

# Standalone 3D Printer with Interlaced Scanning

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## ABSTRACT

3D printers are now being used everywhere from simple prototyping to complex product creation. However, there still are a lot of hurdles to overcome for a much wider adaptation of such printers. One of the biggest problems is the difficulty in 3D model creation. It takes a lot of experience to create such models also, most of the 3D model creating software available today comes at a high price tag. To help with this, 3D scanners are available, but these scanners are sold separately and come at a high price. To solve these problems, a 3D printer with an integrated 3D scanning is proposed here.

**Keywords:** 3D Printing, Kinect, Scanning.

## I. INTRODUCTION

3D printing or additive manufacturing is a process of making three dimensional solid objects from a digital file. The creation of a 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 entire object is created. Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object. It has a vast future potential and is an emerging technology, still at its infancy. 3D printers create things, the possible things that can be made with 3D printers are infinite. However one of the biggest challenges for adopting 3D printer to households is the difficulty in making 3D models and the cost of 3D modelling software Here we try to avoid this problem to an extent by integrating a 3D scanner to the printer so that models can be easily created. In this work, we integrate a 3D scanner along with the printer to produce a standalone device that can scan and print objects without much hassle. In this approach, we use a Kinect sensor as the 3D camera, due to it's high availability and comparatively lower price. The approaches taken to extract the depth information from 3D scanner and to produce a viable 3D model from the noisy and the aliased depth information provided by Kinect is mentioned in the paper. Okarma, in his work has introduced some algorithms applied for the

calibration of the 3D scanning system and image analysis in the experimental system for positioning the work pieces on the CNC machines. [1] Jin Zhou, Ligang, Zhigeng Pan and Hao Yan, in their work, discusses about depth camera such as Microsoft Kinect, which is much cheaper than conventional 3D scanning devices, and thus it can be acquired for everyday users easily. However, the depth data captured by Kinect over a certain distance is of extreme low quality. In this work, a novel scanning system for capturing 3D full human body models by using multiple Kinects is proposed. [2] In Chaoching Ho's work [3], the study presents a low-cost scanning system for acquiring 3D geometry and texture information of large objects and for performing multiscanning patch registration to obtain a whole realistic 3D model. The proposed system is composed of a line stripe laser and a colour CCD camera.

## II. METHODS AND ANALYSIS

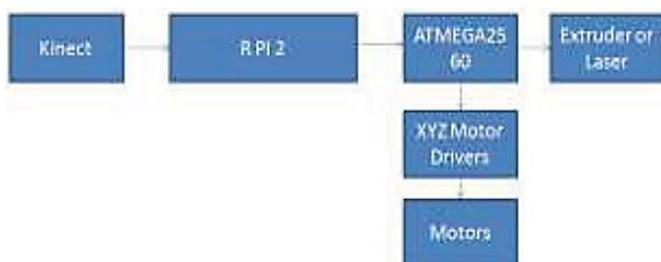
### 1. How Does 3d Printing Work

To 3D print an object, a digital model first needs to exist in a computer. This may be fashioned by hand using a computer aided design (CAD) application, or some other variety of 3D modeling software. Alternatively, a digital model may be created by scanning a real object with a 3D scanner, or perhaps by taking a scan of

something and then tweaking it with software tools. However the digital model is created, once it is ready to be fabricated some additional computer software needs to slice it up into a great many cross sectional layers only a fraction of a millimeter thick. These object layers can then be sent to a 3D printer that will print them out, one on top of the other, until they are built up into a complete 3D printed object. Firstly, there are 3D printers that create objects by extruding a molten or otherwise semi-liquid material from a print head nozzle. Most commonly this involves extruding a continuous stream of hot thermoplastic that very rapidly sets after it has left the print head. There are even experimental 3D printers that output a computer-controlled flow of liquid concrete, and which may in the future allow whole buildings to be 3D printed. A second category of 3D printer creates object layers by selectively solidifying a liquid – known as a „photopolymer“ that hardens when exposed to a laser or other light source. Some such „photo polymerization“ 3D printers build object layers within a tank of liquid photopolymer. A final category of 3D printing hardware creates objects by selectively sticking together successive layers of a very fine powder. Such „granular materials binding“ can be achieved either by jetting a liquid glue or „binder“ onto each powder layer, or by fusing powder granules together using a laser or other heat source.

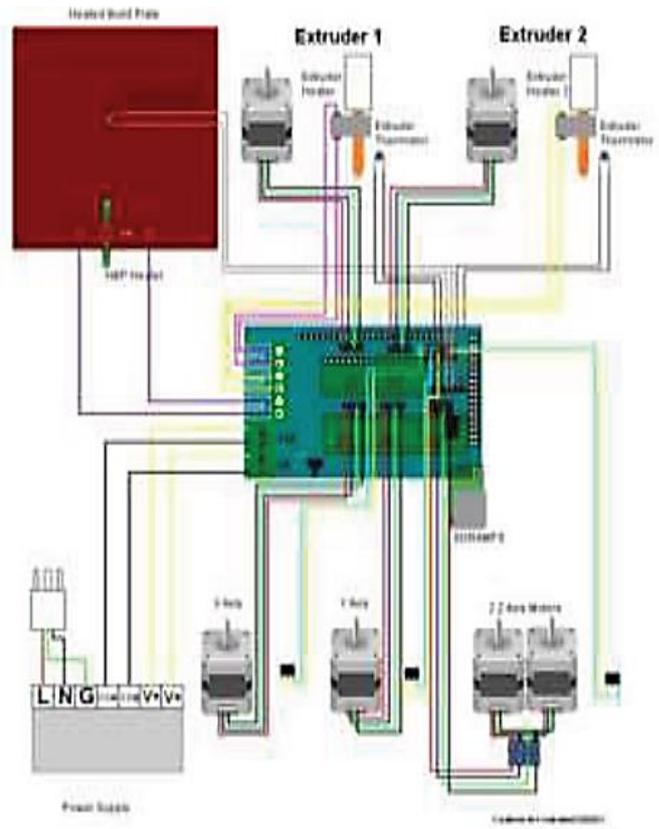
## 2. Proposed Methodology

**A. Block Diagram** The proposed plan of action is to use a powerful single board computer like Raspberry Pi 3 to acquire 3D images from a 3D camera, to process it, segment the image into printable layers and to send the commands to control the printer motors. The 3D scanning is done by a 0003D camera introduced by Microsoft called Kinect. The Kinect is a low cost 3D scanner and this can be integrated to the project for easy scanning



**Figure 1.** Block Diagram of the System

## B. Circuit Diagram



**Figure 2.** Circuit Diagram

**C. Overall Working** The single board computer (Raspberry Pi 3) is at the heart of the system. It does all the calculations for controlling the motors to create the particular layer. The mechanical and electronics of the printer are forked from the RepRap open source 3D printer project. The Raspberry Pi communicates with the microcontroller on board using G codes sent via UART port. G codes is the language used to communicate with CNC machines and the RepRap project uses this convention in its printers. Kinect is connected to the Pi using open source Kinect device drivers. Layer processing and segmentation is done using another open source image processing library called the OpenCV.

## 3. Hardware

### Electronic Components

#### 3.1 Kinect

Kinect is used as the 3D scanner in this project, it was introduced by Microsoft as an add-on to its gaming console (Xbox) to identify humans and use their natural

motions and gestures to control the game. It's made of two main parts: an IR projector and an IR VGA camera. The IR camera is used to identify the distortions caused in the image pattern projected by the camera, this contains information about the depth, and this is further processed by the electronics on-board Kinect to create a "depth map" of its field of view.



**Figure 3.** Kinect

3.2. The Controller - There are two controller sections in the project one is the R Pi2 and the other one is an 8-bit microcontroller from Microchip known as ATmega2560. The R Pi does all the complex computations and works while the 8-bit microcontroller is used to interface with the stepper motor.

3.3. Heated Bed - The print bed is what the printer extrudes plastic onto, where the plastic parts are built up.

3.4. Stepper Motor – To produce precise motion the RepRap project uses stepper motors. Although they are open loop and no care is given to provide positional feedback, except for a home position made by limit switches, the positional accuracy is quite high. It uses four stepper motors. Three or four motors control the x/y/z axis movement and one motor is used per extruder. All the motors are controlled by the A4988 stepper motor with 16 microstep.

### III. RESULTS

3D printing has been done successfully implemented on Raspberry Pi. The slicing and layering is done and is connected to the printer via serial communication.

### IV. CONCLUSION

The significance of 3D printing is ramping up as the more and more applications of 3D printing are

introduced daily. They can be even used to create more 3D printers. In this paper, a simple method was introduced to create an integrated 3d printer and scanner. The method should be still sufficient for most of the basic 3D printing applications.

### V. REFERENCES

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