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

# 1.Introduction:

Technological enhancement in the additive manufacturing era and the community development keeps on spreading the wings of 3D printing technology especially in Fused Deposition Modelling(FDM) method out to all engineering enthusiasts. This end in development of industrial grade as well DIY printers out in the market. 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 vary between15\*15\*15 cm to 30\*30\*30 cm. 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 which is also due to availability of huge spare market nowadays. The foundation consists to 3 axes that are restrained by 3 stepper motor able to move countably based on command. 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.

For direct supervision of inhabitant, the printers are recommended to exploit rooms rather than workspace. FD machine printing duration can be up to 20 hours ample for large and complex objects alongside of loaded filaments in the system. 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 and consuming the running time as well.

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 which experienced previously in the development. 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.

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.

Computer Vision(CV) is the computer based methods of processing the signal, in this case image are the resource. The method is capable of performing all sort of processing like adding images, subtracting, comparing, validating all the possibilities via mathematical formulas. Current generation processor and GPU supports a lot for this computer vision technology hence making the system more viable for high speed operation. Various open source library are out there in market consisting of set of Code written in programming languages which has many mathematical formulas as library to preform. Among the interpreted language, python seems to be more flexible in our case ending up with development language for this project.

Literature review

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, which. Perform the interpretation method to figure out the challenges. 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, once the critical stages are identified then quality check operation based on computer vision to be performed. 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. These various techniques mainly focuses on detecting the challenges and provide a solution which are not automated. Manual interruption is required for all these figured problems.

In the work made by Aleksei L entitled with computer vision based layer wise analysis deals about layer wise analysis by tracking printer error and generates the appropriate printer action. It uses the camera unit support to take images of side view mapping and virtual top view concept to analysis the system with algorithm. That solution fails to detect the filament error which make confusion to figure the exact problem recurring the manual intervention