AUTOMATED SUGARCANE BUD EXTRACTING MACHINE

System design for automation for extraction of sugarcane buds

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Abstract*—Sugarcane cultivation process involves many steps in which the extraction of bud saves more than 50% of investment on the cultivation process for the farmer. Thus better method of extracting buds from sugarcane is being developed. The Automated sugarcane bud extracting machine has sensors to detect the bud. This bud part is positioned at the workstation using conveyor system controlled by stepper motor. The bud is extracted by the help of pneumatic cutter. The microcontroller is used to control the overall process. This implementation of sensors, stepper motor and pneumatic cutter provide flexibility to the operator who is at the workstation. Also improves the occupancy of the machine.

***Index Terms*—Sugarcane bud detection, pneumatic cutter, bud positioning, stepper motor conveyor system etc.**

I. INTRODUCTION

a) SUGARCANE CULTIVATION PROCESS

For growing sugarcane seedling materials, various materials and tools are needed, like a bud chipper, plastic trays, coco-pith and sawdust as planting material, vermicompost and/or bio-gas plant slurry or farmyard manure, polythene sheets, and trash cans and watering cans..

For the nursery, an area of 100 square meters is used for one hectare of field. This is covered with shading net to provide shade to the young plants and to create more favorable conditions for growth, like a warm and wind-free environment. Five quintals of healthy, disease-free, 7-9 months old canes were required for establishing one acre of field. Out of this, only the buds are taken. They are separated from the cane with the help of a specially-designed machine that is called **bud chipper**. The weight of chipped buds is about 85 kg (< 5% of the cane weight). The rest of the canes can be sold to sugarcane juice vendors. **[1-3]**.

b) NEED OF SUGARCANE BUD CHIPPER

The study of sugarcane cultivation shows that there is need of sugarcane seeds which is cultivated by sugarcane bud. Using sugarcane bud chipper the buds can be separated. The device includes a hemispheric knife actuated by a hand operated lever. One needs to place the cane on the platform and press the hand lever. After every stroke the cane needs to be rotated by 180 degrees by the other hand, the chipped buds can be shown directly in the field or may be grown in nurseries. A worker can extract an average of 150 to 200 seeds of buds per hour with a bud chipper machine, which will not meet the requirement of buds for nursery in short period of time. Also problem arises when the worker need to work with the bud chipper continuously to extract buds, which leads to fatigue in his body. This may result in decrease in quantities of buds extraction at the end of the day. Since this is seasonal work the availability of labor having skills is very difficult. Considering all the factors it is not possible to meet the requirement of buds for nursery later to forward them as seeds to grow in field. Hence this methodology is not providing proper facility for the development of nursery.

c) NEED OF AUTOMATION

Automation removes the operator at the workstation. The operator at the mechanized sugarcane extracting machine has to detect the bud and must have concentration on cutting action in every moment. He has to position the bud in workstation at the moment of cutting stroke. It needs one operator at each machine.

The automated sugarcane bud extraction machine involves the sensors to detect bud, conveyor system to position the bud at the workstation also it has control on the cutting action. It provides the flexibility for operators. He can feed the sugarcane which might consist of 8 to 10 buds. Till it extracts all the bud he can be free to operate with the next machine. This flexibility for an operator gives option to work with more number of machines in sequencing methodology.

In fully developed automated sugarcane machine, it is possible to adopt flexible manufacturing system and remove operators. It is possible to adopt loading and unloading stations. It can select the sugarcane from lots and feed to conveyor system. Later with the help of sensors and cutter bud is extracted leaving the remaining part. This future development requires a proper sensor which is concentrated in this work.

II. DESIGN OF THE SYSTEM

The system consists of a "sensor" to detect the presence of buds and to track the position, "Conveyor system" for positioning sugarcane buds to cutter and to transport sugarcane which is controlled by *stepper motor* and pneumatic cutter to extract the bud from sugarcane. The overall process is controlled and operated sequentially by microcontroller.

1) DESIGN AND SELECTION OF SENSOR

The main objective of the system is to detect sugarcane buds and locate the position of the sensor to cutter. Currently no sensors have been developed for the purpose of detection of sugarcane buds. For the purpose of the project a new sensor have been developed which can trace the geometry of the sugarcane. As shown in figure1.1 we can observe there is variation of geometry at the bud area. The change in diameter can be traced using a caster wheel mounted at the tip of cantilever beam as shown in figure 1.2. The full bridge strain gauges are mounted towards the hinged support of the cantilever beam which reads the geometry change and transduce it to an electrical signal. When

the sugarcane is made to move on the caster wheel the cantilever beam trace the diameter change in sugarcane at the bud with the help of strain gauges. The reading of change in diameter of sugarcane is sent to microcontroller [4-5]. The same is represented in block diagram shown in figure 1.3

Figure 1.1

Figure 1.2

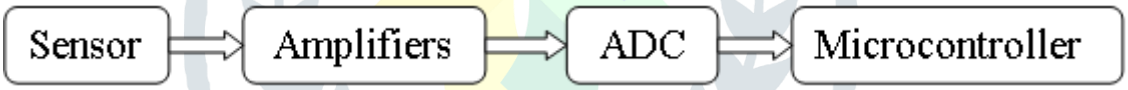

Figure 1.3

2) DESIGN OF CONVEYOR SYSTEM

Stepper motor attached with rubber rollers at the shaft output is used to carry out this work. The stepper motor is selected based on the fallowing features.[6-7]

- Stepper motor can start and stop at any moment of the process.
- The rubber rollers attached to the shaft end of the stepper motor has the capability of driving the sugarcane towards the sugarcane.
- The rubber rollers help in providing proper grip to move the sugarcane towards the tool.
- The number of steps decides the distance covered by the sugarcane.
- The number of steps to reach the cutting tool can be controlled by the microcontroller

By considering the above mentioned features, stepper motors attached to rubber rollers at the shaft output can be used to move the sugarcane. Figure 1.4 shows the block diagram of stepper motor integrated with microcontroller.

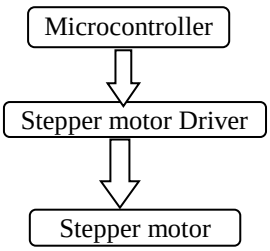

Figure 1.4

3) DESIGN OF BUD EXTRACTING MECHANISM

Pneumatic cylinder is used to extract the bud through the tool attached to the pneumatic cylinder shaft. The tool is positioned in the row of sugarcane flow. The frame is designed based on the below mentioned requirement.

- The frame is designed to hold sensor, stepper motor and cutter.
- The sugarcane is made to run in the row of sensor and cutter using stepper motor.
- Pneumatic cutter is used to extract the bud when the bud is placed in the position opposite to tool.

- The cutting stroke and return stroke is controlled by solenoid valve. The solenoid valve is operated be relay switches which is controlled by microcontroller.

The figure 1.5 shows the block diagram & pictorial view of machine.

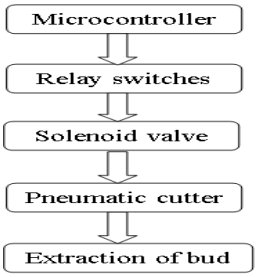

Figure 1.5

4) INTEGRATING SENSORS AND MICROCONTROLLER WITH MACHINE

ATMEL AT-89S52 microcontroller board is used to carry out this work. The AT-89S52 is selected based on below mentioned features.

- AT-89S52 consists of 40 pin which is capable of handling signals between sensors, stepper motor and pneumatic cutter.
- It is capable of handling sensor signals and receives the signals continuously.
- The same microcontroller is configured with stepper motor driver circuit, which receive the signals.
- The stepper motor runs according to the signals received from microcontroller and transport the sugarcane through sensors.
- After receiving the signals from sensor about the presence of bud the stepper motor is instructed to position the bud at the tool.
- After positioning the bud the microcontroller signals the pneumatic cutter to get actuated.
- AT-89S52 can be programmed in such manner to control the overall process in sequential order.

The figure 1.6 shows the block diagram of integrating sensors, stepper motor, and relay with microcontroller (AT-89S52)

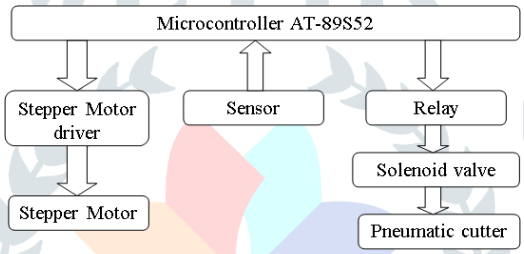

Figure 1.6

5) WORKING PRINCIPLE

When the process starts the microcontroller starts the stepper motor and waits for the sugarcane. When the sugarcane is fed the sugarcane is moved through sensor. The sensor starts sending digital signal to microcontroller. The microcontroller manipulates the data and identifies the presence of sugarcane bud. There will be sudden variation in digital signal from value X to X-100 at bud part. After receiving sensing signal the microcontroller signals the stepper motor to move 140 steps. It takes 140 steps for sugarcane to reach workstation from sensor position. After positioning the sugarcane bud part at the workstation, the microcontroller actuates the solenoid valve by switching the relay on. This leads to the cutting action of pneumatic cutter. After extraction of bud the microcontroller switches off the relay. The solenoid valve reverts the direction of air flow leading to the return stroke of tool. Again the microcontroller initiates the stepper motor to continue the flow of sugarcane. This process continues till all buds from sugarcane are extracted. The microcontroller is programmed in such a way to control overall operation as per the above requirement. The figure 1.7 shows the flow chart of microcontroller program.[5-7]

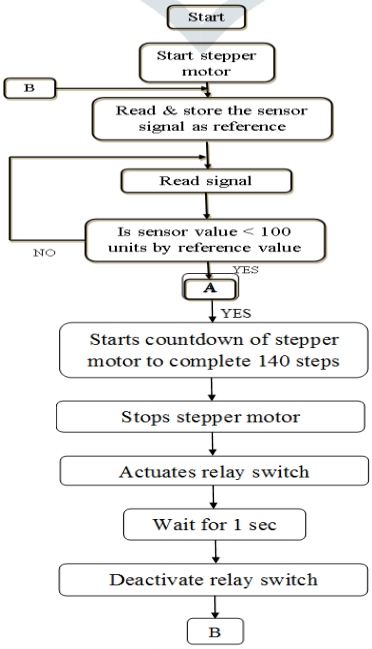

Figure 1.7

6) CONCLUSION

The dissertation of work deals with conceptual development of automated sugarcane bud extracting machine. The existing sugarcane extracting machine needs an operator to detect the bud position and predict the cutting stroke moment to place the bud and extract the bud. The sensor developed replaces the work of operator to detect the bud part. The conveyor system designed replaces the work of position of the bud at the workstation. The pneumatic cutter replaces the unpredicted cutting strokes of machine. The microcontroller controls the overall action of sensor, stepper motor and pneumatic cutter to extract the buds one by one with precision.

This controlled operation provides flexibility to the operator. He can have delay period till it can extract all the bud. Hence the operator can concentrate the remaining work of collecting the bud and get ready to feed the next bud. He can also work with the two or more machine in sequencing method.

Hence the requirement of labour will be reduces and the efficiency will be increased. Installing two or more machines at nurseries provide flexibility of extracting more number of buds with available labours.

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