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Research Article

Design And Development Of Iot Based Automated Solar Seed Broadcaster

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ABSTRACT

Agriculture being the backbone of India has been attaining tremendous evolution using the recent technologies. This paper depicts the development of solar powered seed broadcaster that helps farmer having effortlessness of work. The machine derives its energy source from the sun, which is renewable and eco-friendly source of fuel. The main dictum is to sow the seeds efficiently and reduce the drudgery to farmer. The 12v solar panel then converts solar energy to electrical energy. The microcontroller guides the machine to move through the entire field. With the help of this machine various seeds such as maize, sorghum, millets, etc. can be spread evenly and the ploughing is done simultaneously after sowing. As the result suggest, the seed sowing time had been effectively decreased by 1.3% and the yield had been increased by 1.5%.This machine makes the farmers to work easy and can save more time and investment.

Key words: Seed sowing, Broadcasting, Solar broadcaster, Automatic, Agriculture

1.INTRODUCTION:

Humans can't live without air, water and food. Among this food has to be cultivated[1]. The agricultural sector has consistently been the foundation of India's sustainable development. As India's population increases, so does the demand for agricultural products.[2]. By 2035, the global population is projected to exceed 8 billion, significantly boosting worldwide food demand. [3]. India, where roughly 75% of the population is engaged directly or indirectly in agriculture, has seen only a 26% increase in cropping intensity since 1950-51, reaching 13.7%.[4,5]. Thus, with rapid industrialization impacting food requirements, the modernization of agriculture is essential to keep pace with population growth and escalating food needs.[3]. Numerous operations involved for a crop to become an edible produce. The foremost operation includes tillage and sowing. Sowing must be ensured to be done in appropriate time. In traditional farming methods, seeds are sown manually through broadcasting, or by opening furrows with a plough and then dropping seeds by hand.[2,4]. However, one of the biggest continuous challenges faced by farmers is the shortage of manpower.[6]. By the evolution of engineering and technological aspects machines for sowing have developed for different seed sizes and methods[1,7].Providing nutrients and fertilizers for proper growth of sown seeds are also important. Incorporation of some operations like irrigation, nutrient spraying, tilling along with sowing is accompanied[4,8].

In the current era, the most commonly used agricultural machinery includes tractors powered by fuel. However, this reliance on fuel-powered machinery is not sustainable since fuel is a finite resource and contributes to environmental pollution. [9].On the other hand, price of fuel increases day by day which ultimately increases operating cost of machines making unaffordable for small scale farmers[10].To overcome this solar energy is an eco-friendly energy source[8]. The primary goal is to enhance the efficiency and cost-effectiveness of energy production from photovoltaic cells. Most solar panels are installed in a static alignment, fixed at a specific angle towards the sky. [12]. To ensure success in the agricultural sector, it is crucial to incorporate cutting-edge technologies and understand their functions and the significant roles they play in the field. With the current advancements, utilizing available technologies has become a necessity to achieve optimal results. [13].

Over 70% of farmers are classified as small and marginal, and one of their major challenges is the unavailability of tractors during the critical sowing period. [14]. Many small and marginal farmers have been excluded from the benefits of advancements in agricultural practices and techniques due to the high cost of machinery.[15].With all these information and thoughts, automated solar seed broadcaster has been developed in this research work. This approach emphasizes broadcasting because it offers the highest efficiency for sowing seeds of crops that do not require specific spacing. The fabricated machine is very convenient for the farmers usage.

2.MATERIALS AND METHODS:

2.1. Basic components

The solar operated seed broadcasting machine consists of the following components to full fill the requirement of complete operations of the machine.

Blower

Centrifugal fans are composed of an impeller encased within a casing that features a spiral contour. The air enters axially into the impeller and is expelled from the outer periphery of the impeller, flowing in a radial (or centrifugal) direction. These fans can generate relatively high pressures, making them more suitable for high-pressure applications than axial flow fans. Generally, there are three types of blades used in centrifugal fans: forward-curved blades, backward-curved blades, and radial blades. In this seed broadcasting machine, it is used to blow off the seeds falling from the hopper by which the seeds will be broadcasted. Blower was connected to the motor and its velocity is 8 m/s(approx.), pressure will be 0.5 bar(approx.)

Fig.1.Blower

Hopper

A hopper is a conical container used in industrial processes to store particulate matter or flowable materials. In the context of a solar-operated automatic seed broadcasting machine, a hopper is utilized to hold seeds and dispense them from the bottom as required. This is made up of mild seed material and its capacity is up to 10 kg with overall dimension of 13-inch inlet diameter and 2.5-inch outlet diameter.

Fig.2.Hopper

Bearing

The main use of bearing is to reduce friction and allow smoother rotation. In this machine, bearing was attached to the wheels (4) in order to enable the wheels to rotate smoothly with a minimum of friction. Bearing used in this machine is 6202 ball bearing.

Fig.3.Bearing

Wheels

It is a disc or circle shaped mechanical device used to roll the things. Wheel spins and object on the wheels moves more easily along the ground. In this seed broadcasting machine four wheels were fixed and it was connected to the permanent magnet dc worm gear motor. This is made up of mild steel material with overall size of 2.5 inch with 7-inch diameter and 4mm thickness.

Fig.4.Wheel

Tillage mechanism

In this automatic solar seed broadcasting machine, seeds are sown by scattering them over the soil with a blower. Seeds sown through broadcasting tend to be distributed unevenly, which can lead to overcrowding. To mitigate this, seeds are lightly buried after broadcasting using some form of raking action, typically performed with vertical tillage tools. This helps ensure more even distribution and better seed-to-soil contact, which are crucial for optimal germination and growth. Here a cultivator was attached to the backend of the machine which helps for the even distribution of seeds.

Fig.5.Tillage mechanisms

Frame

The frame was made up of mild steel. The overall dimension of frame were 3 feet length and 1.5 feet breath. Every part of this machine was fixed to this frame work.

Fig.6.Frame

Shaft

A shaft typically refers to a cylindrical component that rotates and transmits power from a motor to the wheels or other parts of a machine. This crucial component is designed to carry rotational forces and drive the mechanics of the system. Totally four shafts were used for fixing the wheels with the frame. This is made up of mild steel material with 15 mm diameter.

Fig.7.Shaft

2.1.2 Electrical components

The following components are used to automate the seed sowing operation.

DC motor

A DC (Direct Current) motor is an electric motor that runs on direct current electricity to supply power for driving mechanical devices and performing various functions in machines. In this machine, it will be connected to a battery where power will be supplied and it will be used to operate the wheels. Motor used is of 12 volt 90 watts with 2900 RPM. Motor was mounted on the frame using nuts and bolts.

Fig.8.DC motor

Solar panel

Solar technologies harness sunlight to produce electrical energy using photovoltaic (PV) panels. These panels are typically constructed from silicon or another semiconductor material, encased in a metal frame and covered with glass. Sunlight is absorbed by the PV cells within the panel, where it is converted into electrical charge. This energy is then stored in a DC battery for later use.

Fig.9.Solar panel

DC battery

DC battery was mounted on the frame. Electric charge produced from the solar panel is stored in the battery. It supplies the power to DC motor in order to operate the wheels and blower. In this machine, 12-volt lead acid rechargeable battery was used. It was mounted on the frame using nuts and bolts.

Fig.10.DC battery

Sensor

Active infrared sensors operate by emitting infrared radiation, which is then reflected off objects back to the sensor's receiver. Unlike radar technology that uses radio waves, active infrared sensors use infrared light to detect the presence and distance of an object based on the time it takes for the reflected radiation to return. This allows the sensor to determine the location, size, and movement of an object. By which the sensor detects how far the object is from the sowing machine and it changes its direction accordingly.

3.DESIGN OF THE MACHINE

The conceptual design and isometric view of seed broadcaster were done with SolidWorks software and it is analysed and the conceptual design is shown. The isometric view of the seed broadcaster is shown in Fig.3.2

Fig.11.Overview of the machine

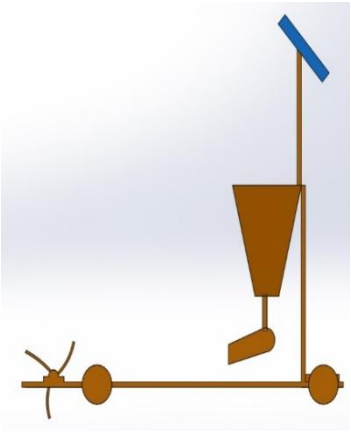

Fig.12.Side view

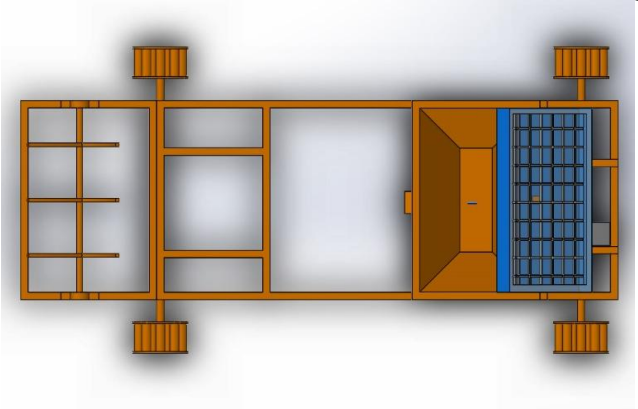

Fig.13.Top view

4. WORKING PROCEDURE

The sole source of energy is received from the electricity generated from the solar panel and stored in the battery. The PIC16F877A microcontroller helps in automating the machine by its programmed logics and the inputs such as length and breadth of field and the turning radius of the broadcaster are to be instructed. Once all the inputs are given the broadcaster start moving. A switch is provided for blower and tillage mechanism. The valve located at the bottom of the hopper is adjusted to open at a rate that aligns with the desired seed distribution, ensuring that seeds are dispensed at the correct rate for optimal planting. The depth of tillage can be adjusted as per the requirement. An IR sensor fitted at the front of the machine detects the obstacles and navigates the machine to overcome the obstacles and move again to the similar path. In this way the whole field is broadcasted and buried in soil in an efficient way.

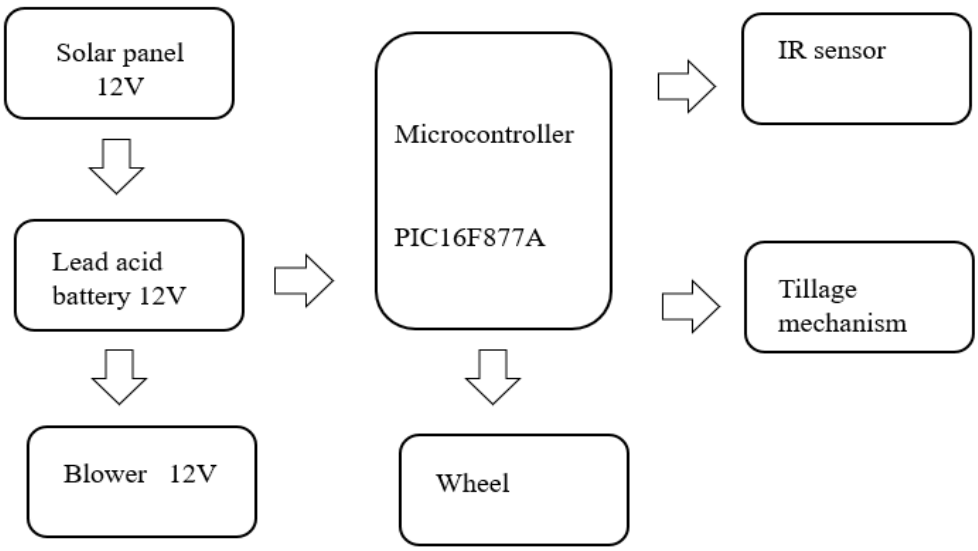

Fig.14 Block diagram

Table.1

S.no	Name of the seeds	Ideals Seed rate (kg/ha)	Conventional Broadcasting method			Solar Seed Broadcaster		
			Seed rate (kg/ha)	Sowing time (hrs/ha)	Yield (kg/ha)	Seed rate (kg/ha)	Sowing time (hrs/ha)	Yield (kg/ha)
1.	Maize	20	20 - 25	8 - 16	2500	16 - 22	5 - 12	2589
2.	Sorghum	8	7 -10	10 - 20	2496	5 - 8.5	8 - 17	2670
3.	Pearl millet	3 - 4	3 - 4	12 - 18	2354	2 - 3.4	9 - 12	2513
4.	Sunnhemp	25 - 35	25 - 35	13 - 20	400	20 - 30	10 - 15	432.5

6. TESTING AND ANALYSIS

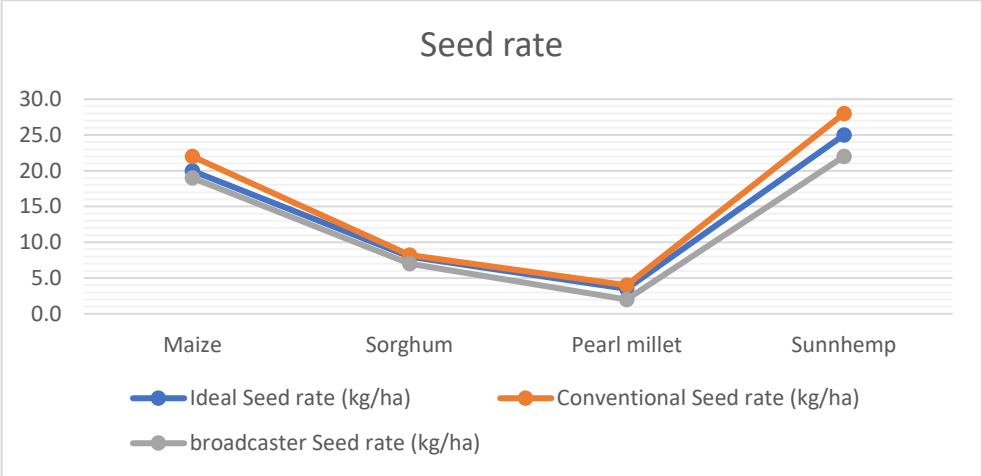

Fig.14.Comparison of Seed rate

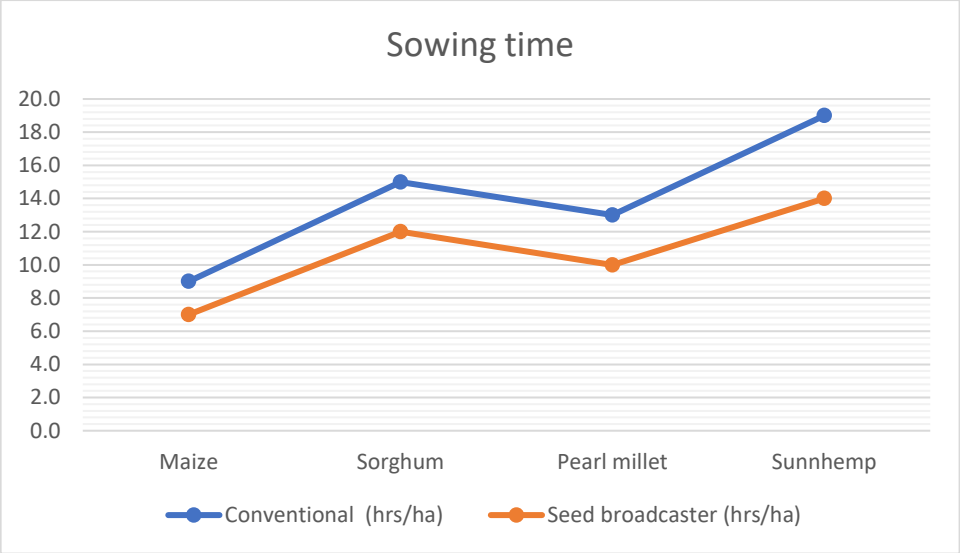

Fig.15.Comparison of Sowing time

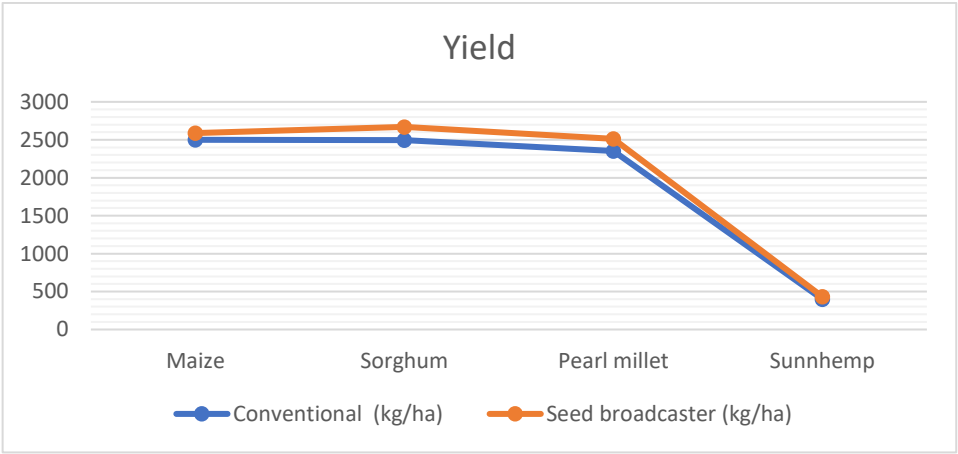

Fig.16.Comparison of Yield

7. RESULT AND DISCUSSION

By comparing the seed rate, sowing time and yield of the convention broadcasting method with solar seed broadcaster, it is found to be effectively reducing the broadcasting time. The yield of the seeds has also been improved by placing the seeds at optimum depth. As the result, the solar seed broadcaster finds to be effective for broadcasting seeds over large area with minimum labour requirement. The seed sowing time has effectively decreased by 1.3% and the yield has been increased by 1.5%.

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