Department of Electronics and Communication Engineering
Vasavi College of Engineering (Autonomous)

ACCREDITED BY NAAC WITH 'A++' GRADE

IBRAHIMBAGH,HYDERABAD-500031

CERTIFICATE

This is to certify that the Mini Project titled **"Grain Flow-rate Meter"**

submitted by

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Students of Electronics and Communication Engineering Department,Vasavi College of Engineering in partial fulfillment of the requirement of the award of the Degree of Bachelor of Engineering in Electronics and Communication Engineering is a record of the bonafide work carried out by them during the academic year 2022-2023.

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HOD-ECE

INDEX

1.ABSTRACT

Grain flow rate meter is a measuring device that is used to measure the flow rate of the rice grains coming out of a machine or so. We can achieve this by a small logic i.e Flow rate= cross section area * speed of flow

Flow rate of grains is very important in the aspect of **agricultural industries** as well as food packaging and food processing industries for calculating the rate of flow of particular solid material. Now coming to the flow rate of grains, as grains are very small in size the impact created on a surface is purely due to their flow rate and barely depends on the shape of the grain, making use of this point we can develop a flow rate sensor in order to measure the flow rate of grains. There are existing flow rate sensors like flow of grain through conveyor system, weighbridge or weigh scale method, and other specialised and sophisticated sensors based on lasers and electromagnetic sensors but they failed to be cost effective.

So we would like to make use of the expression "Q = V x A" Where 'Q' represents the flow-rate ,'V' Represents the velocity of the flow and 'A' represents the area of cross section.

In our project the cross section area of the outlet is controlled by using a stepper motor setup so that it is seen that all the grains flowing out will completely use that cross section area, the cross section area that is to be set is decided by a ultrasonic sensor that is placed at the top of the hopper that continuously monitors the height of rice grains inside the hopper. For speed of the flow we are using a light paddle wheel which is rotated when grains fall on it and using this paddle wheel we can measure the speed of flow by a tachometer module.

Now with these two parameters we can obtain the flow rate and can be displayed on the LCD screen.

2.PROBLEM ACKNOWLEDGEMENT

Ration shops in our Telangana supply rice bags to many people with ration cards, to make sure that these rice have enough protein in them , government has set a ratio of rice to FRK rice , every bag of rice supplied must pass this ratio test or else that bag cant be supplied.

To meet this ratio of rice to FRK ,Currently we have a machine in rice mills that takes in 49kg of rice and 1kg of FRK and rotates them together in a drum and then flushes them out through the outlet.

But this method takes a lot of time and disturbs the output flow of the rice mill, so instead of mixing them by weights do we have any other methods?

3.PROBLEM STATEMENT

The problem statement is to design a equipment to mix two materials in a constant ration when they are flowing without obstructing their flow,

This involves development of two grain flow-rate sensors which need to communicate with each other to maintain a constant ratio of flow from both.

But due to time constraints the current aim of our project is to develop a single **Grain flow-rate Meter** prototype and test it's working performance.

4.PARTS USED

1)HOPPER

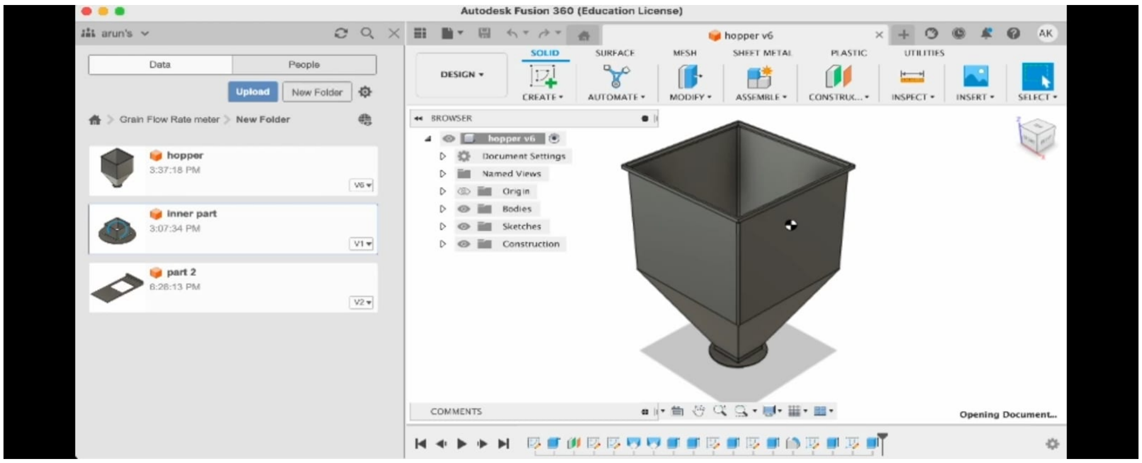

Figure 1: HOPPER

2)OUTLET

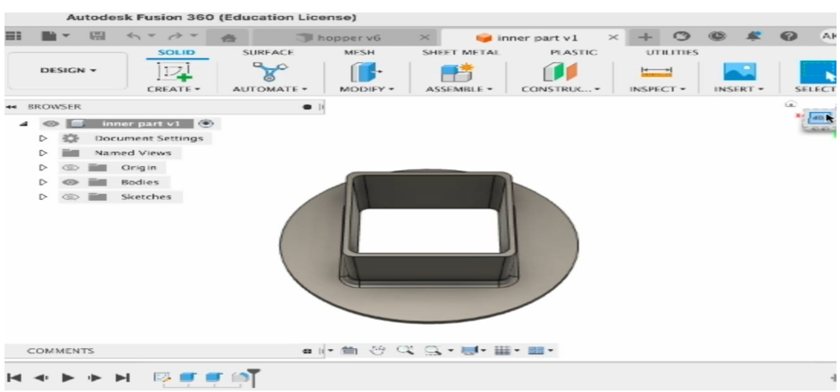

Figure 2: OUTLET

3)OUTLETfig2

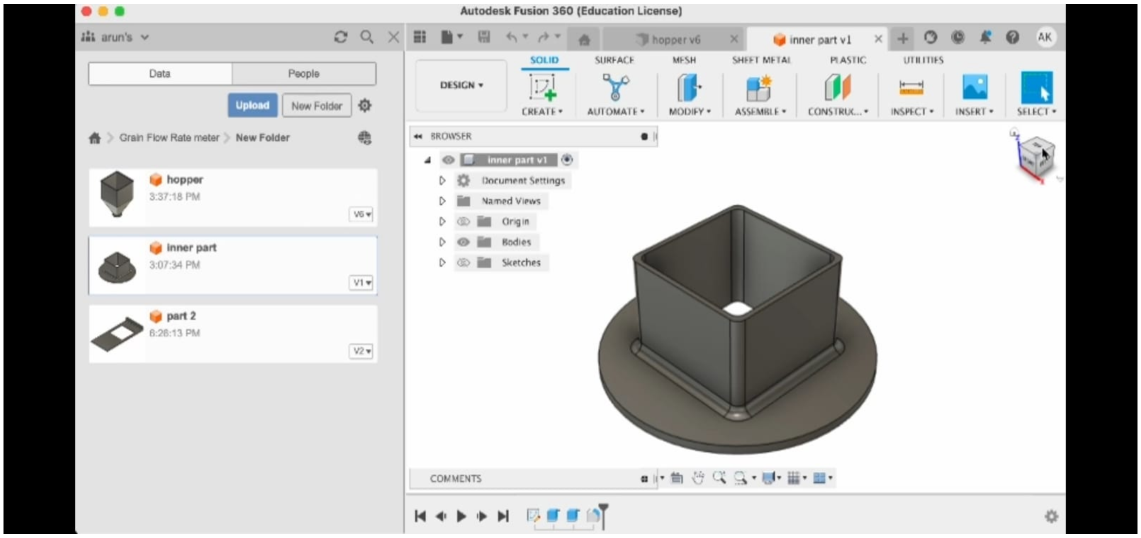

Figure 3: OUTLET2

4)SLIT CONTROLLER

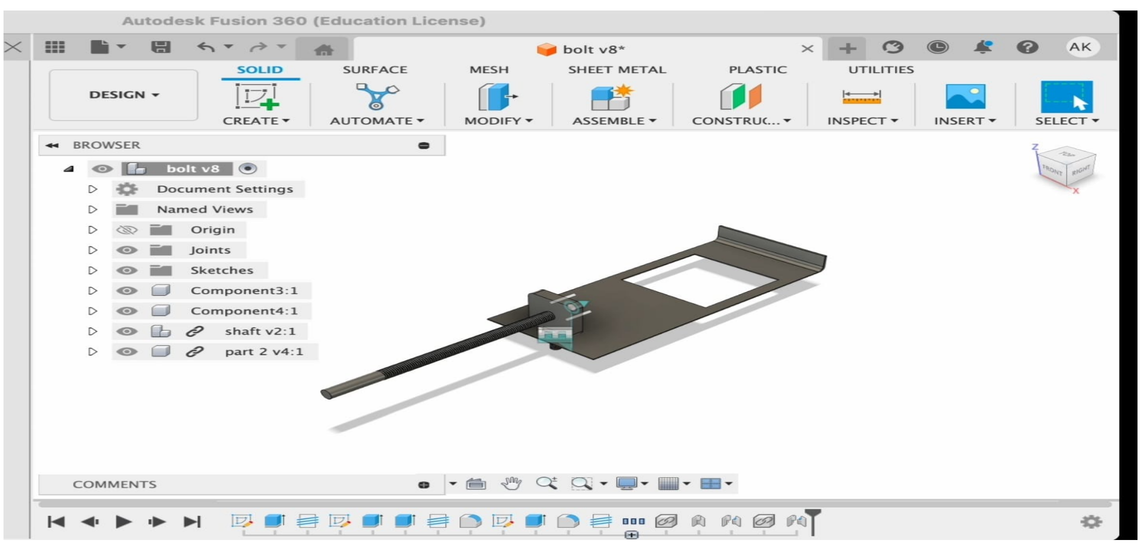

Figure 4: slit controller

5)SHAFT MOUNTED WITH STEPPER MOTOR

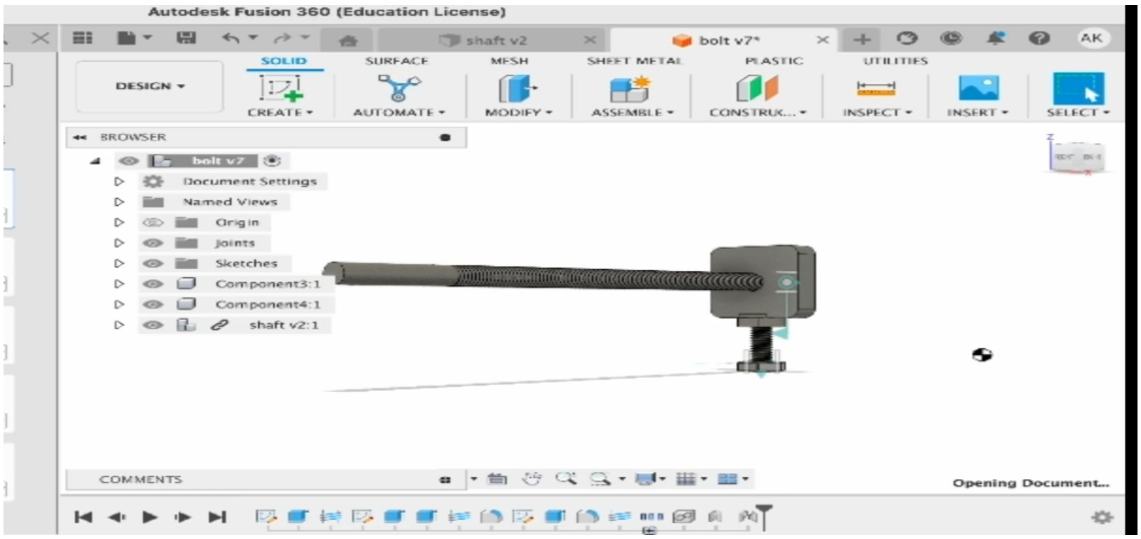

Figure 5: shaft

6)STEPPER MOTOR

Figure 6: steppe rmotor

6)STEPPER MOTOR COUPLER

Figure 7: stepper motor coupler

8)ULTRASONIC SENSOR

Figure 8: ultrasonic sensor

9)TACHOMETER MODULE

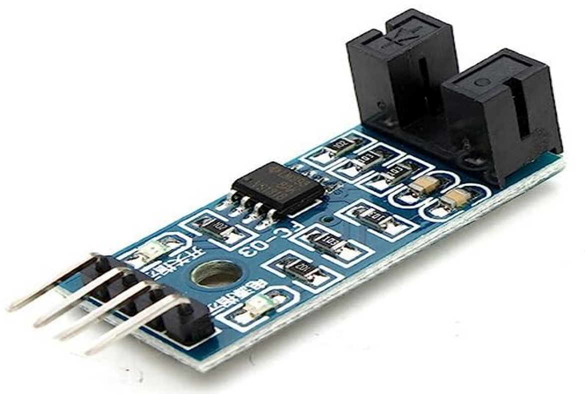

Figure 9: tachometer

10)16X2 LCD DISPLAY

Figure 10: LCD display

5)FLOW OF SOLUTION

1 Identifying the requirements

First we have clearly discussed about the problem statement with the industry people to get an idea on the requirements of our project.

2 Gathering components

Once we got a clarity on the requirements of the project we started gathering components like the rice hopper, we calculated the necessary dimensions of the rice hopper and got it designed using iron sheet along with this necessary add-ons like the outlet flap,bolt to control the flap are also designed. Remaining electronic components which we have used in the project like tachometer module,ultrasonic sensor ,stepper motor,necessary drivers ,Arduino board are also gathered.

3 Assembling

Once we have got all the components in our hand we assembled them to see if any changes are to be done and the changes were made accordingly so that there would be no issues with the next stage of the project.

4 Arduino code

After assembling all the parts together we started to figure out a logical implementation of our idea so that we can implement it on the Arduino uno.

1 Stepper motor

As we were familiar with the functionality of stepper motor we selected a A4988 driver to drive the motor and we started learning the available functions in the AccelStepper.h library so that we can use them for our project and finally We were successful in controlling the output flap using the stepper motor with custom inputs.

2 Ultrasonic sensor

We were successful in controlling the output flap using the stepper motor while we faced some issues while we were trying to control the outlet based on the distance measured by the ultrasonic sensor,because as the ultrasonic sensor continuously measures distance but the stepper motor takes time for the completion of moment this time delay was giving hurdles to our project,but however we were able to clear them by inducing proper delays in the code when needed.

3 Tachometer

We used a paddle wheel setup at the outlet and the speed of the paddle wheel is transferred to the rotary encoder and the rotary encoder is placed in between the two IR sensors of the Tachometer module and the pin to which this module is connected in the Arduino is used as an interrupter and we counted the number of interrupts aroused because the pin keeps on going high and low and based on the number of interrupts and the number of holes in rotary encoder and the time we got the speed in rpm which is converted to m/s By taking into consideration the perimeter of the rotary encoder.

4 Grouping them

After these stages we have combined all the codes together to form one single code and assured that no issue is raised during the execution of the code even all the separate modules are functioning together.

5 Testing

After the completion of all these steps we have tested the output of our model using real rice as an input so as to monitor its performance and clear the technical errors if any and also to know the working thresholds of our project that is, up to how many kgs it can allow in 1hr and what are the various methods to link distance of the rice in the hopper to the outlet cross sectional area so as to maintain a constant flow-rate irrespective of the inlet rice content.

6)SOLUTION PRESENTED

1 Introduction

Now coming to the flow rate of grains, as grains are very small in size the impact created on a surface is purely due to their flow rate and barely depends on the shape of the grain, making use of this point we can develop a flow rate sensor in order to measure the flowrate of grains.

2 Method

To overcome these disadvantages and design a cost effective flow rate meters we can take into consideration the fact that under fixed inclination the speed of the grain flow purely depends only on the flow rate of the grain because the style of falling is same for all the grains so when we take the speed of grain flow (in ms-1) it purely depends on the amount of grain that is flowing which creates a significant impact force on the light paddle wheel resulting in the decrease or increase in the velocity of the paddle wheel which can be monitored as the Speed of the grain.

So, when we multiply this with the cross-sectional area of the channel through which the grain was flowing we get m3s-1 which is the actual flow rate of the grain that is being flown through that channel, But we also know that despite of liquid these grains will not occupy the complete channel while they are flowing through it so to make sure that the grains are completely occupying the channels we use an adjustable gate which adjusts the length of the channel so that the grains use the complete channel and we get the accurate flow-rate of the grains through that hopper.

To make that adjustable gate we take a normal hopper with an adjustable opening, attach a stepper motor to the hopper and add a screw and nut mechanism to push and pull the hopper gate using the stepper motor, the amount of the opening purely depends on the amount of rotations the screw has taken i.e., if the screw has taken 3 rotations and if the screw has a pitch of 3cm then it means that for the three rotations the distance moved by the nut or screw is 3*3 i.e., 9cm.

Now another major task is finding the speed of grains, for this we have two approaches:

1 Approach

In this we are using a light paddle wheel and the speed of rotation of the light paddle wheel is determined by the tachometer module along with a wheel encoder, this tachometer module working is similar to an IR sensor it produces a HIGH output when there is no object or obstacle between the two ports and produces a LOW output when there is an obstacle between the transmitter and receiver, so if we use a wheel of constant perimeter and having a fixed number of holes at its edges say 12 then the module keeps of generating high and low signals when the hole of wheel passes between them and the Arduino treats this one as an interrupt and we count the number of interrupts generated in order to count the number of holes passed.

So the number of rotations is given by the total number of holes passed divided by the number of holes existing on the wheel which is 12 in our case.In-order to get the speed in RPM we need to count this number of rotations for every one minute, but doing so will reduce our refresh rate of the output so what we will do is we will Increase the speed Rotary encoder by using some gearing components between paddle wheel and rotary encoder so that we can just find the speed for 2-5 seconds and then multiply with a scaling factor of 30-12 so that we can get an approximately same RPM but with a greater refresh rates.

2 Approach

In this method instead of taking the continuous velocity changes of the outlet grains we can fix the grain velocity by continuously varying the cross section area of the outlet then the output flow rate purely depends on the area of cross section and the velocity which is constant and depends on the Inlet rate into the hopper which in-turn depends on the Tonnage of the rice mill in Real Time Scenario ex 2tph ,3tph..etc.

This method reduces the tedious process of calculation of continuous velocities using a lite paddle wheel and instead the constant velocity which we maintain depends on the tonnage of the rice mill which can be taken as the "manufacturer reference" we can also take into consideration of adding a light paddle wheel at the output and continuously monitoring the flow rate and also doing the same with fixing a constant velocity just to see the correlation between the two so that we can find the percentage similarity between the both and have a accuracy plot of our project output.

3 Final process

Now we are using a stepper motor coupling coupler in order to couple it with a lead screw and a anti backlash nut so that we can control the movement of the flap using the stepper motor, and presently we are following approach 1 to measure the output flow rate as we don't have any constant input to the rice hopper.

7)FUTURE SCOPE

As this will solve only a part of the problem statement that we have taken, the other half would be integrating two flow-rate sensors and maintaining a constant output flow-rate ratio of the both the flow-rate meters by creating a communicating channel in between them and adjusting each other's flow-rates in-order to maintain a constant ratio.

So our future scope would be integrating two of these flow-rate meters to get a constant output ratio from both of them, As of now we are using Arduino uno board as a whole but in future we would like to make a customized PCB fro this purpose using the same AT-MEGA328P micro-controller so that the product cost even comes-down.

8)CONCLUSION

A prototype of a flow-rate meter to measure the flow-rate of particles whose size is in the order of Cm's is presented.

TEAMMATES

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