International Journal of Advances in Engineering and Management (IJAEM)
Volume 2, Issue 1, pp: 1209-1215 www.ijaem.net ISSN: 2395-5252

Application of IoT & Cloud Computing In E-Cultivation

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Date of Submission: 01-07-2020 Date of Acceptance: 16-07-2020

ABSTRACT: Development of agricultural countries depends on its growth and production. In Pakistan, agriculture accounts for 26% GDP and employs about 48% of the labour force. Current GDP of Pakistan is 305 billion. Agriculture plays a vital role for economy of Pakistan and its development. Pakistan has been producing vital amount of Cotton, Rice, Wheat and other Crops for export as well as for its population. Due to the export, it enhances the position of Pakistani currency and also increases its managerial esteem. Pakistan's progress has always been hindered by the issues concerning agricultural production and management. Smart agriculture is the only possible solution to redeem and modernize the traditional methods which have been used since its independence. Therefore, it is necessary to make agriculture using automation and IoT (internet of things) technologies. The objective of this paper is to use the technological breakthrough of modern era to modernize traditional agriculture into smart and innovative procedure. IoT is a network of interconnected things which make a self-configured network. The development of Smart agricultural IoT based devices is changing the face of cultivation and production and making farming cost effective and easy.

KEYWORDS: Internet of Things, Cloud Computing, Cloud of Things, IoT, unmanned aerial vehicles (UAVs).

I. INTRODUCTION

When it comes to managing our daily lives from airports' passenger flow to taking care of the old folks and heating building, Internet of things (IoT) acts as an intermediary tool. Main components of IoT connects easily to your workplace by an open set which are included to support a paradigm to build systems flexible and cost-effective way. The intelligent device control is set to get modernized by means of capability of network electronics in standard way procedures. Electronic devices transfer the data into the cloud via the use of internet with TCP/IP which represents this world by the so called IoT. Same way our cultivation can be revolutionized and could be converted with standardization of IoT. The unmanned aerial vehicles used in this application have been found two be useful in two similar yet distinguished tasks, as fertilizer applicator and in spraying pesticides as well.

By 2050 the population of this world could reach 9.7 billion. To tackle this huge population of people, IoT could be the saviour in the farming industry. The demand for more food has to be carried out even after resulting of environmental impact from rigorous cultivation practices, and against the problems of extreme weather conditions and arise of climate change. The major purposes of IoT based smart farming is to reduce waste and enhance productivity of crop from ranging the quantity of fertilizers used to the number of expeditions the farming vehicles make for the growers and farmers. Keeping all the factors such as checking environmental factors and observing the crops is not a solution to increase the production and is also not sufficient. When the crop is on the wedge of harvest the most common problems which affect the yield of crop are insect and pest attacks which can be prevented by insecticides and pesticides, bird and animal attacks.

The production phases like; seeding, harvest, cultivation and post-harvest storing proportions need an interconnected system which can make sure of all the factors mentioned above as operational. This paper proposes an integrated system using IoT and automation which provides the suppleness for smart farming, looking over the field as well as operating and controlling field operations. As it is obvious IoT is revolutionizing both our commercial and domestic futuristic lives by automating logistics, industries, transportation, import export, homes etc., then why not agriculture and cultivation.

II. INTERNET OF THINGS (IoT)

The first ever approach towards interconnected network of smart devices was implied with an altered Coke vending machine at University of Carnegie Mellon in the year 1982 which became the first appliance of IoT capable of reporting whether the drinks loaded were not to the inventory or were cold. Kevin Ashton of Procter & Gamble first used the term "Internet of Things" in 1999 at MIT's Auto-ID Centre. As per the matter of fact the impact of IoT has started many industries and sectors ranging from manufacturing, health, communications, suppleness and agriculture too but upon focusing the assertion it feels that the applications of IoT is still scratching the surface and actual ordeal of IoT is yet to be witnessed and discovered. As forecasted by various researchers, 50 Billion devices based on IoT would be connected all across the planet by year 2020. The Internet of Things (IoT) has been defined as (Smith, 2012):

"A Dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual "Things" have identities, physical attributes, and virtual personalities and use intelligent interfaces and are seamlessly integrated into the information network, often communicate data associated with users and their environments".

Many leading giants are providing a wide range of sensors, communications devices, robots, unmanned aerial vehicles (UAVs) and other heavy machinery to integrate the sensed data as per the market demands. IoT is developing every bit of time therefore advance potential is evaluated by a mix mash of thoughts for instance and related advancement tactics, Cloud computing, Big Data, Semantic load, w4 internet. The additional labour force asserted in the agriculture can be diminished as it assumes an essential job in enlarging the production by the use of innovation. A portion of the exploration endeavours are accomplished for advancement of ranchers which gives the frameworks that utilization innovations accommodating for expanding the farming yield.

III. LITERATURE REVIEW

A columnist urged the programming in the power supply for the micro-sensors in the year of 2009, which will decrease the energy deficit. One of the former practices and existing techniques in traditional agriculture is the manual practice of monitoring the parameters. Using this method, the grangers validate all these parametric quantities and measure the readings themselves. A group of analysts came up with a variety of frameworks for the agricultural sector with singular or numerous applied sciences cited above e.g. A Bluetooth based design for the purpose of transmission which allows a defined range and has its own restrictions with device adjustment which is used for the sole purpose of deciding the amount of water to be irrigated based on soil measurement irrigation system.

The paper proposes a unique procedure for agriculture through nexus of an irrigation system through wireless communication technology and a smart sensing system. The cloud computing devices that are capable of constructing an entire computing system with the help of instruments to sensor the detected data by human actors on the ground and from agricultural field images and precisely transmit the information into the integrated depositories in addition with the location coordinates as global positioning system. This suggests a cheap and effective wireless sensor network which actually leads into taking decision about the irrigation to be turned on or off by using the systematic technique of taking over the temperature readings and humidity of soil as per the requirement of harvest controller taken from several positions of farm.

According to the paper image processing is used as an instrument to supervise the pest attacks and diseases on yield and crops throughout husbandry, initially from ranching to reaping the crop. These distinctions are observed in different morphology, colour and texture. This is how an idea is brought forth about optimization of water usage for smart farming and yielded crops by designing an irrigation system powered by IoT. As per the recent exploration the analysts have discovered that the production of farms is decreasing gradually which is an alarming situation therefore automating this particular field with the use of technology will save us lots of hard work and duration in the upcoming times to come.

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IV. METHODOLOGY

This paper proposes a system that not only monitors the crops' conditions but also monitors when and how the water supply and harvest process will be carried out, the three different phases of cultivation are meant to be dealt with the automated system which is proposed. These three segments and their architectures are as follows:

a) Wireless Monitoring System

This designed model has useful and effective implementations in green houses as well as farms with help of drones and weather forecasting devices as shown in Fig.1.3 and Fig.1.4 respectively. When this integrated system is switched on and made functional the data packets are transmitted via the nodes and are sent to the heart of the system by the servers as shown in Fig.1.2. The provided gateway receives all the warnings or notifications sent by the system directly to the Farmer's end. The assigned expert for checking soil and crop production is communicated by the heart of the system in case of any abnormal happenings. The network of sensors enables the user to communicate with the real-world entities as an important integral part of the IoT. In this project we are connecting agriculture to the IoT using the network of sensor's model which allows these interrelations. This association lays out the connection between farmers, farms and enhances the yield of crops. This system is an intensive design developed to acquire preciseness in smart farming.

b) Water Supply and Storage

The water supply and storage system are handled by the control section in which the numeric values are verified by the received user data. If the received packets surpass the numeric values, the LED begins blinking and the alarm is turned automatically ON. The buzzer is then received by the farmer as a notification message and after sensing power is automatically switched off. The description of the values in a detailed version is then sent and received by the farmer and these are synced in the website as well. If the user using the android application which is developed for the sole purpose is operated manually then the farmer can turn the switches according to the need as OFF and ON by clicking the button. The GSM module makes the work done as shown in Fig.1.6. In reflexive mode, the switch is automatically turned according to the need as OFF and ON if the numbers surpass the limit. Then the farmer receives an alert after the microcontroller is started. It is attained by delivering a short service notification alert to the user via GSM module. Various numeric values such as the moisture, PIR sensors (Fig.1.9) and temperature sensor (Fig.1.7) signified the values. The water source is then checked by water level sensors to point out the level of water.

c) Automated Harvest

On big agricultural farming scale, the complex machines with advanced technology shape the daily routine of farming processes. On the contrary, the fields of farming are still designated by multiple manual tasks that include heavy labour. The vision of this paper is to lift the burden of spine-breaking work off the labour's shoulders using the necessary technology, automation and robotics. Therefore, a scalable and modular agricultural robotic concept that enhances smart farming to the next level is proposed by this paper. As proof of concept the proposed configuration is integrated and validated as the experimental platform FRANC as shown in Fig.1. All experiments are performed in real-life outdoor scenarios as vegetable fields that are sowed or planted in row structures. Therefore, a local navigation system based on a crop row detection system which sets the parameters automatically and enables an adaptable GPS-independent navigation. As reviewed the sensor system consists of two stereo cameras and a NIR camera as shown in Fig.1. A NIR pass filter and the sensitivity of the built-in chip form in combination a band pass filter that enables a detection of light from 850nm to 1000nm. [12].

Figure 1.1: Automated Harvest

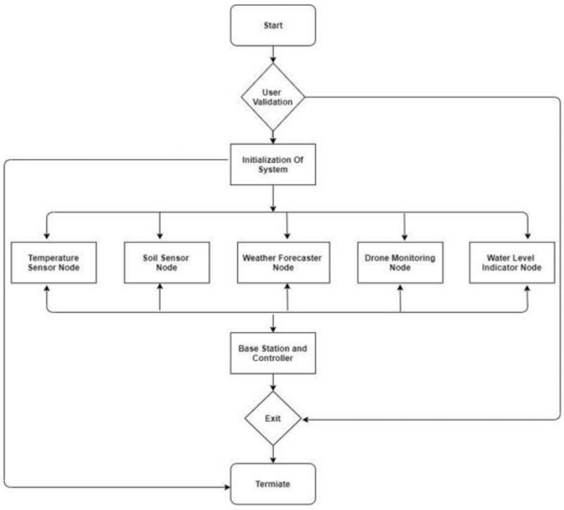

Figure 1.2: Flow Diagram

V. MATERIALS

a) Unmanned Aerial Vehicle (UAV)

Holy Stone HS100 GPS FPV is one of the best and economical drones when it comes to surveillance. This machine is an intelligent remote-controlled quad copter, fitted with the latest GPS tracking system. The HD 2K camera captures the high-quality aerial footage. Fitted with latest technology of "follow me", this feature make sure the quad copter stays above the user while capturing the movements and keeping track of the user.

Figure 1.3: HS100 GPS FPV

b) Weather Forecast Device

Ambient Weather WS-2902A allows monitoring the atmospheric stipulation which is easy enough to notice with best colour display experience instilled with the LCD. The latest Wi-Fi connectivity allows the transmission of data to the biggest weather station of the world. It gives the contrivance connection between local weather conditions by transmitting the data over internet using smart phone, computer or tablet directly to the end user. The interlinked weather forecasting station measures humidity in air, temperature, and direction of wind, solar radiations, UV and speed of wind.

Figure 1.4: WS-2902A

c) Microcontroller

The microcontroller PIC-16F877A is the bestselling microcontroller. This

microcontroller is user friendly and convenient to operate. The syntax is also very convenient to do. Syntax can easily be removed because of memory flash. Many different industries provide a massive range of applications. This could also be implemented in home appliances, security, industrial advancement and remote sensors. The frequencies, transmitter codes and other related data is also received and stored in a featured EEPROM.

Figure 1.5: Microcontroller PIC-16F877A

d) GSM Module

This Global System modem is capable of accessing any SIM network operator and yet can play as a unique SIM number and a mobile phone at the same time. RS-232 protocol is used because it can easily connect to the controller and is integrated via GSM modem. It also sends and receives SMS and make calls. This GSM module is run by 900/1800 megahertz (MHz). It features an LED light buzzer and is protective against tripping voltages.

Figure 1.6: GSM Module RS-232

e) Temperature Sensor

The top-notch temperature sensor is none other than LM 35. This sensor is used widely all over the world because the scaling of temperature is in Celsius and showing output of linear voltage. LM 35 consumes minimum amount of electricity. The maximum output is 5V. LM 35 consists of three terminals such as analog sensor, Vcc and ground. It is proven to be useful in agriculture. LM 35 can take up to +150 degrees to -55 degrees.

Figure 1.7: Temperature Sensor LM 35

f) Soil Moisture Sensor

The soil moisture sensor consists of both digital and analog output. The current does not pass through the soil if it is dry and the sensor operates as an open circuit. Therefore, it displays maximum output. Output is high or low indicated by the LED. In case the current passes from terminal to terminal can only occur when the soil is wet that is why the circuit is commenced as short and displays zero output. This works on the principle of open and short circuit. Operating voltage is 3.3V - 5V, it has analog output and dual output mode which is way appropriate. It also has a hole for bolt fixation. It has LM393 comparator chip and a Panel which has PCB Dimension.

Figure 1.8: Soil Hygrometer Humidity Detection Sensor

g) PIR Sensor

PIR sensors are applied to the central system because they can detect moving objects such as animals, insects and even human beings. The most common uses of PIR sensors are lighting systems and burglar buzzer systems. If a person walks into the field at that time the temperature would increase from normal temperature. The detection of moving objects is triggered when the output voltage is changed due to movement changes caught by the senor. Every object which has an absolute null temperature transmits energy in the form of heat radiations. Human eye cannot see such infrared waves of radiation. These sensors detect the infrared radiations reflected from the moving substance.

Figure 1.9: PIR Sensor

VI. RESULT

The proposed work could be improved by developing the central system for large acres of land for future developments. This system can also be integrated and used to compute the growth of crop in each field and quality of the soil. Various nodes of integrated wireless communication are successfully interlinked and acquired between microcontrollers and the sensors. All experimental and observational procedures prove that the proposed system is a definite solution to farming procedures and irrigation issues using the technological breakthroughs. The yield of crop production can definitely be improved by applying such IoT based system in the agriculture and it can cut the labour force to an improved extent with the help of technology.

VII. DISCUSSION

Such an advanced system can take actions and imply decisions because of the integrated system of IoT even in uneven circumstances. Artificially intelligent smart farms can lead to less human interactive systems where the central system is responsible for the task and procedures and even the monitoring of the field could be taken up by bots working 24/7 tirelessly. This will surely enhance the traditional way of cultivation and help farmers in the most precise way. The user can trust the automated system as it can supervise itself and take decisions making the owner feel more reliable and safe resulting into a trustworthy and lucrative yet innovative deal for the farmers.

VIII. DISCUSSION

The proposed work in this paper is emphasized only on developing a central system working as a nexus and intermediary for the mob devices to acquire advancement and precision in farming. This system is smart enough to connect real world objects and the network system of sensors powered by the internet of things as the backbone of the whole concept. According to these applications, we propose that the yield of crops can significantly increase and also remove ambiguities between the farmer and his farms keeping him up to date.

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International Journal of Advances in Engineering and Management
ISSN: 2395-5252

IJAEM

Volume: 02 Issue: 01 DOI: 10.35629/5252

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