SMART IRRIGATION

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Abstract:

Water management is the most important issue on which the growth of agriculture sector largely depends. Indian agriculture sector is in dire need of investment to meet the expenses. To fuel the capital needs of the agricultural economy and also to ensure that the benefits of growth percolate to bottom of the socio-economic pyramid, farming has to be projected as an avenue of investment for the urban population. The improvement in irrigation system using wireless network is a solution to achieve water conservation as well as improvement in irrigation practices. This irrigation system allows farmers to reduce runoff from over watering saturated soils, avoid irrigating at the wrong time of day and in effect improve the crop yield by ensuring adequate water supply when needed.

Smart irrigation aims to minimise their environmental footprint through efficient water use, and must also run a profitable business. This allows them to reinvest in new and improved technologies which ensure sustainable and responsible irrigation over time.

Key words: *water management, smart irrigation, sustainable water management, raspberry pi technology*

Introduction

India has many rivers whose total catchment area is estimated to be 252.8 million ha (mha) Out of about 1 869 km^3 of surface water resources, about 690 km^3 of water is available for different uses. The ultimate irrigation potential of the country has been estimated to be 139.5 mha. India has acquired an irrigation potential of about 84.9 mha against the ultimate irrigation potential. About 360 km^3 of groundwater is also available for irrigation. Water is the most critical input for enhancing agricultural productivity, and therefore expansion of irrigation has been a key strategy in the development of agriculture in the country If we analyse agricultural growth during the past four decades, we find that high-yielding varieties, irrigated area expansion and fertilizer use have been the major factors contributing to the achievement of green revolution in India

Freshwater use for various purposes in India (million ha-meters)

Use/year	1985	2000	2025
Irrigation	47.0	63.0	77.0
Domestic and livestock	1.7	3.3	4.6
Industries	1.0	3.0	12.6
Thermal power	0.3	0.3	0.4
Miscellaneous	4.0	5.4	11.0
Total	**54.0**	**75.0**	**105.0**

There has been a steady increase in the irrigation potential from groundwater. The contribution of groundwater to total food grain production of the country is significant, as more than 50 per cent of the irrigated area is using groundwater and in several districts it is more than 80 percent.Overexploitation of groundwater resources has caused continuous decline in water level, decline of well yields, drying of shallow wells, deterioration of groundwater quality, seawater intrusion into coastal aquifers and increase in cost of energy required to lift water from a greater depth.

Problem Of Over-Irrigation

Water is very important for the growth of plants but excessive irrigation of field leads to water logging of soil. Too much water is harmful for crop production as discussed under:

It inhibits the process of germination of seeds. This is due to excessive water in the field, which affects the soil aeration. Roots do not grow properly in a waterlogged field. . Excessive water in the field results in salinization of soils. The excessive irrigation may lead to lodging of the crop, may fall on the ground under the effect of strong winds. Due to excess water the roots of the plant may not be able to provide necessary anchorage in the wet soil.. This also results in wasting of expensive water.

Extent and distribution of salt affected soils in India

Sr. No.	State	Saline soils (ha)	Alkali soils (ha)	Coastal saline soil (ha)	Total (ha)
1	Andhra Pradesh	0	196609	77598	274207
2	A & N islands	0	0	77000	77000
3	Bihar	47301	105852	0	153153
4	Gujarat	1218255	541430	462315	2222000
5	Haryana	49157	183399	0	232556
6	J & K*	0	17500	0	17500
7	Karnataka	1307	148136	586	150029
8	Kerala	0	0	20000	20000
9	Maharashtra	177093	422670	6996	606759
10	Madhya Pradesh	0	139720	0	139720
11	Orissa	0	0	147138	147138
12	Punjab	0	151717	0	151717
13	Rajasthan	195571	179371	0	374942
14	Tamil Nadu	0	354784	13231	368015
15	Uttar Pradesh	21989	1346971	0	1368960
16	West Bengal	0	0	441272	441272
	Total	1710673	3788159	1246136	6744968

Table 1 (central soil salinity research institute.org)http://www.cssri.org/index.php?option=com_content&view=article&id=122&I

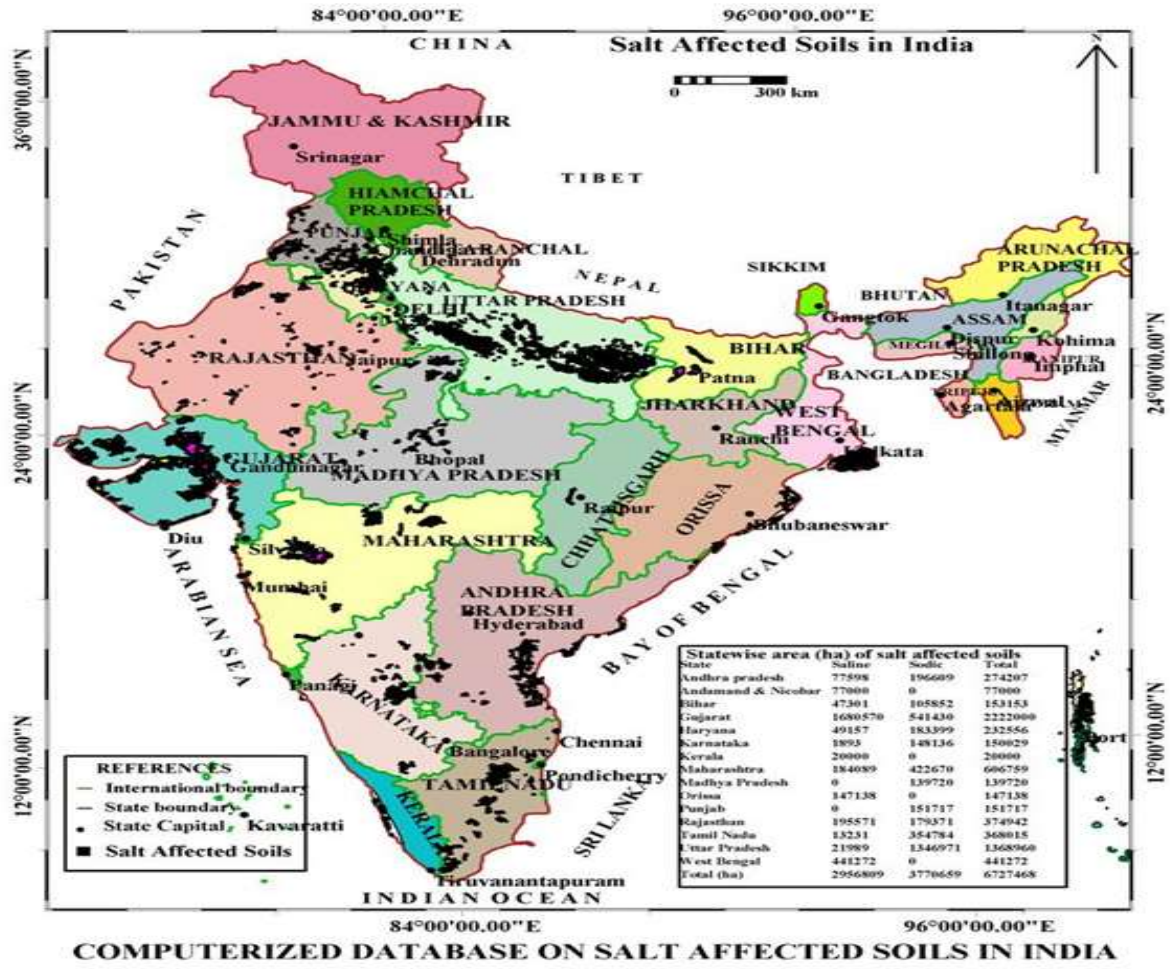


Fig 1 Computerised database of saline soils

Efficient methods of irrigation enable the application of the right amount of water to the crop at the right time and its uniform distribution in the field. Future gains in agricultural productivity of the country shall be critically determined by proper development and utilization of its surface and groundwater resources. Agricultural sector is backbone of Indian economy as population increases demand of water also increases. Usually lots of water wastage takes place in the land, due to improper method of irrigation. The smart farm uses agriculture automation system instead of traditional agriculture. The research goal is to provide long term sustainable solution for automation of agriculture

RESEARCH METHODOLOGY

The paper is based primarily on secondary data. Works done by variousscholars are the bases that have provided data represented in tabular form. Various Government websites comes handy with regards to data collection. Other sources apart from book comes in the form of e journals and newspapers and magazines

LITERATURE REVIEW

Concept of smart irrigation*:* The old irrigation methods are sprinklers and flood type system. In these methods, the consumption of water is in large amount. In the case of slopes in the field large amount of water moves downwards. Thus, the remaining part of field remains unirrigated. Large amount of water goes waste in these methods. Such problem could be overcome by this work which uses sensors with microcontroller, hence 50% water saving is achieved.

In this wireless communication era, mobile phones have become a necessity in thecommon man's life. Besides being capable of making calls and sending messages, the latest advancements in mobile phones facilitate them

to connect to the internet also. With these capabilities, there has been an unprecedented use of mobile phones in many areas of automation. One such area where mobile phone can help with the automation is irrigation process. The main aim of the work is to simplify the method of rrigation using vocal commands through the mobile phone. The Farmer just needs to call a fixed number and utter the control commands through his phone. The control system at the field involves a PIC microcontroller interfaced with GSM modem to receive the command from the farmer and a voice recognition unit which decodes it. The motor is turned on/off according to the decoded commands by the controller. In addition, the system also sends back a message to the farmer's mobile about the action thathas taken place. The power detection and battery backup unit helps in detecting the power availability in the field and inform the farmer about the same, even if the there is no supply at the field. The moisture sensor attached to the system helps in collecting the moisture content of the soil and switch off the motor after it reaches the required value.

Agriculture automation has several methods to getting data from vegetable crop like sensor for environmental measurement. With the help of portable measurement technology including soil moisture sensor, air humidity sensor and air temperature sensor. Moreover, irrigation system using wireless sensor network has installed these sensors, with the purpose for collecting the environment data and controlling the irrigation system via smart phone.

OBJECTIVES:

- To study the existing irrigation patterns and problems associated with it for water management
- To find smart solutions to the problem of over- irrigation and the technology therein
- To find out feasibility of Smart Irrigation in India

According to the Irrigation Association's Smart Water Application Technology (SWAT) information, "Smart controllers estimate or measure depletion of available plant moisture to operate an irrigation system that replenishes water as needed while minimizing excess. A properly programmed smart controller makes irrigation adjustments throughout the season with minimal human intervention

This paper presents an smart irrigation system for agriculture farm with the use of devices like raspberry pi. Python programming language is used for automation purpose. This paper contributes an efficient and fairly cheap automation irrigation system. System once installed has less maintenance cost and is easy to use.This paper focuses on online monitoring of agriculture field with the help of wi-fi on android mobiles and parameters such as temperature and soil moisture. It is more advantageous than the traditional agriculture techniques.

SMART SOLUTIONS SYSTEMDESIGN

TheSystem consists of componentssuchasSoilMoisture Sensor, Humidity Sensors,etcSensors arethedevicewhichconverts thephysical parameterintotheelectricsignal.Theoutputofsensorisanalogsignal,the signalisconverted intodigitalsignalandthenfedtothe processor.Themoisturesensoris usedto measurethe moisturecontent ofthe soil.Copper electrodesare usedto sensethemoisturecontentofsoil.Theconductivitybetween theelectrodeshelpstomeasure themoisture content

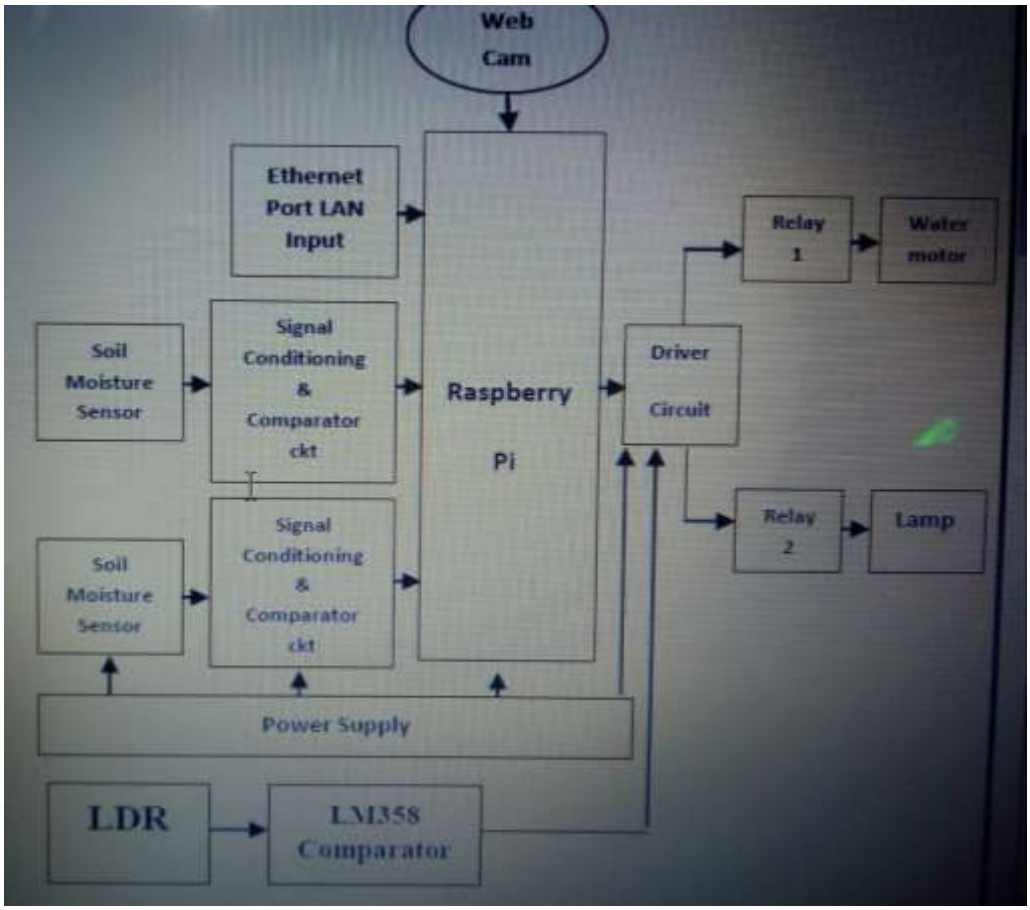


fig 2 soil moisture sensing

Raspberry-Pi

TheRaspberryPiisa small,powerfulandlightweightARM basedcomputerwhichcandomanyofthethingsadesktop PCcando.

Fig 3 raspberry pi

WebcamisinterfacedtoRaspberryPiviaWi- Fimodule.RaspberryPi istheheartofthesystem.The RaspberryPiModelB+incorporates anumberof enhancements andnewfeatures.Improvedpower consumption,increasedconnectivity and greaterIOare amongtheimprovements tothispowerful, smalland lightweightARMbasedcomputer.

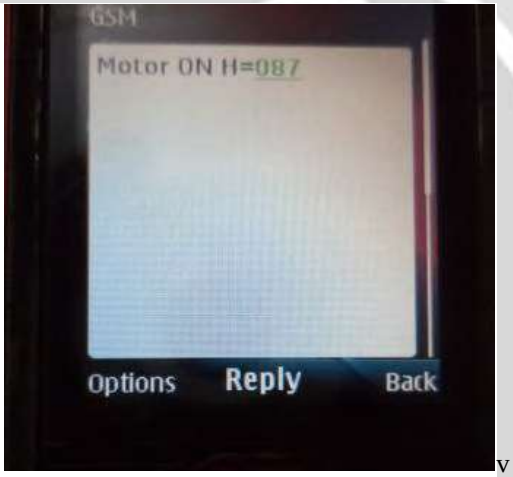
Wireless technology

Smart Irrigation uses wireless sensors. The system also focuses on reducing the cost and energy consumption during the process. The entire field is embedded with sensor nodes including soil moisture sensors, humidity sensors, soil Ph sensor, controller node, solar panels, irrigation sprinkler and control valves. The overall system will be activated for every 1 hour. As the timer triggers, the sensor will sense the data and communicate it to the

nearby controller node. The controller node acts as a router and sends the data to the server. The controller node communicates the information once all the information is ready thereby reducing the power consumption .The LCD interfaced with the controller displays the sensed value from the moisture sensor and alsomessages it to the farmer along with the status of the system.

Fig.4 shows the initial value displayed on resetingthe the voice recognition unit.
Fig 5.hows the LCD which displays the sensed value.

The system also switches off the motor if the sensed value is above a certain limit.



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The Fig.6.andFig.7 show the message delivered to the farmer about the status of the system.

ADVANTAGES OF SMART IRRIGATION

- This makes increase in productivity andreduces water consumption.
- This is safest and no manpower is required.
- Reduce soil erosion and nutrient leaching.
- Require smaller water sources.
- Save Time – The system does all of the work
- Save water – The system is much more efficient than traditional time based systems
- Save money – Less water means lower cost
- Save the plants – plants will be kept in peak health

Smart Irrigation systems can reduce water bills significantly. Whether you are an farmer, irrigation installer, landscaper, maintenance worker or a home owner, systems are affordable, save precious water resources and keep landscapes in peak condition. Smart Irrigation systems enable weather-based watering which take into account seasonal, soil, plant and weather conditions to reduce over-watering, providing optimal moisture to the landscape.

FEASIBILITY -COST ANALYSIS

In a smart irrigation system there are used a very high cost instruments to control the system. But here we use a very low cost hardwires which are easily a Indian farmer buy and implement in farm field. Decreasing the number of sensors are also for a cost effective of the smart irrigation system.

Total Cost In Rupees	Quantity	Unit Cost In Rupees	Component
200	1	200	Soil Moisture Sensor
1000	1	10000	Arduino
3000	1	3000	Raspberry Pi
700	1	700	Modem
1300	1	1300	Monitor
500	1	5000	3 Way Valve
1300	1	1300	Wireless Network

Table 2. Cost Estimates For Smart Irrigation

These are the approximation value of the used hardware in a smart irrigation system which total is approximately Rs.15,000.00-20,000.00. This is very low in cost and easily implement in a farm field. Major Companies involved are Rain Bird Corporation, The Toro Company, Hunter Industries, Netafim, Hydropoint Data Systems, Baseline Inc, Calsense, Galcon Rachio Inc. Weathermatic etc.

GOVERNMENT INCENTIVES

In the challenge of transforming rural India, the Centre has selected 60 villages in three districts of Rajgarh, Sehore, and Satna to develop as 'Smart Villages' under the most ambitious smart cities project. For the development of these smart villages, the NDA government will provide funds for specific development. In this smart villages development, each village will get Rs. 25 crore. it will focus on uplift of rural areas by greater credit flow to give push to agriculture and rural non-farm sector. The project is expected to be of three years duration. However, 20 villages have been selected for development in districts tagged as climate change smart villages with NABARD.

After the smart cities mission, Prime Minister Narendra Modi on Sunday launched the Shyama Prasad Mukherji Rurban Mission (SPMRM) aimed at making villages smart and growth centres of the nation. The SPMRM is an ambitious attempt to transform rural areas into "economically, socially and physically sustainable spaces", or smart villages "which would trigger overall development in the region", according to the rural development ministry. The cabinet has also approved the project with an outlay of Rs.5,142.08 crore for it

Source: India economic summit

CONCLUSION

The smart irrigation system implemented is feasible and cost effective for optimizing waterresources for agricultural production. Thisirrigation system allows cultivation in placeswith water scarcity thereby improvingsustainability. The smart irrigation systemdeveloped proves that the use of water can bediminished for a given amount of fresh biomassproduction. The system is incredibly versatile andeconomical. It doesn't need individuals on duty itis so easy and reliable.

Almost 70% of India lives in villages where the social and economic conditions are sub-optimal. The country has often been touted as an emerging superpower even though most Indians remain super poor. This is why empowering villages through technology and creating rural innovation clusters will be critical to reconcile India's "super power-super poor" conundrum and realize the true potential of Digital India

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