ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 2, Issue 12, December 2017

A Synergic Approach in Creating IOT Based Smart Green India

[1] L. Sujatha, [2] S. Mahalakshmi, [3] V. Pavithran
[1] Assistant Professor, [2][3] Post Graduate Student
[1][2][3] Department of Computer Applications,St. Xavier's College (Autonomous), Palayamkottai, India.

***Abstract:*-- The prosperity of a nation depends mostly on the well being existence of the eco-system. In encompassing a very good eco-system, urban green space plays a vital role. For the past two decades, in a developing country like India, urbanization is at a great pace. The main objective of the study is to bring the dream of our former President Dr. A.P.J. Abdul Kalam, green mission of planting more trees in India, into reality with the implementation of IOT. The study on the implementation of IOT in making Smart Green India accentuates the use of soil moisture, temperature, and humidity sensors for robust and effective monitoring and watering of trees planted in parks, gardens and along the road sides of the urban cities with less manpower. All the environmental data are detected by the sensors, integrated and transmitted by using Arduino, Zigbee, WLAN or mobile 3G/4G system. The water pipes are automatically switched on or off based on the analysis of data obtained. This is the radical shift from traditional method to modern use of technology which mitigates the problems related to workforce shortages. Till date, these technologies have been used only by farmers for elevating agriculture. This study explores for the first time the usage of IOT for enhancing urban green space which is the need of the hour. This article deals with the implementation of IOT framework for agricultural applications, the significance of urban green space, the models of IOT based devices, proposed model and its performance and concludes with the potential for improvements in the future.**

***Keywords:*-- Arduino, humidity sensor, soil moisture sensor, urban green space.**

1. INTRODUCTION

According to a study, the average number of trees needed to offset the annual oxygen consumption of one adult was 30 trees. This means, the number of trees needed to offset the human oxygen requirement would be thirty times of the total human population. It is very difficult to achieve the offset number in urban areas. So there is a need to protect the existing trees, and to plant and foster many new trees in order to increase urban green space.

Of the World's top 20 polluted cities, 13 are in India. Trees are the only sources which can refine oxygen from air. Recently, natural disasters had destroyed many trees. For example, Vardha cyclone in December, 2016 has uprooted at least 258 trees across several places in Chennai.

"The protection of the environment and the mother planet is an article of faith". These are the words of India's Prime Minister, Narendra Modi in a historical event of planting 66.3 million trees within 12 hours in Madhya Pradesh. Government tries to plant more trees by means of new schemes like Green India. But the maintenance of those trees is a very difficult task.

In day-to-day life, people use reminders for every activity by means of electronic devices such as mobile phones. A remote monitoring system and such a reminder is needed for monitoring the temperature, humidity, and moisture level of the soil near planted trees and remind about watering the trees when needed.

A new trending technology, IoT (Internet of Things) helps to monitor and maintain the trees in an effective manner. IoT is a wireless sensor network-based system that aims to achieve the interoperability of various networks. According to the draft IoT policy document, the Indian government plans to invest $15 billion in IoT by 2020.

In recent years, IoT has been experiencing remarkable progress and is regarded as a promising technology to provide automate solutions to problems faced by various industries like agriculture, health services, energy, security, disaster management, etc., through remotely connected devices.

IoT is already used for various purposes in agriculture such as pesticide spraying, monitoring crop health, and automating tractors. This gives us an idea of making use of IoT in expanding the urban green space which is the crucial need of the hour.

II. RELATED WORK

Implementation of IoT in Agriculture

The existing method and one of the oldest ways in agriculture is the manual method of checking the environment

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 2, Issue 12, December 2017

parameters. In this method the farmers they themselves verify all the parameters and calculate the readings. It focuses on developing devices and tools to manage, display and alert the users using the advantages of a wireless sensor network system. It aims at making agriculture smart using automation and IoT technologies.

This idea proposes a novel methodology for smart farming by linking a smart sensing system and smart irrigator system through wireless communication technology. It proposes a low cost and efficient wireless sensor network technique to acquire the soil moisture and temperature from various locations of farm and as per the need of crop controller takes the decision whether the irrigation is enabled or not.
The sensors have been deployed in the fields for the collection of data about the humidity, temperature, and soil moisture. Waspmote agriculture sensor board is used for collection of data because it is specially designed for handling agriculture activities. The sensor board consists of AT mega 1281 microprocessor and 2GB micro SD-card. Every sensor board consists of three different types of sensors, the soil sensor, humidity sensor, and temperature sensor [1].

Smart route to detect pesticide spraying
A start-up by engineering students from Sri Shakthi Institute of Engineering and Technology in South India called Smart Pesticide has devised a solution where ultrasonic sensors are used to locate pests in the crop and sprinkle pesticides in a limited area using a drone. This solution alleviates the hazards of manual spraying of pesticides.
Ultrasonic sensors are placed in the farmland. These sensors record the sound produced by pests and transmit it to the connected computer system, which in turn sends data to the cloud. The sound produced by different pests are analysed and accordingly the cloud will guide the drone to spray pesticide [2].

Tracking crop management
A software named CropIn provides software solutions and analytics for crop management. This application tags crops and tracks their development till the harvest. The system, when fed with information pertaining to sowing time and seed type, provides crop development information at various stages of production. Today, CropIn is used by 40 companies, including Pepsico, and Mahindra Agri, and benefits one lakh farmers across 15 states [3].

Remote control of pump sets in rural India
A farmer of a small landholding has to travel at odd hours, in the middle of the night to switch on and switch off the pump set motors when the power comes on. This is a uniquely Indian problem dogging the rural farmer. Kisan Raja (loosely translated as "king of farmers") developed by Vinfinet, a group of IIT, Chennai students provides a cost effective way of overcoming this problem.
The advantage of Kisan Raja is that these pump sets can be remotely controlled from anywhere and not only remotely protects the motors, but also reports fluctuations to ensure that the motor stays damage free [4].

Driving Intelligent Watering System
Sensors in the ground can judge when irrigation is required. The driving intelligent watering system can ensure that the right amount of water is provided to each plant, minimising water wastage. Similarly, sensors measuring the amount of potassium, sodium and other elements and minerals in the soil can ensure that the right amount of fertiliser is applied to each plant on a far more granular level.

Such systems are already used in greenhouse areas. This is producing higher yields of salad crops, such as tomatoes, through highly controlled environments using hydroponics or low-soil systems. IoT systems help by applying optimised amounts of nutrients and/or monitoring CO2 gas from combined heat and power (CHP) fuel power generators [5].

III. SIGNIFICANCE OF URBAN GREEN SPACE

"Urban green spaces" are considered as urban space covered by vegetation of any kind. This includes: i) smaller green space features (such as street trees and roadside vegetation); ii) green spaces not available for public access or recreational use (such as green roofs and facades, or green space on private grounds); and iii) larger green spaces that provide various social and recreational functions (such as parks, playgrounds or greenways) [6].

Urban green space is the art, science and technology of managing trees, parks, and gardens in and around urban community ecosystems. Trees laden parks/gardens are used for morning and evening walks/exercises and recreation by all kinds of people. A study in nine cities of Sweden indicates that people of all categories, professions, and age consider parks/gardens/urban forests as most effective means for stress-relieving and relaxation. Urban green spaces are the most effective means of removing atmospheric pollution in big cities.

By 2030, when today's teenagers will become adults, 41 percent of India will live in cities. Urbanisation across the world is relentless and with it comes congestion, pollution, mental stress, and a diluted quality of life. The World Health

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 2, Issue 12, December 2017

Organisation stipulates that all residents must live within 15 minutes of a green space [7].
A healthy green space can produce energy in our minds. If we plant trees on a mountain slope, trees will reduce avalanches. The roots of the trees hold the soil tightly. So trees will reduce mudflows. Trees increase ground water level by absorbing the rain water. Trees reduce the CO2 concentration in air. Most of the trees produce food products and medicinal elements. For example a neem tree can cure any type of skin diseases. Mangrove forests act as bio-shield to protect casualties from Tsunami.

Nowadays deforestation mostly takes place for establishing industries, electricity plants, and mines etc. which leads to pollution. The following flow chart shows the deforestation in various states for industrial projects [8].

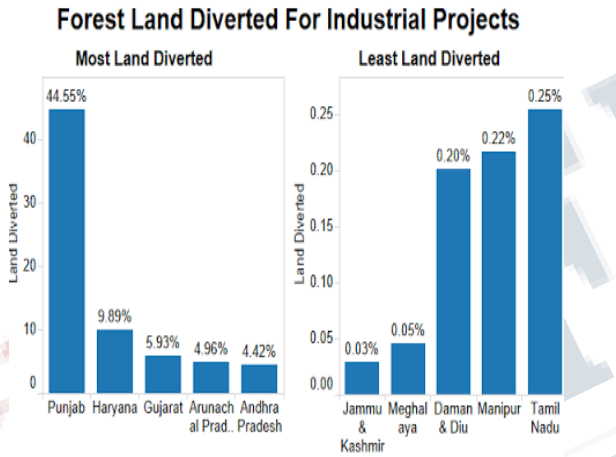

Fig. 1 States and Territories with diverted lands

Due to increasing human population the deforestation and forests are transformed into living towns. Indian Government now concentrates on encouraging planting trees along road sides, and increasing parks and gardens.

India's Former President, Dr. A.P.J. Abdul Kalam had launched an ambitious programme, 'Nallor Pasumai Thittam' (good people's green plan) to plant one crore saplings in Tamil Nadu. He underscored the point that this would effectively counter the ill effects of global warming, reduce pollution, induce rain and make the country prosperous.
During one of his interactions with students, Kalam said, "I would also ask children to plant at least five trees and nurture till they get matured. Every young person has to take a pledge to plant at least five trees and nurture them. A matured tree can absorb about 20 kg of carbon dioxide (CO2) in a year. At the same time, it releases around 14 kg of oxygen (O2) in the atmosphere."

IV. IoT BASED DEVICE MODELS

Till date, IoT based devices have not been developed and used for increasing urban green space. Two IoT based device models that have been used for agriculture in rural areas have been taken as reference models and a new theoretical model has been proposed. Solar power has been used in the proposed model to generate electricity for power supply.

A. Remote Soil Moisture Monitor
Measuring soil moisture is important for agricultural applications to help farmers manage their irrigation systems more efficiently. Knowing the exact soil moisture conditions on their fields, not only are farmers able to generally use less water to grow a crop, they are also able to increase yields and the quality of the crop by improved management of soil moisture during critical plant growth stages.

The hardware of this system includes 8 bit AVR microcontroller, Blue tooth module, and soil moisture sensors. The data monitored is collected at the server. During irrigation period, the farmers have to monitor their distant pump house throughout the night as the electricity supply is not consistent. The system can be installed at the pump house located remotely from the village, it is interfaced with the pump starter and sensors are plugged at different locations in the field for data acquisition. Using this system, they can switch on their pump from their home whenever they want [9].

Fig. 2 Remote Soil Moisture Monitor

Work Flow
It is a smart irrigation node with features like, Smart control of water pump based on real time field data i.e. automatically turning on/off the pump after attaining the required soil moisture level in auto mode, switching water pump on/off remotely via mobile or computer in manual mode, and continuous monitoring of soil moisture.

B. Automatic Plant Watering System using Arduino
The circuit diagram of the automatic plant watering system is shown in Fig. 5. The circuit comprises an Arduino UNO

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 2, Issue 12, December 2017

board, a soil moisture sensor, a servo motor, a 12V water pump and an L293D (IC1) motor driver IC to run the water pump.

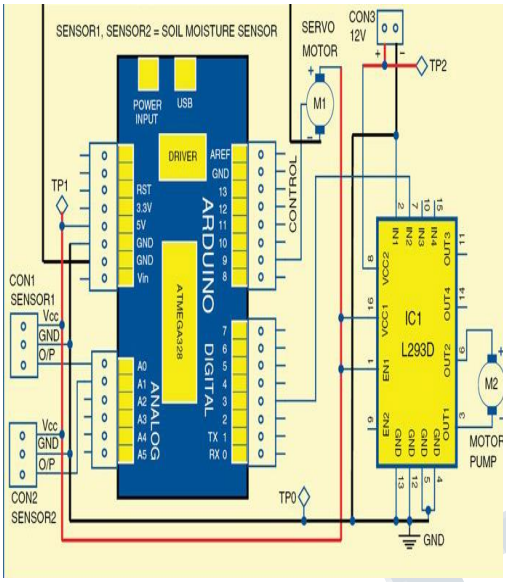

Fig. 5 Automatic Plant Watering System

A contact soil sensor (as shown in Fig. 6) is used in this model because it has to check soil moisture to measure the electrical conductivity. The moisture sensor provides an analog output, which can easily be interfaced with Arduino. In this model, two sensors are connected to analog pins, A0 and A1, of the Arduino board. Each sensor has four pins (Vcc, Gnd, Ao and Do) available for interfacing with the Arduino board. Here, digital output pin (Do) is not used. The water pump and servo motor are controlled by Arduino connected to digital pins 3 and 9, respectively. That is, the servo motor signal control pin is connected to pin 9 of the Arduino board [10].

The program in the Arduino reads the moisture value from the sensor every 20 seconds. If the value reaches the threshold value, the program does the following three things:

1. It moves the servo motor horn, along with the water pipe fixed on it, towards potted plant, whose moisture level is less than the predetermined/ threshold level.

2. It starts the motor pump to supply water to the plant for a fixed period of time and then stops the water pump.

3. It brings back the servo motor horn to its initial position.
Software program

The program is written in Arduino programming language. The code is well commented and is easy to understand. Compile the autowatering.ino code and upload it to the microcontroller, using Arduino IDE version 1.2.

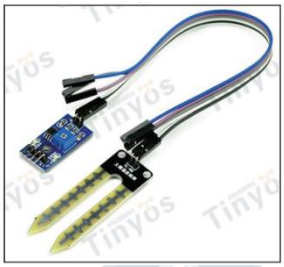

Fig. 6 Contact Soil Moisture Sensor

The sensor will calibrate by itself once it is kept in the soil and the threshold value will be shown on the serial monitor in Arduino. Attach the water pipe on the servo motor horn as shown in Fig. 7.

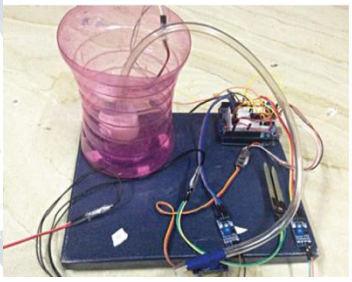

Fig. 7 Automatic Plant Watering System

You can also add an Ethernet or Wi-Fi shield and use the Twitter library, which will tweet from your plants side to send messages about moisture level.

V. PROPOSED MODEL

The proposed model is a remote sensing and monitoring system and contains the following components: Soil Moisture Sensor, DHT11 Temperature and Humidity Wireless Sensor, Microcontroller, Arduino Board, Zigbee or 3G/4G system and Solar Power Panel for power supply as in Fig. 8.

Moisture sensor

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 may vary 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 microcontroller in order to take controlling action of switching water pump ON/OFF.

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 2, Issue 12, December 2017

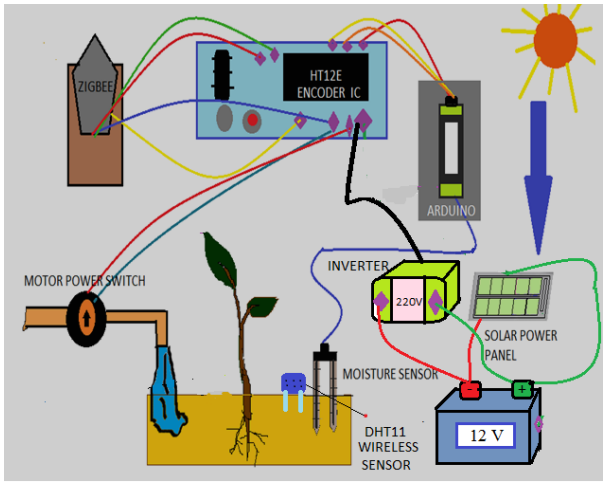

Fig. 8 Proposed model

DHT11 Temperature and Humidity Sensor

It is a wireless sensor for measuring temperature and humidity. This sensor is Relative Humidity (RH) Sensor. The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called relative humidity. Humidity sensors work by detecting changes that alter electrical currents or temperature in the air.

The DHT11 sensor consists of 3 main components. A resistive type humidity sensor, an NTC (negative temperature coefficient) thermistor (to measure the temperature) and an 8-bit microcontroller, which converts the analog signals from both the sensors and sends out single digital signal.

Arduino UNO

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The UNO type Arduino board has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a USB connection, a power jack, a reset button and more. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Zigbee

Zigbee is an IEEE 802.15.4 based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power, low-bandwidth needs, designed for small scale projects which need wireless connection. Hence, Zigbee is a low-power, low data rate, and close proximity (i.e., personal area) wireless ad hoc network. It can transfer data at the rate of 20 to 900 kilobits/second.

Solar Panel

Solar panel absorbs the sunlight as a source of energy to generate electricity or heat (Fig. 9). A photovoltaic (PV) module is a packaged connect assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications.

Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 365 Watts (W). The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 W module will have twice the area of a 16% efficient 230 W module. In this system absorbed power of solar panel is to be stored in battery for future use. A solar charge controller manages fluctuations.

Inverter

A power inverter,or inverter is an electronic device or circuitry that changes direct current (DC) to alternating current (AC).The inverter does not produce any power; the power is provided by the DC source. Here power source is solar panel the DC power saved on 12V battery is to be converted into AC by inverter to provide power supply for arduino board.

Work flow

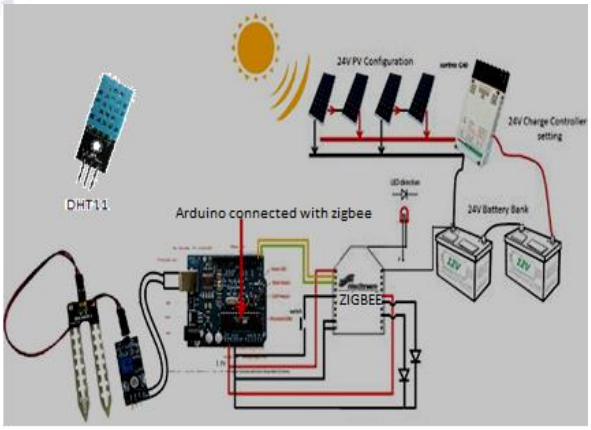

Fig. 9 Remote sensing and monitoring system

While implementing this system in growing trees along roadsides and parks, sensors are fixed along with each one of the water sprinklers. The sensors will frequently sent the readings of moisture level, humidity and temperature to a centralised smart gardening system which is having IC

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 2, Issue 12, December 2017

HT12E, Arduino and Zigbee via cable. The arduino checks the data and switches ON/OFF the sprinklers when needed. Zigbee module will send these information to the data repository for future use via mail or whatsapp. By this the responsible officers can know the current status of those trees.

All the government parks and gardens (Fig. 10) can implement this system to monitor the tree growth. It will be easy to take care of trees with an automated watering system in big parks instead of manual work. Even many road side trees (Fig.11) can be planted in dry areas and monitored using this system easily with less manpower.

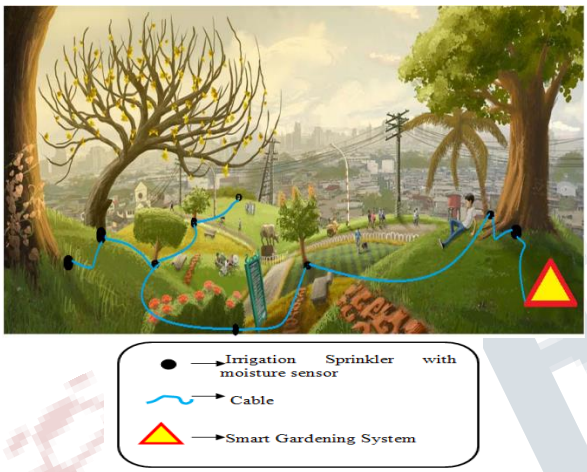

Fig. 10 Smart Gardening System in Parks

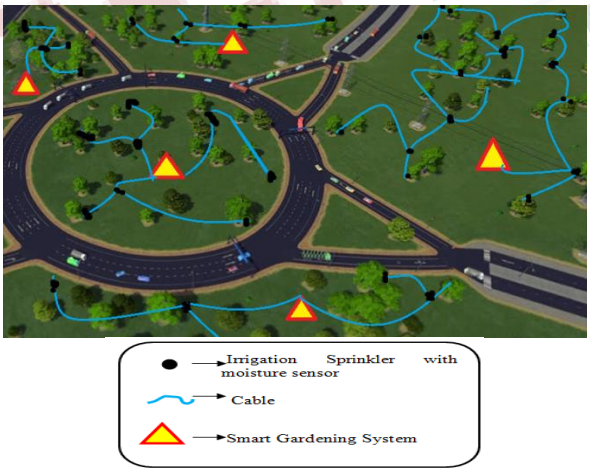

Fig.11 Smart Gardening System along roadsides.

PERFORMANCE

The proposed system is supposed to provide optimal performance in terms of speed, accuracy and time. In existing process, watering may be excessively done for trees with high humidity and moisture and also it takes more time. Since the moisture, temperature, and humidity level are checked and immediately the pumps are set on, with respect to speed, the number of trees watered per unit time will be more using proposed system when compared to the existing system.

VI. FUTURE SCOPE

In future, the remote sensing and monitoring system can be enhanced using IoNT (Internet of Nano Things). Nano-Sensors based Nano devices along with Wireless Nano Sensor Network may be used to monitor the temperature, humidity and soil moisture level. Instead of using separate sensors for each tree, the drones can be implemented to share them in order to take care of multiple trees in different locations. It will reduce the cost and also monitoring efforts.

REFERENCES

[1] Dr. N. Suma, Sandra Rhea Samson, S. Saranya, G. Shanmugapriya, R. Subhashri, International Journal on Recent and Innovation Trends in Computing and Communication, ISSN: 2321-8169, vol. 5, no. 2, pp. 177-181, February 2017.

[2] Sufia Tippu, "Unleashing the Power of IoT on Indian Farmers," Industrial and Medical Technology, E-paper, 19 January 2016.

[3] Anirban sen, "CropIn: an innovation to address problems of Indian farmers", Livemint E-paper, 04 November 2013.

[4] Hamsini Ravi, "The Rural Innovation Series: Kisan Raja to the farmer's rescue", TheAlternative.in, 07 September 2012.

[5] S. Darshna, T. Sangavi, Sheena Mohan, A. Soundharya, Sukanya Desikan, "Smart Irrigation System," IOSR-JECE, e-ISSN: 2278-2834, p- ISSN: 2278-8735, vol. 10, no. 3, ver. II, pp. 32-36, June 2015.

[6] WHO, "Urban Green Space Interventions and Health - A review of impacts and effectiveness," Europe, page.7, 2017.

[7] Vandana Vasudevan, "Indian cities are sorely lacking in neighbourhood parks," (DNA) Delhi, NewspaperDirect Inc., 1 August 2017.
[8] Dabopam Bannerjee, "In just 30 years, India has lost large forests to 23,716 industrial projects," fscroll.in, 04 Jun 2016.

[9] Nikesh Gondchawar and Prof. Dr. R. S. Kawitkar, "IoT based Smart Agriculture" , IJARCCE, vol. 5, no. 6, June 2016.

[10] Ayan Pahwa, "Automated Plant Watering System," ElectronicsForu.com, 5 October 2016.