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Modified optical sensor based seed counter for seed drill

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Abstract

Seed drill is an improvised agricultural implement which is used for sowing seeds into the soil at required depth and distance. Now a day's seed drills become more common for sowing. The calibration of seeds and seed rate determination is very tedious and time consuming in agricultural practices both for small and large farmers. To overcome this tedious work, seed counters are designed and developed to do count seed and calibrates in easy and accurate way. This research involves design and development of digital seed counter to provide accurate seed counting procedure at affordable cost and efficiency. The complete process is controlled using a micro controller and it performs all the operations in a sequence. This seed counter, eliminates operator error and reduces operator fatigue. Light reflecting optoelectronic field counter capable of detecting and counting free falling object with equivalent length/diameter $>$ than or $=$ 0.5 mm in seed delivering tube was developed and tested to evaluate seeding rate. The performance of the device is not affected by the shape and color of the counted objects. An electronic device for counting seeds in the size range from flax to groundnut has been developed. The accuracy of counting is very high, for the tested results. The speed of counting varies from 200 to 300 seeds per minute. In this electrical sensor seed counters can use in laboratories, to count seeds per corn, ear heads etc. The overall accuracy of the seed counters is 99.85% at travel speed of 2.5 Km/h.

Keywords: Sensor, seed counter, seed drill, microcontroller, microprocessor

Introduction

Seed drill is a sowing device that sown the seeds precisely in the soil at proper depth and distance. Then it covers them with soil. It protects the seeds from birds and saves time and labour. Agriculture for four decades has been associated with production of essential food crops. At present, agriculture above and beyond farming includes forestry, dairy, fruit cultivation, poultry, bee keeping, mushroom, arbitrary etc. Today processing, marketing and distribution of crops and livestock produce etc. are all acknowledged as part of current agriculture. Thus agriculture could be referred to as the production, processing, promotion and distribution agricultural products. Agriculture plays a critical role in the entire life of a given economy. Agriculture is the backbone of economic system of a given country. In addition to providing food and raw material, agriculture also provides employment opportunities to very large percentage of population. Crop production, require a number of operations like seed bed preparation, seedling, fertilizing, spraying, dusting, irrigation, harvesting, threshing. Sowing or seedling is art of placing the seeds in a soil.

A perfect seedling gives,

1. Correct amount of seed per unit area.
2. Correct depth at which seed is placed in the soil.
3. Correct spacing between row to row and plant to plant

The planter incorporates electronic programming for spacing and fertilizer application. Durairaj *et al.*, (1994) developed a bullock drawn seed drill with a simple electronic metering system. It had an electronically controlled check valve system that facilitated precision planting of seeds. Field tests indicated negligible variation in plant spacing from the required spacing and seed damage was minimum with an acceptable germination percentage and crop stand.

Rehman and Singh 2002 developed a sensor for seed flow from seed metering mechanism. A sensor based on a light interference technique had been developed for sensing the seed flow from the metering mechanism of the planter. Aware, *et al.*, Aug & Nov 2008 in the metering unit of planters, by introducing LED systems for metering systems. Karthikeyan, (2004). But the problems like slippage and skidding of ground wheel still persists. So keeping these points in view a project was undertaken to develop an electronic metering unit which would be devoid of ground wheel and mechanical transmission.

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Aware, V., 2014. A microprocessor based electronic metering mechanism was design and developed for three row planter to meter the cowpea seeds. The previously developed mechanical metering mechanism exhibited various losses in mechanical linkages and hence proved to be less precise. The metering mechanism was based on the electric rotary sensing. The input was given to the micro controller in the form of electric pulses from the sensor and the switches, which defined the spacing of the seed. The performance of developed planter was tested in the laboratory. For the given input of 15 cm, the output seed spacing obtained was 16.2 cm.

Materials and Methods

Construction of Electronic Sensors and Counters:

Microcontroller

A microcontroller unit (MCU) contains an MPU, memory, and I/O circuitry on a single chip. Such a chip can perform control operations without the need for any external circuitry. Microprocessors are high performance, general purpose brains for PCs and workstations. Instruction decodes and control, arithmetic/logic operations, registers, timing, external Control Includes memory management unit, lots of cache. Performance is the most important feature (cost is important, but secondary).

- Devices with high levels of integration for embedded control
- Microprocessor functions plus on-chip memory and peripheral functions (e.g. ports, timers). "Swiss army knife" of microprocessor technology
- Includes memory management unit, lots of cache
- Performance is the most important feature (cost is important, but secondary) Used mainly in desktop machines

PICs

It have a set of registers that function as general purpose RAM. Special purpose control registers for on-chip hardware resources are also mapped into the data space. The addressability of memory varies depending on device series, and all PIC devices have some banking mechanism to extend addressing to additional memory. Later series of devices feature move instructions which can cover the whole addressable space, independent of the selected bank. In earlier devices, any register move had to be achieved via the accumulator.

External data memory is not directly addressable except in some high pin count PIC18 devices. A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

Seven-segment displays

They are electronic display devices used as an easy way to display decimal numerals and an alternative to the more complex dot-matrix displays. The LDS-C303RI, a common seven-segment display, will be examined. Common anode vs. common cathode will be outlined. LED drivers such as the CD74HC4511E will also be discussed.

Infrared sensor

An IR sensor can measure the heat of an object as well as detects the motion these types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infrared spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltages, change in proportion to the magnitude of the IR light received.

Opt coupler or opt isolator

It is a device that contains a light-emitting diode (LED) and a photo sensor (photo detector, such as a photo resistor, a photodiode, a phototransistor, etc.). The purpose of an opt coupler is to transfer signals from one circuit to another yet keep them galvanically isolated.

Buck converter

A buck converter (step-down converter) is a DC-to-DC power converter which steps down voltage (while stepping up current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) typically containing at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter).

Attachment of seed counters and sensors to the seed drill.

- Attach the IR sensor to the each seed tube.
- The sensors are connected from seed counters through the wires.
- The sensors and seed counters are attached to the 10 – 12 v battery for. power supply

Experimental operation procedure

- Put the seeds to the seed bowl.
- The seeds will pass through a seed tube attached with sensors.
- When the seeds enters the zone of light producing sensors in the seed tube.
- The seed counting data will be taken by the sensors that data can be by the Opt coupler.
- Opt coupler takes the signal from the sensors and sends this signal to the seed counting unit.
- In the seed counting unit microcontroller will analyze the data obtained from the sensors.
- This microcontroller transforms the data to the seven segment display.

Seven segment display will show the direct digital counted numbers. The circuit board made up 5V power capacity, in which microcontroller, capacitor, resistor, relay, opt coupler and sensors are connected/ fixed to the circuit board, as shown fig (1). When seed/object pass in pipe the sensor emits and detects the object and signal send to the digitally display, as

shown in fig (2) & (3). If the sensor emits/detects the seeds its count add in display, if sensors are not detect the seed due to errors it not count add in the display and its stop, as shown in fig (4). After complete set up sensors, counters are attached to

the 6 tyne groundnut seed drill and each pipe one sensor is placed to sense the seed and signal send into digital display, as shown in fig (5).

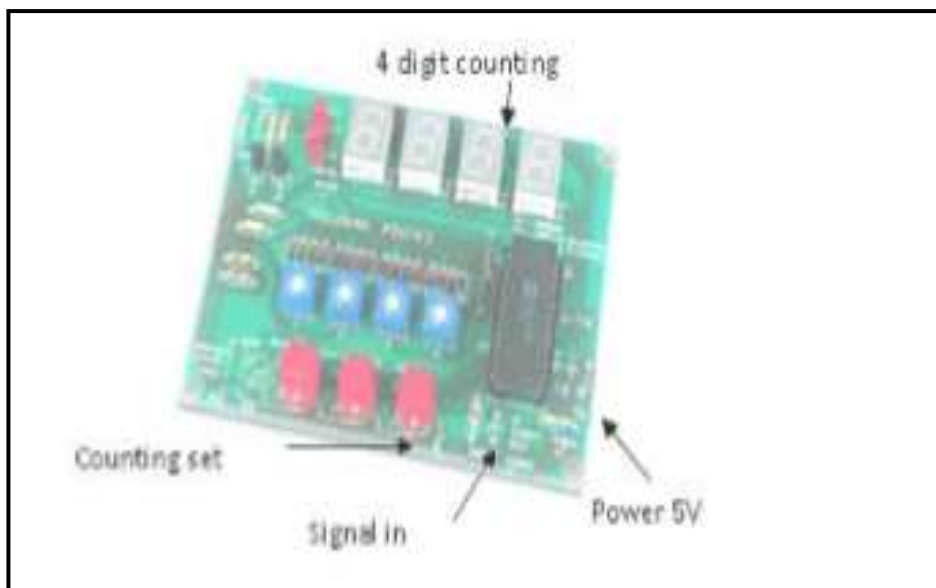


Fig 1: Signal counting circuit

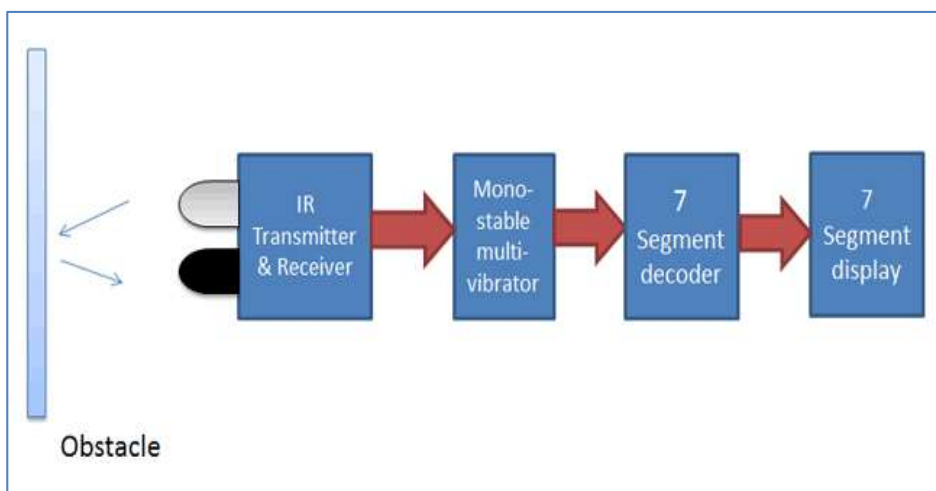


Fig 2: Flow chart of the electronic circuit

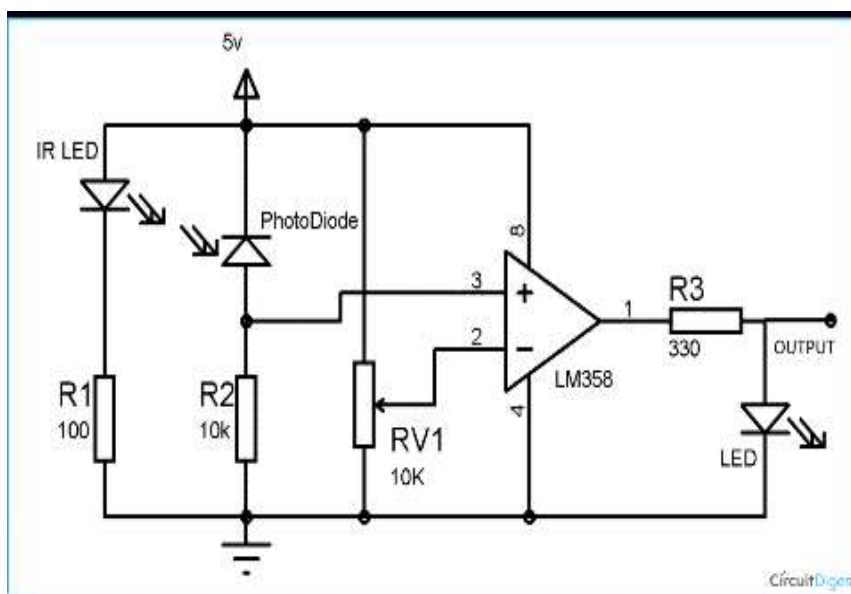


Fig 3: Electronic circuit diagram for IR sensor

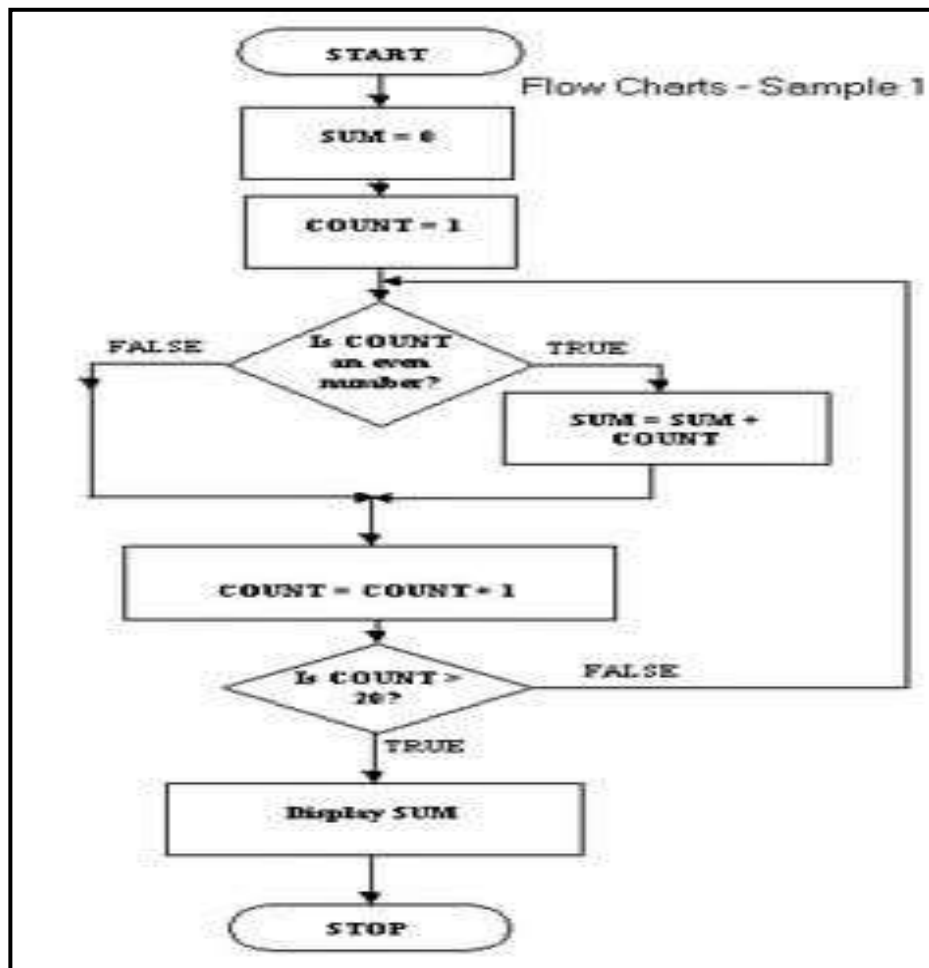


Fig 4: Flow chart of the seed counter



Fig 5: Sensors and seed counters attached to seed drill

Results and discussion

Field test were carried out to determine the seed to seed spacing and seed rate of the developed electronic sensor metering mechanism. Tests were carried out on 50m length at field at forward speed. Seed rate for ground nut was considered as 100-110 kg/ha. It was observed that the average seed to seed spacing was 15, 14.5 and 13 cm respectively and row to row spacing was 30cm at travel speed of 2.5 Km/h.

Observation

- Used seeds – Groundnut

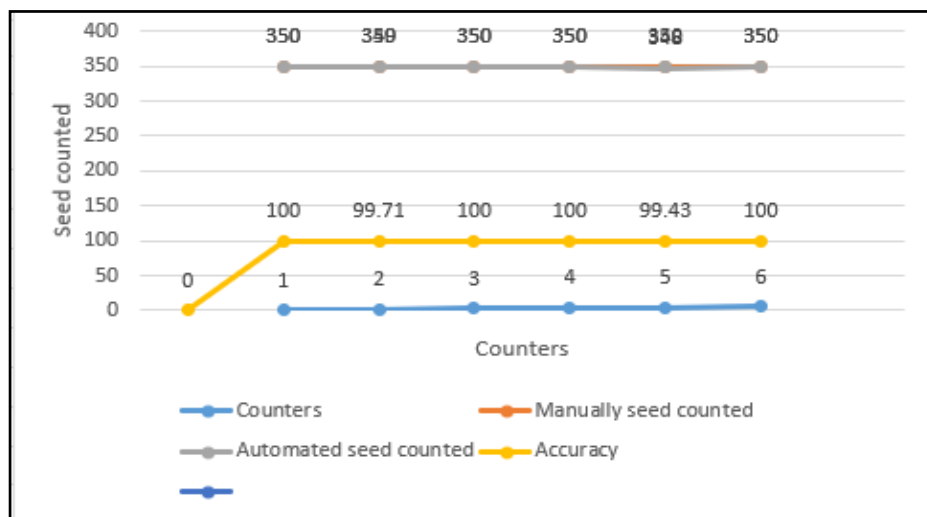
- Total number of input seeds into an hoppers – 2100
- Total number of counted seeds - 2097
- The overall accuracy of the seed counters – 99.85%

During experimental field test we selected 50m length area and manually groundnut seeds counted at 350 seeds and placed in a hopper, when tractor forward speed at 2.5 Km/hr., the sensors are counted at 350,349,348 respectively. The accuracy of counters should be 99.85%, as shown in Table (1).

Table 1: Seed count and calibration

Counters	Manually seed counted	Automated seed counted	Accuracy (%)
1	350	350	100
2	350	349	99.71
3	350	350	100
4	350	350	100
5	350	348	99.43
6	350	350	100

Variety

**Fig 6:** Seed counted at individual counters in forward speed

Conclusion

This research work was carried out to design and develop an optical sensor based seed counter for seed drill with in affordable cost and high efficiency, it was achieved successfully. It consists of various mechanisms for separating & counting the seeds from the feeder and for transporting them. The complete process has been controlled using a micro controller and performs all the operations in a sequence. There was no influence of seed shape, and colour on the accuracy of counting process. In this research work, the usage of optical based IR sensors for count the seeds distribution measurement and pattern characterization in spreading granular particles were introduced, and their feasibility were investigated. In this optical sensor seed counters can use in laboratories, to count seeds per corn, ear heads etc.

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