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The Modern Approach towards Better Agriculture Management with Comparative Study of Micro Controllers

Shikha Ujjainia
Computer Science and Application
Rabindranath Tagore University
Bhopal, India
E-mail: shikhaujjainia90@gmail.com

Pratima Gautam
Dean (CSIT)
Rabindranath Tagore University
Bhopal, India
E-mail: pratima_shkl@yahoo.com

S. Veenadhari
Associate Professor (CSE)
Rabindranath Tagore University
Bhopal, India
E-mail: veenadhari1@gmail.com

Abstract: In the digital era, the IoT devices are kept their feet everywhere in the world. Irrespective of any field such as Engineering, Medical, E-Commerce, Defence and the last but not least Agriculture the importance of IoT applications is being widely realized. The IoT devices are helpful in finding out the better environment for higher crop yields in less time and investment. Many IoT boards or micro controllers are recently available commercially all across the globe. The aim of this paper is to select the best microcontroller suitable for acquiring the information in real time. In this study two microcontrollers are compared which are mostly used by students and researchers to develop an IoT device based decision systems. The analysis of microcontroller is based on some specific criteria like processor speed, hardware design, software design etc. In this study the real time taken by different sensors and sending the data to cloud is being analyzed and compared.

Keywords: IoT, Microcontrollers, Polyhouse, SSCM

I. INTRODUCTION

Farmer's have always used information about weather like wind and rainfall to know when to plant and harvest. In the present era, farmer's are now moving towards the smart farming in which all the environmental conditions like temperature, humidity, soil- moisture, etc are easily controlled by a small device named sensor.

In a general way, nowadays farmers use polyhouse, a covered area where all the favorable condition for the crop production easily measures and control by the sensor. While precision agriculture is first taking in-field variability into account, smart farming goes beyond that by basing management tasks not only on location but also on data[1]. Precision agriculture is a modern farming technique which ensures that soil and crops receive exactly what they need for productivity and optimum health precision agriculture is also known as. “satellite agriculture and site-specific crop management (SSCM)". For fresh and edible agricultural products, the traceability line is long, but carried out quickly because unprocessed products are prone to accelerated decomposition. For this reason, traceability of agriculture produce from the growing plant (seedling) to the final product is very important[7] .

Due to the enormous growth of technology farming becomes more powerful & significant. Today agriculture is encapsulated with advanced devices like GPS, SENSORS that enables to communicate devices, store and analyze the data. IOT(internet of things) is now playing a vital role in the field of agriculture. Data acquire by these devices are used for prediction of future needs. The adoption of access to high-speed internet, mobile devices and reliable, low-cost satellites(for imagery and positioning) by the manufacturer are a few key technologies characterizing the precision agriculture trend. IOT has many applications in agriculture, smart cities, smart homes, healthcare, business sector, traffic monitoring, transport, and logistics, etc. This is a growing megatrend that will influence everything from business to our daily personal lives. Here we are mainly focusing on agriculture as it plays a vital role in the development of our countries economy.

IoT and Technologies have the ability to change agriculture in many ways. We can improve agriculture in following different ways:- 1) Data collected by smart agriculture sensors like soil quality, ph level, weather condition are used to trace crop’s growth; 2) Being able to see any kind of distortion in crop growth, you will be able to reduce the risk of losing your produce. This will help to in waste reduction and cost management and also cure undetermined growth of crop production; 3) We can also automate the multiple processes in our field

like pest control, motor control, irrigation or fertilizing by using smart agriculture devices which will further increase business efficiency thoroughly; 4) It will lead to higher yield quality and quantity.

II. LITERATURE REVIEW

A scalable network architecture for controlling and monitoring agriculture and farms in rural areas with the solution which reduces network latency up to a certain extent was studied [5]. And for this, they used cross layers based channel access and routing solution of sensing and actuating.

A model to measure the thermodynamical condition was developed for each location, including in its training information sensor readings of all other locations [6]. For this they evaluated this approach by training regression and

classification model using several machine learning algorithms.

An automated control system was designed for indoor environment of the greenhouse using an irrigation system or temperature control which will trace agriculture products from seed to final product[7].

A Wireless Sensor Network (WSN) for smart estimation of soil condition was designed that will help to get rid of time-consuming laboratory processes to continuously monitor the value of soil nutrient[8]. The WSN is constructed by very low power autonomous sensor nodes and cloud service communication protocol to generate spatial distribution maps of soil parameters.

The challenges and opportunities for each of the mathematical methods and environments on data fusion for IOT was studied[9]. Where mathematical methods include artificial intelligence, probabilistic method and theory of belief, whereas IOT environments include heterogeneous, distributed, nonlinear and object tracking environments.

III. METHODOLOGY

To build up the network of IoT devices a proper selection of hardware and software platforms are required, and after defining the architecture complexity on the basis of an application under development. An IoT system depends on the device that provides sensing, control, actuation, and monitoring.

Analysis of different boards -

Arduino & Raspberry Pi are the most popular boards among the professionals. One can choose the board as per their requirements like storage, operating voltage, communication support, programming language, etc. While both the Arduino and Raspberry Pi are very versatile little machines, they both have specific things that they are good at.

Figure1. The functions of IoT devices

Arduino – The Arduino is a microcontroller, which is best suitable for controlling the micro-devices like sensors, motors, and light. It's a simple computer that can run one program at a time over and over. It is easy to use and best suitable for a simple repetitive task of reading the temperature and humidity, open and closing the door, wake up light, motion detector alarm, etc. So Arduino board is a freely available open source development microcontroller capable to cope up with a variety of communication protocols that is a must to be used for any kind of IoT devices.

Figure2. Arduino

Raspberry Pi – The Raspberry Pi development board is a small sized Broadcom BCM 2835 SoC based ARM11 power minicomputer. The Raspberry Pi can be easily plugged into monitor because of its inbuilt GPU and audio-visual capabilities[2]. It is not a microcomputer and not made for controlling sensor and other things like that. It's an entire computer, with its own operating system.

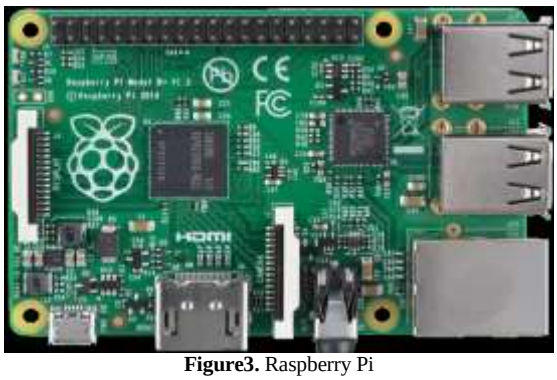


Figure3. Raspberry Pi

After the study, we are now capable to compare two boards with the following parameters [3]–

	Arduino	**Raspberry Pi**
Processor	AT Mega 328	ARM11
Processor speed	16 MHz	700 MHz
Hardware design	Open Source	Closed Source
Analog to digital	Yes	No
Internet connection	Doable	Not Easy
Programming lang.	Arduini, C/C++	Java,Python, C, C++
RAM	2 KB	256 MB
Flash	32 KB	SD Card
Input voltage	7-12 Volt	5 Volt
Analog input	6-10 Volt	N/A
Audio output	N/A	HDMI, Analog
Video output	N/A	HDMI, Composite

*__ARM__ – An ARM stands for " Advanced RISC (Reduced Instruction Set Computer)machine. It is an advanced generation of CPUs based RISC architecture developed by an ARM. RISC processor is designed to perform a smaller number of types of computer instruction so that they can operate at a higher speed.

So the above is the difference shown categorized in hardware and software specification. It can also be compared in terms of –

a) **Power –** In a simple term, Arduino can be plugged into your computer or a battery pack and it will start running code immediately. It does not need any proper shutdown process. On the other hand, Raspberry Pi as it earlier said that it is full flagged minicomputer so it should be shut down perfectly as the normal computer does. Both the Arduino and Raspberry Pi requires low power to run the device.

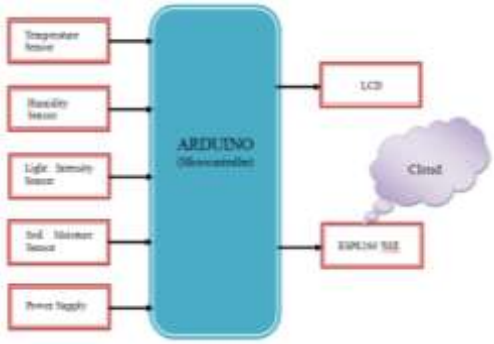
b) **Connectivity –** Raspberry Pi is the best choice to make a personal web server, VPNs (Virtual Private Server) or printer server, etc as it has an inbuilt Ethernet port which gives wireless connectivity.
Arduino does not contain an essential port for connectivity. We need an extra piece of hardware to connect our device to the internet.

c) **Storage-** Raspberry Pi has its own micro SD card to store Audino and video file but Arduino comes with
32kb storage capacity, which is just enough to store programming codes which gives the instruction to the
current program.

d) **USB-** Arduino doesn't come with any USB port that you can use for this type of communication. It just has only one port can be used to connect it to a router, a printer, an external hard drive, or a wide variety of other devices[4].

After the comparative study of the above two boards, the Arduino board was selected for the present sutyd as it is best suitable for the various types of sensors and has several distinct advantages over the other microcontroller platforms. The hardware is low price, and the software IDE can be downloaded for free. The programmer is built in the board, so no additional hardware is required to program the device. Additional hardware is available on the form of expansion board(shields) to connect to peripherical devices such as Ethernet adapters, wireless communication, RFID, Bluetooth, GPS and many other devices with their respective devices. Arduino software includes a variety of libraries for different purposes [12]. And it will be easy to retrieve data received by sensors connected by the Arduino.
The study is divided into two fields such that Field A is the open field where all natural environmental variables like temperature, humidity, soil moisture, etc that effects the crops and are uncontrolled parameters. On the other side Field B is a controlled field i.e., Polyhouse House where in all the environmental parameters can be controlled . Polyhouse cultivation tchnology is a technique providing favorable environment condition to the plants. It is rather used to protect the plants from the adverse climatic conditions such as wind, cold, precipitation, excessive rotations, extreme temperature, insects and diseases. That is why it is necessary to create an ideal microclimate around the plants and this is possible by a Greenhouse, where the environmental conditions are so modified that one can grow any plant in any place at any time by providing suitable environmental condition with minimum labor.
As stated above, to take real-time data wifi modules i.e. ESP8266 wifi module was used to send data over the cloud. Different types of sensors are used to get field and environmental data.

Before moving forward, take a look at the block diagram where we have connected all the sensors to the microcontrollers and all the data is then deliver to the cloud to store and analysis.



DHT11 Sensor – This sensor is very popular for electronics as it is cheap and provide great performance
to measure temperature and humidity. The main specification of this sensor is –

Temperature Range	From 0 to 50°c with variation ± 2°c
Humidity Range	From 20 to 80% with variation ± 5%
Sampling Rate	1 Hz (one reading every second)
Body Size	15.5mm × 12mm × 5.5mm
Operating Voltage	3-5 V
Max Current During Measuring	2.5 mA

As there is one more sensor named DHT22 but DHT11 sensor is best because of its two specifications, first, the sampling rate as in DHT11 Sensor is 1Hz means it will read 1 analog signal and convert it into digital form in every second whereas in DHT22 sampling rate is 0.5 Hz so it will read only one signal in every 2 second. And second, the DHT11 has a smaller body size.

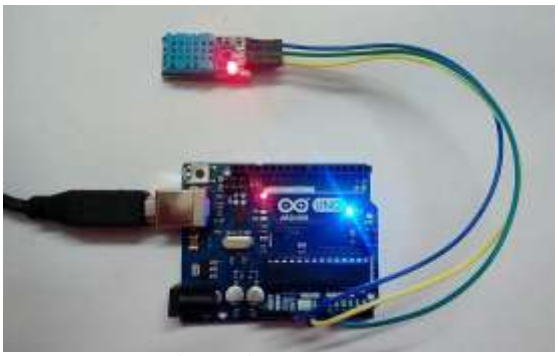


Figure4. Interfacing of DHT11 Sensor with Arduino Sending

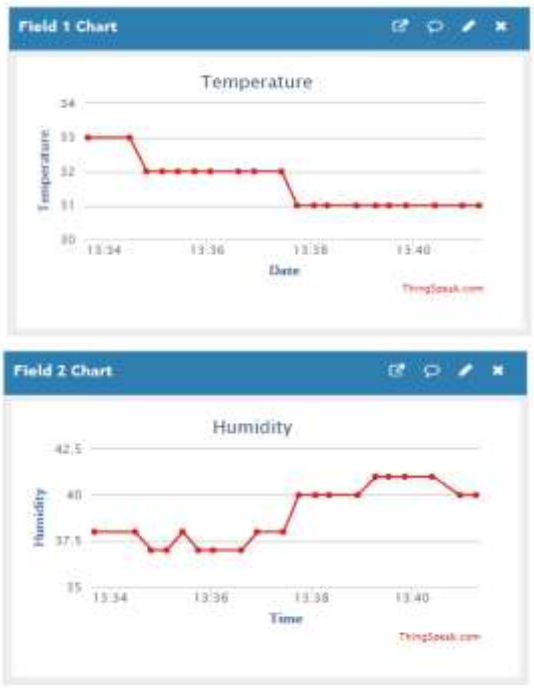


Figure5. Sending temperature and humidity real-time data of over the cloud

Light Intensity Sensor - The light dependent resistor (LDR) is a sensor whose resistance decreases when light impinges on it. This kind of sensor is commonly used in light sensor circuits in open areas, to control street lamps for example. Another possible use is in the spectroscopic apparatus [10].

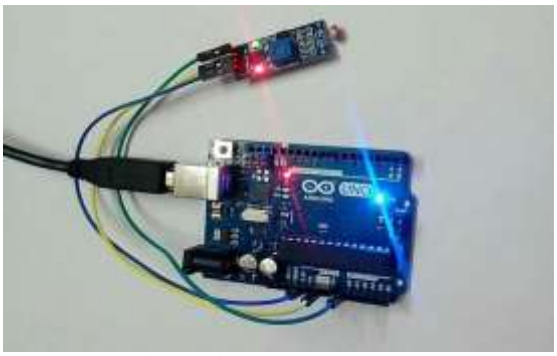


Figure6. Interfacing of Light Intensity Sensor with Arduino Sending light

Figure7. Sending light intensity real-time data of over the cloud

Soil Moisture Sensor –Soil moisture plays a crucial role in any plant growth, where water is needed to control the plant temperature through the process of transpiration as well as for nutrients uptake. When a sufficient amount of water is not present for plant needs, then stress can occur and ultimately lead to reduced quality or death. The soil moisture sensors are used to measure water content in the soil. This moisture sensor uses Immersion Gold which protects the nickel from oxidation. And can be compatible with Arduino UNO, Arduino mega25600, Arduino ADK, etc.

Features of Soil Moisture Sensor	
Working Voltage	5V
Working Current	< 20ma
Interface	Analog
Depth Detection	37mm
Working Temperature	10° C ~ 30° C
Weight	3g
Size	63×20×8 mm
Power Consumption	Low
Sensitivity	High
Out Voltage Signal	0~4.2V

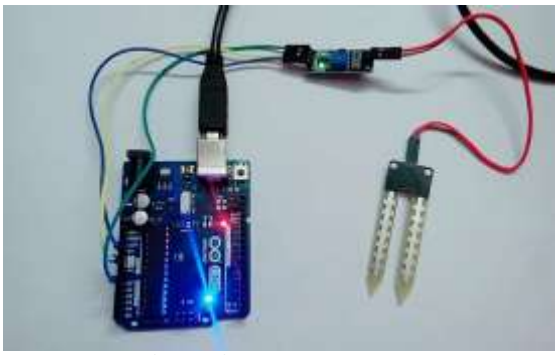


Figure8. Interfacing of Soil Moisture Sensor with Arduino

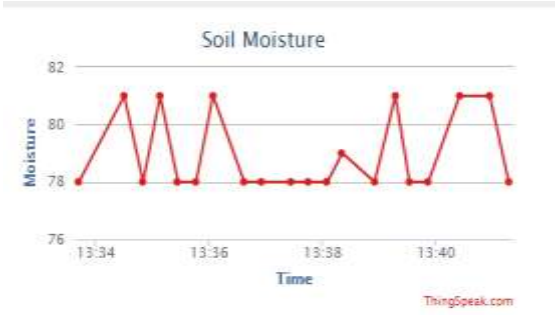


Figure9. Sending soil moisture real-time data of over the cloud

Motor - Relay is used to control a motor. Whenever water level in soil is decreasing below given threshold value motor will be automatically ON by the motor driver circuit. We can also control it by manually.

The agriculture development is promoted only by the idea of agriculture informationization and it is a cornerstone for transforming and maintaining sound and sustaining economic development. In the past five years agricultural infrastructural has given the remarkable result in the field of agriculture. It provides the basement for the agricultural information service

[11]. Nowadays it becomes easy to monitor and control Polyhouse parameter due to Wireless Sensor Network. In the present time of automation and control applications, Wireless Sensor Network are very popular as they are scalable and easy to handle.

IV. CONCLUSION AND FUTURE WORK

This paper investigates the difference between two microcontrollers (Arduino and Raspberry Pi). It is found that arduino is the best microcontroller for research as it is easy to get datafrom different sensors like temperature sensor, humidity sensor, light intensity sensor, soil moisture sensor. Since this is real time data that is required continuously for taking appropriate corrective action the arduino board was found more useful.

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AUTHOR'S BIOGRAPHIES

Shikha Ujjainia received B.Sc. degree in Computer Science from Career College, Bhopal, in 2011 and the Post Graduation Degree in Master of Computer Application from Samrat Ashok Technological Institute(SATI), Vidisha , in 2014. She is currently pursuing the Ph.D. degree with Rabindranath Tagore University, Bhopal, Madhya Pradesh.

Dr.S.Veenadhari completed her Doctoral programme from Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya in 2015, Master of Computer Applications from Nagarjuna University, Andhra Pradesh in 1998 and Master of Technology in Computer Science and Engineering from Makhan Lal Chaturvedi University, Bhopal in 2007. Over 15 years of academic and research experience with 45 research papers published in International and National reputed journals. Six students are pursuing their Doctoral programme and two students completed their doctoral degree under her supervision. Her research interests includes Machine leaning, Big data analytics and Cloud computing. Her expertise in agricultural data analytics through machine learning. She has published several book chapters, technical bulletins, project reports, working papers, training and teaching reference manuals. She has delivered number invited talks in many national platforms of repute. She has worked as Expert member in various committees in different institutions and member of different professional societies like IE,CSI,ISTE.