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GSM Based Pump Automation

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Abstract— The project GSM BASED PUMP AUTOMATION has been developed to operate a pump using GSM devices, such as mobile. This project is specifically designed to operate remote located submersible pumps and motors for benefit of farmers, agriculture people and industries where wireless pump and motor control required. Our project is designed with advanced micro controller technology and quality process. One authentication procedure is also there such that owner has ultimate power to control its use by other users. If owner allows other users to ON/OFF the pump then only it can be operated by particular that user. One list of authenticated users will be handled such that if owner authenticate an user to operate the pump module will not inform the owner anymore to authenticate the registered user. This authentication is required for preventing the misuse of this module.

Keywords— ARDUINO UNO; GSM 300; Remotely controlled pump; Authentication.

I. INTRODUCTION

Today, India ranks second worldwide in farm output. In the years since its independence, India has made immense progress towards food security. Indian population has tripled, but food-grain production more than quadrupled: there has thus been substantial increase in available food-grain per capita. Generally, a substantial amount of time and energy is spent by a person or a farmer to visit his farm for operating motors. The farmer has to travel to fields often during odd hours and in an unfavourable weather just to switch ON/OFF the motor due to unexpected erratic power supply.

A. Physical effort and inconvenience

- Farmers have to travel to fields often at odd hours just to switch ON/OFF the motor due to erratic power supply.
- They often face the risk of wild animals, snakes, hazardous terrain and electric shocks while traveling to the fields in the dark and on a rainy day.
- Existing aids like auto-starters are unreliable and incapable of communicating the operating state of the motor.
- Where a farmer has more than one motor pump set; he has to run around to make sure that all the motor pumps are working when the power is available.

B. Loss/ Frequent damage of irrigation equipment

- Motors and starters often get damaged due to voltage fluctuations, faults in three phase connectivity, and running of motor while water is not getting pumped.
- A delay in knowing about problem, and getting motors repaired, often results in crops not getting irrigated effectively and hence a loss in crop yield.
- Motors, starters and cables located on fields are easy targets for thieves.

C. Wastage of water and electricity

- At times, motor pumps are left running for longer than what is necessary because of the effort involved in switching OFF the motor. This leads to wastage of both electricity and water
- Excessive watering results in soil erosion, wastage in fertilizers used and hence a loss in productivity. Excess fertilizer run-off in to larger water bodies (lakes and rivers), further impacts environment.
- Indiscriminate use of resources is also resulting in exploitation of ground water beyond recharging capacity. Falling water tables further result in increased suction head, and demand greater energy needs.

To resolve these problem we have developed this project.

II. IMPLEMENTATION

This project is based on microcontroller. Here we have used Arduino UNO. GSM 300 kit has been used for authentication purpose. Here is the details of implementation. The GSM BASED PUMP AUTOMATION is implemented on a miniature pump replica.

A. Software

The code for the system is all written in the Arduino programming environment. Knock to Unlock The software is used for many of the background processes such as:

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- Receiving sms using GSM 300
- Matching if sms has been sent from owner's mobile or not
- If it is from owner execute the command and send a status on owner's mobile
- If it is not from owner's mobile, check the number from authenticated numbers database
- If matching found from that database execute the command and send a status on owner's mobile
- If not matched, ask owner to authenticate
- If owner authenticate it save the number in authenticated number database and execute the command and send a status on owner's mobile
- If owner does not authenticate the number command will not be executed

B. Hardware

Arduino -> Arduino is a single-board microcontroller, intended to make building interactive objects or environments more accessible. It is a tool for making computers that can sense and control more of the physical world than our desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Relay Driver -> Relays have been around for a long time and though often now replaced with solid state switches, they have unique properties that make them more robust than solid-state devices and are not going away. The unique properties are high current capacity, ability to withstand ESD and drive circuit isolation. There are numerous ways to drive relays. In preparation for some of the more advanced relay drivers I will be posting in the future, I have listed a few basic relay drivers for our reference. Included are the following: High side toggle switch driver, low side toggle switch driver, bipolar NPN transistor driver, Darlington transistor driver, N-Channel MOSFET driver, and ULN2003 driver.

Power Supply-> It will take 12v Battery as a power supply to activate the Arduino uno.

GSM 300-> This is a plug and play GSM Modem with a simple to interface serial interface. Use it to send SMS, make and receive calls, and do other GSM operations by controlling it through simple AT commands from micro controllers and computers. It uses the highly popular SIM300 module for all its operations. It comes with a standard RS232 interface which can be used to easily interface the modem to micro controllers and computers.

Mini Pump -> Here we have used a mini pump for our project for lifting water.

C. Software Requirements

The Arduino integrated development environment (IDR) is a cross-platform application written in Java, and derives from the IDR for the language and the Wiring projects. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. A program or code written for Arduino is called a sketch. Arduino programs are written is C or C++. The Arduino IDE comes with a software library called "Wiring" from the original Wiring project, which makes many common input/output operations much easier. Users only need define two functions to make a runnable cyclic executive program:

- Setup(): a function run once at the start of a program that can initialize setting
- Loop(): a function called repeatedly until the board powers off.

III. HARDWARE EQUIPMENTS

A. Arduino UNO

The Arduino Uno[1] is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

B. BC547B

The NPN Bipolar Transistor[2] is designed for use in linear and switching applications. The device is housed in the TO-92 package, which is designed for medium power applications.

C. Resistor

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors act to reduce current flow, and, at the same time, act to lower voltage levels within circuits. It measures by OHM.

D. IN4007

It is a rectifier diode with these features – low forward voltage, high current capability, low leakage current, high surge capability.

E. LED

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a pn-junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron

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holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor.

F. Relay

Relay[3] is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit.

G. GSM SIM 300

A GSM Modem is a device that modulates and demodulates the GSM signals and in this particular case 2G signals. The modem we are using is SIMCOM SIM300. It is a Tri-band GSM/GPRS Modem as it can detect and operate at three frequencies (EGSM 900 MHz, DCS 1800 MHz and PCS1900 Mhz). Default operating frequencies are EGSM 900MHz and DCS 1800MHz.

Sim300[4] GSM module used here, consists of a TTL interface and an RS232 interface. The TTL interface allows us to directly interface with a microcontroller while the RS232 interface includes a MAX232 IC to enable communication with the PC. It also consists of a buzzer, antenna and SIM slot. Sim300 in this application is used as a DCE (Data Circuit-terminating Equipment) and PC as a DTE (Data Terminal Equipment).

IV. DFD

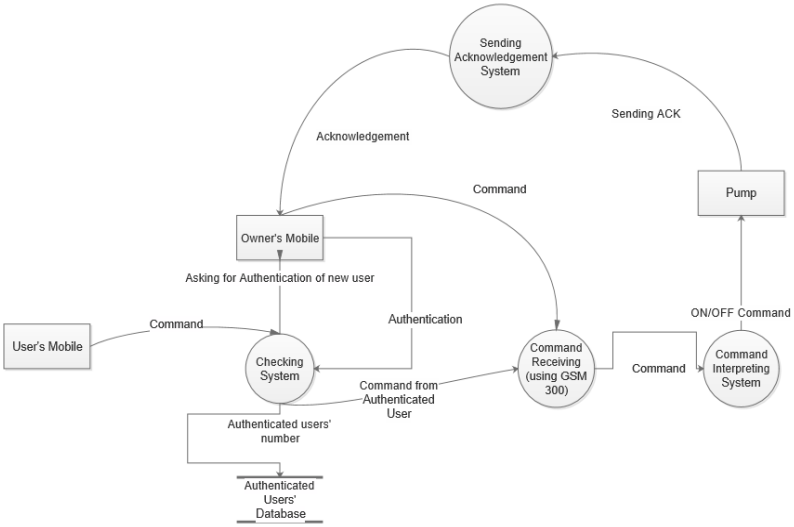

Fig. 1 DFD of GSM Based Pump Automation

V. FLOWCHART

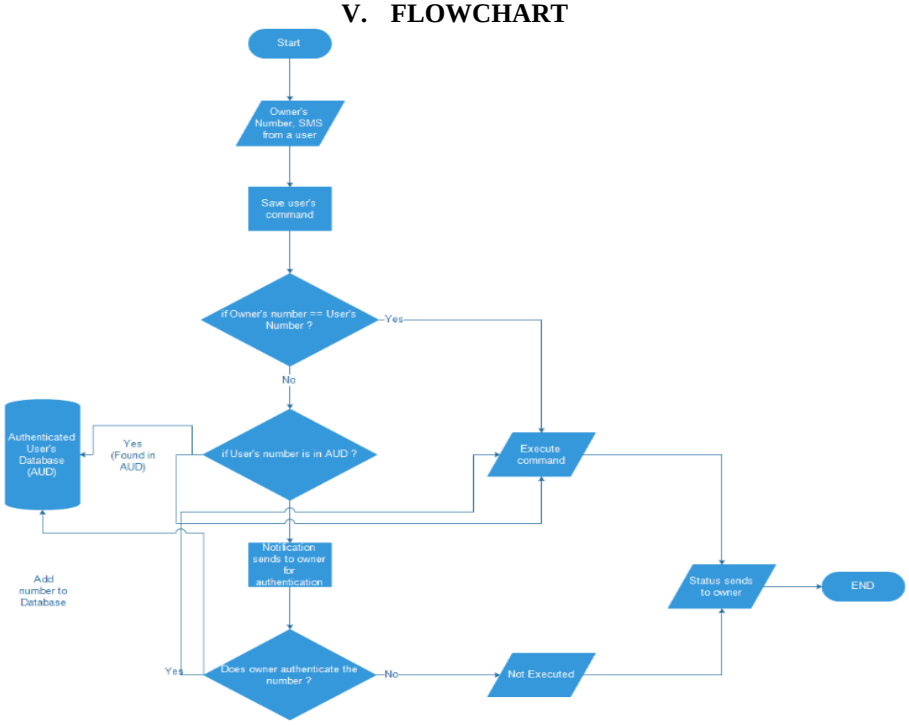

Fig. 2 Flowchart of GSM Based Pump Automation

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VI. ALGORITHM

- Step-0 : start
- Step-1 : input owner's number
- Step-2 : take sms from user
- Step-3 : check if the user's number is equal to owner's number, if true go to step-5 otherwise go to step-4
- Step-4 : if user's number saved in Authenticated User's Database(AUD), if true go to step-5 otherwise go to step-6
- Step-5 : execute the command of user's sms and go to step-8
- Step-6 : if user's number not in AUD, ask owner to authenticate
- Step-7 : if owner authenticates saves the number to AUD and go to step-5 otherwise command will not be executed and go to step-8
- Step-8 : send status of acknowledgement sends to owner
- Step-9 : end

VII. PSEUDO CODE

```
int auth=0,n=0, String users[10],temp="",temp1="";
setup() Function :
//testing if module is working properly or not
pinMode(pin_13,OUTPUT);
Serial.begin(9600);
pinMode(pin_13,OUTPUT);
digitalWrite(13,LOW);
delay(2000);
Serial.println("AT");
delay(2000);
if(Serial.readString().indexOf("OK")== -1)
{
        digitalWrite(13,HIGH);// idicating GSM fail
        delay(2000);
}
Serial.println("AT+CMGF=1");
delay(2000);
Serial.println("AT+CLIP=1");
pinMode(11,OUTPUT);
pinMode(12,OUTPUT);
}
loop() Function
{
        if(Serial.available()>0)
        {
                //digitalWrite(GSMActive,HIGH);
               GSM_exe();
                //digitalWrite(GSMActive,LOW);
        }
}
GSM_exe() Function
//reads GSM
 if((gsm.indexOf("+CMTI: \"SM\"")+1))
{
        int str=gsm.indexOf("SM\"")+4;
        int en=gsm.indexOf('\n',5);
        String st=gsm.substring(str,en);
        Serial.println("AT+CMGR="+st);
        gsm=Serial.readString();
        str=gsm.indexOf(",")+2;
        en=gsm.indexOf('\"',str);
        String sndr=gsm.substring(str,en);//sender of the msg received by ARDUINO
        str=gsm.lastIndexOf('\"')+3;
        en=gsm.indexOf("OK")-3;
        String msg=gsm.substring(str,en);
        Serial.println("AT+CMGD="+st); //deletes sms
        //AUTHENTICATION checking
        if(sndr=='owner')
                auth=1;
```

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```
        else
                auth=0;
        if (sndr='owner' && msg=='YES'){
                auth=1;
                addUser(temp);
                sndr=temp;
                msg=temp1;
        }
        void SMSsender(String, String);
        void execute(String);
        if (auth==0)
                chkAuthentication(sndr,msg);
        if (auth==1) {
                execute (msg);
                SMSsender(sndr,"EXECUTED");
                SMSsender("+919836865420",sndr+"\n"+msg); // Number of owner :P
                auth=0;
                temp="";
                temp1="";
        }
}
 Execute(String s) Function :
if((s.indexOf("ON_11")+1))
         digitalWrite(11,HIGH);
else if( (s.indexOf("OFF_11")+1))
        digitalWrite(11,LOW);
if((s.indexOf("ON_12")+1))
        digitalWrite(12,HIGH);
else if( (s.indexOf("OFF_12")+1) )
        digitalWrite(12,LOW);
SMSsender(String n, String txt) Function :
Serial.println("AT+CMGS=\""+n+"\"");
while(Serial.read()!='>');
        Serial.print(txt);
        Serial.write(0x1A);
        Serial.write(0x0D);
        Serial.write(0x0A);
chkAuthentication(String sndr, String msg) Function:
//Function for User Authentication
for(int i=0; i<n; i++)
if(sndr==users[i]{
        auth=1;
        return;
}
temp=sndr;
temp1=msg;
SMSsender("owner","Ask auth msg");
addUser(String sndr) Function :
users[n]=sndr;
n++;
```

VIII. BLOCK DIAGRAM

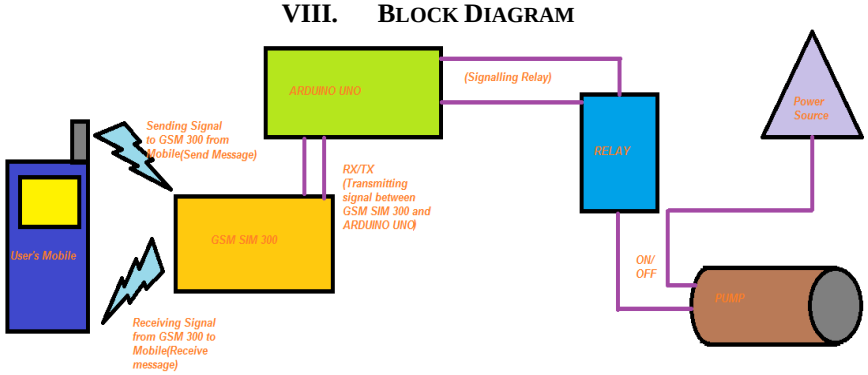

Fig. 3 Block Diagram of GSM Based Pump Automation

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IX. FUNCTIONAL CIRCUIT DIAGRAM

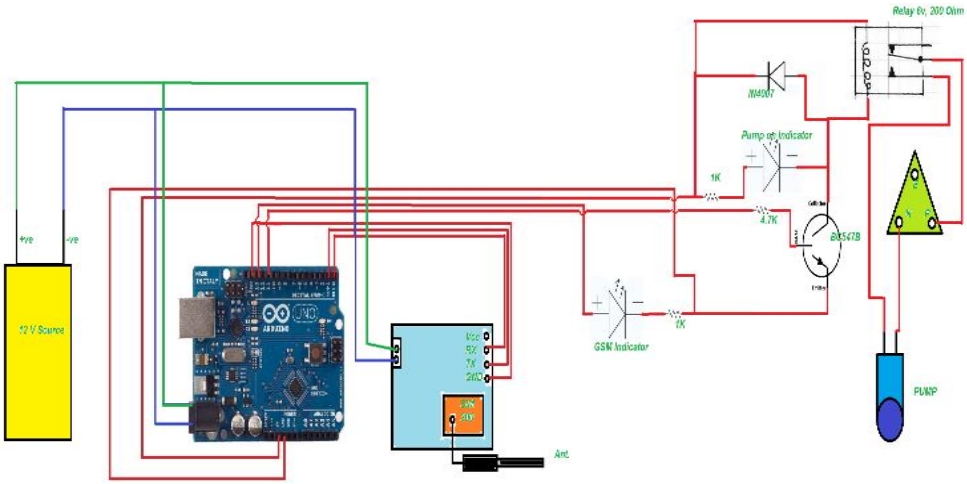

Fig. 4 Functional Circuit Diagram of GSM Based Pump Automation

X. SNAPSHOTS

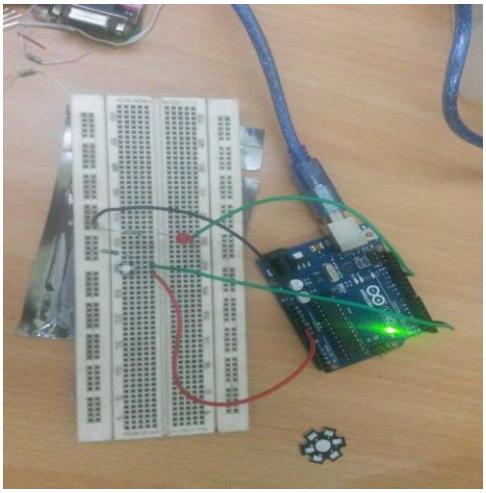

Fig. 5 Snapshot-1 of GSM Based Pump Automation

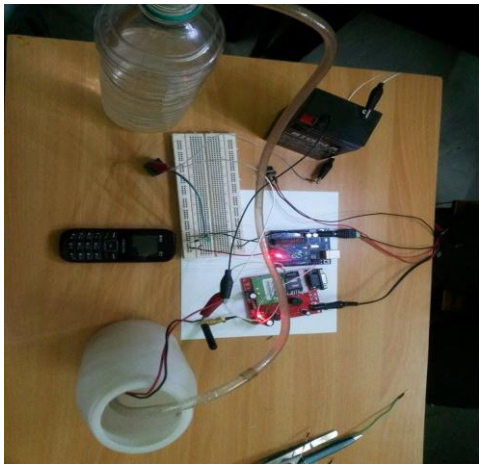

Fig. 6 Snapshot-2 of GSM Based Pump Automation

XI. CONCLUSION

Our project has several advantages –

- User can operate pump/motor from anywhere, from any distance
- User can operate pump via SMS
- Low operating costs due to SMS function
- GSM Technology, Reliable operation, Worldwide Connectivity
- Low Cost, Quality and less maintenance and robust device
- ARDUINO UNO is too much reliable as data will be retained for 20 years

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