Arecanut Tree Climber and Pesticide Sprayer

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***Abstract*- Agriculture is basis to over more than half of the population. Farming has been varying from region to region even within a particular state. That depends on the weather condition, availability of water, terrain.**
Areca nut a tropical crop, popularly known as betel nut in India. It is one of the most important commercial crop in South-East Asia in general and India in particular. The plant grows in well drained, deep clay loamy soil; laterite, red loam and alluvial soils are considered most suitable. Areca nut farming, to achieve good yield, needs large application of organic manures and chemical fertilizers
The farming is also tree based and crop based. As time passed the agricultural practices also changed. Machines came into the rescue of these farmers with innovation that is specific to a particular type of agriculture.
Areca nut is a nut that comes out from arec palm trees. Areca nut trees grow up to a height of 15m to 18m and they are prone to infections as any other plants. Hence it needs to be sprayed with pesticides 3 times at least during the rainy season.
When there is a huge plantation it becomes really hard to climb every tree and spray. The labour required for this is becoming sparse and costly. Therefore, addressing this problem through a technological approach seems to be a novel idea.

***Index terms*- Terrain, Arecanut, Laterite, Areca**

I.INTRODUCTION

In recent years, labour scarcity has emerged as one of the foremost challenges in farming. One crop that has been most affected by this is the supari, or areca nut. The people in rural areas of south India like Karnataka and Kerala mainly depend on agriculture for their livelihood. The main crops grown are Areca nut and coconut. For spraying and applying insecticides on the crown and also for harvesting, skilled laborers have to climb manually up the tree. Such a process looks easy, in reality it is a laborious and dangerous task. Areca nut trees attain a height of about 60-70 feet. It is mandatory to climb the trees a minimum of five times a year for a successful harvest - twice for the preventive spray against fungal disease, and thrice to harvest the areca bunches. The spraying is done in monsoon, while harvest time is typically in summer.

Only skilled labourers can carry out these farming operations. They have to climb the trees using muscle power. In an acre that has 550 trees, a labourer has to climb a minimum of 100 to 150 trees. As this involves real hard, physical exertion, younger generations of labourers are losing interest, with potentially harsh implications for areca nut cultivation. There is a need to invent a device to address efficiency safety and cost effective. The design of the device has to be simple enough for villagers to operate, yet work efficiently to appeal to the majority. Over the last one decade, many farmer-developed spraying devices have been tried but none of them has proved to be very user-friendly. Though regional efforts to make the spraying slightly easier came to the fore occasionally, harvesting areca nut remained a completely manual process - just as it was decades ago.

This project aims to overcome these deficiencies by developing a tree climbing robot for areca nut farming.

II. LITERATURE SURVEY

Outside the tree and it fused both spiral and straight climbs. An arm was provided in order to fulfill the harvesting requirement. The bunch of nuts is located by a camera which is fixated to the arm. The cutting is done by a saw after a clear view of the nuts is obtained. The entire mechanism was controlled by

remote control. They discussed about the hardware setup and controlling units were designed.

[2] Rajesh Kannan, Megalingam, R Venumadhav, Ashis Pavan K, Anandkumar Mahadevan, Tom Charly Kattakayam, and Harikrishna Menon T, analyzed various models of climbing and harvesting devices. Safety, reliability, ease of use, cleaning the tree tops, spraying pesticides were given prior importance. They designed a system that can be controlled by anyone. The designed prototype responds to human gestures with negligible gap in the response time. A prototype of the arm was designed and tested against human gestures and found successful. Their machine was designed to consume less power, so longer working hours doesn't affect the power consumption.

[3] P. Mohankumar, D. Anantha Krishnan and K. Kathirvel, discussed about the ergonomical parameters and ergo refinements of their design model. They designed two models and selected one through trial and error testing on basis of lower physiological cost, safety and discomfort. The inclination of the upper frame of climbing device is increased with respect to the horizontal, while moving towards the top. This resulted in unstableness and insecurity of the labor.

[4] A design of tree climbing robot was presented by Rahul V, Sebin Babu, Sameer Moideen CP, Vineeth VP, Nikhil Ninan. They used three linear electrical actuators - two for gripping and one for vertical up and down motion in their climbing device. They analyzed the model and found the design to be safe. Their climbing mechanism is very similar to a man climbing a tree. They tested their prototype under real life conditions and suitable changes were incorporated. In their paper, "Semi Automated Tree Climber", they discussed about the possibilities of modifying this device.

[5] Justin Gostanian, Erick Read, discussed about the design, construction, and testing of a robot to climb trees to detect Asian Longhorn Beetle infestation. The primary goal was to design and build a robot that could successfully climb a tree. After researching existing climbing robot designs, a robot prototype was built using concepts from the existing designs. The prototype was then tested to determine the effectiveness of the design. The prototype proved to be partially successful, being capable of gripping a tree and staying on, but could not move. Though not entirely successful, the project identified many important aspects in a tree climbing robot's design.

[6] Salice Peter, Jayanth M, Arun Babu M.K , Ashida P.V, Akhil K.T, focused on designing a tree climbing robot. There prime consideration in designing tree climbing robot is of the motion planning and method of gripping. The design has arms involving four legs and sharp end as feet. The mechanical structure is designed to move the structure upwards against the gravitational forces in successive upper body and lower body movements similar to a tree climber. The gripping is designed in a way to dig the upper or lower part of the structure in to the tree facilitating the upward movement. The result shows that it can successfully climb the trees. Tree climbing robot has the potential to be applied to various pursuits, such as harvesting, tree maintenance.

III. PROBLEM DESCRIPTION

There are many diseases which affects the arecanut trees some of them are:

Nut-splitting is more a physiological disorder than a pathological problem of universal occurrence.

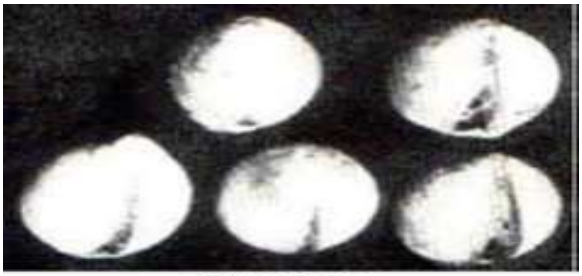

Fig 1: Nut splitting

Yellowing of leaves begin in the inner whorl, gradually spreading to the outer parts of the crown.

Fig 2: Yellow leaf disease

Bud rot is a fatal disease of areca palms caused by Phytophthora palmivora.

Fig 3: Bud rot

- In addition to the diseases mentioned above areca nut are also affected by many pests and insects.
- The labour workforce required for this purpose is high and also it needs skill to carry out that job.
- Availability of labour will also be an issue.
- The farmers are exposed to the toxicity of pesticides and suffer from pesticide poisoning which range from skin irritation to coma or even death.

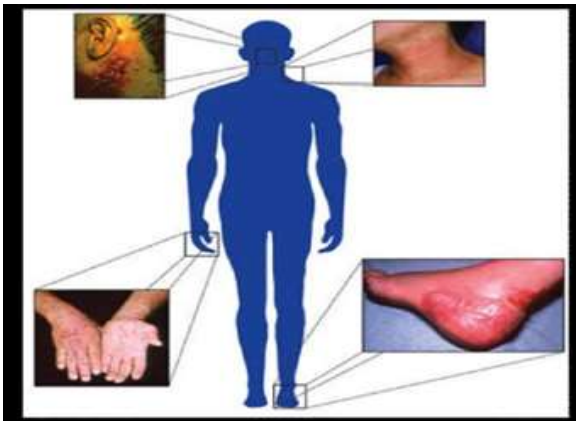

Fig 4: Human disease

IV. OBJECTIVES

The project aims at solving the issue of spraying pesticides to the areca nut trees by providing a low-cost yet efficient technological solution.

- The objective of the project is to design and develop an automatic spraying machine which operates on rechargeable battery.
- The kit must be controlled via microcontroller which becomes a medium between human and the operation of kit.
- The kit should be designed in such a way that it can be easily assembled, dissembled and can be carried from one place to another.
- The number of motors used must be precisely selected along with the electrical power rating and torque requirements as it directly effects the battery requirements.
- The kit is semi-automatic with most the controls in the hand of user.

V. PROPOSED METHODOLOGY

The methodology we try to adopt is in the following way-

- System Requirements
- Design
- Components Requirement
- Implementation

  - Block Diagrams
  - Circuit Diagrams
  - Flow Charts

System Requirements:

Requirements play a major role to start any the project and even when the project is being executed. The objective of the project can be fulfilled only if the corresponding technical requirements are charted out.

The major technical requirements are:

- The main frame along with other accessories is estimated to be around 5kg.
- The weight needs to be carried up-to a height of 18m.
- The spray jet needs to be targeted up-to a distance of 2m and it should revolve around the centre of axis.
- The kit should be controlled automatically by RF transceiver.

Design:

The design consists of the Mechanical, Electrical and Software section as discussed above. In order to come up with the design we need to have an estimate weight that is the limit of weight. So, let's divide the overall weight into three major sections:

- Frame weight
- Payload
- Electrical component weight

HARDWARE DESCRIPTION OF THE PROJECT:

Block diagram:

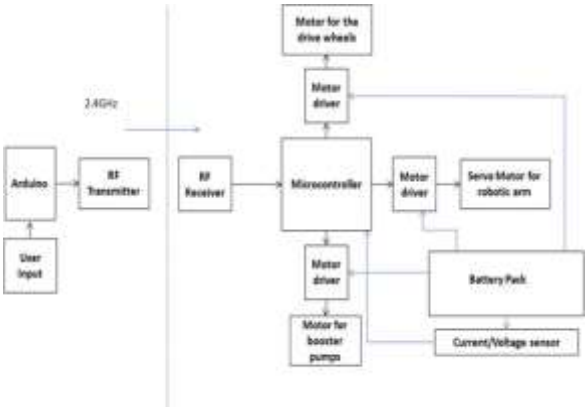

Fig 5: Block Diagram of Components Associated With Sprayer

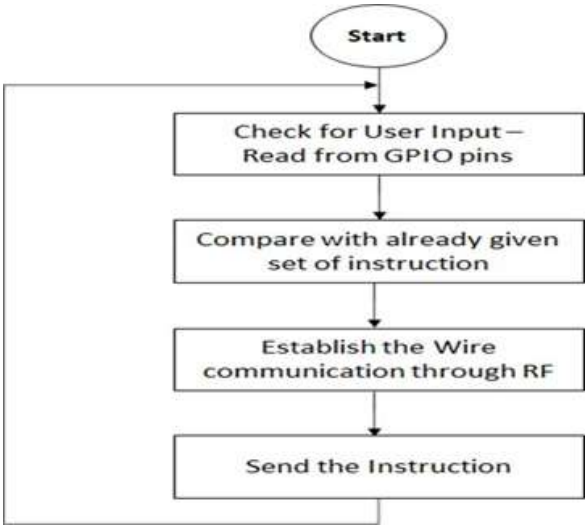

Fig 6: Flow chart of transmitter part

Fig 7: Block diagram of a Transmitter

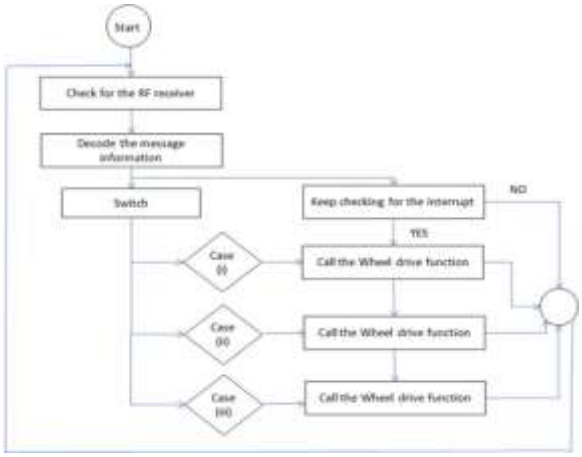

Fig 8: Flow chart of Receiver part

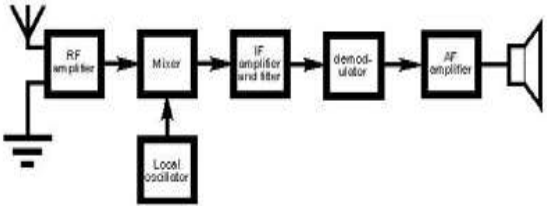

Fig 9: Block diagram of RF Receiver

SOFTWARE DESCRIPTION OF THE PROJECT:

Fig 10: Arduino board

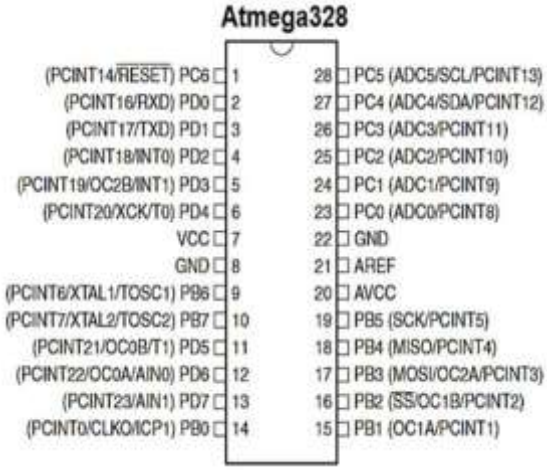

Fig 11: Pin diagram of Arduino Board ATMega328P

Fig 12: RF transceiver

Fig 13: L298N Motor Driver

Fig 14: Coding for Aurdino IDE

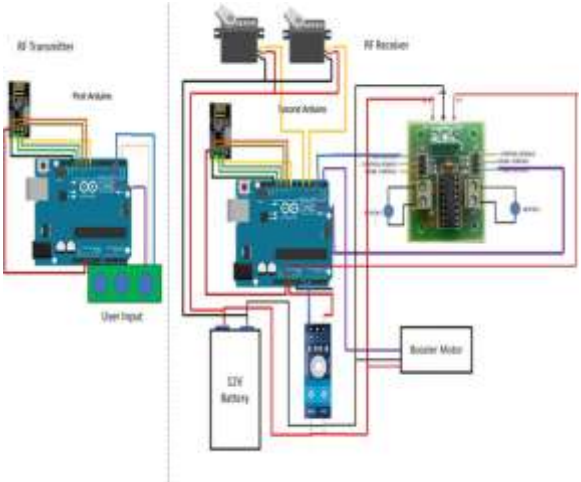

Fig 15: Circuit diagram of the connection between different GPIO pins of the transmitter and GPIO pins of the receiver

VI. WORKING PROCEDURE

- The frame is fixed to the tree truck by attaching both the sides of the wheel to each other through spring.
- The sprayer is switched ON for operation which basically switches ON the microcontroller and establishes the connection with RF transmitter through the RF receiver attached to the Arduino.
- The first instruction received by the receiver will be for driving the drive motors.
- The second instruction would be to arrange the exact position of the nozzle arm.
- Then simultaneously start the booster pump and automate the arm movement which will be moving at a constant speed.
- Once a complete round of pesticide is sprayed, the booster pump is switched off and the nozzle arm is also stopped.
- After the task is done the sprayer is brought down and removed in the same way it was setup by removing the spring connectors.
- After every 15 trees the pesticide is filled into the container manually.
- The battery can be replaced with a charged one once the battery level goes down. Since these are lithium ion cells, they can be charged quickly. They also have high energy density which means compact and light-weight.

VII. TESTING

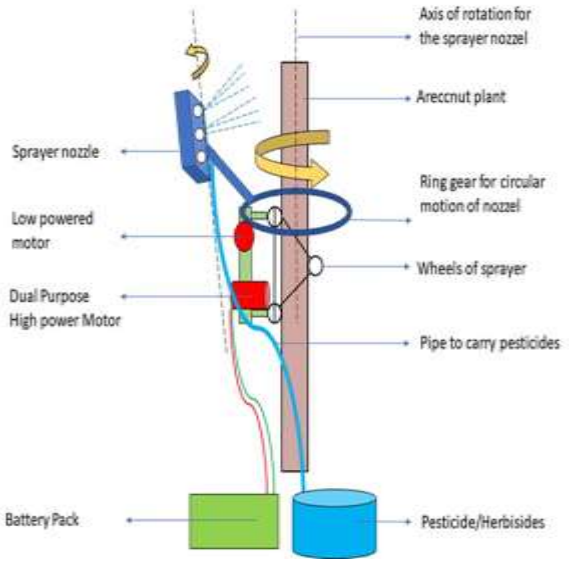

Fig 16: Complete Setup of the Areca nut tree Climber an

Pesticide Sprayer

The testing of the sprayer was done to compare the actual output and designed output.

- Speed of the sprayer
- Distance up-to which the spray is getting reached
- Time taken for the spraying to get over
- Battery backup

VIII. RESULT

This is the most suitable robot for spraying pesticide to the areca nut. The robot is attached and removed from the tree easily. After the robot has been attached, springs are used to fix the robot firmly to the tree. The robot operates on 12V 2000mAh battery and climbs the required height very quickly. Once the robot reaches the required height it stays there without slipping. The sprayer covers a wide angle and sprays pesticide to the areca nut bunch on the nearby tree up to a radius of 15 to 20 meters. After spraying is done it smoothly descends the tree. This robot reduces the time and also dependence on labour. A solenoid valve is used to stop or resume the flow of pesticide. All the above functions of the robot are controlled by remote.

IX. ADVANTAGES

- This project aims at replacing conventional methods of spraying, which are dependent on labourers, with a more cost effective and environment friendly system, dependent on electricity.
- The robot is compact.
- The robot is user friendly and a person with little technical knowledge can assemble it in an ordinary workshop.
- It reduces time and dependence on labour.
- This is the most suitable machine without man climbing on the tree.
- This robot is attached and removed easily to the tree.
- This robot is operated from a safe distance without exposing the farmer to the harmful effects of pesticide.

X. CONCLUSION

The project was aimed to come up with a technological solution which can replace human labour to spray the pesticide. The solution should be affordable enough with simple design which can be easily set-up and controlled by anyone with minimum training given at the initial stage. The prototype was developed using the components locally available in the market and the software tools that are open source in nature.

We conclude that the proposed machine is a safe, reliable, efficient and automatic tree climber which reduces the problems in climbing the areca nut tree and also it solve the problem of spraying pesticides on areca nut and it Branches. The agricultural vehicle for spraying pesticides proposed in this paper might be a collaboration of all basic attainable technologies, to bring out a new and therefore provides personal safety.

There are needy vehicle to assist farmers in tasks involving risks. Projects like this encourage people to take up cultivation of full time and half time jobs. This is essential in developing countries, especially Asian nation, where agriculture is the Backbone of the economy.

- Areca nut tree climber and pesticide sprayer is a unique model which serves as a great help and boon to areca nut farmers.
- The areca nut tree climber and pesticide sprayer has been tested on an areca nut tree with satisfactory results.
- Arduino Uno is used for programming which is a cost-effective device.
- A farmer with little or no technical knowledge can easily operate the robot from the ground with a remote control.
- The project concludes that the areca nut tree climber and pesticide sprayer is a safe, reliable, efficient robot and reduces the risk involved in manual climbing and spraying to a great extent.

XI. FUTURE SCOPE

The prototype will be undoubtedly a gift for the farmer as it ensures safety and protect them from directly getting exposed to the pesticide which was affecting their health. The prototype was then tested and desired results were noted down.

The future scope of the project would be to work on the design aspect with minimum number of motors to be used and making it more efficient. The design would also include the harvesting of the areca nut.

The future improvements for this project are as follows:

- Adding a nut cutter.
- Lowering the weight.
- Computer vision can be added to identify the healthy areca nut.
- The process of spraying pesticide can also be made fully automatic using image processing sensor.
- Wheels with better frictional co-efficient can be designed.

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