

## Urban Farming using Supercaps

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### **Abstract**

*This work presents on automation of irrigation in urban farming using super capacitors. Super capacitors use solar energy for charging and water is supplied to plants in regular fashion which can also be monitored. As there is abundant use of pesticides and insecticides, it decreases the quality of food day by day and also due to increasing population there is great burden on agricultural areas, so from this project we are able to grow healthy and nutritious food at home using IoT which helps us to save water and can be reused.*

**Keywords:** Super Capacitor, NODEMCU, Urban Farming, Water Utilization

### **1. INTRODUCTION:**

Nowadays there is an increase in population, which has become the biggest problem of the advanced world and due to increasing population there are problems like water inadequacy, soil fertility, etc. which are faced. There is also load on agricultural land as the agricultural land which is fertile for the growth of crops are nowadays diminishing due to which there is great burden on primary sector, hence farmers are using inorganic fertilizers and pesticides which are shrinking the quality of food and crop. Also due to increase in population there is less electricity generation which again leads to the complication, so we can use solar energy, but here again storing of charges become difficult so lithium battery can be used which is rechargeable battery, but again here the problem is it has 100-200 rechargeable cycles so the solution of all these problems is using super capacitor as a charge storing unit and NODEMCU as controlling unit. The main aim is to make smart urban farming to increase the quality of food which is automation, so human efforts can be muffled. In this NODEMCU works as controlling unit and supercapacitor which is connected to solar panel works as a battery unit. In this we have also concentrated on the water frugality.

### **2. LITERATURE SURVEY**

- There are many systems developed related to supercapacitors and urban farming Automation of irrigation using arduino using bluetooth module HC05. It has low working range and not that efficient.
- Automation in irrigation using wifi module. In this the range of operation has increased but arduino required external communication.

- Automation in irrigation using NODE MCU and primary source as battery but the charging discharging cycles are less so after sometime it has to be changed ,batteries has to be changed after a specific period of time which cannot be ignored and also cannot be used as a profit oriented product.
- A lot of research work is being carried out currently on supercapacitors in the field of farming.
- Super capacitors being highly efficient with properties like more number of charging and discharging cycles, less charging time, slow discharge rate are used in our proposed work.
- This project also takes into consideration the environmental aspect and financial aspect thus, reducing the consumption of water by recirculating it and making it cost effective respectively

### 3.ELEMENT DESCRIPTION

#### 3.1Supercapacitor(Supercaps):

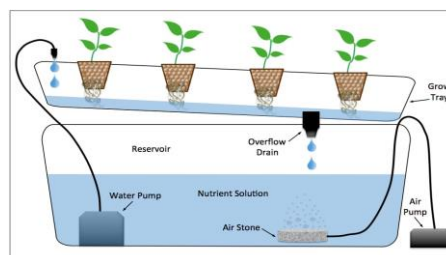
<sup>[10]</sup>A supercapacitor is also called an ultracapacitor. Supercapacitors are the boost converter. Ultracapacitor is the sum of the fast charging of capacitor and low discharging of battery. They are charge/storage devices with low energy density, high power density and exceptional cycle life. It is used to overpass the gap between electrolytic capacitors and rechargeable batteries. Supercapacitors can reach upto one million discharge cycles, while typical batteries can reach only upto 500-1000 discharge cycles. Supercaps have life cycles upto 10-15 years while typical batteries can last for 5-10 years. When lower voltage is applied then the capacitor becomes unstable, hence to make it stable we use DC-DC converter.



**Figure 1.Super Capacitor**

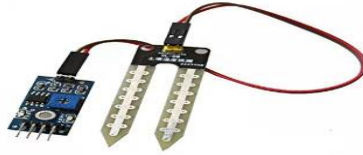
#### 3.2Urban Farming:

<sup>[1][2]</sup>N.F.T Farming (Nutrient Film Technique) is a popular technique of urban farming. It is also used for implanting different types of lucre.Some commercial botanists also grow distinct types of herbs and leafy vegetables. The slope used in this farming is of 1:30 ratio which means for every 30 inches of plane length one inch of drop slope. This method is very beneficial in developing countries like India, due to vast inhabitants and fewer accessibility of sources. NFT farming method is bonanza for this type of area. In this farming we have used PVC pipe and ice-cream cups having holes at the extremity and the water which is not required is sent back to tank and it can be utilised.



**Figure 2.N.F.T Urban farming**

### 3.3 Soil Sensor:



**Figure 3. Soil Sensor**

The soil sensor quantifies water potential present in the soil. It is used to track the water potential also to control irrigation in greenhouses. It consists of a level recognition module in which we are able to set a citation value. DHT11 moisture sensor is used in urban farming. It measures the humidity of the soil by calculating resistance between the two probes. The sensor consists of two probes which measure the potential of water present in the soil. It gives humidity range from 20-80% with 5% accuracy. There are two primary sensor types that measure soil moisture. This sensor has two probes which permits the current to pass through the soil and then the aversion of soil is calculated by reading the moisture content present in water. It runs on a 5V power supply.

### 3.4 Relay:



**Figure 4. Relay**

Relay is an electromagnetic button which allows you to turn on or off the circuit using voltage or current. It has three channel connections which are NO(Normally Open), NC(Normally Closed) and com(common terminal). The switch may consist of any number of contacts in several contact forms such as make contacts, break contacts or combination contacts. Relay works on the principle of electromagnetic desirability. When the fault current is sensed by the relay of the circuit interim magnetic field is produced when the electromagnetic field is energised. The magnetic field is produced when the current flows through the coil. The relay used for NFT Farming is SPST(Single Pole Single Throw).

### 3.5 NODE MCU:

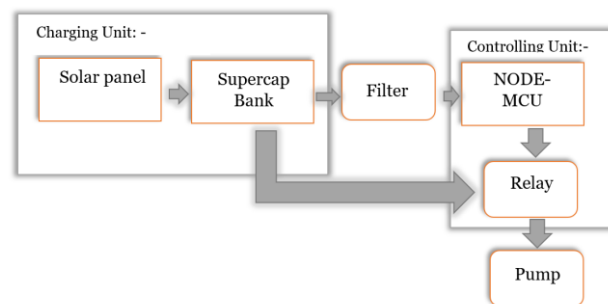


**Figure 5. NODEMCU**

Node MCU is a software and hardware based IoT platform which is used to build the enrollment around a very affordable system and chip which is SOC called ESP8266. It is an open source IoT which

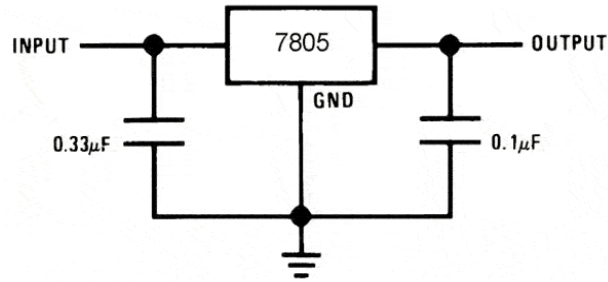
is an eLua based firmware Internet of Things(IoT) platform. Electrical and mechanical equipment cannot connect to the internet on their own. The development boards need a way to connect to the internet. It is an eLua based firmware for the ESP8266 WiFi SOC from Espressif. The best way for the board is to connect the internet to arduino and raspberry pi , but they don't have built in connection support for wireless networks, hence the need for the connection of wifi or cellular module to the board, then it code is written to access the wireless module. Node MCU consists of built in support for wifi connectivity so it is very easy to use for the application. Node MCU hardware design is open for editing, modifying or building a new mcu board. Generally used development boards of node MCU are DEVKIT, AMICA, etc.

#### 4. METHODOLOGY



**Figure 6. Block Diagram**

<sup>[2][10]</sup>As the irrigation system is segregated into two sections : i)Charging Unit ii)Controlling unit We will understand the functioning of this unit.The charging unit comprises Solar panel and Supercap bank.The controller unit consists of NODE-MCU,Relay and Pump. The various components integrate to perform the assigned task efficiently. The Solar Panel consists of numerous solar cells. Solar cells are mostly made up of silicon. Solar panels can last for decades.When photon strikes the silicon cell with enough energy it is capable of removing an electron from its bond leaving a hole. The locations of -vely charged electrons and +vely charged electrons are free to move .As the electric field generated at the P- junction they will only move in one way direction. Towards the N- junction electrons are drawn while the holes are drawn towards the P- junction .At the top of the solar cells the mobile electrons are collected by thin metal fingers. As electrons flow through an external circuit, providing electrical power to a Super capacitor bank before returning back to the conducted aluminium sheet. Each silicon cell puts out ½ a volt. When stringed them together in margins to get more power.The output from the solar panel is connected to the supercapacitor bank. The supercapacitors used are of 500F/2.7V. Total 8 supercapacitors are used. These banks have supercapacitors in series.Protection circuits such as fuse are provided to prevent damaging of supercapacitors.The Output obtained from the supercapacitor bank is 12V. The output obtained from the capacitor bank is divided in two ways +5V to operate NODE MCU and +12V to drive the pump. The NODE MCU operates at +5V. Usually LM7805(5V/1A) Positive Voltage Regulator IC is used with capacitor.The input voltage ranges from 7V-35V and output voltages can be  $V_{max}=5.2V$  and  $V_{min}=4.8V$ . An LM7805 has three pins 1-input , 2-ground and 3-output. Two capacitors are used one at the input stage and the other at the output stage.  $C1=0.33\mu F$  at the Input Stage and  $C2=0.1\mu F$  at the Output Stage.



**Figure 7. Voltage Regulator Circuit**

Once the +5V is applied to the NODE MCU, it helps to run the Relay as well. In this system a SPST (Single Pole Single Throw) Relay is used. Pumps are operated on the relay. Digital input is given to the relays to perform the assigned task. The positive terminal of the relay is connected to the Din of NODE MCU and negative terminal is connected to ground of the NODE MCU. As the relay has three terminals the NO is connected to the positive terminal of the Pump. The positive terminal of the supercapacitor bank is connected to pole of relay and other terminal is connected to the pump and positive terminal is connected to NC of relay. The supply of water can be controlled through the mobile application if the required supply of water is more for the crops then the water is removed from the holes which are made at the bottom of cups. The water goes back to storage tank as the slope of pipe is tilted and the process starts again.

## 5. CONCLUSION

Hence, the paper proposes the newer concept of irrigation in urban farming which increases the efficiency of plant's growth and also saves the energy in this work, we have used solar energy which is non-conventional energy source automated irrigation as it saves time and energy. As we have seen the urban population has a problem regarding purity of crops but after this work we have come to the conclusion that urban farming using super capacitors has good purity of crops and saves energy. Super capacitors are used here because it has more number of charging and discharging cycles. It stores the charge from non-conventional sources which can be used to automate the irrigation process. It has been seen that the growth of plants using this work has high purity and faster growth because of time to time supply of water and nutrients to the crops. This system is expensive but the durability is higher than any of the automated systems. This work also makes less load in the agricultural land of rural areas. This system is easy to install and its use is more durable.

## 6. FUTURE WORK

As supercapacitors are larger in size they can be made smaller to save space as it is a problem in urban areas. Super capacitors can store more energy than rechargeable battery. In lower Voltage supercapacitors become unstable and we use DC to DC converter. Can also be worked for the plants having tap root system. The supercapacitor can be used in conjunction with batteries in industrial auxiliary DC power systems.

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