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Smart Farming using Temperature Sensor, Moisture Sensor, Flow Sensor and Ultrasonic Sensor Leading to Water Conservation.

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Abstract*: For the entire living organisms in this world water is the crucial element for survival. Without water there is no life present, which makes it very difficult to craft the art of survival. As the fresh water resources are very limited in numbers we have to use this usable form of water in a very artistic way so that the future may not get more worsen. Out of 100 %, oceans contribute in almost 97 % of salty water which can be rarely used for any of the daily activities. Only 3 % of water is in the fresh format and can be utilized by all of the living creatures today for their own survival. Nearly 70 % of the Earths land is covered by water and out of this only 3 % of water is available in the usable form and rest of the water is either saline or present in the oceans. Out of the 3 % of the fresh water available on the Earths crust today, only 1% of the water is easily available and accessible to all the living beings as rest of the fresh water is trapped under the North and South Poles – Ice caps, Glaciers and Icebergs. The day our planet Earth was born, it had a amount of fresh water, the same amount of fresh water is available now at this present time, but this available amount of water was quite adequate in the earlier times as the population was under control and also the human activities were under control. The same amount of fresh water today is in crisis as the population has exploded with several other human activities in it. The proposed System has the ability to conserve and to limit the use of water in an adequate and proper manner without wasting it. The use of several Sensors onto the fields will eventually alert the system to start or make ON the water supply if the sensed parameters will fall below the threshold value. The use of WiFi Module will enable us to archive and check the real time physical elements data collected from the field and can directly connected to computers or other USB devices.

Keywords: Water Conservation, Leakage Detection, Sensors, WiFi, Internet of Things(IoT), Wireless Communication Networks (WSN).

I. INTRODUCTION

Water conservation is an essential movement to be carried out keeping in mind the increasing number of population day by day. The World utilizes around 70 % of the fresh water for the purpose of irrigation. This yields to around only 17 % of the Worlds Cropland. The amount of water to be used efficiently in irrigation is a major concern to study, so as to use the exact amount of water needed by the crops. This will eventually lead to support the agricultural policy. This crucial study will lead to an efficient use of water required to cultivate a largely improved yield of crops by using highly improvised and user friendly systems which would indicate and would limit the extra use of water. This will help in supplying the actual amount of water needed by a crop.

Water leakage globally is also a crucial problem faced by many of the continents. Leakage in the fields can lead to excessive amounts of water logging into the soil which eventually damages the roots of newly cultivating crops by decaying them. Water logging into the fields due to leakage in the pipeline structure would also lead to salt formation into the soil, this salt forms a layer above the soil surface damages the crop quality and such crops are eventually more towards attack by several pests which decreases the chances of a healthy outcome. With the proposed system, we can not only detect the pipeline structure leakages established in the fields, but leakages can also be detected in the industrial sectors also, so as to minimize the water wastage which will eventually lead towards Water Conservation.

II. LITERATURE REVIEW

There are many research works on the pipeline structures for the safe transportation of Water and Fuels. As in many countries like India, the transportation of liquids like water and fuels is not very feasible and safe through vehicle; therefore they are being transported from one city to another via a pipeline structure.

S Rashida, in this paper, the design, testing, and implementation of Smart Wireless Sensor Networks is carried out for leakage detection along the long pipeline structures. Here algorithms used are: Wireless Communication and Machine Learning (WML) to detect and learn small leakages. [1] S.M. Quasim, in this paper work, the author has represented the work to bring out the wireless sensor network (WSN) works with the reliability and the inspection aspects to improve the accuracy in Water Pipeline Monitoring. The works and the theory include detection and localization algorithms and also an efficient and reliable Wireless Sensor node System on Chip (SoC) architecture.

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The paper work and theory also implements the Water Pipeline Monitoring Method (WPM) using the Hybrid combination Predictive Kalman Filter (LPKF) and also used Modified Time Difference of Arrival (TDOA) method which make the use of ifferent pressure points and its measurements. [2] A.S.Almazyad, in this paper Radio Frequency Identification (RFID) to give a scalable design and also the simulation of water leakage in pipeline monitoring system. In this proposed paper the use of different sensors to sense and analyze the physical environmental values are used like: Temperature Sensor, Pressure Sensors, Acoustic Sensors, Flow Sensors and PH Sensors to the Water Leakage through a Pipeline Structure. [3]

E. Magiera, this paper has represented the amount of water usage on the household platform. Here the information is gathered first then interrupted and also the information is shared to know the actual water usage in the daily household activities. Also we can plan the actual amount of water to be consumed daily without any extra wastage of fresh water. Due to this we can actually have a close eye towards our unnecessary water usage so as to conserve the very important asset given to us by the Nature. [4]

T. AL-Kadi, this paper has proposed many ways to detect the pipeline leakages using the wireless sensor network techniques (WSN). This paper has also submitted the solution which is magnetic induction based where the pressure is continuous monitored above and below the ground surface by using the ground radio propagation and also the Wireless Signal Networks. [5]

G.Owojaiye, in this research work the author has implemented and proposed the design related issues which the system could face while detecting a water leakage into a pipeline which must further be considered while facilitating or employing the wireless sensor network techniques (WSN) for the pipeline monitoring. The author has further distinguished or classified the design issues in the system into five categories as: Localization and Reliability in the Network, Efficient in Power Management, Harvesting the Energy, Modality Sensing. Also the paper discusses the Co-operative Communication between the different sensors for sensing the leakage points in the system which is being deployed under the sub-sea environments. The author has also submerged a new conceptual idea for the employment of transducer networks for the pipeline structure which is build beneath the ground surface. [6]

A. Candelieri, here the author has presented the approach regarding Hydraulic Simulation and Machine Learning for improvising the leakage management through the Analytical Leak Localization by reducing Time and Costs. The author has also established the investigation in the rehabilitation of the fresh water through a distribution channel or network. In hydraulic simulation the process is carried out by making a leak in each o the pipe to analyze the various Water Pipeline Leakage scenarios. [7]

S. Datta, in this paper the efforts are made to investigate and learn the different fault detecting techniques such as: Pulse Echo Methodology, Vibration Analysis, Acoustic Techniques, Leakage detection System which is based on the theory of – Negative Pressure Wave, leakage detection in the pipeline through the Support Vector Machine (SVM), pipeline leakage detection using a different sensor as – Interferometric Fiber Sensor also the Filter Diagonalization Method (FDM) and many more methods for the Pipeline Fault Detection. The paper here also discusses the advantages and the disadvantages of the proposed different Pipeline Fault Detection methods. After studying such various systems for fault finding the author has come up with the efficient workable system and its positive outcomes. The methods discussed above can be used for several of the fluids including the gases; the fluids can be Water, Fuel, and Gas Oil. The study for the various fluid options is made on different layout patterns like straight or Zig-Zag. The study has been made for the different pipeline structures also like short or long runny pipe. These all outcomes and the theory is being carried out under all the possible operating Conditions, including extreme environmental conditions also. [8]

Summary of Literature Review - From all of the above stated brief literature survey it depicts that the previous works has been significantly proposed the necessity of water conservation by making use of different sensors. From the earlier studies it encourages us to produce such a system which is cost effective and more reliable in providing us the real time leakage data to avoid water wastage.

III. SYSTEM DESIGN

The water leakage detection monitoring system consists of several sensors to detect the real time physical parameters; these sensors are further interfaced with the Microcontroller for further processing.

The brief Block Diagram of the proposed system is as follows:

Sensors used in the proposed system for water conservation are as follows:

1. **Ultrasonic Sensor**: HALJIA HC – SR04.

The used ultrasonic sensdor has the sensing range from 2.5 cm upto 400 cm. In our system we will mount the sensor upside down so as to measure the crops height. By using this sensor we can actually test our implementation whether the system proves out to be a success in conserving the water by only providing the water whenever needed. By doing this if the crops height is as per the expected height then the implemented system proves out to be successful.

The ultrasonic sensor here automatically sends sound signals ranging 40 Khz and senses for the return pulse signal. If the sensor senses the high back signal then the time of the high output IO duration is the time sending the ultrasonic signal to the time its returning back.

The input to this HALJIA HC – SR04 sensor required is 5 Volts and 15 mA. The output or response we get when the input signal hits the target is in the form of Echo Pulse Output.

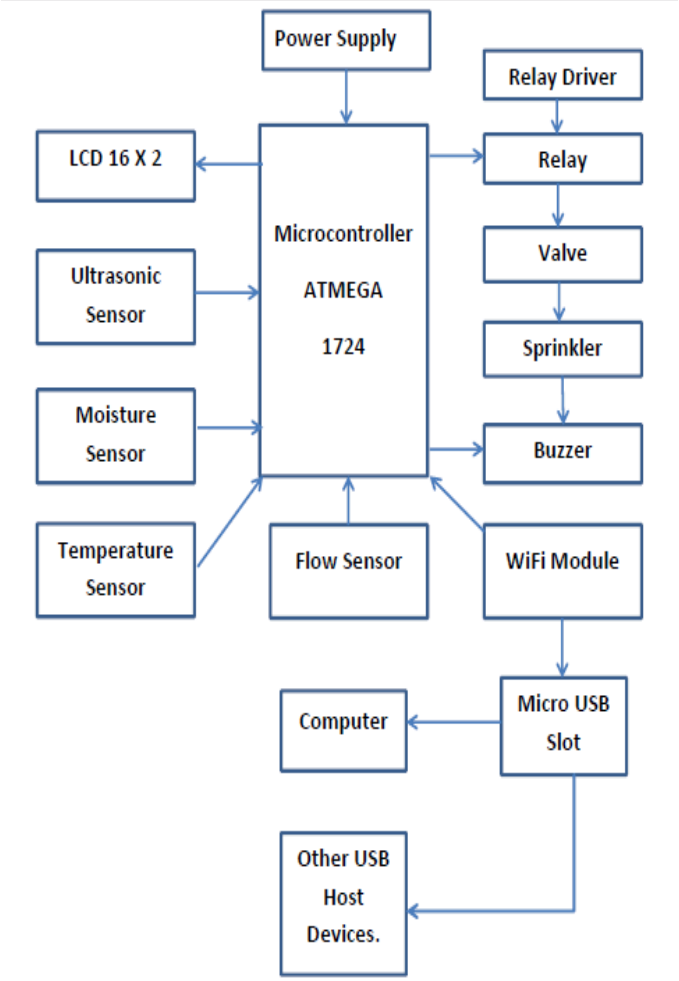


Figure 1 : A Brief Block Diagram of the system.

2. Moisture Sensor: Sunrobotics.

The sensor used here is soil moisture detection module. This sensor used is also referred to as the Arduino based module. SunRobotics sensor is also referred to as Soil Humidity, water and soil hygrometer detection module. This module is best used for the auto irrigation purposes without the need of human interference. The sensor also has dual output mode in which we get output in analog and digital form also. Sensor is used where continously manual interaction is not possible, also the plants in our garden can be nourished and managed without the manual help.

Operating Voltages for the moisture sensor is = 3.3 Volts to 5 Volts.

Figure 2: Moisture Sensor – SunRobotics.

3. Temperature Sensor: LM 35.

The LM 35 Series temperature sensors are most lovable amongst the home experimenters as these series are easily available in the market with really low costs.

LM 35 Temperature Sensor is categorized under precision based integrated circuits (IC).

Producer of LM 35 Temperature Sensor is National Semiconductors with three linear terminals. Temperature measuring range for this sensor is from – 55 degree Celsius to + 150 degree Celsius. The output of this sensor is in digital form in m Volts, the output increases by 10 mVolts for per degree Celsius increase in the temperature in real time. The accuracy for this sensor is 0.5 degree Celsius at 25 degree Celsius. The important characteristic of this temperature sensor is that it has the ability of self cooling and low self heating at the still air.

Figure 3: Temperature Sensor – LM35.

IV. SYSTEM FLOW

System flowchart is as shown below:

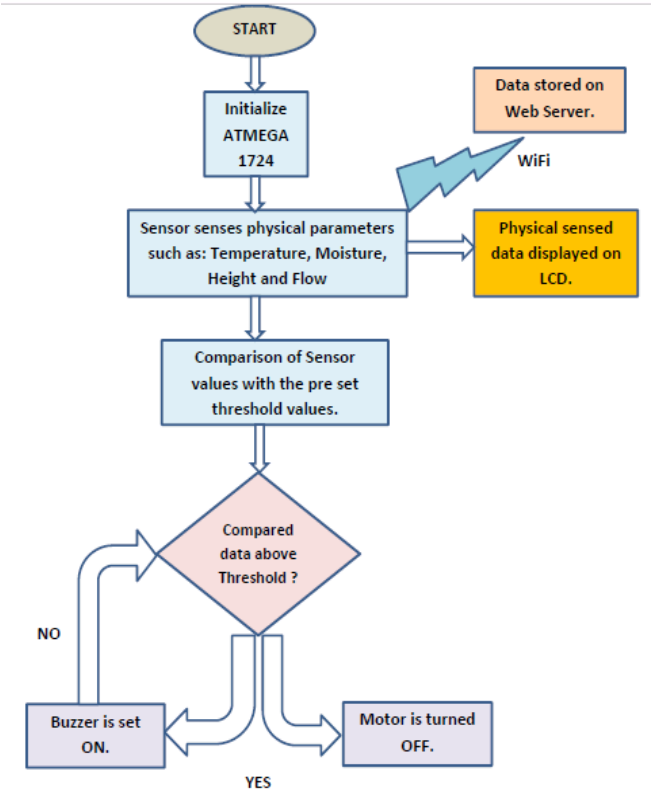


Figure 4: System Flowchart.

System starts with the initialization of the Microcontroller ATMEGA 1724. The sensors used detect the required analog environmental physical parameters which are further compared with the preset threshold values. Controller further checks for the measured analog values and convert these values into its digital format. If the compared values are above the threshold values then following actions are carried out: 1. The Motor is turned to OFF Mode. This is done when the detected moisture of the soil is above expected or threshold value. Motor is also turnes off if the temperature is quit colder than expected.

2. the Buzzer is set to ON Mode. This is to be carried out when the moisture is below the expected value and the captured surrounding temperature is risen above the threshold value.

The process of comparing the captured values with the threshold values continues until the controller detects the difference between them.

The sensed data from the environment is displayed on the 16 x 2 LCD.

Figure 5: LCD Displaying sensed values.

The four different types of sensors used are are mounted (Installation) or placed as described below:

Moisture Sensor: This sensor is can be inserted into the soil to be measured or into the substrate. Due to its sharp edges along the two pins it is easy to dig it into the soil for a perfect real time moisture measurements. Such types of sensors which are directly in contact with the enviornmental physical parameters are usually substrate calibrated for peat, coir, perlite, mineral, wool and also corrode free due to direct contact with the wet or moist soil. Structre of this moisture sensor with the sharpe edges or pins prove sout to be efficient by preventing the original soil structure by not disturbibg the soil patterns. Due to this one can expect a hastle free intallation with accurate moisture readings.

Temperature Sensor: this can be installed along the small branches or bark of the plant.

Ultrasonic Sensor: For this proposed system, this sensor is used to measure the height of the plant to be achieved after a time span. For such crop height measurement, we have to install the sensor upside down so thst the height is measured. As we cannot install such sensors for every crop cultivated, such upside down arrangements can be performed to only some of the crops so as to check the actual crop height achieved versus the required crop height.

V. IoT ANALYSIS

Thingspeak is an IoT Platform rather we can also state it as a pen IoT platform. This platform or application can store, feed and retrieve the data from the things which makes the use of the HTTP Protocol or uses the Local Area Network (LAN). This application enables us to make it use as an sensor logging platform. Through Thingspeak we can also have an location tracking application to make use of. This platform can be also used as a social network where one can also have access to status updates.

Thingspeak is an IoT base platform where we can collect the sensor data and also store it into the cloud and develop the IoT applications. Thingspeak IoT platform enables us to visualize, analyze and process the data onto the MATLAB platform. The data form the sensor can be sent to Thingspeak from Aurdino, Raspberry Pi, and Beagle Bone Black and from other hardware.

VI. HARDWARE DESCRIPTION

A. *ATmega 16A*

This ATMEGA microcontroller is a 8-bit controller with 16 kilo bytes in system programmable flash memory. It has got features like high endurance, high performance with the low market cost, and easy availability into the markets and many more. ATMEGA is build with advance RISC Architecture. ATMEGA 16A has16 programmable input output lines. This controller has the ability to operate at 2.7 Volts to 5.5 Volts. It is featured as the best controller for low power consumption. In its active mode the controller utilizes 0.6 mA of current. For its idle mode power consumption is much reduced at 0.3 mA. In its power down mode, the consumption of power is very limited to less than 1Micro ampere. JTAG interface is possible with the ATMEGA controllers. Software security provision with the programming security lock is also available for such controllers.

Due to this feature, the loss of data due to cyber attacks or due to breach of data can be avoided at the higher levels.

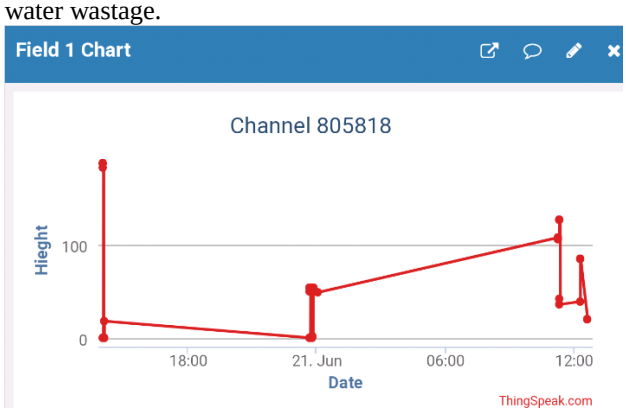
B. *Wi-Fi Module ESP8266*

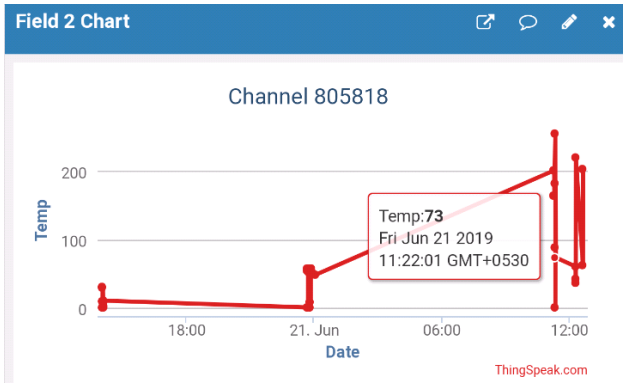
Wireless communication in the proposed system is done by the help of ESP 8266 module. This module provides us with the highly integrated Wi-Fi solutions by having seven external support components. Wi-Fi ESP 8266 is a full system on chip platform which has a full stack of TCP/IP protocols. We can connect this module to the available Wi-Fi through its enabled features and also has build din flash memory. This module is used to develop the internet of things (IoT) applications. The module has in build 16 programmable input output pins.

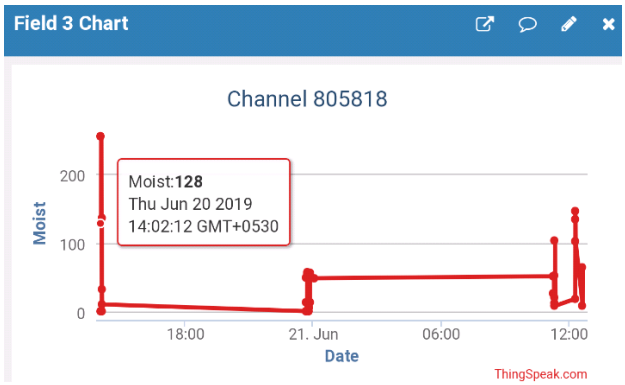
Figure 6: WiFi Module – ESP 8266.

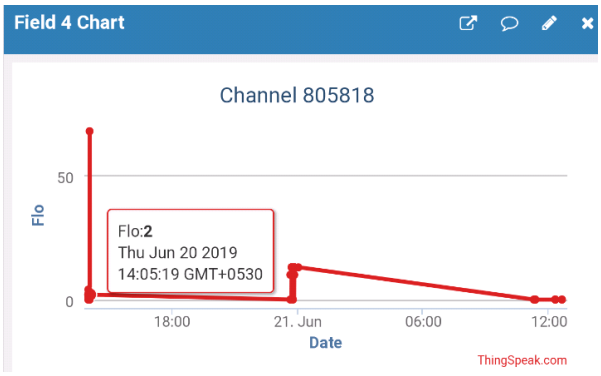
VII. RESULTS

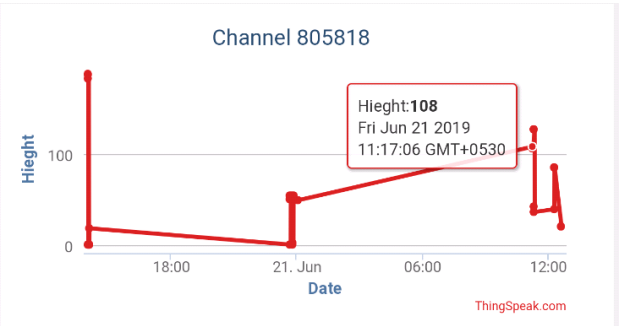
The smart farming proposed system was implemented and run to carry out several implementations. The system was tested and we can check out the actual results in the graphical format on the thingspeak application for different parameters. Real time data fetched from the fields by sensors can be tracked through this standalone desktop and mobile application. Real time parameters from the field are sensed by the sensor, and the collected data by the sensors is then released to the Web Server through the Wi-Fi link module. Thinspeak application can be installed on the personal computer or else on the mobile so that we can monitor the fluctuations in real time of moisture, temperature and for leakage in pipe due the change in output of flow sensor. By doing this we can eventually save more water by providing only the required amount of water into the fields. Also we can conserve water by finding out leakages in the pipe in real time which would help us to save water wastage.











VIII. CONCLUSION

As we conclude the theory work for the smart farming system to minimize and overcome the problems faced for shortage of water due to over usage and wastage. Hardware implementation is carried out for the system in different operating conditions for the sensors so as to study the overall in and out of the system.

By doing this we check the working conditions of the flow sensor to on and off the motor in presence of any leakage detected inside of the pipe so as to avoid unnecessary water wastage. We also carried out system implementation under different temperatures and moisture levels for the soil and checked the working of buzzer which is embedded onto the system as an alarming to start the water supply whenever needed. The system focuses on conserving the main element of the Earths that is Water which is an important aspect for any of the living being present today.

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