Journal of Advanced Zoology

ISSN: 0253-7214
Volume 44 Issue S-5 Year 2023 Page 1563:1570

Crop Security Model for Improvement in Agricultural Productivity Using Iot: Smart Farming

Pramodhini R[1*], Surekha M[2], Sidramayya S M[2]

[1]*Department of Electronics and Communication Engineering, Nitte Meenakshi Institute of Technology, Yelahanka, Bangalore-560064, Karnataka, India.*
[2]*Department of Computer Science and Engineering, JSS Academy of Technical Education, Noida-201301, Uttar Pradesh, India.*
[3]*Department of Electronics and Communication Engineering, S. G. Balekundri Institute of Technology, Shiva Basava Nagar, Belagavi -560064, Karnataka, India.*

**Corresponding author's: Pramodhini R*

Article History

Received: 06 June 2023
Revised: 15 Sept 2023
Accepted: 30 Oct 2023

Abstract

Most of the time in agriculture field, crops ravaged by local animals that leads to huge losses for the farmers. It's very difficult for farmers to barricade entire fields and monitors continuously. Here the crop protection system model is developed for the farmers to prevent the crops from the animals. The model adopts the Arduino Uno based system and uses wired security that gives the shock to animals if they are approaching the field. The fire sensor is also used in the model to detect fire issues. In such situations, the microcontroller will turn ON the motor if there is a fire that interns intimate the farmers through mobile application. The temperature sensor and humidity sensors are also used in the model to provide the details of temperature and soil moisture of the field. The experimental values obtained by the model ensure complete safety of crops from animals and from fire thus protecting the farmer's loss. In addition, mobile applications are also developed to provide the details of parameters such as temperature, moisture, water levels to farmers.

Keywords: *Internet of Things, Sensor, humidity, Arduino Uno, Agriculture.*

CC License
CC-BY-NC-SA 4.0

1. Introduction

The problem of wild animal attacks on crop fields, i.e., crop vandalization is becoming a very common phenomenon in the state of Himachal Pradesh, Punjab, Haryana, and many other states. Wild animals like monkeys, estray animals especially cows and buffaloes, wild dogs, nilgais, Bisons, elephant's deer, wild pigs and even birds like parakeets cause a lot of damage to crops either by running over them or eating them and vandalizing them completely. This leads to poor yield of crops. These animals attack fruit orchards and destroy the flowerings and fruits. In both cases, this leads to significant financial loss to the farmers and orchard owners. The problem is so pronounced that sometimes farmers decide to leave the area barren due to these animal attacks. India is land of farmers, 75% of people of India are dependent on agriculture for their livelihood. But many a time it becomes very difficult for farmers to protect their crops from animal attacks and weather conditions. This may lead to poor yield of the crops and there is a financial loss to the farmers. So, to avoid this, the farmers used the traditional methods to protect their crops from animals like, busting of crackers, placing st archives in field and to have drumbeats. There is a temperature sensor for sensing the temperature of the atmosphere and a soil moisture sensor indicates the moisture content of soil in terms of percentage. A light sensor provides a measure of the light intensity, and a pH sensor determines the pH value of the soil. Thus, analyzing these factors and integrating them using Arduino is a better approach in making the system automated. The following sections describe how crop damage happens and how to take precautions.

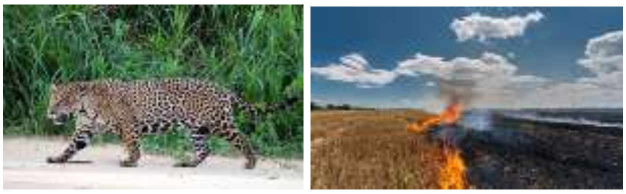

Figure 1: Animal attack and fire accidents in the farm.

2. Literature Review

Related work

Meena [1] developed technological development in Wireless Sensor Networks made it possible to use in monitoring and control of greenhouse parameter in precision agriculture. The atmospheric conditions are monitored and controlled online by using Ethernet IEEE 802.3. Partial Root Zone Drying Process is implemented to save water. Joaquín Gutiérrez [2] proposed optimizing water use for agricultural crops. An algorithm was developed with threshold values of temperature and soil moisture that was programmed into a microcontroller-based gateway to control water quantity. The system was powered by photovoltaic panels and had a duplex communication link based on a cellular-Internet interface that allowed for data inspection and irrigation scheduling to be programmed through a web page. Shakthi [3] reviews the state of art wireless sensor technology in agriculture. Based on the value of soil moisture sensor the water sprinkler works during the period of water scarcity. Once the field is sprinkled with adequate water, the water sprinkler is switched off. Hereby water can be conserved. Also, the value of soil pH sensor is sent to farmer via SMS using GSM modem. Beza [4] investigate the design and simulation of an electronic system for automatic controlling of water pumps that are used for agricultural fields or plant watering based on the level of soil moisture sensing. Hemlata [5] explained the use of modernized techniques such as Internet-of-Things (IoT), Sensors, Cloud-Computing, Mobile Computing, Big-Data analysis in agricultural sector. Soil and environment properties are sensed and periodically sent to Agro Cloud through IoT (Beagle Black Bone). Big-data analysis on Agro-Cloud data is done for fertilizer requirements, best crop sequences analysis, total production, and current stock and market requirements. Nikhil [6] designed for home automation system using ready-to-use, cost effective and energy efficient devices including raspberry pi, Arduino microcontrollers, Zigbee modules and relay boards. Kale [7] introduced an agricultural model in integration with ICT. Over the period, weather patterns and soil conditions and epidemics of pests and diseases changed, received updated information allows the farmers to cope with and even benefit from these changes. It is a really challenging task that needs to provide such knowledge because of the highly localized nature of agriculture information specifically distinct conditions. Selva [8] discussed about the work was possible to discriminate two classes of pesticides in different concentrations by cyclic voltammetry data extracted from the pesticide's solutions using a glassy carbon electrode in the mmol L-1 range to evaluate the potentiality of the proposed method. Giordano [9] explained an integrative approach in the field of Internet of Things for smart Agriculture based on low power devices and open-source systems. The goal of this work is to provide a repelling and monitoring system for crop protection against animal attacks and weather conditions. Gopinath [10] discussed about the outcomes of this system will take agriculture to the next level of advancement. The design will reduce manual labour and errors and thereby increase the productivity of the crops. By using the method of irrigation as specified, crops receive the optimum level of water and wastage of water can be prevented. The available models provide surveillance functionality but fail to provide protection from wild animals, especially in such an application area. They also need to take actions based on the type of animal that tries to enter the area, as different methods are adopted to prevent different animals from entering such restricted areas.

The main objective of the proposed model is to design a security system for farm protection and prohibit the entry of animals into the farm. The model ensures that the alarm is not triggered by the presence of a human in the field and has the capability of turning on/Off automatically which avoids animals and thus protecting the fields from any losses.

3. Materials And Methods

This The proposed model for crop protection against animals uses a Arduino board that forms the main heart of the system; the various sensors and web server are interfaced to the model. Once the value of PIR sensors go High on detecting motion within a range of 10 meters, the camera will be turned ON which first captures an image and then starts recording the video which will be stored on board as well as cloud, simultaneously message will be generated automatically to registered number to inform about the intrusion along with details of the temperature and humidity obtained by interfacing temperature and humidity sensor. Passive Infrared Sensors (PIR) are used to detect any motion of the human body.

Once employed PIR sensors detect motion, the cameras capture an image and start recording the video as well as the owner of the farmland gets notified about the intrusion.

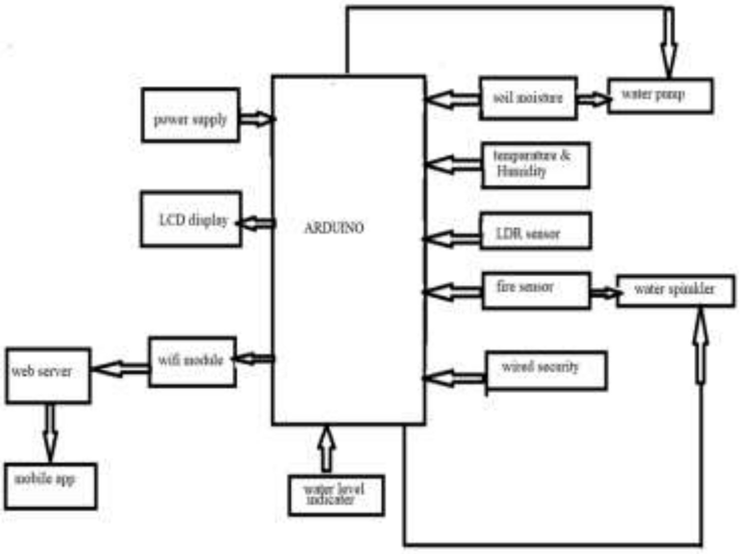

Figure 2: Proposed model

If found to be an animal, the model checks for the number of PIR sensors that have gone HIGH, if fewer sensors' results are high, it denotes a smaller animal, then immediately turn on the rotten egg spray unit, which helps to keep away the pigs. Similarly, if more than half the sensors that turn high denoted which clearly indicating a huge animal such as the elephant which is another major threat to such farmlands, we initiate the electronic firecrackers to turn ON, the loud noise which in turn helps to ward off the bigger animals. Along with this a fire sensor is used to indicate the forest fire and to avoid the spreading of fire from forest and alert message is sent through IoT.

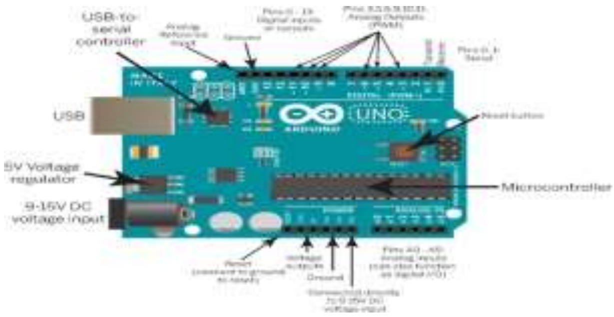

Figure 3: Arduino Board

The Arduino platform [15] shown in fig 3., has become quite popular and programmable circuit boards, which do not need a separate piece of hardware to load new code onto the board.

Figure 4: Fire Sensor

These are thermally sensitive resistors [17] shown in fig 4., whose prime function is to exhibit a large, predictable, and precise change in electrical resistance when subjected to a corresponding change in body temperature.

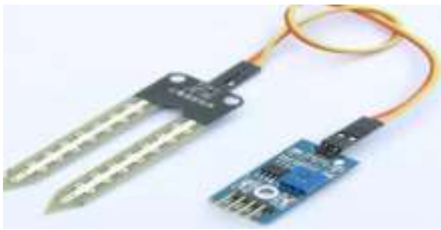

Figure 5: Soil Sensor

Fig 5., shows soil moisture sensors [18], measures volumetric water content in soil. Direct gravimetric measurement of free soil moisture requires removing, drying, and weighing of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

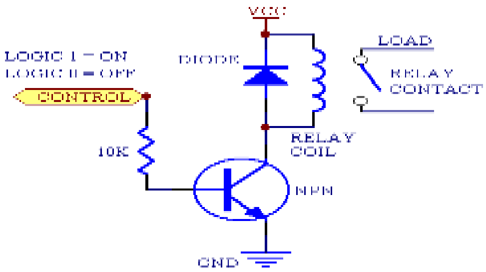

Figure 6: Relay

Relay [20-21] is an electromagnetic switch, used to control electrical devices. Copper core magnetic flux plays an important role and helps to perform ON & OFF Pump.

Figure 6: Temperature Sensor

LM35 [24] is a commonly used temperature sensor and shows values in the form of output voltages instead of degree Celsius. The output voltage of LM35 is proportional to the Celsius temperature having its scaling factor of 0.01 V/°C. The Water Level indicator employs a simple mechanism to detect and indicate the water level in an overhead tank or any other water container. The sensing is done by using a set of nine probes which are placed at nine different levels on the tank walls (with probe 9 to probe 1 placed in increasing order of height, common probe (i.e., a supply carrying probe) is placed at the base of the tank). Level 8 represents the "tank full" condition while level 0 represents the "tank empty" condition.

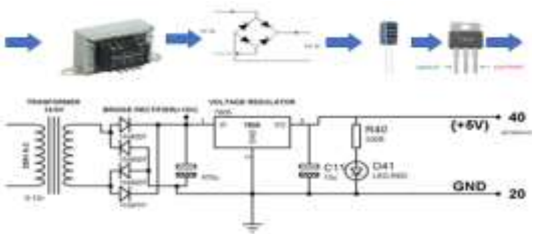

Figure 7: Power Supply

The model [27-30] contains standard power supply with step-down transformer from 230v to 12v and 4 diodes forming a bridge rectifier that delivers pulsating dc which is then filtered by an electrolytic capacitor of about 470microf to 100microF.

3. Results and Discussion

Technology in home automation, industries, e-commerce, online transaction etc., makes tremendous changes in applications that lead to carryout work in these sectors. As most of the Indians are depending on agriculture, it also requires improvement in the technology of the agriculture. So, the model is developed an application for the farmers through which he can have control over his farm without being present on the farm.

Figure 8: Initial Setup

Soil moisture <= 20% → moisture content of the soil is low → water pump on. If Soil moisture content is high, then automatically water pump gets off. Fire sensor status >= 80˚C Sprinkler on otherwise Sprinkler off. Temperature& Humidity sensor → the information will be delivered to mobile app after every minute. LDR sensor → during night intensity of light decreases hence light gets on. Wired Security → 5v supply will be given to the wire that is fenced around the field, which will give shock to the animals or intruders. Power supply → relay as voltage regulator which converts 230 to 12v. Wi-fi module range → 479 meters.

Figure 9: Experimental Values

Whenever each sensor senses and sends the signals to the Arduino then it performs the functions And Whatever functionalities are performed in the Arduino that will be displayed in the LCD that is Temperature, Soil moisture, Humidity which is shown in fig 9.

Figure 10: Model set up

Mobile application is developed for the farmers named as “My App” is shown in figure 11. It contains a main page followed by home page, contains all the parameters like Temperature, Humidity, Soil moisture, Water status, and Fire sensor.

Figure 11: Mobile app for Model showing Soil moisture Values.

Considering the example of the soil moisture, the specification shows the three tables including moisture, status and dates which is shown in figure 11. It shows 0.00 before dipping in the soil after dipping in the soil, then it starts showing the readings of the soil moisture when the moisture of the soil is low then automatically water pump will get on it supply water to the farm.

Applications

The model can be used in Web based applications, can be used 24×7. The system is monitored through a mobile app and the information is sent through clouds; hence it is web-based application can be accessed 24×7. It was also used to protect the farm. The live tracking of the field through mobile app where information is collected from all the parameters and necessary action are taken accordingly, hence this helps in protection of the field. It's used in orchards or fruit gardens and vegetable gardens. As the orchards and fruit gardens require huge investment it is important to protect these fields hence the advanced protective system is required for the fields. As developed model leads to the protection of the field, this increases the crop yield and reduces the financial losses of the farmers, this leads to the economic wellbeing.

4. Conclusion

The model for crop protection is developed for the farmers; the app is simple in operation so it can be operated by the farmers, the system can be installed in remote and rural areas as well and it is one time investment and reduces the financial loss of the farmers due to the crop damage. The experimental values obtained by the model ensure complete safety of crops from animals and from fire thus protecting the farmer's loss. In addition, mobile applications are also developed to provide the details of parameters such as temperature, moisture, water levels to farmers. Further, the model can be modified with Raspberry pi to enhance the features by keeping track of time, by which we can identify the time when animals entered the farm.

References:

1. Meena Kumari and Vidya Devi, "Real- Time Automation and Monitoring System for Modernized Agriculture", International Journal of Review and Research in Applied Sciences and Engineering, vol. 3 no.1, (2013), pp. 7-12.

2. Joaquín Gutiérrez, Juan Francisco Villa-Medina, Alejandra Nieto-Garibay and Miguel Ángel Porta Gándara, "Automated Irrigation System Using a Wireless Sensor Network and GPRS Module", IEEE Transaction on Instrumentation and Measurement, vol. 63 no. 1, (2014), pp. 5-7.
3. N. Shakthipriya, "An Effective Method for Crop Monitoring Using Wireless Sensor Network", Middle East Journal of Scientific Research, (2014), pp. 6-8.
4. Beza Negash Getu and Hussain A. Attia, "Automatic Control of Agricultural Pumps Based on Soil Moisture Sensing", IEEE conference publication, (2015), pp. 8-11.
5. Hemlata Channe1, Sukhesh Kothari and Dipali Kadam, "Multidisciplinary Model for Smart Agriculture using Internet-of-Things, Sensors, Cloud-Computing, Mobile-Computing & Big-Data Analysis", International Journal of Int. Journal of Computer Technology & Applications, vol. 6, no. 3, (2015), pp. 5-9.
6. Nikhil Agrawal and Smita Singhal, "Smart Drip Irrigation System using Raspberry pi and Arduino", International Conference on Computing, Communication and Automation, (2015), pp. 4-7.
7. Patil K. and N. R. Kale, "A Model for Smart Agriculture Using IoT", International Conference on Global Trends in Signal Processing, Information Computing and Communication, (2016), pp. 5-9.
8. Selva, T. M. G., Araujo, W. R. and Paixao, "Electrochemical sensor for discrimination of Carbamates and organophosphorus pesticide" IEEE International Symposium on Olfaction and Electronic Nose (2017), pp. 4-9.
9. Giordano, S., Seitanidis, I., Ojo, M., Adami, D. and Vignoli, "IoT solutions for crop protection against wild animal attacks" IEEE International Conference on Environmental Engineering (2018), pp. 5-11.
10. Gobhinath S, Devi Darshini M, Durga K and Hari Priyanga R, "Smart Irrigation with Field Protection and Crop Health Monitoring system using Autonomous Rover" IEEE International Conference on Advanced Computing and Communication Systems (2019), pp.6-12.
11. P.Venkateswara Rao , Ch Siva Rama Krishna and M Samba Siva Reddy, "A Smart Crop Protection against Animals Attack", International Journal of Scientific Research and Review, vol. 8, no. 6, (2019), pp. 8-1.
12. Srikanth N, Aishwarya, Kavita H M, Rashmi Reddy K and Soumya D B,"Smart Crop Protection System from Animals and Fire using Arduino", International Journal of Engineering Research in Electronics and Communication Engineering, vol. 6, no. 4, (2019), pp. 7-13.
13. K. Jyostsna Vanaja, Aala Suresh, S. Srilatha, K. Vijay Kumar and M. Bharath, "IOT based Agriculture System Using Node MCU", International Research Journal of Engineering and Technology, vol. 5, no. 3, (2018), pp. 5-8.
14. Anjana M, Sowmya M S, Charan Kumar A, Monisha R and Sahana R H, "Review on IoT in Agricultural Crop Protection and Power Generation", International Research Journal of Engineering and Technology, vol. 6, no. 11, (2019), pp.2-6.
15. Abhinav V. Deshpande, "Design and Implementation of an Intelligent Security System for Farm Protection from Wild Animals", International Journal of Science and Research, vol. 5 no. 2, (2016), pp.7-12.
16. R. Nageswara Rao and B. Sridhar, "IoT Based Smart Crop-Field Monitoring and Automation Irrigation System", IEEE International Conference on Soft Computing (2018), pp.4-8.
17. Raghavendra L R, Anusha B M, Nandisha K N, Shreeraksha J K and Tejas Gowda K, "Smart Agriculture", International Journal of Advance Engineering and Research Development, vol. 5, no. 5, (2018), pp. 6-10.
18. Dugyala Karthik and R. Ramesh Babu, "Smart Crop Protection System with Image Capture over IOT", International Journal of Advanced Information Science and Technology, vol. 6, no. 11, (2017), pp. 5-11.
19. Xujian Peng and Haiqing Hu, Jiabao Sun, "Study on Biomass Dynamic Change of Rhododendron-Larix Gmelinii Forests after Fire Disturbance", IEEE International Conference (2011), pp. 3-9.
20. Matti Satish Kumar, T Ritesh Chandra, D Pradeep and M. Sabarimalai Manikandan, "Monitoring moisture of soil using low-cost homemade Soil Moisture Sensor and Arduino UNO", IEEE (2016), pp. 9-13.
21. Navaneetha, R.Ramiya Devi, S.Vennila, P.Manikandan and S.Saravana, "IOT Based Crop Protection System against Bird Wild Attacks" International Journal of Innovative Research in Technology, vol. 6, no. 11, (2016), pp. 8-13.
22. B. Vinay Kumar and K. Raj Kumar, "Zigbee based wireless Sensors Networking for Monitoring an Agriculture Environment" International Journal of Engineering Research and Technology, vol. 2, no. 10, (2013), pp. 5-10.
23. C.H. Chavan and P.V. Karande, "Wireless Monitoring of the soil moisture, Temperature & Humidity Using Zigbee in Agriculture" International journal of engineering Trend and Technology, vol., no. 10, (2015), pp. 4-12.
24. S. Shanti, abhinaya R, Akshaya.V and Gowri.S, "Agriculture Crop Monitoring using GSM in WSN" International Journal of advanced Research in Computer Communication Engineering, vol. 5, no. 3, (2014), pp. 6-13.
25. P. Venkateswara Rao, Ch Siva Ram Krishna, and M. Samba Siva Reddy, "A S mart Crop Protection Against Animals Attack" International Journal of scientific Research and Review, vol. 8, issue 6. (2017), pp. 9-11.

26. S. Santiya, Y. Dhamodharan, N. E Kavi Priya, C.S. Santhosh, and M. Surekha, “A smart Farmland using Raspberry pi Crop Protection and Animal intrusion Detection System” International Research Journal of Engineering and technology, vol. 5, no. 3, (2018), pp.1-6.
27. Pooja.G, Mohamad and Umair Bagali, “A Smart Farmland using Raspberry pi Crop Vandalization Prevention and Intrusion Detection System” International Journal of Advanced Research and Innovative ideas, vol. 1, no. 5, (2017), pp. 6-11.
28. G.Navaneet Balaji , V. Nandini , S. Mitra, N. Priya and R. Naveena, “IOT based Smart Crop Monitoring in Farm Land” Imperial Journal of Interdisciplinary Research, vol. 4 , no.1, (2019), pp. 7-12.
29. Vikas Bavane, Arati Raut and Swapnil Sonune, “Protection of Crop from Wild Animals using Intelligent Surveillance System” International Journal of Research in Advent Technology, vol. 3, no. 5, (2017), pp.5-11.
30. Atchaya. V, Kousalya.V, Divya Bharati K.P, and Arunkumar.M, “Implementation of Crop Protection System Against Wild Animal Attack” International Journal of Advanced Technology in Engineering and Science, vol. 7, no. 2, (2012), pp. 4-11.