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Design of seed counter with photocell sensor and weight measuring capability

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Abstract

The present study is an overview of the design and construction of the seed counting device, which has been registered in the national category under number 102869 in the Industrial Property and Documents Registration Organization of the country. Since a lot of time is spent in agricultural laboratories, a device called seed counter was built, which in this plan, by upgrading and making fundamental changes in it, new capabilities such as programming counting and measuring grain weight were added to it. Therefore, it can be used in research centers, agricultural industry and pharmacy. How to use is fully explained in the text. The use of this device is to count the number and measure the weight of seeds. The mechanism of this device is related to the subject of counting seeds automatically and is also related to electronic knowledge and agriculture. The seed counting device has a much higher accuracy than similar samples due to the use of a photocell sensor, so it can also be used to ensure the accuracy and accuracy of counting and measuring seed weight.

Key words: Seed counter, number count, weight measurement, photocell sensor

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1. Introduction

Today, with the increasing development of technology in agriculture and using modern counting methods, the industry of cultivating different types of seeds in agricultural lands has found a special approach and the use of this industry among developed countries such as the United States, India and the Netherlands has increased (Karikatti and Jangali, 2015). Production and cost reduction. As the second largest producer of vegetables in the world, India produces many of its transplanting processes by automatic counting and regular sowing of seeds in regular rows on agricultural land (Zhan et al. 2018).

Failure to use seed counters in agricultural research centers in Iran has led to problems such as high labor costs, time consuming, inaccurate counting and packaging of fine-grained seeds (Zhou et al. 2010). Due to the lack of experience and sufficient information, special equipment in this field is not only not made in the country, but due to lack of knowledge about this equipment, it is imported from foreign countries to a limited extent and the efficiency of production and quality of greenhouse products and Agriculture per unit area is at a lower level than the world level (Mahalingam, 2016).
For this purpose, designing and manufacturing a device with the ability to mechanically count different seeds for public use, will facilitate the cultivation and packaging of seeds with higher quality (Naderi Beldaji et al. 2008). Therefore, the use of seed counters has been considered in recent years. These devices use a sensor to count the seeds. The term sensor refers to a device that responds to a specific physical stimulus and produces a measurable electrical signal (Kweon, 2013). In general, a sensor is a sensor component that converts physical quantities such as pressure, heat, humidity, temperature, etc. into analog and digital electrical quantities (Ahmadi et al. 2008). It is actually an electrical device that measures changes and converts them into electrical signals (Eskandarzadeh Sabet, and Turkman, 2020). The sensors send various information about the status of the moving parts of the system to the control unit and change the performance status of the devices (Wicaksono et al. 2019).

Regarding the use of sensors, much research has been done in Iran and abroad, some of which are as follows:
In one study, temperature and humidity sensors were used to control and monitor environmental factors in the potato warehouse to reduce potato waste in the warehouse. This system consists of parts such as temperature sensor, humidity sensor, microcontroller and counter and the ability to control the environmental conditions of the warehouse in two different modes.
In another study, impact sensors built on a uniform and constant mass flow of the combine were evaluated, and the data showed how the product performed per unit area at each moment of harvest.
Although so far, the modern method of counting different seeds, which includes placing the seeds in one of the seed counters, has been done by various seeder systems, but the seed counter with photocell sensor and weight measuring capability has many differences and advantages. For example, in the invention with registration number 51845 on 12/21/2007 and the inventors "Tanya Davarian and Milad Ghadr and Abdolhossein Taheri and Hossein Alemi" a device called seed counter has been made that has the ability to count seeds but cannot separate the number It does not show certain seeds and is also unable to measure seed weight. Also, in the invention with registration number 51845 on 12/21/2007 and the inventors "Tanya Davarian and Milad Ghadr and Abdolhossein Taheri and Hossein Alemi" the infrared transceiver system was used and the distinction and innovation of the seed counting device with photocell sensor and the ability to measure the weight of the invention is that photocell sensors and light emitting diodes are installed as a transceiver system. In addition, the

present invention uses a microcontroller as a data processor, while previous inventions used circuits called control circuits (Davarian et al. 2007).
In the present study, a seed counting device was designed and manufactured with a photocell sensor and with the ability to measure weight, which has capabilities such as fast and planned counting of seeds and displaying the exact weight of seeds, etc.
At a glance, the seed counter can be used as a means of ensuring accurate counting as well as facilitating calibration.

2. Research method

The invention of the seed counter with a photocell sensor and with the ability to measure weight has been registered in the Industrial Property and Documents Registration Organization of the country under number 102869 and also the patent advertisement has been published in the official newspaper of the Judiciary. This invention is related to the subject of automatic seed counting and is also related to electronic knowledge and agriculture. The seed counters that have been made have the ability to count the seeds, but the technical problem is that it does not have the ability to separate a certain number of seeds, so we decided to build and plan a new device to solve this problem. Previously recorded devices used an infrared transceiver sensor, and the problem with this type of sensor is that it has noise and noise and causes errors in measurement and counting. By solving this problem, a new solution is used. This solution is to use the photocell sensor as the receiver sensor and the light emitting diode as the transmitter sensor. How to use this device is that the user has to pour some seeds in the tank of the counter and set the required number on the keyboard; The seeds are then inserted into the fall tube by the seeder or seeder and exited one by one in front of the optical sensor, and at the same time the number of seeds counted is displayed on the device display. In the construction of "seed counting device with photocell sensor and weighing capability", an optical sensor has been used, i.e., by passing the seeds in front of the light sensor, a pulse is generated and the microcontroller according to the pulse generated in the circuit, the exact number of seeds Calculates. The components of the seed counter with photocell sensor and weight measuring capability are primary seed tank, secondary seed tank, seeder (seed position), fall tube, photocell sensor and light emitting diode, load cell sensor, microcontroller, keyboard, LCD display, Analog indicator, potentiometer.

1-2. Primary seed tank:

The initial seed tank is the place where the seeds are poured in the machine for counting. At the beginning of the counting process, the seed is transferred from the tank to the fall tube by a seeder or stand, and then the counting is done by passing in front of the light sensor and light emitting diode.

2-2. Secondary seed tank:

This tank is used to collect seeds left from the fall tube and also to measure the weight of grains, a sensor (load cell sensor) is installed in the bottom of the tank that performs the weight measurement operation. And the amount of weight is displayed on the screen at the same time.

3-2. Seed position:

The seeder consists of an electric motor and the location of the seed position is between the seed tank and the guide tube. The electric motor activates the mechanism that causes the seed to fall, and the released seed enters the fall tube.

4-2. Falling pipe:

The fall tube is the passageway for transferring the seeds from the primary tank and the seed position to the transceiver sensor. In fact, the seeds are first poured into the primary tank and then enter the fall tube through the seed position located on top of the fall tube and exit the end of the fall tube by passing in front of the transceiver sensor and in the secondary tank. Is poured.

5-2. Photocell sensor and light emitting diode:

Photocell is a resistor. This resistance, similar to variable resistors, changes its value using light radiation. Another name for a photocell is LDR, which stands for Light Dependent Resistor. This optical sensor has 2 pins. The most common material used in this optical sensor is Cadmium sulfide. The photocell works in such a way that if the light that shines on it decreases, its resistance increases, and if the light that shines on it increases, its resistance decreases because light is an electromagnetic radiation that when exposed to different intensities The surface of the photocell shines, changing its resistance.
In this device, by passing the seed in front of the light emitting diode, the light intensity that reaches the photocell sensor changes, followed by a change in the resistance of the photocell sensor, as well as the sensor voltage, and the microcontroller changes this voltage as a Counts the pulse and each pulse as a seed and records it as a number on the display.

6-2. Load cell sensor:

Load cell is a type of electronic sensor (sensor) for measuring weight and force, which when applied to it, a weak electrical signal in millivolts appears on its output wires. In fact, a load cell is a transducer that converts force and pressure into standard electrical signals and is made in tensile, flexural, compressive and torsional types. Load cell is used to measure force in various factories as well as to measure the tension of cables and the tension of yarn in textile factories and other industries. Digital weight measurement on electronic scales also requires a load cell. Today, different types of load cells with different capacities are widely used in the manufacture of electronic scales and scales. Automatic systems based on measuring the weight of materials in food mills - asphalt mills - chemical plants all use load cells. The load cell consists of a metal core (of a special alloy) and a number of strain gauges. This sensor is installed in the device to measure the weight of counted grains.

7-2. Microcontroller:

The microcontroller is responsible for processing, commanding and receiving input pulses and receiving data as input, and after the calculation, records the calculation output data and sends it to the display for display.

8-2. Keyboard:

Below the keyboard buttons are three separate layers of plastic, two of which are the device's keyboard circuits that can detect the compression of each button. The third layer is placed between the two electrical layers and acts as an insulator. These circuits are usually designed in such a way that they are completed when the button is lowered and electricity flows through them. When the user presses one of the keyboard keys, by completing the circuit diagram and moving a light current in them, it transmits the signals associated with that particular button to the microcontroller.
The keyboard is installed in the machine to record the number of seeds that the operator needs, and the operator uses the keyboard to enter the number of seeds he wants in numbers, and after pressing the confirmation key, the microcontroller receives the data and the program commands Implements the microcosm in itself.

9-2. LCD display:

To connect the LCD monitor, you usually need to use several digital pins, as well as a 5-volt pin and a ground or ground pin, and sometimes a 3.3-volt pin. Even to adjust the contrast of the LCD, which makes the letters legible, a resistor or potentiometer is needed to supply the desired voltage. But if you use the I2C module, we can use only two analog pins and turn on the LCD and print characters and graphics on it. Note that this module, like most modules, requires a ground or 0V connection and a 5V connection for power.
A character LCD monitor is used to display the relevant information. What is referred to as an LCD is an LCD display like a calculator screen that comes with the IC controller and its side circuits, usually with a backlight in a prefabricated package.

10-2. Analog indicator:

The analog indicator is used to show the accuracy of the pulses in this device, and if when for any reason the correct pulse is not received and the seed gets stuck in the tube, immediately by seeing the analog indicator, a technical problem can be detected in the device, and it can be fixed. That problem arose.

11-2. Potentiometer:

Potentiometer or speed pots is a type of resistor used to control speed, voltage or frequency and has three terminals. It is a type of voltage divider or controller that is used to measure electrical potential (voltage). When voltage is applied to the resistor loop (resistor element), the viper can control the amount of resistor used. The operator can increase or decrease the LCD backlight with the volume potentiometer. The seed counter was made with a photocell sensor and with the ability to measure weight after the initial design by industrial parts design software (SOLIDWORKS Premium 2021 SP2).

3. Results and discussion

Given what has been said about the components of the machine, an explanation of the general process of seed counting is given. First, the user places the seeds in the initial tank of the machine. It can then enter the desired number of seeds needed to count on the keyboard. After pressing the confirmation key, the counting machine will start. To count the seeds, the seed position is first rotated by an electric motor to direct the seeds or seeds from the initial tank to the fall tube. After the seeds enter the fall

tube, they pass through the front of the transceiver sensor, exit the end of the fall tube, and are dumped into the secondary tank. As the seed passes in front of the transceiver sensor, a pulse is sent to the microcontroller for each seed, and the microcontroller records the calculation output data and sends it to the display for display. The operator can also increase or decrease the LCD backlight by volume potentiometer.

After the seeds are placed in the secondary tank, if the user needs, its weight is also measured by the load cell sensor located below the same tank, and to show the measured value on the display, the weight data to the microcontroller Are sent.

As soon as the count reaches the desired number of users, the machine automatically stops counting and the user can remove the counted seeds from the secondary tank. If, for any reason, the pulse is not received properly and the seed gets stuck in the tube, a technical problem in the device can be detected immediately by looking at the analog indicator and trying to fix it.

The steps of designing and manufacturing a seed counting device with a photocell sensor and weighing capability are explained in the following figures. Figure 1 shows the perspective view of the whole invention from behind, which is the Secondary tank fig-2, the secondary tank of the device, and the seeds are placed in this tank after counting. Load cell sensor is installed to measure the weight of the counted grains under the secondary tank.

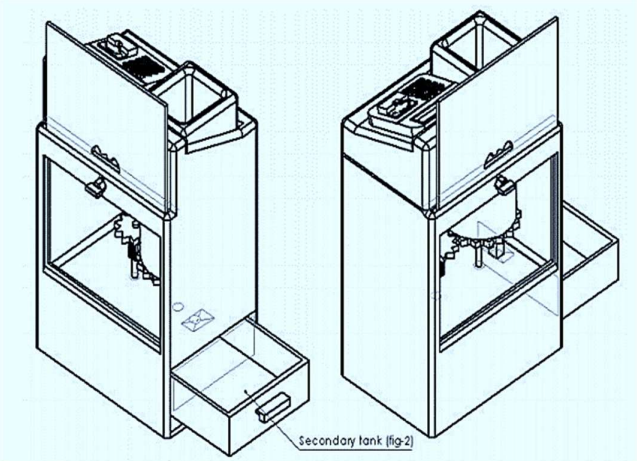

figure 1). Perspective view of the whole invention

For a better understanding of the location of the load cell sensor, Figure 2 clearly shows the position of this sensor below the secondary tank.

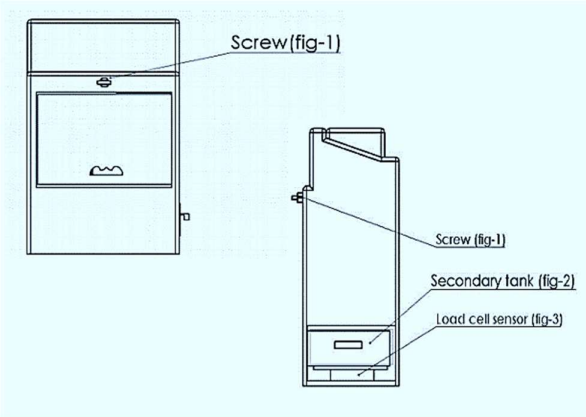

figure 2). Location of Cell Load Weight Sensor

Screw fig-1, shown in the side view of the device, is the screw on the back slider of the device, which can be used to access the internal contents of the device in case of emergency.

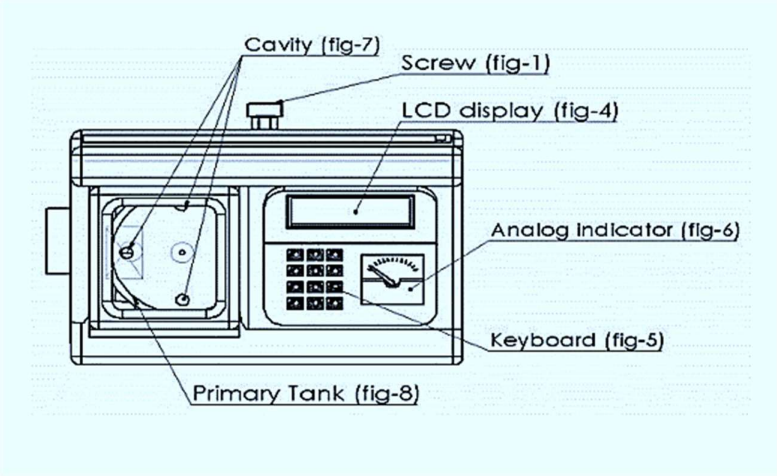

Figure 3). Overview of the invention from above

As shown in Figure 3, the seed position has four cavities or Cavity fig-7. When one of these four holes is placed on the gear hole or Gear fig-5, the seed passes through the seed hole and enters the fall tube and is counted by the light resistance sensor.
The figure below shows the Gear fig-5 gearbox and the Electric motor fig-4.

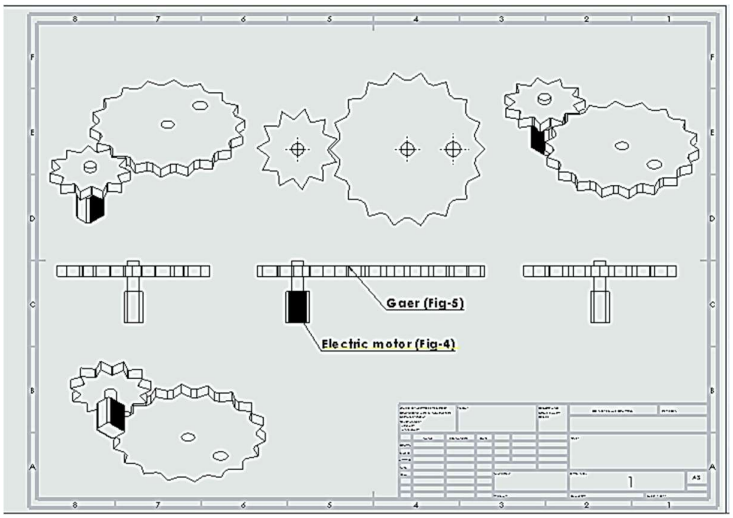

Figure 4). Gear fig-5 gearbox and Electric motor fig-4 from different angles

The point marked in Figure 5 shows the location of the photocell sensor and light emitting diode as the receiver and transmitter system of the device. Seeds are counted in the fall tube as they pass through this area.

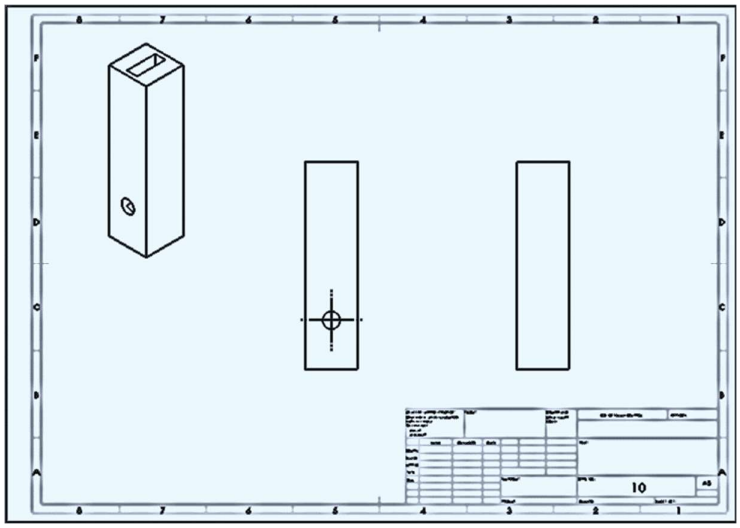

Figure 5). Location of photocell sensor and light emitting diode

After counting the number of seeds and measuring their weight, the data is processed by a microcontroller and sent to the LCD monitor. The design of the LCD display in Figure 6 is designed from different angles.

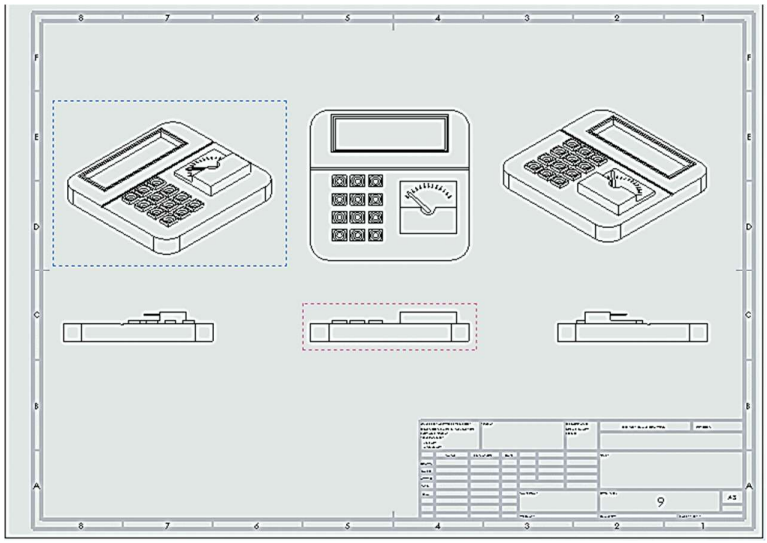

Figure 6). LCD display design from different angles

To the right of Figure 7, a typical LED number is drawn.

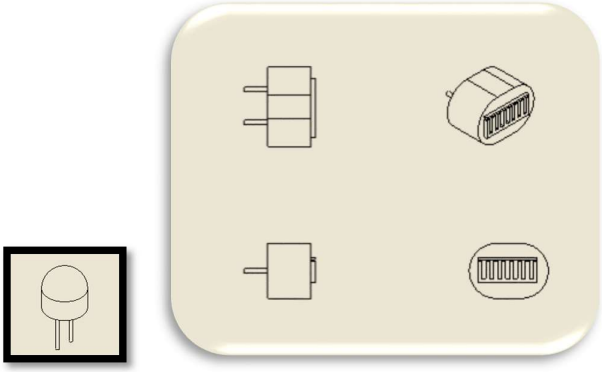

Figure 7). Conventional LED and optical resistance sensor

Also on the left side of the figure above is the light resistance sensor of the device from different angles. These two components are used in the receiver and transmitter systems of the invention.

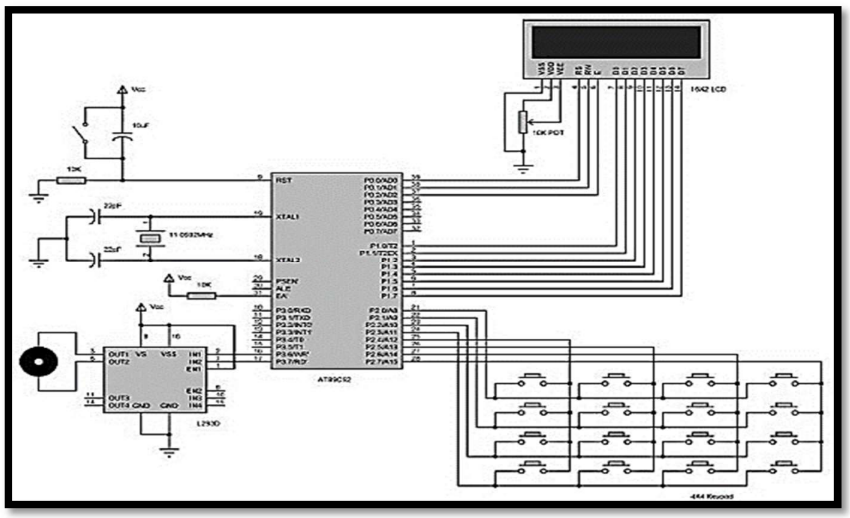

Figure 8). Technical diagram of electrical circuit

Figure 8 shows the technical diagram of the electrical circuit used in the device. After careful observation and based on the above shapes, the seed counter was made with a photocell sensor and with the ability to measure weight. The final shape of this device is given below.
Counting can be done in two ways, which are discussed in two of these methods.
Free counting: The first method of execution is that after connecting the device to the 12-volt power supply, the seeds that it intends to count, fall into the primary tank of the device and the seeds are placed in the secondary tank after counting and the user Can see the number of seeds on the LCD monitor.
Restricted Counting: The second method is to first connect the user to a 12-volt power supply, then enter the number of seeds needed for counting on the keyboard and pour the seeds into the initial seed tank; At this point, the machine starts counting and the counted seeds are placed in the secondary tank. Simultaneously with the count, the number of seeds is displayed on the LCD screen. The machine stops after counting the specified number of seeds and the user can take the counted seeds from the secondary tank.

Here are some of the goals of the device:
1. The purpose of the invention is to reduce noise and increase the accuracy of the device, which we achieved by using a photocell sensor to count numbers, microcontrollers and also using analog indicators.
2. The operator can count and separate the desired number of seeds with any number of seeds that he intends.
3. Another purpose of the invention is that in addition to counting and separating the number of seeds, it also has the ability to measure grain weight.

The application of this device is in several areas, which are:
1- The use of this invention in the agricultural industry will be very efficient because in the process of planting seeds, a lot of time is spent counting its number.
2- In agricultural laboratories, in addition to limited or free counting of seeds, their weight can also be measured.

4. Conclusion

The invention of the seed counter with a photocell sensor and with the ability to measure weight has been registered in the Industrial Property and Documents Registration Organization of the country under number 102869 and also the patent advertisement has been published in the official newspaper of the Judiciary. This invention is related to the subject of automatic seed counting and is related to electronic knowledge and agriculture.
The difference between this invention and other related inventions is that the seed counters that have been made can count the seeds, but the technical problem is that it does not have the ability to separate a certain number of seeds.
In addition, the previous registered devices used an infrared transceiver sensor, and the problem with this type of sensor is that it has noise and noise and causes errors in measurement and counting, thus solving this problem. A new solution has been used, and this solution is to use the photocell sensor as the receiver sensor and the light emitting diode as the transmitter sensor.
The method of counting seeds can be in the form of free counting and counting with restrictions, which depends on the choice of the user or its user.
According to what was stated, the advantages of this invention over previous inventions are:
1- Fast and planned to count of seeds
2- Display the exact weight of the seed
3- Save more time and money
4- Ease of use and portability of the device
5- Ability to install on agricultural machines, especially sowing machines for scheduled counting for regular sowing of seeds and rowers
6- Potentiometer for LCD calibration
7- Using microcontroller as processor and data receiver as input and calculating output data to send to display

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