International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 04, April-2021

A Novel Approach of 3D Surface Mapping using Lidar Technology and Output Data is used in Combat Strategies in Defence

Roshani Katara
M. Tech Research Scholar
R.B.S. Engineering Technical Campus Bichpuri
Agra, U.P., India.

Dushyant Singh
Professor
R.B.S. Engineering Technical Campus Bichpuri
Agra, U.P., India.

***Abstract*:- In this paper we present a 3D object detection by using LIDAR (Light Detection and Ranging). This project based on LIDAR. LIDAR (Light Detection and Ranging) is employed as remote sensing method which uses light within the type of a pulsed laser to live ranges. With variety of military and Arial applications, LIDARs are widely used nowadays. This advanced LIDAR-based military system will be wont to monitor local patch area and may also scan suspicious things at remote locations if it is mounted on robot or drone. LIDAR makes use of light in the form of a pulsed laser to measure ranges. It makes a 3D image formed by coordinated scanned through it. We can use this 3D image for further processing and decision making.**

Keywords:- LIDAR, 3D Object, 3D Object Detection, LIDAR Based Object Detection, LIDAR Techniques, LIDAR Based Technology.

I. INTRODUCTION

Aerial images are widely used in frontline defence forces to make best combat plan. But aerial images have not topographic maps. A topographic map with accurate details gives accurate view about interested area. Some algorithms also used to make topographic maps from plain images. But those maps are not as good as they need in that situation. It is better to get 3D aerial images of area. LiDAR is an important sensor in 3D detection system. It captures 3D scene information as sparse and irregular point clouds, which provide vital cues for 3D scene perception and understanding [1].

3D Object Detection on LiDAR data is a rich growing area of research, and new developments are happening rapidly.

Airborne Laser Surveying (ALS) or LIDAR (Light Detection and Ranging) becomes more and more popular because it provides a rapid 3D data collection over a massive area. The captured 3D data contains terrain models, forestry, 3D buildings and so on. Current research combines other data resources on extracting building information or uses pre-defined building models to fit the roof structures. However we want to find an alternative solution to reconstruct the 3D buildings without any additional data sources and predefined roof styles. Therefore our challenge is to use the captured data only and convert them into CAD-type models containing walls, roof planes and terrain which can be rapidly displayed from any 3D viewpoint [2].

II. RELATED WORKS

A. **Vandana_V, Vidya_B, and Yashaswini_S** This paper presents a simple and cost effective 3-dimensional (3D) mapping of internal structures using Light Detection and Ranging (LiDAR). LiDAR is being controlled in such a way to measures the distance and angles from both servo motors simultaneously on which LIDAR is mounted. These values help to calculate and draw a 3D image of the internal structure. 3D mapping using photogrammetry technique is very sophisticated, time-consuming and costly. The accuracy in photogrammetry process is not acceptable in some cases. 3D mapping provides a very realistic view that enhances the visualization. It has many applications in the field of research, survey, and engineering [3].

B. **Bharat Lohani, Suddhasheel Ghosh** Airborne light detection and ranging (LiDAR) has now become industry standard tool for collecting accurate and dense topographic data at very high speed. These data have found use in many applications and several new applications are being discovered regularly. This paper presents are view of the current state-of-the-art of this technology. The paper covers both data capture and data processing issues of the technology. The paper first discusses various types of LiDAR sensors and their working. This is followed by information on data format and data quality assessment procedures. The paper reviews the existing data classification techniques and also looks in to the new approaches like convolutional neural networks and visual analytics for data processing. Finally, the paper outlines future scope of the technology and the research challenges, which should be addressed in coming years [4].

C. **David Veneziano, Reginald Souleyrette, Shauna Hallmark** Surface terrain in formation is required to economically site new or relocate existing infrastructure facilities and make final

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design plans. Currently, field surveying and photogrammetric mapping are the most widely used methods to acquire these data. However, these methods are time and resource intensive assign if I can't data collection and reduction is required to provide the level of detail necessary for facility location and design. Light Detection and Ranging (LIDAR) is a relatively new alternative technology to obtain terrain information more efficiently. With LIDAR, data can be collected under a variety of environmental conditions, including low sun angle, cloudy skies, and even darkness, resulting in expanded windows for data collection. While less accurate than photogrammetric mapping, LIDAR presents the opportunity to expedite the highway location and design process by providing designers with preliminary terrain information earlier in the process. This paper presents a proposed methodology for utilizing LIDAR in conjunction with photogrammetric mapping to speed up highway location and design activities, including estimates of time and cost savings [5].

D. **Baifen Chen, Hong Chen, Dian Yuan, Lingli Yu** The object detection algorithm based on vehicle-mounted LIDAR is a key component of the perception system on autonomous vehicles. It can provide high-precision and highly robust obstacle information for the safe driving of autonomous vehicles. However, most algorithms are often based on a large amount of point cloud data, which makes real-time detection difficult. To solve this problem, this paper proposes a 3D fast object detection method based on three main steps: First, the ground segmentation by discriminant image (GSDI) method is used to convert point cloud data into discriminant images for ground point's segmentation, which avoids the direct computing of the point cloud data and improves the efficiency of ground point's segmentation. Second, the image detector is used to generate the region of interest of the three-dimensional object, which effectively narrows the search range. Finally, the dynamic distance threshold clustering (DDTC) method is designed for different density of the point cloud data, which improves the detection effect of long-distance objects and avoids the over-segmentation phenomenon generated by the traditional algorithm [6].

Various 3D mapping system are available in the market but all of them can make only small area 3D data that is perfect for 3D printing but if we need wide area data we are out of options. Versatile researches are doing in this area as our system can of research to make data more cohesive as well as accurate. Infrared sensor methods can be used only for obstacle detection. If any 3D map can be formed by this method it is very rough and get very low density of points. Second method is used ultrasonic transducer where an echo of ultrasonic sound detects the distance and get the 3D points from angular movement this method is better than infrared method. But with Lidar technology we can detect more 3D points in a small area compare to the other two methods.

III. METHODOLOGY USED

This project consists of two parts. The First part handles all the servo movements and gets measurement readings from the Lidar sensor and ultrasonic sensor. Second part does the spherical to Cartesian point's conversion and renders them in 3D using web based graphics library WebGL. Both modules communicate with each other over the serial port.
There are two servo motors are used in first part. One motor will used for Yaw and another motor is used for Pitch side movement.

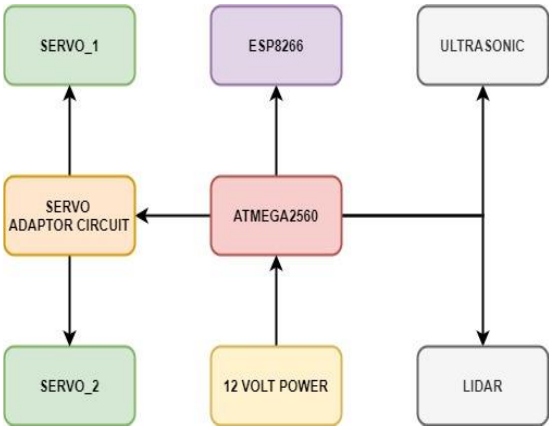

Fig.1 Block diagram

IV. HARDWARE'S DESCRIPTIONS

A. LIDAR :

Lidar could be a method for determining ranges (variable distance) by targeting an object with a laser and measuring the time for the reflected light to return to the receiver. Lidar may be accustomed make digital 3-D representations of areas on the surface and bed, because of differences in laser return times, and by varying laser wavelengths. It's terrestrial, airborne, and mobile applications.
Lidar is an acronym of "light detection and ranging or "laser imaging, detection, and ranging". Lidar sometimes is termed 3-D laser scanning, a special combination of a 3-D scanning and laser scanning.
Lidar is often wont to make high-resolution maps, with applications in surveying, geodesy, geomatics, archaeology, geography, geology, geomorphology, seismology, forestry, atmospheric physics,[4] laser guidance, airborne laser swath mapping (ALSM), and laser altimetry. The technology is additionally employed in control and navigation for a few autonomous cars.

Fig.2 LIDAR Module

B. Wemos Module:

It is a mini WIFI board supported ESP-8266EX. 11 digital input/output pins, all pins have interrupt/PWM/I2C/one-wire supported (except D0) 1 analog input (3.3V max input) and a Micro USB connection. The Wemos D1 Mini may be a great board to develop Wi-Fi based IoT Projects. It uses the favoured ESP8266 Module for its IoT operations. May be easily programmed through USB and requires no additional programmer. This board allows you to jumpstart your IoT Development by letting you concentrate all of your time and energy on software development.

Fig.3 Wemos Module

C. Servo Motor:

A servo motor may be a variety of motor which will rotate with great precision. Normally this kind of motor consists of an impact circuit that gives feedback on the present position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you wish to rotate an object at some specific angles or distance, then you employ a servo motor. It’s just made from an easy motor which runs through a servo mechanism. If motor is powered by a DC power supply then it's called DC servo motor, and if it's AC-powered motor then it's called AC servo motor.

Servo motors are rated in kg/cm (kilogram per centimetre) most hobby servo motors are rated at 3kg/cm or 6kg/cm or 12kg/cm. This kg/cm tells you ways much weight your servo motor can lift at a specific distance. For example: A 6kg/cm Servo motor should be able to lift 6kg if the load is suspended 1cm off from the motors shaft, the greater the space the lesser the load carrying capacity. The position of a servo motor is set by electrical pulse and its circuitry is placed beside the motor.

Fig.4 Servo Motor

D. Ultrasonic Sensor: An ultrasonic sensor is a device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and therefore the receiver (which encounters the sound after it's travelled to and from the target).

In order to calculate the gap between the sensor and therefore the object, the sensor measures the time it takes between the emissions of the sound by the transmitter to its contact with the receiver.

Fig.5 Ultrasonic Sensor Module

E. 16x2 LCD:

An LCD is an electronic display module that uses liquid to supply a visual image. The 16×2 LCD display could be a very basic module commonly employed in DIYs and circuits. The 16×2 translates to a display 16 characters per line in 2 such lines. During this LCD each character is displayed in a very 5×7 pixel matrix.

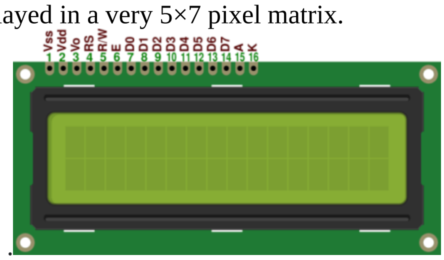

Fig.6 16x2 LCD Display

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F. Arduino Mega:

The **Arduino Mega 2560** is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila [7].

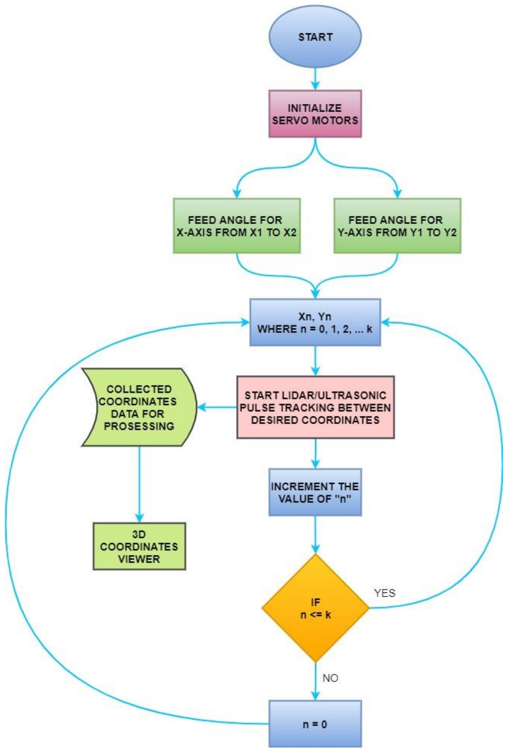
Fig.7 Arduino Mega Board

G. LM2596 Module:

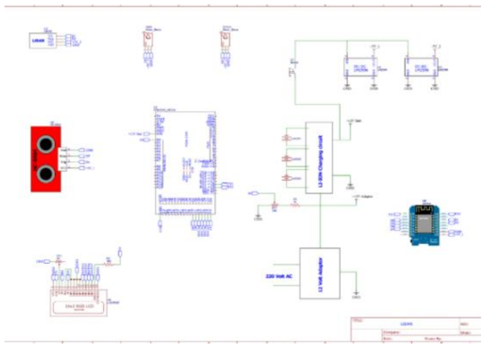
DC-DC Buck Converter Step down Module LM2596 Power Supply is a step-down (buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version. The LM2596 series operates at a switching frequency of 150 kHz, thus allowing smaller sized filter components than what would be required with lower frequency switching regulators [8].

Fig.8 LM2596 Module

V. FLOW DIAGRAM

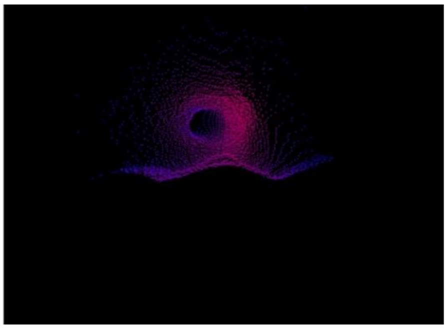


VI. CIRCUIT DIAGRAM



VII. RESULTS

The scanned objects are displayed as a point cloud in the browser.



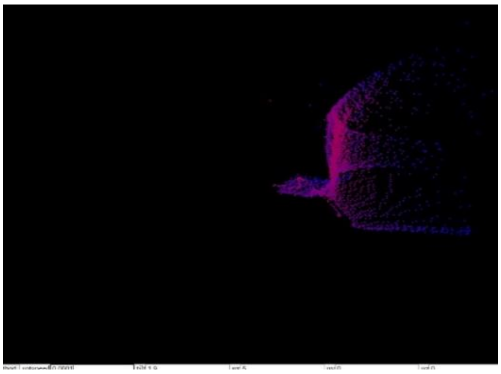


Fig.9 scanning result of an Object

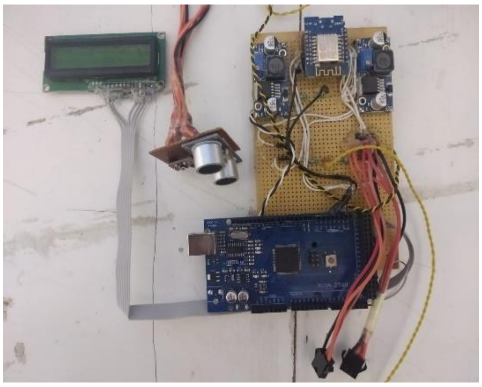


Fig.10 Complete Project Image

VIII. APPLICATIONS

The LIDAR scanning is used in various fields and academic research. It is used in numerous applications: Industrial, Architectural, Civil surveying, urban topography, reverse engineering, archeology, mechanical dimensional inspection and virtual reality applications.

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