

Implementation of 3D Scanner Using IR Distance Sensor

Mahesh Parde¹, Karan Khankal², Thotya S.³, R.S. MESHARAM⁴

ELECTRONIC & TELECOMMUNICATION KGCE KARJAT INDIA

ABSTRACT

As we look throughout history, the wealthy and privileged have had access to useful technologies, before the masses. When cars, televisions, and even computers first entered the market, they were revolutionary but overpriced. This discouraged people from acquiring them. These technologies are not necessities to life, but they play big roles in making life more convenient. 3D scanners are relatively new technologies that have many useful applications, but yet very few people own them, mostly due to the expense of the product. We will talk about a way to create a cheap standalone 3D scanning system, which through the use of processing information taken by a camera and line IRs, can create digitized 3D models. These models can be used in digital animation or printed with 3D printers for a wide variety of applications. Many different technologies can be used to build these 3D scanning devices; each technology comes with its own limitations, advantages, and costs. Many limitations in the kind of objects that can be digitized are still present: for example, optical technologies encounter many difficulties with shiny, mirroring, or transparent objects. There are several different kinds of 3D IR scanners, with prices ranging from the couple thousands to the hundreds of thousands.

Keyword: - *Keywords of paper – MATLAB, Stepper motor, Object, IR sensor, scanning, Arduino, MicroSD card.*

1. MOTIVATION

The research of 3D reconstruction has always been a difficult goal. Using 3D reconstruction one can determine any object's 3D profile, as well as knowing the 3D co-ordinate of any point on the profile. The 3D reconstruction of objects is a generally scientific problem and core technology of a wide variety of fields, such as CAD, CAM, reverse engineering, medical imaging, computer graphics etc. For instance, the lesion information of the patients can be presented in 3D on the computer, which offers a new and accurate approach in diagnosis and thus has vital clinical value.

When it comes to 3D scanning, thoughts often tend towards the endless opportunities to study things and shapes that were previously impossible. However, 3D scanning is also a perfect technology for fixing the previously unfixable. The purpose of a 3D scanner is usually to create point cloud of geometric samples on the surface of the subject. These points can then be used to extrapolate the shape of the subject (a process called reconstruction). If colour information is collected at each point, then the colours on the surface of the subject can also be determined. The "picture" produced by a 3D scanner describes the distance to a surface at each point in the picture. This allows the three dimensional position of each point in the picture to be identified.[1]

1.1. Basic Concept

The main idea behind this project is to obtain the outer surface of the object. IR line will take the outer shape of the thin part of an object. A camera positioned at a know angle captures an image of the object. And send it somehow to the PC "to be tilled later" Then rotate the object so that IR line covers another part of the object, repeat these steps until the whole object is scanned. At PC side prepare the pictures remove everything except the lighted part of the object. Then group all pictures together each in its correct position as its distance from the IR rod. The result is a digital image similar to the word object shape.[3]

1.2 Existing system

It takes 18-20 minutes to scanned the complete object in the existing system. The cost is very high which is around 30-35k. And it has comparatively large size. It uses contact technique which suffer from slow scan rates and may not be ideal for delicate objects such as precious artworks.[2]

Proposed System

- In our project we try to reduce the scanning time from 18-20 minutes to 10-12 minutes.
- The cost price will be of 10k (max.)
- It will be of smaller size and hence portable.
- We use MATLAB software to obtain output.
- We use Non-Contact active technique.

2. BLOCK DIAGRAM:

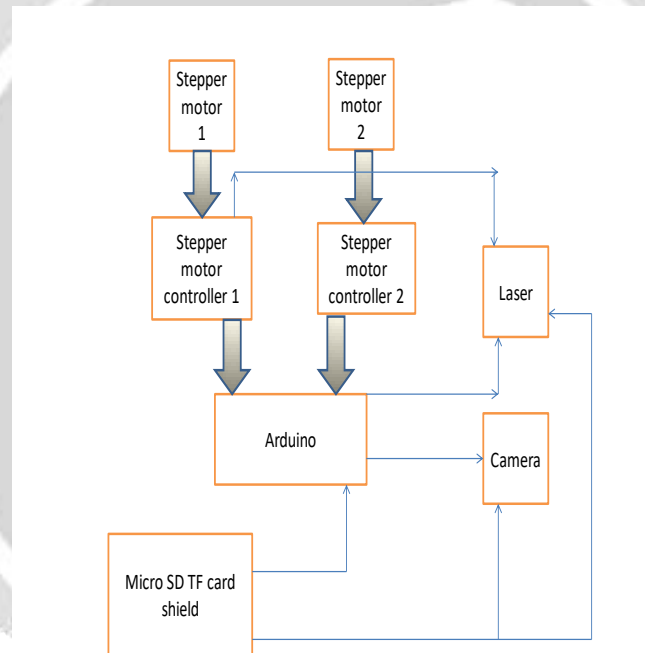


Fig.1 Block diagram of 3D scanner

Working

Active scanners emit some kind of radiation or light and detect its reflection in order to probe an object or environment. 3D IR Scanning or 3D IR Scanners can generally be categorized into three main categories; time of flight, phase shift, and IR triangulation.

These IR-scanning techniques are typically used independently but can also be used in combination to create more versatile scanning system

Research objective

3D IR scanning is a progressive method of reverse engineering. It makes possible to capture form of any object. Digitizing of 3D shape using IR scanning head is a new method, which is being applied especially in metrology, various simulation calculations, reverse engineering and not least in design and art.

Scope of study

- Increase effectiveness working with complex parts and shapes.
- Help with design of products to accommodate someone else's part.
- If CAD models are outdated, a 3D scan will provide an updated version.
- Replacement of missing or older parts.
- Large cost savings when conducting as built design services in Automotive.
- Manufacturing Plants.[5]

2. 2 HARDWARE IMPLEMENTATION:

It uses two stepper motor, 1 and 2. two stepper motor controller, 1 and 2. IR, Arduino, micro SD card.

1. Arduino

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software.

2. Stepper Motor:

A stepper motor or step motor or stepping motor is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any position sensor for feedback (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed.

3. Micro SD Card:

SD Card is used to store the information which is scanned from the object. The information is stored and thus further used for printing purpose.

3. CIRCUIT DIAGRAM:

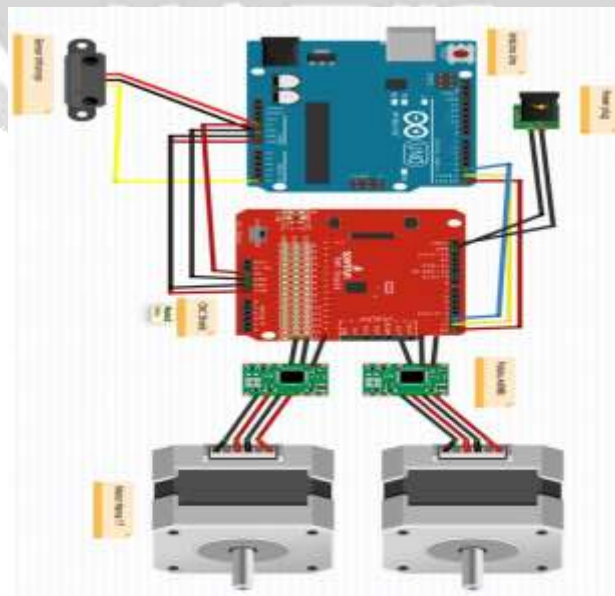


Fig: Circuit diagram of 3D Scanner

4. FLOW CHART:

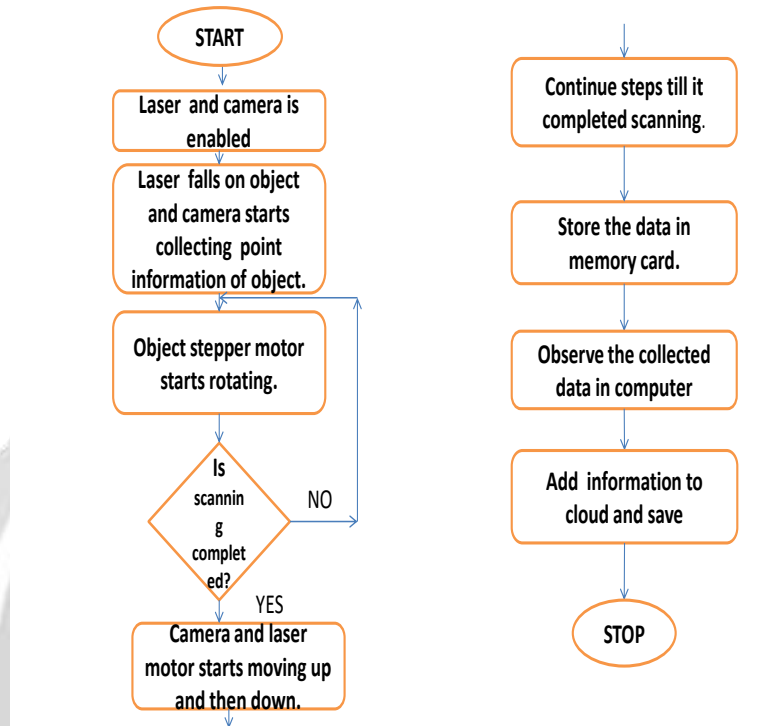


Fig. 3 flow chart of 3D scanner

Explanation

First we give supply and we enabled both camera and laser. Laser light falls on object and at the same time camera start collecting data information which is being scanned by Laser. Object stepper starts rotating so that it scan the different point of an object, it continues till it finish scanning the whole object.

After completing that point the stepper motor of Laser starts moving up and down so that it scan the whole object and all the scanned information is recorded by camera and store in a SD card.

We now check the information which is stored in SD card in computer which we have installed, the MATLAB software. We get the complete idea of the scanned object. Save the data and add the information to the cloud.

5. CONCLUSIONS:

In this project we have constructed a 3D scanner which is better option for existing system. The components used are easily available and mostly cheap. The time taken by the system scanning is also considered to be small here. The 3D scanner are mostly bulky but here we are making this scanner as portable and thus can be used with easily. The use of arduino programming is because of the simplicity so that a normal person with least technical knowledge can also program according to requirement. The use of MATLAB software made the data captured by scanning much easier to store in SD card and use for further application. Thus the system which is proposed is much convenient for the industrial use which require small scale material to be scanned.

6. Output :

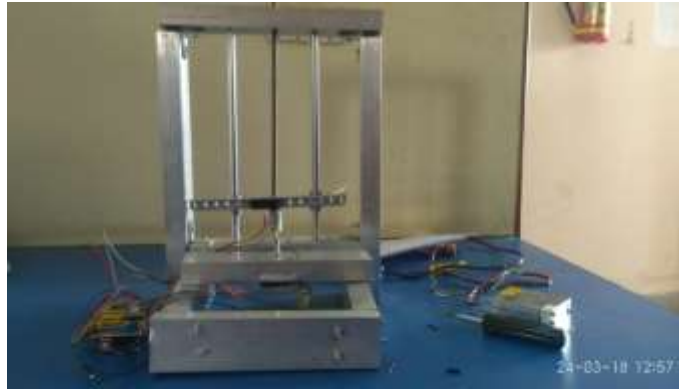


Fig. 4 base of the project (3D scanner)

The above figure is a base frame of the project. It consists of a frame with smooth rod and threaded rod which placed in vertical position(z-axis). It also has a frame for two stepper motor for object and IR sensor respectively.



Fig.5 Arduino, stepper motor and Power supply of 3D scanner.

Arduino is mainly used to control our project it attach with CNC shield with the stepper motor driver. Stepper motor is used to rotate the object and IR sensor. For this project we supply 12 V 2A power supply. We test the project before fixing it to the frame.



Fig.6 IR sensor and scanning object

We placed IR distance sensor along with threaded rod in z-axis. It has a smooth rod giving support to the threaded rod which is attached with the coupler and stepper motor. And object motor is placed in x-axis.

7. REFERENCES

- [1]. Research and Development of 3D Modeling , Xi-Dao LUAN, Yu-Xiang XIE, Long YING and Ling-Da WU 'School of Information System and Management, National University of Defense Technology, Changsha 410073'.
- [2]. '3D Laser Scanners' Techniques Overview Mostafa Abdel-Bary EBRAHIM Professor, Civil Engineering Department. Faculty of Engineering - Rabigh, King AbdulAziz University. Kingdom of Saudi Arabia. Impact Factor (2014).
- [3]. 3D Scanner MRD Project Report, Vangjel F. Author, CSE, Siyan L. Author, EE, Chenkai Z. Author, EE.
- [4]. 3D Laser Scanner Prince Khatarkar, Rahul Gupta and AyushShakya. IIT Kanpur, 19 June 2004
- [5] 3D LASER SCANNERS: HISTORY, APPLICATIONS, AND FUTURE. Article · October 2014 *with* 8,2014.
- [6] A low cost 3D scanner based on structured light C. Rocchini, P. Cignoni, C. Montani, P. Pingi and R. Scopigno Istituto di Scienza e Tecnologie dell'Informazione (ISTI)-Consiglio Nazionale delle Ricerche, C.N.R., Pisa, Italy. EUROGRAPHICS 2001 / A. Chalmers and T.-M. Rhyne.
- [7] FAST 3D SCANNING METHODS FOR LASER MEASUREMENT SYSTEMS, Oliver Wulf, Bernardo Wagner. 2003 – lars.mec.ua.pt.
- [8] A Literature Review on Low Cost 3D Scanning Using Structure Light and Laser Light Scanning Technology Rohit Gupta 1, Himanshu Chaudhary 2 Master Student, Department of Mechanical Engineering, Sri Sai College of Engg. and Technology, Badhani Pathankot, India. July 2017.
- [9]. Characterization of a Large, Low-Cost 3D Scanner Jeremy Straub 1,*, Benjamin Kading 2, Atif Mohammad 1 and Scott Kerlin 11 Department of Computer Science, University of North Dakota, 3950 Campus Road, Stop 9015, Grand Forks, ND 58202, USA 2 Department of Mechanical Engineering, University of North Dakota, 243 Centennial Drive, Stop 8359, Grand Forks, ND 58202, USA. 30 January 2015.