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# Embedded System Based Water Distribution Rationally For Homes Using RFID Technology

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**ABSTRACT**

Now a day we are facing drinking water problems in our life. In course of time we will more struggle of this problem due to shortage of the drinking water, since water is more essential for every family or every human to live, in parallel ground water level is going down gradually. In this paper we have designed and implemented an embedded system based water distribution rationally for homes using RFID Technology, which can be organized in streets and required places. In this system only authorized members can obtain the required water for homes. This system consists of various devices like, microcontroller, keyboard, LCD, RFID reader and stepper motor. The RFID reads the id number from passive tag and sends to the microcontroller, if the id number is valid then microcontroller request to the authorized person's password. After verifying the password the microcontroller request to enter the required water quantity (eg.50 liters per day), then the controller sends the control signals to open the gate vole by stepper motor. This system is more constructive to protect the wastage of waters and man power is reduced. Here the water filling of main tank, based on bore well water level is automated.

**Keywords:** RFID, Keyboard, Microcontroller, stepper motor, water level sensor.

## 1. Introduction

Now days, drinking water is very huge problem in many states including tamilnadu due to insufficient of water in a hurry burry life many people suffered a lot to bring water in time. Water is very essential for every man to save the life. After some years we are going to face this problem very severally. The State government will be in a

position to concentrate more in providing the required water to homes and conserving the wastage of water. To solve this problem we have designed and implemented an embedded system based water distribution for homes rationally, using RFID Technology. This system also having the automatic tank filling method based on bore well water level [1]. This system has two important sections, one is RFID and other is stepper motor. Former is used to identify the authorized customer, after verify their ID(identification), later is to activate the vole by receiving the control signals from the microcontroller in which require water level can be entered (eg.100 liters per day).the detail function of RFID and stepper is described as follows.

### 1.1 RFID Fundamentals

**Radio** frequency identification (RFID) systems typically consist of small low-cost battery-free devices, called tags, which use the radio signal from a specialized RFID reader for power and communication. When queried, each tag responds to a unique identification number by reflecting energy back to the reader through backscatter modulation. Tags are often application-specific fixed-function devices that have a range of 10–50 cm for inductively coupled devices and 3–10 m for UHF tags. Traditionally, RFID tags have been used as a replacement for barcodes in such applications as supply chain monitoring, asset management, and building security [2],[3].There are many different types of RFID systems in the market. These are categorized on the basis of their frequency ranges. Some of the most commonly used RFID kits are low-frequency (30-500 kHz), mid-frequency (900 kHz-1500MHz) and high-frequency (2.4-2.5GHz).Basically, an RFID system consists of three components: an antenna or coil, a transceiver (with decoder) and a transponder (RF tag) electronically programmed with unique information. An RFID reader is a device that is used to interrogate an RFID tag. The reader has an antenna that emits radio waves; the tag responds by sending back its data. An RFID tag is a microchip combined with an antenna in a compact package; the packaging is structured to allow the RFID tag to be attached to an object to be tracked. "RFID" stands for Radio Frequency Identification. The tag's antenna picks up signals from an RFID reader or scanner and then returns the signal, usually with some additional data (like a unique serial number or other customized information). A passive tag is an RFID tag that does not contain a battery; the power is supplied by the reader. When radio waves from the reader are encountered by a passive RFID tag, the coiled antenna within the tag forms a magnetic field. The tag draws power from it, energizing the circuits in the tag. The tag then sends the information encoded in the tag's memory. The RX and TX pins of RFID reader connected to Tx and Rx pins of AT89C51 Microcontroller respectively. Then the reader senses the data from the Tag and transmits the sensed data to microcontroller via serial port [4].

### 1.2 Stepper Motor

Stepper motor is one of the commonly used motors for precise angular movement. The advantage of using a stepper motor is that the angular position of the motor shaft can be controlled without any feedback mechanism. Stepper motors are widely used in industrial and commercial applications. The microcontroller is used to control the

speed, direction and rotating angle of a stepper motor by sending pulse sequences to the motor winding in response to the control commands [5]. Commands executed by the code in this application, as single step the motor rotates in a clockwise or counterclockwise direction (i. e. rotate the rotor through a certain number of degrees) when the corresponding condition is executed. This is a general purpose application for which a degree of adjustment or programmability is required to meet the needs of specific processes and their performances. There are two main types of stepper motor are known as the Unipolar and Bipolar.

*1.2.1 Unipolar Stepper Motor*

A unipolar stepper motor generally has five or six wires and four coils, whereby the coils are being separated by a center tap. The center tap of the coils, which served as the source of power supply, are being tied together where power always enters from this single pole. In a unipolar arrangement, the step can be performed without having to reverse the direction of current in a coil. It is a much simplified control but have a smaller torque.

*1.2.2 Bipolar Stepper Motor*

A bipolar stepper motor usually has only four wires and two independent sets of coils without the center tap. In a bipolar arrangement, the step can only be performed by revert the current in a coil. It tends to be a more complex control as compared to unipolar, but have a greater torque.

## 2. Related Works

In [4], this system is designed and implemented a bank locker security system based on RFID and GSM technology which can be organized in bank, secured offices and homes. In this system only authentic person can be recovered money from bank locker. The main advantage of using passive RFID and GSM is more secure than other systems. The RFID reader reads the id number from passive tag and send to the microcontroller, if the id number is valid then microcontroller send the SMS request to the authenticated person mobile number, for the original password to open the bank locker, if the person send the password to the microcontroller, which will verify the passwords entered by the key board and received from authenticated mobile phone. if these two passwords are matched the locker will be opened otherwise it will be remain in locked position, This system is more secure than other systems because two passwords required for verification. It is a low cost, low in power conception, compact in size and standalone system

Today mobile phone is one of the most important devices for every one which is used in communication purpose and also used in embedded system to control the devices. In [6], the RFID based Bill Generation and Payment through Mobile system is implemented. In this paper, the bill generating in super market using RFID technology and also payment through mobile phone. Mobile payments will become one of the most important mobile services. The most essential consideration is the security of the mobile devices and the applications along with the complexity of

imbursement process. Advantages of this system, i) Increased consumer confidence, leading to increased sales. ii) Considered about the benefits of both consumers and merchants.

The RFID (Radio Frequency Identification) emerges as one of the converging technologies and transportation plays a vital role in urbanization. RFID plays major role in auto ID applications like RFID contact less smart cards used by bus riders, in Super market, Textiles and logistics chain management. In [7], the RFID Based Embedded System for Vehicle Tracking and Prevention of Road Accidents system is designed and implemented. This system is may be to reduce the road accident in Indian roads.

In [8], the RFID Based Exam Hall Maintenance System presents an efficient method of examination hall management. This system is possible for a student to identify the particular exam hall from any other hall, when they swipe RFID card in a card reader located there. This helps them to identify the floor or get directions to their respective halls without delays. The card reader is provided at the entrance of the building, if the students enters wrongly a buzzer alarm sets off, otherwise the room number is displayed on the LCD, connected to controller. RFID technology is emergent technology which can be used in wide range of applications.

## 3. Proposed Method

In this proposed work, the RFID reads the data from tag and send to the microcontroller, if the card is valid then microcontroller display the account holder name and number. Then account holder need to enter the password, if the password is valid then microcontroller request to enter the required water (example: 100 liters) for homes. After that the gate vole is opened by stepper motor. When the required water distribution is completed the gate vole comes to the normal position. This method is simple and more constructive in streets or homes.

### 3.1 Block diagram

The block diagram of embedded system based water distribution for homes using RFID Technology is shown in the figure3. It comprises the power supply section, keyboard, RFID Reader, AT89C51 microcontroller, MAX232driver, relay driver, sensors and LCD. The circuit is powered by regulated +5v dc.

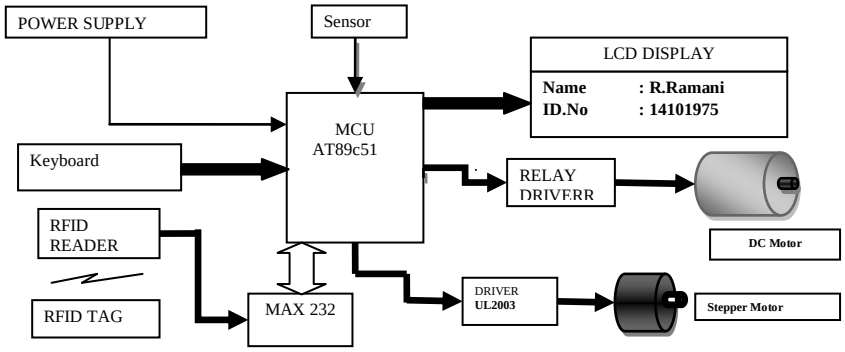



**Figure3.** Power supply

### 3.2 Power supply

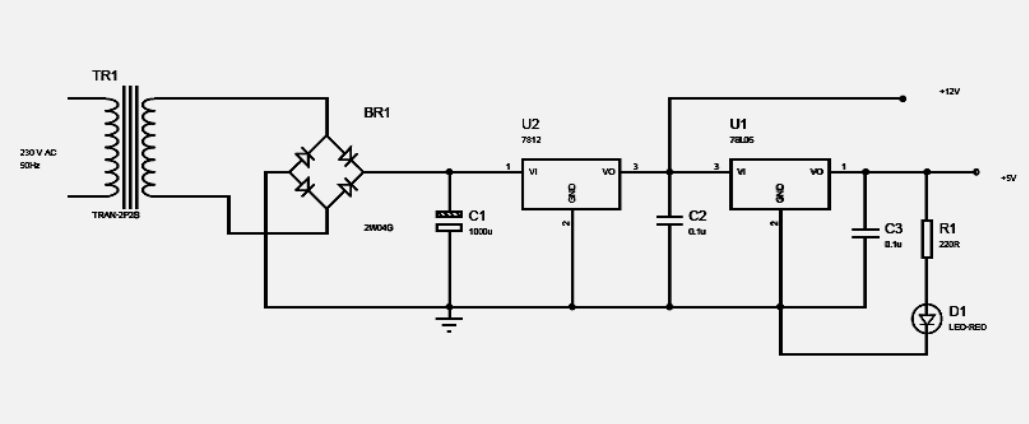



**Figure 4.** Power supply

The power supply section is the important for any electronics circuits. To derive the power supply, the 230V, 50Hz AC mains is stepped down by transformer X1 to deliver a secondary output of 12V, 500 mA. The transformer output is rectified by a full-wave rectifier comprising diodes D1 through D4, filtered by capacitor C1 and regulated by ICs 7812 (IC2) and 7805 (IC3). Capacitor C2 bypasses the ripples present in the regulated supply. LED1 acts as the power indicator and R1 limits the current through LED1.The power supply section is shown in the figure4.

### 3.3 Circuit diagram

Fig.5 shows the circuit of the embedded system based water distribution using RFID technology. The compact circuitry is built around Atmel AT89C51 microcontroller. The AT89C51 is a low-power; high performance CMOS 8-bit microcomputer with 8 kB of Flash programmable and erasable read only memory (PEROM). It has 256 bytes of RAM, 32 input/output (I/O) lines, three 16-bit timers/ counters, a six-vector two-level interrupt architecture, a full-duplex serial port, an on-chip oscillator and

clock circuitry. The system clock also plays a significant role in operation of the microcontroller. An 11.0592MHz quartz crystal connected to pins 18 and 19 provides basic clock to the microcontroller. Power-on reset is provided by the combination of electrolytic capacitor C3 and resistor R1. Port pins P2.0 through P2.7 of the microcontroller are connected to data port pins D0 through D7 of the LCD, respectively. Port pins P3.7 and P3.6 of the microcontroller are connected to register-select (RS) and enable (E) pins of the LCD, respectively. Read/write (R/W ) pin of the LCD is grounded to enable for write operation. All the data is sent to the LCD in ASCII format for display. Only the commands are sent in hex form. Register-select (RS) signal is used to distinguish between data (RS=1) and command (RS=0). Preset RV1 is used to control the contrast of the LCD. A resistor 10k ohm limits the current through the backlight of the LCD. Port pins P3.0 (RXD) and P3.1 (TXD) of the microcontroller are used to interface with the RFID reader through Max232. When an allowed person having the tag enters the RF field generated by the RFID reader, RF signal is generated by the RFID reader to transmit energy to the tag and retrieve data from the tag. Then the RFID reader communicates through RXD and TXD pins of the microcontroller for further processing. Thus on identifying the authorized person, the authorized person enters the password through keyboard, after verifying this password the microcontroller request to enter the required water quantity (eg.50 liters per day) then the controller sends the control signals to open the gate vole by stepper. Stepper motor comes to original position after distribution of required water. The water level sensor circuit for bore well and water tank comprises transistor Q1 and Q2 as sensor driver and water sensor1 (A, B), sensor 2(C, D), dipped into the bore well and tank along with the pipe. Sensor A is dipped to the threshold point for pumping and sensor B is dipped below the pipe to the bottom of the bore well and similar to water tank. When water in the bore well fills to the threshold level, it is sensed by sensor A. Sensor A is connected to the base of transistor Q1.when there is a high voltage at the base, T1 conducts and a low voltage is available at its collector. This low signal is fed to pin12 (port pin p3.2) of the MCU. Similarly, for a low voltage input at the base, T1 stops conducting and a high voltage signal is available at its collector. so port pin 1.4 of the MCU gets a high signal input. The high or low voltage signal at port pin 1.4 is monitored and processed by the program in the MCU, and decision to turn the motor off taken when the water level dips below sensor A. Pin 13 (port pin p3.3) of the MCU is the output pin. It is connected to relay driver transistor Q3 and LED2, Q3 drives relay RL1, which in turn, activates the motor. When the water level in the bore well dips below sensor A, the conducting path between sensors A and B breaks. Hence a signal is received by the microcontroller. The system turns off the motor through relay. In this way, the motor is protected from airlocks and burn outs due to dry running. This process is similar to the water tank.

**3.4 Motor Driver IC**

ULN2003A IC is used for stepper motor control in the system because the MCU cannot supply sufficient current to drive the stepper motors. ULNA2003A supports TTL, DTL, MOS or CMOS Compatible Inputs. It can provide output current up to 600mA and output voltage up to 50V with transient-protected outputs. The Common

pin of the ULN2003A is connected to 12V supply. The input pins of ULN2003A are connected to output of the MCU. The outputs of ULN2003A are connected to different coils of the Stepper Motors [Fig. 3]. If logic one is input to a pin of ULN2003A the output pin is shorted to ground. This completes the circuit by shorting that output to ground. Thus the corresponding coil connected to that output is energized [9].

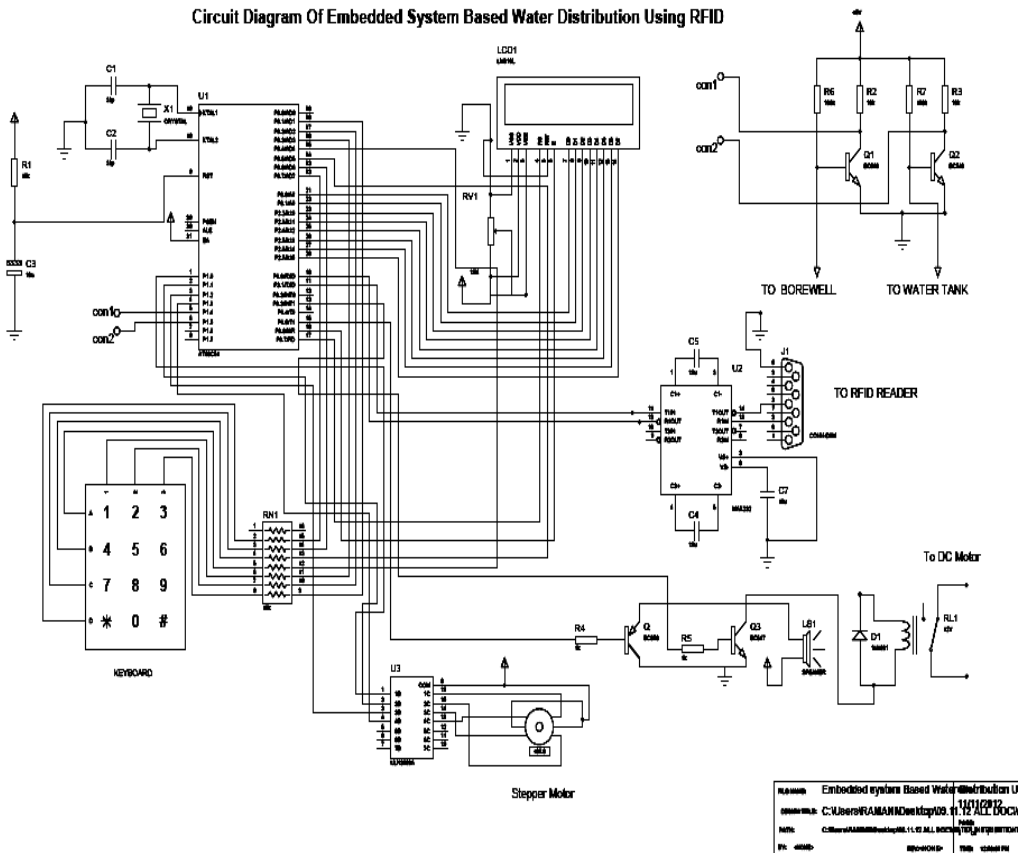
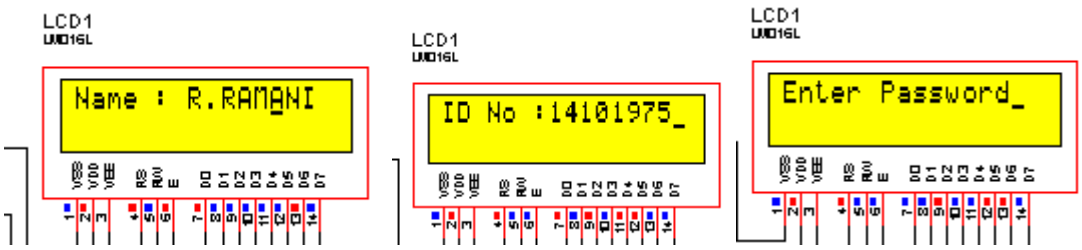
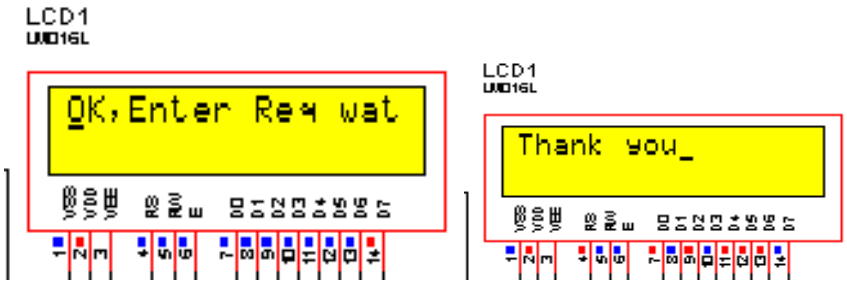



**Figure 5.** Embedded system based water distribution rationally for homes using RFID technology

## Output results

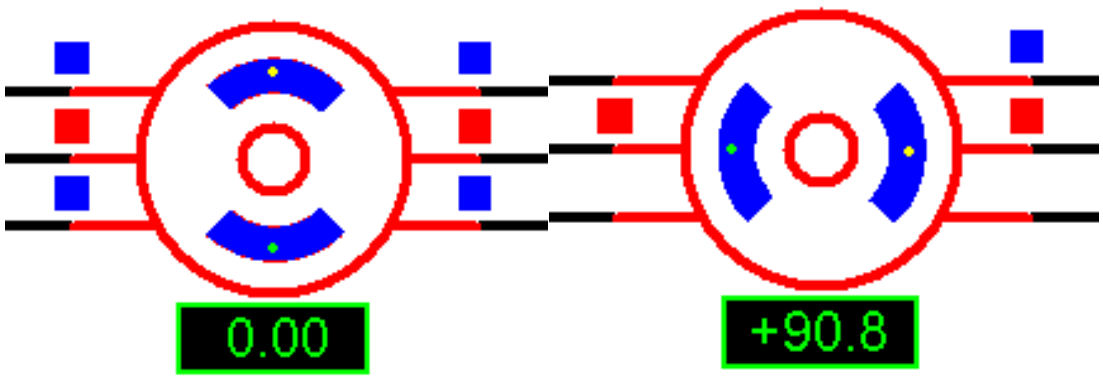



a) b) c)




d) e)

**Figure 6:** output display of LCD during the execution, a) customer Name, b)customer ID No, c) Enter Password, d)after password verification enter the required water, e) thank you




a) b)

**Figure 7:** Stepper Motor rotation to open the gate vole, a) Initial position, b) 90 degree rotation open the vole.

## 4. Software Program Testing

The software program is written in c or assembly language and compiled using keil software. After compiler operation the hex code is generated and stored in the computer. The hex code of the program is burnt into the AT89C51 by using Top win Universal programmer.

### 4.1 Hardware Assembling and Testing:

First step, we need to make single side PCB layout of the embedded system based water distribution using RFID technology for testing the circuit, proceed as follow

1. After assembling all the components on the PCB, RFID Reader is connected with TX and RX pins of microcontroller through MAX 232.
2. Connect ground pins of the RFID to the ground rail of the circuit.

3. This projects are implemented and tested successfully by us.
4. This system is very useful for water distribution to homes or office.

## 5. Conclusion

We have implemented an embedded system based water distribution rationally for homes using RFID. It is a low cost, low in power conception, compact in size and standalone system. The microcontroller receives the passwords entered from the keyboard. If these passwords are correct the microcontroller provides necessary control signal to open the gate vole for water flow. After complete the required water distributions the gate vole comes to the normal position (closed position). Since sometimes the people are not getting sure in position of water tap, if water flow is stopped itself i.e., whether the tap is opened or closed. The authorized body can suggest the required water quantity supplied rationally to home, there by wastage of water can be reduced.

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