CHAPTER II

REVIEW OF LITERATURE

Design and development of any system need background knowledge. So, A brief summary of research on the evaluation of smart runoff measurement system reviews is categorized as given below.

2.1. Runoff

2.2. IoT in Agriculture

2.3. Ultrasonic Sensor

2.4. I2C Communication

2.5. Web Application

2.1 Runoff

Sherman and Mockus (1949) proposed plotting direct runoff versus storm runoff. Also building on this idea suggested that surface runoff could be estimated from collection of factors: soil type, areal extent, and location, land use, antecedent rainfall, duration and depth of a storm, average annual temperature and date of storm.

Wendt *et al.* (1986) evaluated that event coefficients of variation were relatively constant for both runoff and soil loss at about 20% except for events producing low runoff and soil loss. Differences in runoff and soil loss among plots varied with event. Only minor amounts of observed variability could be attributed to any of several measured plot properties, and plot differences expressed by the 25 events did not persist in prior or subsequent runoff and soil loss observations at the site. The relatively huge amount of unexplained variability shows that several replications of treatments are needed to confidently estimate mean runoff or soil loss for comparison purposes and those effects of factors having relatively minor effects on runoff or soil loss may be difficult to detect statistically.

Chaudhary *et al.* (2013) investigated experimentally the effect of watershed (i.e. field plot of 22mx5m) slope on rainfall-generated runoff and resulting curve numbers (CN) for a given soil (Hydrologic Soil Group C) and land use of sugarcane.

As expected, the plot of 5% slope yielded the largest runoff and, in turn, CN compared to those due to the plots of 3% and 1% grades, for the same rainfall, soil, and land use. The derived CN values are fairly close to those from NEH-4 (National Engineering Handbook section-4) CN-values, supporting the applicability of NEH-4 CN values to Indian watersheds.

Balvanshi and Tiwari (2014) studied on indirect methods for the computation of runoff is the National Resource Conservation Service curve number method. This paper gives a review of the origin of the curve number method and development of the curve number equations. The Natural Resource Conservation Service curve number technique is a well-accepted tool for the estimation of direct runoff from storm rainfall. CN model is used where constraints like slope, land cover, type of soil. area of watershed etc. are considered for runoff estimation.

Stewart *et al*. (2014) developed a new instrument to measure plot-scale runoff. Accurate measurement of the amount and timing of surface runoff at multiple scales is needed to understand fundamental hydrological processes. At the plot-scale (i.e., length scales on the order of 1 to 10 m) current methods for direct measurement of runoff either store the water in a collection vessel, which is unconducive to long-term monitoring studies or utilize expensive installations such as large-scale tipping buckets or flume/weir systems. We developed an alternative low-cost, robust and reliable instrument to measure runoff that we call the "Upwelling Bernoulli Tube" (UBeTube). The UBeTube instrument is a pipe with a slot machined in its side that is installed vertically at the base of a runoff collection system. The flow rate through the slot is inferred by measuring the water height within the pipe. The geometry of the slot can be modified to suit the range of flow rates expected for a given site; we demonstrate a slot geometry which is capable of measuring flow rates across more than three orders of magnitude (up to 300 L min−1) while requiring only 30 cm of hydraulic head. System accuracy is dependent on both the geometry of the slot and the accuracy of the water level measurements. With an off-the-shelf pressure transducer sensor, the mean theoretical error for the demonstrated slot geometry was ~17% (ranging from errors of more than 50% at low flow rates to less than 2% at high flow rates), while the observed error during validation was 1–25%. A simple correction factor reduced this mean error to −14%, and further reductions in error could be achieved through the use of taller, narrower slot dimensions (which requires greater head gradients to drive flow) or through more accurate water level measurements. The UBeTube device has been successfully employed in a long-term rainfall-runoff study, demonstrating the ability of the instrument to measure surface runoff across a range of flows and conditions.

Cao *et al.* (2016) runoff plot is a useful tool for erosion and hydrologic monitoring. Previously, the methods of V-notch weir, flow flume, and tipping bucket have been widely used to measure the runoff and sediment on the slope. Here, we report an automatic runoff and sediment monitoring system developed based on the tipping bucket method. This monitoring system consists of a tipping bucket flow sensor, a distributed water sample acquisition device, and a dot counter. This system can perform the distributed acquisition of runoff and sediment samples and the automatic measurement of runoff at any time point. Compared to the conventional water sample acquisition method and the existing runoff measuring methods, this system is highly automatic, easy to operate and electricity-free. Hence, the new system is suitable for fieldwork. This monitoring system can be widely used to monitor the soil erosion process of slope runoff plots, which is characterized by non-pressure, low head, and small flow, under natural and artificial rainfall conditions. Therefore, this system can be widely used in runoff plots for erosion research.

2.2 IoT in Agriculture

Yuan *et al.* (2016) Internet of Things (IoT) technology has become one of the leading subjects of scientific research field because of its potential application. This paper briefly introduced the introduction of IoT technology and agriculture IoT technology. Agriculture development in China is transiting from traditional to modernization, and equipment with modern material conditions is urgently needed. In the first section, it describes the concept of IoT and agriculture of things, as well as some of the key technologies of agriculture networking applications, namely (a) agricultural sense technology; (b) wireless transmission technology; (c) RFID technology; (d) agricultural product quality security technologies; (e) intelligent irrigation technology; and (f) precision seeding and spraying techniques, The second part introduces the development status of IoT technology in intelligent agriculture, and the use of resources in agriculture, agroecological monitoring of the environment. and agricultural production of fine management, application analysis and safety of agricultural traceability aspects. With the development and progress of science and technology, information technology in agriculture has become increasingly important, especially in recent years. With the development of new networking technologies, intelligent agriculture also shows a broad development prospect.

Mohanraj *et al.* (2016) studied Field Monitoring and Automation using I0T in Agriculture Domain Agriculture sector in India is diminishing day by day which affects the production capacity of ecosystem. There is an exigent need to solve the problem in the domain to restore vibrancy and put it back on higher growth. The paper proposes an e-Agriculture Application based on the framework consisting of KM Knowledgebase and monitoring modules. To make profitable decisions, farmers need information throughout the entire farming cycle. The required information is scattered in various places which include real-time information such as market prices and current production level stats along with the available primary crop knowledge Acknowledge dataflow model is constructed connecting various scattered sources to the crop structures. The world around is getting automated replacing manual procedures with the advancement of technology, since it is energy efficient and engross minimal manpower. The paper proposes the advantages of having ICT in Indian agricultural sector, which shows the path for rural farmers to replace some of the conventional techniques. Monitoring modules are demonstrated using various sensors for which the inputs are fed from Knowledgebase. A prototype of the mechanism is carried out using TI CC3200 Launchpad interconnected sensors modules with other necessary electronic devices. A comparative study is made between the developed system and the existing systems. The system overcomes limitations of traditional agricultural procedures by utilizing water resource efficiently and also reducing labour cost.

2.3 Ultrasonic sensor

Wang *et al.* (2013) studied on design and application of distance measure ultrasonic sensors. An ultrasonic sensor to detect the distance measurement system is introduced. They reported the working principle of ultrasonic distance measurement, the structure properties of ultrasonic sensors, the ultrasonic sensors in the transmitter and receiver probe and their inter-action problem in details. Ultrasonic sensor is a component of detecting the distance. STC89C52 SCM (single chip machine) is a control component. The system mainly consists of five parts, such as the smallest single-chip system, the ultrasonic transmission circuit, the ultrasonic receiving circuit, the digital display circuit and the alarm circuit. Application software of ranging is written. The accuracy and error in the other related issues of the distance ultrasonic sensor are studied by experiment. The system is designed for portable, low power consumption and high precision. It can be applied to water level measurement, robot obstacle avoidance, parking sensor and other areas.

Panda *et al.* (2016) studied the effects of environment on accuracy of ultrasonic sensor operates in millimeter range. The growing use of ultrasonic sensor now demands millimeter range of operation with high accuracy. Ultrasonic sensor uses sound waves for its ranging and the speed of sound is influenced by many environmental parameters. They discuss the list of environmental parameters which have a major influence on the accuracy of the ultrasonic sensor and also to formulate a simplified mathematical equation to calculate instantaneous speed of sound by considering these influencing parameters. Comparison result shows the derived simplified equation for calculating instantaneous speed of sound gives maximum percentage error of 0.33 for the temperature range of 0-50 C. They focus on the steps to calibrate ultrasonic sensors for millimeter range of operation.

2.4 I2C communication

Jacob *et al.* (2016) evaluated I2C communication in development of modular controller boards. This study proposes the usage of I2C, (Inter-Integrated Circuit) communication protocol for a modular general purpose controller board of mobile robots. For the past few years, a trend of purchasing an off the shelf controller board by designers that would later be altered to fit a robot specification and design are increasing. This modular controller board allows users to use this modular controller board for their designs with minimal modification or without. Rather than purchasing an all-in-one controller board that might be costly, modularity means that only the needed modular board is requested to be purchased. A total of four modular controller boards have been developed, which are main controller module, motor controller module, sensor module, pneumatic controller module, and one extension power supply module. All these modular controller boards incorporate the latest I2C communication protocol between the modular boards, which is faster and reduces the connecting wire between the modular boards. The potential of using I2C communication protocol in the proposed board is verified through a comprehensive series of experiments and the results suggest that the I2C is suitable and robust enough to be used in the development of this modular boards.

Kaith *et al.* (2016) reported that an implementation of I2C Slave Interface using Verilog HDL. The focus of this paper is on implementation of Inter-Integrated Circuit (I2C) protocol following slave module for no data loss. They introduced the principle and the operation of I2C bus protocol. It follows the I2C specification to provide device addressing, read/write operation and an acknowledgement. The programmable nature of device provides users with the flexibility of configuring the I2C slave device to any legal slave address to avoid the slave address collision on an I2C bus with multiple slave devices. This paper demonstrates how I2C Master Controller transmits and receives data to and from the Slave with proper synchronization.

2.5. Web Application

Kao. *et al.* (2018) design and developed an IoT-based web application for an intelligent remote SCADA system. They gave a design of an intelligent remote electrical power supervisory control and data acquisition (SCADA) system based on the Internet of Things (IoT), with Internet Information Services (IIS) for setting up web servers, an ASP.NET model–view– controller (MVC) for establishing a remote electrical power monitoring and control system by using responsive web design (RWD), and a Microsoft SQL Server as the database. With the web browser connected to the Internet, the sensing data is sent to the client by using the TCP/IP protocol, which supports mobile devices with different screen sizes. The users can provide instructions immediately without being present to check the conditions, which considerably reduces labor and time costs. The developed system incorporates a remote measuring function by using a wireless sensor network and utilizes a visual interface to make the human-machine interface (HMI) more instinctive. Moreover, it contains an analog input/output and a basic digital input/output that can be applied to a motor driver and an inverter for integration with a remote SCADA system based on IoT, and thus achieve efficient power management.

Channe *et al.* (2018) developed multidisciplinary model for smart agriculture using Internet-of-Things (IoT), sensors, cloud-computing, mobile-computing & big-data analysis. Although precision agriculture has been adopted in few countries; the agriculture industry in India still needs to be modernized with the involvement of technologies for better production, distribution and cost control. They proposed a multidisciplinary model for smart agriculture based on the key technologies: Internet-of-Things (IoT), Sensors, Cloud-Computing, Mobile Computing, Big-Data analysis. Farmers, Agro Marketing agencies and Agro-Vendors need to be registered to the Agro Cloud module through Mobile App module. Agro Cloud storage is used to store the details of farmers, periodic soil properties of farmlands, agro-vendors and agro-marketing agencies, Agro e-governance schemes and current environmental conditions. Soil and environment properties are sensed and periodically sent to Agro Cloud through IoT (Beagle Black Bone). Big data analysis on Agro Cloud data is done for fertilizer requirements, best crop sequences analysis, total production, and current stock and market requirements. Proposed model is beneficial for increase in agricultural production and for cost control of Agro-products.