Vision sensing for filament clogging and exhaustion in Fused Deposition Modelling Printers

# 1.Introduction:

Today consumer grade 3D printers with the dimension of 50cm edge length are generally cubical. Due to consumer grade printer mechanics, the build area size may 15\*15\*15 cm. This machine is a user friendly, where you can even place them on your desk which weighs about 10kg whereas emission of potential harmful fumes during the printing process it is advised to be away from the users.

Fused Deposition Modelling(FDM) is familiar consumer grade 3D Printers. Based on this various technology for 3D printings or Additive manufacturing(AM) exists from metal powder or ceramic positioned laser entering over laminated object modelling, adhesive based stereolithographic to thermoplastics.

FDM works on a simple mechanism and cost efficient to manufacture as they don’t require expensive and complex components. The foundation consists to 3 axes that are restrained by 3 stepper motor. Compared to stereolithographic here we can reduce the granularity of object by affixed constellation which enables 3 degrees of latitude along this axis and besides from print-head and print-bed, axis and motors are the main components as their makeup be of 3 axes that are controlled by 3 stepper motors.

For direct supervision of inhabitant, the printers are recommended to exploit rooms rather than workspace. Following reasons that occurs during printing mistake:

* Print bed misalignment
* Nozzle misalignment
* Nozzle clogging
* Deficiency of printing material or agitate of material flow
* Lack or loss of bond to print bed
* Shock or vibration

FD machine printing duration can be up to 20 hours ample for large and complex objects. The main objective is to reduce the misprint as they drain material and soak the printing time for longer time without producing a useful object.

In order to pacify the problems user can place cameras [Video or web cams] in or at printer for remote supervision adequacy. Facilitate laser scanners, currents or thermography are other approaches of detection errors. In order to get the information on problems and errors the user to watch the video constantly or in interval that helps to receive information on problems and assess remotely on printing progress. The design is to support the user to detect the printer error by utilizing machine vision. The benefits of early detection of printer errors reduces material waste and occupancy of printer resources. In need of constant surveillance for preventing completion of printing process, inappropriate or broken object to reduce the time effort of the user.

On our personal experience we have also identified failure modes of these system to be common and symptomatic which are

* Work piece warpagess
* Build plate delamination
* Extrusion failure

To identify these failures modes video frames and BLOB detection are presented in an in-line computer vision system which uses differential imaging between consecutive.

To detect the system failure mode, it’s recommended for array of five cameras from multiple angles to capture images. These captures are used for comparison of current work piece and model has good state.

Since there are some techniques and studies to scale down the failure modes of 3D printers. Nuchitprasitchai et al to detect incomplete print and nozzle block. Garanger et al enforce closed-loop system control for AM process to stiffness objects like leaf spring. Delli and Chang designed binary 3D printing to check the quality at critical stages during printing process. Fastowicz and Okarma developed the texture analysis with Haralick texture feature calculated from a Gray Level Co-occurrence Matrix (GLCM). Cummings et al developed with the help of ultrasonic to manipulate the temperature of print bed during printing process, to detect the closed loop frame work control and to rectify the failures to filament bonding. And finally Heterogeneous sensor are developed by Rao et al to analysis the surface roughness of framework.