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Agriculture Drone Model with Zigbee Network

B.V. Rama Krishna[1]

Research Scholar, Dept. of CSE, Acharya Nagarjuna University, Guntur, India[1]

ABSTRACT: One of the major sectors adopting new technologies rapidly in India is Agriculture. The innovations in Electronics developed smart devices to handle high quality digital data with quality of service. In this paper a model developed to create application oriented Drone to assist Agriculture sector. The proposed model modules and functional elements are overviewed in this paper. Zigbee network chosen for this model since it establishes fast network between electronic data transmission devices which is reliable and cheaper. The model supports many services related to agriculture and provide reliable information to portable hand held devices with efficient time and cost saving. A comparative study performed over traditional Agriculture services and proposed system service over Quality of Service.

KEYWORDS: Agriculture, Crop, Drones, Quality of Service, Sensors, Smart Devices, Wireless, Zigbee.

I.INTRODUCTION

Majority of industries depends on products of agriculture and allied sources. The improvement in technology is essential to yield high crop rate. Due to the migration of village people to cities and increased Industrialization farms are facing labour problem [3]. The implementation of agriculture farming vehicles with robotic controllers reduced environmental impact over crop productivity [1]. Multi-platform oriented autonomous robots designed to perform the goals independently in farms [8]. The utilization of high quality digital cameras in agriculture robots collects rich information about environment and crop growth [9][5]. Drones are light weight mobile electronic vehicles specifically collects information using Ariel surveys. Research is going on utilization of drones in real time environments [10][11]. The application of automated robots for fertilizer supply and pest management activities improving the productivity keeping environment states safely [2][10]. Many types of robots introduced to agriculture sector to perform wide range of activities from sowing to weeding reducing labour utilization rate with increased yield rate [4]. The CAD (Computer Aided Design) and CAE (Computer Aided Engineering) technologies supported with virtual prototyping, validate oriented design and geometrical models supporting the innovative agriculture robot design [7]. The utilization of microprocessor based controllers into agriculture instruments supported many digital devices interaction with these heavy instruments [2][5][10]. The land surveying, monitoring drought or flood affected zones using Infrared photography is in use by developed countries [6]. The designed robots can be controlled using autonomous, Tele and remote control mechanisms [6]. In this paper a special Drone (Electronic Surveyor) model architecture developed to assist Agriculture fields monitoring activities. These light weight and robust vehicles collect valuable information from agriculture crop lands.

II.ZIGBEE SYSTEM

Zigbee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection. The Zigbee network support both control and monitor services with complete user friendly interfaces. It supports best frequency bands to digital data transmission services. The long battery standby (9Hrs-10Hrs) and long life (100 days to 7,000 days) makes it as best choice for remote based wireless data device networks. The data transmission rate is low 250Kbps since it establishes communication with smart phones and laptops with limited data transfer among mobile apps this rate is satisfactory. The power of Zigbee lies in its allocation of nodes per network

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unlike Wi-Fi and Bluetooth it supports around 65000 nodes per network. Hence, Zigbee is a low-power, low data rate, and close proximity (LAN) wireless ad hoc network. The features of Zigbee are listed below in Table 1.

Table 1: Zigbee System Characteristics

TECHOLOGY	DISCRIPTION
PAN (Personal Area Network)	Used within 10-150 meters with low power consummation.
Security	128-bit key based symmetric encryption for data.
Data Transfer Rate	256Kbps good for electronic device communications.
High band width	2.4 GHz with wide network topologies.
Globally Standardized	IEEE ratified (IEEE 802.15.4)
Network Layer	Optimal Routing Algorithms

III.AGRICULTURE DRONE MODEL

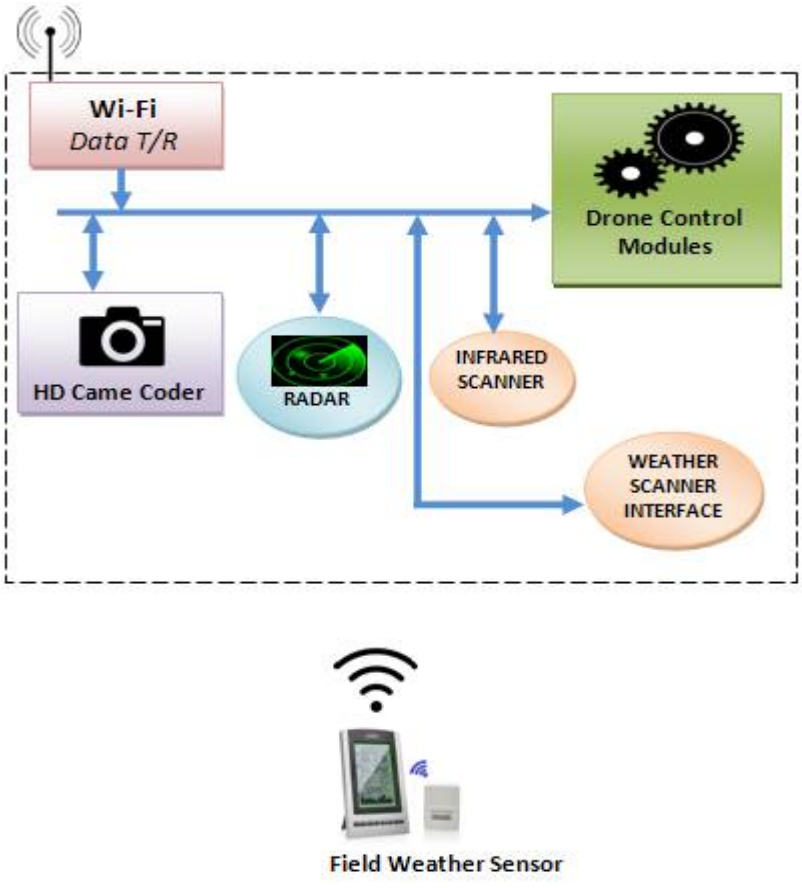

Fig 1: Agriculture Drone Model

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Agriculture Drones are special purpose drones intended to assist farmers and agriculture officers I field monitoring and information collection activities. The block diagram of ADM (*Agriculture Drone Model*) has shown in Figure 1 and Circuit block diagram of ADM shown in Figure 2. The functional modules are as follows

Wi-Fi Data Transmitter and Receiver (T/R):
Zigbee network based Wi-Fi device used to support digital data transmission and receiving among smart systems to drone. Supports interfacing with smart phones, Tablets and Laptops with good data rate of transfer 1Mbps. The coverage of Zigbee network is limited (100-150 meters) but supports wide range of data transmission schemes. Since drone are movable and equipped with high storage media and not intended to online data transmission this network is well suited. The Digital Soil Monitoring Sticks (DSMS) are placed over agriculture fields provides soil statistics on demand by ADM when it covers those zones.

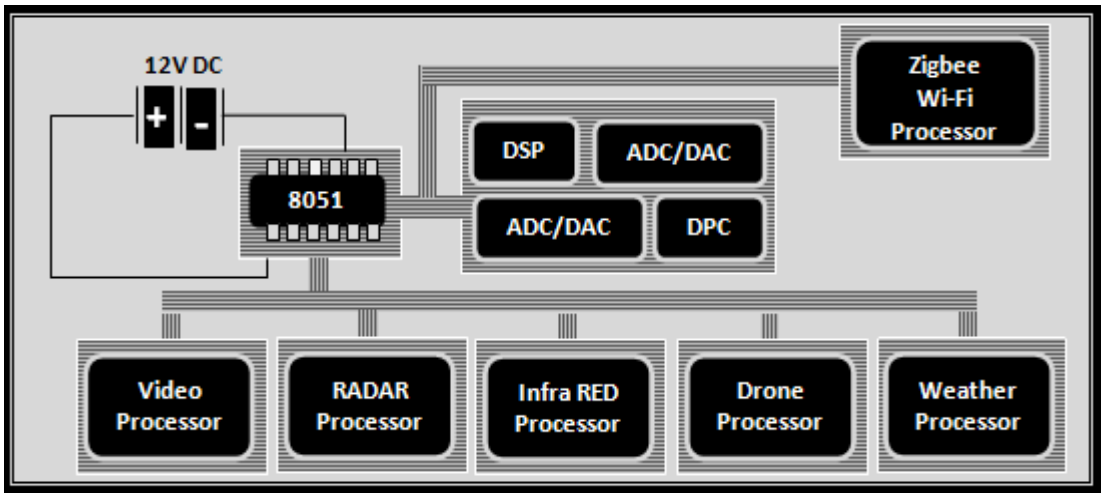

Fig 2: Agriculture Drone Model Block Circuit Diagram

HD-Cam Recorder:
The field monitoring includes video capturing and snapshots of interesting crop zone patterns. Selection of camera depends on the drone functionality since ADMs also used to monitor the crop zones during night time also Night-Vision supported HDMI cameras are used in this model. The internal storage media should support at least 4 hours of continues recording of videos. This module controlled by Drone Control Modules (DCMs). The special Digital Image Processing module of DCM supports more options for video/image controlling.

RADR:
RDAR module of ADM uses ultrasonic waves to pest monitoring. The SONOGRAMs generation and manipulation facilities are supported with micro-controller programming. The Zigbee system facilitates functions to handle this system of drone.

INFRA-RED Scanner:
The Infra-red technology used to capture details of crop-growth, insect manoeuvre and Land surface scanning. The module controlled by DCM

Field Weather Sensor:
A stick like device used to track the soil humidity, dampness and climatic metrics on demand. The ADM control module extracts these metric statistics when it covers those sensors with wireless signals. The information recorded by drone can be shared with smart handheld devices.

Drone Control Module:
The core module is responsible for guiding and controlling ADM. Collection of Sensor control modules, ARM module and Signal processing modules tailored into a micro program to control ADM functionalities. Drone control module

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helps to calibrate and consolidate agriculture services offered by it. The Zigbee system module is the core for drone network establishment and communication.

IV. AGRICULTURE DRONE EUIPMENTS

The Agriculture Drone supports with built-in electronic sensory equipments to support several agriculture field inspection services. The latest equipment and technical properties are specified in Table 2. The drone supports VGA/HDMI video recording facilities to auto switch according to the resolution needed to capture video. The two modes Night vision and Panoramic used to capture visuals in night time, day light with optimal resolution. Supporting 360º of rotation gives flexibility for sensitive capturing of video during motion of drone. The selection of data storage media should be chosen such that it can assist drone up to 4 hours minimum. Memory sticks/Cards are best as they are considerably very light weight with high capacity (8GB-32GB) of storage. The data transmission and signal receiving done through wireless media, Zigbee network used for this special drone. The Zigbee network components are lightweight and support modern smart device interfacing. Also we can use Wi-Fi dongles to assist but they do not support inbuilt smart device interfacing. Zigbee system minimizes the done control program complexity.

Table 2: Agriculture Drone Equipment Characteristics

EQUIPMENT	Technology	
VIDEO RECORDER	VGA/HDMI (350×750 to 1080×1080)	
	Night Vision/Panoramic	
	360º Rotation	
	4-6 Hours recording Capacity	
WIRELESS TRANSMITTER	2.4GHz- 3.8GHz	
	High-Speed Data	
	Mobile Device Interfacing	
ULTRASONIC R/T	1.4MHz to 2.6 MHz	
	Sonogram Filtering & Booster	
Wi-Fi VIDEO R/T	2.4GHz to 3.65GHz	

V. ADM DATA TRANSMISSION SCHEMES

The ADM (Agriculture Drone Model) supports encryption oriented data transmission. Data can be distributed Bi-directional with authentication services. The topologies adopted can be Star, Mesh or Ring but mesh topology widely

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used for swarm based communication establishment among large number of Drones. The data encoding schemes supported by Zigbee system enables latest encoding schemes to handle digital and analog data efficiently. The inbuilt devices filter and amplify the analog signals to support high rate digital conversions.

VI. ADM Vs TRADITIONAL

A comparative analysis performed over traditional human based agriculture services and ADM services. Figure 3 represents the results over the factors like cost and accuracy in contrast to time. It is clear that ADM maintained good accuracy as well as low cost in providing agriculture field based services. The modern technology utilization reduced labour but need some knowledge in handling these electronic devices which need minimal effort by the farmers of modern society.

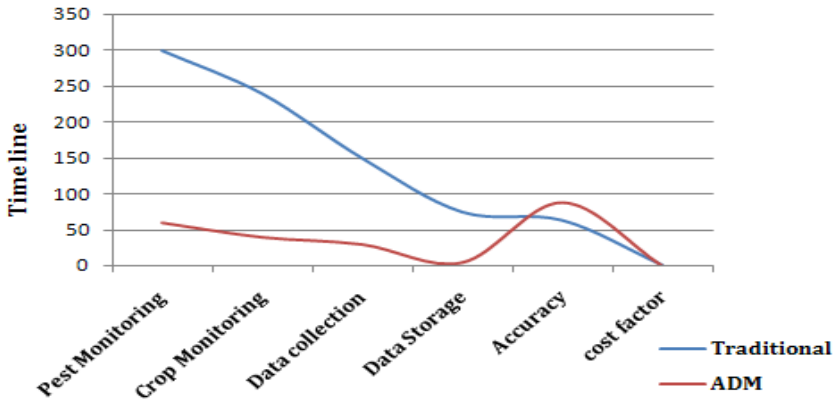

Fig. 3 Traditional Vs ADM

$$Quality\ Of\ Service = \frac{Overall\ System\ Performance}{Individual\ module\ Performance}$$

$$ADM\ QOS = 92.3434\ \%$$

$$Traditional\ QOS = 58.1122\%\ to\ 64.3312\ \%$$

The QOS factors states that ADM services are maintaining better performance in quality compared to traditional human based services. There is an increment of 34.231% quality in services which can be further enhances by applying novelistic drone routing mechanisms.

VII.CONCLUSION

The application of ADM in agriculture crop fields proved to be an increase in accuracy during data collection and information processing over transmission media. The enhancement of existing Drones with minor inclusions of Zigbee system improves the mobile communication facilities among smart phones, Wi-Fi based Laptops. The proposed model needs some area coverage strategies. The Quality of Service shown increase in performance and reduced time complexity. The application of ADMs assuredly reduces the labour investments in agriculture sectors.

It provides greater flexibility to Indian farmers to overcome labour cost factor during cultivation of crops. The smart device interfacing facilities supported by ADM drone enables interactive co-ordination with various government supported agriculture service sites. In future we are going to implement this model in real-time and research how this drone helps in field data processing with the assistance of Information Retrieval Systems.

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BIOGRAPHY

Author currently pursuing Ph.D. (CSE) from Acharya Nagarjuna University. His areas of interest are *Data Mining*, *Cloud Computing* and *E-Commerce*. He was the author few journal publications and books related to Information Technology. He is working as Associate Professor in CSE-department in a reputed Engineering College.