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Design and Development of Vending Machine using AVR ATmega 8515 Microcontroller

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Abstract: Now-a-days vending machines are becoming very popular in western countries because of their ease, less wastage of time and effort, availability near doorstep and variety of products. But in India, vending machines are still not so popular according to the customer's requirement. In this paper, a model of vending machine is proposed which dispenses liquid products by accepting the paper currency. The model of vending machine is customer friendly with a feature of fake currency detection. This machine is implemented using AVR ATmega8515 microcontroller. Various modules of the machine are interfaced with the microcontroller. Currency recognition through IR sensor makes this model simple and inexpensive as compared to the previous work where either coins or tokens are used or difficult techniques like image recognition for detection of currency.

Keywords: AVR ATmega8515, microcontroller, currency detection, STK 500, AVR Studio 4

I. INTRODUCTION

Vending machines are a long back origination of the controlled automation. With time many features are being added and the machine is advanced day by day. The term 'vending machine' refers to a machine which accepts payments in the form of coin, token or card, and dispenses a product [1]. The item dispensed by the machine may be a beverage, a snack, a ticket, a receipt, or simply change of a larger denomination of currency. Most often the vending machines used depend on coin intake with currency recognition techniques like image subtraction techniques [2] [3]. Such machines are common in Western countries; however, they are yet to gain a major presence in India [4]. Also current vending machines do not prove to be much convenient and secure. Thus a model for the vending machine is implemented which accepts paper currency, detects it with less expensive techniques and is more secure.

II. APPROACH

The design concept involves designing of a model of vending machine which accepts paper currency and then produces liquid output through solenoid valve plunger. Upon placing order through a push button switch and inserting currency, firstly detection of paper currency with the help of IR sensor is done which differentiates between a piece of paper and an actual paper currency. Upon detection only the order is completed. If the currency is fake then the LCD (Liquid Crystal Display) displays order cancel and there will be no output. Each step of placing order, inserting money, placing cup and taking order is displayed on LCD. While designing the model following steps are followed:

As shown in figure 1 the flow chart explains the process of the model of our machine. Push button switches are used to place order. Then according to the LCD display currency is inserted and checked through IR Sensor. If the currency is detected to be fake then LCD displays order cancel and if it is OK then LCD will display place cup. When cup is placed under plunger then relay is activated and orifice opens to pour the liquid. The cup is detected through the IR sensor.

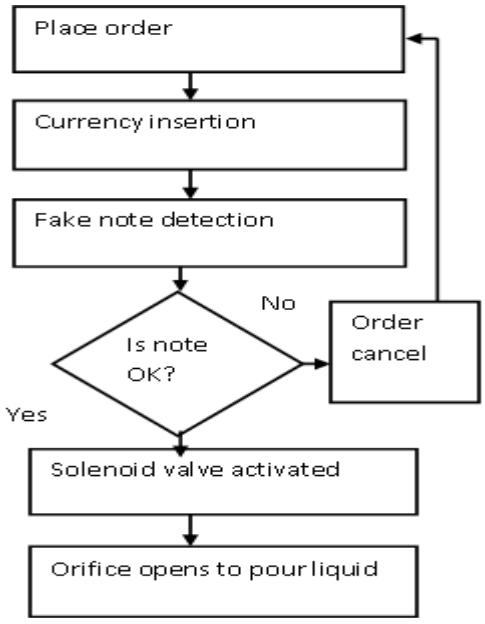

Figure 1. Flow Chart of the vending machine

III. FEATURES OF THE VENDING MACHINE

The various features of the vending machine are:

a. Works on +5v and +12v.
b. Customer friendly.
c. Inexpensive and secure.
d. Accept paper currency.
e. Fake note detection through inexpensive technique.
f. Vend liquid product (e.g. tea or coffee).

g. Only note of Rs 10 will be accepted.
h. Push button Switch panel used to give order.
i. 16*2 Alphanumeric LCD used to display each step.

IV. IMPLEMENTATION OF HARDWARE

The electronic part of this model is designed using AVR ATmega8515 microcontroller. AVR Studio 4 and STK 500 kit is used to compile the code and program the microcontroller. Block Diagram of the model of vending machine:

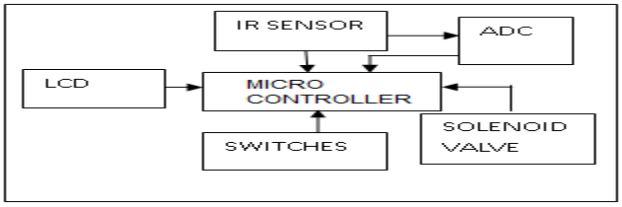

Figure 2. Block Diagram

The block diagram shown in figure 2 shows the various modules used in the model of vending machine. IR sensors are used to detect the currency so that if a paper is inserted instead of currency then it is recognised. Whenever paper currency is passed across the IR (infrared) sensor it gives a low voltage whereas a paper gives a high voltage at the receiver of the sensor. Thus by using an ADC (analog to digital convertor) it differentiates a currency by a piece of paper. IR sensor is also used to detect the placement of cup under the plunger. LCD is used to display each step for the process. The switches are used to give the order and the solenoid valve is used to give liquid output.

A. Overview of the various sections interfaced:

a. Microcontroller Section:

AVR ATmega8515 microcontroller is used in this model. It is an 8 bit high performance microcontroller and uses low power. This controller is used due to its various advanced features like appropriate input/output pins, memory etc, availability and ease of use. It is faster to operate as it has got a set of 130 powerful instructions mostly single cycle. It has 8kB of in system self programmable flash and 512 B internal SRAM. So it does not require any external memory [5].

b. Power Supply Section:

This section provides the necessary +12v and +5v to the microcontroller and other sections using regulators 7812 and 7805 respectively. A 9-0-9v centre tap transformer is used.

c. Switch Section:

Two push buttons are used to place order either tea or coffee as shown in figure 3 [10].

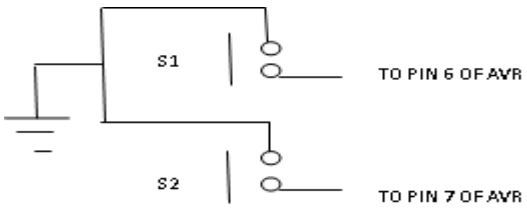

Figure 3. Connection of switches

d. LCD Section:

LCD stands for Liquid Crystal Display [6].

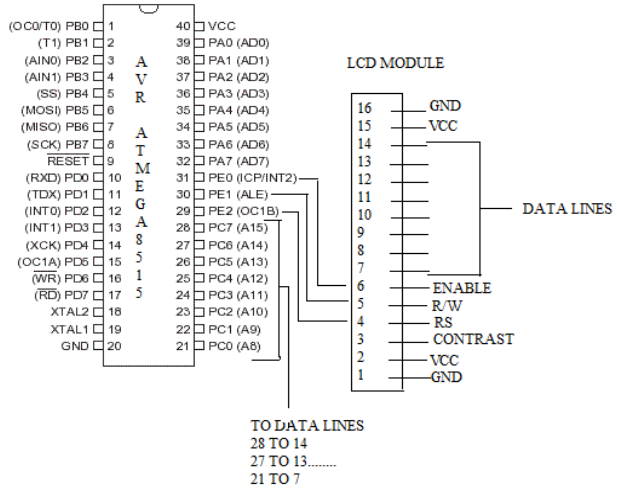

Figure 4. Circuit Diagram for LCD interfacing

JHD 162A LCD is used for displaying the details of order placing and completion. 162A means 16*2 alphanumeric display. Figure 4 shows the interfacing of the LCD module with the microcontroller [10].

e. Solenoid Valve Section:

The purpose of a solenoid valve coil is to convert electrical energy into linear motion [7]. The coil consists of copper wire (or aluminium) wound around a hollow form. When electric current flows through the coil, a magnetic field is created. This is accomplished by placing a ferromagnetic core inside the coil.

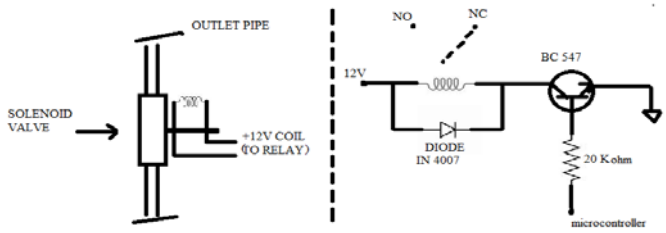

Figure 5. Solenoid Valve Section

In a solenoid valve, the ferromagnetic core is called the valve plunger. When the current flows through the coil, the lines of magnetic flux turn the plunger into an electromagnet. The magnetic field causes the plunger to slide further up into the coil, opening the valve body orifice or pilot orifice. Solenoid valve coils are available for both DC and AC electricity. The most common voltages available are:

a) 6-Volt DC
b) 12-Volt DC
c) 24-Volt DC
d) 24-Volt AC
e) 120-Volt AC
f) 220/240-Volt AC

As shown in figure 5 a 12v DC solenoid valve is used and activated through a 12v relay [10].

f. IR Section:

IR stands for infrared. IR section is used to detect that the cup is placed under the solenoid valve opening. When the cup is placed at the position then the relay will get activated and the plunger is pulled up so that the orifice opens and liquid is dispensed into the cup. The time for which the orifice opens is already adjusted according to the size of the cup through programming [8].

Also IR sensor is used to differentiate the paper currency from paper. IR receiver gives a high voltage when a paper currency is passed through it and a low voltage when any other paper is passed through the sensor. The connections of IR sensor pair is shown in figure 6. With the help of ADC thus we can set the voltage and detect the currency.

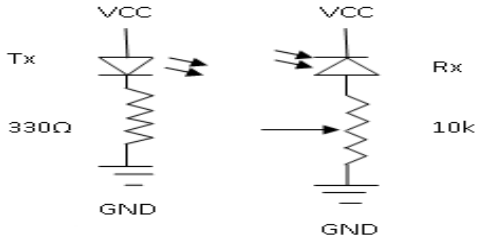

Figure 6. IR Section

g. ADC Section:

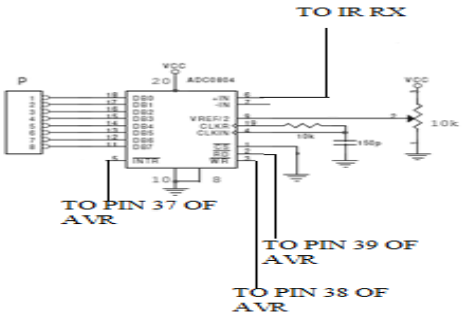

Figure 7. ADC Interfacing

ADC stands for analog to digital convertor [9]. As shown in figure 7 ADC Section is used with the IR sensor section to detect the currency as the IR sensor gives a voltage difference when a currency is passed and when the paper is passed. Thus ADC is used to set the different voltage level and detect the currency [10].

V. RESULT

The result can be described in three different sections:

First is the currency detection section. When the currency is inserted it comes across the IR sensor which detects the paper currency using ADC thus recognizing that it is not a piece of paper. The size of Rs. 10 note is identified by using two pairs of IR sensors one at the beginning of insertion and the other at the end equal to the currency length. (Size 137*63mm of Rs.10)

Second section is the placing of order. First the LCD displays to place the order. Then the customer gives order through the switch for the particular product and inserts the currency. When the currency is detected, the LCD displays place cup.

Last section is the dispensing of output. When the cup is placed, the IR sensor detects it and the relay gets activated. Thus the plunger is pulled up and liquid output is dispensed into the cup.

The time is already adjusted according to the size of cup so that liquid does not flows out.

Programming is done through STK500 kit using AVR studio 4.

VI. CONCLUSION

The model of the vending machine successfully detects the paper currency and dispenses liquid output. It is also proved to be customer friendly. The system developed in this research work can be used as a base for future development. Recommended areas for future work are:

a. A mixing tank can be placed for the preparation of coffee or tea as in this design it only dispenses the already present liquid in the tank.
b. Also in this design as currency is only accepted in Rs.10 form thus different currencies usage and return of change facility can be implemented.
c. A method to check the level and maintain the temperature of liquid can also be applied using ADC or LM 35.

VII. REFERENCES

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