­­­­Chaff Cutter Biweekly Report

Adding safety features in a Chaff Cutter Machine is imperative, considering the high rates of amputations and injuries to the user.

While brainstorming ideas of making a safety add-on feature, we had three factors under consideration:

1. Minimal Response Time
2. Cost-effectiveness
3. Easy-to-install

Thinking under the lines of these three factors, we shortlisted a few practical and implementable solutions, as mentioned below:

* Image Processing
* Thermal Imaging
* Motion Sensing
* EMF Sensing
* Capacitive touch
* Walt Disney’s Swept Frequency Capacitive Sensing named Touché said to have 99% accuracy.

We officially began our work by thinking of adding image processing to the machine but rejected the idea because of slow processing speed and high cost of components involved including a high-resolution camera and an on-board fast computer like Raspberry Pi or Beaglebone Black.

Our second attempt was to test Thermal Imaging. We initially tried making our own thermal sensor but the results it produced were fluctuating and thus unsatisfactory. Consequently, we have put the idea of thermal imaging on hold until an IR based digital temperature sensor (MLX90614/90615) is made available.

While thinking of probable solutions, we also tried to see if a PIR sensor could be of any help but after some trials, we were disappointed by the response time of a PIR sensor and hence, this idea is now off the table.

Making an EMF sensor also turned out to be futile since the values given by the sensor were highly fluctuating and unreliable.

The most practical and workable solution hitherto, is the use of Capacitive Touch Sensing. Firstly, it only required a resistor, capacitor and an Arduino board. By using the CapSense library, we implemented the sensing mechanism and it worked perfectly fine. Not only is this solution cost-effective but at the same time it is easy to install and has a very quick response time, thus fulfilling all of our requirements. Nevertheless, this idea still had two drawbacks:

1. The Capacitance of human bodies vary, depending on various factors, and there has to be a particular range, which can cater for every user. Although we have tested a few users and have agreed upon a particular range for now. However, it needs more testing to make it foolproof.
2. Most part of the machine is made up of metal/wrought iron and as a result, has a conducting path all over it. Therefore, instead of detecting a touch only on the rollers, just before the blade, it detects it all over the machine. This was highly undesirable and so we have thought of a few possible solutions to avoid this problem. However, for this to work, the machine would have to undergo a few mechanical modifications.

As far as the CAD modeling of the machine is concerned, the group has already completed the drawing of the external gears and is working to continue with the design of internal gears, which will be complete in the coming week.

Future Target:

While trying to modify and improve our capacitive touch sensor, we came across ‘Walt Disney’s Swept Frequency Capacitive Sensing’ named ‘Touché’, which has accuracy of around 99% and can be connected with any kind of object. The best thing about Touché is that it can give different values of capacitance at different locations hence, solving the problem of our capacitive sensor.

We will test Touché, in the coming week and we hope that it will work perfectly fine, and give capacitance only at localized parts of the machine i.e. the rollers.

Summarizing, we now have three different sensing dimensions in mind and by combining these three dimensions, we can ensure a sound and safe kit on our machine. The three-layered sensing kit will contain:

* Simple Capacitive Touch
* Touché
* Thermal Imaging with MLX90614/90615

This three-layered system will ensure complete safety of the user, for good.

If time permits, we will also add a maching learning algorithm to our three-layered sensing assembly so that it can learn and behave for any environment and situation using previously recorded datasets.

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