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A Sustainable and Automated Irrigation and Field Monitoring System Using IoT

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ABSTRACT:- Internet of Things is an emerging and upcoming phenomenon which is an interconnection of vivid devices featuring numerous domains. It could also be interpreted as network of things where there is free flow of information to carry out desired results. Agriculture has always been the backbone of our country's economy throughout the last century. Agriculture had been engulfed with various problems which are solved using the help of IOT in the form of Smart Agriculture. As, smart Farming constitutes solution to many major concerns on the appraisal like constant supervision of agricultural farms in ever changing environment. IOT sensors play a pivotal part in smart agriculture as these provide the required inputs concerned to agricultural fields. This paper aims to make use of prominent and cutting- edge concepts of IOT represented in smart farming through automation.

Keywords:- IoT, Temperature, Water Sensors, irrigation Management, CC3200.

1. INTRODUCTION

Internet of Things is a compilation of various methodologies, which accumulate data and information from various topologies of devices to process and produce desired outcomes. IOT has a large plethora of applications in the form of Smart driving systems, Smart cities, Security control systems, E-commerce, Smart home, Industrial control, ecosystems, Health care etc. As, of the recent survey carried out by United Nations which has suggested that dependency on agriculture is going to take a huge hike. As, increase in dependency on agriculture is reasonable due to ever increasing population throughout the world. Agriculture plays a pivotal role in any country's economy by providing plenty employment opportunities in many sectors.

Agriculture practiced by farmers needs to be subjected to various changes to solve many problems like low yield cropping patterns and constantly changing weather patterns. IOT brings in the much-needed change that is required to solve the vivid problems present in the present-day agriculture faced by farmers. The solutions provided by IOT are low cost and optimal with highest efficiency by taking the inputs provided for consideration. A large contingent of factors do come into significant proportions that influence the productivity of the farm are insect and pest attacks, improper water usage which are evident in present circumstances.

A revolution is inevitable to take place in the field of agriculture with the advent of trending technologies like Internet of Things and Wireless Sensor Networks to solve the daunting problems that need to be addressed immediately. The Main Server is set to receive data using wireless protocol from the rest of the Wireless Sensor Network which collects data and information from various sensors.

A new system is created in IOT based smart farming through the aid of sensors which estimate various parameters and irrigation system which is automated. The farmers are given instant updates of their field conditions by the application of IOT in the form of smart farming. It is evident that IOT based smart farming is a conventional and efficient approach.

Gaining data and information like temperature, water and humidity of the agricultural field is exhibited through sensors and camera which is equipped to the CC3200 Chip. As, the sensors detects the water level and capture images could be sent instantly to the farmer's mobile with the use of Wi-Fi and can also control the irrigation process with ease.

IOT tackles dark looming and complex problems faced in daily agriculture by providing best of possible solutions which could be easily implemented. As, these solutions transform and bring major reforms to farming methods.

The huge chunk of implementation has revolved around the idea of using wireless sensors in the juncture with agricultural apps to help store important information in the form of environmental conditions like temperature, rainfall, wind speed and soil contents using cloud platforms to improvise and revolutionize the present farming techniques.

The IOT based smart farming could also enact as a base for the upcoming and future driven agricultural operations like organic and family farming. IOT based smart farming also serves as a great initiative for eco- friendly methods of farming which provides great advantages like efficient water usage, input optimization etc.

2. STATEMENT OF PURPOSE

This paper mainly emphasizes on monitoring of irrigation management to irrigate the farm using water sensors and

environment which include temperature and humidity of a farming field through sensors and the highly efficient CC3200 chip. A camera is also attached to capture any evident real-time snaps of the farm for constant surveillance. When the farm is irrigated as per the process, an SMS is sent to the farmer for conformation.

3. LITERATURE SURVEY

[1] G. Niklesh, has published a paper named "IoT based Smart Agriculture" in the International Journal of Research in Computer Science and Engineering.
He initially put forward his thought on IOT being used in agriculture which would inevitable take shape as Smart Agriculture. The paper urges to put emphasis on using the breakthrough technologies like IOT and automation. As, automation involved Smart Robot which could be controlled through GPS were tasks like spraying water onto the plants, monitoring is performed. Major emphasis is placed on monitoring of field surroundings and theft prevention. The whole model revolves around the use of raspberry pi operated through microcontroller, camera, sensors.
The paper also stresses on providing valuable in sites on filed surveillance, irrigation and storage issues in the topology of the farm. The solution is provided through Smart Robot which is controlled by use of GPS (or) remote.

[2] Raja Lakshmi had published a paper named " Based Crop- Field Monitoring and Irrigation Automation" in the 10th ISCO.
The paper describes monitoring of crop-fields using sensors which provide valuable and upbeat inputs on the field dimensions. The constituent part of data transmission is exhibited through wireless protocols where the stored data that was collected from sensors is sent to web server in the JSON format. JSON format is predominantly known for data encoding. The automation comes into effect in the form of instant working of irrigation system as soon as water and temperature deuterated well below the desired extent. Fast and instant updates about the farm are periodically sent to farmer's mobile for providing a chance to condition the farm.
This system will be more useful in areas where water is in scarcity and it is 92% more efficient than the conventional approach.

[3] B. Tan may had published a paper named "IoT based Smart Security and Monitoring Devices for Agriculture" in 12th International Conference subjected to Cloud computing.
Security, prevention and providing protection to attacks from various external factors are the main topics that were analyzed in this paper. The focus was to provide accurate and fast updates on the field with the help of Python 3.0 Scripts by taking inputs from vivid sensors. An efficient algorithm was also built to take input data and provide an accurate and pinpoint notifications to the users. A dedicated PIR sensor is used to sense heat with an additional aid from webcam and URD sensor.

[4] A. Arsenio had published a paper named "Wireless Sensor System for Smart Agriculture on the Cloud" at 4th World forum on IOT.
The paper appeals on an evident and all-important concept of Wireless Sensor Networks where operations are performed on the data like analysis and collection. The data which was collected were about the farm surroundings like water level, temperature. Efficient analysis is done using cloud computing for adequate storing of data acquired through Sensors.

[5] M. Rawidean Kassim had published a paper named "Wireless Sensor Network in agriculture application" at an International Conference on Computer and Information systems.
This paper stresses on implementation of ZigBee Technology using CC3200 Chip in agriculture in the form of greenhouse technology. CC2530F256 is also used as control node for data acquisition, data processing. The data is compiled at real-time and accurate using vivid sensors through wireless protocols. The system which is developed is highly efficient and scientifically advanced by taking in data for maintaining cropping patterns.

4 THEORETICAL ANALYSIS

4.1 MANUAL IRRIGATION:

Generally, to irrigate an agricultural field, the total farm area is divided into small grids like arrangement of land which help the farmers in the process of irrigation. The process starts with turning on the motor in the field by farmer. The motor then supplies the water to the field. Later, the farmer guides the flow of water into those prearranged grids or sectors (1). The following figure explains the process. The farmer then irrigates each grid in the field manually, collecting the soil with the hand and then cover the opening (1) so that the water redirects to the opening of other grid (3). Finally, when the last grid of the field is irrigated (6), the farmer turns off the motor. The farmer manually irrigates the field in this procedure.

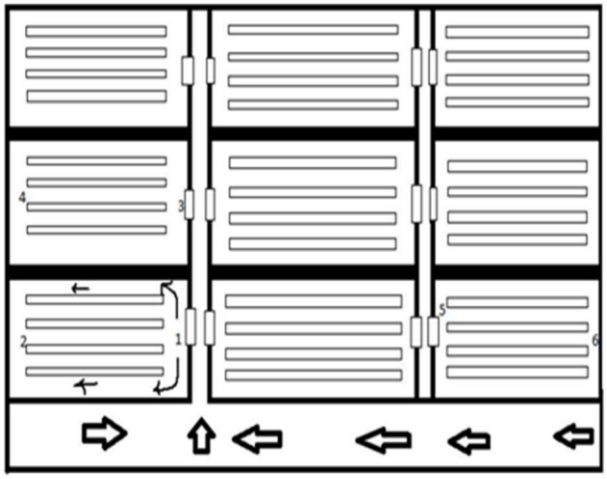

Fig1: Representation of Manual Irrigation.

4.2 IRRIGATION USING IOT:

Using IOT in agriculture automates the above process. This automated procedure includes the arrangement of sensors in the agricultural land as shown in the figure. In each grid, sensors are arranged in the soil and at the opening of each grid, a gate like disk is arranged which can open and close the grid when the power signal is received. The process starts by providing an input signal to the motor by the farmer. When the waters start flowing into the field, the gate of first grid is opened(1) .

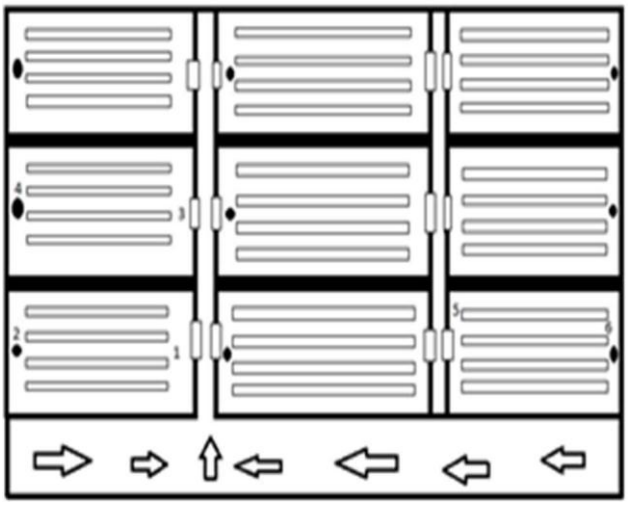

Fig2: Representation of Irrigation using IOT.

4.3 EQUIPMENT USED

CRS451V: Stainless-steel Vented Water-Level recording sensor.

The CRS451V includes submersible water-level and water- temperature sensor. It senses, collects data, retrieves the data. It is cost effective and easy to use. The advantages of this sensor include piezo resistive, temperature-compensated.

Fig3: CRS451V Sensor

The work includes the procedure to irrigate the farm smartly. The procedure includes the usage of Water sensors in each grid of the farm. When the corresponding sensor senses the water, it will be confirmed that sector of the farm is irrigated, and the water flow should be redirected to the next sector. This process is done until the last sector of the farm is irrigated.

When the final sector of the agricultural farm is irrigated, the circuit will break, and the motor is Turned off immediately. Later the advancement of this project includes the usage of Chips, cameras, Cloud etc.…to increase the productivity without human interaction.

The crux and core implementation aimed in this paper revolves around the CC3200 chip. The CC3200 chip is highly computationally in regards with performing through integration with large diaspora of modules and devices.
Block Diagram slated below is a pictorial outline of the system model that the paper intends to implement.
CC3200 Chip is the chief constituent and a vital cog of the system model that we intend to implement .CC3200 chip comprises of premier parts like a Microcontroller, network processor bundled with a Wi-Fi unit. There are many great characteristics of CC3200 Chip like Low power consumption, small size resulting in high portability. It also ensures fast and highly reliable connections.

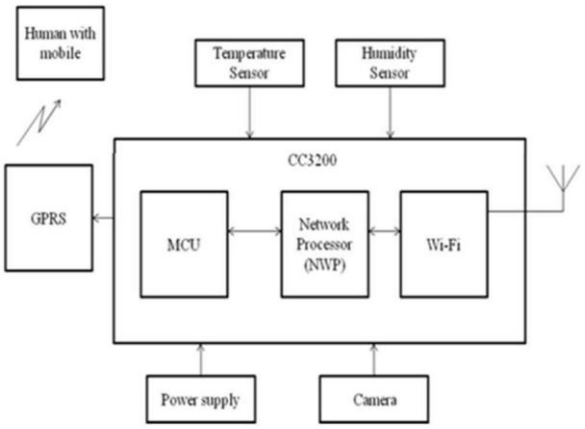

Fig1: Block diagram of proposed system

Irregularities in environmental conditions like brutal changes in weather patterns, ever changing water table beneath the ground etc. As, these unconditional changes would surely influence the yield of the crop that is to be produced. Monitoring comes into play as a crucial phenomenon due to the reason that crops are very dependent on the environment. Monitoring is carried out using various sensors which contribute by taking inputs of various elements of field.
TMP007 is a typical infrared sensor which calculates the temperature experienced on the field. It also useful in designing digital control and math engine for efficient processing. It is highly regarded for its accuracy in sensing temperature in the real-time scenario. HDC1010 serves as the sensor used to track down the humidity levels exhibited in the farming field.
CC3200 is also equipped with a camera though the PCB using a highly competent camera sensor called MT9D11.The camera has its own significance by capturing real-time images of the farm condition. The images that are captured are sent to farmer(or)the user's mobile through GPRS (General Packet Radio Services).

4.4 DESCRIPTION OF CC3200 LAUNCHPAD

CC3200 chipset does consist of a micro controller, Network Processor with a Wi-Fi unit .CC3200 does also comprise of an internal MCU application processor. NWP consists of sub- particles like Host Interface, Processor. As, NWP is directly connected to Micro Control Unit for operation. Wi- Fi unit does also consist of few sub-elements which constitute to it's working.

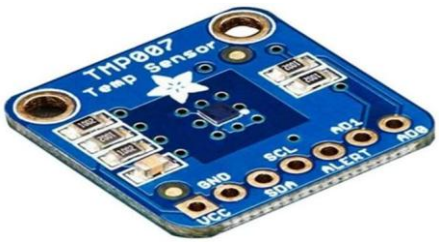

Fig5: Temperature Sensor

Microcontroller does act as a simulated (or) compact size computer to carry out specific operations. It does consist of parts like processor, memory, peripherals.

4.5 POWER MODES

CC3200 Chip does operate on three power modes to change the stand at the usage based upon the situation. As, these power modes predominately describe about the range of the task that is subjected upon MCU. The three power modes are hibernating, sleep, active. Each have their own significance or worth at the time of operation.

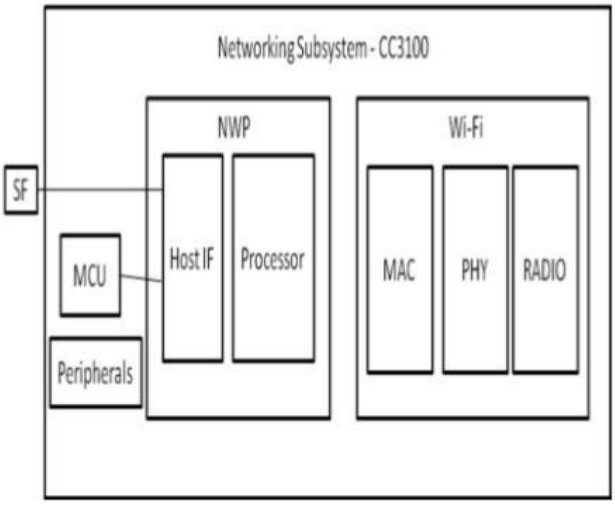

Fig6: Representation of power modes

At times, both NWP and MCU could contribute to change in power mode. Switching power modes on the respective situation of demand prolongs the functioning of the chip.

4.5.1 PREMIER FEATURES 1.Dedicated internet support to microcontroller 2.Interface operation with 3 LEDs and 2 buttons 3.Support for Flash Programming via serial port 4.Embedded antenna on the Chip

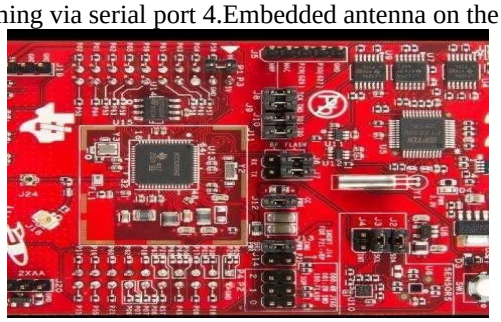

Fig7: CC3200 Chip.

4.6 PROMINENT SENSORS

Temperature Sensor (TMP007): TMP007 is the best available infrared sensor which is also used in numerous applications. It is far better at sensing minute temperature readings when considered to the rest available in the market. As, it considers a wavelength of range as low as 5 micrometers to 15 micrometers in the stipulated field. The measurement of temperature could also be done without contact. An embedded thermophile which is sensitive to temperature changes grasps the readings from the object.

Fig8: A Snapshot of TMP007

TMP007 also has various great characteristics like low power consumption, high sensitivity etc. TMP007 is ideally of size 1.7 mm x1.8 mm x 0.565 mm.

Humidity Sensor (HDC1010):

The humidity that is experienced in the farm is ideally calculated through a humidity sensor. As, HDC1010 is the best and adequate among the lot of humidity sensors available in the market. It exhibits high range of desirable features like low power consumption which is quite necessary in the real-time environment for prolonged usage.

It also boasts of great stability required to calculate high humid levels. All the desired characteristics are obtained due to its premier design which also helps to be resistant to environmental obstacles like dirt, fog etc.

Camera (MT9D111):

A Camera is a must at the thick of all the things to reach our prime goal of transmitting the live status of the farm to the farmers through GPRS.CC 3200 Chip also offers great opportunity to integrate the Camera using MT9D11 sensor.

Fig 1 umns

Fig9: A Snapshot of Camera

4.7 EXPERIMENTAL INVESTIGATION

We have gone through vivid range of sensors for calculating temperature and humidity of the farm. As we have looked for a greater replacement to TMP007 sensor that was proposed in this paper as TMP007 is not cost efficient. we have also mined for an adequate replacement for CC3200 chip which is a chief component in this paper. The major issue of implementing CC3200 chip it is the affordability as, this system model could not be implemented in small scale due to the burden of huge expenditure, so an efficient and economically feasible alternative should be proposed in comparison to the existing CC3200 chip.

CC3100 Booster Pack provided with Ethernet and Wi-Fi. The information which was received from the sensors were 82% accurate. Therefore, we can use this in the implementation.

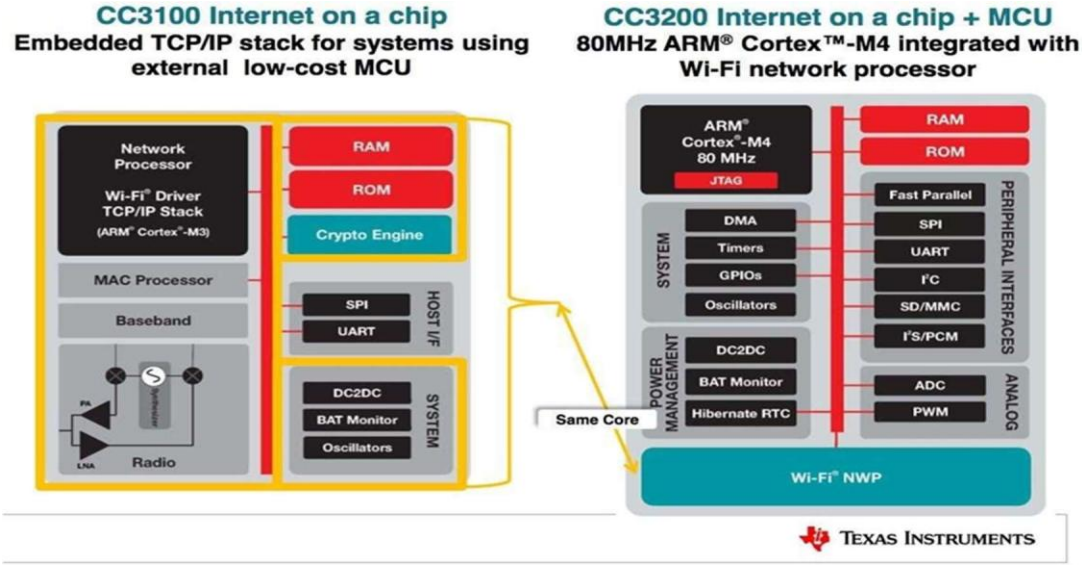

Fig10:Interface between different peripherals

The possible alternatives that were investigated for CC3200 chip are:

BOLT is an open source developing tool which is cost efficient, ensuring high reliable connectivity across vivid platforms like windows, IOS etc.

Fig11:A Snapshot of Bolt

5 EXPERIMENTAL RESULTS

Irrigation Management is done without human Interaction and the monitoring of the agricultural field is done. We have regressively experimented on CC3100 booster pack for replacing C3200 chip, but the odds have turned out to suggest

completely in favor of CC3200 due to its high efficiency in case of BOLT which was admired to be highly efficient delivered desired results.
The information which are sensed by the sensors were 82% accurate so therefore we can use this in the implementation.

6 DISCUSSION OF RESULTS

BOLT has delivered efficient results due to its highly reliable storage of data by using cloud computing. The results that were projected were said to be 92% accurate which seems to be far better when compared to proposed system model which yields only 82% accuracy by the usage of CC3200 chip.

7 SUMMARY

The aim of this paper was to introduce a new and adequate practice of farming in the form of smart agriculture which was brought through the concept of automation in irrigation and monitoring and application of IOT technologies. This inevitably urges for the use of vivid sensors to calculate many fluctuating factors in the farm setup like temperature, humidity etc. As, proper processing is done to the inputs recorded through the sensors by the CC3200 chip. Camera is also used to capture numerous wide ranged images regarding the present status of the farm. These images would be instantly sent to the farmer through GPRS.
This procedure would surely encourage and bring forth a much- needed incremental growth in production when compared to a traditional method.
The data secured through the sensors is especially 82% accurate which signifies that it could be practically feasible to implement.

8 CONCLUSION

Wireless monitoring is a step forward into the real-time implementation of automation. In order to help humans to provide much necessary presence and cast out eh scenario of constant human surveillance at the farm. Hence, proving that Internet of Things provides the much needed and desired results in agriculture which is expected.
Wireless monitoring of field reduces the human power and it also allows user to see accurate changes in crop yield. Therefore, the use of Internet of Things in Agriculture will yield better results. The system is very helpful to the farmers in improving their crop yield and monitoring the farm through instantaneous updates.
The famer is also well informed about temperature, humidity of the field. It would also invariably urge the farmer to take good care of the farm by providing adequate information.

9 RECOMMENDATIONS AND FUTURE SCOPE

The three sensors that were used in this paper could be replaced by a topology or group of sensors across the field to attain better and accurate results. We could also take aid through by implementing a popular algorithm named K –Means clustering for classification of data and information to draw out better results.
We could also use a cloud platform for storing in data and information to predominantly predict and calculate much necessary reforms that could be implemented in the latter periods of time.
This would help in structuring trends and would enable us to draw out much necessary conclusions. Cloud services like AWS, Google Drive could be highly recommended.
The system could also emulate a Greenhouse setup for the greater good of promoting an eco- friendly environment. There could also be integration of various other techniques like solar usage into the mix for obtaining better results.

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