CHAPTER-2

LITERATURE REVIEW

2.1 LITERATURE REVIEW

ZHANG Xiaoshuan et. al suggests a system for precision irrigation for vine's growth by developing a PVIDSS system and provides an efficient way to improve the irrigation efficiency [17].

Limitation- Paper suggests improving the irrigation efficiency, but doesn't discuss any procedure to monitor the values of parameters required to make it more efficient.

Aggarwal, Rajan, et al. discusses about one of the major problems for irrigation in an agriculture field is the shortage of water. WSN based weather forecast information using GSM is developed, which is on the bases of data collected from sensors [18].

Limitation- Paper discusses the GSM based WSN system which is licensed network and hence user needs to pay for using the network. Present requirement is license free network where end user need not pay for the use of network.

Kuang-Yow Lian et al. proposes a system which monitors the environmental parameters like temperatures, humidity , quality of air and the electric load. The system is implemented using smart phones. The developed system will also be able to measure the vibrations of operating machinery.

For intelligent monitoring, ZigBee and Wi-Fi protocols are used. The integrated system is fabricated by 32 bit ARM core Arduino Duo module. The measurement results were displayed using the Android and web based system. TCP/IP protocol has been used to transmit the data to a cloud device [19].

Limitation- Zigbee, Wi-Fi and ARM based factory monitoring system is discussed, but the issue of cost and code size has not been tackled in this paper. It is not a cost effective solution.

Mohamed Hefeeda et al. in this paper a sensor network has been designed for observing early symptoms of fire in the forest. Fire weather index system is analyzed for this purpose. With the help of wireless sensor network efficient fire detection system has been developed. [20].
Limitation- Paper discusses the use of fire sensor in forest, but doesn't include other components for wild life security.

Garcia-Sanchez et al. demonstrates an Irrigation Management System by using wireless sensor network. Paper talks about an advanced irrigation scheduling based on IMS for Manja Township, City of Blantyre. The system is based on a remote monitoring mechanism using GPRS modem [21].
Limitation- The system is based on GPRS, which is not a cost effective solution.

Wang, Ning et al. proposes a routing method for efficient Irrigation Management System using Bluetooth sensor. Paper describes a multi hop Bluetooth ad-hoc network model. The model collects data from sensor through Bluetooth sensor and alerting the farmer with mobile phone [22].
Limitation- The proposed system is based on Bluetooth network and alerts the farmer by sending message on mobile phone, which is not a cost effective solution.

Wenyan, Li. proposes a solar energy based water-saving irrigation system using the ZigBee wireless sensor network. Zigbee nodes collect the data from soil temperature and moisture sensors and transmit the data by the GPRS network [23].
Limitation- Paper describes only the irrigation system but doesn't include other important parameters like fire sensor, gas sensor etc.

Fried Ewald et al. describes the several challenges to be addressed in implementation of ubiquitous computing. The next generation technological

innovation will be through this technology. In this paper the author suggest methods to implement ubiquitous computing by considering the criteria of economic sustainability and social computability [24].

Limitation- The paper describes the technical and legal challenges of ubiquitous computing, but implementation strategies are not discussed.

Venayagamoorthy describes the Wireless sensor networks (WSNs), its challenges, failures, and computational constraints. Further importance of computational intelligence for WSN is discussed. This paper shows that computational intelligence conveys additional features in the WSN like flexibility, autonomous behavior and robustness. It also takes care of communication failures and scenario changes. A comparison of computational intelligence algorithms with WSN solutions is described [25].

Limitation- Importance of computational intelligence in WSN is discussed but its role in agricultural field is not included. The implementation strategies are also not discussed.

Mrugala et al. in this paper a management application of an automobile warehouse has been proposed for dynamic locating the automobile using handheld device. This device will be worn by the end user for monitoring the warehouse and to compute the parking space dynamically [26].

Limitation- A computing system is proposed for warehousing of automobiles, but its application in other related field like environmental monitoring is not discussed.

Velázquez et al. proposes a handheld assistive device for the blinds to improve the quality of life. [27].

Limitation- The paper describes the RF communication but doesn't include its application in the other related fields.

V.Vanitha et al. discusses an extended service oriented architecture for designing customizable sensor network and also discusses the solution to overcome the limitation of sensing systems like robustness, complexity etc. The system is basically improvement in service oriented architecture of embedded systems [28].
Limitation- Paper describes the architecture for wireless sensor networks but doesn't discuss about application of WSN in related fields like precision agriculture etc.

Goel et al. suggests a solution for measuring and controlling **the environmental parameters like temperature, pressure and humidity remotely by using** an integrated wireless SCADA system. It consists of GPRS based mobile network and The SCADA system is integrated with GPRS mobile network . **D**ata collection or data logging can be done in faster and cheaper way in this system by using the personnel free inspection. [29].
Limitation- This paper proposes GPRS based monitoring system which has wide coverage range but needs large infrastructure for implementation.

Chengbo Yu et al. propose an environment monitoring system and discuss the reason of choosing ZigBee technology as communication module in Wireless Sensor Networks. The system uses CC2430 board and verifies the correctness and feasibility [30].
Limitation- Wireless sensor network based monitoring system is discussed using Zigbee, but its application in agricultural field is not included.

Jiang, Peng, et al. describes a wireless sensor network based measurement and control of water environmental system. The system has been implemented by three nodes. They are base station node, remote control node and data monitoring node. The system developed has accomplished the task of online measurement of ph value and the temperature of the water [31].

Limitation- Paper only discusses about water monitoring system using only one type of sensors. The problem of implementing multiple sensor nodes using WSN are not discussed.

Dr.S.S.Riaz Ahamed in this paper the IEEE ZigBee slandered has been discussed. The paper suggests that network security is provided by Zigbee which can be implemented for small power consumption and minor cost [32].
Limitation- Paper is all about the features of ZigBee technology, but its applications in wireless sensor networks are not included.

Luis Ruiz-Garcia et al. in this paper the application of latest technical and scientific innovation in wireless sensor networks for the agriculture and food sector. The main focus of the paper is on WSN, RFID and ZigBee. The future applications of wireless sensor network in agricultural and food industry have been illustrated [33].
Limitation- The system that uses technologies related to RFID and Zigbee is developed for agri-food industry but the effects of various environmental parameters on the agri culture field are not discussed.

Mitsugu Terada in this paper a sensor network based on ZigBee module has been proposed for acquiring and monitoring data. In this implemented sensor network PC acts as a base station. ZigBee module communicates to PC via USB interface. The sensors collect the data and communicate to the base station. The format used for data recording in the display device is by means of hexadecimal number system [34].
Limitation- However the latest technology is aiming at development of small handheld / wearable devices for recording of data.

E.S. Nadimi a,b et al. in this paper a system has been developed for monitoring online the presence or absence of cows in a grassy area by using wireless sensor

network. Wireless sensor nodes are attached to the cows which can communicate with central station or server via gateway [35].

Limitation- Zigbee based animal monitoring network is developed but its application for a monitoring environmental parameters were not discussed.

Cho, Min Je, et al. discusses the role of ubiquitous sensor networks in disaster preventing system. The system proposes a platform to prevent man-made disasters in case of a gas leak explosion by monitoring and controlling relevant facilities [36].

Limitation- The paper describes the role of sensor networks for monitoring environmental parameters but only limited to gas sensor.

V. G. Sangam et al. in this paper a data acquisition system has been interfaced with AT89C51 microcontroller for development of bio analyzer for monitoring concentration of glucose**.** The optimization of different parameters has been done for performance enhancement [37].

Limitation- System is developed using AT89C51 microcontroller. More cost effective and high performance solutions could be used.

Liu, Chong describes the importance of wireless sensor networks for collecting and monitoring environmental variables such as meteorological parameters or pollutants.

The system can efficiently monitor and detect anomalies, a context for the monitoring and near-real-time assessment of environmental data is proposed that offers reduced data representation utilizing fuzzy clustering for the shrinkage of spatial data combined with an LZW scheme for the compression of temporal data [38].

Limitation- The paper describes the implementation of system based on fuzzy logic. The other less complex algorithm can be used for the same purpose.

Kamarul Ariffin Noordin suggests an implementation scheme for remotely measuring environmental parameters like temperature, atmospheric pressure and relative humidity by using the sensors. The sensors output are analog in nature and hence converted to digital signal by means of a Analog to digital converter interfaced with a microcontroller.

A data logger is interfaced through an USB port to PC. The measured signal is displayed in a LCD. Data analysis is done by the PC with a graphical user interface . [39].

Limitation- A data logger is implemented through the USB link with PC, which is neither portable nor a user friendly solution. The display used in this paper is a LCD display. More cost effective solutions like by displaying in LED's or wearable devices are feasible.

Zhang, Qian, et al. presents a low power ZigBee sensor network with bidirectional communication and control of inter-node data pack reception designed for use in agricultural fields. The network consists of sensors, routers to propagate over larger distances, and a computer to controls the complete system. The end devices provide data from the sensors to the personal computer at variable time points determined by the central node. The central node controls the water flow to the plants in a greenhouse [40].

Limitation- Paper describes the neural network based irrigation control system only more parameters could be monitored and controlled which is not discussed.

Frigioni, Daniele et al. discusses Demetreseu and italiano's algorithm for routing for maintaining shortest path for all pairs of nodes [43].

Limitation- The paper discusses only one type of algorithm without comparing it with other related algorithms.

T. Starner explores the possibility of harnessing the energy during the user's everyday actions to generate power for his or her computer. Power generation by leg motion is analysed [44].
Limitation- Power generation by leg motion is described but its applications and result analysis are not included.

Marinetti, Luca, et al. discusses about a neural network based intelligent water-saving system. In this paper soil moisture sensor, air temperature sensors are used as precise irrigation equipment for best water utilization [45].
Limitation- This paper does not discuss other methods for implementing intelligent systems. The paper only describes few limited sensors.

Rasin, Zulhani et al. elaborates the use of wireless sensor network (WSN) for a water irrigation control monitoring. In this paper, the authors shows a system where water flow is controlled through a control room by giving command to motors, based on data collected from sensor nodes [46].
Limitation- WSN based water irrigation system is discussed but real hardware is not developed, implemented and tested.

Catarinucci, Luca shows simulation based results for irrigation applications based on Wireless sensor networks using Zigbee. Simulation results show the robustness of the proposed multipath links using dynamic multi paths [47].
Limitation- Only simulation based results are discussed. However no hardware system is implemented.

Gagnon, Romain presents, a pumping station measurement and control system by using ZigBee and 3G network. The experimental results show that the system overcomes the defects of control system [48].

Limitation- The paper describes the Zigbee and 3G based networks. But it doesn't discuss the comparison of other technologies related to wireless communication.

Dursun, Mahir et al. in this paper author has designed a method for precision irrigation by implementing fuzzy logic. The paper infers that the system will be having high reliability in terms of communication and high accuracy in terms of control [49].
Limitation- The test results are based on simulation only, no hardware implementation is discussed.

Kim, Yunseop et al. has developed and implemented an automated sprinkler irrigation system which would be site-specific and by utilizing it amount of water can be saved. Authors have also incorporated the technical specifications of ZigBee network [50].
Limitation- This system is focused only one parameter. The other relevant parameters have not been discussed.

Gutierrez, Jessica, et al. in this paper authors have implemented an interfacing of temperature and soil moisture sensors with microcontroller in order to control the actuators [51].
Limitation- Information on the environmental parameters are not displayed for easy monitoring by the end user.

Ganesan, Deepak, et al. describes the importance of wireless sensor networks for collecting and monitoring environmental variables such as meteorological parameters or pollutants. The system can efficiently monitor and detect anomalies. A context for monitoring and near-real-time assessment of environmental data is proposed which offers reduced data representation utilizing fuzzy clustering for the shrinkage of spatial data [52].

Limitation- The paper discussed the development of fuzzy logic based wireless sensor network for monitoring the environment parameters, which is complex system. Other simple solutions are not discussed.

Zhang, Yang et al. The paper discusses about measurement of parameters which is situated away from the main body of the wireless sensor network. Errors , noise, security are examples of this type. This paper compares the existing techniques and provides a guideline for selecting a technique for a particular solution. [53].

Limitation- this paper discusses guidelines but actual implementation scheme for the measurements are not shown

Ganesan, Deepak et al. in this paper the author explores the feasibility of a system for networking many numbers of wireless devices whose size can be small and consumes less power. This paper also proposed a system that tries to implement uniformity in sensor network for handling of the observed data [54].

Limitation- The paper discussed the data handling in sensor networks with pattern mining. The real hardware development and implementation is not discussed.

Alippi, Cesare, et al. in this paper the author presents a detailed analysis of the major problems in the wireless sensor networks in terms of energy. The author also discusses that lifetime of a battery is limited and it is the only source of power for sensor nodes. Hence it infers that the major requirement for sustenance of the wireless sensor network will depend upon how efficiently energy is managed in the network [55].

Limitation- Paper focuses on the management of energy in the sensor network. It discusses the policies to use energy efficiently. No hardware complexities are discussed.

Lee et al. the author has implemented wearable device based electrocardiogram measurement system for monitoring of health in real time. The wearable device can be fixed on shirt for transmitting signals from the body continuously. The sensors worn in the shirt consumes small power and is very compact in size. The noises are eliminated by using adapted filter [56].

Limitation- Wearable technology for health monitoring is explored in form of a shirt. However displaying a communication of other types of signal is not included in this paper.

Varkey et al. proposes a novel wireless sensor based system for recognition of daily work done by the workers in specific company. Furthermore a new algorithm is designed and implemented in order to observe the amount of work done and the payment is done on that basis [57].

Limitation- The paper describes the algorithm to control the on fly range movements and same algorithm is used for controlling the motor movement, but the performance is not compared with other algorithms.

Milenković et al. in this paper the author has implemented a prototype for monitoring of health using sensor network. In this paper the author has developed the overall architecture and has discussed about the organization of hardware and software. The synchronization of time, management of power and signal processing on the chip has also been implemented [58].

Limitation- The paper discussed the use of sensor network for health monitoring by observing the motion and heart activities of the person. The other applications for the same type of network are not discussed.

Pandian et al. in this paper the author has discussed about the implementation of wearable device based physiological monitoring and its applications. Wearable sensors which are fixed to the fabric of the clothes collect information from the human system and send the physiological data to a data acquisition system. The

system after acquiring data processes it and then transmits it to remote location for monitoring [59].

Limitation- Wearable technology for physiological monitoring is discussed. The applications of this technology for other applications need to be explored.

Darwish et al. In this paper the author has shown the importance of body area network and WSN for monitoring of health of the patients. The author has also shown how this technology can be utilized for monitoring of health old and disabled and also discusses ways and means by which these disadvantaged people can live a normal life by using this technology. It also presents the drawbacks and problems faced by present day technology. [60].

Limitation- The paper describes about the application of WSN in monitoring health parameters but application for other parameters are not described.

Tsow, Francis, et al. the author has implemented a bluetooth interfaced based toxic sensors. By means of experiments the authors have shown that the system can detect the desired toxicity. The other applications of the system like detecting various gases are also demonstrated [61].

Limitation- The paper describes the development of device which can detect toxic volatile organic compound and results show the device is useful in environmental health monitoring. Bluetooth has been used for communication which has a very limited range. Sensors nodes for other types of sensors are not discussed.

Alemdar et al. In this paper author reviews the existing health care system of elderly persons and children. The paper also demonstrates the use of wireless sensor network for day care and active life of the citizens. It also analysis the challenges and benefits faced by the existing system [62].

Limitation- Paper includes the review for already existing health care system based on wireless sensor networks for health care, but doesn't discuss on implementation strategies.

Römer et al. the paper describes a multidisciplinary research area for collaboration between various stack holders in wireless sensor network and infers that a close collaboration is required in order to design an efficient system [63].
Limitation- Paper describes the multidisciplinary research area in the wireless sensor networks but its real hardware complexities are not discussed.

Ndzi, David Lorater, et al. In this paper the authors have calculated the attenuation of signal due to different types of vegetation like mango and palm oil The paper also suggests the best model for deployment of sensor nodes in agricultural fields. The paper also suggests the best position of placement of nodes in different types of plantation.[64].
Limitation- The vegetation attenuation model shows only the attenuation of signals at different frequencies for different plants but algorithm for optimum placement of nodes are not discussed. Simulation of optimum placement of nodes were also not done.

Yahide et al. elucidate how web based intelligent drip irrigation system is solution to water management and precision agriculture. In web based system water supply can be controlled by using solenoid valve. The whole system is micro control based and can be operated from remote location. Smart sensor based decision making by end user like farmer is implemented in this paper is used to take sensor reading of soil like soil moisture, temperature, air moisture and light micro controller take decision control by user (farmer). Web based intelligent irrigation system helps a farmer to take decision on water management in farm and there is no need to maintain irrigation time table [65].

Limitation- The paper elaborates the web base precision agriculture for water management system. But this is not a cost effective solution for farmer.

Kulkarni et al. the author discusses about networks of autonomous sensor nodes for environmental monitoring. It also discusses various challenges of the WSN. The paper goes on to discuss the use of particle swarm optimization for solving the optimization issues for deployment and localization of sensor nodes [66].

Limitation- The paper describes the PSO as optimization algorithm for optimal deployment of nodes in field for WSN. But hardware implementation of the deployment is not discussed.

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Wenqi, G. U. O. et al. proposes a variety of mathematical models to serve as analytical tools in quantifying battery discharge characteristics. However, batteries, as the primary power supply, still fail to last their projected working time. To further analyze the factors that affect battery discharge, and understand the characteristics of WSN power supply, this paper surveys both physical and network communication parameters that can affect battery lifetime and cause the difference between the simulation and application results. Furthermore, it introduces new energy harvesting techniques such as photovoltaics or piezoelectric generators [67]

Limitation- The paper focusses on the energy efficiency of WSN. It discusses different techniques for energy harvesting, but it is only survey based data and no experiment has been performed for data collection.

Park, Gyoutae, et al. has developed a system for improving the management of gas safety with the help of WSN and smart appliances. The system includes the subsystems for automatic extinguishing , detection of gases. It also includes the gas meter controlled by a microcomputer for monitoring gas flow and pressure. The whole procedure of early warning in case of a gas flow to the detection of any hazardous gases is controlled by the network[68].

Limitation- The develop system has only one type of sensor. However the effect and measurement of other environmental parameters are not discussed.

Kulkarni et al. this paper describes the implementation strategies for UAV assisted deployment of sensor nodes. The image processing techniques are used for identifying the exact place of deployment and PSO and BFA are also used for deploying the WSN nodes. The paper infers that PSO based localization is faster than BFA but less accurate [69].

Limitation- The UAV is used for disaster monitoring in the given paper. PSO and BFA are used for image segmentation and deployment of sensor nodes. But only simulation results are discussed, real hardware complexities are not discussed or considered.

Jose, Deepa V et al. Mobile sink assisted algorithm for efficient energy management in WSN has been simulated in this paper[70].

Limitation- Only simulation has been done but no hardware implementation of the same has been discussed.

Bai Q et al. the author has presented algorithm for implmentation of PSO. The same can be used for rapid development and it is easy to use. The author also has shown various applications of PSO in different technological fields[71].

Limitation- PSO has not been implemented for the specific instance of autonomous deployment of sensor nodes.

Gupta B.K et al. this paper describes how to use PSO for placement of nodes. It adresses the issues related to optimal deployment of sensor node. It also gives comparisoin between various optimization algorithm and infers that PSO gives a better solution[72].

Limitation- the implementation of the algorithm using standard simulation software is not done.

B.S.Paul et al. describes how wireless communication in an agricultural field is adversely affected by vegetation in the surrounding. In this paper the author also proposes model for optimum placement of these nodes when agricultural field is surrounded by vegetation. [73]

Limitation: Only one type of vegetation was considered. The scattering effect for different vegetation will be different.

Nikitha et al. describes deployment of sensor nodes using PSO. The author also tries to maximize the coverage by placing the nodes optimally. [74]

Limitation: It only considers the placement of nodes in the barren field without vegetation.

2.2 Chapter Summary

From the literature review, it can be inferred that the wireless sensor network has very important role in precision agriculture. There are sensors available to monitor the field parameters which need to be interfaced with advance controllers for proper monitoring and measurement of environmental parameters relevant to agriculture field. Although interfacing of such devices for limited number of sensors have been reported in the literature but an integrated system for measuring and controlling a major section of environmental parameters need to be implemented. Also the display of such data on a user friendly /handheld device for ready interpretation by a non-technical person like farmer also needs to be implemented. The optimum placement of sensor nodes have been reported but the effect of various types of surrounding vegetation on placement of these nodes and its software solution using optimization technique needs to be implemented.