



# Design and Fabrication of Automatic Rubber Tapping machine

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**ABSTRACT:** This project is a helping hand for the laborers in our society. The fully automatic rubber tapping machine completely eliminates the human labour and also helps in extracting high yield of latex compared to the conventional method. The machine was designed and machine parts were drawn using AUTOCAD. The basic parts of a fully automatic rubber tapping machine are flexible gear drives, threaded shaft, Geared Dc motors, spur gear, lead screw, cutting blade. Various control hardware used are Arduino Uno Rev 3, Real Time Clock (RTC), relays, battery and switches. The incision made on the tree is in helical manner with the proportioned cutting made with help of vertical and horizontal motors. These motors are controlled using an Arduino REV 3 (for its coding purpose). The cutting blade used in this machine is stainless steel which is cheap and reliable. The power transmitted to the machine is 12 V. In terms of calculation, design of spur gear is calculated using spur gear designing equation.  $F_w$  greater than  $F_d$  hence the design is safe

**KEYWORDS:** Threaded shaft, CAD, Arduino

## I. INTRODUCTION

Rubber is a plantation crop that is widely grown in southern India. There exists a vast majority of rubber cultivators in Karnataka and Kerala. The rubber plant is not a native plant of India. Dutch colonists who also cultivated rubber in their plantations in Indonesia introduced the rubber plant to Kerala, India; because of its similar tropical climate. Rubber is an economic crop. The rubber plant produces sticky, white latex that is collected and processed to produce natural rubber. Natural rubber is an elastomer that was originally derived from latex, a milky colloid produced from *Hevea brasiliensis* or Rubber tree. A rubber plant has to grow for about seven years before it can be harvested on a regular basis. A rubber tree can produce latex for over 25 years from when it is first tapped. Rubber trees have straight trunks and smooth green leaves. The tree would be 'tapped', that is, an incision is made into the bark of the tree. The latex from within the tree seeps to the surface of the cut and trickles down the cut into a container, tied to the trunk of the tree. This rubber latex is harvested from trees through a process called "rubber tapping". The tree bark on the inner side contains layers of vessels called lactiferous vessels. This contains the rubber latex. A cut is to be made into a layer that contains these vessels to extract the latex. This layer of vessels is very close to the Cambium layer of the rubber tree. During the tapping process care should be taken as to avoid the blade in the tapering tool to go deep into the bark and damage the cambium. If the cambium is damaged, the damaged area will form bulged uneven surface post healing. The damaged cambium makes the tree susceptible to microbial attacks, which in the worst case could kill the tree. A downward half spiral cut is made in the tree, approximately four feet from the ground and circling about half the tree. The latex flows down the spiral into the collecting cup. It usually takes about two to three hours before the sap hardens and closes the cut in the tree. The coagulating time is greatly dependent on the temperature of the surrounding area. Every morning the rubber tapper empties the latex collected in the collecting cup placed below the cut from each tree. Then using the tool removes a thin layer of the bark just above the previous cut, through the cut the latex starts dripping into the collecting cup. A typical rubber tree yields rubber latex for about 25 years, after which the rubber tree will stop producing latex. The tree is then cut and used for commercial applications.

## II. RELATED WORK

The rubber plantation is found in the vast majority along the coastal regions of Karnataka and Kerala. As the world in general is looking towards the advent of technology to accomplish simplest of tasks, this project is an attempt to bring such technological advancement in the area of rubber tapping. To replace the manual labor, a number of semi-automatic and automatic tapping machines have been designed in the past. As skilled labor is hard to find, referring to the journal “Design and testing of a semi automatic rubber tree tapping machine(SART)”, a study was undertaken to design a semi-automatic rubber tapping machine where in a cheap unskilled labour could tap a tree with precision. This approach would require the unskilled labor to understand the operation of the semi-automatic rubber tapping machine. Learning this would have a greater learning curve than learning to tap with a conventional tapping blade. This would take us back to the original problem that we had with the conventional tappers. From the journal” Automated Rubber Tapper”, an attempt to make an automatic tapping machine was undertaken. The machine had a RTC, which was designed to make the tapping process automatic. The incision that it made was limited to only one, i.e. each morning a worker has to manually place the tapping blade one step down to make the next incision. This would not make the machine completely automatic but dependent on human intervention. Referring to The journal “Autonomous Navigation in Rubber Plantation”, which discussed autonomous navigation in rubber farms, a system was proposed where an autonomous robot would do all the work in the rubber farm. The key point here is to replace the laborers with intelligent machines. It proposes the development of a machine which can autonomously navigate through rubber plantations with obstacle detection capabilities. Sub tasks like tapping and latex collection can be attached to this and can be utilized to improve the efficiency and reduce the cost of production of natural rubber. This approach though a novel one is still conceptual, which may be achievable in the near future. The proposed system with a wide variety of sensors and robotics would increase the cost of the actual product which in the current economy would burden the farmer.

## III. METHODOLOGY

Automatic rubber tapping machines aim to bring automation in the rubber tapping industry. The process to tapping is completely automatic there by eliminating the need of manual tappers. The device consists of a tapering blade, whose movement is controlled by two DC geared motors. The combined horizontal and vertical movement of the motors makes a downward half spiral incision on the rubber tree trunk. Automatic rubber tapping machines aim to bring automation in the rubber tapping industry. The process to tapping is completely automatic there by eliminating the need of manual tappers. The device consists of a tapering blade, whose movement is controlled by two DC geared motors. The combined horizontal and vertical movement of the motors makes a downward half spiral incision on the rubber tree trunk. Power= 20W = 0.020KW (From various journal power delivered by the motor is taken as 20W)  $d_2=200\text{mm}$   $N=60\text{rpm}$   $i=4$  Material properties: Both pinion and gear are made of the same material. i. e. Cast Iron Grade 25 Static stress of pinion and gear,  $\sigma_{d1}=\sigma_{d2}=56.4\text{MPa}$  BHN of gear and pinion,  $\text{BHN}_1=\text{BHN}_2=220$  Assuming  $\alpha=20$  degree FDI system Assume diameter of pinion,  $d_1=50\text{mm}$  Assuming no of teeth of pinion,  $z_1=20$  teeth, To find module (m) Since the diameter is known, we have  $m=\sqrt{(F_t/\sigma_d C_v k Y)}$   $v=\pi d_1 N/60=3.14 \times 0.05 \times 60/60=0.157\text{m/s}$  For  $v < 8\text{m/s}$   $C_v=3.05/3.05+v=3.05/3.05+0.157=0.951$  Here  $Y=\pi y_1=3.14 \times (0.154-0.912/Z_1)3.14 \times (0.154-0.912/20)=0.34$   $F_t=1000\text{PCs}/v$  Assume service factor  $C_s=1$  (for light material)  $F_t=1000 \times 0.02 \times 1/0.157=127.39\text{N}$   $m=(127.39/56.4 \times 0.951 \times 10 \times 0.34)=0.8358\text{mm}$  Standard  $m=1$  No of teeth on pinion  $Z_1=d_1/m=50/1=50$  teeth  $Z_2=200/m=200/1=200$  teeth

## WORKING OF DESIGNED MACHINE

The machine consists of two flexible gear drives which give circular motion for the cutting tool and a threaded shaft which gives vertical motion for the cutting tool.

- The two flexible gear drives are connected by a shaft and a threaded shaft is attached to this shaft by means of a clamp.
- It consists of 2 motors, one fixed on the threaded shaft for vertical movement and the other fixed on the gear drive shaft for circular motion.
- The cutting tool is attached to the threaded shaft by means of an internal threaded clamp. The external thread of the threaded shaft and the internal thread of the clamp mesh together to produce the vertical movement of the cutting tool. When the threaded shaft is rotated, the thread movement makes the tool upwards and downwards.
- The direction of the rotation of the threaded shaft should be interchanged for the corresponding upward and downward motion of the tool. This interchanging of direction of the threaded shaft is done by reversing the direction of the motor by means of arduino.



- The cutting tool motion backed by gear drive and threaded shaft is controlled by Arduino Uno Rev3. The arduino gives proportional vertical and circular movement to the cutting tool for rubber tapping operation.
- The Real Time Clock used in the machine is to make an incision on the rubber tree every alternate day and it sets an alarm for the tapering process to start automatically.
- The Arduino compares the time at which the alarm is set with that of the time maintained from RTC. When both the time is matched when the device is turned on.

#### IV. CONCLUSION

At present the agricultural sector is facing a shortage of manual labour than any other sector in the world. As agriculturists form the backbone that proper tools are supplied to them to overcome any obstacles that they face. The only solution for this is the application of economically balanced technology in those areas. The “Automated Rubber Tapping Machine” designed here is one such application of technology in the field of rubber tapping where it requires highly skilled rubber tappers. It simplifies and automates the whole process of rubber tapping. The device is more reliable than manual workers.

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