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## GLASS SHEET COUNTER USING ARDUINO & PHOTOELECTRIC SENSOR

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**Abstract:** There are many processes to count the objects like counting using an ultrasonic sensor or using an external camera with the help of computer vision. In this paper, we have proposed the implementation of the industrial photoelectric sensor with an Arduino microcontroller to detect transparent objects like glass sheets and implement the output on the external LCD screen to get the real-time object counting.

### I. INTRODUCTION

Glass has become one of the most prominent aspects of our life. It serves many purposes involves types of furniture like windows and doors, facades, tableware (cups, plates, bowls), bottles for drinking, interior design, and furniture element like mirrors, partitions. Nowadays multiple glazing glasses are becoming the center of the market.

Many glass manufacturing companies are developing their methods and working processes. Glass industries have been flourishing for a very long-time technology has improved a lot since then but there are some problems which are still unresolvable One such problem is, counting the transparent glass accurately. A lot of industries have been facing such problems, which we have tried to resolve through this article. In this paper, we have focused on the measurement of glass sheets as accurately as possible using Arduino mega and a photoelectric sensor.

#### 1.1 Purpose of the research:

We are doing this research based on the industrial project “Glass sheet counter using Arduino & photoelectric sensor”. In the glass industry, making and providing glass is the center of purpose. However, doing all this process needs the best management and controls overall the machines. A single mistake can be the failure to process and production of glass. This failure will lead lack of stock production and industries’ management failure.

#### 1.2 Types of Glass:

##### 1.1.1 Toughened Glass:

- Toughened glass is also known as tempered glass.
- They are up to five times stronger than regular plate glass.
- They can resist thermal breakage.
- Use for preparing windows, doors, displays.

##### 1.1.2 Annealed Glass:

- Annealed is also known as standard (float or clear) glass.
- Use for tabletops, cabinet doors, and basement windows.

#### 1.1.3 Low E Glass:

- Low-e glass helps keep unwanted UV rays out of your home that can damage your skin and furniture.

#### 1.1.4 Tinted Glass:

- Use for visual privacy (changes the Color of the window).

#### 1.1.5 Frosted Glass:

- It scatters the light, which blurs the image while still transmitting the light.

#### 1.1.6 Mirrored Glass:

- Use for architectural or decorative purposes.

### 1.3 Counter

Counters and timers are important devices that are widely used in the automated process of various industries. In the digital and computer sense, a counter is a tool that keeps (and sometimes displays) the number of times an event or process has taken place, usually concerning a clock. The most common type is a consecutive digital logic circuit with an input line called a clock and multiple output lines. The values in the output lines represent the number in the binary or BCD number system. Each heartbeat is used to increase the clock setting or to reduce the number on the counter. Prices usually fall below one-third of the range; mechanical, electromechanical, and electrical calculators and controls. Each technology offers a set of unique benefits that allow you to make the best use of the services you need to better process your unique industrial application.

Electronic calculators can have many different functions for calculating, controlling, and monitoring time. These include arithmetic functions, controller, batch counter, counter, counter-counter, preset, pulse counter, delay cycle, position indicator, measurement meters or tachometers, and time meters. Power reset will not be available, manually, remotely, or auto-reset (model depends). Electronic counters are available in several installation settings and include stand-alone, DIN train mounting, panel or flange mount, PCB mounting, portable, and mounting options. Mechanical calculators and electromechanical (electronic) counters are commonly used as totals, with some models available as pre-set counters. They clearly show calculations based on rotary input, ratcheting, or voltage pulse. Readout with 10 wheels with 0-9 numbers printed after comparison. The calculation is achieved by connecting directly to a rotating or repeating machine object - e.g. The growing area of mechanical or electromechanical counters is strongly influenced by its combination or assembly requirements or pulse power source. There are many types of field calculators such as Pulse counter, binary counter, counter-counter, time counter, digital counter, airborne particle counter, counter displacement counter, energy counter, stroke counter, people counter, revolution counter.

### 1.4 Sensor

A sensor is a device that receives and responds to a specific type of input from a physical location. Direct inputs can be light, heat, movement, humidity, pressure, or one of many other natural phenomena. The output is usually a signal that is converted to a display that is readable to humans in a sensory environment or transmitted electronically through a network for continuous reading or processing. Sensors are among the industrial applications used in the control, monitoring, and security process. In simple terms, Industrial Automation Sensors are input devices that provide output (signal) with a specific body value (input). Sensors utilized in Automation: In industrial automation, sensors play a crucial role in making products more intellectual and automatic. Photoelectric Sensors detect objects, changes in surface conditions, and other items through a variety of optical properties. A Photoelectric sensor consists primarily of an Emitter For emitting light and a receiver for entering light. When emitted light is intruded or reflected by the swing object, it changes the quantum of light that arrives at the receiver. The receiver detects this change and converts it to an electric affair. The light source for the maturity of the photoelectric sensor is infrared or visible light (generally red, or green/blue for relating colors). A color-contained photoelectric detector contains the optics, along with the electronics. It requires only a power source. The sensor performs its modulation, demodulation, modification, and affair switching. Some tone-

contain sensors give similar options as erected in control timekeepers or counters because of technological progress, tone-contained photoelectric detectors have come decreasingly lower.

Remote photoelectric detectors used for remote seeing contain only the optic factors of a detector. The circuitry for power input, modification, and affair switching is located away, generally in a control panel. This allows the detector, itself, to be veritably small. Also, the controls for the detector are more accessible, since they may be bigger. When space is confined or the terrain too hostile indeed for remote detectors, fiber optics may be used. Fiber optics are unresistant mechanical seeing factors. They may be used with either remote or tone-contained detectors. They've no electrical circuitry and no moving corridor, and can safely pipe light into and out hostile surroundings.

There are three major types of photoelectric sensors: thru-beam, retroreflective, and diffused. Each sensor has its strengths and can be used in a variety of ways.

#### ❖ **Thru-Beam**

In thru-beam sensing, also known as opposed mode, two separate devices are used to make or break a beam. One sensor houses the light emitter while the other houses the receiver. A thru-ray detector detects objects when an object interrupts the light ray between the two detectors.

- Thru-beam sensors can be used to
- turn up veritably small objects.
- determine the filler situations inside holders.
- ascertain spliced or lapped accouterments.
- discover the precise position of a specific object.
- Detect the contents of a vessel.
- dig up opaque objects.

The advantages of using a thru-beam sensor are that it's the most accurate type of sensor and has the longest sensing range of the three Thru- ray detectors are also the stylish choice when using them in a dirty terrain. It's important to keep in mind that there will be at least two separate parts that need to be installed to make this device work correctly.

#### ❖ **Retroreflective**

In retroreflective seeing, both the light source and the entering device are planted in the same casing. The detector works in tandem with a glass. The light emitted from the sensor is aimed at the reflector, which is then sent back to the light-receiving element. The detector detects the presence of an object when the light path is intruded. In addition to retroreflective sensing, there are polarized retroreflective sensing. Concentrated retroreflective seeing features a concentrated optic block which reduces the response to "hot spot" light from a candescent face of the detected object.

- Determine large objects.
- Descry objects moving at high speeds.
- Detects reflective tape at high speeds.
- Sense a transparent (clear) glass or plastic product.

Retroreflective is a more affordable and only slightly less accurate option than thru-ray detectors. When working with clear or transparent products, retroflected detectors are a stylish option. Another advantage is that retroflected detectors only need to be wired on one side while thru-ray detectors bear wiring on both sides of the device.

❖ Diffused

In optic propinquity seeing, also known as verbose, the light source and the receiver are housed in the same device. Diffused detectors descry objects when the light ray, emitted towards the target, is reflected by the detector target. What makes diffused detectors a great robotization option is that they're more compact than typical units, as all factors are in a single casing.

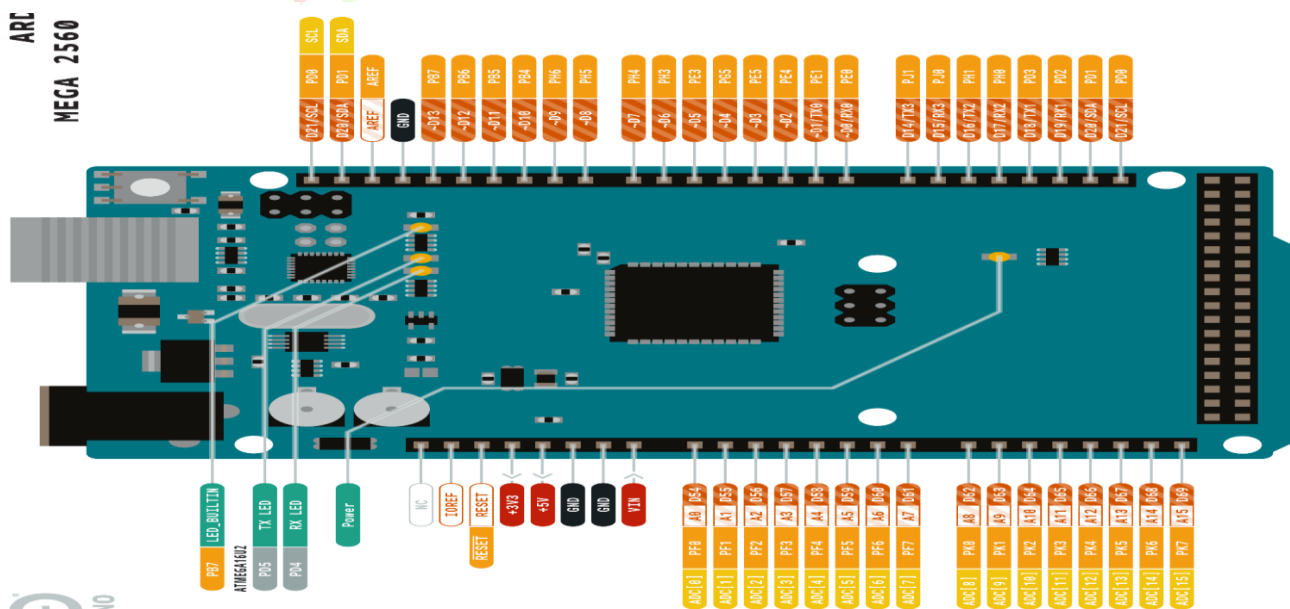
Diffused sensors can be used to:











- Determine multiple objects on a common conveyor system.
- Determine translucent objects.
- Descry the fill level inside containers.
- Detect the presence of parts, boxes, and web materials.
- Determine specific identifying features to determine an object’s orientation.
- Ascertain unwanted conditions for product inspection tasks.

Diffused detectors are the easiest to install because everything is included in a single device and is a cost-effective seeing result. The downsides to diffused detectors are they’re less accurate when used in position detecting than thru-ray and retroreflective detectors and they aren’t as effective on translucent objects. In addition, these detectors can be the most affected by color, texture, the angle of incidents, target characteristics, and dirty surroundings.

## II. PROJECT COMPONENTS

### 2.1 Arduino Mega



 Ground	 Internal Pin	 Digital Pin	 Microcontroller's Port
 Power	 SWD Pin	 Analog Pin	
 LED	 Other Pin	 Default	

The Arduino Mega 2560 is a microcontroller board grounded on the AT mega 2560. It has 54 digital input/output legs (of which 15 can be used as PWM labors), 16 analog inputs, 4 UARTs (tackle periodical anchorages), a 16 MHz demitasse oscillator, a USB connection, a power jack, an ICSP title, and a reset button. It contains everything demanded to support the microcontroller; simply connect it to a computer with a USB string or power it with an AC-to-DC appendage or battery to get started. The Mega 2560 board is compatible with the utmost securities designed for the Uno and the former boards Duemilanove or Diecimila.

The power pins are as follows:

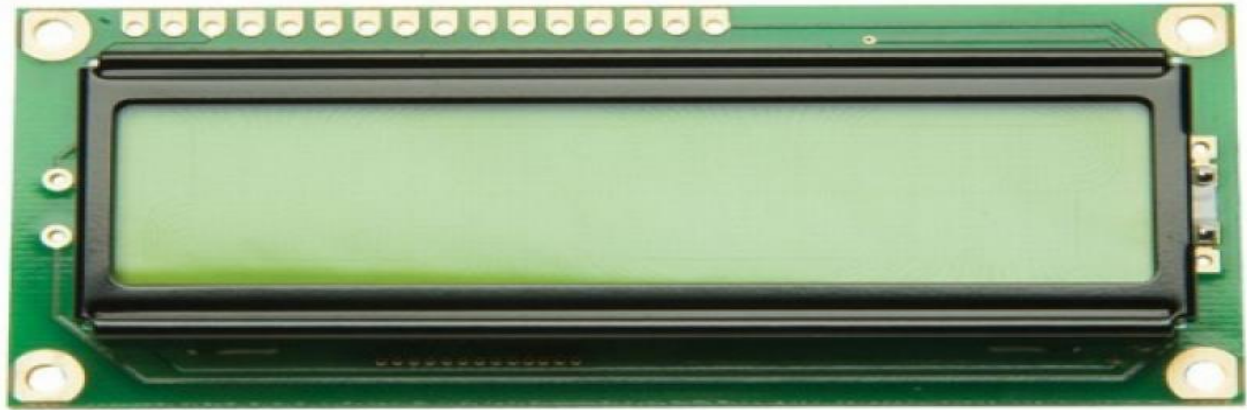
- **Vin.** The input voltage to the board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V.** This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.
- **3V3.** A 3.3-volt supply is generated by the onboard regulator. The maximum current draw is 50 mA.
- **GND.** Ground pins.
- **IOREF.** This pin on the board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.

Each of the 54 digital legs on the Mega can be used as an input or affair, using `pinMode ()`, `digitalWrite ()`, and `digitalRead ()` functions. They operate at 5 volts. Each leg can give or admit 20 mamas as recommended operating condition and has an internal pull-up resistor (dissociated by dereliction) of 20-50 k ohm. An outside of 40mA is the value that mustn't be exceeded to avoid endless damage to the microcontroller.

In addition, some pins have specialized functions:

- **Serial:** 0 (RX) and 1 (TX); Serial 1: 19 (RX) and 18 (TX); Serial 2: 17 (RX) and 16 (TX); Serial 3: 15 (RX) and 14 (TX). Used to receive (RX) and transmit (TX) TTL serial data. Pins 0 and 1 are also connected to the corresponding pins of the ATmega16U2 USB-to-TTL Serial chip.
- **External Interrupts:** 2 (interrupt 0), 3 (interrupt 1), 18 (interrupt 5), 19 (interrupt 4), 20 (interrupt 3), and 21 (interrupt 2). These pins can be configured to trigger an interrupt on a low level, a rising or falling edge, or a change in level. See the `attachInterrupt ()` function for details.
- **PWM:** 2 to 13 and 44 to 46. Provide 8-bit PWM output with the `analogWrite ()` function.
- **SPI:** 50 (MISO), 51 (MOSI), 52 (SCK), 53 (SS). These pins support SPI communication using the SPi library. The SPI pins are also broken out on the ICSP header, which is physically compatible with the Arduino /Genuino Uno and the old Duemilanove and Diecimila Arduino boards.
- **LED:** 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- **TWI:** 20 (SDA) and 21 (SCL). Support TWI communication using the Wire library. Note that these pins are not in the same location as the TWI pins on the old Duemilanove or Diecimila Arduino boards.

## 2.2 16 x 2 LCD display



A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in a 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. This LCD has two registers, namely, Command and Data.

## 2.3 FRC Cable



Flexible flat String or FFC Cable refers to any variety of electrical string that's both flat and flexible, with flat solid operators. FFC is a type of flexible electronics. Still, the term FFC generally refers to the extremely thin flat string frequently plant in high viscosity electronic operations like laptops and cell phones.

It's suitable for internal wiring in an office outfit, audio, and videotape machines, it's a popular choice for construction or form, Useful for the electronic design, and Genuine Arduino products. You can use Ribbon Cable, JTAG ISP AVR Cable, FPCA-Type Strip string as per your need.

## 2.4 Adapter



5V power inventories (or 5VDC power inventories) are one of the most common power inventories in use moment. In general, a 5VDC affair is attained from a 50VAC or 240VAC input using a combination of mills, diodes, and transistors. 12V power inventories (or 12VDC power inventories) are one of the most common power inventories in use moment. In general, a 12VDC affair is attained from a 120VAC or 240VAC input using a combination of mills, diodes, and transistors. 12V power inventories can be of two types 12V regulated power inventories and 12V limited

power inventories. 12 V regulated power inventories come in three styles Switching regulated AC to DC, Linear regulated AC to DC and Switching regulated DC to DC.

We've used 5V appendage as a power source for Arduino mega also 12V appendage as a power source for the photoelectric detector.

## 2.5 5V Relay



A 5v relay is an automatic switch that's generally used in an automatic control circuit and to control a high-current using a low current signal. The input voltage of the relay signal ranges from 0 to 5V.

## 2.6 Resistor (Carbon film resistor)



A carbon film resistor is a type of film resistor, which is also called thermal corruption carbon film resistor. We used two 1K ohm resistors.

## 2.7 Photoelectric sensor



This is a Switch Infrared Beam Photoelectric Sensor Photocell E3JK-5DM1 with a detecting distance of range 5M. The photoelectric switch uses the object to block or reflect the ray and detects the presence or absence of the object through the coetaneous circle gate circuit. All objects can reflect light and can be detected.

## 2.8 NO Contact switches



Typically, open (NO) and typically closed (NC) are terms used to define the countries of switches, detectors, or relay connections under when its coil isn't agitated. It's the abecedarian of process robotization. A NO contact or a typically open contact is the bone that remains open until a certain condition is satisfied. For illustration, let us consider a limit switch.

A limit switch consists of at least one NO contact in it. The NO contact in the limit switch remains open until its selector is pressed. When the selector is pressed the contact closes and starts conducting. In the case of propinquity switches, NO connections remain open until it senses some object also in the case of pressure switches, the contact remains open until the preset pressure position is reached.

### III. CIRCUIT DESIGN USING PROTEUS SOFTWARE

#### 3.1 Proteus Software

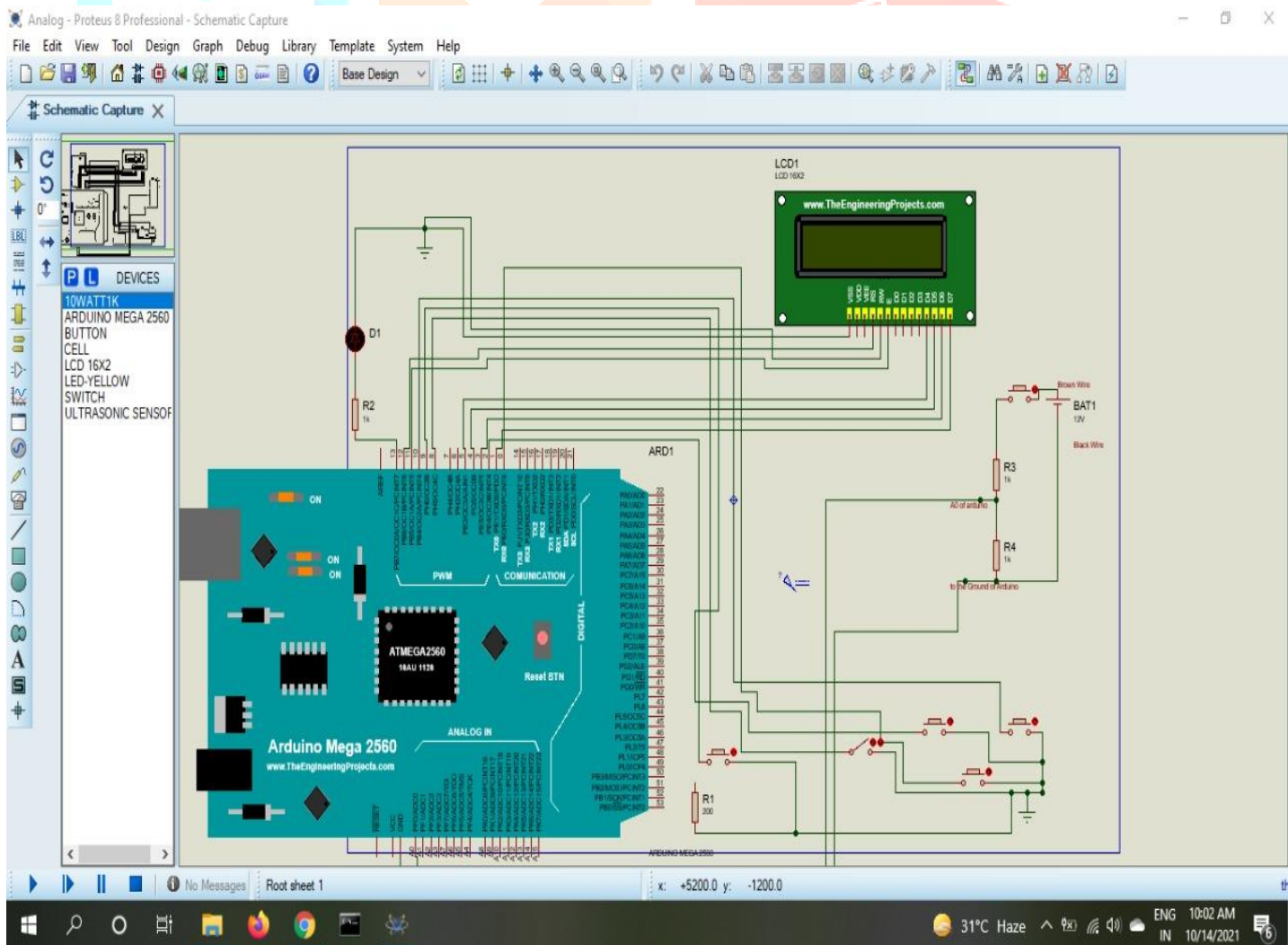
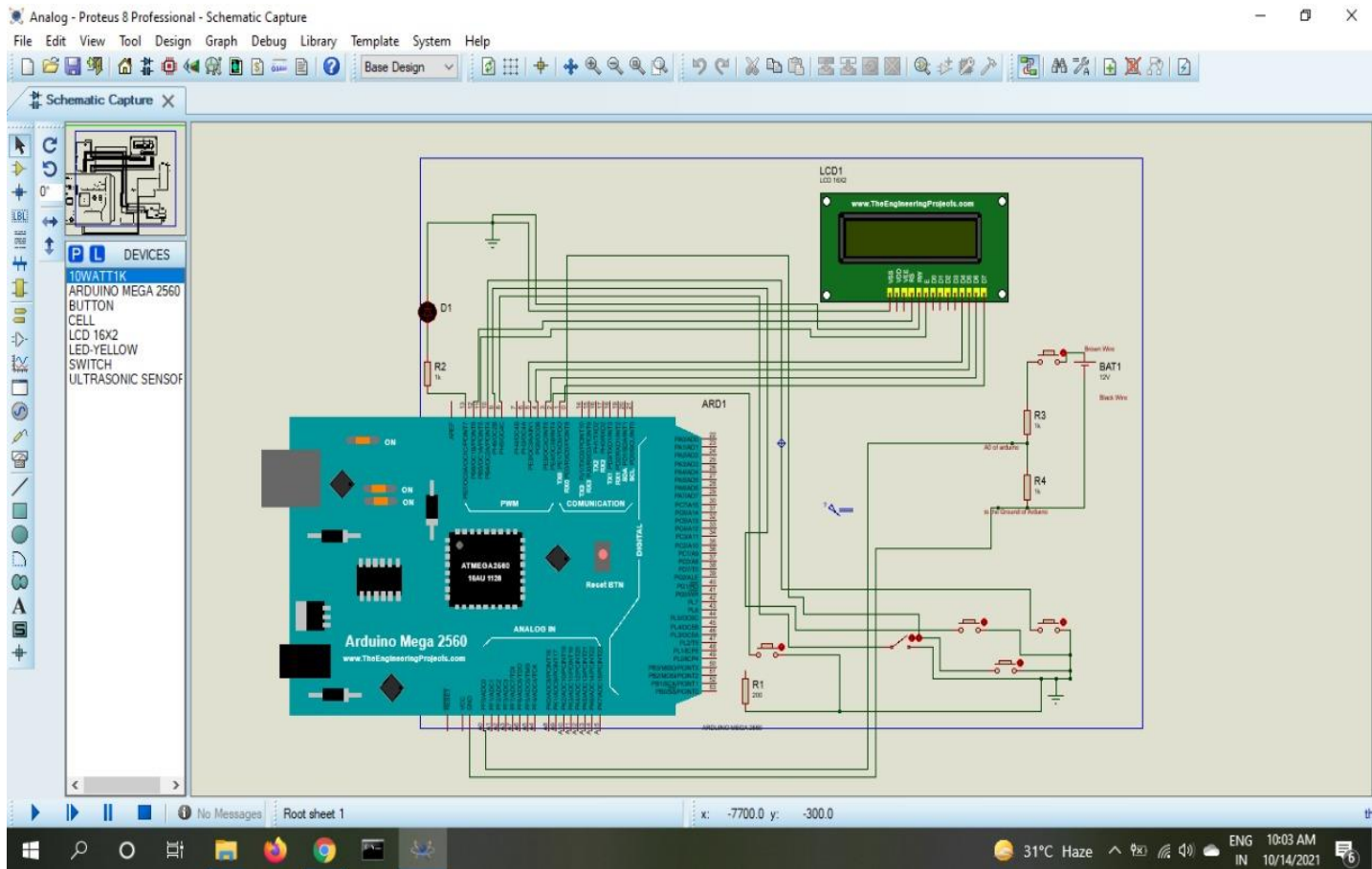
What's Proteus? Proteus is a work operation robotization platform designed from the ground up by diversified energy assiduity professionals to help the assiduity digitally transfigure and transition to a low carbon future. It brings together talent accession, design operation, and finance into one pall-grounded mecca. Proteus is a Virtual System Modelling and circuit simulation operation. The suite combines mixed mode SPICE circuit simulation, animated factors, and microprocessor models to greasecosimulation of complete microcontroller-grounded designs.

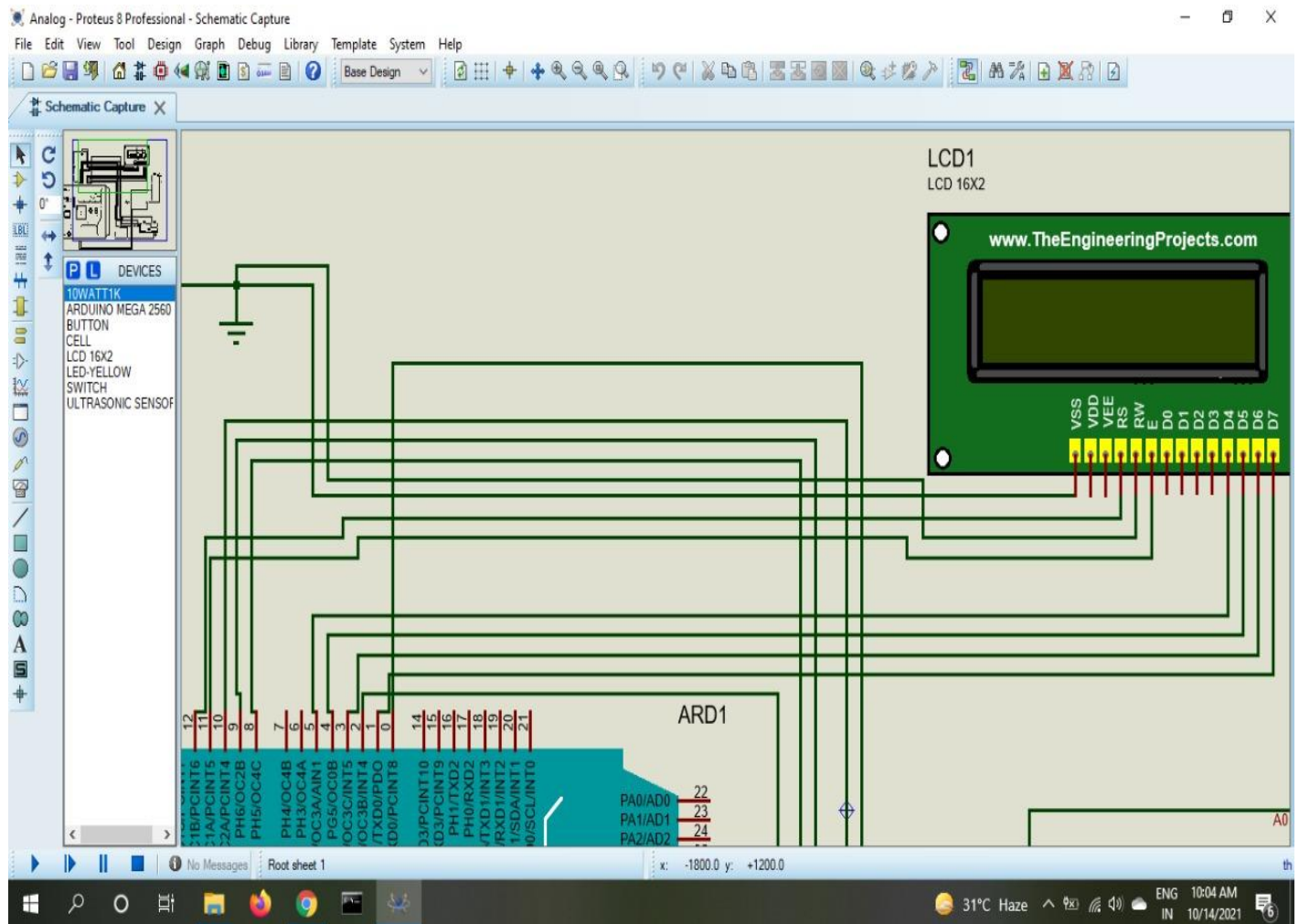
Proteus also can pretend the commerce between software running on a microcontroller and any analog or digital electronics connected to it. It simulates Input/ Affair anchorages, interrupts, timekeepers, USARTs, and all other peripherals present on each supported processor. Proteus has a wide range of factors in its library. It has sources, signal creators, dimension and analysis tools like oscilloscope, voltmeter, ammeter., examinations for real-time monitoring of the parameters of the circuit, switches, displays, loads like motors and lights, separate factors like resistors, capacitors, inductors, mills, digital and analog Integrated circuits, semi-conductor switches, relays, microcontrollers, processors, detectors, etc.

It offers PCB designing up to 14 inner layers, with face-mount, and through-hole packages. It's bedded with the bottom prints of a different order of factors like ICs, transistors, heads, connectors, and other separate factors. It offers Bus routing and homemade routing options to the PCB Developer. The schematic drawing in ISIS can be directly transferred to ARES.



### 3.2 Circuit Design using software





#### IV. INDUSTRIAL APPLICATION

Distance glass manufactures the pier process. Glass, which has been made since the time of the Mesopotamians and Egyptians, is little further than an admixture of beach, pop ash, and lime. When hotted to about 1500 degrees Celsius ( $^{\circ}\text{C}$ ) this becomes a molten mass that hardens when sluggishly cooled. Glass, which has been made since the time of the Mesopotamians and Egyptians, is little further than an admixture of beach, pop ash, and lime. When hotted to about 1500 degrees Celsius ( $^{\circ}\text{C}$ ) this becomes a molten mass that hardens when sluggishly cooled. The first successful system for making clear, flat glass involved spinning. This system was veritably effective as the glass hadn't touched any shells between being soft and getting hard, so it stayed impeccably absolute, with a' fire finish'. Still, the process took a long time and was labor ferocious. Nonetheless, demand for flat glass was veritably high and glassmakers across the world were looking for a system of making it continuously. The first nonstop strip process involved squeezing molten glass through two hot breakers, analogous to an old mangle. This allowed a glass of nearly any consistency to be made no-stop, but the breakers would leave both sides of the glass marked, and these would also need to be base and polished. This part of the process rubbed down around 20 percent of the glass, and the machines were veritably precious.

The pier process for making flat glass was constructed by Alistair Pilkington. This process allows the manufacture of clear, tinted, and coated glass for structures, and clear and tinted glass for vehicles. Pilkington had been experimenting with perfecting the melting process, and in 1952 he'd the idea of using a bed of molten essence to form the flat glass, barring altogether the need for breakers within the pier bath. The essence had to melt at a temperature lower than the hardening point of glass (about  $600^{\circ}\text{C}$ ), but couldn't boil at a temperature below the temperature of the molten glass (about  $1500^{\circ}\text{C}$ ). The stylish essence of the job was the drum. The rest of the conception reckoned on graveness, which guaranteed that the face of the molten essence was impeccably flat and vertical. Accordingly, when pouring molten glass onto the molten drum, the underpart of the glass would also be impeccably flat. However, it would flow over the molten drum until the top face was also flat, vertical, and

impeccably resemblant to the nethermost face If the glass were kept hot enough. Once the glass cooled to 604 °C or lower it was too hard to mark and could be transported out of the cooling zone by breakers.

The glass settled to a consistency of six millimeters because of the face pressure relations between the glass and the drum. By fortunate coexistence, 60 percent of the flat glass request at that time was for six-millimeter glass. Pilkington erected an airman factory in 1953 and by 1955 he'd induced his company to make a full-scale factory. Still, it took 14 months of non-stop product, going the company£ a month, before the factory produced any usable glass. Likewise, once they succeeded in making marketable flat glass, the machine was turned off for a service to prepare it for times of nonstop product. When it started up again it took another four months to get the process right again. They eventually succeeded in 1959 and there are now float shops each over the world, with each suitable to produce around 1000 tons of glass every day, non-stop for around 15 times. Float shops moment make a glass of near optic quality. Several processes-melting, refining, homogenizing- take place contemporaneously in the 2000 tonnes of molten glass in the furnace. They do in separate zones in a complex glass inflow driven by high temperatures. It adds up to a nonstop melting process, lasting as long as 50 hours, that delivers glass easily and continuously to the pier bath, and from there to a coating zone and eventually a heat treatment zone, where stresses formed during cooling are relieved.

The principle of pier glass is unchanged since the 1950s. Still, the product has changed dramatically, from a single consistency of 6.8 mm to a range from sub-millimeter to 25 mm, from a strip constantly marred by eliminations and bubbles to nearly optic perfection. To ensure the loftiest quality, the examination takes place at every stage. Sometimes, a bubble isn't removed during refining, a beach grain refuses to melt, an earthquake in the drum puts ripples into the glass strip. The automated online examination does two effects. Originally, it reveals process faults upstream that can be corrected. Examination technology allows further than 100 million measures an alternate to be made across the strip, locating excrescencies the unaided eye would be unfit to see. Secondly, it enables computers downstream to steer knives around excrescencies. Float glass is vended by the square meter, and at the final stage, computers restate client conditions into patterns of cuts designed to minimize waste.

Many top companies in India are improving themselves in the glass manufacturing process. Some of them are listed below:

- Asahi India Glass Ltd
- FUSO Glass India Pvt Ltd
- Glass Wall Systems India Pvt Ltd
- Gold Plus Glass Industry Ltd (Gold plus Group)
- Gurind India Pvt Ltd
- PIRAMAL Glass Pvt Ltd
- Pragati Glass Pvt Ltd
- Saint-Gobain India Pvt Ltd
- Sisecam Flat Glass India Pvt Ltd
- SCHOTT Glass India Pvt Ltd

We completed this “Glass sheet counter project using photoelectric sensor and Arduino” project for a glass sheet production company in Talaja, Panvel, Navi Mumbai. This project can successfully count the glass sheets without any error moreover we can manually add or subtract the number of quantities of glass sheets as per the requirement of customers and the market. As you can see the switchboard below, where you can go in the Manual Mode by SET button and increase or decrease the requirement of glass sheets using UP or DOWN buttons. You can add a Limit to the counter which means only a limited number of glass sheets or a group of glass sheets can go through the conveyor belt. As per the figure shown below you can RESET all the counter values if required. Lastly On/Off button will help to power on or power off the system.



Sensor stand

Switch Board

**V. PROGRAM DETAILS**

<https://highlion.blogspot.com/2021/10/programming-for-glass-sheet-counter.html>

**REFERENCES**

This was completely an industrial project, so there is no reference.

