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Automatic Monitoring of Pest Insects Traps Using Image Processing

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Abstract

Monitoring pest insect population is currently an important issue in crop protection. At farm level insect population monitoring is consistently operated by repeated surveys by a human operator of adhesive traps, disseminated through the field, where insects remain stuck when attracted. This is a laborious and time-consuming activity, and it would be of great advantage for farmers to have an affordable system performing this task automatically. A system based on a distributed imaging device that is able to automatically acquire and transmit images of the trapping area to a remote host station is proposed. The station evaluates the insect density evolution at different farm sites and sends a message to the server that pesticides are required, when insect density goes over threshold or an alarming level through GSM technology. The network architecture consists of a master node hosted in a PC and a set of client nodes, spread in the fields, which act as monitoring stations. The master node coordinates the network and retrieves the captured images from the client nodes. A GSM modem which is interfaced with PC through USB port is used to send messages to the particular numbers for required attention in this regard for further action.

Keyword: *MATLAB, GSM modem, camera*

1. Introduction

An accurate and timely monitoring of pest insects population is a key issue in crop protection. At farm level, pest population levels during crop season are routinely monitored by means of adhesive traps disseminated through the field at appropriate spatial density, when insects remain stuck when attracted into by colour appearance or odorous baits like sex pheromone. This task requires repeated surveys in the field with visual observations of traps and recording of the number of insects captured by a human operator. Being these survey process a highly laborious and time consuming operation, they are unlike to be conducted at the necessary monitoring frequency, often yielding poor results, significantly affected by observer's skill or fatigue, or by surveying conditions [1-2]. The ongoing developments in new micro, low cost imaging devices and in wireless communication technology could give a valuable contribution in facing automatic monitoring of pest insects by establishing a camera able to remotely assess the adhesive traps captures in the field.

Indeed a successful development of such system would potentially allow taking decisions about insect control strategies at farm based on continuously updated maps of pest insect population levels which are retrieved in a server from a distributed network of cameras transmitting from the field. An alternative solution, explored in this study, is based on adopting very simple stations only having ability of capturing and transmitting images to the host in the network. A host station will process all the received images and count the trapped insects. This same station will eventually provide an interface to the operator to show in real time the population map and its trend, as well as a message will be sent through GSM module when insect density goes over an alarming level. Also, this system can be applied to the areas hard to reach [1-5].

2. Related Work

It is given that, pests are those that directly spoil the crop, and pest control has always

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been considered the most complicated challenge to overcome. A well-known technique to perform pest control monitoring is based on the use of insect traps conveniently spread over the specified control area. Depending on the variety of insect, each trap is properly installed with pheromones or other chemical substances that attract the insects we want to capture. The traps are designed in such a way that insects entering in the trap are unable to leave it, so pest monitoring systems will periodically collect the data of each trap captured to perform an efficient pest control monitoring [2].

To get most reliable results, image processing should be performed only on the trap active area [1]. Energy saving of wireless sensor network node is usually available from the hardware, operating systems and communication protocols. In this project we are using GSM modem which uses low power [5]. The large scale, long distance, and long-term monitoring for agricultural information can be achieved by using proposed monitoring system. Much improved spatial resolution and temporal resolution is obtained compared to traditional methods for monitoring the data of pest population [6].

Using GSM was 100% based on cross checking the sent and received data, and the integrity of transmission is guaranteed. Also by using GSM, data or message can be saved from attacks and information is provided to the user [7]. They proposed method they firsts identify Aphids after they go for other two insects. Aphids were easy to discriminate because they have small variation in color information and the body size was substantially different from other species. They proposed pest detection system including four steps name as color conversion, segmentation, reduction in noise and counting [8].

An automatic electronic trap is designed to monitor the flight of codling moth males, to identify the pest and to forward the information on trapped males. The results showed how the modifications performed on the standard sticky traps did not causes a reduction of the trap capability to catch the males, and also that the photos taken by the system and sent to a remote unit allowed an easy moth identification and detection. Also, they showed that the modifications introduced in the standard traps do not affect the capture capacity of the traps [9].

This paper describes the monitoring of pest insect population by using wireless sensor network in field.In this project they just found the insect count and they are not controlling so further [10]. The GSM transmission techniques enable this system to engage in long- distance data transmission, so the system can be deployed to the areas hard to reach [11]. One of the major advantages of using insect pheromone traps with lure is that they are designed to attract a single particular species of insect. Some other non targeted insects may accidentally visit the trap but their numbers will be lower than the target pest. Therefore, insect identification is automatic with lure-based (pheromone) traps and this trap data can significantly complement field scouting. But problems like, Lures should be replaced once every month. Too many non-target insects could also be problematic issue [12].

3. Flow Chart

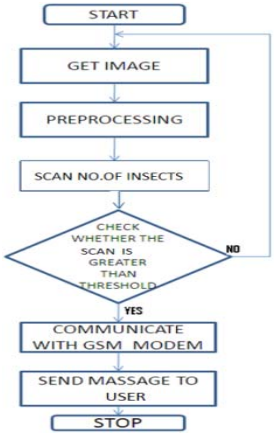

Figure 1. The designed system performs trap monitoring task

The designed system performs trap monitoring task and calculates the insect density of the trap by capturing the trap image and then preprocessing it. The preprocessing includes image binarization, erosion, dilation, filtering etc. Later on scanning the number of insects and performing the further action depending on the insect density using the following algorithm.

4. Working

The developed network is based on the GSM communication protocol. It allows implementing several networking architectures with moderate energy consumption. The system network consists of a master node, called *base station*, which is hosted inside a PC, and a set of client nodes. The master node has the role of coordinating the network. This node sends to the clients the request for shooting a picture (image) and then collects all the images, sending them to the PC. The images are processed by the PC that produces the insect count. The client nodes have the role of acquiring the images upon request and transfer them, towards the master node. As the measured physical quantities are represented by images, the device complexity is an issue here: each node should contain a camera, host is required to manage image capturing and processing. Recently, such small capturing devices have become available. The camera is connected to the Computer. The communication between the Computer and the camera is through the USB port. Communication between host and GSM modem consists of three phases: connection, setup, download. The first one is necessary for channel synchronization.

In the download phase, the GSM modem receives message to be transmitted & then transmit it to the specified number [1]. Insect recognition and counting in images isn't a trivial task as lighting conditions in real environment are subjected to large changes. To tackle this challenge, the implemented image processing has to cope with light changes and with irregularities in the glue over the trap. A first possibility is to apply an image transform in color space such that insects become linearly separable from the background. A single plane can indeed separate the pixels belonging to insects. However, the position and orientation of this plane does change according to lighting and surface condition that makes this transformation useless on the field. Therefore a more principled approach has been developed. We consider each single image and extract its luminance and we estimate the background image by applying a median filter to the luminance image. Once the background is available, insects become clearly visible on the image obtained subtracting the background from the original image, after this processing the GSM module which is connected to computer through USB port will send the message to the users when the insect population goes over threshold.

We developed the system which performs the monitoring task automatically using image processing and taking action towards controlling the pest by sending message to the user through GSM modem.

The host station performs image processing on the trap captures in the following steps: Binarization, thresholding and counting.

We applied the above procedure to the trap captures then we got the results shown below in Figure 2, Figure 3 and Figure 4. And depending on the number of count the message is sent to the user. If the count is greater than the defined threshold value the system communicates to the GSM modem and message is sent for further action.

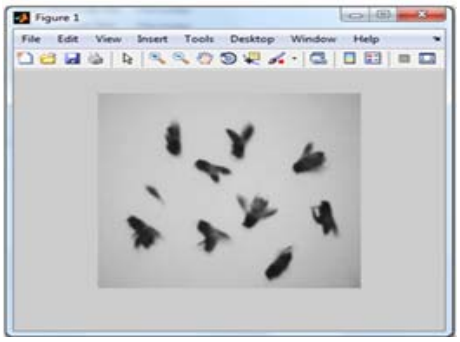

Figure 2. Capture Image

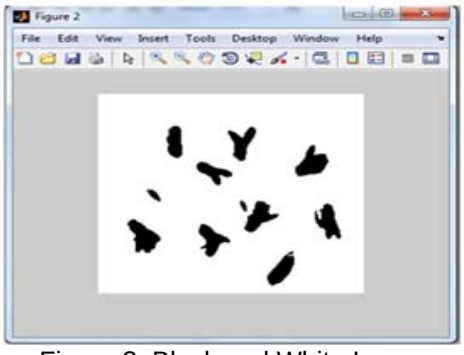

Figure 3. Black and White Image

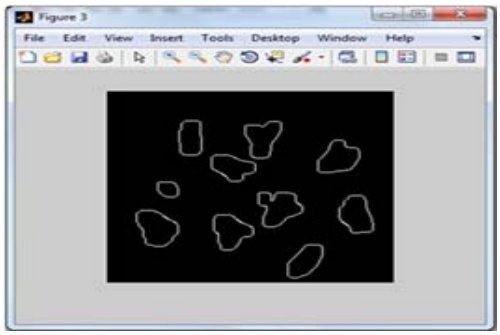

Figure 4. Image Showing Count of Insects

5. Result

The designed system has successfully shown results of automatic monitoring of pest insects traps; also provided the step towards controlling of pest. By using pheromone traps this system can be more efficient that it will send message of particular pesticide depending on type of pest.

6. Conclusion

In this paper, we give brief summary about various methods and technique which were provided by various authors for agricultural pests detection. Every methodology is having its own methods as well as environments in which it applied. There are some methods which are applied to only greenhouse environments whereas some of methods is able to identify only one pests name as white fly. From survey it is conclude that there is necessity for proposing one unique method which will identify not only large pests as well as larvae stage of various pests. Our future scope is to propose one methodology for identification of different pests of various crops which not only detects and tells which pest has affect the crop as well as it provide the solution to prevent it or to control it. Our proposed system is helpful to farmers as well as robotic vehicle system which is used for spraying pesticides automatically when any pests occur in the field.

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