Development of IOT Based Smart Security for Agriculture

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Abstract- *Agriculture sector living the backbone of the Indian economy deserves security. Security not in terms of resources only but also agricultural products needs security and protection at very initial stage, like preservation from attacks of rodents or insects, in fields or grain stores. Such challenges should also be taken into consideration. Security systems which are being used now a days are not smart enough to provide real time alert after sensing the problem. The integration of traditional methodology with latest technologies as Internet of Things and Wireless Sensor Networks can ahead to agricultural modernization. Keeping this scenario in our mind we have designed, tested and analyzed an 'Internet of Things' based device which is capable of analyzing the sensed information and transmitting it to the user. This device can be controlled and monitored from remote location and it can be implemented in agricultural fields, grain stores and cold stores as long as security purpose. This paper is oriented to accentuate the methods to solve such problems like identification of rodents, threats to crops and delivering real time declaration based on information estimation and processing without human intervention. In this device, mentioned sensors and electronic devices are integrated using Python scripts. Based on attempted test cases, we were capable to achieve success in 84.8% test cases.*

Keywords—*Internet of Things (IoT); Agriculture; Security; Raspberry Pi; Sensors; Wireless Sensor Network (WSN);*

I. INTRODUCTION

Over the past years information and communication technologies have been introduced in agriculture, improving food production and transportation[1]. However the integration of these technologies are not yet used for security purpose. The significant challenge facing the security in agriculture is the interaction between security devices and to provid them intelligence to control other electronic devices such as cameras, repellers etc to enhance security in various fields. For example, a basic CCTV camera installed in a grain store cannot be of use until recorded media is accessed and it also cannot process the information about what is happening at particular location. In implementation and adoption of information and communication technologies, cost is also a major factor. It is not easy to achieve exchange of information among devices and upgrading their functionality while keeping their cost to a reasonable level . So, the natural conclusion is that the security and monitoring systems must be responsible for transmitting data over network, analyzing the information and notify the user with real time information of surroundings. This lack of information transmission and data analyzing has been "solved" by integration of internet of things with currently available security devices in order to achieve efficient food preservation and productivity. Although the food crop loss and debilitation of diseases are due to various threats as rodents, pests, insects and grain pathogens, while this research is the designing and analyzing of security device, considering damages to post harvest crop by rodents and grain stores as applicable area. In the context of Smart Security and Monitoring System for Agriculture (S2MSA), we address the challenge of integrating Internet of Things with electronic security devices and systems to improve the efficiency of food preservation in grain stores.

INTERNET OF THINGS:

Kevin Ashton in 1999 proposed the term "Internet of Things" to refer inter connected devices. It's a major tech revolution in information and communication technology with updated infrastructureand networks where all the connected devices are able to identify and communicate with each other . According to Gartner, in near future, about 25b identifiable devices areexepected to be a part of this computable network by year 2020 . Thus, agriculture can be a vast area to integrate Internet of Things with distributed autonomous sensors to monitor environmental condition of grain stores and to analyze data and pass the information to remote user.

WIRELESS SENSOR NETWORK:

Wireless Sensor Network abbr. WSN is a distributed collection of small devices, capable of local processing and wireless communication. As the implementation of wireless communication technologies in industrial areas are necessary due to inaccessibility to remote location at everytime, to transmit the informations generated by sensors along with controlling them. So, to achieve interoperability between devices in industrial areas, design and implementation of wireless communication system is done. The structure of report is as follows. In Section II the literature review, includes theoratical contribution and analysis of current security devices and technologies. Section 3 discusses the Research and developement methodology of device in 978-1-4673-8203-8/16/$31.00_c 2016 IEEE 597which we present our architecture and design modules and the data transmitted between them. Section 4 presents example on how our device operates and the statistics of efficiency. Finally, Section 5 concludes the paper.

HARDWARE REUIREMENT:

1. PIC MICROCONTROLLER
2. PIR SENSOR
3. ULTRASONIC SENSOR
4. TEMPRATURE SENSOR
5. MOISTURE SENSOR
6. LCD DISPLAY
7. GPRS MODEM

SOFTWARE REQUIREMENT:

1. MP LAB----(CONTROLLER SIDE)
2. JAVA----(ANDROID APP)

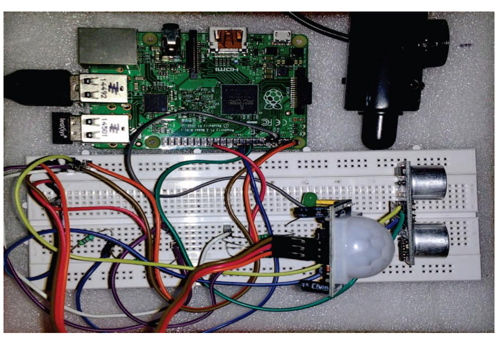

Figure 1. Hardware

II. PIC MICROCONTROLLR

The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC placed microcontroller fabricated in CMOS (complimentary metal oxide semiconductor) that uses separate bus for instruction and data grant simultaneous access of program and data memory. The main advantage of CMOS and RISC combination is low power consumption resulting in a very cramped chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques.

PIC (16F877):

Various microcontrollers offer different types of memories. EEPROM, EPROM, FLASH etc. are some of the memories of which FLASH is the most recently developed. Technology that is used in pic16F877 is flash technology, so that data is reserved even when the power is switched off. Easy Programming and Erasing are other features of PIC 16F877.

PIC START PLUS PROGRAMMER :

The PIC start plus development system from microchip technology produce the product development engineer with a highly flexible low cost microcontroller design tool set for all microchip PIC micro devices. The pic start plus development system inserts PIC start plus development programmer and mplab ide. The PIC start plus programmer gives the product developer ability to program user software in to any of the supported microcontrollers. The PIC start plus software functioning under mplab provides for full interactive control over the programmer.

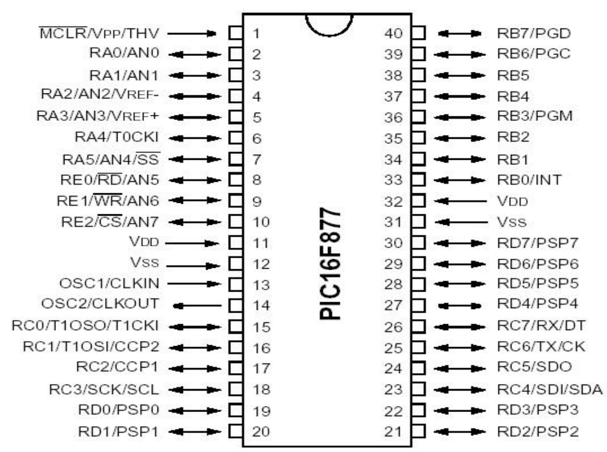

Figure 2.

III. CORE FEATURES

- High-performance RISC CPU
- Only 35 single word instructions to lread All single cycle instructions except for program branches which are two cycle
- Operating speed: DC - 20 MHz clock inpu DC - 200 ns instruction cycle.
- Pin out compatible to the PIC16C73/74/76/77
- Interrupt capability (up to 14 internal/external
- Eight level wide hardware stack
- Direct, indirect, and relative addressing modes
- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)

- Watchdog Timer (WDT) with its own on-chip RC Oscillator for predictable operation
- Programmable code-protection
- Power saving SLEEP mode
- Selectable oscillator options
- Low-power, high-speed CMOS EPROM/EEPROM technology absolutely static design
- In-Circuit Serial Programming (ICSP) via two pins
- Only single 5V source needed for programming capability
- In-Circuit Debugging via two pins
- Processor read/write access to program memory broad operating voltage range: 2.5V to 5.5V
- High Sink/Source Current: 25 mA

Commercial and Industrial temperature ranges Low-power consumption:

< 2mA typical @ 5V, 4 MHz
20mA typical @ 3V, 32 kHz
< 1mA common standby current

PERIPHERAL FEATURES:

Timer0: 8-bit timer/counter with 8-bit prescaler

Timer1: 16-bit timer/counter with prescaler, can be incremented at the time sleep via external crystal/clock

Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler Two Capture, Compare, PWM modules Capture is 16-bit, max resolution is 12.5 ns, analyze is 16-bit, max resolution is 200 ns, PWM max. resolution is 10-bit

10-bit multi-channel Analog-to-Digital converter

Synchronous Serial Port (SSP) with SPI. (MasterMode) and I2C. (Master/Slave)

Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9- bit address detection.

Brown-out detection circuitry for Brown-out Reset (BOR)

IV. LITERATURE REVIEW

For developing an intelligent security device based on IoT, M2M framework, sensor network and database management are the foundations. The fields like data analytics and pattern matching also influences security devices. Researchers have been developing various IoT based security devices but a little work is done in agricultural area. According to previous research in crop's security, developing countries, which are using traditional storage facilities for staple food crops, can't protect them, leading to 20- 30% loss of agricultural products such as rice, corn etc. Currently available solutions targets only insects, pests and grain pathogens. While other study states 5 to 10% loss in rice crops on average, in Asia is due to damage caused byrodents.These rodent impacts are also associated with the debilitating rodent borne diseases. As in Asian and Pacific countries death rate due to rodent borne diseases is higher in comparison with some illness such as HIV-AIDS Rodents damaging agricultural products is a problem to be managed by promotion of intensive smart agricultural systems and support systems for farmers that derives by monitoring data should also be developed for rodents . Based on smart agriculture, by using information and communication technologies, internet of thing can provide us with a security system for private fields and farm products, thus improves the monitoring and security of pre-harvest and postharvest grain.

Distribution of resource, delegate control of devices and balance of loads to improve efficiency of resource devices are using, is achieved by integration of hardware resources into clustures using vitalization technology. To obtain large amount of data, by using various information sensing techniques of IoT using RFID, wireless communication etc. are integrated withagricultural based information cloud to form smart agricultural device. Data collection is also a major part in security devices. Here, data i.e. sensory information using various sensors. Information generated from sensors are transmitted to server or platform (IoT based M2M platform) over network so that it can be accessible through remote location for further processing and monitoring. Once the data is transmitted to the server, client machine is used to access it, process it and notify user based upon filtered information .Internet of Things is used with IoT frameworks in order to easily view, handle and interact with data and information. Within the system, users can register their sensors, create streams of data, and process them. In addition, the system has searching capacity, helping the user with a full-text query language and phrase suggestions, allowing a user to use APIs to perform operations based on data points, streams and triggers. It is also applicable in various agricultural areas apart from security. Few areas are :

- Water quality monitoring
- Monitor soil constituent, soil humidity
- Intelligent greenhouses
- Water irrigation
- Scientific disease and pest monitoring

To develop more cost efficient system by avoiding the need of maintainance, free from geographic constraints and to access affordable services, extended ”as-a-Service” framework in cloud computing can be integrated with Internet of Things to deliver financially economical IT resources.

V. THING-AS-A SERVICE

In IoT and Cloud era, sensing, actuation, data generation, storage, and computation has extended the cloud services ahead of SaaS, IaaS, and PaaS. Thing-as-a-Service is introduced in order to develop a cloud of Things where different kind of resources as sensors can be integrated based on the tailored thing-like schema.

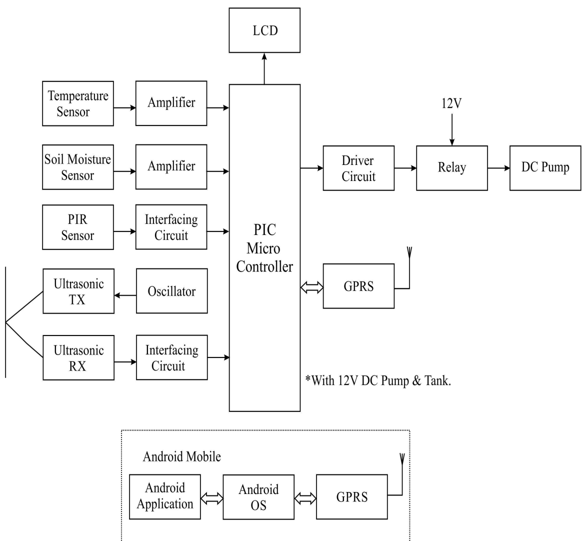

Figure 3. Block diagram

VI. ARCHITECTURE

Device uses 3 interface for data collection, analysis and transmission. IoT architecture is categorized in 3 level architecture and five level architecture. Figure - 1 shows the working phenomena of device based upon 3 level architecture .Fig.1 Device’s ArchitectureThese layers, categorised as

- Perception layer : Layer which is used to differentiate the different type of sensors used in device.\
- Network layer : Layer used for process and transmit the information over network.
- Application layer : This layer is responsible for various practical application based on users’ need.

Extra key level mentioned between application layer and network layer is known as middle-ware layer which consists of data analyzing system to take automated actions based upon information . This layer provides dedicated services among connected devices.

DATA TRANSMISSION:

The analyzed data and information is further stored in SQL based database provided by ThingWorx’sIoT platform (Figure-4) using cURL command line tool and library through HTTP protocal. Further, a SMS application programming interfeace is used to deliver analyzed information to user including IP address of the server to access webcam daemon.

APPLICATION:

After data processing, on application interface, a website’s link will be sent to the user along with timestamp and information, and based upon the distance calculated by ultrasonic ranging device, repeller will be activated with a particular frequency within range (30kHz to 65kHz) which is aversive to rodents.

VII. RESULTS AND DISCUSSION

The proposed smart security system is implemented using Python Programming Language and the devices are controlled Fig. 4. Screenshot of ThingWorx’s Platform Test with S2MSA using Python scripts and RPi Libraries. After the collection of the data further processing and transmission of the data to ThingWorxIoT platform’s server is needed for that a script is written in Python along with API written in cURL is used. ThingWorx is a internet of thing based platform provided by PTC LLC. to provide machine to machine services and internet of thing based application. cURL is a computer software project written in C Language which provides library and command line tool for transferring using it’s library ”libcurl”which supports common range of protocols including HTTP, HTTPS, FTP, FTPS, TELNET, IMAP, POP3 and SMTP.

can be used in different areas. This project can undergo for further research to improve the functionality of device and it’sapplicable areas. We have opted to implement this system as a security solution in agricultural sector i.e. farms, cold stores and grain stores. The results of the work point to the following directions of research that are likely to be needed for further improvement.

- It may be helpful to extend the security system to prevent rodents in grain stores.
- It can be further improved for the identification and categorization between humans, mammals and rodents.

- ➢ Device can be enabled to collect more information about surroundings and presence of threats so that implementation of machine learning is achieved.
- ➢ Location of device in area can also be change based upon the location of grains for more effective results.

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