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Development of Sensor Based Electronic Control Unit (ECU) for Site Specific Precision Water Applicator for Planter

Vikki Prasad Sahu
Assistant Professor
(Department of Agriculture Engineering)
Shri Krishna University, Chhatarpur (M.P.)

ABSTRACT

Amid sowing of seeds by utilizing created grower, it is seen that most of the ranchers utilizing surge water system which is devours more water with less effectiveness. As a result craved plant populace per unit range isn't gotten causing reduction in yield. To play down the misfortune of water for seeds, a sensor framework has been created for grower. This consider presents the devolvement of microcontroller-based site-specific water implement framework that coordinating seed location inside seed tubes utilizing IR sensors, combined with exact water application encouraged by transfers and solenoid valves. The framework points to optimize rural water system by conveying water.

The framework design incorporates IR sensors inserted inside seed tubes, empowering the location of seeds amid the planting handle. These sensors communicate with a microcontroller unit, which forms the seed location information and facilitates water dissemination. Utilizing an calculation custom-made for seed-specific water system, the framework enacts transfers to control solenoid valves, coordinating water solely to seed areas inside the field.

The research facility assessment of the created microcontroller based sensor framework with pre-existing grower uncovers that the varieties of real no. of seeds dropped and show perusing of the LCD screen was found to be 6.33% at 2.0 km/h, 9.0% at 2.5 km/h and 15% at 3. km/h working speed. It was found that the seed location variety increments with increment in speed. The normal water release from the spout was found to be 31.37, 42.54 and 55.24 ml at 0.8, 0.9 and 2.0 moment actuation time of solenoid valve separately. It was watched that, water release increments when increments in actuation time of solenoid valve. After actuating sensor framework normal water sparing was found to be 47.28% at 0.8 sec, 35.86% at 0.9sec, and 15.29% at 2.0 sec. It was watched that water sparing creases when increments in enactment time of solenoid valve in both the conditions .

KEYWORDS

Microcontroller, Site-specific water applicator, IR Sensor, Seed detection, Solenoid valve, Relay.

INTRODUCTION

India is one of the developing countries of Asia having lower land productivity as compared tothe developed nation due to low level of farm mechanization. India is an agricultural country as agriculture is considered to be the back bone of Indian economy. Involvement of farm machinery in agriculture is an important input to enhance production and productivity as well as reduce the cost of cultivation. Recent developments on farm machinery are aimed at optimum utilization of inputs and proceed towards precision farming.

Water management is paramount in countries with water scarcity. As a result, research on conserving water during irrigation has grown throughout time. Smaller farmers are unable to install this kind of system due to the high cost of typical commercial sensors for agricultural irrigation systems. Nonetheless, producers are already providing inexpensive sensors that may be linked to nodes to create reasonably priced irrigation control and agricultural monitoring systems. We identify the variables that irrigation systems track in relation to weather, soil properties, and water quantity and quality. We give a summary of the most popular wireless technologies and nodes. Finally, we will go over the difficulties and ideal methods for putting sensor-based irrigation systems into place (LauraGarcía*etal*.,2020).

During the dry season, the plants will suffer insufficiency in water supply which would stunt the growth of plants that have been planted. Many people's busy daily routines cause them to forget to water their plants, and as a result, their plants finally die from a number of illnesses. Consequently, effective management of the water supply is necessary for plants (Olayiwola*et al*.,2022).

Automatic irrigation system provestob every helpful for those who travel. Automatic irrigation systems can save a lot of water and be highly economical if they are properly planned and coded. Water is wasted when watering with a pipe or an oscillator, and neither technique targets the roots of plants. It is possible to build automatic irrigation systems that provide the necessary amount of water in a specific region while also encouraging water saving (BishnuDeoKumar*etal*.,2017).

By measuring the water level, soil temperature, nutrient content, and weather forecasting, smart irrigation technology is designed to boost production without requiring a lot of human labour. Through the primary network connecting all of the agricultural field's nodes, machine-to-machine technology was created to facilitate data sharing and communication between them as well as between them and the server or cloud **(**Shekhar *et al*.,2017).The concept of an automated and effective irrigation system that can boost output by 40% by creating remote sensors with Arduino technology (Savitha and Uma Maheshwari, 2018).

It is essential to develop an automatic watering plant that functions during both the rainy and dry seasons. The gadget made use of a microcontroller chip that was designed to detect moisture in agricultural soil. The machine mechanically watered the plants when the soil became dry. On the other hand, the machine would not water them if the soil was moist. Because the requirement for water was constantly met, the result was healthy plants(IpinPrasojo,*etal*.,2020).Using detecting technologies including visible LED sensors, capacitive type sensors, microwave sensors, piezoelectric sensors, ultrasonic sensors, and image processing techniques, numerous researchers have attempted to identify the flow of seeds in a planter's delivery tube. Among these IR technology was found better because of high accuracy, smaller size, less power consumption, low cost and easier control of input/output signals (RahemanandKumar,2018).

MATERIALSANDMETHODS

Components used for Development of Microcontroller Based Site Specific Water Applicator for Planter

Different straightforward electronic components utilized for advancement of microcontroller based site-specific water utensil for grower. The detail determinations of utilized components within the display examination are as takes after which areas given in

Table 1.

1	Microcontroller	7	Relay Switch
2	Arduino UNO CH340 board	8	DC motor high pressure diaphragm pump
3	16*2 LCD display with I2Cmodule	9	Hose pipes and connectors
4	IR obstacle sensor	10	Spraying Nozzle
5	IR transmitter	11	12V DC Power supply
6	IR receiver Solenoid valve		

The Performance Evaluation of Developed Microcontroller Based Site-Specific Water Applicator for Planter

The improvement of microcontroller based location particular water implement was assessed beneath research facility and real field conditions. It is crucial to verify the creation of a microcontroller-based site-specific water applicator in terms of seed identification (%), water discharge amount (ml), water saving (%), and water missing index percentage (%) in both laboratory and real-world field conditions. For more precision, the test was repeated three times for the 20 ground wheel spins at three different speeds (1.00 km/h, 1.5 km/h, and 2.00 km/h) and seed tube mouth opener diameters (10mm, 15mm, and 20mm), mentioned in Table-2.

LABORATORY EVALUATION

For the purpose of this inquiry, for mounting of IR sensors and solenoid valves a plastic water tank with a capacity 10 lit was utilized as water tank inside the show approximately. The solenoid valves were attached to the pre-fixed pins of the relay switches board, and the sensor pin configurations were connected to the microcontroller. The water pump was directly linked to the battery terminals, the VCC and GND pins were connected to the microcontroller's 5V pin, and an ON/OFF switch, was used to manage the circuit to turn the constructed sensor system ON and OFF to shield it.IR sensor was mounted on the seed tube and secured by the help of dim; An IR sensor was placed on it and covered with a black tape.

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Table2:Design of experimental parameters

S.NO.	Variable	Parameters	No.oflevels	Levels Values
1.	Independent	Speed of ground wheel	3	(1,1.5,2.0) km/h
		Diameter of seed tube mouth opener	3	(10,15,20)mm
		Activation time of solenoid valve	3	(0.5,0.8,1.0)sec
2.	Dependent	Seed detection (%) Variation in seed detection(%) Amount of water discharge (ml) Water missingnd expercentage(%) Water saving percentage(%)		

RESULTS AND DISCUSSION

Components used for Development of Microcontroller Based Site Specific Water Applicator for Planter

By employing an infrared sensor to detect the seed in a seed delivery tube and activating a solenoid valve to deliver site-specific water, a microcontroller-based site-specific water applicator was created to deliver the water at the appropriate moment. Relay switches were therefore also utilized to activate the solenoid valve. The solenoid valve was activated and the IR sensor signals were read and processed using an Arduino UNO CH340 microcontroller board. The microcontroller's digital pin 7 was linked to the IR sensor's output pin.

SEED DETECTION

Seed detection was achieved at various ground wheel speeds (1.0, 1.5, and 2.0 km/h) for 20 revolutions and with a seed tube mouth opener diameter of 10, 15, and 20 mm. The experiment was repeated three times for greater accuracy. The observations were made at each operating speed, and the average values are displayed in the table 3 below-

Table3: Seed detection at 1km/h operating speedfor20 revolutions of ground wheel.

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Diameter of Seed tube mouth opener(mm)	Replicate	No. of seed drop	Actual no. of Seed detected	Average Seed Detected, (%)
D1=10	R1	100	84	83.66
	R2	100	82	
	R3	100	85	
D2 =15	R1	100	93	94.66
	R2	100	96	
	R3	100	95	
D3 =20	R1	100	89	91
	R2	100	93	
	R3	100	91	
Seeddetectionat1.5km/h operating speedfor20revolutions				
D1=10	R1	100	84	85.66
	R2	100	87	
	R3	100	86	
D2 =15	R1	100	92	92
	R2	100	89	
	R3	100	95	
D3 =20	R1	100	85	85.66
	R2	100	83	
	R3	100	89	
Seeddetectionat2km/hoperatingspeedfor20revolutions				
D1=10	R1	100	80	82
	R2	100	84	
	R3	100	82	
D2 =15	R1	100	89	89
	R2	100	91	
	R3	100	87	
D3 =20	R1	100	85	85.33
	R2	100	87	
	R3	100	84	

It is observed from table3.1,the Average seed detection (%) at speed of 1km/h for 20 revolutions. D1 = 83.66 %, D2 = 94.66 %, D3 = 91% Hence, the lowest seed detection is in theD1 =83.66% and the highest seed detection % in D2=94.66%. It is observed from table 3.2, the Average seed detection (%) at speed of 1.5 km/h for 20 revolutions D1 = 85.66 %, D2 = 92%, D3 = 85.66%, Hence, the lowest seed detection is in theD1 =85.66% and the highest seed detection%inD2 = 92%. It is observed from table 3.3, the Average seed detection (%) at speed of 1.5 km/h for 20 revolutions. D1=82 %,D2=89 %,D3=85.33

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%,Hence, the lowest seed detection is in the D1= 82 % and the highest seed detection % in D2 =89%.

Variation between actual no. of seeds dropped and seed detection

Average variation between actual no. of seeds dropped and seeds detection was observed at 3 operating speeds of (1.0, 1.5, 2.0) km/h for 20 revolutions observations were recorded at each speed of operation and the average values were shown in figure-1 given below

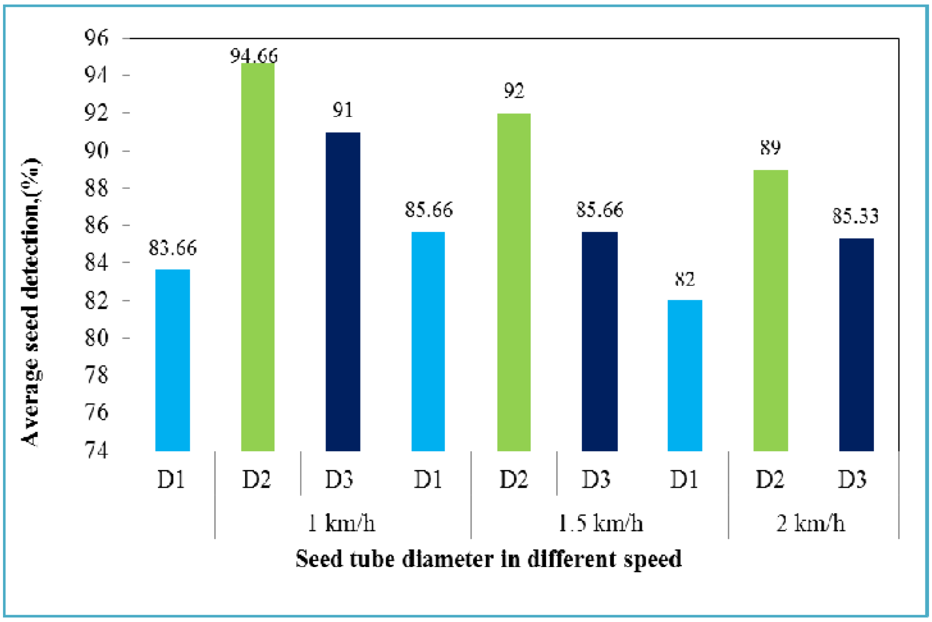

Fig.1: Average seed detected in three different speeds for 20 revolutions of ground wheel.

It is seen from Table 4, the average variation between actual no. of seeds dropped andseed detection at speed of 1 km/h for 20 revolutions, D1 = 15.66 %, D2 = 5.33 %, D3 = 9.0 %.Hence, the lowest Variation between actual no. of seeds dropped and seed detected, in the D2=5.33% and the highest in D1 = 15.66%.

It is seen from Table 3.5 that the average variation between actual no. of seeds dropped and seed detection at speed of 1.5 km/h , D1 = 14.33 %D2 = 8.0 %D3 = 13.33 %, Hence the lowest Variation between actual no. of seeds dropped and seed detected, is in theD2 = 8 % and the highestinD1=14.33%. It seen from Table 3.6 that the average variation between actual no. of seeds dropped and seed detection at speed of 2.0 km/h, D1 = 18.0 %,D2 =11.0 %, D3 =14.66 %. Hence, the lowest Variation between actual no. of seeds dropped and seed detected, % is in the D2 = 11 % and the highest in D1 = 18%.

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Table 4: Variation in seed detection at 1.0 km/h operating speed for 20 revolutions of ground-wheel (Here, V= Variation between actual no. of seeds dropped and seed detected and AV= Average variation between actual no. of seeds dropped and seed detected).

Diameter of seed tube mouth opener (mm)	Replicate	No. of seed dropped	Actual no. of seed detected	V(%)	AV(%)
D1=10	R1	100	84	14	15.66%
	R2	100	82	18	
	R3	100	85	15	
D2 =15	R1	100	93	7	5.33%
	R2	100	96	4	
	R3	100	95	5	
D3 =20	R1	100	89	11	9.00%
	R2	100	93	7	
	R3	100	91	9	
Variation in seeddetectionat1.5km/h operating speedfor20revolutions					
D1=10	R1	100	84	16	14.33%
	R2	100	87	13	
	R3	100	86	14	
D2 =15	R1	100	92	8	8.00%
	R2	100	89	11	
	R3	100	95	5	
D3 =20	R1	100	85	14	13.33%
	R2	100	83	16	
	R3	100	89	11	
Variation in seed detectionat2km/h operating speed for 20 revolutions					
D1= 10	R1	100	80	20	18.00%
	R2	100	84	16	
	R3	100	82	18	
D2 =15	R1	100	89	11	11.00%
	R2	100	91	9	
	R3	100	87	13	
D3 =20	R1	100	85	15	14.66%
	R2	100	87	13	
	R3	100	84	16	

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It is found that the variation between actual no. of seeds dropped and no. of seed detection less in D2= 15mm which is (5.0 to 11.0) %, and more in D1= 10mm which is (14.0 to18.0) % at three operated speeds the variation increases with increase in speed. From (1.0 to 2.0)km/h Hence, the sensor system was detected variation the no. of seed switchless percentage in D2=15m minall the 3 operating speed.

It clearly observed the average variation of speed and seed detection is very less at the speed of 1.0 km/h and diameter of seed tube mouth opener at D2 = 15 mm is less and effective in3 operated speed for the developed sensor system.

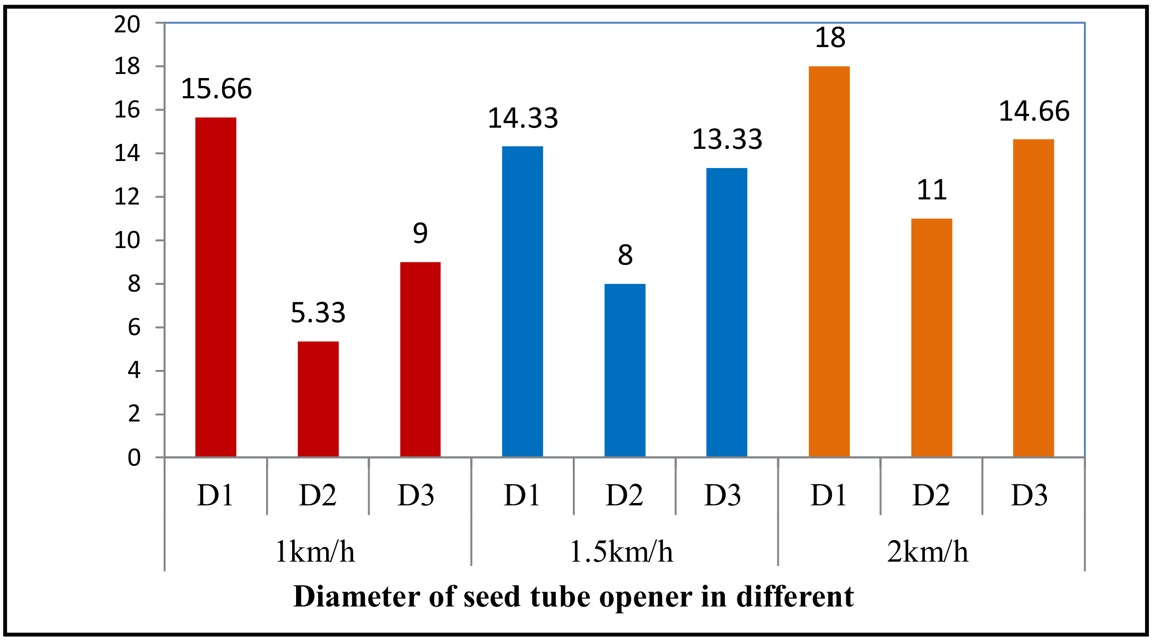

Fig.2: Average variation % between actual no. of seeds dropped and seed detected.

Amount of water discharge measured

The accuracy of the created electronic control unit's operation was determined by laboratory testing. When concentrating the seed in the seed delivery tube, the infrared sensors responded effectively. In addition to the sensor's activation, the solenoid valves also showed good response. When the solenoid valve in the seed tube was activated for 0.5 seconds, the output discharge varied between 30.90 and 31.80 ml, with an average of 31.37 ml. likewise, it was discovered that the output discharge of a solenoid valve with a 0.8-seconds activation varied between 42.10 and 43.00 ml.

While the output discharges of a solenoid valve with a 1.0 second activation was seen to fluctuate between 54.80 ml and 55.80 ml, with an average of 55.24 ml, and an average of 42.54 ml. It demonstrates unequivocally that the solenoid valve's discharge is independent of the quantity of seeds dropped at once. This demonstrates that IR sensors and an electronic control unit based on solenoid valves are suitable for providing a consistent water discharge at the designated location and time.

No. of Replication	Amount of water discharge measured(ml)		
	Solenoid valve(S1)		
	Activation time (0.5 sec)	Activation time (0.8sec)	Activation time (1.0sec)
R1	31.8	42.1	55.6
R2	30.9	43	54.8
R3	31.4	42.5	55.8
Avg.	31.37	42.54	55.24

Table4: Amount of water discharge measured from the solenoid valve.

CONCLUSION

The capacities of IR sensor hand-off module, solenoid valve, water pump and LCD show were watched in both research facility and field conditions. It was seen that all the components of created microcontroller framework working appropriately and seeds were identified and water connected individual successfully by the sensors framework. The research facility assessment of the created microcontroller based sensor framework with pre-existing grower uncovers that the varieties of real no. of seeds dropped and show perusing of the LCD screen was found to be 5.33% at 1.0 km/h, 8.0% at 1.5 km/h and 11% at 2.0 km/h working speed the varieties of real no. of seeds dropped and show perusing of the LCD screen interface changes from 5 % to 15%.. It was found that the seed discovery variety increments with increment in speed. The normal water release from the spout was found to be 31.37, 42.54 and 55.24 ml at 0.5, 0.8 and 1.0 moment actuation time of solenoid valve individually. It was watched that, water release increments when increments in enactment time of solenoid valve. After actuating sensor framework normal water sparing was found to be 46.28% at 0.5 sec, 32.86% at 0.8sec, and 14.29% at 1.0 sec. It was watched that water sparing creases when increments in actuation time of solenoid valve in both the conditions. The water utilization with utilizing created sensor framework with the pre-existing grower is less as compare to without utilizing sensor framework.

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