Agriculture Parameter Monitoring Using Raspberry Pi : A Review

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Abstract– *In This Paper, Raspberry pi based agriculture parameter monitoring using ARM microcontroller that measures and controls different global parameters. The system consist of master and slaves with wireless method of communication with Raspberry pi. The parameters that can be followed Humidity sensor, Temperature Sensor, and IR sensor. Master node collects the parameter data from the slave node. Here raspberry pi act as a slave node and master node is ARM controller.*

Keywords- *Raspberry pi, ARM Microcontroller, Temperature Sensor, Humidity Sensor, IR Sensor.*

I. INTRODUCTION

The modern world is in a transition stage where problems regarding global issues, such as global warming and alternative energy sources, are integrated with new challenges demanding immediate solutions. Society's center of attention has shifted from economic growth to sustainable development, where environmental, social, and economic features are considered together, rather than separately. Policies that developed sustainability in all sectors of the economy (manufacturing, agriculture, and services) are now considered as a part of good governance. Problems such as climate change, population growth, and poverty (especially hunger), occur in a context of a slow consumption of natural resources and the agitation of reduced coal energy stocks. These are some of the global issues that are thought to need multidisciplinary perspective in order to be addressed successfully. This system focuses on agricultural production and improvement. This overall process has a important role in fulfilling the basic human requirement for food. The production, preparation, packaging, used closed loop irrigation system and determined irrigation amount based on distributed soil water measurements. Irrigation systems can also be automated through information on volumetric water content of soil, using dielectric moisture sensors to control actuators and save water, in place of a predestined irrigation schedule at a particular time of the day and with a particular duration. The technological growth in Wireless Sensor Networks made it possible to use in monitoring and control of greenhouse parameter in precision agriculture.

II. LITRETURE REVIEW

After the research in agriculture sector, researchers found that an amount produced of agriculture product goes on decreasing day by day. We use of technology in the area of agriculture plays important part to Increasing the production as well as diminishing extra man power, water requirements A fully automation accessing of irrigation motor where Prototype consists number of sensors node placed in different directions of Polly house farm field. Each sensor is integrated with a wireless networking device and data received. The Raspberry Pi 3 is used for transmit message through internet [1] Used closed loop irrigation system and determined irrigation amount based on distributed soil water measurements [2] Irrigation systems can also be automated through information on volumetric water content of soil, using dielectric moisture sensors to control actuators and save water, instead of a predetermined irrigation schedule at a particular time of the day and with a specific duration [3]. The technological development in Wireless Sensor Networks made it possible to use in monitoring and control of greenhouse parameter in precision agriculture [4].

III) SYSTEM STRUCTURE

The designed system consists of various modules: Raspberry pi, ARM Microcontroller, Temperature Sensor, Humidity Sensor, IR Sensor.

A. Block Diagram:

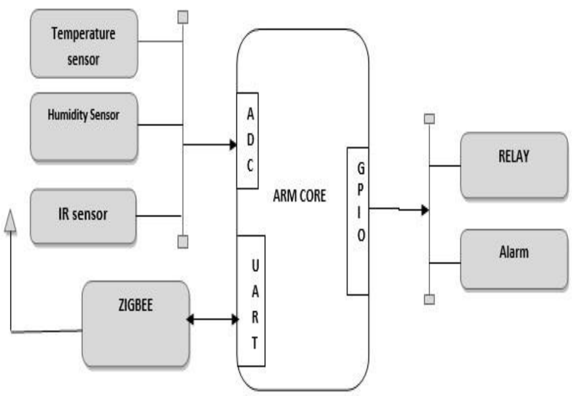

Fig. 1 Master section

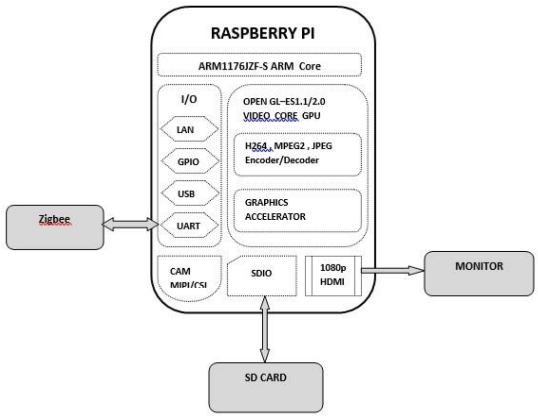

Fig.2 Slave section

Hardware Used:

a) Raspberry Pi:

The Raspberry Pi is small pocket size computer used to do small computing and networking operations. It is the main element in the field of internet of things. It supply access to the internet and hence the automation system with faraway location controlling device becomes possible. Raspberry Pi is obtainable in various versions. Here, model Pi 2 model B is used and it has quad-core ARM Cortex-A53 CPU of 900 MHz, and RAM of 1GB. it also has: 40 GPIO pins, Full HDMI port, 4 USB ports, Ethernet port, 3.5mm audio jack, video Camera interface (CSI), the Display interface (DSI), and Micro SD card slot.

Fig.3. Raspberry Pi

b) Temperature and humidity sensor

Temperature and humidity are important factors which impact growth of plants. A digital element produced by sunroom technologies is used to measure the temperature and relative humidity, the schematic diagram of the sensor shown in figure 4. In the digital component LM35 IC which was manufactured by national Semiconductors is used to measure temperature and HS1101 is used to measure relative humidity. This sensor reads the temperature and humidity values and coverts to digital and outputs in simple serial interface of two types, Serial and SPI output. The sensors work on a 5V DC supply, and supply current of 20mA. The operating temperature range of LM35 sensor is 60°C. The accuracy of LM35 is ±2°C. Humidity value ranges from 1 to 100% RH. The accuracy of humidity sensor is ±5% RH. The read values of the sensor are connected through the data line TXD output serial data is connected to the port pin of P0.9 as shown in figure 4.

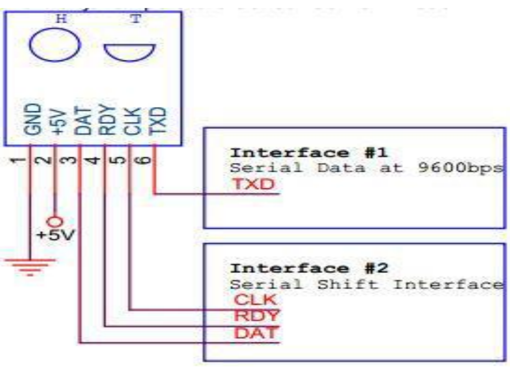

Fig 4. schematic diagram of temperature and humidity sensor

c) Soil Moisture sensor:

Soil moisture is manufactured by iteadstudio. It is mainly used to detect the presence of moisture in the soil . Soil moisture sensor gives the output in two different forms i.e. analog and digital. In digital mode the sensor reads the value and compares it with the threshold voltage, if the value is above threshold then it gives 0V digital output. if the value read by the sensor is below the threshold voltage, a high output voltage of 3.3 or 5V will be generated in this way we can directly read the current soil moisture if it is above threshold or not. In analog mode the accurate dryness of the soil is read in percentage. The pin connection and switching of modes is shown in the figure 2. In order to have the exact percentage value sensor is activated in analog mode. The data pin is connected to the channel-2 of the inbuilt ADC using port pin P0.29 Soil moisture sensor measures the water content in soil. It uses the property of the electrical resistance of the soil. The relationship among the measured property and soil moisture is calibrated and it varies depending on environmental factors such as temperature, soil type, or electric conductivity. Here, It is used to sense the moisture in field and transfer it to raspberry pi in order to take controlling action of switching water pump ON/OFF.

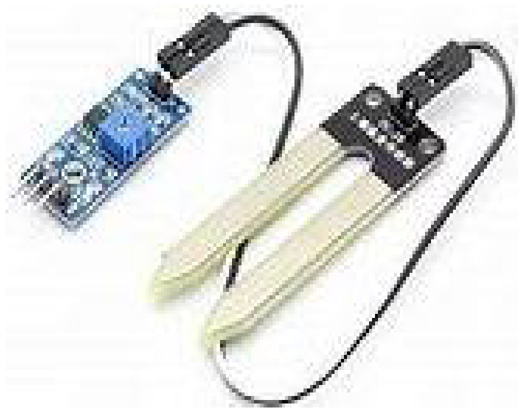

fig5. Soil moisture sensor

d) ARM7LPC2148Microcontroller:

Features:

1. 16/32- bit ARM7 TDMI-S microcontroller

2. In-system programming / In-Application programming (ISP/IAP)

3. 40kB of on-chip static RAM and 512kB of on-chip flash memory

4. Two 10-bit ADCs provide a total of 14 analog inputs, with conversion time as low as 2.44µs per channel

5. Multiple serial interfaces including two UARTs 6. 48 of 5V tolerant fast general purpose I/O pins 7. CPU operating voltage range of 3.0V to 3.6V

d) ANALOG TO DIGITAL CONVERTER :

The analog to digital converter is in built in ARM7 LPC2148 microcontroller. The analog to digital converter is a 10 bit resolution with programmable acquisition of data. One channel out of 14 channels which are divided in ADC0 and ADC1 are used to take analog data from the soil moisture sensor. 10 bit data conversion time is ≥2.44µs the sensed value from the sensor is converted to digital equivalent. The digital values are given to the microcontroller with a reference voltage of 3.1V. Used ADC register are ADDR2-A/D channel-2 Data Register.

e) INTERFACING ZIGBEE TO MICROCONTROLLER:

ZigBee is wireless communication protocol for low power, low rate, dependable, and secured wireless personal area network, developed by ZigBee alliance based on IEEE 802.15.4 standards.. ZigBee network is supported by a multi-hop network in order to communicate with two devices they have to depend on other median devices. In a ZigBee network there are three device types. (i) A Coordinator (ii) router and (iii) end device. A network consists of a coordinator node and multiple router and end device nodes. Before establishing a network Xbee modules are first configured using X-CTU software one as a coordinator and others as routers. An Xbee series 2 is shown in figure 6. Pin 2 of Xbee is interfaced to the microcontroller to port pin P0.1 from which the data is transmitted.

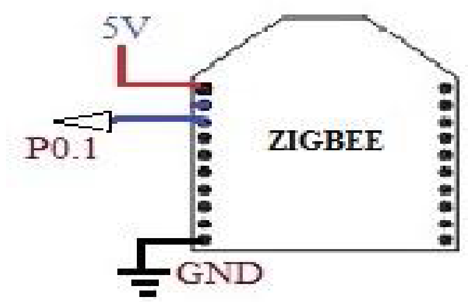

Fig 6. ZigBee series

Software used:

1. For programming keilµ4 and for dumping the code flash magic are used.
2. 2. For configuring Xbee modules X-CTU software is used

3. Python is high-level programming language for general-purpose programming. Created by Guido van Rossum and first released in 1991, Python has a design philosophy that emphasizes code readability, and a syntax that allows programmers to express concepts in fewer lines of code,[25][26] notably using significant whitespace. It provides constructs that enable clear programming on both small and large scales.

IV) Conclusion:

The sensors are effectively interfaced with raspberry pi and wireless communication is achieved. Execution of such a system in the field can surely help to improve the yield of the crops and aids to handle the water resources successfully minimize the wastage.

V) FUTURE SCOPE:

Our project can be improvised by using a sensor to note the soil ph. value such that usage of unnecessary Fertilizers can be reduced.

VI) ACKNOWLEDGEMENT:

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VII) REFERENCES:

1. Chandankumar Sahu, Pramitee Behera, "A Low Cost Smart Irrigation Control System", IEEE Sponsored 2nd International Conference on Electronics and Communication System (ICECS 2015)

2. Joaquin Gutiérrez, Juan Francisco Villa-Medina, Alejandra Nieto-Garibay, and Miguel Angel Porta - Gándara, "Automated Irrigation System Using a Wireless Sensor Network and GPRS Module" ,IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, 0018-9456,2013 .
3. G. Yuan, Y. Luo, X. Sun, and D. Tang, "Evaluation of a crop water stress index for detecting water stress in winter wheat in the North China Plain," Agriculture. Water Manag., vol. 64, no. 1, pp. 29–40, Jan. 2004. .
4. F. R. Miranda, R. Yoder, and J. B. Wilkerson," A site-specific irrigation control system," presented at the ASAE Annu. Int. Meeting, Las NV Jul. 27-30,2003, Paper No. 031129.
5. Siwakornjondarat, pongpisittwuttidihachotti " smart farm monitoring using Raspberry pi and arduino" IEEE 2015 Conference on communication technology (14CT2015)
6. Bogue, R. Sensors key to advances in precision agriculture. Sensor Review. 37(1), 2017,
7. Ferentinos, K. P., Katsoulas, N., Tzounis, A., Bartzanas, T., &Kittas, C. Wireless sensor networks for greenhouse climate and plant condition assessment. Biosystems Engineering, 153(1), 2017, 70-8.
8. Manikandan, K., & Raja ram, S. Automatic Monitoring System for a Precision Agriculture Based on Wireless Sensor Networks. International Journal of Science, Engineering and Computer Technology, 6(6), 2016, 208
9. Keshtgary, M., & Deljoo, A. An efficient wireless sensor network for precision agriculture. Canadian Journal on Multimedia and Wireless Networks, 3(1), 2012, 1-5.
10. Kim, Y. D., Yang, Y. M., Kang, W. S., & Kim, D. K. On the design of beacon based wireless sensor network for agricultural emergency monitoring systems. Computer standards & interfaces, 36(2), 2014, 288-299.