

## Research Article

### Design of Sugarcane Peeling Machine Based on Motion Controller

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**Abstract:** Sugarcane is a common raw material for sugar, but in the process of machining, there will be suspended solids in the cane juice, in order to process better, the sugarcane should be peeled. Traditional way of peeling is by man, production efficiency is low. In this study, a kind of sugarcane peeling machine was designed based on motion controller, it can realize the automation of input, peeling and output. It can make certain contribution for sugarcane processing.

**Keywords:** Motion controller, peeling, sugarcane

#### INTRODUCTION

Sugarcane is a common economic crop, grown in the south of China. It is commonly used to refine sugar. According to statistics, about 80% materials for refining white sugar in our country is from the sugarcane (Chen *et al.*, 2013). In the processing of refining sugar, the sugarcane juice squeezed out often has a lot of suspended solids, in industrial production, suspended solids will be removed by means of adding chemical additives (Zhong *et al.*, 2004). But if the sugarcane surface processing can be done before refining sugar, it can reduce the content of sediment and rocks. It is a good way to reduce the concentration of the suspended solids in sugar cane juice, which can reduce the number of adding chemical additives (Zeng, 2011). In the actual production, it is often through the sugarcane peeling to reduce content of sediment and rocks and it also can increase the quantity of sugarcane juice.

At present, sugarcane peeling is using artificial way mostly in our country, the efficiency is low (Lin, 2009). It is necessary to design a highly efficient sugarcane peeling machine for improving production efficiency and reducing the production cost. In recent years, the motion controller with advantages of fast processing speed and good reliability has been widely used (Wu *et al.*, 2004). In this study, in view of the difficulties in the process of sugarcane peeling, a sugarcane peeling machine based on motion controller was designed, it is aimed to make a certain contribution to sugarcane processing.

#### THE WORKING PRINCIPLE AND STRUCTURE DESIGN

**The working principle:** Sugarcane is different from other crops, its radial dimensions can be changed and

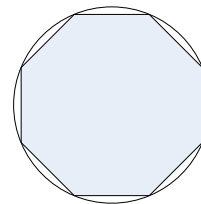


Fig. 1: The blade cutting schematic diagram

there are always curved shapes on it, general blades cannot apply. So it is necessary to design the blades according to the characteristics of the sugarcane to meet the requirements of the sugarcane peeling. In this study, a kind of blade that its tool rod can be freely adjustable was designed to adapt to different radial size and bending. The blade cutting schematic diagram is shown in Fig. 1, the sugarcane was peeled by eight cutting blade along the circumferential direction, sugarcane section was positively octagon after cutting.

Because that the hardness of sugarcane is large and not easy to brake, feed part adopts the opposite vertex rubber wheel as an executive device and servo motor as a power device.

#### Structure design:

**Whole structure:** Sugarcane peeling machine is mainly composed of feed part and cutting part, feeding part is divided into the feeding and discharging two parts. Structure diagram is shown in Fig. 2.

**Feed part:** Feed part is mainly composed of servo motor, rubber wheel and drive mechanism. When it is feeding, the rubber wheel is driven by feed servo motor and the sugarcane is driven by the rubber wheel; when it is discharging after peeling, the rubber wheel is driven by discharging servo motor and the sugarcane is also

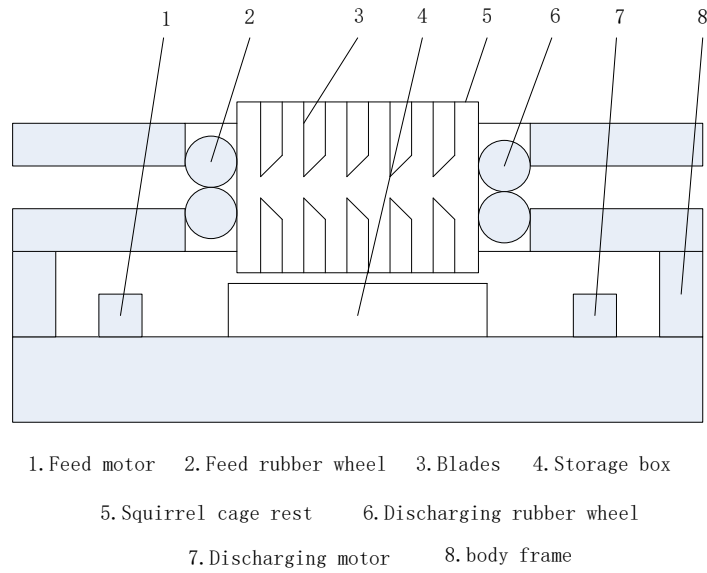


Fig. 2: Structure diagram

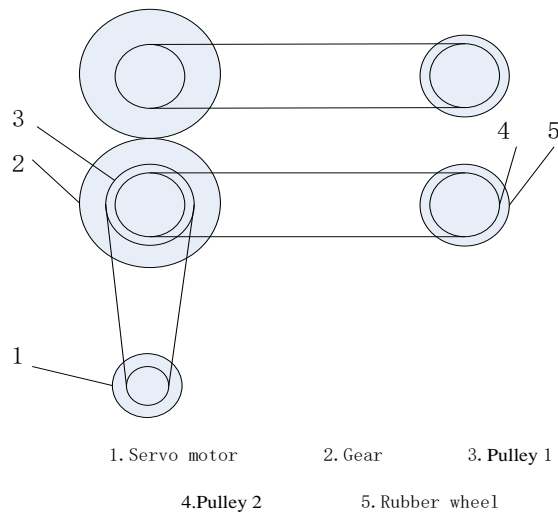


Fig. 3: Drive mechanism

driven by the rubber wheel. The sugarcane go forward by the friction between the rubber wheel and sugarcane.

Sugarcane peeling machine drive mechanism is shown in Fig. 3, servo motor drive pulley 1 to turn, gear is connected to the pulley, the pulley and gear rotate at the same time, pulley drives rubber wheel to rotate. Through two gears meshing, two rubber wheels reverse rotate, rubber wheel drive sugarcane to move forward. The connection between the rubber wheel and body frame is elastic, so that it can adapt to different diameter of sugarcane. There is equipped with photoelectric switch before the feed rubber wheel and the discharging rubber wheel, when they detect the sugarcane, photoelectric switch sends signal, servo motor will drive the rubber wheel to drive sugarcane.

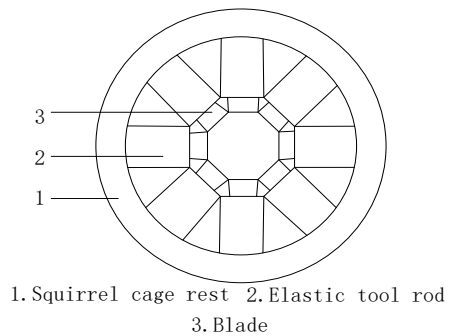


Fig. 4: The diagram of cutting part

**Cutting part:** Cutting part adopts squirrel-cage rest, the connection of cutting blades and tool rest is same with

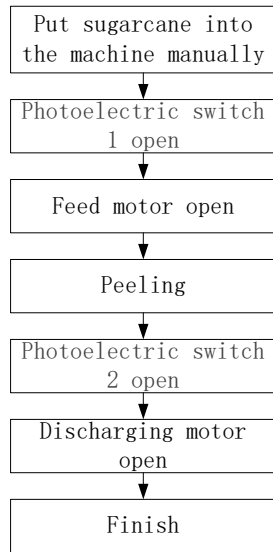


Fig. 5: Control flow chart

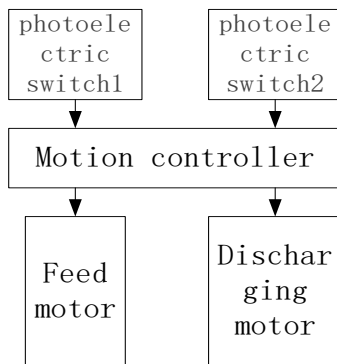


Fig. 6: System building

Table 1: System I/O allocation

Input		Output	
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INO	IN1	OUT0	OUT1
Feed photoelectric switch 1	Discharging photoelectric switch 2	Feed servo motor	Discharging servo motor

the connection of rubber wheel and rack, it also adopts elastic connection, so as to adapt to the different diameter of the sugarcane. The diagram of cutting part is shown in Fig. 4.

Squirrel-cage rest is used to support elastic tool rod and blade, elastic tool rod is fixed on the rest by screws, so that the sugarcane can be close to the blade. Eight elastic tool rods are fixed on the steel tubes which outer wall has holes with screws.

### PEELING PROCESS AND CONTROL SYSTEM DESIGN

**Peeling process:** First open the equipment switch and put sugarcane into the machine by man; Feed

photoelectric switch detects that sugarcane is coming, then it sends a signal to the system, feed servo motor starts. Feed rubber wheel rotates and drives sugarcane to go forward to the cutting part. Cutting blade will cut on different positions of the sugarcane in turn, sugarcane rind falls to the storage box; After peeling, sugarcane continues to move forward, when photoelectric switch detects that sugarcane is near the discharging rubber wheel, it sends a signal to the system, discharging servo motor starts, discharge rubber wheel rotates and drives sugarcane forward until the sugarcane come out of the machine. Sugarcane peeling machine control flow chart is shown in Fig. 5.

**Control system design:** Motion controller has the advantages of high control precision, fast reaction speed and good reliability, it is widely used in recent years (Wang, 2011). In this study, the motion controller is served as control core of sugarcane peeling machine and photoelectric switch is served as detecting element, system building is shown in Fig. 6. System I/O allocation is shown in Table 1. Because that the installation feed and discharging photoelectric switch is before of rubber wheel, so at the end of a sugar cane conveying, rubber wheel cannot provide power, this problem can be solved by taking advantage of time delay process of the motion controller.

### CONCLUSION

In this study, in view of the difficult in the process of sugarcane peeling, a kind of automatic sugarcane peeling machine based on the motion controller was designed. It can implements the automation of the whole process of feeding, peeling and discharging, sugarcane peeling machine can replace manual labor, greatly improve the production efficiency and reduce the production cost. It has great significance on sugarcane processing.

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