Smart System for Automatic AC Motor starter based on GSM

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***Abstract*-- Geographically India is having very diverse geometric conditions, which lead to many irrigational conditions and circumstances. As per the survey conducted by the Government of India, 75% of the population lives in the countryside where farming is the key source of earning. Present studies indicate that there is a drastic change in the weather condition due to globalization and scarcity of resources, which have directly affect adversely on the farming. The major issues that raise the rate of reducing farming conditions can be consider as improper irrigation systems, Losses, Improper practices etc. In present irrigation system, farming is very tedious and involves the physical presence of a farmer. Due to improper timings of electric supply for field irrigation system sometimes the conditions were so uncomfortable and dangerous too for watering the field thus looking into those problems faced by farmers we proposed a low cost easily maintainable watering solution for farmers. In this, we use preexisting Mobile GSM network and with the help of Automatic AC Motor Starters, we will control the action of Water irrigation systems. The complete design is based on a simple SEE – SAW Structure of Starter Automation. The focus of this design is to keep design criticality as less as possible, which makes it easy to maintain and repair.**

I. INTRODUCTION

The history of Indian agriculture is very ancient and evolves over a very large time span. Studies say that Indian agriculture began by 9000 B.C., which indicates the remarkable possibility of early cultivation of plants, and domestication of crops and animals. The techniques being developed for agriculture improves cultivation of land which gives the stability in human beings Globally around 40% of irrigation is supported by groundwater supplies whereas this percentage is quite higher in India about 50%of total irrigation is based on groundwater supply. The poor farmers depend on various other ways for watering their crops, such as through pumps, Motes, Windmills, and canals etc. from studies we find that the major causes of low farming are caused due to many Natural and unnatural conditions. Which given as

- Heavy Rain Fall
- Low Rain Fall
- Natural Calamities
- The scarcity of Safety Awareness
- Improper Tools
- Improper Irrigation / Watering System

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In general, farmers use three phase induction motors as a key source of providing water supply in the field, which requires a starter to start the motor. The main problem that a lie with the operation of these motor starters is that it requires manual operation. At many places, availability of electricity at right time is big problem. That time it is quite difficult for a farmer to go and operate the field water motor thus having these problems in mind we are proposing a GSM Based Automatic single phase or Poly Phase Motor Starter for Irrigation motor System. This starter is connected to SEE-SAW transmission system along with GSM control. It can be useful to start the motor from a long distance by using pre-existing GSM Mobile technology.

II. EXISTING WATER SYSTEM

It is very well known that a major part of irrigation is controlled by heavy-duty motors, which requires huge power ratings. These irrigation motors require a starter to start the motor safely. The starter used according to the motor power ratings. It is a very hectic task to control currently used Starters. In addition, these motors once damaged require huge sum to repair.

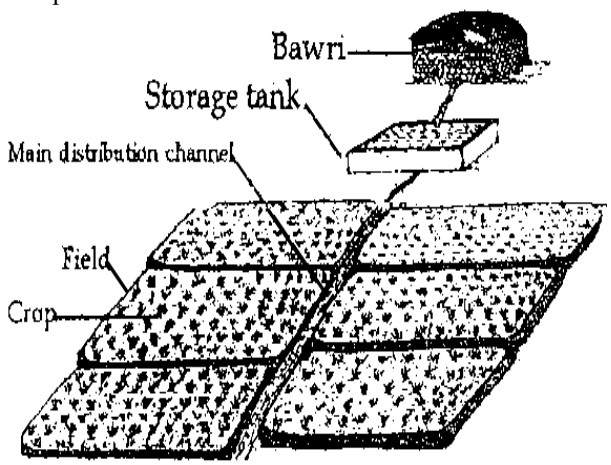

Fig.1 Existing Field Watering System

In most of the cases, the water is transferred to secondary storage from the primary water source and then it is channelized to agriculture land by pumps or lifted by human or animal power [1] [2] [3]. During our literature study, we came across many different kinds of solutions, some of them based on the smart architecture of Irrigation system and some of them based on the smart and wireless Control [4] [5] [6] [7] [8] [12]. The existing irrigation system does not make efficient way of utilizing water. Even though In general, most of the farmers use inefficient manual system for irrigation in their

field [9]. Thus there is very wide scope of developing microcontroller based circuits and utilizing sensor system agricultural applications to reduce their efforts [10] [13].Whereas some of the project were designed to provide starter device for soft starting process especially for AC motors. Some of them are SCR based, some of them are based on Opto Triac and Power Electronics Base [14] [15] [16].

III. STANDARD PROPOSED SYSTEM DESCRIPTION

As we, all know that today almost everywhere we can get mobile network. So there is nothing better than mobile network which provide us wireless connectivity for our project. Thus, we have designed a system based on GSM Modules, which used to switch the starter automatically and ultimately the motor. The basic Block Diagram for the proposed wireless Motor starter system shown in following fig.2. GSM Modules based wireless motor starter can be designed based on any Low cost GSM mobile or on GSM module. The basic working of design is divided into three major parts like

- Master Console Available with Farmer
- Slave / Target Console
- SEA – SAW Transmission Mechanism

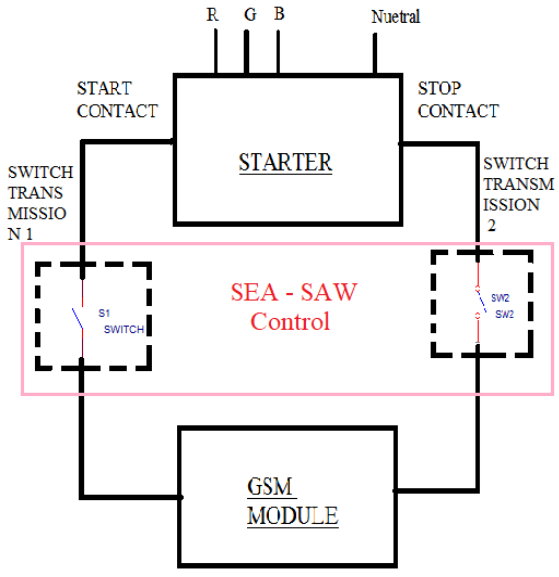

Fig.2 Block Diagram of proposed system

A. Master Console

Master console is the GSM Transmitter device available with the farmer. This master console formed by utilizing any Mobile phone or GSM base transmitter module, which will be responsible for the generation of the control signal. We prefer to use mobile phones on master console side to reduce the design cost of product and to increase flexibility of the product. We can also utilize different wireless systems Like RF transceiver, Zigbee Transceiver etc.

B. Slave / Target Console

Slave or / Target console is of main interest. In this console, we utilizes either cell phones or GSM modules to receive controlling signals from Master consol. Once the signal received from the master console then Slave / Target console will generate a two controlling signals (ON_signal and OFF_Signal) which are then applied to the SEE-SAW Controlling mechanism.

C. SEA – SAW Transmission Mechanism

This transmission mechanism is the heart of our design. As the name suggests it shows SEA – SAW action of controlling arms. This terminology is arise from the alternate mechanism used to Connect or Disconnect the Starter supply to make the complete load to excite or to disconnect the load from the source thus making load to turn ON or OFF.

Basic SEA-SAW Mechanism formed by very few elements like

- Connecting Wires
- Transmission Arms
- V Shape Grooves
- Damping / Controlling Spring
- Moving / Gear motor Assembly
- Guard Line

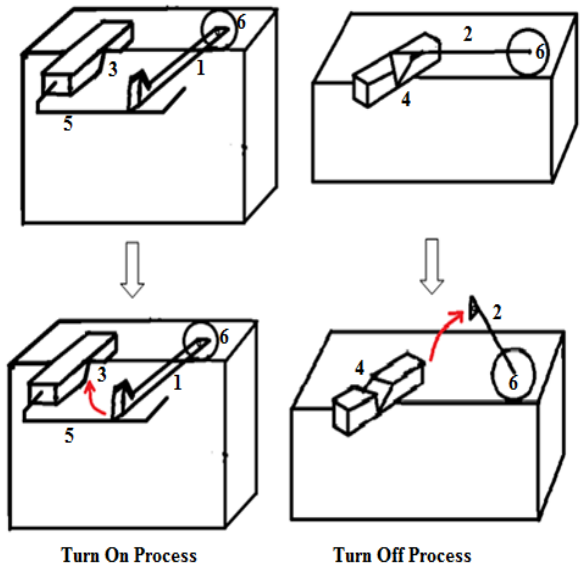

Fig.3 Proposed SEE-SAW Transmission Mechanism

IV. PRINCIPAL OF WORKING

We all are very well aware of Electromagnetic phenomenon. The heart of proposed system is DC motor. The complete concept based on how the motor is used. There are prime three

characteristics of DC motor

1. Back Electromotive force (EMF)
2. Motor Torque
3. Current taken by Motor

To work motor in normal speed one need to fulfil above three characteristics in required condition. Our control system work because of under torque condition. The operation of a DC motor is relatively straightforward. A coil is placed in a magnetic field, and when an electric current passes through the coil, a torque is produced, causing the motor to turn. The entire process driven by applying electrical power to the coil, with the source voltage having a direct relationship to the motor's output speed.

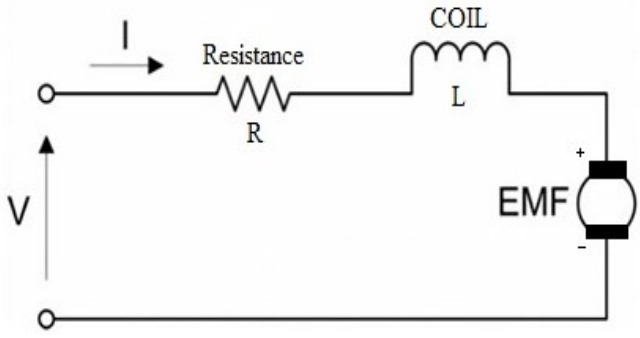

Fig.4 Generalised DC motor circuit

Above figure indicates relative circuit for typical DC motor in which applied voltage (V) formulated as

$$\text{Applied Voltage } (V) = I \times R + L\, dI / dt + E_b \quad (1)$$

Where, I = Current, R = Resistance, E_b = Back EMF

and L = Coil.

$$\text{Back EMF } E_b = K_E \times \omega \quad (2)$$

Where, K_E = Electrical Constant of motor

ω = Angular velocity

Substituting eq. 2 in eq.1 we get

$$(V) = I \times R + L\, dI / dt + K_E \times \omega$$

As Current is constant trough motor hence discarding inductance so we get

$$(V) = I \times R + K_E \times \omega \quad (3)$$

In addition, torque of the motor related with the turning or twisting moment of force about an axis. The current, I, through the motor coil directly related to the motor's torque.

$$\text{Torque } Tq = K_T \times I \quad (4)$$

$$\therefore I = Tq / K_T \quad (5)$$

Where, K_T = Torque constant

Substituting eq. 5 in eq. 3 we get

$$V = (Tq / K_T) \times R + (K_E \times \omega)$$

$$\omega = [V - ((Tq / K_T) \times R)] / K_E \quad (6)$$

For DC motors, the torque and electrical constants, K_T and K_E, are equal i.e. K, so that the modified angular velocity can be showed as

$$\omega = (V/K) - (Tq / K^2) \times R \quad (7)$$

Thus based on eq. 7 we have to such supply voltage, which will cause under torque condition. This under torque condition will make small angular rotation at shaft. So that when control signal reaches to slave console, it give small rotation to the corresponding DC motor resulting to shift load on the shaft which is responsible to either make or break the contact.

V. Working Steps

- Consider default condition at beginning where default represents Switch off condition in which no load is active.
- Now consider turn on Condition in which the consumer will make a call to Slave / Target Console.
- After receiving call, it will check previous condition as it is first time of use so the previous condition is default set to off.
- Upon receiving call at Slave / Target Console will generate controlling signal based on previous condition.
- Upon receiving control signal SEE – SAW network activated and it will turn on the load by connecting lower side of SEESAW transmission.
- After making Load ON it will release the contact and SEE - SAW gains its original condition.
- When consumer wants to turn off activated load then he will make another call to Slave / Target Console and based on previous condition it will generate control signal for the SEE – SAW Mechanism, now this time top side which is connected on the contact plate will disconnects by making SEE – SAW action.
- After particular time elapses that displaced side of SEE – SAW mechanism returns to its original position and continues until new control signal does not generate by Slave / Target Console.

As per Consumer electronics point of view we have consider the applicable areas where it could be possibly use along with irrigation application. There are many consumer electronic products, which requires 3 phase or 1 phase of electric supply. Having these things in mind we have provides the possibility to use either single-phase load or three-phase load. It is suitable to use this controlling mechanism along with Direct on Line (DOL) motor starter.

Fig.5 Proposed System Implementation

VI. Result and Conclusion

From the implementation of proposed system, we confirms the automatic controlling of AC Starter is possible with the help of small DC motors working in under torque condition. Proposed system is very easy to repair and maintain as it make use of Simple DC motor for better controlling of AC Motors.

Acknowledgment

The proposed design of automated motor starter has applied for patent. Patent Application No. 201721025264.

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