SMART IRRIGATION FOR SMART CITIES A SYSTEM 
NEEDED FOR INDIA-A REVIEW 

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ABSTRACT

India is eagerly looking forward to an actual demonstration of the smart city experience on the ground. Three-fourths of Indians will live in cities by 2030 and the water supply and demand gap will widen to 9,600 crore litre/day from 2,700 crore litre/day as of now. A city that uses information and communication technology and the Internet to address urban challenges such as transport, sanitation, water distribution, health, governance is considered a smart city. Road side gardens, nurseries and lawns at administrative areas are part of the smart cities and using smart irrigation concept to irrigate the above in a controlled way is becomes necessary. Approximately, 70 % of the water withdrawn from various fresh water sources is used for agricultural activities and better irrigation practices need to be followed using latest information and communication technologies using sensor controlled solar powered drip and irrigation methods to optimize the water usage. Smart Irrigation System is an automated, well maintained irrigation system which keeps the lawns and landscape beautiful and healthy, while minimizing water waste with the help of solar energy. As per the estimate majority of the water is wasted due to overwatering caused by inefficiencies in traditional irrigation methods and systems and adopting the smart irrigation will be a best solution. This system monitors soil conditions and plant water use and automatically adjust according to the scheduling. This is an one time investment project and effective especially for smart cities. This study presents a smart irrigation technique for irrigating the road side gardens, lawns and nurseries in upcoming smart cities.

KEYWORDS: automated, smart irrigation, moisture, sensors, drip irrigation, solar power
1. INTRODUCTION

1.1 SMART IRRIGATION
Present generation has become smart using technologies. So smart technologies have become order of the day. As the technology is getting advanced, everything is becoming automatic and smart in our usage. Using smart devices helps to increase the efficiency which enhances the capability and helps to minimize the cost. Similar to the gadgets what we use in our day to day activities at home in Irrigation system also these smart technologies can be adopted then we may term it as Smart Irrigation system.

Fig1: The graph shows exponential decrease of water per capita

1.2 WHY DO WE NEED SMART IRRIGATION
Earlier India enjoyed abundant water resources. But now population growth and overexploitation has lead to a situation where there is demand for water. From the survey we can clearly see how the water percentage is reducing year by year from 1960 to present. If the rate continues it leads to water scarcity. So there is an emergency to conserve water. The reason behind this shortage of water is using traditional system of irrigation. During traditional system requirement of water to plants is not monitored properly. When the soil is moist enough water is still provided to plants. This excess amount of water is not absorbed by the plants and is wasted thus. To monitor the water requirement of the plants a system is needed. Implementing smart irrigation helps to decrease the loss of water caused by using traditional system.

1.3 SMART CITY

Smart cities mission was launched on June 25, 2015 aiming to boost the economic growth of the country to be achieved by encouraging development at grassroot level. Having a focus on building sustainable development model, the strategy of the Smart Cities Mission is as following:

Development of Pan cities, wherein at least one smart solution is applied city-wide. Step-by-step development of areas based on three fold model:

1. Retrofitting
2. Redevelopment

Smart city is an ambition to use the technology to make our city a sustainable, livable, successful one and which helps to reduce its climate footprint by innovations. It is difficult to state smart city in only one definition the basic definition is the employment of new technologies and more processes to have a cleaner and quicker smarter way of life along with reducing the climatic footprint. United nations estimates that in the upcoming years that is between 2015-2050 world population is going to increase by 32% it means from 7.2-9.7 billions inhabitants, the urban population will increase by 63% from 3.9 to 6.3 billion. The current estimations are suggesting that by 2030 over 60% of world population will live in the cities and the significant growth will be in Asia, Africa and Latin America. Smart city means urbanisation. The need of urbanisation is due to the migration of population from rural areas to cities hoping for the better life i.e for jobs, education, medical care, access to culture etc. In 2050, India will reach 1.7 billion inhabitants with its mega cities Mumbai, New Delhi. As our planet becomes more urban the cities need to be smarter. This extended urbanization methods and ways innovate to administrate the complexity of urban life over population, energy resources management and environmental protection etc. As the number of urban residents are growing means...
that cities are built more and more densely. As a result green areas will disappear, favouring the new construction.

1.4 SMART IRRIGATION FOR SMART CITIES

As discussed in the above lines urbanisation leads to the decrease of greenery so to balance the greenery we can use the smart irrigation concept. Smart irrigation was earlier used for agriculture purpose as the Indian agriculture was dependent on monsoons which does not have sufficient source of water. This automatic irrigation system was implemented to provide water to plants according to their moisture level and soil type. By using this smart irrigation concept we can bring back the greenery which is going to be vanish because of the rapid urbanisation. It was proposed to help the farmers to get the good yield. Now we can use this concept in the cities as well as to have the environmental protection. As smart city means everything done in a smarter way this smart irrigation also done with the smart way using the sensors of the required type which can water the plant at a required time resulting in the healthy growth.

2. METHODS

Many of the authors used different methods for implementing smart irrigation. Smart irrigation is done by using Arduino, Zigbee module, Raspberry Pi, sensors, IOT based using GPRS modules with wireless sensors, GSM, solar panels etc.

S.G. Manoj Guruet al. (2017) had outlined in Smart irrigation system using Arduino in this method they have discussed that using soil moisture sensor the moisture content of the soil can be measured in the root zone and an Arduino chip which is an open source platform and consists of both programing and circuit board and a piece of software too. GPRS/GSM module is used to establish the communication between computer and GPRS/GSM. Relay is used to control electrical circuit. Solenoid valve is used for controlling the plunger inside the coil to move. Hence it is cost effective for optimizing water resources for agriculture production. It helps in the places of water scarcity improving sustainability. It is versatile and economical which does not need any individuals on duty. It is so easy and reliable.

Micrea Eremia et al. (2017) have presented the evolution of smart city term and the most representative characteristics of it. A connection between smart city and smart grid is also discussed. The development of smart cities highly depends on the level of intelligence of electrical networks that have to ensure the electrical energy supply to all consumers and to ensure that some city characteristics are achieved among which improving the efficiency but the most important aspect is the easy coordination between the urban administration, operators of various infrastructures and those who are responsible for the public safety and health. Smart grids are capable of stimulating the consumers to modify their load in critical conditions to maintain the electrical infrastructure unaffected. It finally describes a smart city as regards the terminology and their characteristics while a suggestive connection is created between a smart city and smart grid.
Iker Zubizarreta et al.,(2016) in this paper it is provided that a multi disciplinary analysis of applications from cities throughout the world. It is an analysis of awareness of the interconnection between the different topics has also been included. In summary many good tools exist but a limited unitary vision of the cities. This scenario is a mirror of the cultural situation that is missing in the technology approach. Smart cities are not only an aggregation or a merger of some applications they represent a new cultural idea of cities.

G.Parameswaran et al.,(2016) this project helps the farmer to irrigate the farmland in an efficient manner with automated irrigation system based on the soil humidity. In this humidity sensor is used to find the humidity of the soil and based on this only the micro controller drives the solenoid valve. Irrigation status is updated to server using personal computer. Java platform used here for getting the information via serial communication from microcontroller and to update in the server. In addition for better cropping system, fertilizers required for crops, best crops to cultivate for particular climatic and soil conditions are updated to server at regular basis by monitoring soil PH level, Temperature level of the field area etc., With the help of PC host crop is monitored continuously and helps in the better productivity. So this project helps for the better yield of crops than before.

Joshi Sujata et al.,(2016) discuss in the paper that with the advancement of smartphones technology helped mankind to solve some of the difficulties. Similarly smart city is a futuristic approach to alleviate obstacles trigged by ever increasing population and fast urbanization which is going to benifit the government as well as the masses. Now a days cities are deprived of vital elements like quality of life and socio economic development which can be done by smart cities. Smart cities are an attempt to make cities more efficient, sustainable and liveable. In other words smart city is a city that can monitor and integrate functionality of all critical infrastructures like roads, tunnels etc., control the maintenance activities and helps in optimizing the resources while keeping an eye on the security issues as well. Hence the paper exploring various aspects and dimensions of the smart city to bridge the gap in literature regarding the concept of smart cities and its implementation, a framework is developed to get better insights about the idea of smart city. On the basis of deep reasearch of literature they identified six significant pillars for developing the framework as Social, Management, Economic, Legal, Technology and Sustainability simply called as SMELTS. It’s essential to act fast as the need of providing a sustainable development and satiating the needs of increasing population without disturbing the environment will become critical soon. SMELTS can be considered as the important factor affecting a smart city initiative.

G.M.Pushpanjali et al.,(2016) describes the sensing of moisture content and chemical constituents of soil and hence regulating the water supply on priority. For the working of the model a probe is used which is sensitive to quality of water and its chemical constituents. Each segment has a probe, if the moisture around it is less than threshold set value it sends data to microcontroller through Zigbee. If the moisture around is less then the threshold set value probe sends the data to microcontroller through Zig Bee. Further it is followed by analyzing of the data by micro controller and has prrogrammed in such a way that it sends the data to control flow of water depending upon the given priority. This refers
that while sending information about chemical constituents and the moisture level of soil to the mobile number registered with SMS. Process is followed by supplying of the water to that segment for particular time and duration according to the programme. Through the same process the moisture content increases with the reduction in the water supply. This kind of flow is controlled by solenoid valve and SMS is sent to registered number till the process continues. This process not only helps in water scarcity also checks the water quality.

Ch. Apparao et al., (2015) discussed that a simple device functioning underneath the soil can assist electronic circuit board to either switch off or switch on the motor as per the required moisture developed. The developed soil moisture sensor was calibrated in such way it switches the motor on when soil moisture reaches field capacity and switch off the motor when soil moisture reaches 80% of field capacity. The main aim is to have a low cost automated drip irrigation based on soil moisture so that it can be affordable to every farmer easily.

Chimata Suhasini et al., (2015) in this paper they have discussed a methodology so that it could be easy to the farmers. Because in earlier olden days farmers are supposed to visit their agricultural land and check the moisture content of the soil manually. To avoid this more human efforts a technology is used. In this it allows the user to monitor and also maintain the moisture remotely regardless of time. It is really an effective and economical way to reduce the human effort and the wastage of water in agricultural land. Current problems faced in agriculture are reduced water level in land and the availability of human resources. So this mobile irrigation system can help farmer in many ways. This system has a huge demand and future scope too. It can be widely used in agricultural field. Thus project is proposed out using ARM7TDMI core with the help of GSM technologies.

Bhakti B. et al., (2015) have discussed in their paper that an automatic irrigation system is developed to optimize the water use for agricultural crops. It consists of distributed wireless network of soil moisture and temperature sensors placed at the root zone of plants. A gateway unit handled sensor information enables actuators and transmits data to a web application. An algorithm is developed with threshold values of temperature and soil moisture that was programmed into a microcontroller-based gateway to control water supply. System is powered by photovoltaic panels and had a duplex communication link based on a cellular-internet interface that allowed for the data inspection and irrigation scheduling to be programmed through a webpage. This system saves water when compared with the traditional system it is due to the energy autonomy and low cost the system has the potential to be useful in water limited geographically isolated areas.

Priyanka and Sakshi Chaudhary in this paper they have implemented a smart home irrigation system. It consists of two types of sensor motes called TelosB and IRIS, special soil humidity sensors which are mote driven with the use of relays and a java application that is used for data collection. This system manages to maintain soil humidity levels regardless of external factors like variations caused in temperature and sunlight. The
System is also aware of the different needs of water. So this system is adaptive not only to environmental conditions but also to the specific water needs that different plants may have.

Jason Repko et al., (2012) This paper introduced the concept of smart cities by examining the decline and restructuring of the industrial city in order to establish a reference point to how cities have begun to rethink their economic models. They progressed through touchstone events and publications to establish a timeline for smart cities concept. Chourabi framework focuses on the granular model with which they examined planning initiatives of Helsinki, Finland, Chicago etc. They established that any model which attempts to define a city as smart will only be effective if it is integrative and multi-dimensional across domains. It has allowed for a more comprehensive examination of initiatives to establish each as smart.

Richa Yadav et al., have discussed in their paper that this project will be very useful for maximum plant growth in our fields because we can automatically provide water to the crops when they need it most and also prevent the wastage of water by setting the level of water with the help of ultrasonic transceiver. Solar energy is used in the system to convert the sun light directly into electrical energy which is used as a power supplier to replace the DC motor electricity source and is a renewable energy which helps to run the motor and pump water when needed to the plants. This project also consists of sensors and drivers, sensors are used to lacte the levels of temperature, moisture of the soils. So combinely both the software and hardware components help to have a system to grow plants and crops easily.

Srishti Rawal mainly focus on IOT based smart irrigation system. The system is a combination of hardware and software components. The hardware component consists of an embedded system and the software component is a webpage designed using PHP. It is hosted online which consists of data ion which the readings from sensors are inserted using hardware. Sprinkler control is set to threshold value at which irrigation should begin. When the moisture content is detected less than the threshold value the sprinklers get switched on till the soil gets the required moisture. The hardware device consists of moisture sensors Arduino Uno and GSM GPRS SIM900A. The GSM modem is the primary one to transmit the data from Arduino to internet. Information is transmitted to online database from sensors. The values obtained through sensors enable the system to turn the sprinkler on and off. So hence this method is a solution for the problems in the existing manual process of irrigation by enabling efficient utilization of water resources.

N. Usha & Dr. T. Menakadevide describes the smart irrigation using Raspberry Pi. A webcam is interfaced to the Raspberry Pi via wifi module in order to monitor the automatic control of water motor and also the plant growth. Here Raspberry Pi is used as an embedded Linux board which is designed on the basis of ARM V8 microcontroller architecture. Board has an ethernet interface and runs the simple data web server. Sensors are connected to Raspberry Pi board gives the resistance variation at the output. Signal received is applied to the comparator and to signal conditioning circuit which consists of...
potentiometer to decide the moisture level above which the output of comparator goes high and this output signal is given to Raspberry Pi board. If the moisture level is above the moisture level then the motor will be off, if the moisture level is low motor will be on through the relay. To monitor this process at night time LDR is used which automatically controls the light. Relay is connected to the motor to on/off the motor. Readings from different sensors are collected and send to the micro controller. It stores the collected data in database and analyze the the stored data. Readings are shown on the pc using wifi connection. Thus the system controls the flow as per the requirement along with automation.

Mark Deakin discussed in this paper that the triple helix model of innovation refers to a set of interactions between academia, industry and governments to foster economic and social development. This method is used to overcome the limitations in the advancement of smart cities ranking and increases the internet access development, which makes the resources efficient hence the work easier. Which in turn helps to overcome the limitations and increases the advancement in development of the cities.

3. DISCUSSION:

Smart irrigation helps to minimize the environmental footprint through efficient water use. Smart irrigation helps in minimal wastage of water. It allows to reinvest in new and improved technologies which ensure sustainable and responsible irrigation over time. It also allows controlling the amount of water delivered to the plants when it is needed. Based on the types of plants by monitoring soil moisture and temperature. Smart irrigation helps to minimize the human efforts. Smart Irrigation systems helps to reduce water bills significantly. Whether you are an irrigation installer, landscaper, maintenance worker or a home owner, systems are affordable, save precious water resources and keep landscapes in peak condition. Smart irrigation helps in the healthy growth of plants. Smart irrigation helps to control the pollution too.

3.1 RELIABILITY:
Irrigator cannot trust the automatic system to work correctly every time. Sometimes failures will occur. These errors are because of human errors in setting and maintaining the systems. A re-use system is good.

4. RESULTS AND DISCUSSIONS:
Smart irrigation system along with smart city can help to bring back the greenery in the upcoming urbanised cities. This system can be used in the road side gardens which helps to reduce the level of pollution to an extent. Smart irrigation helps to control the wastage of water. It helps in the healthy growth of plants. It is an automatic system which does not require any labour to be present on the field of area. Smart irrigation helps in saving money.

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