LIDAR SYSTEM FOR 3D SCANNING FOR AUTONOMOUS DRIVING CAR

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ABSTRACT

Autonomous automated vehicles are the next evolution in transportation and will improve safety, traffic efficiency and driving experience. Automated vehicles are equipped with multiple sensors (LIDAR, radar, camera, etc.) enabling lo- cal awareness of their surroundings. A fully automated vehicle will unconditionally rely on its sensors readings to make short-term (i.e. safety-related) and long-term (i.e. planning) driving decisions. In this context, sensors have to be robust against intentional or unintentional attacks that aim at lowering sensor data quality to disrupt the automation system. LIDAR is a system that uses rotating laser beams. This technology is being used in the experimental autonomous vehicle being developed by BMW, as well as those by Google, Nissan and Apple. This laser-based system will have to come down enough in price in order to be used in mass-market cars. In the next few years it will.

Keyword: - *LIDAR, Embedded Board, Bluetooth, Camera, robot, VELODYNE, BMW, ford.*

1. INTRODUCTION

VELODYNE has a High Definition LIDAR (HDL) sensor that is able to meet the stringent demands for autonomous vehicle navigation. Their HDL unit provides 360- degree azimuth field of view and 26.5 o elevation field of view, up to 15 Hz frame refresh rate, and a rich point cloud populated at a rate of one million points per second. Light pulses have previously been used to measure distance. This elementary technology emits a light pulse from a laser diode. The light travels until it reaches a target, at which time a portion of the light energy is reflected back towards the emitter. A photon detector is mounted near the emitter and detects this reflected signal. The time difference between the emitted and detected pulse determines the distance of the target. When this pulsing distance measurement system is actuated, a large number of sampled points (designated as a point cloud) can be collected. If there are no targets present, then the light would never return any reflected signal. If the light was pointed towards the ground, then the road surface would provide a signal return. If a target was positioned within the point cloud, then a notch would be seen in the data. The distance and width of the target can be determined from this notch. With this collection of points in the point cloud, a 3D picture of the surrounding environment begins to emerge. The denser the point cloud the richer the picture becomes.

1.1 GOAL OF THE PROJECT

LIDAR was born in the 1960s, just after the advent of the laser. During the Apollo 15 mission in 1971, astronauts mapped the surface of the moon, giving the public the first glimpse of what LIDAR could do. Before LIDAR was even considered for automotive and self-driving use, one of the popular use-cases of LIDAR was archeology. LIDAR provides a ton of value for mapping large-scale swaths of land, and both archeology and agriculture benefitted tremendously from it. The fundamental challenge with the SICK LIDARs (which powered a significant portion of the 2005 challenge vehicles) is that each laser scan is essentially a cut made by a single plane, and so you had to be methodical in how you pointed them. Many teams mounted them on tilting stages, in order to use them to sweep a segment of space. In simple terms: SICK was a 2D LIDAR (a few beams of light in one direction) vs. the modern 3D LIDARs (tons of beams of light in all directions) we know today.

1.2 SCOPE

Throughout the past decade, we have witnessed one of the greatest strides in automobile technology with the focus on autonomous cars. Our application of technology will change as we advance towards the reality of self-driving vehicles. Various techniques will be used to allow vehicles to understand their surrounding environment in a dynamic driving environment, and the vehicle must be able to act in response to specific changes in their environment. These vehicles require a broad range of technologies and infrastructures to operate properly. Each vehicle is required to continuously collect and interpret vast amounts of information. Every system of the car must work with the surrounding environment, and technological advancements must be made to ensure autonomous vehicles work within several contexts.

2. BLOCK DIAGRAM

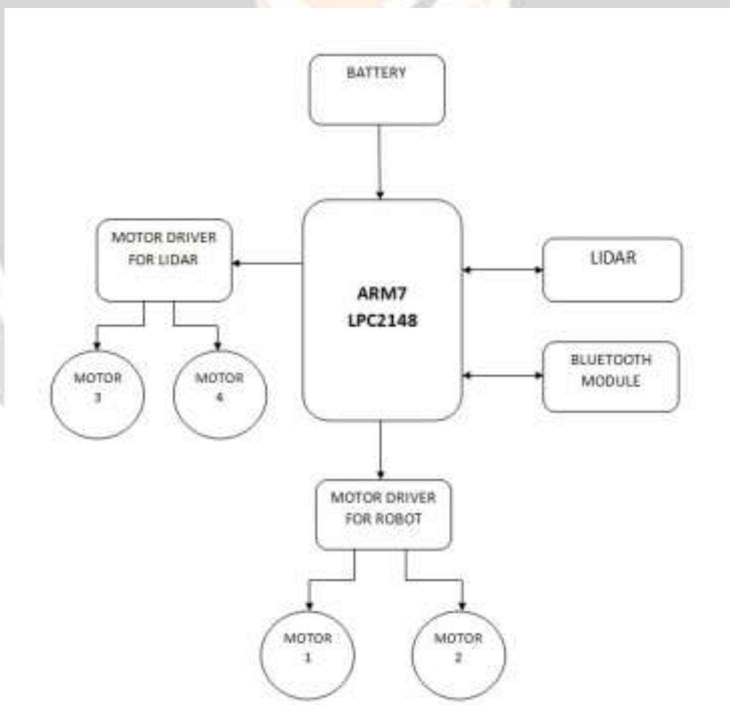

Fig -1: block diagram

We are going to implement this circuit on robot so we need a battery supply. Also we are going to design power supply for backup. Circuit needs a supply of 12v dc and 5v dc. A battery of 12v and 2 amp is used which will be sufficient for the circuit. ARM7 LPC2148 is the main control unit of this circuit. To which all sensor and motor are interfaced. LIDAR is a serial communication device which would give serial data to arm7 through Rx Tx pins. It would send the distance of objects in front of it to ARM7. We would program ARM7 to read this distance and move the wheel of robot. This data would be send to android application also. A Bluetooth module hc-05 is interfaced to ARM7 through serial communication. This would be plotted in form of graphs on android phone. A motor driver ICs are used to rotate the motors. 2 motor are used to move the vehicle and 2 motors are used to move the lidar. These are l293d IC which can operate 2 dc motors at a time. When supply is given to the circuit the lidar will start scanning the surrounding and calculating the distance of the objects surrounding to it. This same data will we display on android app in the form of 3d picture which would give the exact distance to the driver about the object.

2.1 BLUETOOTH MODULE

This module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connections. The Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. The Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. it uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature). It has a footprint as small as 12.7mmx27mm.Hopefully it will simplify your overall design/development cycle.

2.2 TYPES OF MOTORS

There are two types of Motors used in LIDAR Sensors: DC Motor and Servo Motor. A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields Small DC motors are used in tools, toys, and appliances. A servo motor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. Servo motors are used in applications such as robotics, CNC machinery or automated manufacturing.

- DC MOTORS
- SERVO MOTORS

3. LIDAR

Fig-2: LIDAR Sensor

LIDAR is a tool to measure the shape and contour of the ground and environment. It bounces a laser pulse off a target and then measures the time (and distance) each pulse traveled. The science is based on the physics of light and optics, measuring wavelengths in nanoseconds. In a LIDAR system, light is emitted from a rapidly firing laser. LIDAR gathers its information by sending out laser light and gathering the light each laser beam generates. Laser light travels and reflects off points of things in the environment like buildings and tree branches. The reflected light energy then returns to the LIDAR sensor where it is recorded. Time of Flight or TOF is the way LIDAR measures the environment and it is the most viable and proven technique used for detecting target objects. Simultaneously, as the lasers fire, firmware within a LIDAR system is analyzing and measuring the data. The optical receiving lens within the LIDAR system acts like a telescope gathering fragments of light photons returning from the environment. Lasers generate and _re out billions of photons, but for each 1M photons sent out, 1 photon returns. Lasers send out 1B photons to generate 1000 photons of returning information. The more laser beams used in a system, the more the information about the environment is gathered. Single laser LIDAR systems and systems with 8 or fewer lasers are at a disadvantage because fewer photons are retrieved, thus less information compared to a multi-laser LIDAR system equipped with 16 or more laser beams.

3.1 ARM7 CONTROLLER

ARM7 is a group of older 32-bit RISC ARM Processor cores licensed by ARM Holdings For Microcontroller use. This generation introduces the thumb 16-bit instructions set providing improved code density compared to previous design. The most widely used ARM7 Designs implement the ARMv4T Architecture But some implement other which has 37 register. All these design use Von Neumann Architecture. Thus few Version comprising a cache Donot Separate data an instruction cache.

3.2 APPLICATIONS

- This robot can be use for pick and place the require object by giving directions to the robot but IR pair should by replace depending upon the application.
- By doing extra things, it can be used in army application.
- Automatic changeovers of traffic signals.
- Intruder alarm system.
- Counting instruments access switches parking module.

3.3 FUTURE SCOPE

- Work for an extended period of time without intervention from human or a need for powersupply.
- Avoid situations that are harmful.
- The designed mobile robot will be able to avoid obstacle perfectly like programmed.
- If the current project is interfaced with a camera robot can be driven beyond line of sight and range become practically unlimited as networks have very large range.

4. CONCLUSIONS

LIDAR enables a self-driving car (or any robot) to observe the world with a few special super powers: Continuous 360 degrees of visibility Imagine if your human eyes allowed you to see in all directions all of the time. Insanely accurate depth information Imagine if, instead of guessing, you could always know the precise distance (to an accuracy of 2cm) of objects in relation to you If you have seen a self-driving car before, you have probably seen a LIDAR sensor. Its typically the bulky box mounted on the roof that spins continuously, as seen below on UBER and BAIDU self-driving cars. How does a sensor that has 360 degree vision and accurate depth information work? Simply put: a LIDAR sensor continually fires off beams of laser light, and then measures how long it takes for the light to return to the sensor.

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