Development of IoT Based Smart security and monitoring Device for Agriculture

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***Abstract*- Agriculture plays a vital role in the development of agricultural country. Security in agricultural field is required not only in terms of resources but also for agricultural products. Protection at very initial stages, like protection from attacks of rodents or insects, in fields or grain stores are needed. In the context of providing smart security and monitoring the system, for agriculture can be addressed by integrating the agricultural system with internet of things (IoT). Using Raspberry pi and various sensors, the efficiency in agriculture can be improved. The information generated from different sensors are sent to main server using Raspberry pi. All the parameters in the agricultural field can be controlled and monitored from remote location. This paper addresses, solving problems like identification of rodents, threats to crops and delivering real time notification based on information analysis and processing without human intervention.**

***Index Terms*- Agriculture, security, internet of things, raspberry pi, PIR sensor, URD sensor.**

I. INTRODUCTION

The term Internet of Things was first proposed by Kevin Ashton in 1982. Internet of Things (IoT) is an environment of connected physical objects that are accessible through the internet. The 'thing' in IoT could be any object with build-in-sensors that have been assigned an IP address and have the ability to collect and transfer data over a network without manual assistance . IoT is a combination of hardware and software technologies along with embedded devices which enables to provide services and facilities to anyone, anytime, anywhere required using any network. The connectivity then helps us to capture more data from more places, ensuring more ways of increasing efficiency and improving safety and IoT security. IoT is transformational services that can assist companies improve performance through IoT analytics and IoT Security to convey better outcome. Businesses in the utilities, oil & gas, insurance, manufacturing, transportation, infrastructure and retail sectors can reap the benefits of IoT by making more informed decisions, aided by the torrent of interactional and transactional data at their disposal. The interconnection of these sensor devices , is expected to lead in automation in almost all fields, while also enabling advanced applications like a smart grid, and expanding to areas such as smart cities.

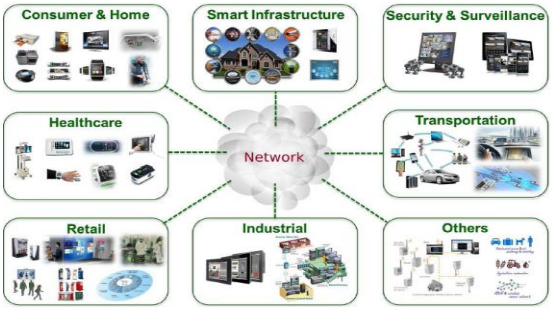

Fig 1: Application of IOT

The health care applications are increasing more day by day because of sensor devices. The IoT has the potential to give rise to many medical applications such as glucose level sensing, ECG monitoring, blood pressure monitoring, body temperature monitoring. The healthcare system mostly tries to work on the wireless sensor networks, embedded device technologies and ubiquitous computing. IoT systems need to provide the services to anyone at anytime and anywhere. IoT applications can be proved to be very effective in the agriculture

paradigm like rising the quality, quantity and cost effectiveness of agricultural production. Many farmers still use the traditional methods of farming which results in low yielding of crops and fruits. But wherever automation had been implemented and human beings have been replaced by automatic machineries, the yield has been improved. Through the use of various sensors and wireless devices, farmers can obtain information about soil moisture, soil temperature, and nutrient conditions of the soil or the occurrence of plant diseases and pests in plants. On the basis of the information received from various IoT devices in the field, farmers can react in a timely manner and apply appropriate corrective measures. Data obtained from the operation of agricultural machinery using sensors, enables operators to adjust machine operation to working conditions so as to achieve higher effectiveness and rise in the quality of the production .

A.WIRELESS SENSOR NETWORK

Wireless Sensor Network abbr. WSN is a distributed collection of small devices, capable of local processing and wireless communication. To transmit the information generated by various sensors along with commands for controlling them, the implementation of wireless communication technologies in industrial area is necessary due to inaccessibility to remote location. So, to achieve interoperability between devices in industrial areas, design and implementation of wireless communication system is done.

B. RASPBERRY PI

Raspberry Pi is a low-cost, credit-card sized single-board computer. The Raspberry Pi was created in UK by the Raspberry Pi Foundation. Raspberry pi is used as a server to analyze data and transmit information to user.

II. RELATED WORK

In [3] Secured Smart Healthcare Monitoring System Based on IoT, proposes that PIC18F46K22 microcontroller is used as a gateway to communicate to the different sensors such as temperature sensor and pulse oximeter sensor. The microcontroller picks up the sensor data and sends it to the network through Wi-Fi and hence provides real time monitoring of the health care parameters for doctors. The data can be accessed by the doctor at anytime. The controller is also connected with buzzer to alert the caretaker about difference in sensor output. But the major issue in remote patient monitoring system is that the data as to be securely transmitted to the destination end and provision is made to allow only authorized user to access the data. The security issue is been addressed by transmitting the data through the password protected Wi-Fi module ESP8266 which will be encrypted by standard AES128 and the users/doctor can access the data by logging to the html webpage. At the time of extremity situation alert message is sent to the doctor through GSM module connected to the controller. Hence quick provisional prescription can be easily done by this system. This system is efficient with low power consumption capability, easy setup, high performance and time to time response.

In [4] A Review Paper on Smart Health Care System Using Internet of Things proposes that the patients' body parameters can be measure in real time. Sensors collects health of patients parameters and transfers that data to Arduino Uno which further transfer that data to cloud with the help of Wi-Fi module. This data is stored into MySQL database server which manages data and provides accessibility. User can view this data with the help of commands as well as Android App which is installed in Smart phone, Tablet or PC. Cloud computing handles authentication, privacy, security, data management etc. If data is abnormal then patient gets notification and care takers will get mail about it. With the help of different decision making algorithms decisions can be made and according to its people have access to database. Patient can check their medical record Hence, this system provides Quality Health Care to everyone and error free and smooth communication to patients.

In [5] Smart Blood Pressure Monitoring System Based on Internet of Things proposes smart blood pressure monitoring system based on Internet of Things, which is characterized by three aspects. A) Monitor side: it measures the user's blood pressure along with other blood pressure monitors in operation at the server-side to ensure data accuracy. B) User side: with smart solutions, users can use the electronic blood pressure monitor to measure, record and send the data to data processing center for storage. C) Doctor side: doctor workstation may monitor users' blood pressure in real time, and give

warnings or advices. It improves the accuracy and credibility significantly.

In [2] Application of IOT Based System for Advance Agriculture in India suggests internet of things based sensor network for agriculture use. The sensors consist of Soil moisture sensor, soil temperature sensor, and ph sensor for soil. All these sensors are connected to each other by wireless sensor network xbee and will convey data to a station pc in the control room. From control room it will be uploaded to website where farmers can access all the data on his smart phone and tablet. This system also controls water requirement and fertilizers requirements from these sensor data for different type of crop in different time of year. The stored data of the sensors can be further analyzed and used for future uses such as in which condition we get maximum yield from crops so that farmer can plan according to it. Also this IOT based system provides atomized irrigation and fertilizer usage in real time to farmer which is very useful.

In [6] Smart System Monitoring On Soil Using Internet of Things proposes that how the sensed data will be processed and stored in cloud and from cloud the data will be relayed to the registered farm owners through their pH one or device in user understandable form. Also if pH rate of the soil is low the application suggests the pesticides to be used to improve cultivation .This will be very helpful to the farmers who are away from the land, and improves the crop cultivation.

In [7] Application of IoT in monitoring and controlling agricultural production proposes that IoT devices plays key role, with a focus on their realization by available microcontroller platforms and appropriate sensors such as Arduino products. Autonomous sensor devices gather data within monitoring systems and participate in the control process by sending signals to the actuators. Such an IoT based system provides users with the opportunity to remotely monitor conditions and production development. This system enables users to help savings in inputs, achieve cost reduction and trace the production process on the farm.

III. PROPOSED SYSTEM

Internet of things is playing an important role in remote monitoring systems. It's used to develop intelligent security systems with the ability to analyze data and transmit information over network to the remote location. Here we are considering the real time monitoring in agricultural fields. In the proposed system some hardware devices are used such as Raspberry pi, PIR sensor, URD sensor, Web camera and Ultrasonic repeller, to solve the problem of identification of rodents, which are threats to crops. Delivering real time notification based on information analysis and processing without human intervention. The Raspberry pi is used as a server to analyze data and transmit information to user. PIR sensor is used to detect the motion of the object; URD sensor is used to calculate the distance between the object (rodent or pest) and restricted area. Web camera is used to capture a snap of area. Ultrasonic sound based rodent repeller which will be activated by server based upon data analysis.

The development of IoT system depends on standards and protocol stacks available for interconnecting small and low-power devices [8] . The system is connected to the device wirelessly with the help of Wifi or Bluetooth. The wireless sensor network plays an important role in the IoT. We have many low power WAN technologies such as SigFox, LoRaWan, LTE-M, NB-IoT, On-Ramp. Here we are considering Zigbee, which is of low power consumption. It is specially designed for IPV6 which is a standard protocol.

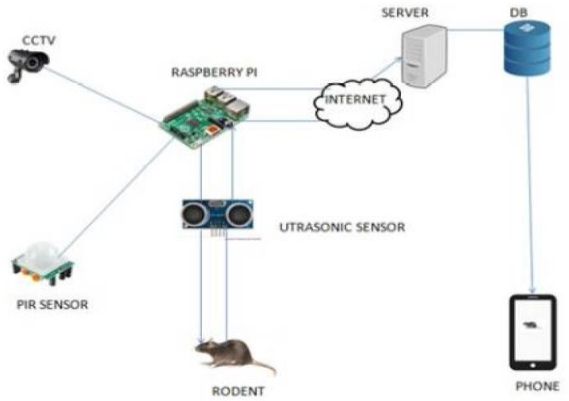

Fig 2: Block diagram

Components used are:

1) Rapberry Pi 2 Model B+
2) PIR Sensor
3) Ultrasonic Ranging Device
4) Web Camera
5) Ultrasonic Sound Repeller

Platform and Language Used:

1) PTC's ThingWorx's IoT platform for M2M Services
2) Python
3) Linux based Raspbian OS

Below is shown the pin diagram of GPIO Header Raspberry pi 2 model B+.

PIN	GPIO	PIN	GPIO
1	3.3v	2	5v
3	GPIO 2	4	5v
5	GPIO 3	6	GND
7	GPIO 4	8	GPIO 14
9	GND	10	GPIO 15
11	GPIO 17	12	GPIO 18
13	GPIO 27	14	GND
15	GPIO 22	16	GPIO 23
17	3.3v	18	GPIO 24
19	GPIO 10	20	GND
21	GPIO 9	22	GPIO 25
23	GPIO 11	24	GPIO 8
25	GND	26	GPIO 7
27	ID-EEPROM	28	ID-EEPROM
29	GPIO 5	30	GND
31	GPIO 6	32	GPIO 12
33	GPIO 13	34	GND
35	GPIO 19	36	GPIO 16
37	GPIO 26	38	GPIO 20
39	GND	40	GPIO 21

Table 1: GPIO header input output pin

Sensors and camera is connected to GPIO (General purpose input output) header. PIR sensor has three pins as VCC, OUT and GND, while ultrasonic ranging device (HC-SR04) contains four pins as TRIG, ECHO, VCC and GND. Device also contains a ultrasonic sound based rodent repeller which will be activated by server based upon data analysis. Raspberry pi B+ GPIO header (Table-1) consists of 40 pins which includes 5v, 3.3v, GND and 26 GPIO pins and 2 ID-EEPROM pins to provide connectivity to I/O devices. Space selected was a small area with the size of 10 sq. m.

After installing and activating the device, a script written in python language is used to identify motion of rodents using heat sensor which provides discrete values. Considering these descrete values as flag signal, URD sensor is activated to calculate the distance of rodent from the restricted area . Simultaneously webcam daemon is activated to capture a snap of area. Ultrasonic ranging device and web camera is dependent upon the values generated by PIR sensor.

The analyzed data and information is further stored in SQL based database provided by ThingWorx's IoT platform using cURL command line tool and library through HTTP protocol.

After data processing, on application interface, a website's link will be sent to the user along with timestamp and information. 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.

IV. CONCLUSION

'Internet of things' is widely used in connecting devices and collecting information. The system is designed for identification of rodents in grain stores. The security system for agriculture is implemented which is highly accurate in notifying user and thus the activation of repeller based on the information gathered from various sensors.

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