Remotely Controlled Automated Irrigation System

Jay Nagdeo, Priya Mehta

*Department of Electronics and Telecommunication Maharashtra Institute of Technology Pune,
Maharashtra, India*

Abstract:- In the present scenario of farming a lot of automation has been included in order to get timely and proper growing of crops. Due to land unavailability the farms are outside the city and the farm owners have to travel large distances just to start the motors for irrigation. This technology helps to control the irrigation system from a far away distance as it works on GSM technology. So by just sending a SMS (Short Message Service) the farmer can look after his farm from his home itself. Another problem that mainly arises in farms which are out of city is the frequent load shedding. To tackle this problem the GSM module that is present on the farm notifies the farmer if the power supply is present or load shedding is going on. The failure causing devices are monitored and are reported to the user. Main problem lies with the pumping motor. These are usually three phase motors and can get damaged by several factors like over current, Short Circuit, Phase failure etc. This technology helps to report all these problems directly to the user in an easy to understand graphical way by using an Android application.

Keywords:- Irrigation, Microcontroller, Sensors, GSM module, Android Application.

I.   INTRODUCTION

In present scenario, irrigation techniques in India are through the manual control in which the farmers irrigate the land at regular intervals. Manual operation of the routine practices in agriculture requires lot of attention and care. Also it is difficult to perform desired jobs efficiently and precisely. Ultimately this may result in lower crop production, non-uniform growth and poor quality. The introduction of automation in irrigation system will result in increased application efficiency and drastically reduce labour requirement. The proposed system helps to monitor and control the irrigation system [5] using a simple mobile phone. The automation includes distant control of pumping systems and provides alarm notifications during malfuncficning. Monitoring and controlling through mobile is done using a simple Android application.

The system uses a Field Monitoring station that collects real time data from a farmer's field. By monitoring how much moisture is present in the soil in real-time, it adjusts the farms' irrigation systems accordingly (automatic control of motors). This data from field is sent to the farmer in real time only, using the GSM technology. The android application also allows the farmer to manually select the ON/OFF operation of pump motors. Android application provides easy to understand graphical interaction with the user.

Apart from moisture sensing to control water usage, the Field Monitoring station also performs real time condition monitoring of the 3 phase motor. Motor current acts as an excellent transducer for detecting fault in the motor. Current analysis involves the measurement of electric current around any one phase through CT's. This current is then analysed for detection of fault. The faults in motor can occur due to factors like short circuit, overcurrent, phase failure, etc. The continuous availability of power supply is also monitored by the system. In case of load shedding, the problem is reported to the farmer on his mobile. These faults are detected by microcontroller which communicates with the GSM modem and then, GSM modem sends the message to the user. In addition to above features, the system also monitors the water level of the well to which motor is connected. This helps to avoid the damage due to dry run condition of the motor by controlling the motor on/off depending on the water level. In this way, a continuous and remote monitoring of the field is possible using this automation system.

Drawbacks of existing systems:

In the existing manual irrigation systems, the efforts required by the farmer are more and the throughput is less. If timely irrigation is not done, crops can get damaged. This can happen when the farmer is away from the farm. Now-a-days automated irrigation systems using GSM module are available to control the motors for irrigation, but these systems do not consider other factors like moisture level in soil, load shedding, water level in well, motor faults etc. It is important that the farmer is notified about the load shedding in farm else the farmer will be in notion that motor is ON after sending the message to turn on the motor which in fact will be OFF during load shedding. This will lead to improper irrigation of crops resulting in low productivity. In case the power supply is present and the message is sent to turn on the motor, still there is a possibility that the motor is off. This can happen due to blown fuse or tripped MCCB. It is important to check that all the phases of

three phase motor are working properly else the motor can get damaged. So these faults must also be notified to the farmer which is not done by the existing systems. The existing automated irrigation system does not consider the water level present in the well. This is important as in absence of water, the motor can enter into dry run state which will damage the motor.

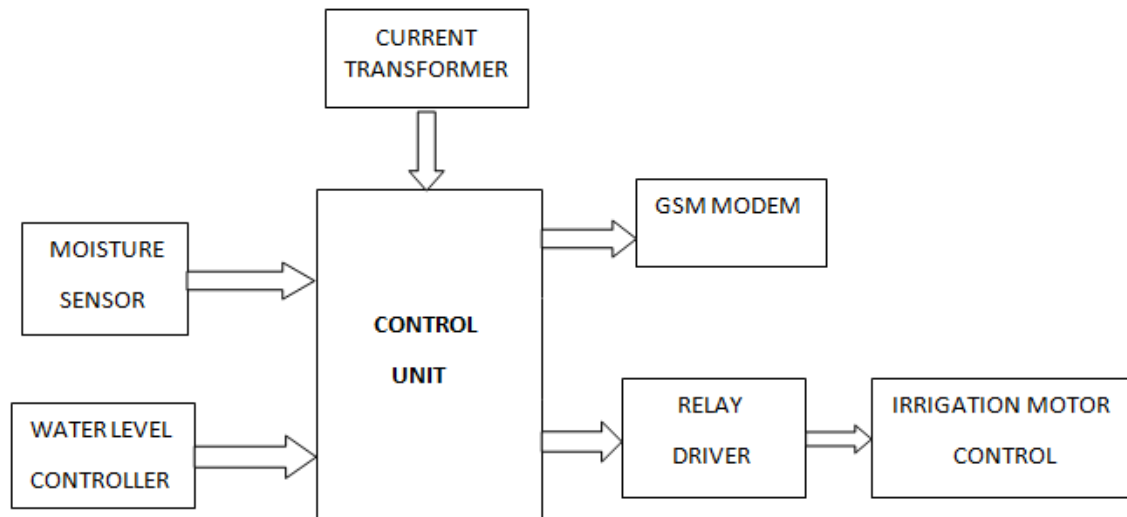## II.   SYSTEM ARCHITECTURE

Fig.1. Block diagram of the Automated Irrigation System

This system consists of a main control unit which handles all the peripheral elements attached to it. The system monitors the following subsystems:-

A.   Motor
1)   *Phase Failure:* Usually for farming a powerful motor is needed to pump the water in to the fields and so a 3-Phase motor is required for this purpose. But the problem that lies with a 3-Phase motor is that all the 3 Phases must be working at a time else the motor gets damaged [6]. So in order to check the working of each Phase a Current Transformer is attached to each Phase and the reading is given to the central control unit. If the reading of any of the three Phases is erroneous the central unit switches of the motor, thus protecting it from any permanent damage. This status reported to the farmer on his mobile via GSM Module.
2)   *Over current Condition:* During very heavy load conditions, the motor tends to draw more current from the supply. This current if above limit can harm the internal drive circuitry of the motor. So a MCCB (Mounted Case Circuit Breaker) Switch is used as a protection device. When over current takes place the MCCB switches off the supply to the motor. The digital output from the MCCB is given to the control unit which checks for its state and if off reports it to the farmer on his mobile via GSM Module.
3)   *Short Circuit:* When a live and neutral point gets connected accidently by any factors like water, open wires, electronic circuit damage, etc., very high current flows through the system which can destroy the motor and the circuitry connected to it. So as to avoid such conditions Fuses are installed on each phase [9]. Fuses tend to blow when high current flows through them and which is above their limit and so protect the motor from any damage. The status of the fuse is monitored by the control unit using a simple resistive circuit which is conveyed to the farmer on his mobile via GSM module.

B.   Moisture Level
Irrigation of farm is must but excessive irrigation can lead to water logging in the fields. This condition is most likely to arise in systems where the farmer is remotely operating the irrigation system. He may be unaware of the irrigation conditions on the farm. This problem can aggravate in rainy seasons when the field might be already irrigated due to rainfall. So to avoid this, Moisture sensors are incorporated in our system [7]. An array of moisture sensors is installed at proper distances in the field to detect the moisture levels of soil in various parts of field. This data is fed to the control unit which in turn notifies the farmer about the current moisture level in the field [4]. The percentage moisture level is notified in steps as decided by the farmer as

different crops need different amount of water. Depending on this level, the farmer can control the on/off condition of motor remotely thus avoiding wastage of water.

C.   Water Level

This system also monitors the level of water [10] in the well to which the motor is connected. This is required to avoid dry run condition which damages the motor. The system turns on the motor only when the water level is above the predetermined limit.

III.   GSM TECHNOLOGY AND MODULE

The GSM family of technologies has provided the world with mobile communications since 1991. In over twenty years of development, GSM has been continually enhanced to provide platforms that deliver an increasingly broad range of mobile services as demand grows. GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting mobile voice and data services [1]. GSM supports voice calls and data transfer speeds of up to 9.6 kbps, together with the transmission of SMS (Short Message Service).GSM operates in the 900MHz and 1.8GHz bands in Europe and the 1.9GHz and 850MHz bands in the US. The use of harmonised spectrum across most of the globe, combined with GSM's international roaming capability, allows travellers to access the same mobile services at home and abroad. Terrestrial GSM networks now cover more than 90% of the world's population. GSM satellite roaming has also extended service access to areas where terrestrial coverage is not available.

Fig.2. GSM Module

GSM module is GSM transreceiver system that uses a network provider to connect and transfer data. GSM modem is a simple device which uses a SIM card to send and receive the messages. The modem can be controlled by the microcontroller using serial communication. AT commands are used to configure the GSM modem.

IV.   ANDROID TECHNOLOGY

Android is a Linux-based operating system designed primarily for touch screen mobile devices such as smart phones and Tablet computers. Android is open source and Google releases the code under the Apache License [2]. This open source code and permissive licensing allows the software to be freely modified and distributed by device manufacturers, wireless carriers and enthusiast developers. For developing app java programming is to be done in eclipse platform [3].

We have developed an Android app which provides a user friendly interface to the farmers to access this system. There are pictorial icons for selecting various options like Motor On/Off, etc. App receives the current status of the field or any faults in the control unit through the GSM technology. The android application displays the moisture level of the soil and water level in the well using which the farmer can decide to take proper action. In this way the farmer remains updated with the activities in his farm even at a far away distance with the help of this remote monitoring.

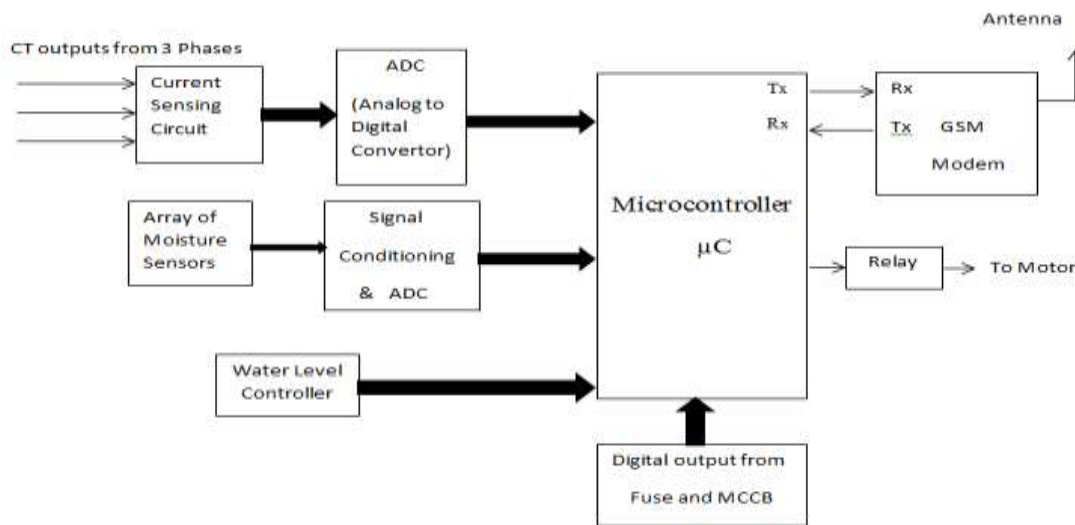**Fig.3. Android Application**

V. SYSTEM IMPLEMENTATION

Fig.4. the automated irrigation system using GSM

Above figure shows the detailed architecture of our system. The microcontroller chosen must have many Input/output Pins to connect all the peripheral devices, a serial port, ADC and interrupts [8]. One of the main problems tackled by our system is that of load shedding which is prevalent mostly in farm areas away from cities. For this the controller and other modules are given supply through a separate battery which is charged by the main electrical supply at the farm. The main supply if present is detected by a current transformer and the status is reported to the farmer.

A three phase motor can get damaged if any of the phases is not working properly. For this a Current Transformer is attached to each of the 3 phases. The secondary current output from the current transformer passes through the current sensing circuitry whose analog output is then given to the ADC (Analog to Digital Converter) which is then connected to the pins of the microcontroller.

An array of moisture sensors is spread all over the field to give the moisture levels at different parts of the field. These moisture sensors are connected to a Signal Conditioning circuit which is needed to make the output of the sensor suitable for the ADC. The output of the ADC is then given to the microcontroller. Even inbuilt ADC of the microcontroller can be used for this purpose.

To detect the level of water in the Well water level controller is used. Different types of water level controller are available in the market like contact, contactless etc. Any one of this can be used which gives a digital output to the microcontroller.

To check if the fuse is blown or MCCB is tripped digital output is taken from them and given to the microcontroller. Microcontroller processes the data given to it by the peripheral devices connected to it and caries out series of tasks as shown in the following flowchart.
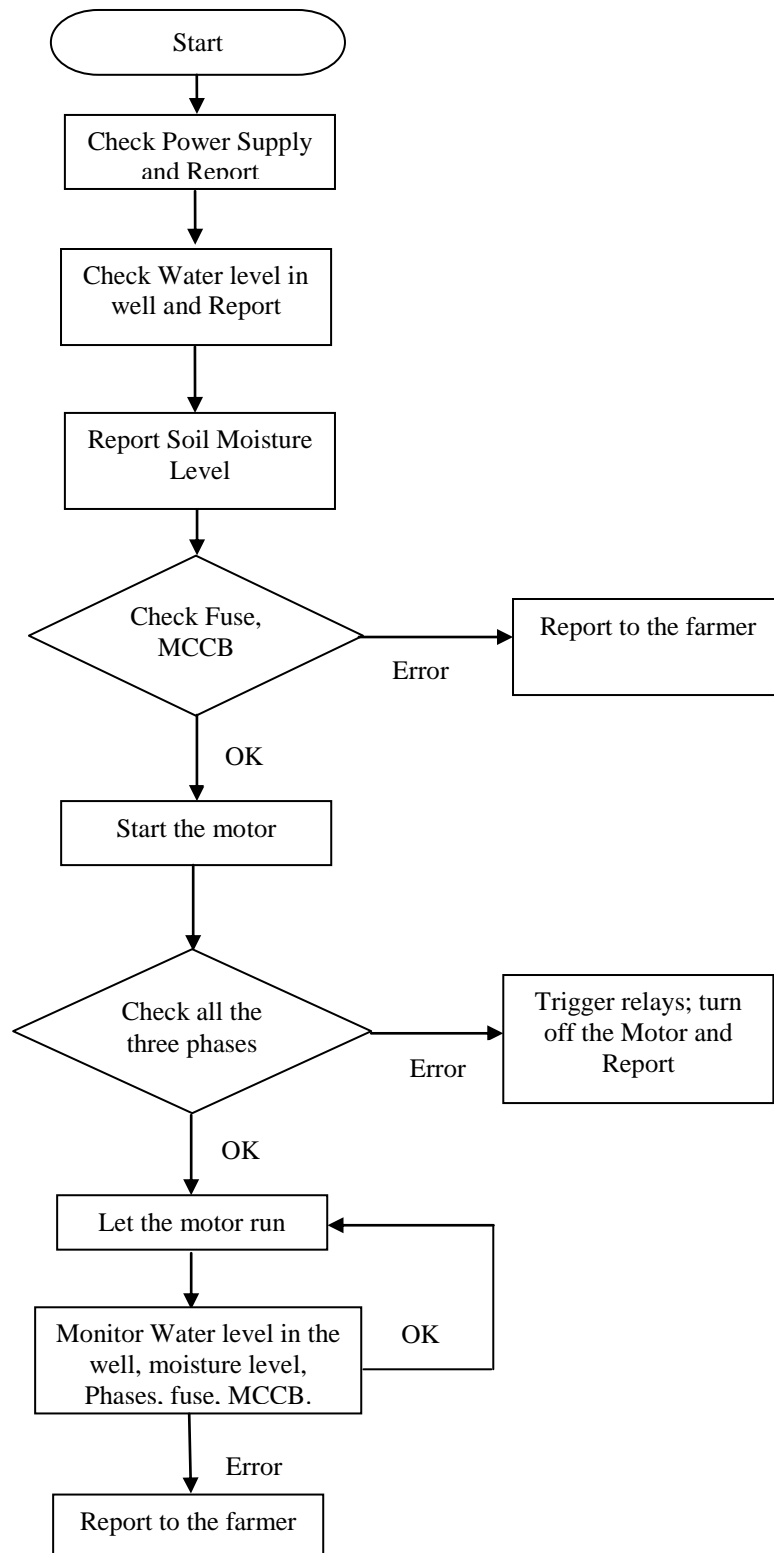
Fig.5. System Flowchart

VI. CONCLUSION

As per the proposed system, the control unit continuously monitors the on field condition and reports the farmer if any error or fault occurs, on his mobile via GSM module. The system also allows the farmer to remotely control the motor through his mobile phone by using the SMS service. The system can notify the on field condition to the farmer anywhere in the world as long as GSM has the coverage of the service provider. The on field condition monitored by the system includes moisture level in soil, water level in well, faults in power supply, etc. A GSM modem is used to send and receive the messages from the farmer. The farmer is provided with a user friendly graphical interface of Android App. GSM modem is controlled by the microcontroller using simple AT commands. Depending on the field data, microcontroller communicates serially with the modem and then the modem sends the report to the farmer's mobile. When farmer needs to control the motor, the message is received by the modem and is processed by the microcontroller and accordingly action is taken on the field.

REFERENCES

[1]. Overview of The GSM system: IEEE Communication Magazine April 1993
[2]. An Introduction to Android: Huang Kuguang, Database Lab. Inha University
[3]. Android Application Development, Danial Switkin, Google Inc.
[4]. H.T.Ingale, N.N.Kasat −'Automated Irrigation system', International Journal of Engineering Research and Development.
[5]. Manish Giri, Dnyaneshwar Natha Wavhal, Department of Computer Engineering MIT Academy of Engineering Alandi(D), University of Pune-Automated Intelligent Wireless Drip Irrigation Using Linear Programming
[6]. N. B. Shaikh1, Prof. S. S Dhamal2, S. S. Hadpe3, K. P.Varade4 , Department of Electrical Engineering, S.V.I.T, Nashik, Maharashtra, India-"Online Off-Site Condition Monitoring Of Three Phase Induction Motor by Using GSM Technology"
[7]. Rafael Muñoz-Carpena and Michael D. Dukes - Automatic Irrigation Based on Soil Moisture for Vegetable Crops
[8]. K.Prathyusha1 M. Chaitanya Suman Assistant Professor, Department of ECM, K.L.University, Vaddeswaram, Guntur District, Andhra Pradesh, India. Assistant Professor, Department of ECE. Vignan Nirula College of Engineering , Guntur District, Andhra Pradesh, India.- DESIGN OF EMBEDDED SYSTEMS FOR THE AUTOMATION OF DRIP IRRIGATION
[9]. Craig Wahgren, Karen Leix, J.H Webb – Current Limiting Fuses address safety and power quality concerns.
[10]. S. M. Khaled Reza, Shah Ahsanuzzaman Md. Tariq, S.M. Mohsin Reza - 'Microcontroller Based Automated Water Level Sensing and Controlling: Design and Implementation Issue', WCECS 2010, October 20-22, 2010, San Francisco, USA.