IoT based 3D Printer

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Abstract :- *The main objective of this project is to print things remotely and monitor or aspects of your 3D printer using a Raspberry Pi computer. You can remotely load new print, monitor your extruder temperature. Turn your printer off and on, check the status of your prints, and watch your prints with a live video feed and more.*

3D printing is any of various processes in which material is joined or solidified under computer control to create a three-dimensional object. Where a 3d object is created with material being added together, typically layer by layer. Additive manufacturing is a method of manufacture where layers of material are built up to create a solid object. Objects can have a very complex shape or geometry and are always produced from a digital 3D model or a CAD file. It is the requirement to convert a CAD model into an STL file. Then slicer program takes the STL file and convert it into G-code. G-code is a numerical control (NC) programming language.
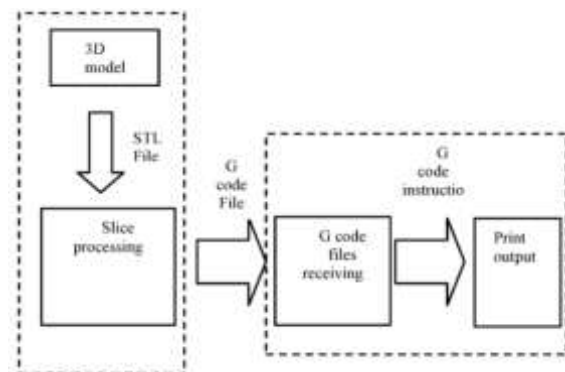
As the system is IoT based octoprint provides a web interface for controlling 3D printers, allowing the users to start print job by sending G-code to 3D printer connected via USB. Octoprint is free, open source software that allows you to remotely perform and monitor all the aspects of your 3D printer using a Raspberry Pi. For most 3D printers, a computer running the host software must stay connected to the 3D printer at all times during use. An increasing number of 3D printer operators are looking for way to use their 3D printers remotely.

***Key words:* IoT, 3D printing, additive manufacturing, Octoprint, G-code.**

Introduction:

3D Printing or additive manufacturing is a process of making three dimensional solid objects from a digital file. The creation of 3D printed object is achieved using additive processes. In an additive process an object is created by laying down successive layers of material until the object is created. Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object. 3D printing is the opposite of subtractive manufacturing which is cutting out/hollowing out a piece of metal or plastic with for instance a milling machine. 3D printing enables you to produce complex (functional) shapes using less material than traditional manufacturing.

Producing a digital model is the first step in the additive manufacturing process. The most common method for producing a digital model is computer aided design (CAD). Reverse engineering can also be used to generate a digital model via 3D scanning. Then convert a CAD model into an STL file. Slicer program takes the STL file and converts it into. G-code is a numerical control(NC) programming language.

There are basically two ways to do 3D printing. First, a g-code file can be saved onto an SD card using a computer, then the SD card can be transferred to the 3D printer.

Second, Octoprint provides a web interface for controlling 3D printers, allowing the user to start a print job by sending G-code to a 3D printer connected via USB. Octoprint monitors the status of the print job, as well as the printer itself, primarily the temperature of the print head (hot end) and the temperature of the bed, if the bed on the printer is heated.

The technologies which are used in ALM are stereo lithography (SLA), laser sintering(SLS) and fused deposition manufacturing (FDM).

The FDM printing process start with a string of solid material called the filament. This line of filament is guided from a reel attached to the 3D printer to a heated nozzle inside of the 3D printer that melts the material. Once in a melted state, the material can be extruded from on a specific and predetermined path created by the software on the computer. As the material is extruded as layer of the object on this path, it instantly cools down and solidifies –providing

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the foundation for the next layer of material until the entire object is manufactured.

I. Objective :

The main objective of this project is to print things remotely and monitor all aspects of your 3D printer using a Raspberry Pi computer. Most host software communicates with the printer via a wired USB connection. When an increasing number of 3D printer operators are looking for ways to use their 3D printer remotely. Wireless 3D printer has a number of advantages over the traditional wired setup.

II. Block Diagram :
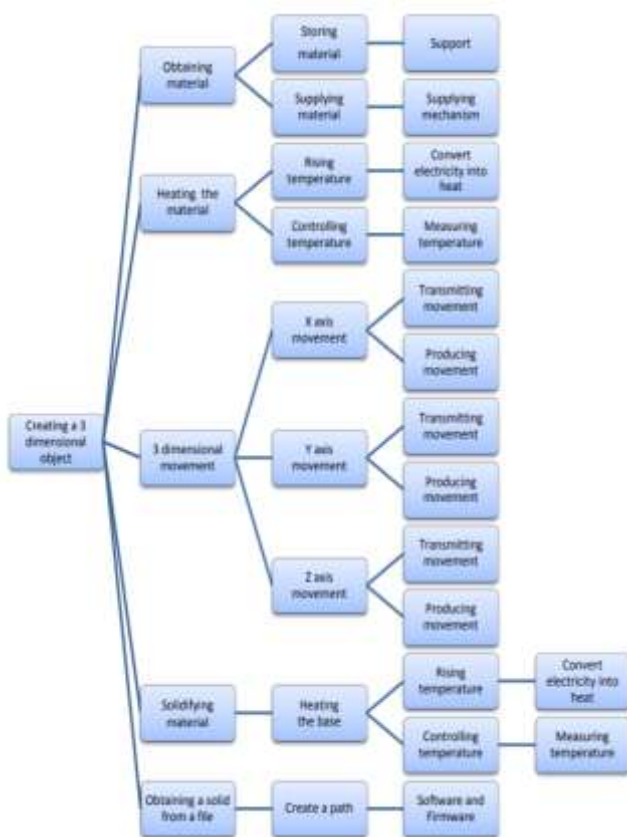
The picture shows the structure of the typical 3D printer. The print table is the platform where the object for printing has been situated. It provides the basic support for manufacturing objects layer by layer.

The extruder is most important part of 3D printer. As the extruder in the normal paper printers, this extruder is also used to pour ink for printing. The movement of extruder in various dimensions creates the 3D print. For printing a 3D object, the extruder has to access X, Y and Z Coordinates. For achieving this many techniques are used according to the printers specifications required for various applications.

When the STL file is input to the printer, controller extracts each layer from it and also extract each line segment from

each layer the it gives control to the movement of the extruder at require rate. The X direction movement of extruder is made possible by the X-motor. When X-motor rotates, the shaft also rotates and the extruder move in X direction. The Y direction movement of extruder is made possible by the Y-motor. These movements are generated by stepper motors which, in turns, are controlled by controller that sends electrical signal to the motors.

In order to solidify the thermoplastic filament, it is necessary a platform or base where the material is supported and cooled. If it is not pre-heated, it will shrink. To prevent material shrinkage, the base must be heated at an elevated temperature and is called heated-bed. Temperature of heated bed controlled by controller.

III. Hardware Description:

1. MKS-BASE:

MKS BASE is a feature rich all-in-one electronic solution for Reprap and other CNC devices. It features an onboard ATmega2560. Its five motor output are powered by A4982 stepper drivers. MKS-BASE is suitable for 3D printer manufacturers on batch production, and being used as main control board.

Features:

1. Arduino MEGA compatible Atmega2560 and FT232 processor are compatible with all RAMPS class firmware.
2. Firmware can use the same configuration as ramps 1.4.
3. Easy DISPLAY+SD-CARD connector, RepRapdiscount SmartController compatible pin header on board.
4. Up to 5 motor driver with A4982.
5. Recoverable fuse for short-circuit protection.
6. 3x temperature ADC connector for thermistors.

2. Raspberry Pi:

Control the print process, use octoprint on a Raspberry Pi connected to 3D printer.

Features:

1. 1.4 GHz 64-bit quad-core ARMv8 CPU, 1GB RAM.
2. 802.11n Wireless LAN, 10/100Mbps Lan speed.
3. Bluetooth 4.2, Bluetooth Low Energy
4. 4 USB ports,40 GPIO pins, Full HDMI port, combined 3.5mm audio jack and composite video
5. Camera interface (CSI), Display interface(DSI),Micro SD card slot, VideoCore IV 3D Graphics core.

3. Stepper Motor Drivers NEMA-17:

These chips are responsible for running the stepper motors. They fire the coils of the motor in sequence, causing it to move in increments. The stepper driver also controls how much electrical current is fed to the motor.

Features:

1. 4-wire bipolar operation.
2. Compatible with NEMA17 standard.
3. Motor shaft diameter: 5m.
4. Step angle:1.8degrees
5. Holding torque:4N.m(min)
6. Phase current:1.2A
7. Standard Voltage:2V.

4. Extruder:

The extruder is a core of the printer. It is where the plastic gets drawn in, melted and pushed out. It is essentially a fancy hot glue gun.
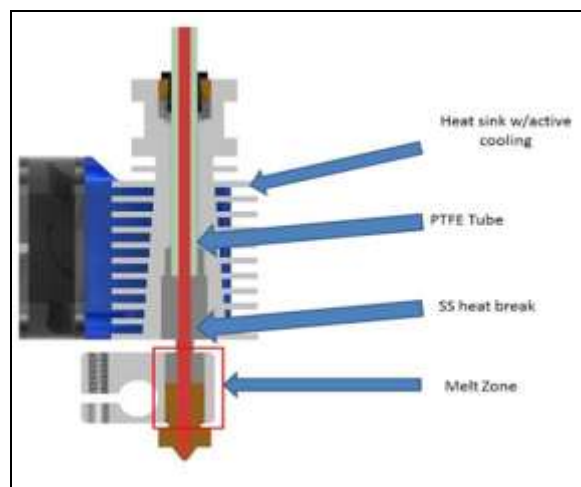

Features:

1. Precision engineered for popular dule extruder 3D printers.
2. For ultra-flexible filament.
3. Simple to fit.
4. Ultra-precise printing
5. Faster prints.
6. Self cleaning.

5. Lead Screw:

A lead screw, also known as power screw or translation, is a screw used as a linkage in a machine, to translate turning motion into linear motion.

6. Hot End:

- **Heat Sink:**

This ensures that heat does not travel up the plastic and melt it prematurely before nit reaches the nozzle. This phenomenon is called heat creep and it causes jams, especially with PLA.

- **Layer cooling fan:**

This fan cools off the plastic immediately after it is deposited by the nozzle.

- **Temperature sensor:**

These are all various type of sensors for determining the temperature of the hot end. Thesmistors are the most common type of sensor, but some printers will use thermocouples for extremely high temperature printing.

- **Nozzle:**

The nozzle is simply with a small hole for the melted filament to come out of.

- **Heated Bed:**

The print bed is the surface that your objects are printed on to. Typically it will consist of a sheet of glass, a heating element, and some kind of surface on top to help the plastic stick.

- **End Stop:**

The end stops are how the printer knows it is. They are little switches that get pushed whenever an axis moves to end.

IV. Software requirement:

Two type of software's are used one is for creating G-code and another is for controlled printer wireless.

1. Cura:

Cura can be used with almost any 3D printer because it is an open-source slicer.

A so-called slicer takes a 3D drowing and translates this model into individual layers. Then generate the match in code that the printer will use for printing.

Producing a digital model is the first step in the additive manufacturing process. The most common method for producing a digital model is computer aided design (CAD).

It is requirement to convert a CAD model into an STL file. Once STL file has been generated the file is imported into a slicer program.

This program takes STL file and converts it into G-code. G-coded is numerical control (NC) programming language. The slicer program also allows the designer to customize the build parameters including support. Layer height, and part orientation.

2. **Octoprint:**

OctoPrint provides a web interface for controlling 3D printers, allowing the user to start a print job by sending G-code to a 3D printer connected via USB. It is monitors the status of print job, as well as the printer itself, primarily the temperature of the print head and the temperature of the bed, if the bed on the printer is heated.

All 3D printers need host software to function. Host software is responsible for sending the actual commands to the 3D printer that tell the printer how to build an object. An increasing number of 3D printer operators are looking for ways to use their 3D printers remotely.

V.   Results:

VI.   Conclusion :

This paper shows the how to converting the virtual 3d model into a physical object. Additive manufacturing is a method of manufacture where layers of material are built up to create a solid object. Main objective of this project is to controls 3d printers aspects remotely.
An increasing number of 3D printer operators are looking for ways to use their 3D printers remotely. The system is IoT based octoprint provides a web interface for controlling 3D printers. Wireless 3D

printer has number of advantage over the traditional wired setup. You no longer need to use an SD card to copy files from your computer to your 3D printer. It enables wireless printing on your network.

VII.   References :

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