Design and Implementation of IOT based Rodents and Greenhouse Monitoring in Agriculture

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Abstract: Agriculture sector being the foundation of the Indian economy merits security. Security not only for assets just but rather additionally farming items needs security and assurance at extremely starting stage, like protection from attacks of rodents or creepy crawlies, in fields or grain stores. Security frameworks which are being utilized now a day are not sufficiently shrewd to give constant warning in the wake of detecting the issue. Keeping this situation in our mind we have planned, tried and investigated a 'Internet of Things' based gadget which can examine the detected data and after that transmitting it to the client. This gadget can be controlled and checked from remote area and it can be executed in agricultural fields, grain stores and cold stores for security reason. This complements the techniques to take care of such issues like recognizable proof of rodents, dangers to crops and conveying ongoing notice in view of data examination and preparing without human mediation. This project introduces an observing and control framework for greenhouse through Internet of Things(IOT). The framework will screen the different ecological conditions, for example, humidity, soil moisture, temperature etc. If any condition crosses certain limits, a message will be sent to the enlisted number through GSM module. The outcome of this project is Scientists have been creating different IoT based security gadgets yet a little work is done in agriculture zone. As indicated by past research in crop's security, developing nations, which are utilizing customary storerooms for food crops, can't secure them, prompting 20-30% loss of products, for example, rice, corn etc. As of now accessible arrangements targets just creepy crawlies, pests and grain pathogens. While other review states 5 to 10% loss in rice crops, in Asia is because of harm brought on by rodents. These rat effects are additionally connected with the crippling rat borne diseases. As in Asian and Pacific nations death rate because of rat borne maladies is higher in correlation with some disease, for example, HIV-AIDS. The work is executed for remote checking and control of greenhouse parameters with the assistance of sensors and GSM. The model was tried under different conditions and the experimental results were found as expected.

Keywords: Internet of Things(IOT); Agriculture; Greenhouse; Rodents; GSM.

Introduction

Over the previous years data and correspondence innovations have been presented in farming, enhancing sustenance generation and transportation [1]. Be that as it may, the reconciliation of these advancements is not yet utilized for security purposes. The huge test confronting the security in farming is the cooperation between security gadgets and to give them knowledge to control other electronic gadgets, for example, cameras, repellers and so forth. To upgrade security in different fields. For instance, a fundamental CCTV camera introduced in a grain store can't be useful until recorded media is gotten to and it likewise can't handle the data about what is going on at a specific area. In usage and reception of data and correspondence innovations, cost is additionally a central point. It is difficult to accomplish trade of data among gadgets and redesigning their usefulness while keeping their cost to a sensible level. In this way, the normal conclusion is that the security and observing frameworks must oversee transmitting information over system, examining the data and tell the client with constant data of environment. This absence of data transmission and information investigating has been comprehended by mix of Internet of things with right now accessible security gadgets to accomplish effective sustenance protection and profitability. Although the sustenance trim misfortune and incapacitation of maladies are because of different dangers as rodents, pests, creepy crawlies and grain pathogens, while this exploration is the outlining and examining of security gadget, considering harms to post collect harvest by rodents and grain stores as material range. With regards to Smart Security and Monitoring System for Agriculture (S2MSA), we address the test of coordinating Internet of Things with electronic security gadgets and frameworks to enhance the effectiveness of nourishment safeguarding in grain stores. Greenhouses Environment Control System shape a vital piece of the agribusiness and cultivation areas in our nation as they can be utilized to develop plants under controlled climatic conditions for ideal create. Proper natural conditions are fundamental for ideal plant development, enhanced product yields, and proficient utilization of water and different assets. Automation is process control

of modern hardware and procedures, in this manner supplanting human administrators [2]. The soil moisture conditions, environment temperature and different climatic parameters administer plant development. Automating the information procurement handle permits this data (soil moisture, temperature and different atmosphere parameters) to be gathered at high recurrence with less work prerequisites. The rising interest for harvest generation and quality has essentially expanded the use of top notch greenhouse. The expanded populace requests for huge measure of yield generation. We can develop the harvests which require some ecological conditions in the greenhouse. In this project, we will present an overview of the IOT marvels and in addition its applications on greenhouse. IOT is a dream of a world in which most protests are associated; transmitting refreshes about their execution so the general population who utilize them to do things more brilliantly [4]. The fundamental idea driving the IOT is that essentially every physical thing in this world can likewise turn into a PC that is associated with the web [6]. In this venture the sensor will detect the indispensable parameters of nature. The detected qualities will be shown on a LCD display. The sensors are associated with the microcontroller. The microcontroller utilized here is the ARM 7 Cortex LPC2148[2].

Literature Survey

[9] Grant R. Singleton. ''*Rodents Impact on rice production in Asia.*'' IRRI Discussion Paper Series No. 55, 35 pp.
As of now accessible arrangements targets just creepy crawlies, pests and grain pathogens. While other review states 5 to 10% loss in rice crops, in Asia is because of harm brought on by rodents. These rat effects are additionally connected with the crippling rat borne diseases. As in Asian and Pacific nations death rate because of rat borne maladies is higher in correlation with some disease, for example, HIV-AIDS.

TABLE I
COMPARISON BETWEEN HIV-AIDS AND LEPTOSPIROSIS BASED ON
DEATHS AND CASES FOUND (PHILIPPINES)

Source: Grant R. Singleton. 2010, ''*Impacts of rodents on rice production in Asia.*'', & PIDS, NEC, Department of Health, Philipinnes

Disease	2008		Jan-Oct 2009	
	Cases	Deaths	Cases	Deaths
HIV-AIDS	528	4	629	1
Leptospirosis	832	41	2777	161

10] Malhi, C.S. and Parshad, V.R. (2009) Sheikher C. and Jain, S.D. (2011) Preharvest rodent damage and control. *Proc. Indian Natn. Sci. Acad.* B57, 391–6.
All field yields are influenced by rodents. The example and the degree of harm, depending on the species and the power of pervasion, change in various yields and geological areas. Most of the evaluations of harm identify with the develop or pre-harvest phases of the product however rodents cause harm at all phases of the harvest from sowing to collecting. The fields for the most part grow extensive rat populaces in the mid-year because of improved proliferation amid the rainstorm downpours joined with the bounteous accessibility of food amid the ripening stages. Among the oil seed crops groundnut regularly endures extreme assault by rodents.

K. Rangan et al., in [2] have discussed
Greenhouse is monitored using an Embedded Systems Approach. They have utilized an inserted framework to deal with monitor and control the greenhouse parameters. They are measuring humidity, temperature, soil moisture by sensors. The message will be sent to the proprietor through GSM.

PC.M.K. Gayatri et al., in [4]
Have discussed about Smart Agricultural Solutions to Farmers for better yielding utilizing IOT. They clarified about the IOT idea. The issues identified with the agriculturists are hampering the reason for our development. One of the answers for these issues is to help agriculturists utilizing modernization procedures. This paper clarifies joining the benefits of the significant attributes of developing advancements, for example, IOT and web.

Asolkaret al., in [5]
Have examined An Effective Method of Controlling the Greenhouse Using GSM. The nursery approach has been displayed supporting GSM remote innovation. This viably monitors and controls the temperature, humidity, soil moisture. Here the GSM will send message. Also, the proprietor must answer to make a suitable move.

System Design And Implementation

Hardware Requirements:
1) ARM 7 processor LPC2148 Microcontroller & ARM Cortex 11.
2) PIR SENSOR
3)Repeller
4)Temperature Sensor
5)Humidity Sensor
6)Soil Moisture Sensor
7)LCD Display
8)Solar Panel
9)Power Supply
10)Web Camera
11)LDR Sensor
12)Water Pump
13)Fan
14)Water Level Sensor

Software Requirements:
1)Embedded C
2)Embedded JAVA
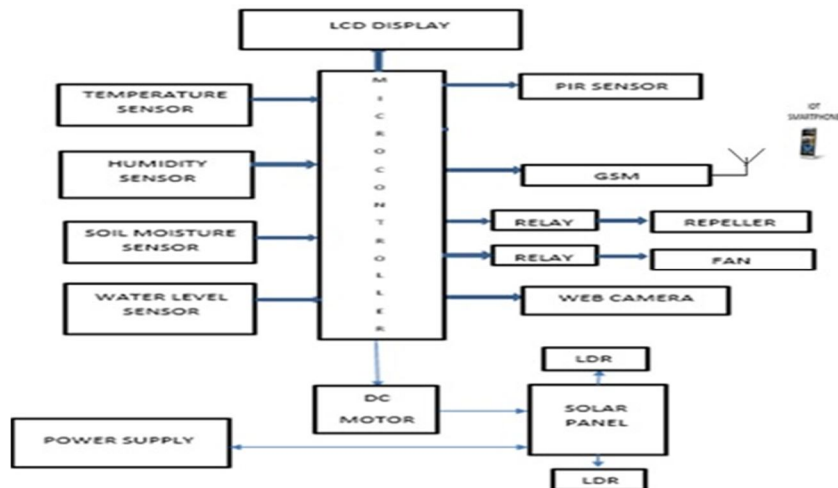3)KEIL
4)Flash Magic
5)Eclipse

Fig. 1 Block diagram

Many embedded frameworks have considerably extraordinary plans as per their capacities and utilities. In this project design, organized measured outline idea is received and the framework is principally made from a solitary microcontroller, temperature sensor, LCD, PIR sensor, Humidity Sensor, Soil Moisture sensor, Water level Sensor, LDR sensor, CPU fan, GSM, Rodent repeller, relay, Solar Panel, DC motor, and Mobile Camera. The microcontroller situated at the center of the block diagram frames the control unit of the whole project. Implanted inside the microcontroller is a program that causes the microcontroller to make a move considering the sources of info given by the output of the sensors.
To detect occupancy of Rodents the occupancy sensor is used,
the occupancy combines PIR sensor that can determine whether a Rodent is present or not. Once PIR sensor recognizes warm it switch on the camera and the repeller and a snap of that area is captured, alongside it, gadget sends arbitrary number of warnings (in view of timestamp) to client.
Based on sensor output the plug load devices and IT equipments are operated. The environmental sensing such as temperature, is done through temperature sensor LM35.

Working Principle

Rodent Monitoring
In the proposed situation, the exploration issue is to create canny security frameworks with capacity to examine information and transmit data over system to the remote area [1]. Writing overview gives the idea about present work done in field of farming security and IoT. This can be improved by coordinating couple of new advancements with present plan. Current IP based CCTV surveillance cameras require network connectivity for monitoring from remote area. It doesn't have capacity to tell client by dissecting information. In the gadget, fundamental sensors and electronic gadgets are utilized. The tactile data is examined keeping in mind the end goal to actuate electronic gadgets and in the wake of dissecting information, the data is transmitted to client.

Architecture
Gadget utilizes 3 interfaces for information gathering, examination and transmission. IoT design is classified in 3 level engineering.
These layers, are ordered as
• Perception layer: Layer which is utilized to separate the distinctive sort of sensors utilized as a part of gadget.
• Network layer: Layer utilized for process and transmit the data over system.
• Application layer: This layer oversees different reasonable application considering clients' need.

Circuit Design
The sensors and camera are associated with GPIO header. Gadget likewise contains a ultrasonic sound based rodent repeller which will be actuated by server in view of information examination.

Data Analysis
Scripts in Embedded C language can be utilized to distinguish movement of rodents utilizing heat sensor which gives discrete values. Considering these discrete values as banner flag, webcam daemon is initiated to catch a snap of territory. Web camera is needy upon the qualities created by PIR sensor.

Application
Based upon the motion detected by PIR sensor, repeller will be activated with a frequency within range (30 kHz to 65 kHz) which is aversive to rodents.

Greenhouse Monitoring
The framework contains sensors, microcontroller and actuators. Soil moisture and temperature of the field are the most basic parameters. The electromagnetic sensors are utilized to recognize soil moisture. This strategy spares 53% of water contrasted with sprinkler water system. In this work, minimal effort soil moisture sensors, Temperature, water level and humidity sensors, are utilized [3]. They constantly monitor the field and send it to the cloud. The sensor information is put away in database. The web application is outlined in such an approach to break down the information got and to check with the edge estimations of moisture, humidity and temperature. The basic leadership is done at server to mechanize water system [4]. On the off chance that soil moisture is less than the threshold value the motor is switched ON and if the soil moisture exceeds the threshold value the motor is switched Off.   The sensor is interfaced with microcontroller and customized. The microcontroller continually monitors the digitized parameters of the different sensors and confirms them with the predefined threshold values and checks if any remedial move is to be made for the condition right then and there of time through GSM [5]. When it is customized it is kept in the field. The temperature and Humidity sensor are utilized. The aggregate sum of water vapor in air is characterized as a measure of humidity. Relative humidity is computed in light of the fact that when there is an adjustment in temperature, relative humidity is likewise changed. The temperature and humidity changes happen prior and then afterward irrigation. The measure of water droplets in air is expanded after irrigation. This causes diminish in temperature which thus expands the relative humidity of the environment. The temperature and humidity readings are frequently informed to the client so that the client can have the capacity to know the field conditions from anyplace.
As the framework likewise utilizes a LCD display for persistently cautioning the client about the condition inside the greenhouse, the whole set-up progresses toward becoming easy to use. Hence, this framework dispenses with the disadvantages of the current set-ups and is composed as a simple to keep up, adaptable and ease arrangement [2].

Motion Detection Using Background Subtraction Method
Motion detection means it's a procedure of distinguishing an adjustment in position of an object in respect to its environment or the adjustment in the surroundings in respect to a protest. Motion detection can be accomplished by both mechanical and

electronic techniques. Background motion detection technique is a basic strategy for movement recognition by a settled camera contrasts the present picture and a reference picture or background picture pixel by pixel and essentially tallies the quantity of pixels with change more than the threshold value and accordingly movement is distinguished [7][8].

Background Subtraction Method

Background subtraction [7], otherwise called Foreground Detection, is a system in the fields of image processing and PC vision wherein a picture's closer view is separated for further processing (object recognition etc.). For the most part, a picture's areas of intrigue are items (people, cars, rodents and so forth.) in its forefront.

Background subtraction is a generally utilized approach for distinguishing moving objects in recordings from static cameras. The justification in the approach is that of recognizing the moving objects from the contrast between the present edge and a reference outline, regularly called " background image ", or " background model ". Sometimes, distance of the moving objects likewise frames a reason for it to be viewed as a back ground, e.g. if in a scene one individual is near the camera while there is a man far away is disregarded because of its little size and the absence of data that it gives. Background subtraction is a class of methods for dividing out objects of enthusiasm for a scene for applications, for example, reconnaissance. A decent background model ought to likewise respond rapidly to changes in background and adjust to oblige changes happening out of sight. A strong background subtraction calculation ought to have the capacity to deal with lighting changes, redundant movements from mess and long haul scene changes. The accompanying examinations make utilization of the capacity of V (x, y, t) where t is the time measurement, x and y are the pixel area factors,

e.g. V (1, 2, 3) is the pixel intensity at (1, 2) pixel area of the image at t=3 in the video sequence [7].

Using Frame Differencing:

Frame difference (absolute) at time t+1 is,

$$D\ (t+1) = |V\ (x,\ y,\ t+1) - V\ (x,\ y,\ t)| \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots.(1)$$

The background is thought to be the frame at time t. This distinction image would just demonstrate some intensity for the pixel areas which have changed in the two frames. Even though we have apparently evacuated the background, this approach will work for situations where all closer view pixels are moving and all background pixels are static. An edge "Th" is put on this distinction image to enhance the subtraction [7].

$$V\ (x,\ y,\ t) - V\ (x,\ y,\ t+1) > Th \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots.\ (2)$$

(this implies that the difference image's pixels intensities are „thresholded" or filtered on the basis of value of Th). The precision of this approach is subject to speed of development in the scene. Speedier developments may require higher thresholds [7][8].

Frame Subtraction

To begin with, the scene is changed over to a array of pixel qualities. These pixel qualities are the arrived at the midpoint of Red, Green, and Blue (RGB) values for every pixel. The pixel estimations of the previous frame are then subtracted from the current frame's pixel values, and the outright estimation of the values is taken. The outcome is a array of values that speak to how much every pixel has changed between the two frames, with higher values representing more change. The measure of change in a region of pixels can be deciphered as the measure of motion that is occurring in that area. This information representing more change can then be used to figure out where in the scene the most movement is occurring [7][8].
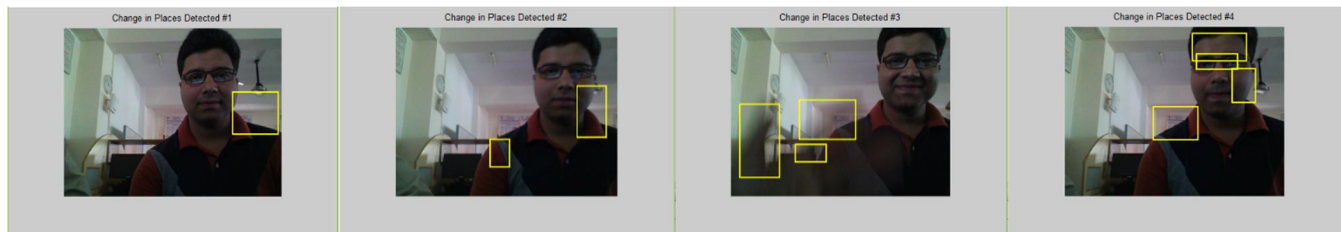

Fig 2. Results of Motion Detected
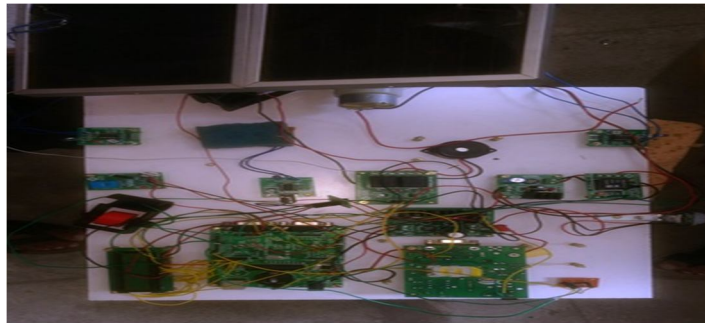
Snapshot of The Prototype

Fig 3. Developed Prototype

Results

The sensors are associated with the microcontroller. The sensors will detect the distinctive parameters and will show the output in the LCD display. Also, the messages will be sent to the proprietor.

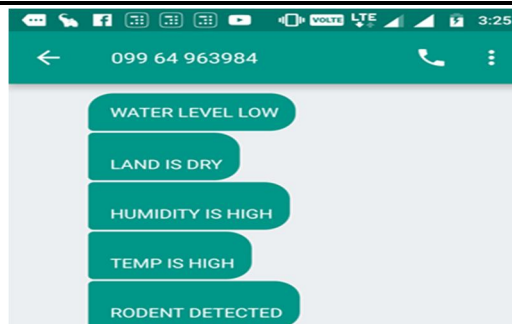| Table 2: Test Results 2				Table 1: Test Results 1			
Parameters	Morning	Noon	Evening	Parameters	Morning	Noon	Evening
Temperature (°C&F)	26°C	33.00°C	29°C	Temperature (°C&F)	26°C	34.00°C	29°C
	78.80 F	91.40 F	84.20 F		78.80 F	93.20 F	84.20 F
Humidity (%)	76%	63%	72%	Humidity (%)	76%	63%	71%

Fig 4. Snapshot of the Message Received From GSM

Conclusion And Future Scope

'Internet of things' is generally utilized as a part of interfacing gadgets and gathering data. The framework is intended for recognizable proof of rodents in grain stores, fields and Greenhouse Monitoring. Subsequent to gathering and breaking down the information, calculation is intended to give precision in telling client and initiation of repeller. Once PIR sensor recognizes warm it switch on the camera, alongside it, gadget sends arbitrary number of warnings (in view of timestamp) to client.

For future upgradation, gadget will acquire a matrix of sensor boards comprising PIR sensors. The gadget can incorporate pattern recognition techniques for machine learning and to recognize objects and sort them into people, rodents and warm blooded animals, additionally sensor combination should be possible to expand the usefulness of gadget. Enhancing these points of view of gadget, it can be utilized as a part of various territories. This project can experience for further research to enhance the usefulness of gadget and its material ranges.

The work indicate the accompanying bearings of research that are probably going to be required for further change.

• It might be useful to extend the security framework to avert rodents in grain stores.

• It can be additionally enhanced for the distinguishing proof and classification between people, mammals and rodents.

• Device can be empowered to gather more data about environment and nearness of dangers so that execution of machine learning is accomplished.

• Location of gadget in range can likewise be change in view of the area of grains for more successful outcomes.

This project depicts the outline of a greenhouse monitoring in light of IOT. Agribusiness extends even in urban regions are on an ascent lately, in novel structures. Innovative advance makes the horticultural part develop high, which here is made by the IOT. The IOT will significantly change way we experience our every day lives and what data is put away about us. This observing framework percepts diverse parameters inside the greenhouse utilizing sensors and GSM to give the updates. The created framework can be demonstrated beneficial as it will advance the assets in the greenhouse. The entire module is of low cost, low power operation consequently, effectively accessible to everybody.

The remote observing and control framework for environmental parameters in Greenhouse based on GSM technology is developed and tested. The exploratory outcomes demonstrate that the framework has a few feature as:

1) It can be utilized in agriculture vegetable nursery to monitor the environmental parameters to beat the drawback of customary measuring and controlling.

2) It can be kept at a long distace, constant checking for parameter of geenhouse also, the data can be acquired at any time.

3) It has the benefits of GSM innovation , not requiring links, low power utilization, modest cost, great robustness, adaptable expansion, helpful introducing over the conventional estimation and control framework.

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