Ministry of Higher Education
and Scientific Research
Al-Muthanna University
College of Science
Department of Physics

Design of Sensors Using Laser Technology

The Graduation Research Project Is Submitted to the Department of Physics at the College of Science as part of the Requirements for Obtaining a Bachelor's Degree in Physic

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بسم الله الرحمن الرحيم

هُوَ الَّذِي أَنْزَلَ مِنَ السَّمَاءِ مَاءً ۖ لَكُمْ مِنْهُ شَرَابٌ وَمِنْهُ شَجَرٌ فِيهِ تُسِيمُونَ ۝ يُنْبِتُ لَكُمْ بِهِ الزَّرْعَ وَالزَّيْتُونَ وَالنَّخِيلَ وَالْأَعْنَابَ وَمِنْ كُلِّ الثَّمَرَاتِ ۗ إِنَّ فِي ذَٰلِكَ لَآيَةً لِقَوْمٍ يَتَفَكَّرُونَ

صدق الله العليّ العظيم

النحل (10-11)

اقرار المشرف

اشهد ان هذا البحث الموسوم بـ

(*Design of Sensors Using Laser Technology*) والمقدم من قبل الطلبة:

١- دلال علي كاظم

٢- اية علي عبيد

٣- هاجر حمود ناصر

جرى تحت اشرافي في كلية العلوم / جامعة المثنى كجزء من متطلبات الحصول على شهادة البكالوريوس في الفيزياء.

التوقيع:

الاسم : أ. م. د. فراس فائق كاظم

التاريخ: \ \2022

بناءاعلى التوصيات المتوفرة أرشح هذا البحث للمناقشة:

التوقيع:

الاسم:

التاريخ: \ \2022

إقرار لجنة المناقشة

نشهد نحن أعضاء لجنة المناقشة الموقعين ادناه قد اطلعنا على هذا البحث الموسوم ب ***(Design of Sensors Using Laser Technology)*** والمقدم من قبل الطلبة:

١- دلال علي كاظم

٢- اية علي عبيد

٣- هاجر حمود ناصر

وقد ناقشنا الطلبة في محتوياتها وما يتعلق بها كجزء من متطلبات الحصول على شهادة البكالوريوس في علوم الفيزياء فوجدناها مستوفية لمتطلبات الشهادة وعليه نوصي بقبول البحث بتقدير (   ).

رئيس اللجنة

/ / 2022

عضوا

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رئيس القسم

/ / 2022

الإهـــــــداء

بسم الله الرحمن الرحيم

وصلى الله على محمد وعلى آله الطيبين الطاهرين وبعد..

اهدي هذا الجهد المتواضع الى الذي اخرجنا من الظلمات الى النور الذي قاتل على التنزيل الرسول الامجد ابي القاسم محمد والى آله الطاهرين

الى من سعى وشقى لْنعم بالراحة والهناء الذي علمني ان ارتقي سلم الحياة بحكمة وصبر والدي العزيز

الى التي حاكت سعادتي بخيوط منسوجة من قلبها الطاهر وحملتني بروحها النقية والدتي العزيزة

الى من سهل لنا الامر، وقدم لنا العون والمساعدة، الى من صاغوا لنا علمهم حروفا تنير لنا سيرة العلم والنجاح اساتذتنا الكرام

الئ أرواح شهداء عراقنا الحبيب ومن نعتز بأسمائهم تمجيداً وتخليداً.

شكـــر وتقديـر

الشكر في اوله واخره لله سبحانه وتعالى الذي منحنا القوة والصبر لُنجاز هذا المشروع . كما نتقدم بالشكر للأستاذ الفاضل الدكتور فراس فائق كاظم كتعبير بسيط لمساعدته واشرافه في انجاز المشروع . وكافة الاساتذة الافاضل في جامعة المثنى – كلية العلوم – قسم الفيزياء. وكذلك نتقدم بالشكر الجزيل الى كل من نصحنا ولو بكلمة واحدة والى كل من ساندنا عند حاجتنا اليه . داعين المولى القدير لهم التوفيق والحصول على الدرجات العلى ودوام الصحة والعافية

Content:-

Abstract:

Laser sensors can be used to measure distances to objects and their related parameters (displacements, position, surface profiles and velocities). Laser sensors are based on many different optical techniques, such as triangulation, time-of-flight, confocal and interferometric sensors. As laser sensor technology has improved, the size and cost of sensors have decreased, which has led to the widespread use of laser sensors in many areas. In addition to traditional manufacturing industry applications, laser sensors are increasingly used in robotics, surveillance, autonomous driving and biomedical areas. This paper outlines some of the recent efforts made towards laser sensors for displacement, distance and position.

Chapter one

Principles of Sensor

Introduction

Sensor is a sensing tool that detects the physical surroundings. Some of it measures temperature, some of it measures pressure, some of it measures radiation, and some that measures electrons or protons, as it converts the signals falling on it into electrical impulses that can be measured or counted by a device. With this, we can know the intensity of the effect, and there are also types of it that can be linked to computers and through programming it is possible to form a picture of the distribution of measurements, as is the case in magnetic resonance imaging that detects tumors in humans. There are many types of sensors according to use, including: optical sensors, Induction sensors, tactile sensors, infrared sensors, acoustic sensors.(The function of the sensor is to convert physical signals (natural: temperature, altitude, distance, speed, etc.) into electrical signals) [1].

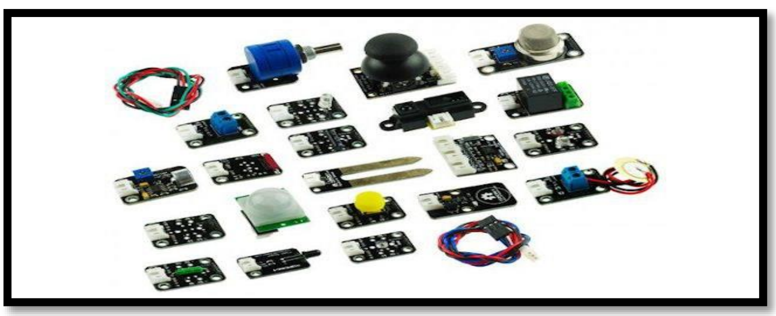

Figure (1.1): Some types of sensor [1].

1-1: The Idea of Making Sensors

The mechanism of action of sensors is multiple, according to the quantity and physical quality to be felt, or dealt with by the sensor. For example, if the physical quantity to be dealt with is a light quantity, the idea of the sensor is an electronic resistance, whose resistance is affected when exposed to light by a certain amount of light.

When the light falls on the resistance in the required quantity, the resistance force of the electric current decreases, allowing the electrical current in the electrical circuit to pass to the device to be turned on, so that the device works as soon as the light falls on the light resistance [2].

1-2: Sensor Rating

There are many possible classifications of sensors, some of them are easy and simple, and others are difficult and complex. In this article, God willing, we will review the easiest and most common classification, as the sensors are classified into three groups [3]:

- **First Classification:**

1- Active sensors: behave like an energy generator as they convert the energy associated with a physical quantity into electrical energy (current, voltage, or charge), and these sensors can operate even without an external power source. Example: Photovoltaic cells convert light intensity into electric current or voltage [4].

2- Passive sensors: They act as a variable impedance, so in order to give us voltage (or current or charge) at the output we must connect it to an external power source. Example: We can use the variable resistance as a motion.[5]

- **Second Classification:**

The other type of classification is based on the detection methods used in the sensor, including electrical, biological, chemical, radiological detection methods, etc. [6].

- **Third Classification:**

1-Analog sensors.

2-Digital sensors.

1-3: Sensor types and their Applications

1- temperature sensor
2- proximity sensor
3- accelerometer
4- infrared sensor
5- Blood pressure device
6- light sensor
7- ultrasonic sensors
8- Smoke, gas and alcohol sensor
9- touch sensor
10- color sensor
11- humidity sensor
12- Flow and level sensor
13- Vision and imaging sensor
14- Contact Sensor
15- Motion Sensor
16- Photoelectric Sensors
17- Position Sensors

18- Pressure sensors

That all these sensors are used in order to carry out the measurement of one of the physical properties, for example, temperature, resistance, capacitance, conductivity, heat .transfer, etc., of physical quantities [8].

1- Temperature Sensors:

One of the most common and popular sensors in use is the .temperature sensor The temperature sensor, as its name suggests, is sensing (measuring) the temperature, that is, in a more correct sense, it measures the .changes in temperature In a temperature sensor, changes in temperature correspond to a change in its physical properties such as .resistance or voltage.

Figure (1.2): Types of temperature sensors [8].

The temperature sensor is available in different types such as;

- Temperature sensor ICs (eg LM35)
- thermistors
- thermocouples
- RTD (Resistant Temperature Devices), etc.

Temperature sensors are used almost everywhere such as computers, cell phones, automobiles, air conditioning .systems, industries, etc. [6].

2- Proximity Sensors:

The proximity sensor is a non-contact type sensor that detects the presence of an object in front of it Proximity sensors can be implemented using different technologies, for example optical technologies (such as infrared or .laser), ultrasound, capacitance, etc. [7].

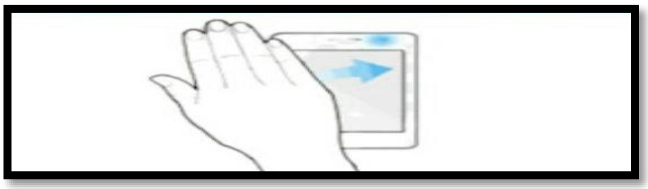

Figure (1.3): Proximity sensor [7].

Sensors in smart phones Some of the applications where proximity sensors are used are cell phones, automobiles (parking sensors), industries (product alignment), ground proximity in .aircraft, etc.

3- Infrared Sensors:

An infrared sensor is a light-based sensor that is used in various applications such as proximity .sensing and object detection [8].

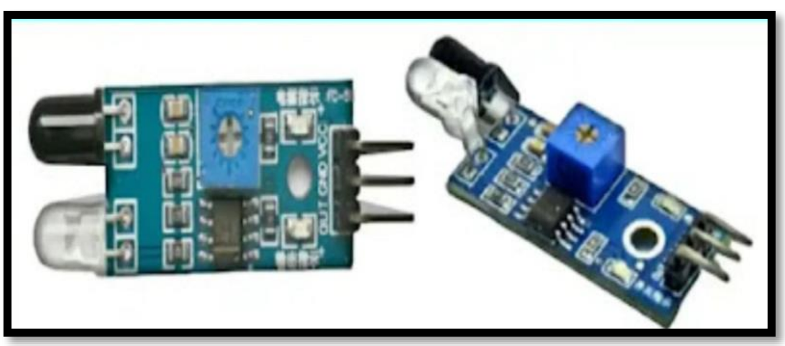

Figure (1.4): Infrared sensor [8].

Infrared sensors are used as proximity sensors in almost all cell phones.

Types of infrared sensors

There are two types of infrared sensors:

- The first is the transitional type.
- The second is the reflective type.

In a transition-type infrared sensor, an infrared transmitter (usually an infrared LED) and an infrared detector (usually a photo diode) are positioned facing each other so that when an object or person passes between them, the sensor detects that person. The other type of infrared sensor is reflective infrared sensor. In this type, the transmitter and detector are placed next to each other facing the object (or person). When an object comes in front of the sensor, the sensor detects that person. There are also various applications through which infrared sensors are implemented, for example mobile phones, robotics, industrial assembly, automobiles, etc. Technological applications also there are some small projects, where infrared sensors are used to drive street lights: for example street lights using infrared sensors.

4- Ultrasonic Sensors:

The ultrasonic sensor is a non-contact type device that can be used to measure distance as well as the speed of an object.

The ultrasonic sensor works on the basis of the characteristics of sound waves with a frequency greater than the range audible to humans. Using the time of the velocity of the sound wave, the ultrasound sensor can perform an object distance measurement (similar to a sonar), in which the Doppler Shift property of the sound wave is used in order to do the object velocity measurement [9].

Figure (1.5): Ultrasonic sensor [9].

The Arduino based Range Finder is a simple ultrasonic sensor project. It is a device for measuring range using ultrasound.

Below we will show you a small list of projects based on a few of the sensors mentioned above [9], these projects are as follows:

- The light sensor or as it is o called the light detector using the LDR impedance that we explained above.
- Fire sensor (alarm circuit using a smoke detector).
- Make a Breathalyzer
- Touch sensor - DIMMER touch switch circuit using ARDUINO.
- Color sensor - color sensor with the use of the Arduino device.
- DHT11 humidity sensor using Arduino.
- Tilt angle sensor using an Arduino.

5- Radiation Sensors:

Electronic devices that sense the presence of alpha, beta, or gamma particles and provide signals for meters and projectors [9].

Figure (1.6): Radiation detectors come in different types depending on the desired application [9].

6- Proximity Sensors:

Electronic devices used to detect the existence of non-contacting objects. A proximity sensor can detect objects typically in a range of up to several millimeters, producing a constant current signal to the controller. Proximity sensors are generally short-range devices but are also available in designs that can detect objects up to several inches [10].

Figure (1.7): Proximity Sensors [10]

7- Pressure Sensors:

Electromechanical devices that detect forces per unit area in gases or liquids and provide signals for inputs of controllers and display devices. A pressure sensor (diaphragm) and strain gage bridge are usually used to detect and measure the force exerted for each region [10].

8-Position Sensors:

Electronic devices used to sense valve positions, doors, etc., and to provide signals to inputs of controllers or projectors. Position sensors are used where positional information is required in countless control applications [10].

9- Photoelectric Sensors:

These are electrical devices that sense the passage of objects within their field, although they are also able to detect color and location if necessary. These sensors rely on measuring changes in light emitted using an emitter and receiver [10].

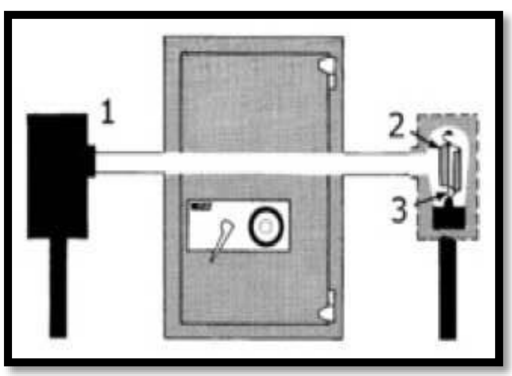

Figure (1.8): A form of photoelectric sensor [10].

10-Motion Sensors:

Electronic devices that can sense the movement or stopping of parts, people, etc., and provide signals for inputs of controllers or projectors. Key specifications include the intended application, sensor type, sensor function, and minimum and maximum speeds [10].

Chapter Two

Arduino Technology and Applications

2-1: Introduction

The Arduino project was started at the Interaction Design Institute Ivrea (IDII) in Ivrea, Italy [11]. At that time, the students used a BASIC Stamp microcontroller at a cost of $50. In 2003 Hernando Barragán created the development platform wiring as a Master's thesis project at IDII, under the supervision of Massimo Banzi and Casey Reas. Casey Reas is known for co-creating, with Ben Fry, the Processing development platform. The project goal was to create simple, low cost tools for creating digital projects by non-engineers. The Wiring platform consisted of a printed circuit board (PCB) with an ATmega128 microcontroller, an IDE based on Processing and library functions to easily program the microcontroller. In 2005, Massimo Banzi, with David Mellis, another IDII student, and David Cuartielles, extended Wiring by adding support for the cheaper ATmega8 microcontroller. The new project, forked from Wiring, was called Arduino [12].

The Initial Arduino core team consisted of Massimo Banzi, David Cuartielles, Tom Igoe, Gianluca Martino, and David Mellis. Following the completion of the platform, lighter and less expensive versions were distributed in the open-source community. It was estimated in mid-2011 that over 300,000 official Arduinos had been commercially produced [13], and in 2013 that 700,000 official boards were in users' hands.

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board [14].

2-2 Principles of Arduino

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package [15].

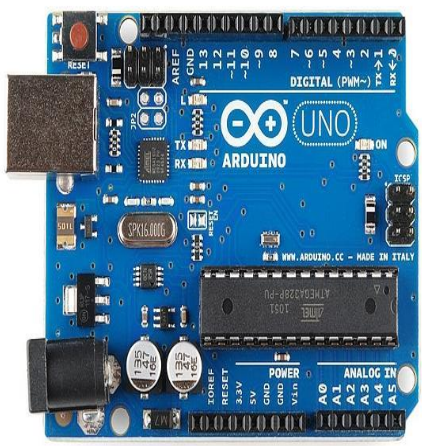

Figure (2.1): schematic of Arduino circuit [15].

2-3 Hardware

Arduino is open-source hardware. The hardware reference designs are distributed under a Creative Commons Attribution Share-Alike 2.5 license and are available on the Arduino website. Layout and production files [16] for some versions of the hardware are also available.

Although the hardware and software designs are freely available under copy left licenses, the developers have requested the name Arduino to be exclusive to the official product and not be used for derived works without permission. The official policy document on use of the Arduino name emphasizes that the project is open to incorporating work by others into the official product.[17] Several Arduino-compatible products commercially released have avoided the project name by using various names ending in -duino.

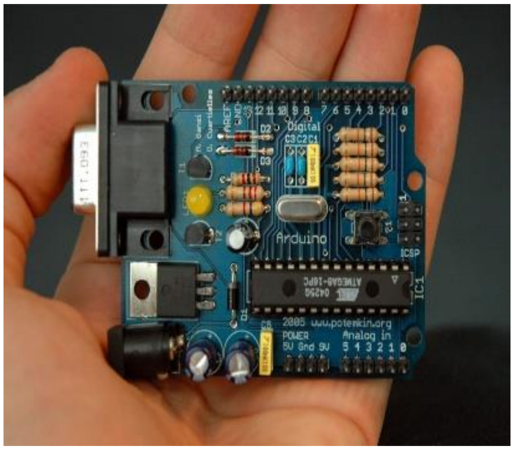

Figure (2.2): An early Arduino board with an RS-232 serial interface (upper left) and an Atmel ATmega8 microcontroller chip (black, lower right); the 14 digital I/O pins are at the top, the 6 analog input pins at the lower right, and the power connector at the lower left [27].

Most Arduino boards consist of an Atmel 8-bit AVR microcontroller (ATmega8, ATmega168, ATmega328, ATmega1280, or ATmega2560) with varying amounts of flash memory, pins, and features [18].

The 32-bit Arduino Due, based on the Atmel SAM3X8E was introduced in 2012 [19]. The boards use single or double-row pins or female headers that facilitate connections for programming and incorporation into other circuits. These may connect with add-on modules termed shields. Multiple and possibly stacked shields may be individually addressable via an I^2C serial bus. Most boards include a 5 V linear regulator and a 16 MHz crystal oscillator or ceramic resonator. Some designs, such as the Lily Pad, run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions [20].

Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory. The default boot loader of the Arduino Uno is the Opt boot loader [21]. Boards are loaded with program code via a serial connection to another computer. Some serial Arduino boards contain a level shifter circuit to convert between RS-232 logic levels and transistor–transistor logic (TTL) level signals. Current Arduino boards are programmed via Universal Serial Bus (USB), implemented using USB-to-serial adapter chips such as the FTDI FT232. Some boards, such as later-model Uno boards, substitute the FTDI chip with a separate AVR chip containing USB-to-serial firmware, which is reprogrammable via its own ICSP header. Other variants, such as the Arduino Mini and the unofficial Boarduino, use a detachable USB-to-serial adapter board or cable, Bluetooth or other methods. When used with traditional microcontroller tools, instead of the Arduino IDE, standard AVR in-system programming (ISP) programming is used [22].

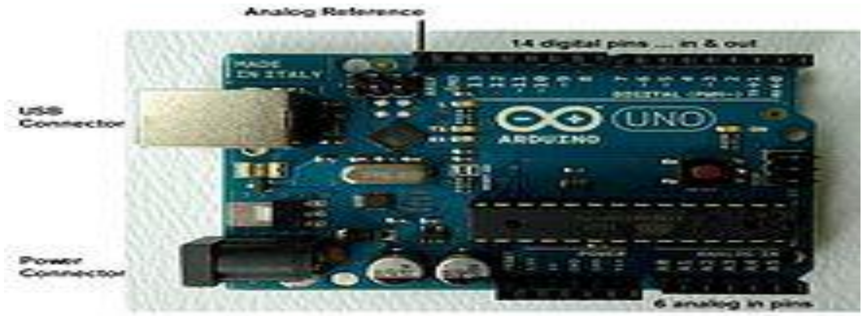

Figure (2.3): An official Arduino Uno R2 with descriptions of the I/O locations [22].

The Arduino board exposes most of the microcontroller's I/O pins for use by other circuits. The Decimal, [a] Duemilanove, [b] and current Uno[c] provide 14 digital I/O pins, six of which can produce pulse-width modulated signals, and six analog inputs, which can also be used as six digital I/O pins. These pins are on the top of the board, via female 0.1-inch (2.54 mm) headers. Several plug-in application shields are also commercially available. The Arduino Nano, and Arduino-compatible Bare Bones Board [23] and Boarduino [24] boards may provide male header pins on the underside of the board that can plug into solder less breadboards.

Many Arduino-compatible and Arduino-derived boards exist. Some are functionally equivalent to an Arduino and can be used interchangeably. Many enhance the basic Arduino by adding output drivers, often for use in school-level education [25], to simplify making buggies and small robots. Others are electrically equivalent, but change the form factor, sometimes retaining compatibility with shields, sometimes not. Some variants use different processors, of varying compatibility.

2-4 Software

A program for Arduino hardware may be written in any programming language with compilers that produce binary machine code for the target processor. Atmel provides a development environment for their 8-bit AVR and 32-bit ARM Cortex-M based microcontrollers: AVR Studio (older) and Atmel Studio (newer) [26].

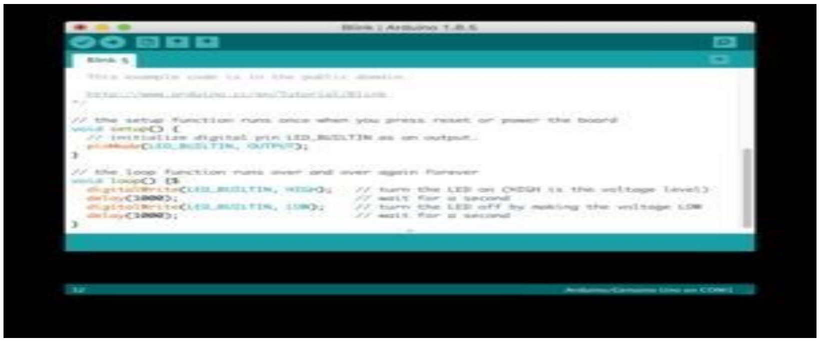

Figure (2.4): Screenshot of Arduino IDE showing Blink program [26].

2-4-1 IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Microsoft Windows, macOS, and Linux) that is written in the Java programming language. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. The source code for the IDE is released under the GNU General Public License, version 2 [27].

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware [27].

2-4-2 IDE 2.0

On October 18, 2019, Arduino Pro IDE (alpha preview) was released. Later, on March 1, 2021, the beta preview was released, renamed IDE 2.0. The system still uses Arduino CLI (Command Line Interface), but improvements include a more professional development environment, auto completion support, and Git integration.[63] The application frontend is based on the Eclipse TheOpen Source IDE. The main features available in the new release are [28]:

- Modern, fully featured development environment
- Dual Mode, Classic Mode (identical to the Classic Arduino IDE) and Pro Mode (File System view)
- New Board Manager
- New Library Manager
- Board List
- Basic Auto-Completion (Arm targets only)
- Git Integration

- Serial Monitor
- Dark Mode

2-5 Types of Arduino

There are many types of Arduinos and each has different abilities and characteristics:

- **Arduino Uno:**

The Uno is a great choice for a first Arduino. It contains everything you need to get started in the field, 14 digital I/O clips (6 of them can be used as PWM outputs), 6 analog inputs, a USB connection, a power jack and a reset button and so on, it contains everything needed to support the microcontroller. It only needs to be connected to a computer with a USB cable or powered by an AC adapter or battery to start [29].

- **LilyPad Arduino:**

LilyPad is a wearable technology developed by Leah Buechley and designed collaboratively by Leah and SparkFun [30]. It has a great shape and has large fastening pads and a flat back to allow it to be sewed to clothing with conductive threads. LilyPad also has its own line of input/output, power and sensor panels that are also designed specifically for electronic textiles and are washable [31].

- **RedBoard:**

This one was developed by spark fun and the RedBoard can be programmed via a USB Mini-B cable using the Arduino IDE and it also runs on Windows 8 without having to change the security settings [32]. Promise more stable due to USB / FTDI chip plus it is completely flat which is easy to embed in projects and the on-board power regulator can handle voltage from 7 to 15 volts [33].

- **Arduino Mega:**

This type has a large number of clips, making it suitable for projects that require a large range of digital inputs or outputs (eg projects with a lot of lights and buttons) [34].

- **Arduino Leonardo:**

It is one of the first types to use an integrated microcontroller, which makes it inexpensive and simple [35].

Chapter Three

Arduino Laser Sensor and its Applications

3-1 Introduction

One of the most interesting developments in the field of telecommunications is the use of laser light to transfer information over large distances. The ever increasing cost and the lack of space available in congested metropolitan cities, as well as the rapid developments in the field of Internet of Things (IoT) call for the advent of a less costly communication system. The advancements in the field of semiconductor lasers have made possible the use of lasers for signal transmission which reduces the need for broadcast rights and buried cables. Therefore, with the development of applications in space technology, and the increasing importance of wireless sensor networks, laser communication has become the subject of great research and development activity. A remarkable feature of laser technology is the concentration of energy to extremely high intensities that remain relatively constant over long distances due to low divergence. The main advantage of this system over RF communication and fiber optics are high transmission security and reliability.

3-2 Laser Sensor

The LASER sensor (KY-008) gives a small intern beam or emits a dot shaped, red laser beam. The figure 4 shows laser sensor. This module has three pins i.e. From left to right pin 1 is signal output, pin number 2 is +5 volts (DC), and pin 3 is GND. Using this system, we have experimented a laser sensor which has both transmitter and receiver units into one module [36]. This sensor theoretically measures up to 1000 cm or 10000 mm. Laser is basically concentrated on light source.

LDR detector (Light Dependent Resistor), Photo diode & photo transistors are used to detect lasers

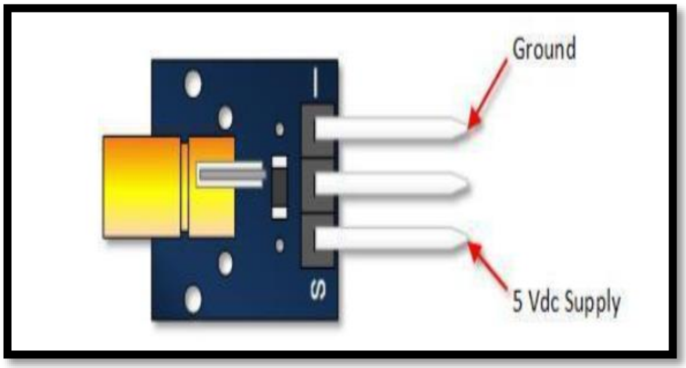

Figure (3.1): Laser sensor.

3-3 LDR Detector

To detect a laser, a light dependent resistor (LDR) is needed [37]. An LDR is a device which has a resistance that varies according to the amount of light falling on its surface. The LDR detector is as shown in fig (3.2). When light hits the LDR, the LED will light up. The variable resistor is used to fine tune the amount of light needed to activate the LDR detector.

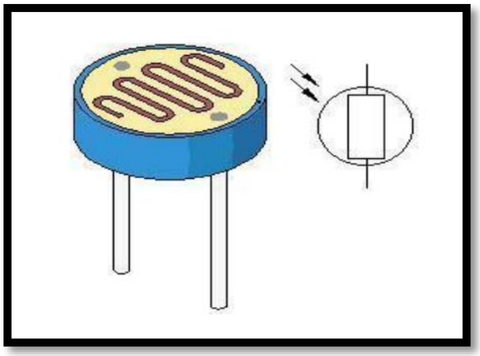

Figure (3.2): LDR and circuit symbol.

3-4 Implementation of Laser Sensor

Figure (3.3) shows block diagram of laser sensor using Arduino board. LASER sensor has both sensor and detector for finding the obstacle. The LASER light has to fall on the LDR detector.

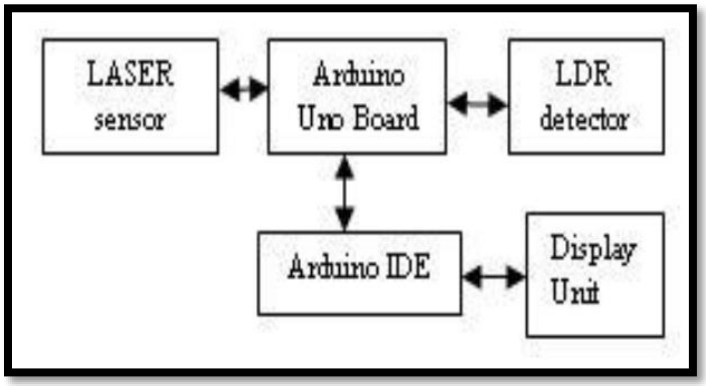

Figure (3.3): Block diagram of laser sensor.

Figure (3.4) shows experimental setup of LASER sensor. This sensor gives digital output like 0 or 1. If the obstacle is present, the output will be 1 and if the obstacle is not present the output will be 0. The output is monitored through the serial monitor of the Arduino IDE software. The laser will not sense the obstacle in wider angle. It is a narrow angle detector. It measures the distance up to 1000cm or 10000mm.

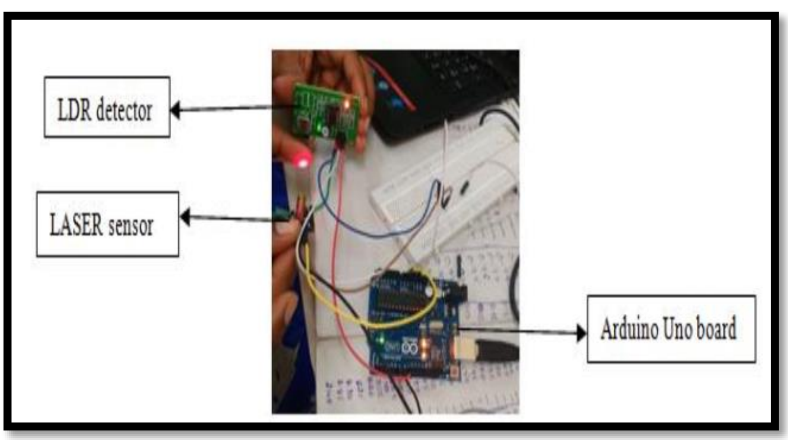

Figure (3.4): Experimental setup of LASER sensor.

Table (3.1) shows all sensors features like ultrasonic sensor, IR sensor, LASER sensor:

Table (3.1): Features of distance measurement sensors.

Features	**Ultrasonic sensor**	**IR sensor**	**LASER sensor**
Model name	HCSR04	FC 51	KY008
Wavelength	75nm	700nm to 1mm	650nm
Power Delivered	+5 V DC	3.3V-5V	5V(DC)
Operational Current	15mA	at 3.3 V ,~23 mA at 5.0V: ~43 mA	30mA
Frequency	40KHz	35KHz	30 KHz
Efficient Angle	<15^0	<15^0	<15^0
Calculating Angle	30^0	45^0	0^0
Pulse Width of Trigger Input	10μS	-	+ve single TTL pulse
Aspect	45mm x 20mm x 15mm	4.5cm (L) x 1.4 cm (W) x 0.7cm (H)	18.5mm x 15mm

Chapter Four

Conclusions

4-1 Conclusions

A laser sensor technology is a measurement value recorder working with laser technology and turning the physical measured value into an analogue electrical signal. This means that the laser sensor is conceived for contactless measurement. The laser sensor works based on the triangulation principle. With a laser sensor you can measure the length of a road, a distance's length and positions, without any contact. This happens at a very high resolution. Laser sensors also dispose of various linearities, in addition to the various resolutions.

There are laser sensors that are especially designed for tarnished and metallic surfaces or for black surfaces. Thanks to the integrated intelligent signal analysis, the laser sensor can deliver an exact result. And this irrespective of the color of the respective surface. Thanks to the emitted laser beam that is extremely focused, the laser sensor is able to perform finer measurements than devices based on light diodes.

These sensors are integrated in a point laser or a line laser. The line laser is different from a point laser in the sense that the former projects one resp. two fixed lines. The lines are produced with integrated fixed lens. Point lasers produce one or several points. Thanks to the compact and very robust design of a laser sensor, it is possible to integrate it in very small devices or e.g. to include it as a component of industrial robots.

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