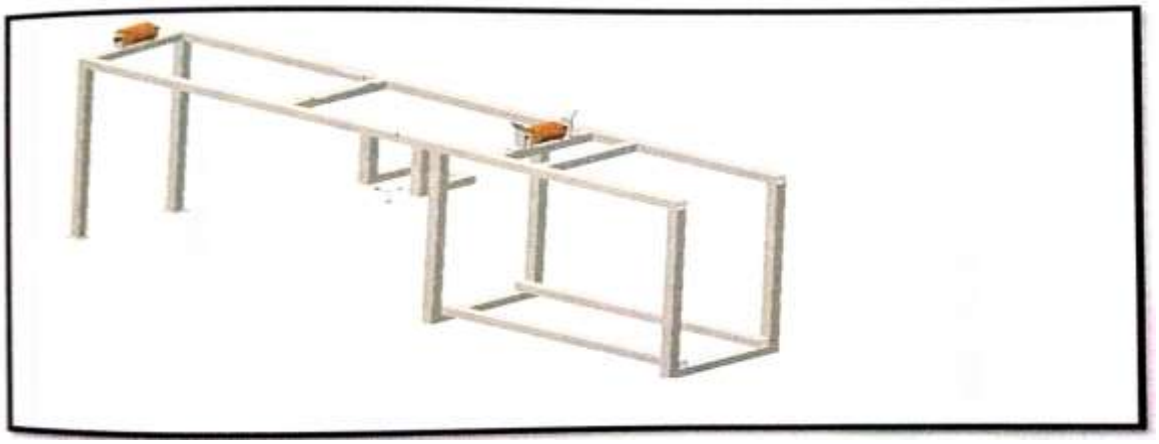

Fig 4- Assembly of rollers for belt drive

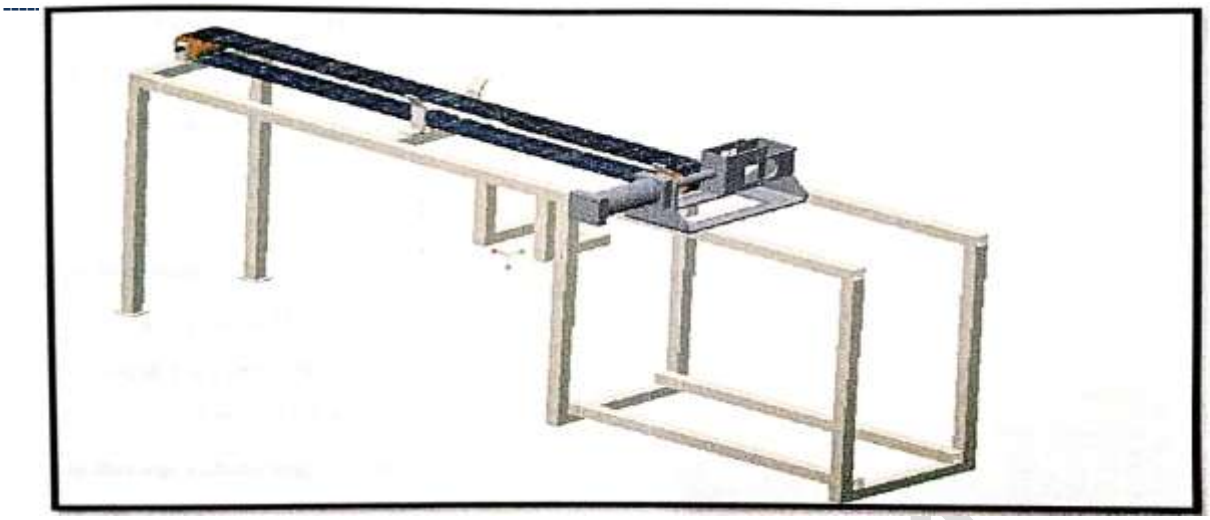

Fig 5- Addition of belt and cutting cylinder

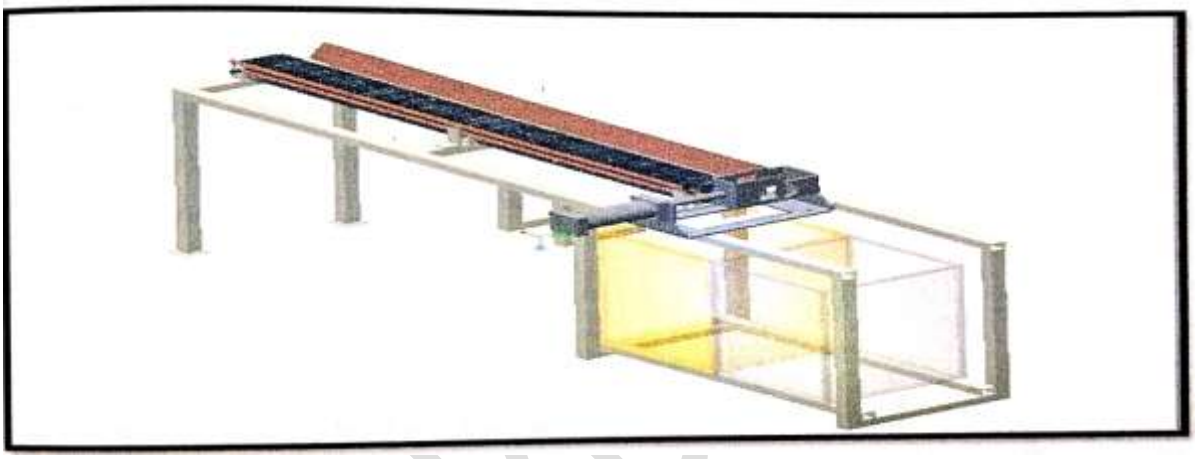

Fig 6- Adding side plate and collection box

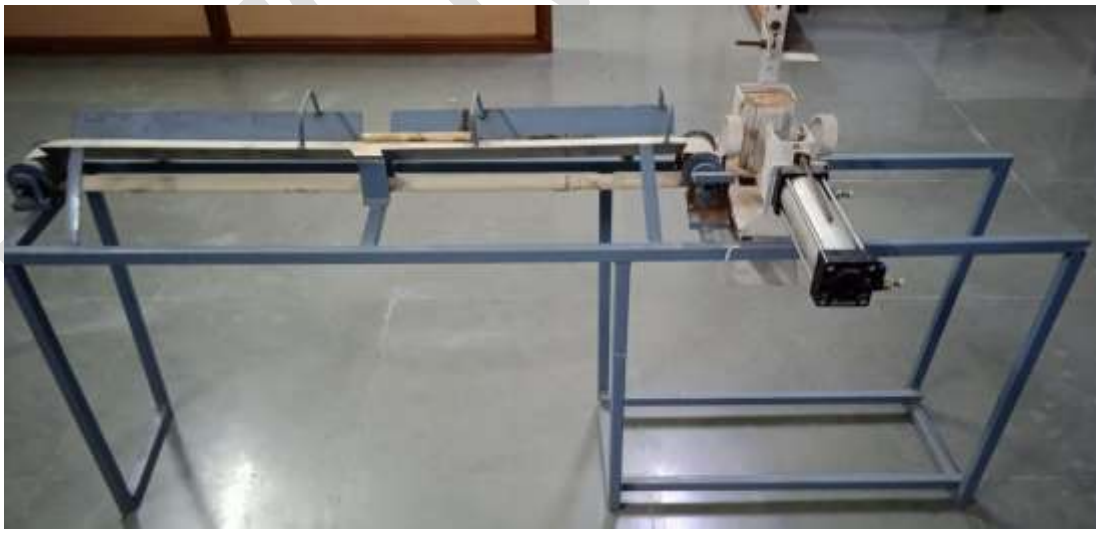

Fig 7- Actually fabricated machine

4.2 Image Processing System

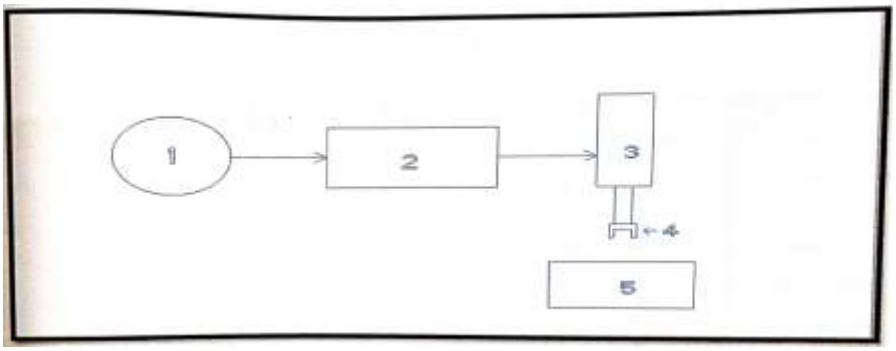

Fig. 8- Image processing system

1) Image capturing device.(camera)
2) Microprocessor.
3) Prime mover (pneumatic cylinder)
4) Cutting blade
5) Cutting platform

In the above figure there are five main components are shown. These are arranged in order as shown in figure. In this device imaging technology is used for detecting the nodes of the sugarcane. A camera is used to capture the images. The camera is connected to the microprocessor. Arduino is used for this purpose. The microprocessor will be connected to the prime mover. Blade is connected to the prime mover (pneumatic cylinder).

For detecting nodes of the sugarcane using image processing technology, programming was done using MATLAB. First of all camera captures photos of the sugarcane then it sends it to the microprocessor where that images are processed and nodes are detected. Then microprocessor gives a signal to the prime mover. Prime mover actuates the blade and cuts the sugarcane in the predetermined length.

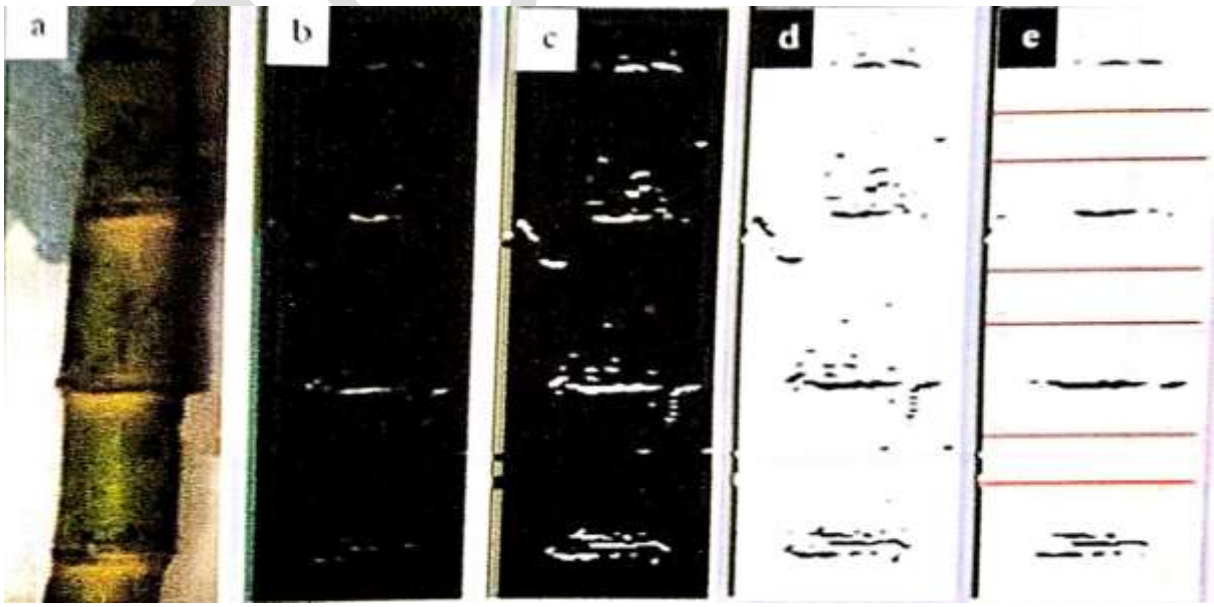

Fig. 9- Images captured by camera and the processed images [6]

5. WORKING OF SUGARCANE NODE CUTTING MACHINE

The fabricated frame is having provision for belt conveyor, pneumatic cylinder, and camera. The belt is supported by an additional flat platform in order to avoid sagging. Provision is also made to restrict the sugarcane stalk from falling down while the node is being cut. Camera is attached at the given location and its inclination is adjusted properly to capture the images. The camera, stepper motor for belt drive, the pneumatic cylinder are all connected through the microcontroller for communication. The user interface is accessible through a desktop PC.

Sugarcane stalk is placed on the conveyor and the supply is switched ON. The conveyor carries the sugarcane over the belt. The camera captures the images and processor processes the images and compares with the template. When a match is found, the conveyor stops and the pneumatic cylinder which holds the cutter blades is actuated. The blade cuts the node and the node drops in a bin. The extra portion(waste piece) falls on the other side. As soon as the cutting action is over, the conveyor starts again and the process continues.

CONCLUSION

An automated sugarcane node cutting machine was fabricated for the said purpose. Image processing technology is applied in order to cut the nodes at proper location. The machine cuts the nodes automatically and at appropriate positions. This assures prevention of damage to the nodes being cut. The conventional method of sugarcane node cutting was laborious, time consuming and unsafe. Also the damages to the nodes to be planted is also more in manual cutting and stalk length also varies which makes it difficult for planting. The fabricated machine overcomes all above problems and provides an efficient, safe and automated means of node cutting. Problem of labor shortage is also addressed as this machine operates with minimum human intervention.

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