

3D Construction Printer

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3D Printing is one of the most promising developments of today. 3D Concrete printing results in a low cost and highspeed construction method and allows building objects of virtually any size, without compromising printing resolution or speed little is known. In addition, in our project we can make a small samples of big things like homes and shelters, so by implementing as fast as possible the project we save the homeless people to have homes as fast as we can, Homes take months to be completed in traditional way but by 3D printing it will take a few days.

Keywords: 3D printing - Construction – Shelters – Homeless - Traditional.

I. INTRODUCTION (HEADING 1)

One of the biggest and most serious problems in the world is *HOMELESSNESS*. Homelessness is not a single person's personal issue nor does it affect people in the same way. All the nations are facing the same crisis of homelessness and poverty. Homelessness can be defined as living in the street, staying overnight in a temporary shelter, staying in places not meant for human habitation or living in housing that is below the minimum standard or lacks secure tenure.

Homelessness is a problem virtually every society suffers from. Homelessness in Egypt is a major social problem that affects some 12 million people in the country. Egypt has over 1,200 informal housing areas that do not comply with normal construction rules, allowing homeless people to build shacks and other shelters for themselves. According to UNICEF, there are 1 million children living on the streets in Egypt.

II. Literature Review

Stereolithography, first technology of 3D printing. was born in 1983. Stereolithography is a technology that can build objects with a high level of details, smooth surface finishes, and tight tolerances and extremely complicated geometry and that's the reason why it is used in many fields like for example: medicine, automotive and plane industry, and even art and design.[1]

Stereolithography uses an ultraviolet (UV) laser to solidify a thin layer of resin. Similar technique for 3D printing is selective laser sintering (SLS). In 1988, Fused Deposition Modeling FDM was invented by S. Scott Crump.

FDM is a technology where ductile materials which are hardening itself during cooling process, are extruded through double headed nozzle.

III. SYSTEM DESIGN

The project consist of 2 phases (Hardware phase and Software phase) the hardware phase (4 axes , Standard Linear Guide Rail, Standard linear bearing, Ball Screw 1605 with Nut, Nut Housing, Stand For Stepper Motor, BF12,Bk12,4 stepper motors (Nema 34 closed loop)) and the software phase (Arduino Mega 2560 , Ramps 1.4 , LCD , limit switch , closed loop stepper motor driver , power supply) when we put the design into the slicer it turns to G-code and our machine read the G-code and begin to build the design.

The block diagram is shown in Fig. 1.

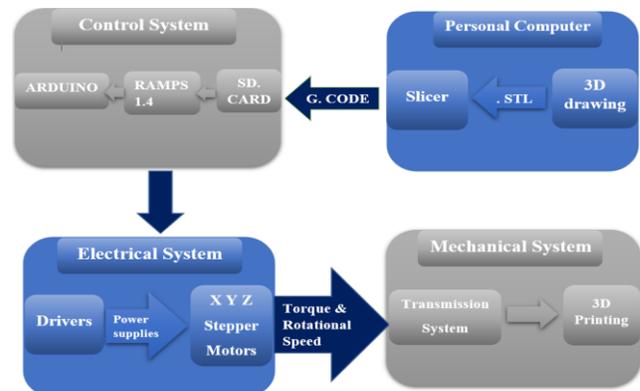


FIG.1 BLOCK DIAGRAM OF PROJECT DESIGN

IV. HARDWARE DESIGN

We connect our Arduino mega to ramps 1.4 to help us in connections and the ramps 1.4 has the connections of each axis we connect all the -ve of each axis to the ground and each +ve such as (pulse , enable and direction) each one has its own connect and for more safe we have limit switches in case the machine doesn't respond .

The Wiring diagram is shown in Fig. 2

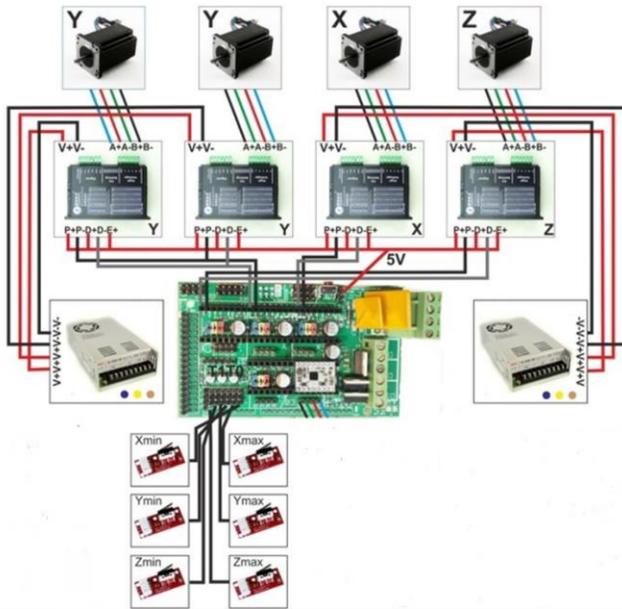


Fig. 2 wiring diagram of the project

V. SOFTWARE DESIGN

For example we need to print house so we make the design on any cad program such as 3D max or solid works and we get the outout .STL file and put it in the slicer program such as Cura we get the output G-code and give this code to the machine then it begin to print the house The Sequence to print the design is shown in Fig. 3.

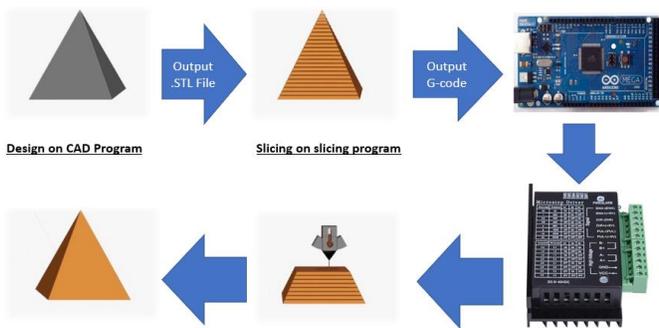


Fig.3 printing stages

VI. MATERIAL AND METHODS

A key characteristic 3D printing of concrete is the interdependency of the design, material, process and product properties. The printing speed, pump pressure, other factors are influenced by the setting reaction of concrete.[2]

Concrete mix must be designed to meet certain characteristics which are : - Concrete must be printable; that is, they must conserve fresh-state workability for as long as required to be pumped easily - Upon extrusion, the material must be sufficiently firm to maintain their shape under their own weight. - It must develop strength in a short period to support the weight of the successive layers applied during printing. - They must not harden too rapidly; however, ensuring cohesion between successive layers can only be guaranteed if both the lower and upper layers are fresh. The starting point for any 3D printing process is a 3D digital model, which can be created using a variety of 3D software programs. The model is then 'sliced' into layers, thereby converting the design into a file readable by the 3D printer. The material processed by the 3D printer is then layered according to design and process. In the construction industry, the most common software platform that is used is Building Information Modeling (BIM). Material and methods is shown in Fig. 3.

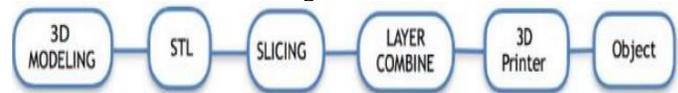


FIG. 3

VI. RESULT

The company who buy this machine will be able to build houses or shelters or any thing in easy way and more safe and with affordable price in short time compred with the tradtional way as we can build a house in less than 24H , and this machine we can use it as a multi function machine as we can change the nozzle head and put the new head of the new shape that we want to print .

Conclusion

The construction 3D printer can be used in many things as it is expected that governmental agencies and construction companies would go for 3D printing procedure to construct their future structures and can build safe shelters. This technology is:

- > First time technology in Egypt.
- > Less time.
- > Not costly.
- > Faster and more accurate construction method.
- > More safe.

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REFERENCES

- 1-<https://yaleglobal.yale.edu/content/cities-grow-so-do-numbers-homeless>
- 2-<https://homelessworldcup.org/portfolio-posts/egypt/> :text=Homelessness
- 3- .Manju R, Deepika R, Gokulakrishnan T, Srinithi K, Mohamed MI "A Research on 3d Printing Concrete"
- 4- S. El-Sayegh · L. Romdhane · S. Manjikian "A critical review of 3D printing in construction: benefits, challenges, and risks"
- 5- Izabela Hager, Roman Putanowicz "3D Printing of Buildings and Building Components as the Future of Sustainable Construction?"
- 6- R.J.M. Wolfs "3D PRINTING OF CONCRETE STRUCTURES"
- 7- Guilherme Ruggeri Pereira, Fernando Gasi, Sérgio Ricardo Lourenço "Review, Analysis, and Classification of 3D Printing Literature: Types of Research and Technology Benefits"
- 8-<https://www.sculpteo.com/en/glossary/lom-definition/> :text=Laminated
- 9- Miriam R. Simon Cater, B.S, M.F.A "Permeability and Porosity Reduction of Fused Deposition Modeling Parts via Internal Epoxy Injection Methods"
- 10- Michael Montero, Shad Roundy, Dan Odell, Sung-Hoon Ahn and Paul K. Wright1 "Material Characterization of Fused Deposition Modeling (FDM) ABS by Designed Experiments"
- 11- Neil Leach, Anders Carlson, Behrokh Khoshnevis and Madhu Thangavelu "Robotic Construction by Contour Crafting: The Case of Lunar Construction"
- 12- Mohammad Reza Khorramshahi , Ali Mokhtari "Automatic Construction by Contour Crafting Technology"