MICROCONTROLLER BASED AUTOMATIC DRIP IRRIGATION SYSTEM

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Abstract: Irrigation of plants is usually a very time-consuming activity; to be done in a reasonable amount of time, it requires a large amount of human resources. In past, all the steps were executed by humans. Nowadays, some systems use technology to reduce the number of workers or the time required to water the plants. An automated irrigation system is suggested to minimize the water input and human efforts. While satisfying the plant's needs. This paper represents the design of automatic drip irrigation system which will allow the user to ON/OFF the system using their mobile phones by sending an SMS. Also there is a timer mode in this system which provides the flexibility of ON/OFF the system for a particular period of time after that the system will gets OFF automatically. Temperature sensor and Humidity sensors are also their which senses the temperature and humidity and according to that it will switches ON/OFF the system.

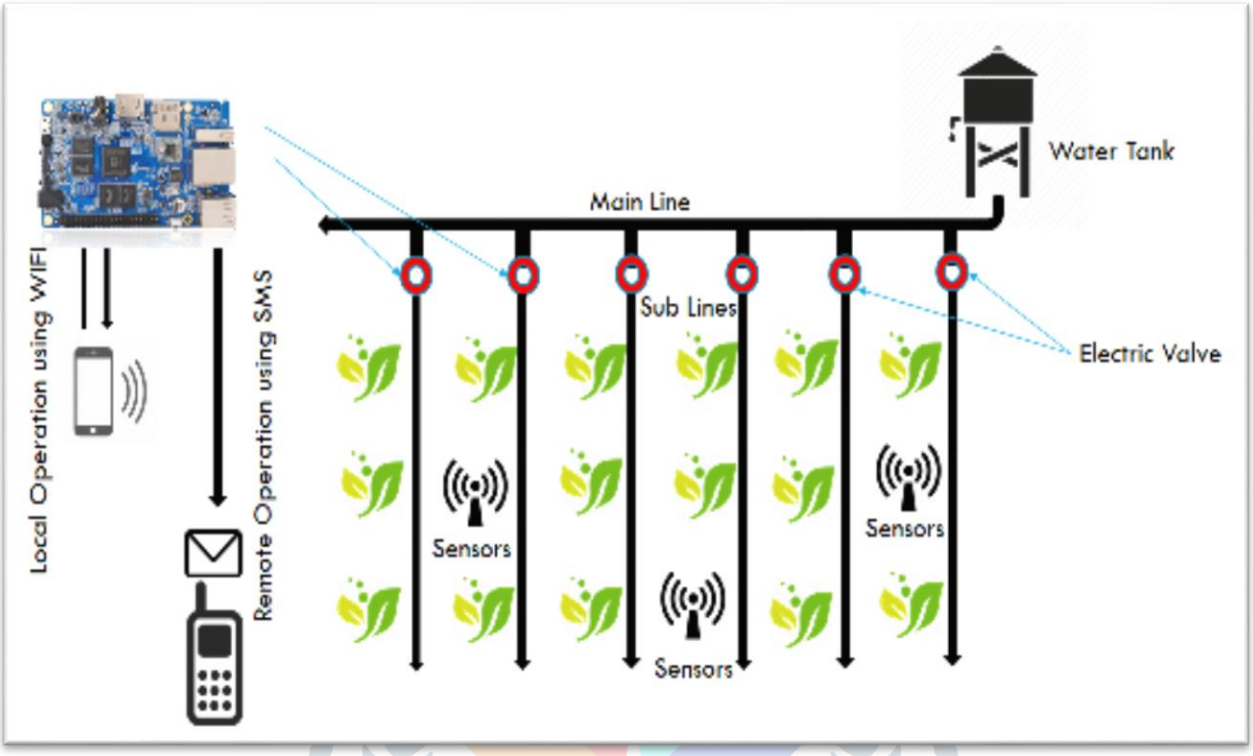
Keywords: **MSP430 microcontroller, Solenoid valve, Sim900 Modem, Temperature sensor.**

INTRODUCTION

Water is the resource that all living species need like human beings, animals, plants, etc. Due to the excessive and continuous extraction of water from earth via wells or bore wells is responsible for the reduction of the water level which leads to making a lot of land in the zones of un-irrigated land. Hence proper planning of water usage is needed. There is an immense demand for new techniques of water saving in irrigation systems. The lack of rain water and scarcity of land water also results in the decrement a volume of water on earth. In the drip irrigation technique, the water is provided to the root zone of plants using drip due to which a large amount of water can be saved. Figure 1 shows drip irrigation automation system design. At Present, the farmers have been irrigating the land manually in which the farmers must irrigate the lands at every regular interval. This technique may consume extra water. Sometimes to avoid drying of crops, water is provided to roots of the plants. Because of this growth rate becomes slow, the weight of fruits becomes lighter, etc. Automatic drip irrigation system can solve this issue entirely. Today the availability of carrying agricultural activity is less; therefore, automation in agriculture is needed. Proposed irrigation system uses valves to

turn ON or OFF automatically. Drip irrigation can be applied to a wide range of field conditions.

Fig.1 Drip Irrigation Automation System Design



OBJECTIVES AND AIM OF THE STUDY.

- The objective of this project was to design a small-scale automated irrigation system that would use water in a more efficient way, in order to prevent water loss and minimize the cost of labour.
- The following aspects were considered in the choice of design solution:
  - Installation Costs
  - Water Savings
  - Human Intervention
  - Reliability
  - Power Of Consumption
  - Maintenance
  - Expandability

A critical consideration is the installation costs, since costs generally determine the feasibility and viability of a project. The installation must be simple enough for a domestic user. The water savings was also an important aspect, since there is a demand to minimize water loss and to maximize the efficiency of water used. Since the objective is minimize the cost of labour, minimal supervision and calibration must be needed. The system must operate with optimized consistency. The power consumption must also be monitored. For

maintenance, the replacement parts must be readily available and easy to install in the case of failure. Finally, the possibility for implementing the system at a larger scale should be investigated.

DESIGN APPROACH.

The components of Microcontroller Based Automatic Drip Irrigation System are as follows:

1. Solenoid Valve
2. Temperature Sensors and Humidity Sensors.
3. MSP430 Microcontroller Unit
4. Sim900 Modem.
5. Drip lines with Emitters

Fig.2 Solenoid Valve

Fig.3 MSP 430 Microcontroler

Fig.4 SIM900 Modem

- This device can be operated into four modes, they are,

1) Manual Mode
2) Timer Mode
3) Sensing Mode
4) Hybrid Mode

1) Manual mode: -

- In the manual mode the user gives command to the motor pump and pump acknowledges with reply for each command.
- Command Format:
- "SET#0001#" used to ON the pump.
- "SET#0000#" used to OFF the pump.
- Here the four bit specifies four electrical equipments.
- And 0 specifies OFF and 1 specifies ON.
- "REFRESH"

- REFRESH command returns data like humidity, temperature, voltage in each line, current values in each line, mode, and timer value.

2) Timer mode: - In timer mode, user sends full command with some parameter then the remaining processing steps are carried out by the device itself.

- In semi-automatic mode user sends the command string like "SET#0001#XXYY".
- In timer mode once motor is started it will operates up to the time that is set by the user.
- User does not need to shut down the motor. It will automatically turned off by the controller and after the completion of the task it will notify the farmer.
- In above example xx represents hours and yy represents minutes.

3) Sensing Mode: - In Sensing mode, once device is installed for the irrigation process some reference data about humidity and temperature is feed up in to it using following syntax.

- SAVE#MODE#TEMP#HUM#TIMER
- Mode – Represents the mode of operation.
- Temp – Represents the reference temperature for the crop.
- Hum – Represents the reference humidity level for crop.
- Timer – Specifies the default timer value.
- Now each time the sensors measure the collected humidity and temperature data with the reference data.
- If it is lower than the reference data then automatically irrigation will be carried out.
- And once humidity and temperature level of the soil reaches to the reference level then irrigation process will be turned off.

4) Hybrid Mode: - In hybrid mode, system will operates in the timer+sensing mode, the function of the timer and sensing mode is combined in the hybrid mode.

- It provides sensing based operation with time limit.
- Apart from modes and operation the system give the required operational data and fault detection facilities.

METHODOLOGY.

There are mainly three methods used for Automation:

(a) Time-based system:- The basic aim is to prepare system schedule according to water requirements of the crop. Here time is the basis for operation.

(b) Volume-based system:- In this type of system, a land is divided into the small part called a field or section, and every section or field will receive the pre-allocated volume of water.

(c) Sensor (priority)-based system: - In this system, sensors give feedback to the controller, depending on which the controller initiates various actions as required. In this paper, the

methods mentioned above (Time based, Volume based and Priority based) are combined in one system.

- Equipment's used in this project are listed below:

- **Software Parts :-**
  - SIM 900 Modem
  - Electronic Valves (Solenoid Valves)
  - MSP 430 Microcontroller
  - Temperature Sensors
- **Hardware Parts :-**
  - Wooden Sheets
  - PVC Pipes (Main lines/ Sub-lines)
  - Water Tank
  - Plants

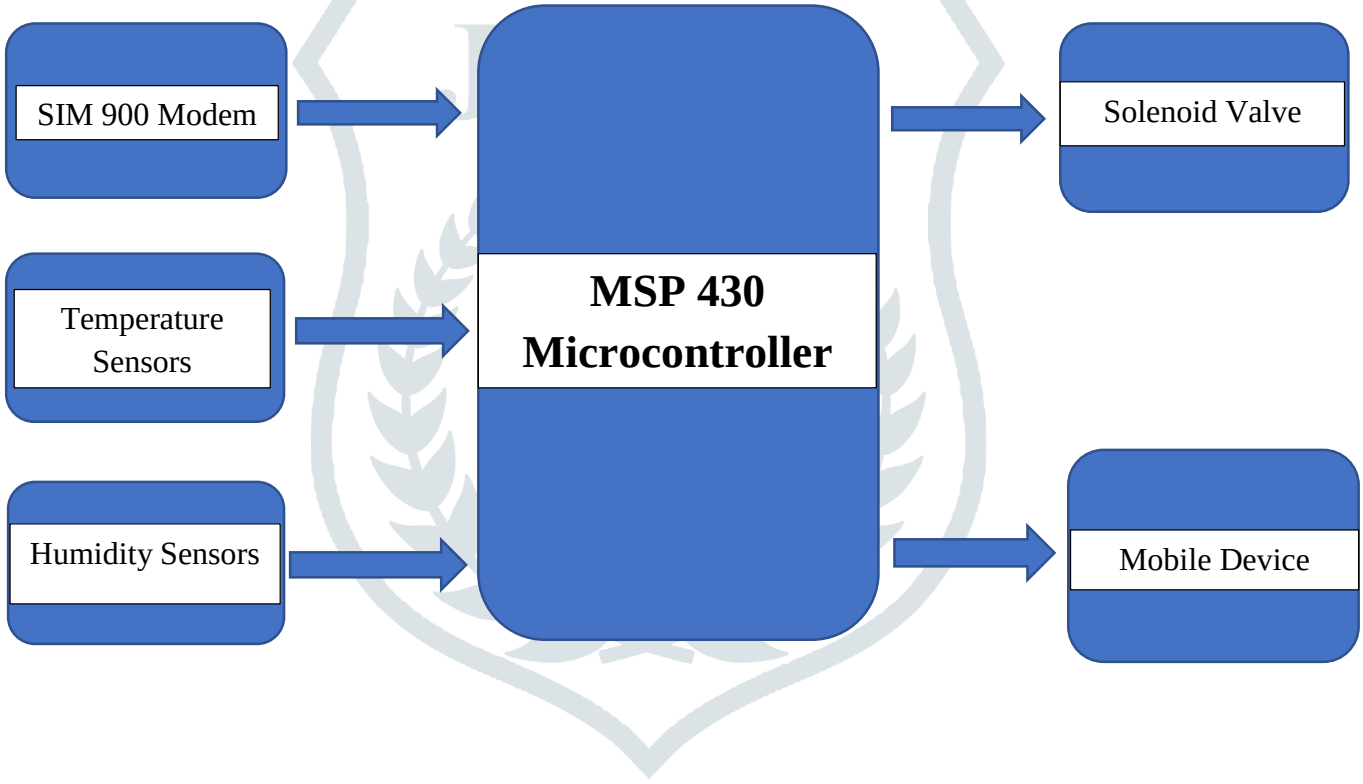


Fig. 5 Block diagram of system

The block diagram of microcontroller based automatic drip irrigation system is as shown in Fig. 5 which consists of various blocks.

This above Figure 5 is an overall block diagram of MSP 430 Microcontroller based automatic irrigation system which consist of two sensors which are connected to controller and sensed values from these sensors are send to the mobile application.

Figure 5 shows the block diagram of smart irrigation system. Farmers start to utilize various monitoring and controlled system in order to increase the yield with help of automation of an agricultural parameters like temperature and soil moisture are monitored and control the system which can help the farmers to improve the yield.

Fig. 6 Drip Irrigation Automation System

This proposed work includes an embedded system for automatic control of irrigation. This project has wireless sensor network for real-time sensing of an irrigation system. This system provides uniform and required level of water for the agricultural farm and it avoids water wastage. When the moisture level in the soil reaches below threshold value then system automatically switch ON the motor. When the water level reaches normal level the motor automatically switch OFF. The sensed parameters and current status of the motor will be displayed on user's android application.

RESULTS

After completing the plan and the collection of the components of the smart Irrigation system, it's been met the goal. Also, all of the requirements were implemented in order to finish this smart Irrigation system, so that it becomes full production and finalize. After that, the system became tested, and the end result became as required. The system will now get ON/OFF according to the user's desire or need, user can send a SMS for switching ON/OFF the system with the help of SIM 900 modem. The user also will not have to approach the field for switching ON/OFF the system. Also, all 5 rows can be irrigated at a same time, if all plants sensor are activated.

Furthermore, the chosen approach will yield following results.

- Reduced labour
- Reduced Monitoring
- Decrease in water input

- Low power consumption

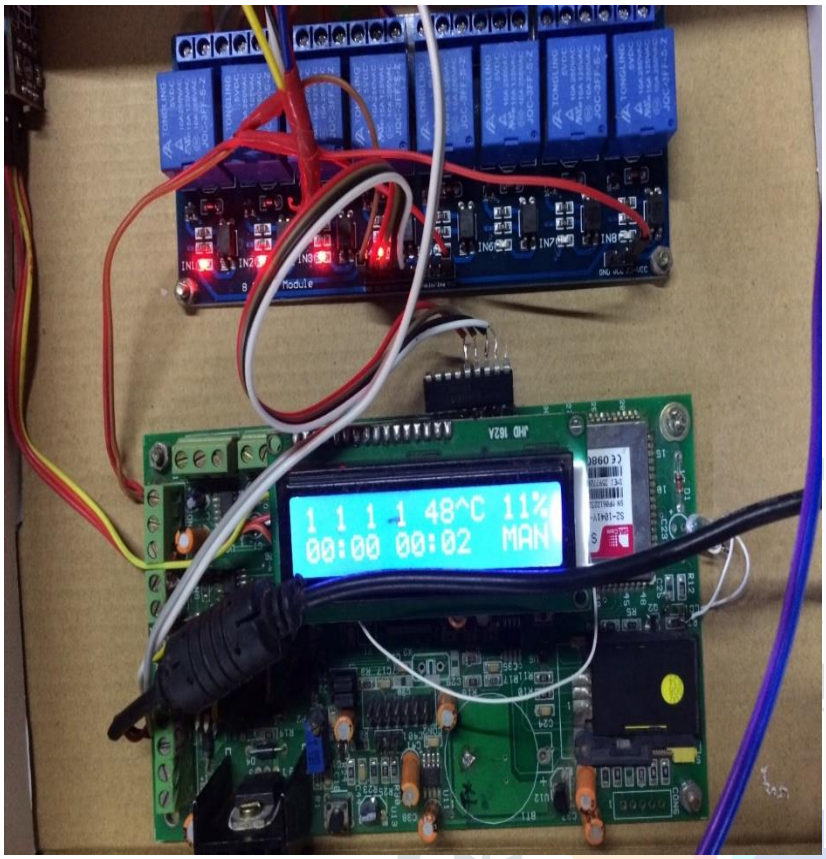


Fig. 7: Result in microcontroller

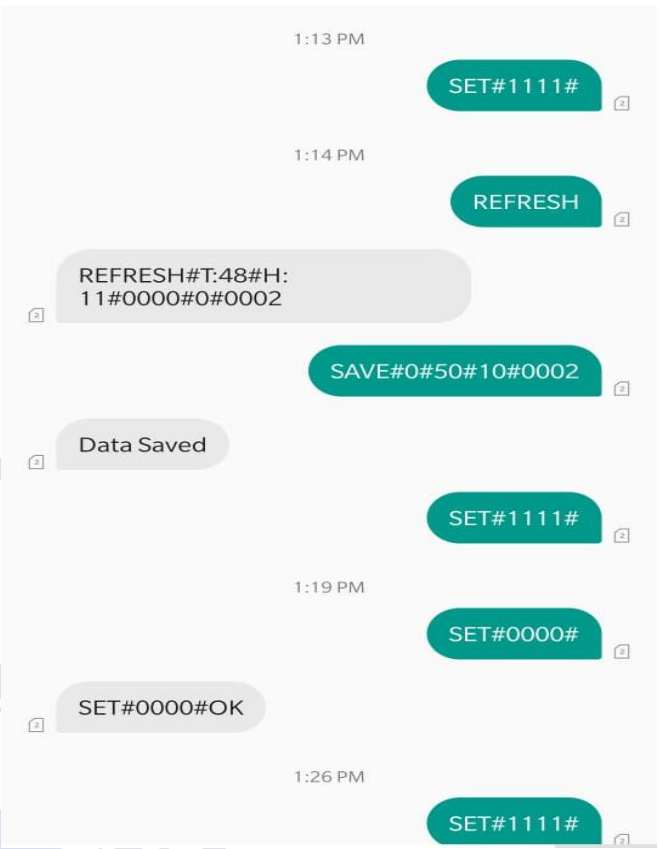


Fig. 8: Command given to the microcontroller

Fig.7 Shows the results obtained in microcontroller by execution of model. And **Fig.8** Shows the command given to the microcontroller and feedback received after executing the command.

CONCLUSIONS:

- An automated irrigation was successfully designed and assembled. It serves to reduce the consumption of water used, the human monitoring time and the labour associated with standard methods. It can be installed easily in a home environment and requires little resources.
- The materials that required for this project has been difficult to find. Selection of the suitable plant plate to fix it in the foam and artificial grass has the significant problem.
- Also, wires connection have been complexes to connect. Furthermore, Sequence of system scenario has been not easy to decide to function.
- The MSP 430 microcontroller and SIM 900 modem were quite challenging, because of a single mistake can damage any electrical part. It was not easy to write the software for the Smart Irrigation

System and upload it in microcontroller to run the water pump and opening valves, but with the help of microcontroller, the program was completed with perfect results.

- The design is still in a prototype stage. More tests need to be conducted before the efficiency, durability, and reliability can be demonstrated.
- Additionally, many improvements can be made to make the system more versatile, customizable, and user-friendly.

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