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Chavda SK
Assistant Professor, Department of Agriculture Engineering, CPCA, SDAU, Dantiwada, Gujarat, India

Gaadhe SK
Senior Research Assistant, Department of FMPE, CAET, JAU, Junagadh, Gujarat, India

KM Gojiya
Research Associate, Agriculture Research Station (Fruit Crops), JAU, Junagadh, Gujarat, India

RV Bhabhor
Yung Professional, CNRM, SDAU, Dantiwada, Gujarat, India

Chavda JM
Assistant Professor, Department of Agriculture Engineering, CPCA, SDAU, Dantiwada, Gujarat, India

Alok Gora
Professor and Head, Department of Agriculture Engineering, CPCA, SDAU, Dantiwada, Gujarat, India

Corresponding Author:
Chavda SK
Assistant Professor, Department of Agriculture Engineering, CPCA, SDAU, Dantiwada, Gujarat, India

Development of wind and solar powered bird repeller

Chavda SK, Gaadhe SK, KM Gojiya, RV Bhabhor, Chavda JM and Alok Gora

Abstract
Crops production and grain efficiency decreases due to poor maintenance of the farm and pest attack. Birds eat sown grains which considering decreases plant population, hence other all production. Wind and solar powered bird repeller was best solution for small and marginal farmers to protect farm from pest bird. A solar and wind powered bird repeller was developed in this study to small and marginal farmers, it consisted of two units, in which one was wind powered and other one was solar powered. The wind powered system consisted of wind vane, bearing, mirror reflector and reflecting plastic material. Wind powered was developed based on reflection principle to scare bird by disturbance through sun light. Solar powered system consisted of solar panel, battery, wires, dc motor, solar charge controller, Microcontroller (Node MCU), L298N motor driver, relay, metal plates. The Node Microcontroller (Node MCU) controlled the time interval of the repeller and also control the system was switching on and off through the Wi-Fi. The combine wind and solar powered bird repeller system was found quite effective to scare the bird from the field.

Keywords: Bird repeller, reflection scarer, solar system, mechanical sound

Introduction
In everyday life, farmers are facing different kinds of problems in agriculture. Different kinds of animals enter into the field and damage crops. For reducing those kinds of problems, they use different measures and techniques. Now a day birds are one of the major problems in agriculture. Birds attack on the crop, eat and damage it. Bird-attacks are very much detrimental to farmers as the bird's attacks in colonies or groups in large numbers and damage a large portion of standing crop, which decreases the farm yield in every season.
Bird control is important because pest birds can create health-related problems through their faeces, including histoplasmosis, cryptococcosis, and psittacosis. Bird repeller is the dispersal of birds using sound that makes them uncomfortable. Bird scare sound rage is mainly 92-116 dB. A bird repeller is any of a number of devices designed to scare birds, usually employed by farmers to dissuade birds from eating recently planted arable crops.
In India, most of such activities of birds are either advantageous or disadvantageous to the farmers. Birds play a duel role in Indian Agro-Ecosystem. The food of the birds is mostly three types which one grain, seeds, fruits, green vegetation of the crop plants and grasses, insects, other arthropods rodent, etc. found in soil, crops and other plants. Birds of agricultural areas include granivores, frugivorous, insectivores, carnivores, nectarivores and omnivores. A few granivorous and omnivorous bird species have been able to harvest energy and reproduce very efficiently in agricultural habitats leading to their large population build-ups. Insectivorous and carnivorous bird species are considered to be useful to agriculture They keep a very potent check on populations of insect, rodent and pests of crops.
The most common domestic birds are pigeons (*Columba livia domestica*), sparrows (*Passer domesticus*), starlings (*Sturnus vulgaris*), common myna (*Acridotheres tristis*), Jungle myna (*Acridotheres fuscus*), crows (*Corvus splendens*) and blackbirds (*Turdus merula*) in India as well as in many countries in the world.
Crop damage occurs at various stages of crop production. Birds remove the seeds after sowing, pull out and devour the sprouted seeds and grains in the milky stage as well as during the ripening stage. The study has identified 63 species of birds from 19 families that cause damage to several crops. A whopping of 52 bird species for cereals crops, 14 bird species for the pulses crop, 15 bird species for oilseeds, and 23 bird species fruits were identified. Birds also cause damage to the crops of smaller grains such as pearl millet and sorghum as well as maize.

The several methods mainly lethal and non-lethal are available for bird repelling which include chemical repellent, net, spike guards, shooting the birds with a gunshot, and making a loud noise by fragment firecrackers in order to scare the birds which are mostly costly. Methods of bird control include physical deterrents, visual deterrents, multi-sensory deterrents, sonic devices, trained birds of prey (falconry), chemicals, contraceptives and active barriers etc. Traditional methods are a trial and error method, and the birds become habitual of such techniques.

The most effective method is physical barriers such as nets and fibers for agricultural areas. Different sorts of netting have been shown to be effective in keeping birds out of crops, but their usefulness depends on their cost and how many times they can be re-used. However, the use of properly mounted and maintained net is quite expensive.

Electronic bird repellent devices produce extremely effective audio and visual threats that frighten, irritate, and disorient birds, forcing them to seek calmer, untreated areas. They are also used on airfields to prevent birds from accumulating near runways and causing a potential hazard to aircraft. Electronic bird deterrents condition pest birds to stay away from treated areas for good. In order to protect these areas against bird damage, some electronic-based mechanical methods are adapted for control. The use of the battery in repeller easily gets discharged due to continuous operation.

Materials and Methods

1. Location of Experiment

The wind and solar powered bird repeller was developed in Department of Farm Machinery and Power Engineering. The Performance of the equipment was evaluated at Instruction Farm of CAET Godhra, Kakanpur, Main Maize Research Station, AAU Godhra and in farmers' fields near CAET Campus, Godhra.

2. Design consideration for bird repeller

- Environmental friendly.
- Simplicity in fabrication.
- Easy in assembling and dissembling for installation at different location in the field.
- Use of locally available materials.
- Low cost.
- Regulate sound interval to prevent habituation of birds.
- Combination of visual and sound repelling to improve effectiveness.

3. Development of wind and solar powered bird repeller

In the development of the wind and solar-powered bird repeller, the basic emphasis was given on the simplicity of fabrication, the use of locally available material and the low cost of construction. Ease of assembling and dismantling the machine for inspection and installation at different locations were also considered.

The wind and solar-powered bird repeller consisted of two units, in which one was solar-powered and the other one was wind-powered. The solar-powered system consisted of solar panel, battery, wires, dc motor, solar charge controller, Node MCU (microcontroller), L298N motor driver, relay, metal plates, and wind-powered system consisted of the wind vane, bearing, mirror reflector and reflecting taps.

3.1 Solar Powered Bird Repelling Unit

For a sound system, a solar-powered bird repelling unit was designed. The electric motor pounding on the metal plate. Metal plate, beater, dc motor, rechargeable dc battery, solar panel, solar charge controller, microcontroller (Nodemcu), relay, and motor driver were the primary components of the system.

3.1.1 Beater

With a coupler connection to the dc motor, little iron balls were connected to the tip of the spring. The sound is produced when the iron ball strikes the metal plates while the dc motor is rotating. The weight of the iron ball and the radius of rotation were determined as 0.05 kg and 14 cm respectively by different trials.

Force = mass × gravitational acceleration
= 0.05 × 9.81 = 0.49 N

The required torque was calculated as…

Torque = Force×Radius of rotation
= 0.49× 0.14
= 0.0686 N-m

For various revaluations of the beater, the needed power was determined using the equation and shown in the table.

Table 1: Torque and power requirement

Sr. No	Revaluation of the beater(rpm)	Torque (N-m)	Power (watt)
1	100	0.0686	0.7180
2	200	0.0686	1.4360
3	300	0.0686	2.1540
4	400	0.0686	2.8720
5	500	0.0686	3.5900

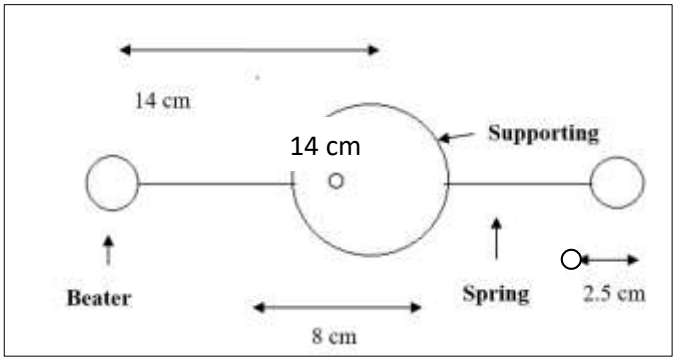

Fig 1: Sound producing beater

3.1.2 DC Motor

The beater was rotated by a DC motor (brushed permanent magnet). The beater was attached on the motor shaft with a supporting plate.

Power consumption of motor per day = power requirement×workig hours
= 3.6×4 = 14.4 watt-hr.

12V DC, 5 kg-cm DC motor used for the system and power consumption of motor was calculated for average working of 4 hours per day.

Table 2: Detailed specification of DC motor

RPM	300
Operating Voltage	12V DC
Shaft diameter	6mm
Shaft Length	21 mm
Torque	5 kg-cm
Load current	300 mA (Max)

3.1.3 Rechargeable DC Battery

A solar panel was joined to a 12V rechargeable lead-acid DC battery, which was then connected to the solar charge controller. When the solar panel is exposed to sunlight, the battery stores the charge and uses it when the device is in use. The solar panel's electrical charge is stored in the battery during the day. It has enough Ampere hour storage to provide the necessary power. Lead-acid batteries are known for their great reliability, low self-discharge, and inexpensive initial and ongoing expenses.

Capacity of battery that produces the energy using 12V battery and maximum depth of discharge (DOD) of lead-acid battery was 50%.

Battery capacity = $\frac{\text{Watt hour}}{\text{DOD}\times\text{Voltage}}$ (Okwu *et al*, 2017) [15]

= 14.4/ (0.5x12) = 2.4 Ah

As per market availability 12V, 4.5 Ah dc battery was selected.

Table 3: Specifications of DC battery

Type	Lead acid rechargeable DC battery
Voltage	12V
Battery capacity	4.50 Ah

3.1.4 Solar panel

Solar panel used to charge the battery of the developed bird repeller with the specification of 5W Capacity, Output power of 12V, the efficiency of monocrystalline solar panel of 15-20 % with the dimension of 1 ft². (Okwu *et al*, 2017) [15].

Ipv = $\frac{E}{(V\times H)}$

Photovoltaic current (Ipv) = Total current required to charge the battery from the solar panel.

E= power consumption of motor., V= system voltage = 12V., H= peak sunshine hour, 5 hrs.

Ipv = 14.4/ (12 x 5) = 0.24 A

In order to compensate for the losses due to the inefficiency of the solar panel, 20% of Ipv is added so that: Ipv = 0.24+ (0.2 x 0.24) = 0.288 A.

Solar panel peak voltage, Vp = 17.3V

Peak power, P_p = Ipv×Vmp = 0.288A × 17.3V = 4.98 W

As per market availability 5W solar panel was selected.

Table 4: Technical specification of solar panel

Peak power	5W
Maximum IP voltage (Vmp)	17.5V
Maximum current (Imp)	0.28A

3.1.5 Solar charge controller

The solar charge controller was used in the system to manage power going into the battery bank from the solar array. It ensures that the deep cycle batteries are not overcharged during the day, and power doesn't run back to the solar panels overnight and drain the batteries.

Calculation for selection of solar charge controller

Solar panel=5 W

Battery Voltage = 12V

So,

P/V = I (CHARGE CONTROLLER)

5/12 = 0.42 A

Safety factor, 20 % of 0.42 A = 0.084 A

So, (0.42 +0.084) A = 0.504 A

Fig 2: Solar Charge Controller

As per easily market availability 12V, 1 A DC solar charge controller was selected with specification given below.

Table 5: Specification of solar charge controller

Battery voltage	12 V
Charge current	1 A
Self-consume	<0.10 mA
Operating temperature	-35 ºC ~ +60 ºC

3.1.6 Microcontroller (Nodemcu)

Nodemcu (microcontroller) is an open-source IoT platform. It was utilised to programme the bird repeller to manage the mechanical sound interval, as well as to turn on and off the solar-powered unit via Wi-Fi. It comes with software for ESP8266 Wi-Fi systems as well as hardware based on the ESP-12 module. It uses the Blynk app on an Android phone to control the bird repeller through Wi-Fi.

Table 6: Specifications of Nodemcu

Wi-Fi Module	**ESP-12 module**
USB port	Micro USB port for power, programming and debugging
Brand Name	Lolin Nodemcu
Dimension	4.8 x 2.4 x 0.5 cm
Voltage	5.50 V
Miscellaneous	Reset and flash buttons

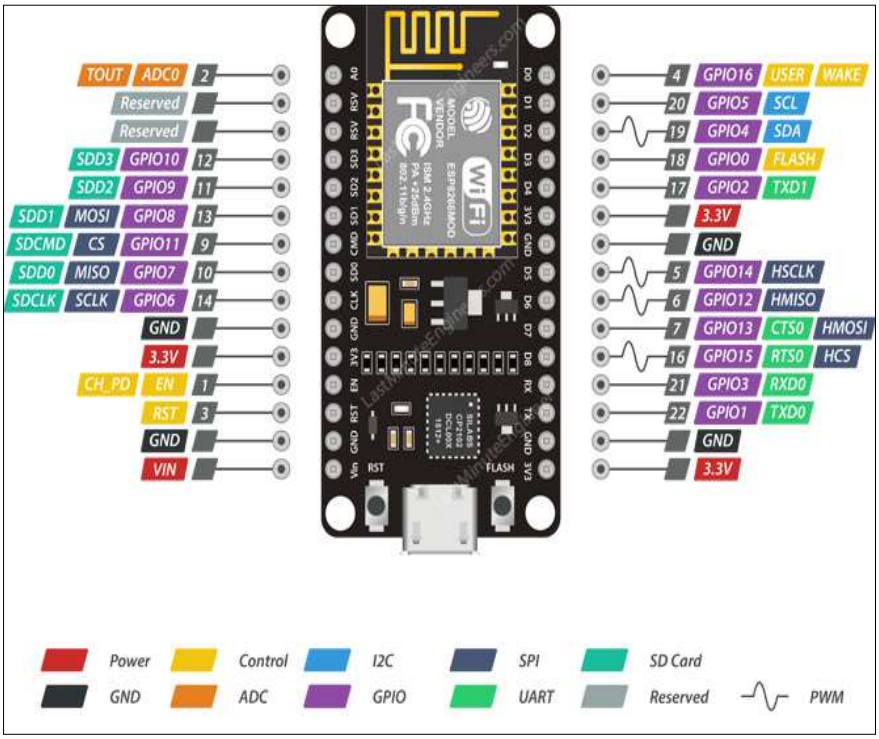

Fig 3: Microcontroller (Nodemcu)

3.1.7 Relay

By using an android phone with Wi-Fi, the relay was utilised to turn on and off the bird repeller. It can control both AC and DC applications such as Solenoids, Motors, Lights, and Fans. Terminal blocks (COM, NC, NO) are provided for quick and easy connection. The relay was used to turn on and off the solar-powered system's 12 V DC electric motor.

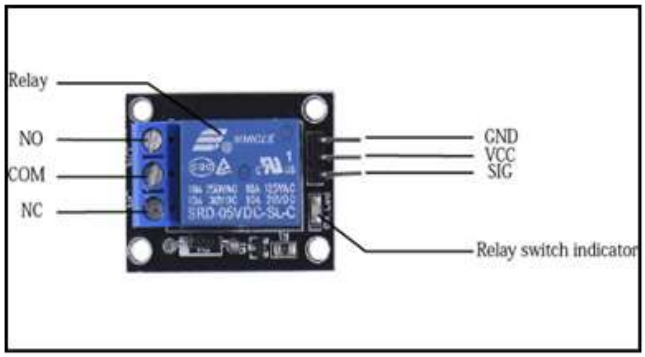

Fig 4: Relay

Table 7: Specifications of relay

Channel	One channel 5V relay
Maximum Load	10A,
Logic Input Voltage	DC 5V
3 pin Male header for easy interface with microcontroller.	
Freewheeling diode to protect microcontroller.	
LED Status indicators to indicate the relay ON/OFF status.	
Mounting holes provided for easy mounting	

3.1.8 Motor driver (L298N)

The motor speed was regulated by the Motor Driver (L298N Dual H Bridge), and the rpm was controlled by the microcontroller illustrated in Fig 3.6. The motor controller's specifications are listed in tables 3.8 and 3.9.

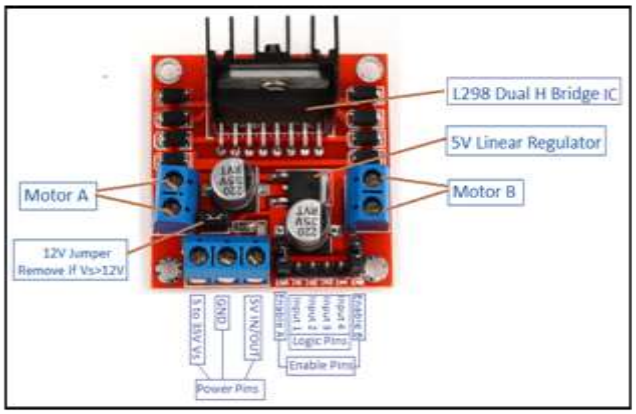

Fig 5: Motor driver (L298N)

Table 8: Pin descriptions of Motor Driver (L298N Dual H Bridge)

Out 1: Motor A lead out 1	EnA: Enables PWM signal for Motor A
Out 2: Motor A lead out 2	In1: Input for Motor A lead out 1
Out 3: Motor B lead out 1	In2: Input for Motor A lead out 2
Out 4: Motor B lead out 2	In3: Input for Motor B lead out 1
GND: Ground	In4: Input for Motor B lead out 2
5V: 5V Logic Input	EnB: Enables PWM signal for Motor B

Table 9: Technical specifications of motor driver

Type	Double H Bridge Drive Chip: L298N
Logical Voltage	5V
Drive Voltage	5V-35V
Logical Current	0-36 Ma
Drive current	2A (MAX. single bridge)
Max Power	25W
Dimensions	43 x 43 x 26 mm

The input voltage of a DC motor can be changed to alter its speed. PWM (Pulse Width Modulation) is a common way for doing this. PWM is a technique for adjusting the average value of an input voltage by transmitting a series of ON-OFF pulses.

The Duty Cycle, which is proportional to the width of the pulses, determines the average voltage. The average voltage applied to the dc motor (High Speed) increases as the duty cycle increases, while the average voltage applied to the dc motor decreases as the duty cycle decreases (Low Speed). Figure 3.7 shows the PWM approach with varied duty cycles and average voltages.

3.1.9 Switch

The switch was connected in the circuit which regulates the ON and OFF of the solar powered unit manually. A simple 12-volt DC switch was used.

3.1.10 Circuit of different components of solar powered bird repeller unit

As illustrated in figure 3.8, all of the above components were assembled/attached. In a plastic box, the Nodemcu board, relay, L298N motor driver, solar charge controller, and 12v dc battery were built. The solar panel and dc motor were installed on the bird repeller frame, as well as a switch.

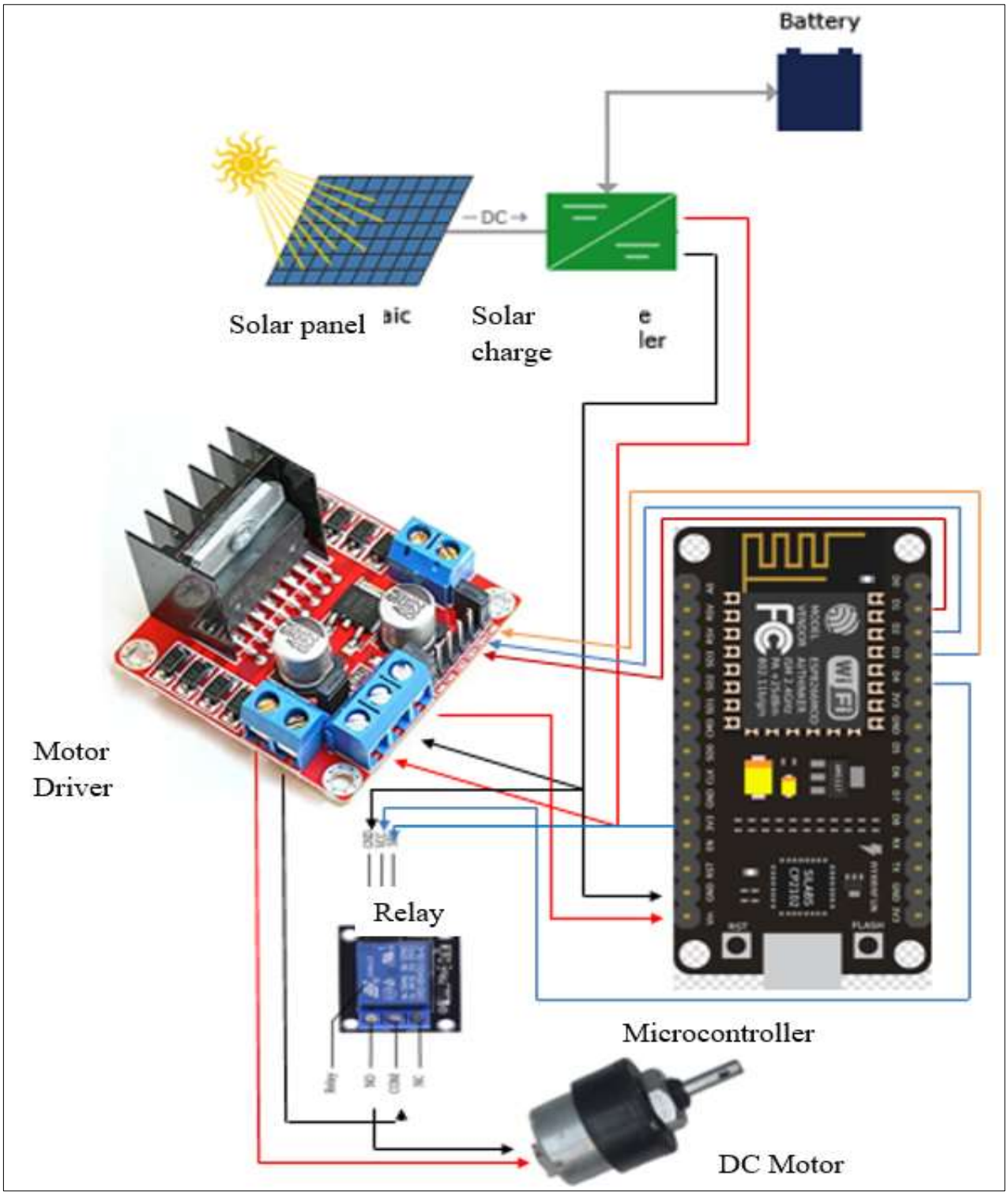

Fig 6: Circuit diagram of developed solar powered bird repeller system

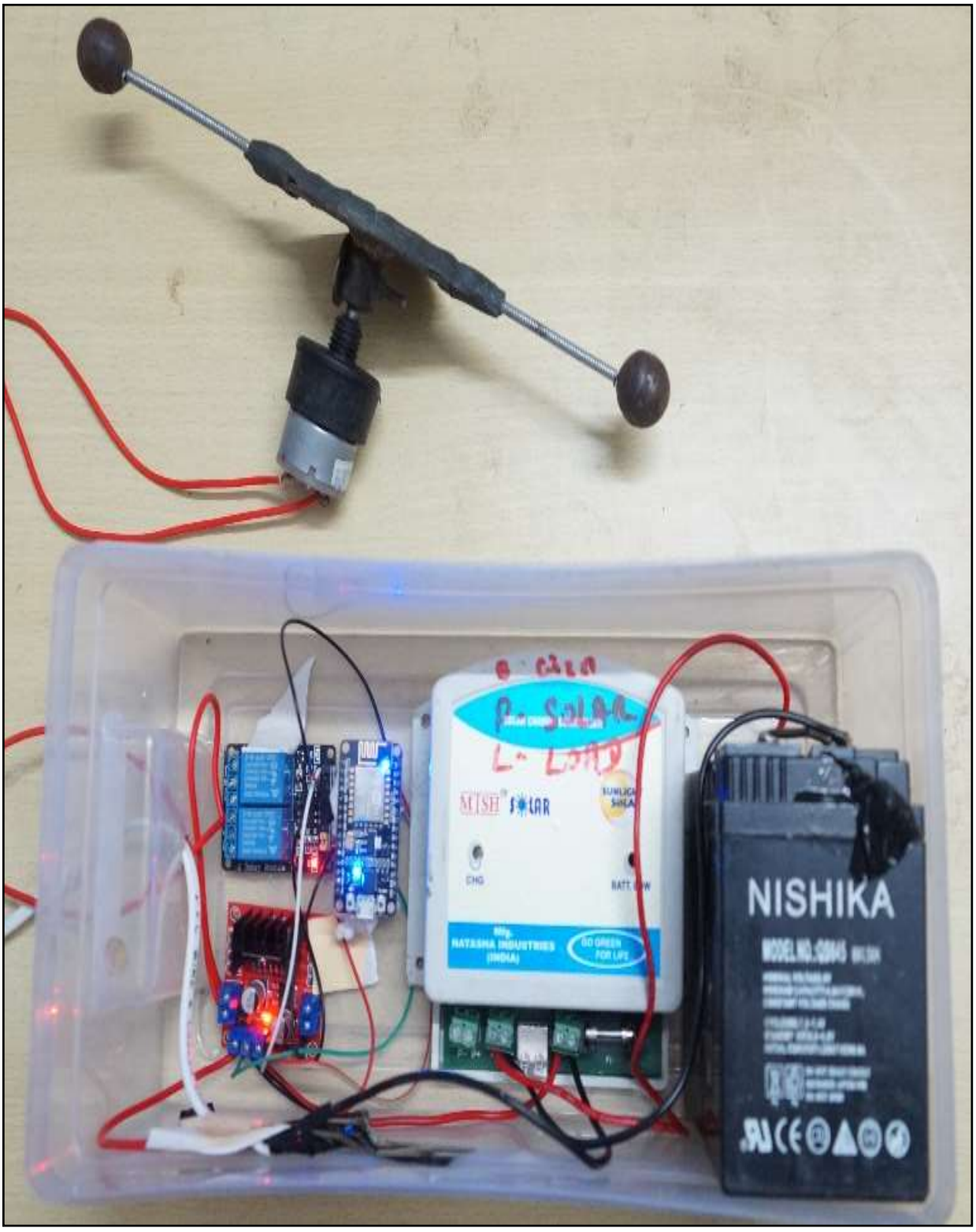

Fig 7: Developed solar powered bird repeller system

3.2 Bird Repeller Frame

To integrate various components of the bird repeller, the frame was manufactured as shown in fig.3.13. The mild steel strips were used to hang the metal plate. The hollow iron square pipe has dimensions of 20×20×3 mm. On a frame, nuts and bolts were provided to modify the parts as needed. The bird repeller frame's adjustable section was a DC motor with a beater, and metal plates were adjusted as needed using the included nuts and bolts.

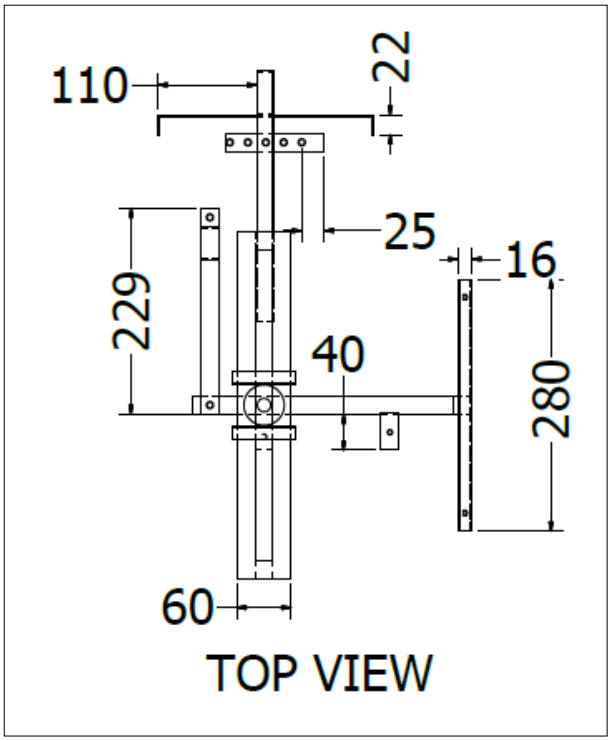

Fig 8: Detailed drawing of bird repeller frame top view

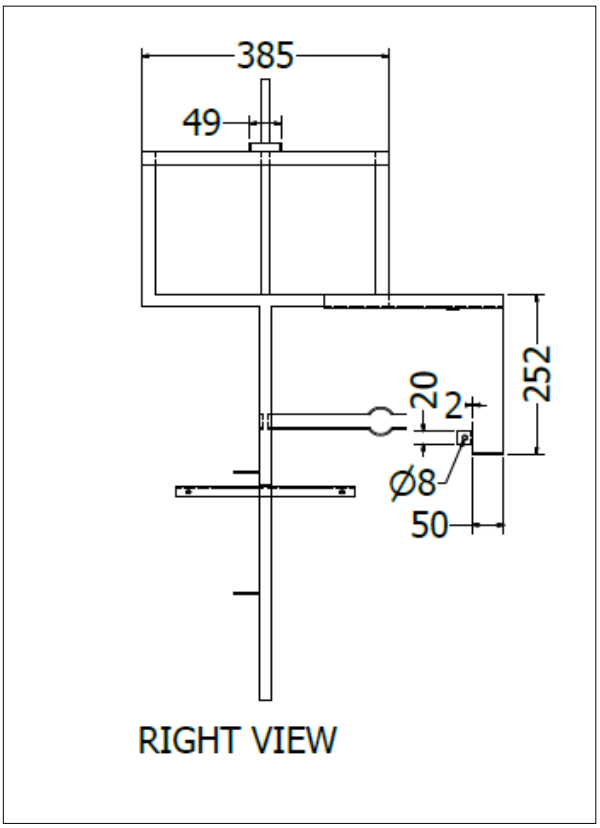

Fig 9: Detailed drawing of bird repeller right view

3.3. Wind Powered Bird Repelling Unit

The wind-powered bird repelling unit works rotating on sunlight reflect. It consists of the spherical mirror reflector and strap reflector & egle-Bird eye reflected. The rotating mirror reflector is using sunlight to create flashing lights during the daytime hours and scare the flying birds from the farm. The rotating movement of the rotating unit creates fear and doubt in any birds. Doubt create tension and uncertainty and keep away birds from farm.

3.3.1 Spherical mirror reflector

During the day, the Reflector utilised sunlight to create flashing lights to scare away birds. A simple but effective bird scarer is a mirror reflector that prevents birds in flight from settling on protected farmland. This procedure was entirely silent, and it did not disrupt humans in any way, yet it was efficient in removing the bird without affecting the environment. It is weatherproof because it is made of a mirror and plastic.

A small spherical shaped mirror with a spherical shaped outer surface was chosen to reflect light in all directions throughout the entire field. The aspherical plastic body of 130mm diameter was selected which was easily available in the market and used as a foot valve of the water tank. It was attached to the bird repellent's top. Various bits of mirror were adhered to the entire surface with adhesive. As a result, light from it reflected all across the field, scaring the birds.

Fig 10: Spherical mirror reflector

3.3.2 Horizontal arm

The horizontal arm was selected to hold the wind vane and to fit on the vertical shaft. It was supporting part of the wind vane. Hollow Square PVC pipe was used with 450 mm length at each side and (25×25×2 mm) square section.

Materials are chosen using a trial-and-error technique. The three materials were put to the test, with the iron plate being the most difficult to spin under low wind velocity due to its heavy weight. Aluminum sections/straps were also put to the test, and due to their poor strength, they bent while connecting the wind vane to the plate's outer edge. PVC square pipe as chosen because it is lightweight and strong enough to withstand the wind when used with a wind vane.

3.3.3 Bearing

In a bird repeller, a roller bearing was used to reduce friction between rotating shafts and the mechanical system that supported them. The inner and outer diameters of the bearing were 1.5 and 4.5 cm, respectively.

3.3.4 Wind vane cups

To drive birds away from the farm, a wind vane was utilised to rotate mirror reflectors. In the laboratory, the wind vane cup was tried with several sizes and forms of funnels until the final funnel was chosen. As seen in fig. 3.17, it has an outer diameter of 18 cm and a height of 9 cm.

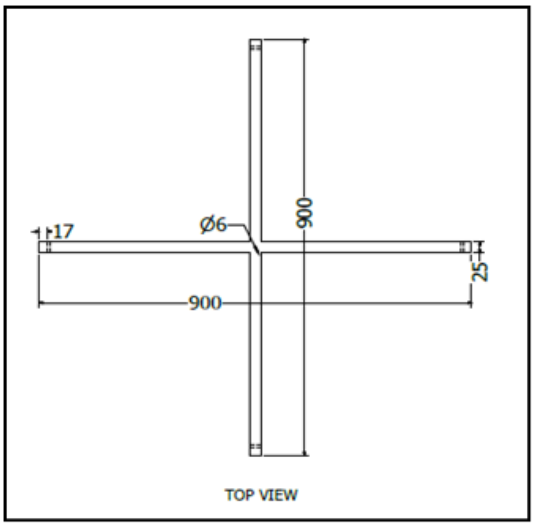

Fig 11: Detailed drawing of horizontal arms

The horizontal arms supported the conical funnels. The rotating shaft was fitted in a roller bearing, which was fixed on the mainframe, and the horizontal arms were mounted on a vertical shaft. The cups are forced to rotate the shaft at a rate proportional to the intensity of the wind speed from any direction. In comparison to metallic funnels, plastic funnels are lighter on weight and more readily available in the market at a lower cost. The funnel's reduced weight allows it to rotate even at moderate wind speeds.

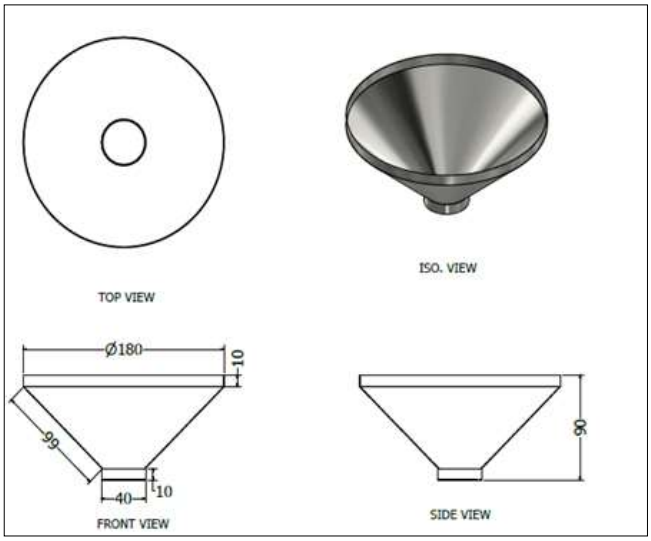

Fig 12: Detailed drawing of wind vane conical cups (funnel)

3.3.5 Reflecting tape

To terrify the bird, reflective tape was used on the inside and outside of the wind vane cups and wind vane arm to generate a spinning reflection and flashing sunlight during the day. Red and silver color reflective tapes with a width of 30 mm and a thickness of 25 microns were the most effective.

3.3.6 Eagle Bird eye cylinder

Predator birds such as hawks, kite falcons, and others are scared of birds ruining fields, thus a reflecting eagle bird eye cylinder was used to scare birds away. When combined with sound bird deterrent devices, it was an excellent visual bird deterrent strategy for creating a "unsafe" environment for pest birds. The Bird scare eye used a combination of holographic reflecting materials. The holographic substance used in the bird scare eye reflects sunlight and has a holographic effect, scaring the birds away from the farm.

The 14 cm diameter and 17.5 cm height bird scaring eye cylinder was chosen, and the thin plastic sheet of a holographic reflected eye was wrapped around the cylinder's outside surface. And so of its light weight, the plastic cylinder was chosen because it can readily rotate along with the rotation shaft without causing resistance.

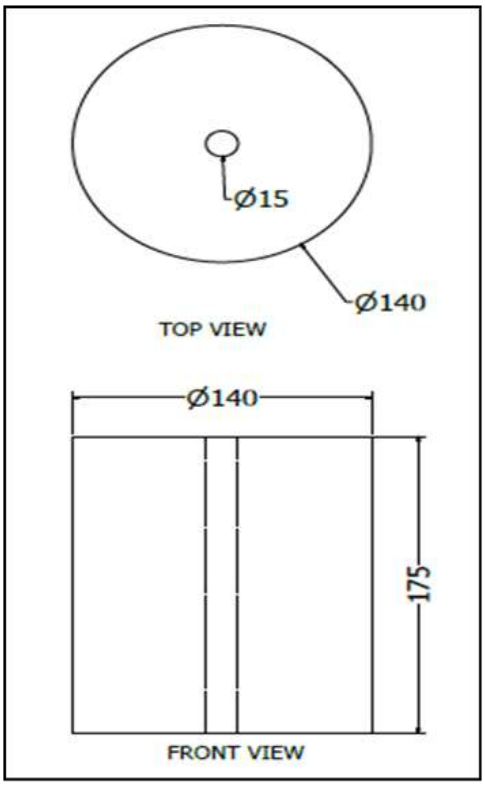

Fig 13: Detailed drawing of the holographic bird scare eye

Fig 14: Holographic bird scare eye

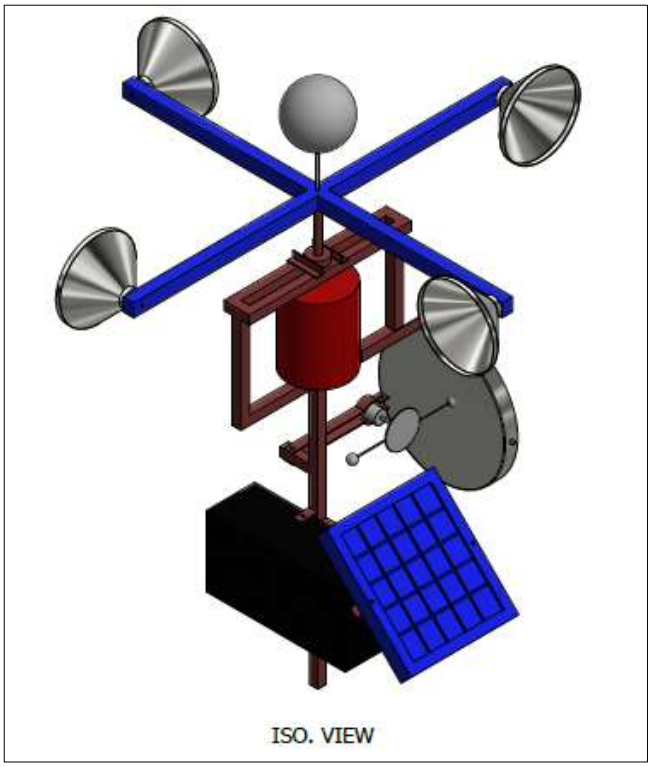

Fig 15: Detailed drawing of developed wind and solar powered bird repeller

Fig 16: Developed wind and solar powered bird repeller

Table 10: Fabrication cost of developed wind and solar powered bird repeller

Sl. No	Item	Specifications	Quantity	Rate(Rs/unit)	Total (Rs.)
1	Wind cone (funnel)	180 X 90 mm^2	4 No	25/piece	100
2	Spherical mirror reflector	13 mm dia.	1 No	80/piece	80
3	Horizontal arm (PVC square pipe)	900 mm	2 No	100/piece	200
4	Reflecting tap	10 m	1 No	20/piece	20
5	Bird scare eye holographic material with plastic cylinder	-	1 No	120/piece	120
6	Hollow Shaft	1.5 cm dia.	1 No	80/piece	80
7	Bearing	1.5 cm inner dia.	1 No	50/piece	50
8	Dc motor	12v, 300 mAh	1 No	200/piece	200
9	Iron ball with spring(beater)	-	1 No	50/piece	50
10	Solar panel	5 W	1 No	450/piece	450
11	Solar chage controller	1 A	1 No	400/piece	400
12	Dc battery	4.5 Ah	1 No	250/piece	250
13	Nodemcu (Microcontroller)	-	1 No	265/piece	265
14	Motor driver	L298N	1 No	209/piece	209
15	Relay	One channel	1 No	78/piece	78
16	Wires	Jumper wire	13 No	2/piece	26
17	Frame (iron square pipe)	-	8 kg	50/kg	400
18	Stand iron pipe	-	7 kg	50/kg	350
19	Nuts and Bolts	6ø X 20	0.300 kg	75/kg	22
Total Amount (Rs.)					3350
Total material cost of repeller					3350
Fabrication charges @ 30% of material cost					1005
Total cost of machine					4355.00

3.4 Testing procedure of wind and solar powered bird repeller

It is order to test a bird repeller's performance in terms of effective rpm of the motor, material, height of the repeller, distance covered by the repeller, sound level at various distance levels, number of birds found in the field, number of birds scared, and effectiveness measured at various distance levels in order to evaluate its performance.

3.4.1 Field test

The field test was conducted in the CAET Godhra Instruction Farm in Kakanpur, the AAU Godhra Main Maize Research Station, and farmers' fields near the CAET Campus in Godhra. The most effective sort of metals was chosen, as well as the optimum rpm required for excellent sound output.

3.4.2 Sound level measurement

With the help of a sound level meter, the sound level (dB) of a bird repeller was measured at various distances (1, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60 m). The decibel is the sound level meter's measurement unit.

Fig 17: Testing sound pressure level at different distance

3.4.3 Selection of metal plates

To create mechanical sound, three plates made of different materials were used: stainless steel, bronze, and brass. The sound level meter captured the noise they were making. Three springs were used to suspend the plate. The vibration was caused by the way the pounding plate was set up. Due to the plate's unrestricted oscillation, it produces a high-intensity sound when it is hung. Plates of stainless steel, bronze, and brass with a diameter of 30 cm and a thickness of 2 mm were chosen based on local market availability.

3.4.4 Speed of the dc motor

Speed plays an important role in producing a variable sound level. The multiple analog values were set to generate different rpm of the motor by combining Node MCU with an L298N motor (PWM) driver to control the rpm of the motor. The test was conducted with five different motor rpms, namely 100, 200, 300, 400, and 500, and the best motor speed for sound generation was chosen for the purpose of testing the designed bird repeller.

The sound level was tested at three different heights (6, 8 and 10 feet), distance (1, 30, 60 meters), and optimum speed (300 rpm). For additional testing, the stainless steel plate was chosen.

3.4.5 Design of Experiment

Response Surface Methodology (RSM) emphasizes the modeling and analysis of the problem in which a response of interest is influenced by several variables, and the objective was to optimize this response. The main advantage of RSM is to reduce the number of experimental runs needed to provide sufficient information for statistically acceptable results. A three-level, one-factor face-centered design was employed, which pull the axial points into the faces of the cube at +/- 1 level. This is desirable because it is only a three-level design and ensures that the axial runs will not be any more extreme values than the factorial portion. The independent variables selected for the experiments were: Height X1: 6, 8 and 10 (feet), and distance X3: 1, 30 and 60 (m). Face-centered design is coded and un-coded levels of two variables and one level were employed for experiments as shown in table 3.11. During the analysis of the data by using Response surface methodology; the experimental design was studied by a single level of parameters (height, speed, and distance) and one level of response (sound level) stated earlier. Results were analyzed using Face centered Central Composite Design with the help of Design-Expert Software (12.0.0.6). CCD is appropriate to study factors with three or five levels. (Myers *et al*., 2016).

Table 11: Coded and un-coded levels of face centered design

Sr. Number	Coded variables		Un coded variables	
	X1	X2	X1: Height of repeller (feet)	X2: Distance (m)
1	-1.00	-1.00	6	1
2	1.00	-1.00	10	1
3	-1.00	1.00	6	60
4	1.00	0.00	10	30
5	-1.00	0.00	6	30
6	1.00	-1.00	10	1
7	0.00	1.00	8	60
8	0.00	0.00	8	30
9	0.00	0.00	8	30
10	0.00	0.00	8	30
11	0.00	0.00	8	30
12	0.00	0.00	8	30
13	0.00	0.00	8	30

3.4.6 Observations of the density of birds

The number of birds of various species during the field experiment and the number of birds scared were determined by adapting a simple method by installing pegs at equidistance of 60 m from the point of installation and four persons with secrecy taking the observations.

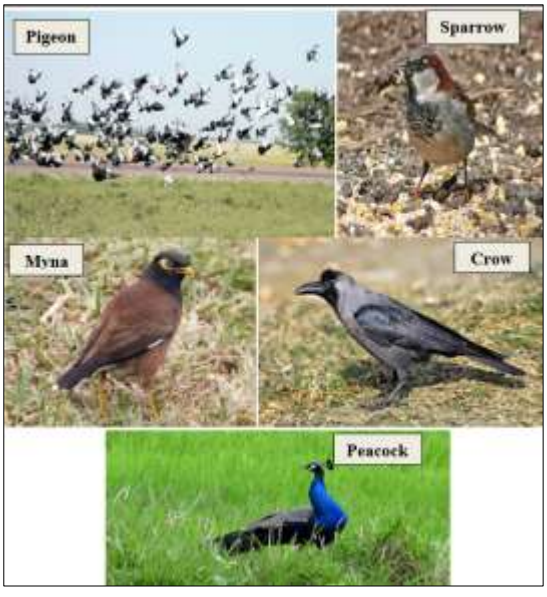

Fig 18: Common birds in maize field

3.4.7 Testing of solar powered bird repelling system
The best combination of plate materials (stainless steel), motor speed (300 rpm), and repeller height (10 feet) was chosen for additional bird repeller testing in terms of the number of birds detected in the field and the number of birds scared during the morning, afternoon, and evening hours. Based on sound generation by a metal plate with optimal speed and height, a solar-powered repelling device was tested. The test was conducted based on sound level, with the number of incoming birds into the field being calculated and then flew away due to the effect of the repeller's noise/sound.

3.4.8 Testing of wind powered bird repelling system
Continuous observation in the maize field for 18 days was used to determine the effect of light reflection. It was put to the test at Godhra's Main Maize Research Station, Kakanpur's Instructional Farm, and a farmer's field near the college. The number of birds in the field was counted, the species was determined, and the number of birds was calculated. The number of birds scared in the morning, afternoon, and evening was then recorded after the reflector was installed.

3.4.9 Testing of combine effect of wind and solar powered system birds repelling system.
For further testing of the bird repeller in terms of the number of birds detected in the field, the number of birds startled, and the effectiveness of reflection, a combination of solar-powered and wind-powered systems was chosen. The effectiveness of the reflector and the sound level of the bird repeller for scaring away the bird during the morning, afternoon, and evening were the main focus of the experiment.

Conclusions
The majority of the crops planted in the research area were maize, which was likely damaged by pest birds. It reduces farm production, and losses have an impact on the revenue of small and marginal farmers. The created wind and solar powered bird repeller was successful in keeping birds out of the farmer's field. Birds such as peacocks, mynas, sparrows, crows, and pigeons have attacked farms in the research area. Birds were repelled using a combination of wind and sound units, as well as a low-cost bird repelling system for small and marginal farmers.

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