An Agricultural Guide based on Cloud Computing and Big Data Analysis

Ruhul Ambia Remon[1], Rishad Islam Shantho[2], M Shahir Rahman[3], Helalur Rahman Khan[4], Mahdiul Islam[5], A.B.M. Hosnee Mobashir[6]
Department of CSE, Military Institute of Science and Technology (MIST), Dhaka-1216, Bangladesh
Email: {[1]ruhul.remon, [2]rishadxjcc, [3]shahir.rahman3502, [4]helal.rahman, [5]mahdiul2013, [6]abm.hosnee }@gmail.com

***Abstract*— Rivers are the backbone of the agriculture of our country.Rivers are contributing to the most of the agriculture of the country. But the same rivers bring disaster during monsoon. Due to the lack of efficient early warning system for natural disasters like flood every year Bangladesh suffers huge losses which includes crop damage, loss of livestock and destruction of social, physical and institutional infrastructures.This paper gives an outline for the development of an information system based on the existing systems with the utilization of some sensors and IoT and utilize the existing dams as the main source of irrigation. This paper also proposes a novel idea of collecting and sharing real-time information on Weather, rainfall,water level and basing on the collected data the accurate prediction on farming.**

***Index Terms*—Dam management, Iot,Predictive farming, Flood Detection, Big Data Analysis**

I. Introduction

Bangladesh is a riverine country. About 700 rivers including tributaries flow through the country constituting a waterway of total length around 24,140 kilometres (15,000 mi). The rivers covers the landscape of the country as a net and maintain water supply throughout the country. But the rivers also bring disaster through flood. Almost every year during monsoon Bangladesh suffers huge economic loss due to the unpredicted flood which wash away most of the lower lands of Bangladesh.

In disparity, flooding resulting from extreme hydro and meteorological events and taking place in unexpected magnitudes and frequencies can cause loss of lives, livelihoods and infrastructure. They can also damage the environment. In general, it was analyzed that worldwide flood is the most destructive natural hazards causing extensive damage to the built and natural environment, and devastation to human settlements. Economic losses due to the effects of damaging floods have increased significantly in Bangladesh. The frequency of natural disasters has been increasing over the years[1], resulting in loss of life, damage to property and destruction of the environment. With a Proper early warning system can help people to defend themselves from the disaster and reduce loss to a great extent. Side by side utilizing the existing irrigation dam to provide round the year water supply to the cultivation and agricultural field, the agriculture can get a big boost which will finally contribute to the economy of the country. . Generally, the dams are monitored through traditional surveillance techniques and the water management except the monitoring of level of water in some of the dams which is automatized. Management of water resources through dams becomes complex as the number of users depending on dams is huge and these users may have conflicting interests. This situation gets much complex with the fact that the available resources are limited with high possibilities of droughts and floods. This affects the densely populated areas. Dam monitoring is a tedious and long term process which has to be improved step by step. A new system for dam water monitoring and management should be established which can provide water level in real time and can allow us to come to quick conclusions regarding the safety operations of the dams. Internet of Things (IoT) can be defined as a network of devices which are interconnected. It comprises a set of sensors, communication network as well as software enabled electronic devices that enables end users to acquire accurate data from time to time through the communication channel and allows for data interchange between users and the connected devices. This system can be used to automatize the control of dams without human interference. This can also be used to gather information on the level of water throughout the country and can be used to route water based on the requirements. We can get information on the water availability in a particular region and route the water to that area if theres scarcity. This helps a lot in irrigation. Keeping a check on the safety of dam from time to time is one of the important measure to ensure the safety of dams. Use of Wireless sensors network with software for dam safety management helps in improving the functionality of dams. Another aspect of the system is predictive farming using cloud computing and big data analysis. The real time weather monitoring and sharing information over cloud can help farmers to plan ahead the right time for the right crops thus help them economically beneficial.

II. Literature Review

Various efforts have been made to bring early flood detection and warning closer to people to reduce the damage incurred by the flood. Md Nazrin Napiah et al.[2] has proposed and implemented an approach in which they used android application to alert people about the flood. The water level sensor would sense data and send it to a database using a faster and cheaper Zigbee module. Through the database warnings are sent to user after analysing the data. Kalpesh R.Dashpute et al.[3] used ultrasonic sensors, Node MCU

and SMS based service was also approached to alert the rescue team and the residents. Similar kind of work was also done by Jagadeesh Babu Mallisetty et al.[4] with the help of water level, water flow, temperature, humidity, pressure and rain sensors connected to cloud through Raspberry pi 3 and Wahidah Md Shah et al.[5] through sending alert messages to users by the use of GSM module.

The advancement of microcontroller devices has made the theme of Internet of Things(IoT) possible. Mahendra Salunke et al.[6] had analyzed the importance of IoT in terms of flood detection. They proposed a five layer flooding detection system which not only concerns about the rural area but also the urban area. They proposed an algorithm in their paper which helps in the analysis of the data received from the sensor in to the data center. On a wide scale Massimo Ancona et al.[7] has designed and analyzed IoT/M2M based flood monitoring system in urban area through rain gauge and river gauge. But it had to face many challenges regarding power consumption, availability of sensors etc. But the conceptual solution was strong enough.

For effective management of water, usage of microcontrollers and IoT is under a extensive research. UNVP Rajendranath et al.[8] proposed alerting user through SMS service whenever water is necessary in the field by sensing data through moisture and humidity sensor placed at the root of plants was proposed in the early stages of the research. A smart irrigation system was proposed by Kizito Masaba et al.[9] through the use of sprinklers controlled by a microcontroller through a servo motor. The microcontorller communicates with the moisture, temperature and humidity sensors through bluetooth.The system finds out which portion of the field needs irrigation and activates the sprinkler which will fulfill the need of water.

Another idea was generated by Merlin Suba et al.[10] which covers the application of Sensor based Irrigation system through wireless sensor networks, which uses a renewable energy as a source. In this system Wireless Sensor Networks Plays a major role in Environment monitoring system and provides unmanned irrigation. WSN consists of moisture sensors, Energy harvesting systems using PV cells, Boost converter, storage devices for the storage of energy, embedded controllers and uses Super capacitors as storage device. The detection unit consists of moisture sensor, soil fertility sensor and on stream camera.

Predictive farming using Big Data analysis is a rising topic for research. Senthil Vadivu et al.[11] has used this technique on various crop fields to predict and forecast the yield of crop. Their idea is to analyse the attributes of farm land and farming methods and apply predictive analytics methodology over huge data set to forecast the outcome of the commodity. The huge data set can be short and long term weather, data sets and soil category from national soil database etc. Using this Big Data analytics we can apply the result for implementation and design of a feasible network of integrated farm models, crop growth models, soil water balance model, algorithm for machinery selection based on crop type and algorithm for farm optimization. Data inputs can be drilled down to find out the pattern of crops and commodities for machinery and labor availability, crop rotations, yield and crop input maps to work out with marketing strategies and for picking and locating correct inventories to balance the demand and supply.

T Rajasekaran et al.[12] used Waikato Environment for Knowledge Analysis contains collection of visualization tools, algorithms for data analysis and prediction. It directly provides user friendly graphical user interface. It can be used to implement portability, free availability under GNU, data processing and modeling, ease of use due to GUI. It is fully implemented in Java Programming Language.The ZeroR claasifier is simplest classifier. This classifier considers all the target attribute and required possible values. More specifically output will always found using target attribute from given data. ZeroR does not include rule that depends on non target attribute. So we can predict the mean for numerical value given in dataset. ZeroR classifier supports for several data processing tasks, classification, regression, visualization tasks. By using ZeroR classifier, data prediction can be done using the data by assuming that the data is available as single file or relation. Using this algorithm the predictive analysis of the farming field will be much easier.

III. Methodology

Our system consists of two parts. One part is about the hardware setting using the sensors and other part is about the software portion built using the data collected through the sensors.

A. Hardware

We divided our project into some integral parts according to our features. The main features which the project will demonstrate are:

1) Flood Detection
2) Weather Detection
3) Irrigation Control
4) Prediction on Farming

Our goal is to collect enough information through the sensors to provide the aforementioned services.

For Flood Detection we need to measuring the depth of water at different level using water level sensor module at different levels. Also we will take into account the amount of rainfall using rain sensor.

Fig. 1: Water Level Sensor

For Weather detection we will take help of the wind spped sensor, wind direction sensor, rain sensor and BME280

which gives us real time reading of temperature, pressure and humidity.

Fig. 2: Temperature, Humidity and Pressure Sensor

For irrigation control we are taking help of soil moisture sensor which will notify us about the water condition of the field. As per the requirement we will be able to direct flow of water using servo motor to control the gate.

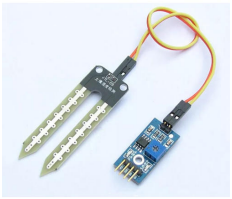

Fig. 3: Soil Moisture Sensor

For predictive farming we will take all the info gathered through our sensor and analyze it to deliver output as per our requirement.

IV. Implementation

In order to fulfill the purpose of our project we started the implementation phase of our project. At first we focused on implementing different sensors that we need. The sensors that are store bought and implemented are:

1) Water Level Sensor
2) Water Flow Sensor
3) BME280 for measuring temperature, humidity and air pressure
4) Soil Ph meter
5) Soil Moisture sensor

For measuring the wind speed and wind direction anemometer we needed a industrial grade anemometer. Since we have decided to provide the services of our project at a low cost so we have gone for the implementation of anemometer and wind direction sensor.

The anemometer is implemented using the hall effect sensor which is also used for water flow sensor. Using three cups we made a round structure which will move in the direction of the wind. We placed the structure on a smooth moving base of a hard disk drive head. The wind moves the cups and the speed of the rotation is measured by hall effect sensor.

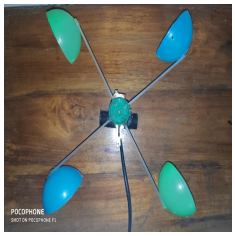

Fig. 4: Wind Speed Sensor

In a similar fashion we have created a wind direction sensor. We placed a arrow with fin on a CD drive motor base which indicates the direction of the wind.

Fig. 5: Wind Direction Sensor

We also implemented a rain gauge as per the Weather Station guidelines and some improvisations. In the weather station the reading is taken manually in a 8 inch diameter container. We also used a 8 inch diameter pipe but instead of manual reading we converted it to digital reading. We used a 5 volt ground and wired the pipe at different height. When water comes in contact with any wire at a particular height which gives us reading that amount of rain is upto this height.

Fig. 6: Rain Sensor

After implementing the sensors we started designing our prototype. We created a box of 24*14*7 cm dimension made of partex. We implemented a dam to contain the water. As per the structure of dam and spillway we tried to recreate the structure though we are not concerned about the structure. Our concern is to control the gate of the spillway remotely using our sensors. We used servo motor to control the gate of the spillway. After implementing the main flow of water we also depicted two fields in the ground. We placed one soil moisture sensor on each field. For flowing water into the canal and controlling the irrigation we used gates controlled by servo motor and water pump to pump water into the field.

Fig. 7: Project Prototype

V. Experimental Result

The goals of our system is to provide the listed features above. Among them we have been able to provide flood warning, irrigation control and weather prediction with some help of external dataset. We are still working on predictions regarding farming. We will be updating our project for further development in that regard. But the basic structure of our project is established and we can deliver a prototype. All the sensors of our project are working fine and they are sensing data from the environment which are then used to control the irrigation of the land. The gates are controlled by servo motor and water is distributed in the land using pump. In case of excess water in the land we can suck out the water by reverse pumping using the same water pump.

VI. Future Works

This project is intended to work as a agricultural guide for a typical farmer. So we can add further features to this project which will help the farmers to keep track of their farming land more efficiently. We can add pesticide control as a feature of the project where the user can automatically control and prevent the side effects of pesticide in the field. We can also add a feature which will give the farmers update about their crops even if the farmers are not in the field. In these way our project can help in lot of ways to the farmers to control their agriculture digitally and efficiently.

VII. Conclusion

Digitization of the Agricultural sector of Bangladesh is a must to improve the production level of our country. For that we need to come up with new ideas and experiments to help the production of crops as much as possible. Again we need to keep in mind that the experience of the farmers are lot in this aspect. So we need to create a perfect balance where the farmers can exert their experiences and also use the help of technology as smoothly as possible. Our project is keeping this aspect in mind and trying to help in the betterment of the agricultural sector of Bangladesh.

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