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AGRICULTURE CROP SECURITY USING IoT

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Abstract: We live in an exciting time where more and more everyday items "things" are becoming smart! "Things" have sensors and can communicate to other "things" and can provide control to more "things". The Internet of Things, IOT, is upon us in a huge way and people are rapidly inventing new gadgets that enhance our lives. The price of microcontrollers with the ability to talk over a network keeps dropping and developers can now build things inexpensively using the concept of IOT technology and also android mobile application. Main objective is all about protecting the farm from animals that causes lot of damages to the crops and also to financial status of farmers who depends completely on the yield of crop. The android mobile application helps for the better interaction with user and to access the data and manage the system.

Keywords: Agriculture Crop Security, IoT, SMD, Google Firebase

I. INTRODUCTION

The Internet of things (IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items-embedded with electronics, software, sensors, actuators, and network connectivity that enables these objects to collect and exchange data. It has the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society". The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. Experts estimate that the IoT will consist of almost 50 billion objects by 2020.

In 1995, "thing to thing" was coined by Bill Gates. In 1999, +IoT (Internet of Things) was come up by EPC global. The goal of IoT is bring out a huge network by combining different types connected devices. IoT targets three aspects Communication, Automation, Cost saving in a system. IOT empowers people to carry out routine activities using internet and thus saves time and cost making them more productive. IOT enables the objects to be sensed and/ or controlled remotely across existing network model. IOT in environmental monitoring helps to know about the air and water quality, temperature and conditions of the soil, and also monitor the intrusion of animals in to the field. IOT can also play a significant role in precision farming to enhance the productivity of the farm.

Smart connectivity with existing networks and context-aware computation using network resources is an indispensable part of IoT. With the growing presence of Wi-Fi and 4G-LTE wireless internet access, the evolution towards ubiquitous information and communication network is already evident. However, for the Internet of Things vision to successfully emerge the computing paradigm will need to go beyond traditional mobile computing scenarios that use smart phones and portables and evolve into connecting everyday existing objects and embedding intelligence into our environment. For technology to disappear from the consciousness of the user, the Internet of things demands: a shared understanding of the situation of its users and their appliances, software architectures and pervasive communication networks to process and convey the contextual information to where it is relevant, and the analytics took in the Internet of Things that aim for autonomous and smart behaviour. With these fundamental grounds in place, smart connectivity and context-aware computation can be accomplished.

A radical evolution of the current Internet into network of interconnected objects that not only harvest information from the environment (sensing) and interacts with the physical world (actuation/ command/ control), but also uses existing Internet standards to provide service for information transfer, analytics, applications, and communications. Filled by the prevalence of devices as Bluetooth, radio frequency identification (RFID), Wi-Fi, and telephonic data services as well as embedded sensor and actuator nodes, IoT has stopped out of its infancy and is on the verge of transforming the current static Internet into a fully integrated future Internet.

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II. PROBLEM SPECIFICATION

Problem Statement: The yielding crops are destroyed by the harmful animals such as monkey, buffalo, rabbit, pig, peacock etc., may cause serious damage to crops. They can damage the plants by eating plants parts or simply by running over the field and trampling over the crops. Animals even harm humans in the surrounded area. Farmer suffer from crop damage thereby he will get financial, economic and social damage, and his life will be miserable. Example, if seasonal crops like mango is been damaged, he will not be able to overcome from losses as he earns in that particular season.

Objectives

- The main aim is to prevent the loss of crops and protect the area from animals which causes major damage to the agricultural area.
- So our technical approach will be helpful to the farmers in protecting fields and save them from financial and economic loss.
- Use of these products prevents food grain damage there by increases nationwide crop production which improves import/export of food products.

III. REQUIREMENT ANALYSIS

Requirements Analysis is the process of defining the expectations of the users for an application that is to be built . It involves all the tasks that are conducted to identify the needs of different stakeholders. Therefore requirements analysis means to analyze, document, validate and manage software or system requirements *System requirements: When a software is purchased for a computer, one should first make sure that computer supports the system requirements. These are the necessary specifications that computer must have in order to use the software. Functional Requirements: Functional requirements describe system behavior under specific conditions and include the product features and functions which web & app developers must add to the solution.

Non –Functional Requirements: Non-functional requirements are requirements that specifies criteria that can be used to judge the operation of the system, rather than specific behaviors.Functional requirements define what a system is supposed to do whereas non-functional requirements define how a system is supposed to be. The non-functional requirements are the constraints or the environment in which the software is developed.The different non–functional requirements are listed below:

*Timeliness:In the web application, the alarm rings at scheduled time and day.

*Reliability:The system should be reliable.

Software requirements: Programming Language used: Kotlin, Xml, HTML and CSS, Kotlin in Android Studio, Operating System: Windows 10, BackEnd: Firebase.

IV. DESIGN AND IMPLEMENTATION

High level design (HLD) explains the architecture that would be used for developing a software product. The architecture diagram provides an overview of an entire system, identifying the main components that would be developed for the product and their interfaces. The HLD uses possibly nontechnical to mildly technical terms that should be understandable to the administrators of the system. High level design is the design which is used to design the software related requirements. In this chapter complete system design is generated and it contain the SMD app , web application and database. A. System Architecture: Figure 1 represents the system architecture. The user interacts with the android application. The android application is connected and synchronized to the database. This database is also connected to the web application. Therefore both the anroid and web application have the same database.

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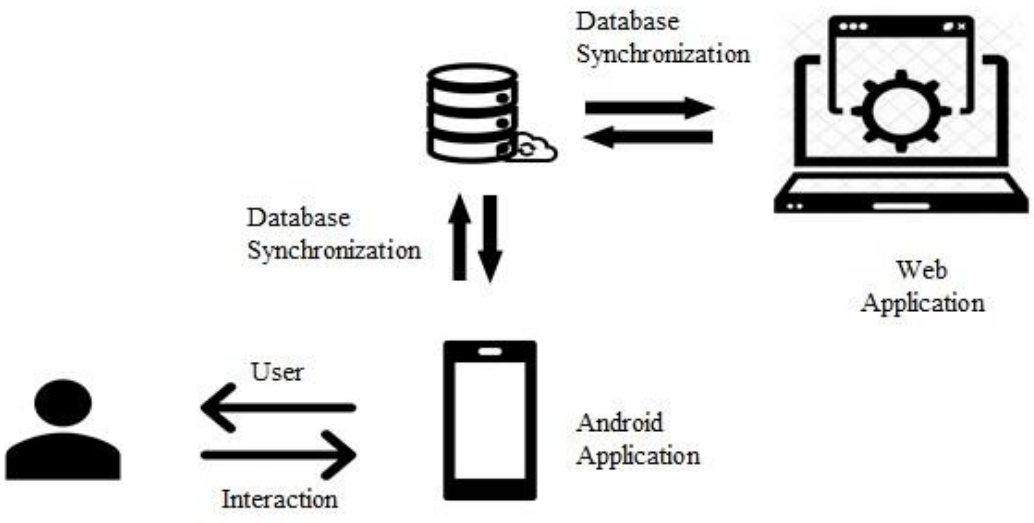

Fig 1: SMD Architecture

A. Firebase as Database

1)Firebase is a backend platform for building Web, Android and IOS applications. It offers real time database, different APIs, multiple authentication types and hosting platform. Firebase can power your app's backend, including data storage, user authentication, static hosting, and more. Focus on creating extraordinary user experiences. We will take care of the rest. Build cross-platform native mobile and web apps with our Android. You can also connect Firebase to your existing backend using our server-side libraries or our REST API.
2)Firebase Features: Real-time Database − Firebase supports JSON data and all users connected to it receive live updates after every change, Hosting − The applications can be deployed over secured connection to Firebase servers.
3)Firebase Advantage: It is simple and user friendly. No need for complicated configuration., The data is real-time, which means that every change will automatically update connected clients, Firebase offers simple control dashboard, There are a number of useful services to choose.
4)Firebase Limitation:. Firebase free plan is limited to 50 Connections and 100 MB of storage.

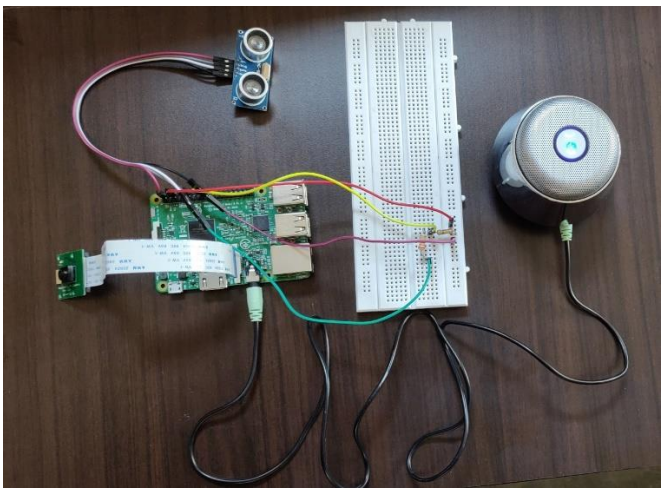

Fig 2: System Implementation

B. Connections

The US Sensor Working Voltage are 5V, ranging from 2cm-500cm with resolution of 0.3cm which outputs the frequency of 40KHz, twice the frequency the human ear can hear. The US Sensor has 4 pins that are Vcc, Trigger, Echo, Ground. Vcc is Connected to the 5v Pin in the Raspberry Pi, Ground connects the Ground pin, Trigger activates the sensor that need to be connected to the GPIO Output pin, whereas Echo Returns the Signal which must be read by the GPIO input pin.

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Here is how it works, a 10ms high pulses send from the Raspberry Pi to the Sensor. This Signal produce an asyclesonic burst at 40KHz. When the sensor hear the echo it determine the time between Producing the burst and Receiving. To communicate this back to the Raspberry pi it sends 1 high Pulse for the length equal to how long it took to hear the echo, So the length of the pulse is proportional to how far the object is and then listen to the echo pin.

We have to calculate the distance between the sensor and some object. The pulse will travel at some distance d to the object and distance back to the sensor. So when we use the equation for speed, the distance would be 2d that is Speed = Distance/Time

The camera consists of a small (25mm by 20mm by 9mm) circuit board, which connects to the Raspberry Pi's Camera Serial Interface (CSI) bus connector via a flexible ribbon cable. The camera's image sensor has a native resolution of five megapixels and has a fixed focus lens. The software for the camera supports full resolution still images up to 2592x1944 and video resolutions of 1080p30, 720p60 and 640x480p60/90.

C. Implementation steps

Step 1 : Connect the US sensor to raspberry pi through bread board with the help of resistors.
Step 2: Implement the code for calculation of distance and decide with the maximum distance, so that if animal crosses that distance alert can be generated.
Step 3: Connect the raspberry pi camera to the raspberry pi.
Step 4: Connect the speaker to the raspberry pi.
Step 5: Now implement the code so that captured image is stored in the local memory later uploaded to the firebase.
Step 6: When the alert is generated, the code is implemented so that the current date and time, and the distance of animal from the US sensor is sent from raspberry pi to the firebase real-time database at the same time the roaring sound should play on the speaker.
Step 7: From the firebase the data is retrieved to the mobile application.
Step 8: The user should be provided with authorized user id and password.
Step 10: After the successfully login, the list of attacks is shown.
Step 11: By clicking on each attack id, the complete details is shown with the image from the cloud storage.
Step 12: Search code is implemented with the date range given by the user.
Step 13: And also the user is provided with the logout facility.

D. Flow diagram

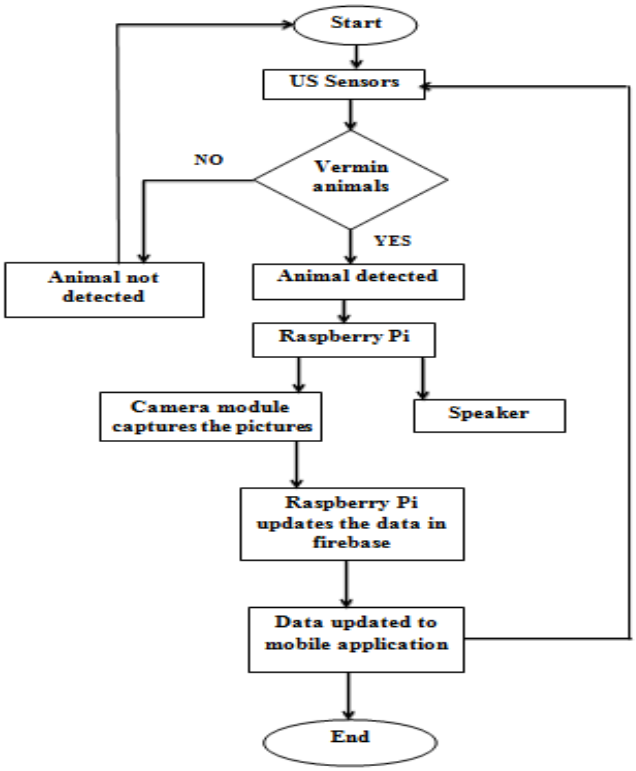

Fig 3: Flow Chart

The process starts as soon as the Vermin animal comes to the farm. If the animal comes in contact with the US Sensor the animal will be detected, else the animal will not be detected. If the animal is detected then US sensor sends the

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message to the Raspberry Pi , and immediately the Raspberry Pi send the message to the Raspberry Pi Camera Module which captures the image of the animal. The Raspberry Pi also triggers the speaker which generates roaring sound of tiger to scare away the animals. The Raspberry Pi Camera Module then takes the picture of animal and update the image to firebase, then the image taken is updated to the Mobile Application

V. RESULTS AND ANALYSIS

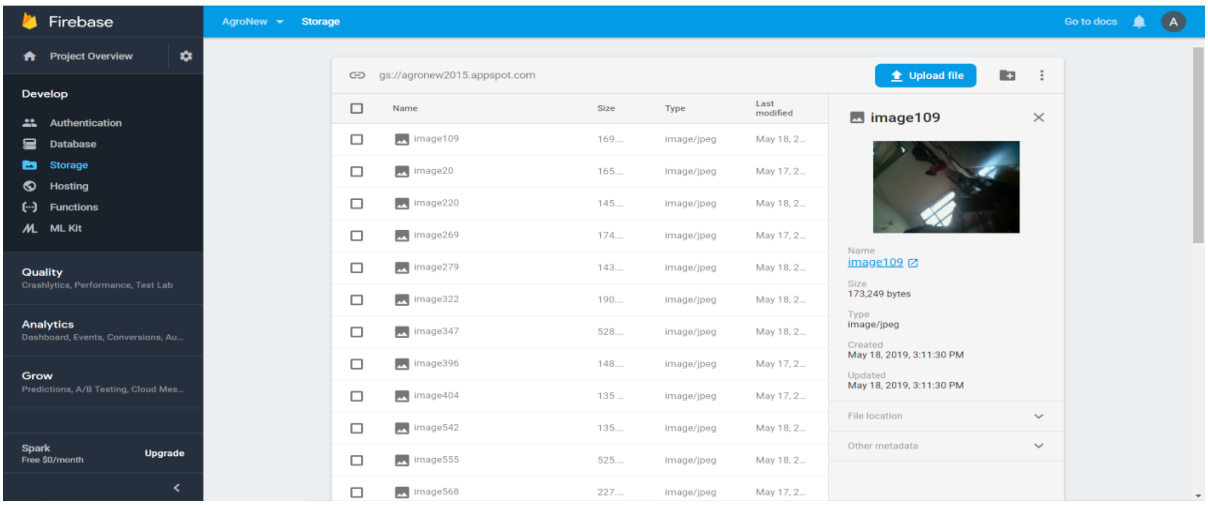

Fig 4: Firebase Cloud Storage

The images from Raspberry pi stored in cloud storage and this is retrieved by using unique url address this is shown in fig 4.

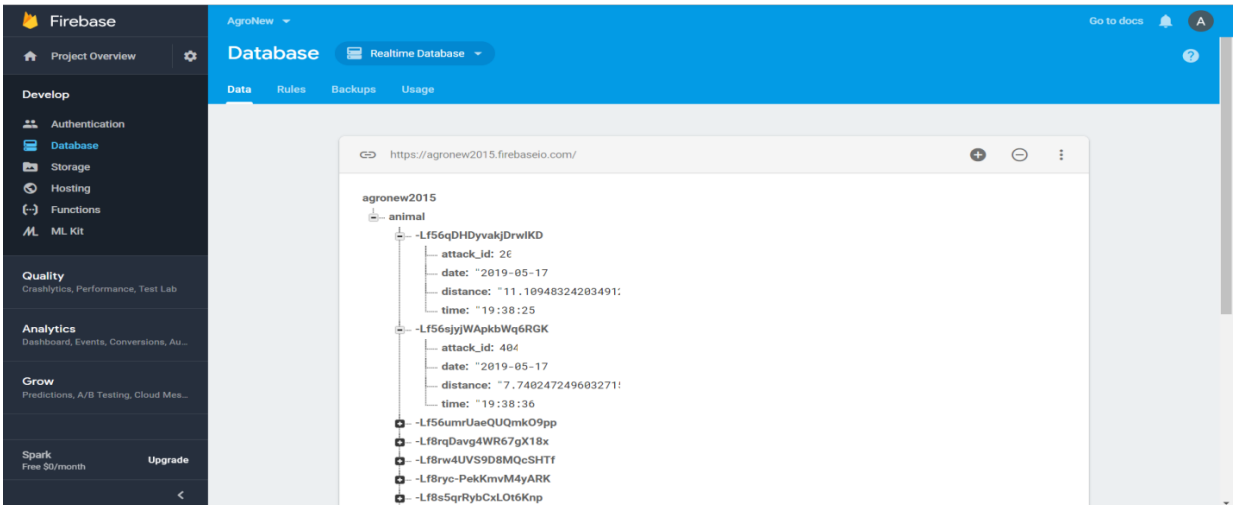

Fig 5: Firebase Database

The data is stored in the firebase in the form of tree; this is shown in fig 5.And later this is retrieved in the application and shown to the user.

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Fig 6: Login Page

The figure 6 is login page, user has to login by using authenticated credentials.

Fig 7: Attack List

The figure 7 shows the list of attack happened in the farm with few details that is date, id and time.

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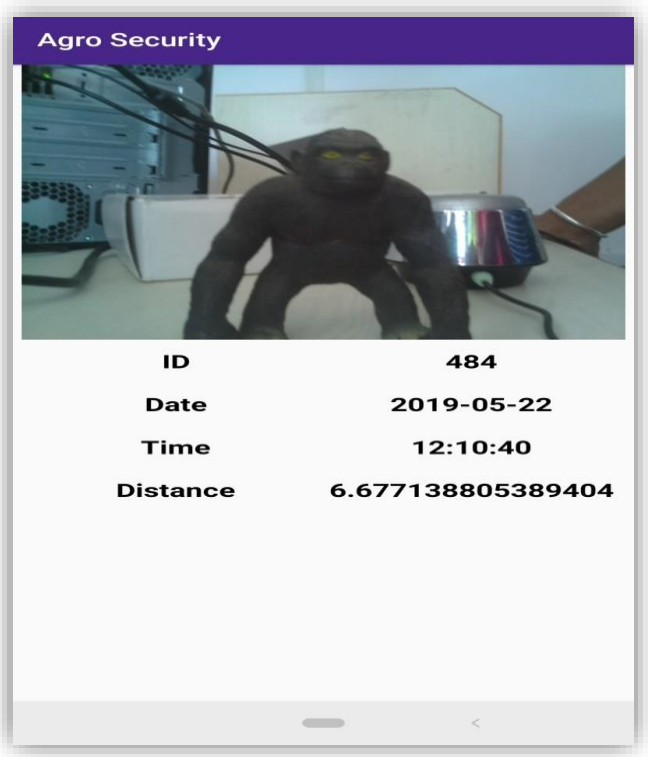

Fig 8: Attack Details

The figure 8 shows the complete details of the attack lists which has captured image and distance.

Fig 9: Search Page

The figure 9 is the page where we can search the lists of attack happened in a particular date.

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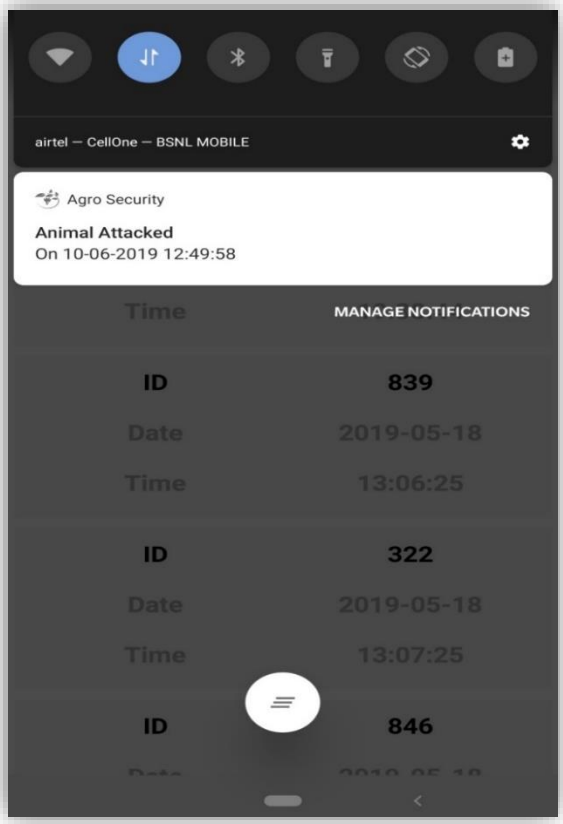

Fig 10: Notification

As shown in fig 10 when a attack occurs a notification is sent to user through the mobile application.

VI. CONCLUSION

Internet of Things has enables the agriculture crop monitoring easy and efficient to enhance the productivity of the crop and hence profits for the farmer. Our project mainly is developed for farmers who are suffering from serious threats by animals. Internet Of Things and mobile application technology helped us in achieving our objective. Artificial tiger model can be implemented. We can use this model without internet connectivity using Zigbee, NodeMCU, and RaspberryPi. Using RaspberryPi camera module, we can implement image processing by recognising animal face and capture the image. Object detection functions can be used. It uses the captured image and detects objects present in them like person, animal with distance between them. Also we can send the notification to user the moment animal is detected.

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