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Effective Crop Loss Assessment for Picture Based Insurance Claim

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Abstract
Farmers in India are having a lack of awareness and knowledge about the various agricultural-based insurances for their loss/damage to crops. In this paper, we are trying to identify a solution for this issue with a smartphone-based insurance automation system. Providing the right information to the formers and the regular follow up on the cultivation of the crop is the primary focus on the automation system. Apart from that, the claim for the crop loss or damage caused by the climatic changes has to be updated automatically to the insurance agents to make the formers get the insurance claims quickly and earlier. For the loss assessment, the pictures taken from the smartphones by the formers themselves are sufficient if they had followed the regular procedure for uploading the crop field pictures. The system is designed to keep the picture capturing protocol with high accuracy and formulated to estimate the amount of crop loss accurately through the smartphone captured images. Finally, the limitations are analyzed in line with alternative insurance approaches.

Keywords: *Crop Loss, PBI, Picture Capturing Protocol, Small-Holder Farmers*

1. Introduction

The ability to monitor crop development is critical for tracking and controlling agricultural activities. Remote sensing could be used in resolving this issue globally. But this kind of remote monitoring involves satellite imaging, which has the limitations of regular capturing of crop field pictures and will not be suitable for small area agricultural forming [2]. Crop damage events cannot be detected effectively with the help of spatial resolution satellite images. Also, this image information needs some additional data to fill the statistical gaps with high resolution, which are not available for public surveys.

Picture-Based Insurance (PBI) for crops bids a new approach of providing reasonable and easy-to-estimate crop insurance. Farmers can use their smartphone to capture the pictures of crop fields and upload for insurance claiming to minimize the costs of loss verification. Most of the smallholder farmers lack access to affordable insurance [1]. This is because their farms are comparatively too small and far away for insurers to verify the damage on insured crop fields. However, with the technological developments, insurance companies may not be interested to send an insurance agent to the spot to verify a farmer's claim. They could merely evaluate losses by processing smartphone pictures of damaged crops, taken by farmers themselves, as long as these pictures reliably document crop damage due to a natural tragedy and document that crops were managed properly until that event [6][7].

The limitation found with the Weather index-based Insurance (WBI) is its inability to detect the loss of crop in terms of quantity. This method can be applied only for the large scale farm areas and region-wise insurance claims. Crop damage can be viewed clearly through pictures captured from new smartphones. Farmers can afford a smartphone and able to take pictures of their crop fields [4]. If they take pictures at regular intervals, then the pictures are clearly stating the crop damages visible and quantifiable.

On the other hand, PBI is found more viable for a genuine insurance claim to the small crop fields. This approach can also be extended to large scale farm sectors. This approach will reduce the cost of verification by the insurance markets.

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2. Related Works

Porter et al. initiated the smart insurance claim system during the climatic changing seasons and disaster periods. They exposed the loss of smallholder farmers during such natural hazards to produce reliable identity documents for the insurance coverage and claims, which are very much limited with the manual inspection on the field [8]. The amount of insurance claim is comparatively small, and the actions cost much related with the loss assessment by deploying the manual verification to the crop field after the damage. Next, the Index based Insurance (IBI) came into play with the technological advancements which came up with the predetermined index for loss assessment resulting from the climatic events and weather forecast failures [11].

By determining the insurance payouts based on the IBI, the amount of rainfall or the average temperature-related forecast information couldn't help much in the to assess the individual fields [9]. This will be suitable only for the complete area assessment based on the location. This will not support the smallholder farmers to claim their damage to the small crop area. Hence the demand for the IBI based claim is not feasible for all levels of farming sectors.

Michal et al. described some of the truths about the demand for Micro-Insurance schemes for the betterment of small scale farming sectors. This aimed to assist the farmers in understanding the factors which determine the demand and need for the microinsurance products[13]. They have also produced some practical studies and assessments and reported on their research findings with proven examples and solutions [14].

Daniel et al. used the lab-based experiments to assess the valuations of insurances during the rainfall season. They attempted to prove the demand for a new form of insurance for the micro products and revealed that the mixture of pure insurance and savings related to Weather Insurance Savings Accounts (WISA) and suggested to introduce successful mixed insurance products for further researchers [9]. Insurance companies are given instructions to generate profits from the micro insurances under some circumstances. They proposed with a bright idea to demonstrate commercially viable and sustainable insurance schemes based on their case studies.

3. Pbi Application Design

Picture Capturing Protocol

PCPCam is an android based application for smartphones, which is designed to incorporate the necessary steps and procedures for the effective implementation of the Picture Based Insurance (PBI) process. Formers are given the training to capture a picture of their crop field using this application by the demonstration process given along with the mobile application [18]. The application allows the user to take a picture of the site at any random position and random angle covering the maximum possible area in the field. The user identifies that a random picture captured position, and the user has to take further pictures on the same position and angle on a regular basis. The repeated pictures can be taken two days once or twice a week based on the type of crop cultivated. The pictures taken during every stage of the growth should maintain the same position and angle by the smartphone camera, and the focus needs to cover the same maximum area of the field. For making this process easier for the formers, and the aided tool can be used for keeping the same camera position on the crop field. The fixed tool based stand can be kept fixed on the field and can support the formers to keep the smartphones on the stand to capture the PCPCam images.

The positioning of the smartphone camera can be made on the position and angle if the system is provided with a ghost image of the initial picture taken at the beginning. This will help the formers to capture the images as per the PCP protocols designed in the system. PCP protocol is designed in such a way to minimize the moral hazards and tampering of taken images. For this design, the users are advised to take pictures facing the north direction and 3 repeated pictures per week. This procedure will be followed throughout the entire season.

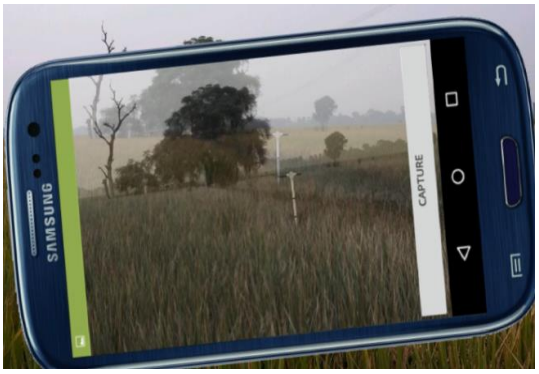

Figure 1: Visual aids for maintaining a fixed view

Ghost Image

The ghost image provided in the PCPCam application will be enabled once the camera is in OPEN mode. The image will consist of a transparent version of the initiative taken image as a mild view to allow the user to capture the further repeated images to be in line with the base image. This includes the static features and positions in the landscape of the picture. The pictures are taken in the same location identified and the same angle positioned with the supporting tool in the field. For more authenticity over the images taken, we integrate the google geo-tags along with the ghost images. The authenticated pictures with location tags are uploaded by the users into the server regularly. Hence the loss assessment is based on the continuous monitoring of the captured images from time to time. This system will not encourage the zooming snapshots of the damages crops as they can be tampered and misused.

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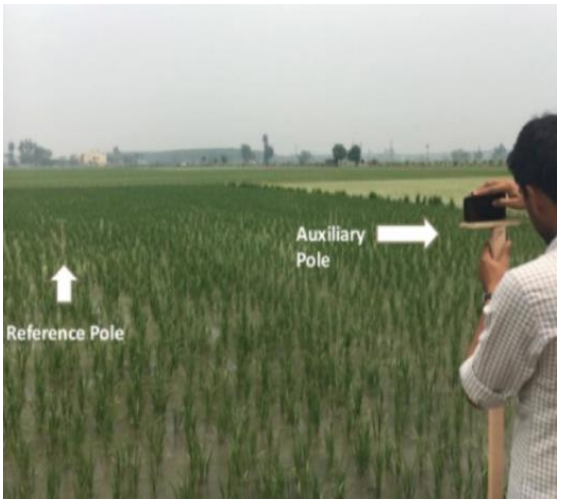

Figure 2: Reference and Auxiliary Poles

The auxiliary pole is serving as a tripod to keep the same position for the mobile phone to capture the repeated pictures. The reference pole is helping the user to keep the fixed reference point on the plot.

4. Pcp Integrated System Design

Our system is aiming to design efficient automated processing on captured images for loss assessment. Farmers are asked to take 3 repeated pictures between 10 am and 3 pm every day. They are instructed to take the pictures at the same location with the same north-oriented angle. For making the system more flexible and user-friendly, an android based application is developed for taking the geo-referenced image of the crop field.

The best way of reducing the blur effects in the captured images is by learning how to hold the smartphone camera stably without using any substance tool. The user of the camera has to hold their arms far away from their body as maximum as possible. This enables them to have more control when capturing pictures. Also, the users can keep elbows slightly away from the body in the sides, which can give extra stability for the capturing, like keeping the smartphone on a stable object. Users can also be provided with the tripod attachment to hold the mobile phones into it if the user is a beginner. The users are instructed not to zoom with smartphone cameras. Even though the smartphone is provided with an optical zoom option that captures the zoomed pictures without compromising the image quality, it is advised not to use the digital zooming for this application. This will lead you to lose some data in the captured images and reducing the quality of the picture with no way backward. Taking pictures without zooming provides more flexibility and the ability to modify the original with zoom in/ zoom out features.

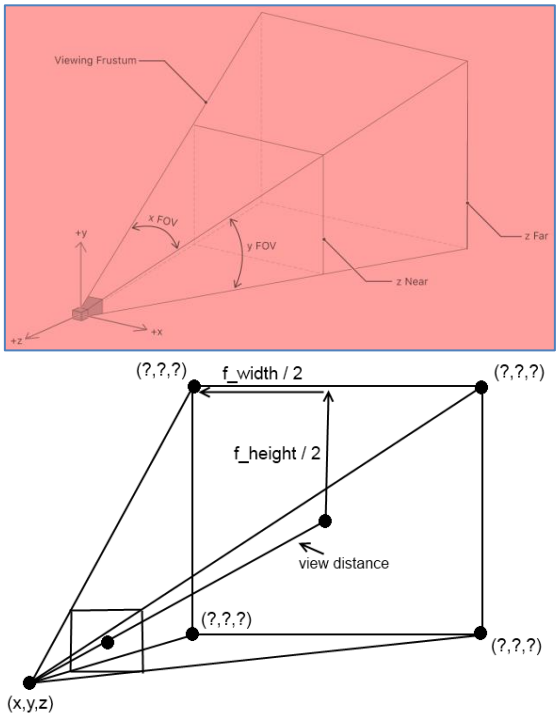

Figure 3: a) Ghost image captured Reference Frame b) Actual image acquisition Frame

The initial observation image is taken as the base image, which gives the benchmark for analyzing the subsequent images. Then the further image capturing can be done with reference to the initial image in relevance to the location. The design of the app is provided with the interactive map for checking the farmer's crop field position and the initial reference image taken location.
The system is designed to keep the picture capturing protocol with high accuracy and formulated to estimate the amount of crop loss accurately through the smartphone captured images. Finally, the limitations are analyzed in line with alternative insurance approaches.

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Figure 4: Sample images taken on the crop field with different position and orientation

Images of the crop fields have been captured by the farmers using their smartphone camera every day in a regular interval of time. The location of the image is referenced by the inbuilt function provided in the mobile app, is integrated with the camera. The reference frame could be adjusted with the beginning image taken during the start of the season [16]. This image in the reference can be fixed within the frame, and the reference image is displayed with the image acquisition frame as a skeleton reference. This reference image will help the farmers to correctly click the field image in the same position and in the same orientation. The newly captured image with the reference frame will be automatically processed for the final adjustment for the image clarity with the region of interest [21]. This helps to ensure an identical view of the captured frame throughout the season. The app is designed such that it can adjust the white balance in the captured RGB images and will produce the final image for the user to upload in the server along with the daily report.

5. GeoTag enabled Images

In order to ensure the originality of the pictures captured, which are going to play a vital role in damage claim from the insurance agency, the application is designed to automatically integrate the setting options of the smartphone camera to enable to add the location information. This will ensure the geographical identification of the claimed digital image where it was actually taken. The android camera application also has a manual setting, which enables the user to add GPS coordinates of the capturing image along with the image data file. For the active inclusion of such sensitive information along with the image data file, the application will automatically configure the additional settings in which the picture capturing mode is enabled on for PCPCam application.

Figure 5: Android device Setting option related to GeoTag information

In the setting options of the smartphone, choose to select the Location option, and tap to continue to see the

menu labeled as "Location and Security." Use GPS satellite option to place a remark next to the location identified. The Store Location in Pictures option, which enables the GeoTagging, gives further procedures as per your mobile phone operating system setup. These manual configurations are enabled automatically with the PCPCam application, and it allows users to acquire pictures without any further misleading to the forgery.

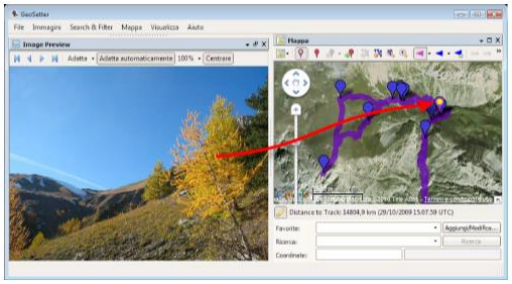

Figure 5: GeoTag identified Location Verification

6. Final Discussion

It is mandatory to keep all image data throughout the season for the practical loss assessment of the crop field. This image data is useful at the time of damage claim by the farmers during disasters and regular damages [20]. This could be evaluated from the images submitted on a regular basis, as reported in the server with the date, time, and location information. Loss assessment can be carried with a minimum of two captured images taken on consecutive days [12]. For a better assessment of the amount of damage, the nearby dated images have to be considered for the growth estimation. Minimum of 4 perfect images captured during the same period, usually in the same week of time, will be considered to identify the growth level of the crop during each stage.

7. Conclusion

In this work, the picture based Insurance approach has been taken to the further level with authenticated picture based claim verification. The insured product could be regularly monitored and verified with the relevant information uploaded in the server on a regular basis throughout the season. This approach reduces the cost of the workforce from the insurance agency to deploy a person to verify the growth of the crop in the field daily. This systematic approach also enables a standard low-cost index on the damage claim estimation without incurring much expert knowledge and opinion.

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