Design And Fabrication Of Copra Sweeping Robot

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Abstract*: Copra Crushing Industry has one of the production processes that is being used widely in the Oil production and manufacturing industries. Considering a fully equipped plant, the production ranges from 500-560 tons of oil per month. A good yielding copra provides 95% of output that has 5-7% of moisture content. Lesser the moisture content higher the yield. In the process of oil extraction, the copra is fed into the chute that is pumped onto the main silo for steaming process. This feeding process is done manually; hence, there are many mishaps occurring like copra falling away from the chute. A dried copra is crunchy enough to pierce the leg of the employees. Therefore, our paper aims to provide solution to these issues and ensure the safety of the employees. Design and fabrication of copra sweeping robot is proposed in this paper. The robot runs on wheels utilizes a sweeper mechanism to accumulate dried copra in a coconut oil extraction plant. This application of mechatronics comes under the field of Mobile Robotics. It is used to sweep the copra to one side so that the employees could pass through the place without any harm. It is provided with an attachment for the sweeping process. This could ultimately ensure employee safety and increase the productivity.

***Index Terms*: Oil Production and Manufacturing, Yield, Silo, Mobile Robotics, Mechatronics**

I. INTRODUCTION

One of the main objectives of the industries around the world is to ensure the safety of its workers and to provide them with safe environment. There are various safety measures taken by these industries to accomplish this objective. Some of them employ robots to provide safety and keep the surroundings clean and to help their workers to involve in their work without any inconvenience. Safety measures varies from industry to industry. This robot is fabricated particularly for the Oil Manufacturing Industries. In order to develop the robot, various projects that are used for the purpose of cleaning in indoor facilities have been referred. The paper [1] defines the basic idea of cleaning in family environment. It does the process of sweeping and dusting. This paper aims to develop an Autonomous cleaning robot with the integration of modern sensors and different path planning algorithms.

In this reference paper [2], a floor cleaner robot has been developed based on ATMEGA328. This cleaner robot is an indoor appliance, which works in both Controlled and Automatic mode. It is both a vacuum cleaner as well as floor cleaner robot. The main purposes are sweeping and mopping operations. Detachable mop is also used for mopping which makes it versatile. In the automatic mode, robot performs all operations by itself. The proposed system has peculiarity of displaying the elapsed time and the proportionate cost so that it can be used for commercial purposes also. In this reference paper [3], a small cleaning robot is proposed with a simple navigation algorithm to make the working of the robot autonomous. Even though there are a numerous navigation algorithms available, a new algorithm called the Rectangular spiral advance has been implemented to the automatic controlling of the robot in indoor conditions.

II. CONCEPT

The robot is to be employed in the loading area. The copra will be emptied and loaded on to the silo for steaming process through a chute. The copra are contained in a sac and the sac is cut, to empty the copra. At this process, there are a large number of wastage as the copra not getting into the chute falls down on to the ground. The dried copra is hard enough to cut or harm the workers. Therefore, the functioning of the robot is to sweep the copra shells to one side of the room, making the work safe and easy for the workers to perform. The robot is systematically designed in such a way that it performs sweeping of dried copra effectively without the need of human presence and intervention in the work area. The methodology followed in the design and fabrication of the proposed robot includes identification of the purpose of fabricating the robot, considering its features, payload considerations, reliability of operation, designing the robot in CAD software, simulating its performance and then fabricating the model and testing it. This methodology is followed in a systematic manner from initial design till the final fabrication of the robot.

III. COMPONENT SELECTION AND PROPERTIES

A. Arduino Mega

The robot is based on the Arduino Mega 2650 microcontroller. The **Arduino Mega 2560** is a microcontroller board based on theATmega2560. It has 54 digital input/output pins, 16 analog inputs, 4 UARTs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

Revised Manuscript Received on August 05, 2019.

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It contains everything needed to support the microcontroller. Simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The specifications of the microcontroller is shown in Table 1.

Table 1: Microcontroller specifications

Microcontroller **ATmega2560**	
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz

B. Bluetooth Module

The HC-06 Bluetooth module is used to connect the rover with Bluetooth device for the process of controlling the motion of the robot. This helps to control the robot using a Bluetooth enabled mobile phone.

C. DC Motor

The DC motor is used to provide motion to the robot. Four DC motors are required to drive the four wheels of the robot. These gearless motors provide the high thrust necessary to push the copra shells. They are directly connected to the wheel.

D. Motor Driver

The motor driver used in the control circuit is L298N IC. The L298N is an integrated monolithic circuit in a 15- lead Multi-watt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver de-signed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors.

E. Servo Motor

Servomotors can be generally used for rotary and linear actuation mechanisms. In this robot, two servomotors are used for lifting the sweeper setup to 180 degrees for freeing the copra shells. These servomotors are controlled by the Arduino Mega 2560 microcontroller.

F. Power Supply

The Power supply is provided by the Li-Po battery of specification 2200 mAh and 11.1V operating voltage. Moreover, all the other electronic components receive power from this battery through interconnections. The battery is charged for up to 6 hours for a power delivery time of up to 2 hours.

IV. FLOW CHART AND CAD MODEL

Fig 1 shows the block diagram representation of the copra-sweeping robot. The Arduino Mega 2560 microcontroller acts as the controlling unit of the robot with necessary connections to the wheel motor drives, sweeper servomotor and the Bluetooth module. The Bluetooth module receives control signals and transmits status and parameter signals to the master mobile phone through the mobile's Bluetooth. A power meter measures the power consumed by the motor by measuring the current drawn by the motor. It then helps the microcontroller to calculate the time to charge the battery. The current drawn by the motor is measured by the hall element based 5 A current sensor IC ACS 712.

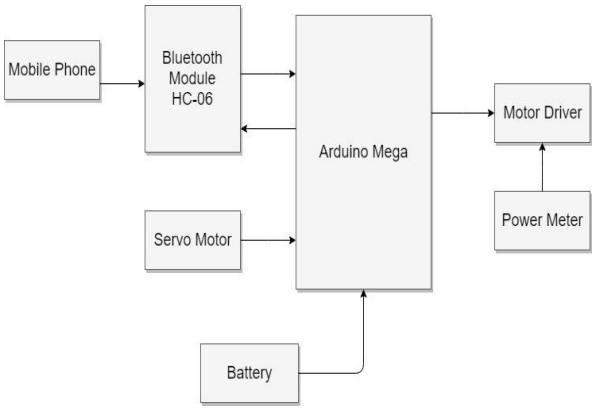
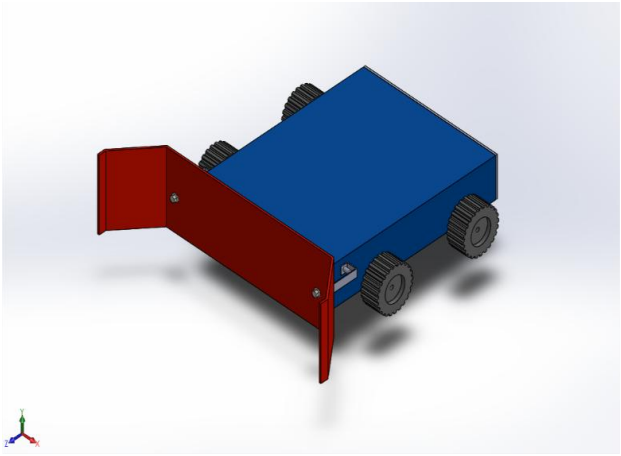
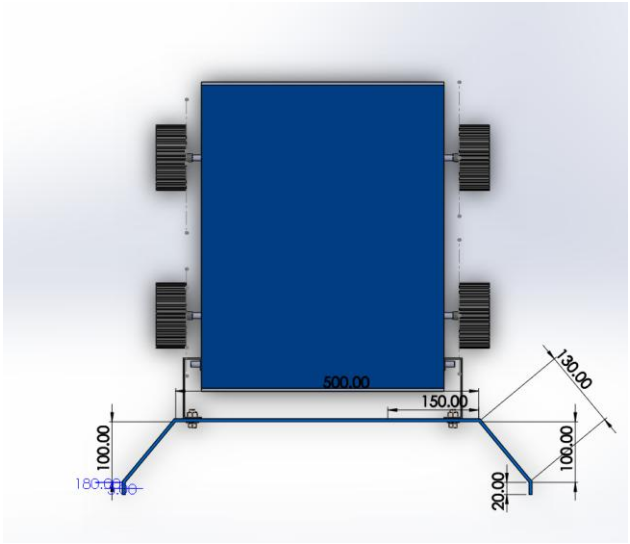


Fig 1: Flowchart representation of the system

The CAD Model of the robot is shown here. The mechanical components of the robot include the body of the robot and the sweeper fabricated from 1mm sheet metal made of stainless steel, four wheels with rubber grip, DC motors for wheels, servomotors for the sweeper, battery and the microcontroller.



(a) Isometric view



(b) Top view

Fig 2: Prespectives of the Copra Sweeping robot.

The above diagrams are the Isometric view and Top view of the proposed model of the Copra Sweeping Robot.

V. CONCLUSION

The objective of this paper has been successfully achieved through design and fabrication of the Copra sweeping robot. Layout of the machine is shown in isometric view in the paper. The machine was fabricated as per the design and used for copra sweeping purpose. Satisfactory operation of the robot in the industrial environment is verified through several trials and tests. The robot is currently designed for specifically for coconut oil extracting industry. It can however be made versatile so that it can be used in various other outdoor applications as well. This robot can also be upgraded to autonomous mode using a series of sensors and incorporating path planning as well as Navigation .Algorithms.

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