Development of Smart Farm Security System with Alarm Mechanism using Image Processing

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ABSTRACT

Area security is very important nowadays, no one wants their investments to be ruined by someone who intends to rob or destroy the property. The proponents came up with this research to strengthen the existing security system and develop a new way of securing a particular area. This system will use image processing to determine the identity of the one who entered and distinguish if that one is authorized personnel, an intruder, or a crop-destroying animal. A Closed-circuit television (CCTV) will be used to monitor the area and provide a video record for security purposes. A motion detector controlled by the Arduino Microcontroller will be the one to address the Graphical User Interface (GUI) that is to be programmed by the proponents when to take the snapshot on the video which is displayed on the GUI that will be used on image processing to determine the identity of the captured object. An opto-isolator will be used as the switch for the alarming system; it is connected on parallel port which is converted from USB port to command when the switch will be on or off. If the system detects that there is an intruder or crop-destroying animal, an alarm will trigger until it is turned off by the respondents.

Keywords: *image processing, Closed-circuit television, parallel port, USB port, Graphical User Interface, opto-isolator.*

INTRODUCTION

This section means to talk about the inspiration and achievements of the research. It states the problem that leads the proponents with this study as well as its background. The goals and extensions of the task are expressed with its significance. This area would set as a support in characterizing the acceptability of the study.

Background of the Study

Agriculture plays an important part in an economy. Agriculture provides us food and raw material as well as employment chances to a massive extent of population in our country. For decades, agriculture had been connected with the generation of fundamental nourishment yields and farming was synonymous so long as farming was not marketed. In any case, as the procedure of financial advancement quickened, numerous more different occupations partnered to farming came to be perceived as a piece of agriculture. Furthermore technology has assumed a major part in building up the farming business and has changed the agricultural industry by substituting human labor with machines that are activated or controlled by people or other machines. Smart farming is commonly used by agriculturist to make the quality and also quantity of agricultural production using detecting technology to make farms better and more intelligent. This sort of technology is also called precision agriculture or also known as smart farming where the idea is about how will observe, measure and react to inter and intra-field variability of crops.

Nowadays, security is becoming an significant matter for farmers, despite that the threat of a violence on farm is marginal, we must consider our liability to criminal deeds such as robbery of farm equipment or chemicals, criminal disruption involving unsecured equipment and machinery, destruction of bioengineered plants, common vandalism. Acts of terrorism have elevated our consciousness of the requirement for increased personal and farm security. Unauthorized access to farm chemicals and application equipment are greatest security danger to farms, nurseries and greenhouses where plants are developed. And as an adult we know that insecticides should be stored away from children. In addition, insecticides should be protected from trespassers, vandals, intruders, and thieves who may accidentally, or intentionally, use these chemicals to damage other individuals, crop or non-crop lands, the environment or even themselves. Be responsible for the safety of yourself, your family, representatives, and your group. Set up your farm to endure the pressure of unauthorized activity. Thus this study aims for the solution for the problem. This system will help to secure and monitor the particular area to lessen the time and effort of farmers.

In due course, the proponents design and implemented a system that utilizing a sensor and CCTV which the advocate will use to identify the trespasser inside the secured area and produce a yield. This yield is a security system that has an alarm which will trigger when a movement recognized. So with this, the proponents' think of a system which is security with alert mechanism which includes recognition of undesirable individual, creature or an item in an ensured range, so at whatever point there's a suspicious intruders it will be identify and set off the caution. In this case, the authorized personnel in a particular area will be frightened that there is intruder distinguished.

Objectives of the Study

The general objective of this study is to develop a smart farm security system with alarm mechanism using image processing.

Specifically, the study aims to:

1. Detect movements inside the farm using motion sensor.
2. Take a snapshot on the video record that is displayed on the GUI by the control of Arduino.
3. Process the captured image in MatLab image processing application.
4. Determine if the moving object captured is an authorized personnel, intruder or crop-destroying animal by its color.
5. Trigger the alarm based on the detection.
6. Test the accuracy and reliability of the system.

Significance of the Study

This project can contribute a unique way of securing a certain place, particularly, farms. Based on some studies the proponents have read, the security for farms is only under surveillance of a camera, no alarming system [2].

We all know that in this country there are a lot of farm owners, a trusted security system is for sure what they want to ensure the safety of their land. That is why it is important to develop this study to enhance the security level of such places like farms.

This study will have a large impact on education because we all know that planting is a part of basic education. By the help of this study, the health of the crops that can be used for academic purposes will be longer because of proper security that could happen using the proposed system.

Security system with alarm mechanism is unusual because normally the existing security system for a particular place is only monitoring using a camera. What makes this study unique the image that is captured by the camera will be processed using MatLab image processing application to determine if the one who is entering the farm is valid, and if not, an alarm will occur right away by the control of the Opto-isolator until it is turned off, so that no harm can happen on the plants. The captured images will be placed on a certain folder to be fetched by the MatLab to process the image.

Scope and Limitation of the Study

The study includes image processing using an application that process the captured image to determine the identity of a certain object on the photo, whether it is an animal or a person who intends to enter the farm. There is a motion detector to be placed inside the farm. The proposed farm to be built is a closed environment so that the motion detector will be accurate on detecting some movements inside. If there is something moving, the programmed GUI in VB.NET by the proponents will screenshot the video displayed on the application. Those captured images will be placed on a certain folder to be fetched by the MatLab for the image analysis and pre-processing.

Images will undergo in some process in order to identify the moving object. The histogram of the image is one part; it is a graphical representation of the pixel's number in an image as their intensity function. Next is the image filtering, the linear filtering of an image is finished by an operation which is convolution. It is an area operation in which every yield pixel is the weighted aggregate of neighboring information pixels. The network of weights is known as the convolution bit, otherwise called the filter. Then the image binarization, the input image will be converted to a binary by thresholding, getting the image edges and eroded.

The concept of the image processing part is to detect if there was an intruder who entered the farm using a surveillance camera, it is determined by the color which is set by the developer. The image will undergo on some function in the image processing toolbox to come up with the desired result. If the color that is detected by the MatLab image processing application does not match the processed color of the photo captured, an alarm will trigger by the control of the Opto-isolator as the switch, it will be turned off by the authorized personnel who responded.

The prototype is supported by an alarm or a Piezo Buzzer that will trigger if the detection in the processed image is positive. In this case, the intruder or the crops destroying animal may panic and destroy the crops but at least they will be frightened and will go out of the farm.

The system is only capable of a single image process at a time. This means if there is an on-going process of the captured image; the system will stop taking snapshots of the video record until the system is done processing the photo.

The study will only takes place on a certain part of the school which is Lyceum of the Philippines-Laguna, the proponents and their colleagues of the related study will create a small farm to support the data and information that will be used on the study. The proponents only consider daytime monitoring for the accuracy of the detection due to the limitation of hardware specifications to be used in the system.

REVIEW OF RELATED LITERATURES

This section focuses on related literature, studies and the synthesis. The proponents gathered some references that would give them different ideas, perspectives and data in building up the study. By these studies, the proponents could think of a generous learning about creating inventive thoughts that would add to the study.

Based on the table of comparison, it can be seen that the research are done with the same goal which is security using different methods and efficiency. Therefore, the proponents decided to improve the security of the smart farm by implementing digitized and computerized monitoring standards since it has not yet been installed with any advanced security medium. Furthermore, the proponents designed a prototype that will monitor and detect the security of smart farm by capturing the image of the exact moment when something suspicious moves inside the farm. If the detection is positive, an alarm will trigger for the authorized personnel to respond.

On the review of the related literatures, some have the same approach on improving the security of a certain place and also they have differences on some process that they tackle for the security purposes. There are some that used alarm mechanism, some used image

processing, but there is no study yet that includes both intelligence in one system for the security of a farm. That is why the proponents came up with this kind of research because security is more efficient if detection using image processing is linked with the alarm mechanism.

CONCEPTUAL AND THEORETICAL FRAMEWORK

This chapter means to discuss the research process followed by the proponents in the development of Smart Farm Security System with Alarm Mechanism and Notification using Image Processing. This section includes the software and hardware to be used in the study and its process to come up with the desired result. It approaches the conceptual framework of the study as well as the theoretical.

Conceptual Framework

This research aims to develop a reliable security system for a Smart Farm which is to be formed in a particular part of Lyceum of the Philippines-Laguna. The system includes image processing by using MatLab, a major tool for image processing procedure. Figure 1 represents the high-level block diagram of the proposed system for more comprehensible procedures and Figure 2 is the methods of research used by the proponents.

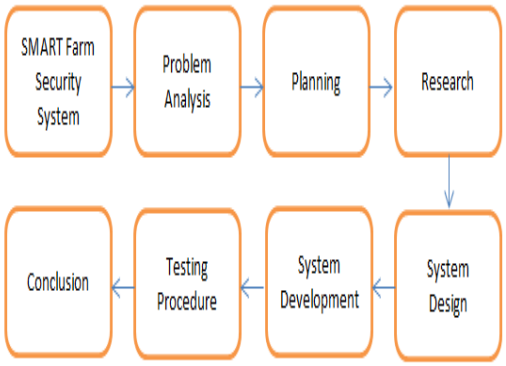

Figure 1. Methods of Research

Figure 1 shows the methods of research that is to be followed by the proponents to accomplish the system. First is to analyze the existing problem regarding the security of agricultural place. Next is to plan how to work and resolve the problem. Then do the research processes in order to increase the knowledge and ideas about the system. Next, design the system according to what is planned, then develop it based on problems that occurred. After that, do the testing procedures and come up with conclusions about the created system.

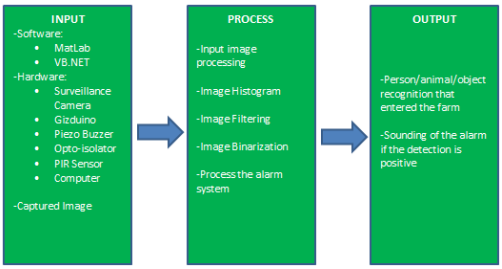

Figure 2. IPO Chart

The figure 2 above explains how the system works and the needs to make it work. The surveillance camera will transmit the video record to the computer server through Wi-Fi connection and will

be displayed on the GUI which is to be programmed in by the proponents. If the motion sensor detects movement, it will command the application to take a snapshot by the control of Arduino through Wi-Fi connection also. The captured image will be saved a certain storage file and will be used for image processing for detection purposes. If the system detects that there is something or someone unwanted in the farm, an alarm will trigger for the authorized personnel to respond.

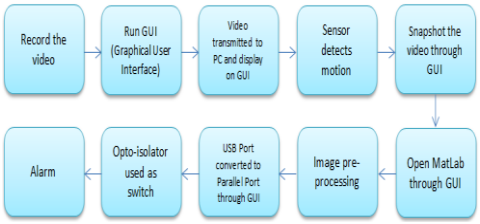

Figure 3. Block Diagram of the System

A part of the campus' vacant lot will be used by the proponents for the system to be implemented to be used in the study. The proponents will use a camera to record the video and to be transmitted to the main server and be displayed on GUI which is to be programmed by the proponents in Visual Basic.NET. If the sensor detects movement, by the control of Arduino Microcontroller the application will take a snapshot on the video and that image will be processed to monitor the condition of the farm. The proponents only consider daytime monitoring for the accuracy of the detection due to the limitation of hardware specifications to be used in the system.

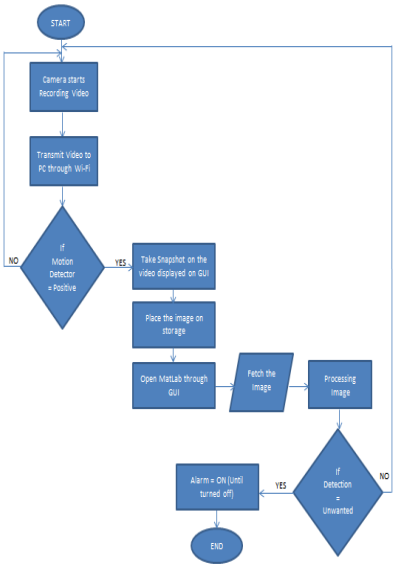

Figure 4. Flow Chart of the System

The figure above shows the flow of the system. If the motion detector detects something moving, the camera will capture the image. The image will be processed by MatLab for recognition purposes. If the system recognizes something unwanted in the farm, an alarm will sound until it is turned off and a notification will be sent to the authorized personnel for them to be aware on what happening in the farm. The camera will transmit the video record to the main server through Wi-Fi connection and will be displayed on the GUI which is to be programmed by the proponents. If the motion sensor detects movement, it will command the application to take a snapshot by the control of Arduino through Wi-Fi connection also. MatLab will be opened by the control of GUI and the captured image will be saved in a certain storage file and later will be fetched by the image processing application to be used for detection purposes. If the system

detects that there is something unwanted in the farm, an alarm will trigger for the authorized personnel to be aware.

Theoretical Framework

Gizduino (Arduino Clone)

A pre-amassed Arduino board incorporates a microcontroller which is modified utilizing Arduino programming dialect and the Arduino improvement environment. In quintessence, this stage gives an approach to construct and program electronic parts. Arduino programming dialect is a streamlined from of C/C++ programming dialect in view of what Arduino calls draws, which utilize essential programming structures, variables, and capacities. These are then changed over into a C++ program [13].

Arduino permits clients a basic pathway to make intuitive articles that can take contribution from switches and sensors, and control physical yields like lights, engines, or actuators. Since the dialect depends on very much utilized structures, Arduino can collaborate with other programming on the PC like Flash or even web APIs like Twitter.

Visual Basic.NET

Visual Basic was presented as the main programming dialect that backings programmable graphical client interfaces (GUI) utilizing dialect supplied objects. In 2002, there were other five renditions discharged in the business sector, each has diverse elements to expand the force level of the dialect. In 2001, Microsoft discharged the .NET stage; it is a redesign variant of Visual Basic that takes after the .NET stage. VB.NET permits developers to compose a Web or desktop application and programming with the same dialect; it is likewise completely protest situated as restricted earlier forms that backing the object-oriented dialect.

VB.NET is an object-oriented language that comprises of two basic parts. First is the visual part, it contains of objects sets and second is the language part which is made of a high-level routine programming language. These two elements were combined to create a different application which is usually seen inside the desktop.

MatLab Image Processing

MatLab is one application that has a superior language for specialized computing. It can be utilized for processing, picturing, and programming a simple to-use environment where the client can take care of the issues effortlessly, quick, and readably. It is additionally an imparting framework whose essential information component is a cluster which does not require any dimensioning on the framework. It is great in tackling network, vectors, or even a part to make the outcomes less complex and precise [14].

Toolbox for Image Processing gives a complete arrangement of reference-standard such as calculations, capacities, and application utilized for

picture preparing, examination, representation, and calculation improvement. It can perform picture investigation and in addition picture division, commotion lessening, picture upgrade, and a considerable measure of elements utilized for any picture exercises or strategies to get the fundamental article in the photograph. In utilizing this programming application, you should consider the determination necessities on your desktop on the other hand PC like multicore processors, GPUs, and C-code era to run the programming smooth and quick.

Toolbox for Image Processing supports different arrangements of picture sorts, including high dynamic reach, gigapixel resolution, installed ICC profile, and tomographic. In accordance with this perception capacity, it gives the clients a chance to investigate the picture, extricate the picture at its most extreme capacity and also recordings. Looking at the area of pixels, modify shading and differentiate, or make histograms and control the whole protest inside the application.

Image Histogram

The histogram of the image is a graphical representation of the pixel's number in an image as their intensity function.

Image Filtering

The linear filtering of an image is finished by an operation which is convolution. It is an area operation in which every yield pixel is the weighted aggregate of neighboring information pixels. The network of weights is known as the convolution bit, otherwise called the filter.

Image Binarization

In the binarization, the input image will be converted to a binary by thresholding, getting the image edges and eroded.

Surveillance Camera (CCTV)

Security cameras are a great approach to give security to your home or working environment. And in addition furnishing you with video footage of any occasions which may happen, they additionally go about as a noticeable obstacle to crooks. [26].

Motion Sensor

The feature of "motion sensing" on most lights is a system which is passive and detects energy that is infrared. They are known as PIR or passive infrared detector. So as to make a sensor that can determine a person, you have to make the sensor touchy to human body temperature. People, with a temperature of skin around 93 degrees F, transmit infrared vitality with a wavelength somewhere around 9 and 10 micrometers. Consequently, the sensors are regularly

touchy in the scope of 8 to 12 micrometers [27].

Piezo Buzzer

An device in electronics routinely used to make sound. Light in weight, clear improvement and low esteem make it easy to use in some applications like auto/truck pivoting pointer, PCs, call ringers et cetera. Piezo ringer relies on upon the inverse rule of piezo force found by Jacques and Mr. Pierre Curie. It is the miracles of making force when weight in mechanical is associated with particular materials and the other route around is in like manner substantial. Those materials are so called piezo electric. These materials are either really open or manufactured. Piezoceramic is class of engineered material, which stances piezo electric effect and is comprehensively used to make plate, the heart of piezo ringer. Right when subjected to a trading electric field they develop or pack, according to the repeat of the sign along these lines making sound [29].

Opto-isolator

An opto-isolator is a semiconductor gadget that uses an optical transmission shortly in a way to exchange an electrical sign between the circuits or components of a circuit, while keeping them electrically disengaged from each other. These parts are utilized as a part of a wide assortment of interchanges, control and observing frameworks that utilization light to keep electrical high voltage from influencing a lesser power framework accepting a sign [28].

Proposed Design

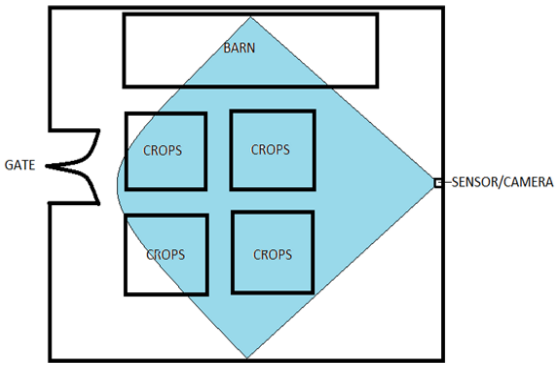

Figure 5. Proposed Layout

Figure 5 is a 2D layout of the proposed farm and explains that the camera/sensor cannot cover all the corners of the farm but can cover a wide range throughout the farm.

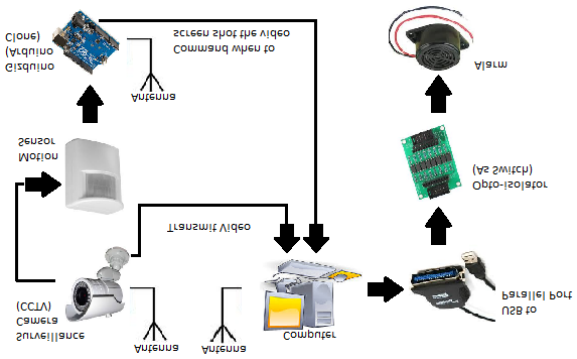

Figure 6. System Flow

In this research, the proponents aim to develop a system which will make the target location more secured. This study includes image processing to secure the Smart Farm that is to be developed. The image processing will help to detect the objects that can harm the crops or other equipment in the farm. If the detection is positive, an alarm will sound

for the person who guards the farm to be alert.

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