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Design and Implementation of a Scaring Technique for Rice Farm Bird Intrusion System in Agricultural environment

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***ABSTRAC : This** paper presents the design and implementation of a system that detects and scares off a bird from a rice farm. Presently, there are a large number of rising problems associated with pest birds in residential, industrial, and agricultural zones. This research implements the use of the siren system as a buzzer, and the entire design was carried out using the proteus design software with and Arduino IDE extension. The intrusion system was designed to operate in two different modes namely, normal and security modes. Proper programming was done using the Arduino IDE so as to enable the interface of the attached sensors and the Arduino UNO board. The results show that at normal mode 1, when sensor 1 was high or low and when sensor 2 was low or high, the siren was OFF. Also, at normal mode 2, when sensor 1 was high or low and when sensor 2 was high or low, the siren was OFF. Also, in security mode, when sensor 1 was high or low and when sensor 2 was high or high, the siren was ON. This indicates that at normal modes, the system will not sound the siren when both sensors are active or inactive, while, in security mode the system will sound the siren when both sensors are active or when either sensor are active.*

KEYWORDS: *Intrusion system, Proteus software, Arduino, Rice farm, Scaring technique*

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I. INTRODUCTION

One of the major challenges faced by farmers (especially rice farmers) in Nigeria is the inability to effectively control pest birds which negatively influence food production. Infact, birds account for about annual loss of 15% in rice production world-wide, (Adeniyi et al., 2018).

The Global Rice Science Partnership (GRSP) identifies birds as the second most important biotic constraint in African rice production after weeds based on farmer surveys in 20 African countries (Mey and Demont, 2013).

The birds are the major problem in agriculture because they are feeding on the crops thereby reducing its productivity. Farmers cannot stay on the field for 24 hours and protect the crops because it is time consuming (Shashi et al., 2022).

Aside from physical yield losses, other problems caused by pest birds include extensive labour requirements for bird scaring, the associated use of child labour, possible health or environmental hazards resulting from the use of chemical poisons and the discouragement of farmers from dry-season rice cultivation. Although the adverse impact of birds on rice has received much international attention in the past and is still generally recognized, little research on bird damage or control is currently conducted given the increasing importance of bird damage in some regions. Birds can become serious pests when large flocks migrate seasonally and concentrate in large populations. Many techniques are available to protect crops from bird damage (Maurice et al., 2019).

Birds normally collide with aircrafts at diverse stages of flight causing deaths. Birds loitering in airports can cause enormous financial loses. An estimated amount of 44-billion-naira worth of damages yearly is reported in Nigerian airline industries (Dukiya and Ahmad, 2014).

Many traditional ways are used by farmers like white cloth banging, erection of scarecrows, noise making devices like crackers and carbide guns with polythene bags, killing and catching birds. Many bird repellent chemicals like Trimethacarb, Methiocarb and Curb and poisonous chemicals are also used (Aishwarya and Kumar, 2019).

Large fields require a large labour force for bird scaring which possess a great challenge to assemble to drive bird during peak periods. Field close to breeding sites are more vulnerable to damage from birds and the presence of bushes, trees in the area of the field increase susceptibility because these provide birds with roosts and netting site (Olasehinde et al., 2022).

Murthi, 2021 developed a solar powered bird repeller system with effective bird scare sound. Even though several researchers have carried out research on how to control birds, there are a number of growing problems associated with pest birds in residential, industrial and agricultural areas. The main reasons of the pest birds control solutions have been limited with traps, playing similar sounds.

Rivadeneira et al., 2018 protected crops from birds using sound technology in agriculture. Japanese farmers used many methods to protect their crops from birds. The most effective way of doing this is to cover the field with netting. However, nets are costly and cannot be used in large fields.

Ogochukwu et al., 2012 carried out construction and testing of ultrasonic bird repeller. The use of ultrasonic waves which human ears do not detect but are perceived by small bird is a novel technology that can effectively repel such birds from designated places. Ultrasonic waves were successfully generated with automatically varied frequency (between 15 KHz and 25 KHz) amplified and broadcast at high enough sound pressure level from locally fabricated solar powered electronic device. The 7.98W device produced an ultrasound of 118dB which cover a distance of 45.02m2 while 23.98W device produced an ultrasound of 123dB which also cover a distance of 232.26m2 when placed on the elevation of 0.78m but when placed on the elevation of 1.86m, their average area coverage will be 175.83m2 and 429.53m2, respectively.

In order to overcome this problem caused by birds, we have carried out a research on the design and implementation of a scaring technique for rice farm bird intrusion system to actively detect the presence of birds, protect farmer’s crops and save them from significant financial losses. Also, mechanical and electrical noise-making devices have been used to replace the traditional bird scare.

The statement of problem is that farmers are faced with pest birds that feeds on their crops and reduces its productivity. The objectives are to design and implement a siren system using Proteus software that can scare the bird.

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II. MATERIALS AND METHODS

The materials used in this research work include the Proteus software, Arduino UNO, microcontroller software board, sensors and Arduino IDE, Liquid Crystal Display and controllers switch.

A. PROTEUS IMPLEMENTATION OF THE SIREN SYSTEM

The method adopted for the design of the rice farm bird scaring intrusion system is explained in the block diagram shown in Figure 1. The microcontroller acts as the brain while the sensors are the eyes to the system. The output signal decides the action of the human supervision that monitors the system. The functional details of the components used are microcontroller Arduino UNO (ATmega328) with input voltage = 5 - 12V, operating voltage = 5V and supply current = 50mA. Vibration sensor (SW-420) with operating voltage = 3.3 - 5V, operating frequency = 38KHz. Infrared sensor with operating voltage = 3.3 - 5V, supply current = 20mA and Siren system with output capacitance = 100µF, input capacitance = 0.01µF, output resistance = 8.2KΩ and input voltage = 5V.

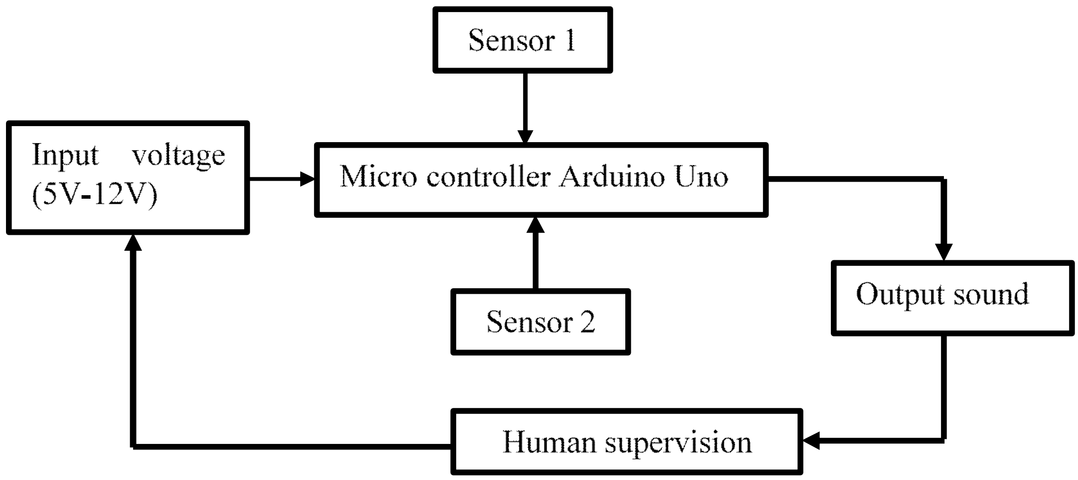

Fig.1: Block diagram of the rice farm bird scaring intrusion system

The Proteus design suite was used for the design of the siren system and the overall circuit. Arduino UNO microcontroller software board and its interfacing sensors such as the IR sensor and the vibration sensor were implemented on Proteus design suite. Arduino IDE was used to write the calling programs and codes for the Arduino to display the operation modes of the rice farm bird intrusion system.

B. WORKING PRINCIPLE OF THE PROPOSED FARM RICE BIRD SCARING INTRUSION SYSTEM

The proposed system is an intruder system with its focus on birds and attributes of birds that can be sensed for a particular sound they make. There is a need to differentiate between vibration in farm and the presence of an intruder in the rice farm as clogging of leaves by wind can also cause vibration.

The system consists of two sensors, a vibration sensor and an infrared sensor with different properties. The infrared sensor detects the presence of an item when its cuts across its wave angle. Both sensors are connected to the input pins of the Arduino UNO which acts as the system controller which interface the sensors with the overall system.

The LCD screen helps to display the prompts as observed by the system and the display shows two different switching modes when it was programmed in the micro controller. A "YES" indicates the presence of an intruder and a "NO" indicates the absence of an intruder. Also, the system works on the AND/OR logic.

The normal mode describes when the user is present in the rice farm while the security mode describes the moment at which the user is not in the rice farm. At normal mode, the system does not detect the presence of an intruder and will not turn OFF the siren even when an intruder is sensed by the sensor. In the security, the

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infrared sensor indicates the presence of the intruder alongside the vibration sensor and the siren will turn ON when the intruder is detected.

Table 1: Siren Logic at Normal and Security Modes

Vibration sensor	Infrared sensor	Normal mode	Security mode
YES	YES	Siren (OFF)	Siren (ON)
YES	NO	Siren (OFF)	Siren (ON)
NO	YES	Siren (OFF)	Siren (ON)
NO	NO	Siren (OFF)	Siren (OFF)

At the start of the system, the user selects a mode, then the system initializes the mode, if a human being is present, then the system stays on the normal mode. In the absence of a human being, the system remains on security mode.

III. RESULTS AND DISCUSSIONS

A. SIMULATION RESULTS

Figs. 2 to 4 show the simulation of the system when connected to an oscilloscope. The results obtained from the research shows that for the normal mode, the system allows the user in the farm without the siren turn ON and for the security mode, the siren turn ON once an intruder was detected. This is because the user was not in the farm to detect the sensor. The results obtained also shows that a user can select between two sensors since the infrared sensor has more detectable range than the vibration sensor. When this was compared with previous studies (Agossou et al., 2022), the design farm rice bird scaring intrusion system gave an improved result as the intruder was detected.

B. NORMAL MODE

The results obtained from the oscilloscope for normal mode is shown in Figs .2 and 3 respectively. On the normal mode, the siren system remains OFF for the four occasions of the sensor activities as seen from Table 1.

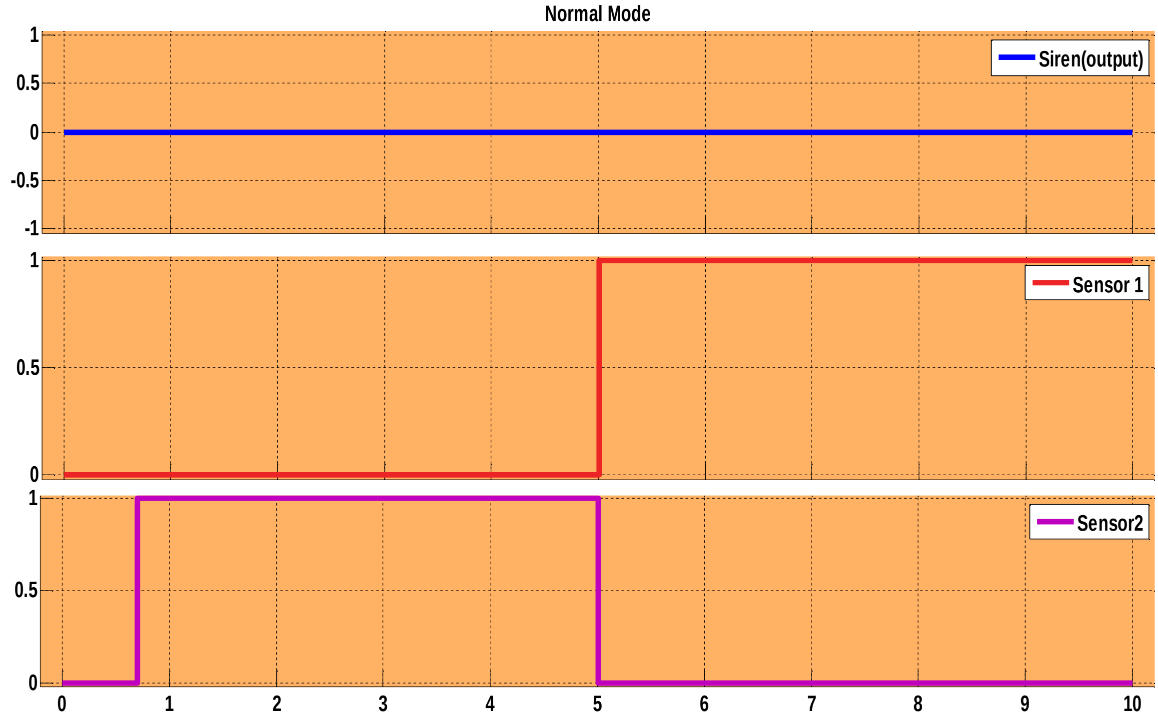

Fig. 2: Plot showing system operation at normal mode 1

The siren system remains OFF when sensor 1 is high and sensor 2 is low. It also goes OFF when sensor 1 is low and sensor 2 is high. Fig.2 shows that when both sensors are active and inactive the siren system will not be activated (ON).

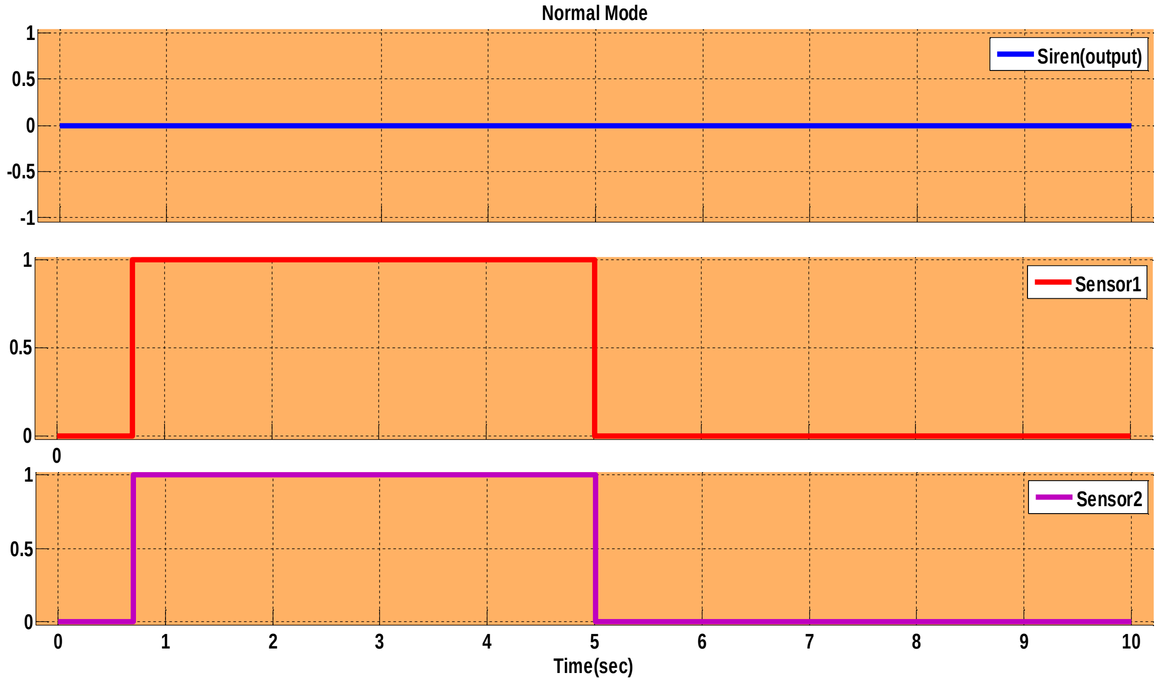

Fig.3: Plot showing operation of system at normal mode 2

The siren system remains OFF when sensor 1 is high and sensor 2 is high. It also goes OFF when sensor 1 is low and sensor 2 is low at normal mode.

C. SECURITY MODE

The results obtained from the oscilloscope for security mode is shown in Fig.4. On security mode, the siren system goes ON for three occasions of the sensor activities as seen from Table 2.

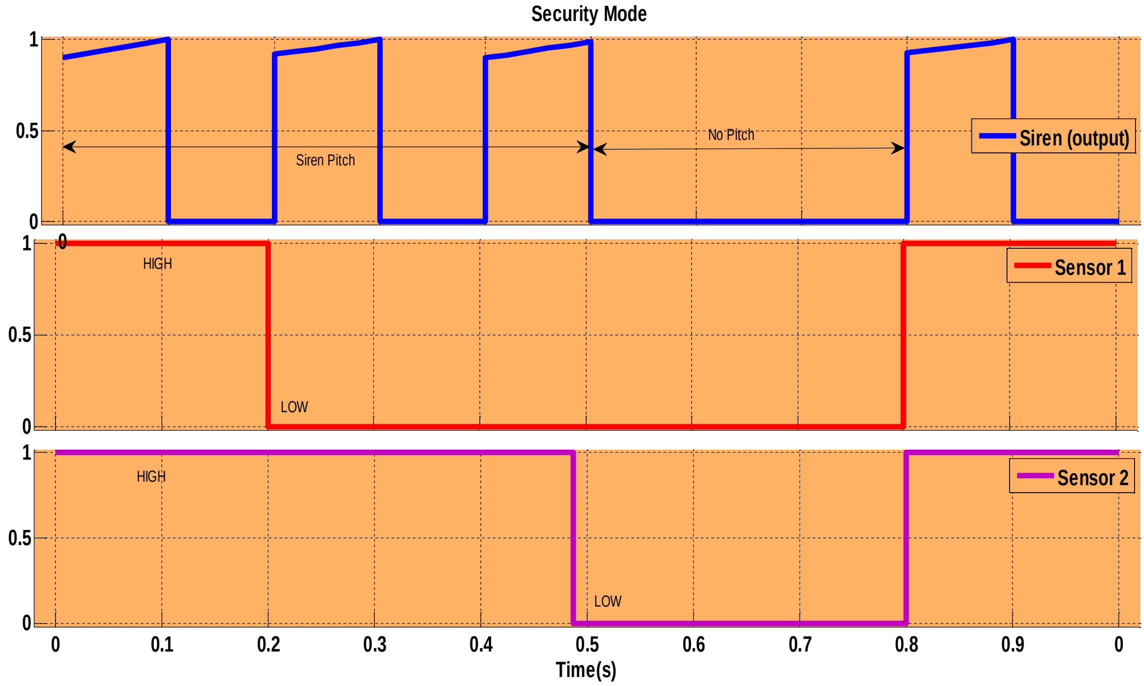

Fig.4: Plot showing system operation on security mode

The siren system goes ON when sensor 1 is high and sensor 2 is high. It also remains ON when either sensor 1 is low and sensor 2 is high at security mode. This means that at security mode, the system will sound the siren when both sensors are active or when either of the sensor are active. On security mode, the siren remains OFF only when both sensors are low. When compared with previous studies (Nagaraju et al., 2019), the sensors of the design siren system were sensitive than the existing sensors.

D. DETECT-ABILITY AND DETECTABLE RANGE

It is important to compare the sensors used in the design for their detect-ability. During simulation, the detect-ability for each of the sensors was obtained using the variable resistor to vary the reference distance of each sensor from an arbitrary bird intruder. Table 2 gives the tabulated values for detectable range and detect-ability for each of the sensors. Fig.5 shows a plot of the detectable range against detect-ability for the implementation of each sensor.

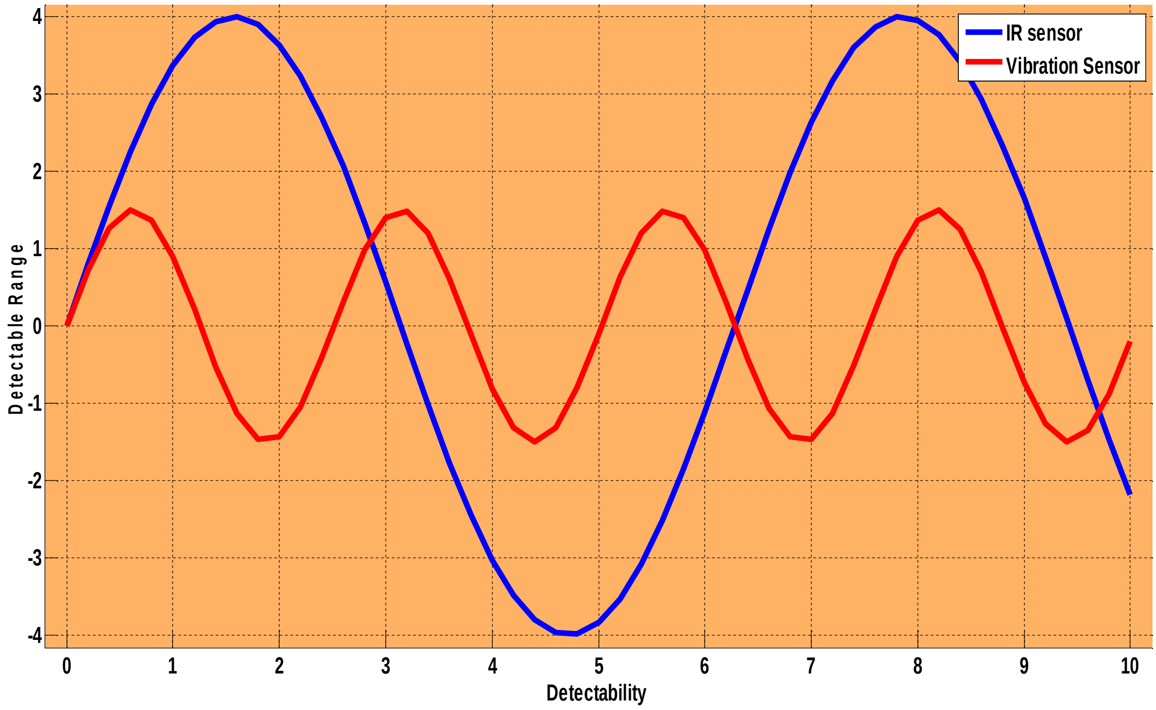

Fig. 5: Plot comparing detectable range against detect-ability for both sensors

The plot shows that the vibration sensor has more detect-ability at a lower range while infrared sensor has a lower detect-ability at a detectable range.

Table 2: Values for Detect-ability and Detectable Range for Both Sensors

Detect-ability (m/s)	Detectable Range (m)	
	Infrared Sensor	Vibration Sensor
0	0	0
0.200	0.794677323180245	0.719138307906305
0.400	1.55767336923460	1.26220647721184
0.600	2.25856989358014	1.49624247990608
0.800	2.86942436359809	1.36394614023852
1	3.36588393923159	0.897708216155935
1.20	3.72815634386891	0.211680012089801
1.40	3.94179891995384	-0.526174841534430
1.60	3.99829441216602	-1.13520374296189
1.80	3.89539052351278	-1.46629517649765

2	3.63718970730273	-1.43838641199471
2.20	3.23398561527836	-1.05831048835559
2.40	2.70185272220460	-0.419123247298389
2.60	2.06200548728586	0.322679982131723
2.80	1.33995260062362	0.985479898078185
3	0.564480032239467	1.40699996516211
3.20	-0.233496573710322	1.48403736993507
3.40	-1.02216440810733	1.19773066893523
3.60	-1.77008177317941	0.618177727862632
3.80	-2.44743156377088	-0.112726680692719
4	-3.02720998123172	-0.816031666334057
4.20	-3.48630308965435	-1.31954363995751
4.40	-3.80640829555807	-1.49998530982606
4.60	-3.97476401453386	-1.31317826203264
4.80	-3.98465843534336	-0.8048593770648
5	-3.83569709865255	-0.0994828460267957
5.20	-3.53381862288061	0.630250555239969
5.40	-3.09105795022394	1.20567663982744
5.60	-2.52506655148928	1.48591103354231
5.80	-1.85840871765502	1.40234258328702
6	-1.11766199279569	0.975431760235667
6.20	-0.332357611269975	0.309701222906684
6.40	0.466196819401985	-0.431854974997608
6.60	1.24616545405352	-1.06767801355369
6.80	1.97645340455445	-1.44209623781934
7	2.62794639487517	-1.46343900820223
7.20	3.17467145539662	-1.12648087015750
7.40	3.59483238324651	-0.513720927704404
7.60	3.87167868812595	0.224815814494444
7.80	3.99417338149842	0.908309804579414
8	3.95743298649353	1.36941787609145
8.20	3.76292222671909	1.49524469141820
8.40	3.41839563235312	1.25498345780408
8.60	2.93758839149645	0.707458504641290
8.80	2.33966877156705	-0.0132769639356058
9	1.64847394096703	-0.730761768690764
9.20	0.891559656400991	-1.26933060626276
9.40	0.0991017018134382	-1.49712304196909
9.60	-0.697307124891912	-1.35836754300994
9.80	-1.46591651700770	-0.887036294797695
10	-2.17608444355748	-0.198527625146660

IV. CONCLUSION

The scaring technique for rice farm bird intrusion system was carried out to actively detect the presence of birds in the farm and to scare off the birds. The results show that at normal modes 1 and 2, the siren was OFF, when sensor 1 was high or low and when sensor 2 was low or high. The results also show that at security mode, the system will sound the siren when both sensors are active or when either of the sensors are active.

When the detect-ability value was 0.200, the infrared sensor and vibration sensor was 0.794677323180245 and 0.719138307906305. Also, when the detect-ability value was 10, the infrared sensor and vibration sensor was -2.17608444355748 and -0.198527625146660. This indicates that when the detect-ability value was low, both sensors produce a high value but when the detect-ability value was high, the same sensors produce a low value.

The siren remains OFF only when both sensors are low. This research paper will help farmers to protects their crops and save them from significant financial losses. It will also help them to achieve better crop productivity which leads to their economic wellbeing.

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Conflict of interest

The authors declare that there is no conflict of interest in the publication of this paper

Recommendations

It is recommended that researchers should use other relevant software tool to prevent birds and other animals from destroying their agricultural products.

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