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AUTOMATED MEDICINE DISPENSING MACHINE: A COMPREHENSIVE REVIEW

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ABSTRACT
The purpose of the Automated Medicine Dispensing Machine is to improve the speed, security and dependability of medicine distribution in medical environments. Manual dispensing in pharmacies and hospitals frequently results in errors like incorrect dosages or delays, endangering patient safety. The goal of this project is to address these problems by implementing digital verification and automation to guarantee that medications are dispensed accurately and only to authorized users. An RFID reader, keypad, LCD display, GSM module, and motor driver are just a few of the connected components that are managed by the microcontroller at the heart of this system. Prescription information is stored on each patient's RFID card. The system automatically releases the medication from the proper outlet after verifying the data and identifying the correct medication and dosage when the card is scanned. Additionally, the GSM module improves communication between patients and medical personnel by sending a confirmation message to the registered mobile number. This automated system guarantees precise and prompt medication delivery, lessens human error, and lightens the workload of pharmacists. It is particularly helpful in rural areas where medical personnel may be scarce and in hospitals with high patient volumes. Because of its modular design, the machine is easily scalable for larger installations in medical facilities.

KEYWORDS: Vending machine, Medicines, Arduino, Microcontroller, Installation.

INTRODUCTION

Snack vending machines, which may be used to buy and sell a variety of snacks, are a common example of how vending machines have been utilized to offer a wide range of customers with a variety of products spanning from processed to green grocery. If the vending machine is completely automated, customers can complete transactions without assistance from a human or time constraint. While some vending machines only accept cash in the form of currency, others allow credit cards for electronic transactions in addition to cash. If the vending machines are mobile, they can be relocated to different locations and go on providing the services normally. There is no cashier, customers are free to buy things whenever they want, and you can shop for the item you want at any time of day, every day of the year. A self-contained on-site medication dispensing mechanism and a storage space for the various medications that can be given according to user needs are features of an automatic medication vending machine. The machine's main parts include stepper motors for medicine

administration, a sizable storage area for pills, and an inventory monitoring system for tracking storage.

Enthusiasm for the Work

People who live in remote locations and those who travel great distances in buses or trains are often concerned about diagnosis. However, aside from the possibility of a full recovery, the availability of medications also plays a significant role. Our motivation for this endeavor came from the lack of 24-hour medical services in remote areas and the lack of medications in bus stops, train stations, and roads. The purpose of this prototype is to provide short-term relief so that people have a greater chance of avoiding health withdrawal before they can see a doctor.

The Suggested System

This Arduino ATMega 2560 autonomous medical vending machine was designed to address the shortcomings of the current approach and create a system that would allow individuals to receive medication around-the-clock. The machine will be extremely helpful to society because it can primarily dispense over-the-counter (OTC) medications, pain relievers, etc. There are four steps involved in the dispensing of medication.

1. Verification of the registered user
2. Choosing the necessary medication
3. Payment
4. Obtaining the requested medication

Designing Methods

This paper's main focus is on giving users the medications they require. An input sensor is an RFID card. The user-provided input via the buttons is then sent to the microcontroller for further processing. The necessary medication is dispensed by the microcontroller working together with the motor drivers. The motor's rotation process is managed by those motor drivers. The spring that is attached to the motor rotates. The medication then falls and reaches the output at the same time. Since no human involvement is necessary, the entire process is automated.

A. Hardware Requirements

- Microcontroller board (ARDUINO)
- Keypad
- RFID reader
- LCD display
- GSM modem
- Stepper motors

B. Software Requirements

- Arduino IDE
- Embedded c-language

C. BLOCK DIAGRAM

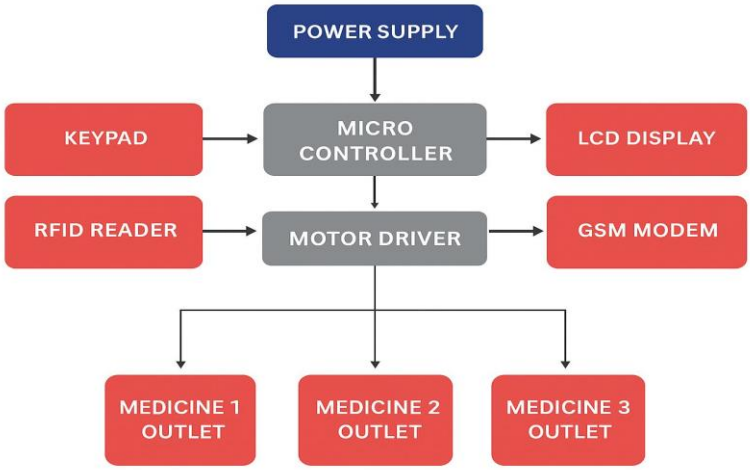

Fig. 1: Block Diagram.

D. Description of the Component

Microcontroller board (ARDUINO)

- The ATmega2560 serves as the foundation for the Arduino Mega microcontroller board.
- It features a 16 MHz crystal oscillator, four UARTs (hardware serial ports), 54 digital input/output pins (14 of which can be utilized as PWM outputs), 16 analog inputs, a USB port, a power jack, an ICSP header, and a reset button.
- It comes with everything required to support the microcontroller; to get started, just plug it in via a USB cable to a computer or power it with a battery or AC-to-DC adapter.

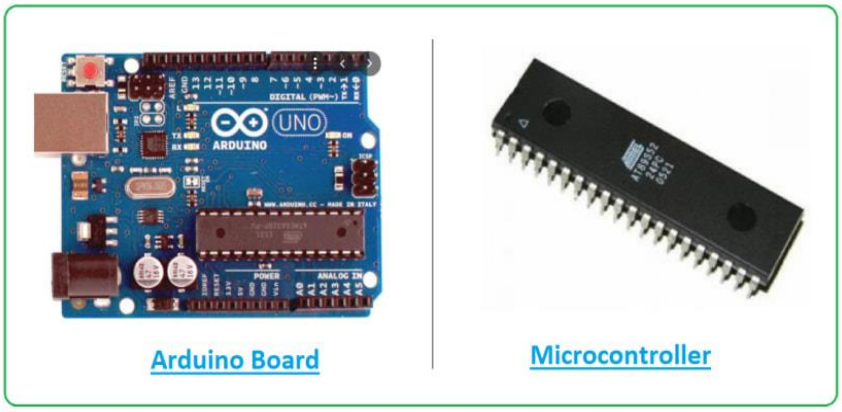

Fig. 2: Microcontroller Board (ARDUINO).

Keypad

The 40-pin ribbon cable from JP1 or JP2 to the DE2 connects to the hex keypad, a peripheral. In a 4 by 4 grid, it features 16 buttons that are labeled with the hexadecimal numbers 0 through F.

Fig. 3: Keypad.

RFID Card Reader

RFID stands for "radio-frequency identification," a technique that uses radio waves to allow a reader to read digital data contained in smart labels or RFID tags (see below). RFID and bar-coding are comparable in that a device records information from a tag or label and stores it in a database. RFID is a member of the Automatic Identification and Data Capture (AIDC) technology group. With minimal to no human involvement, AIDC techniques automatically recognize things, gather information about them, and input that information straight into computer systems. RFID techniques do this by using radio waves. An RFID tag or smart label, an RFID reader, and an antenna are the three basic parts of an RFID system. RFID tags employ an antenna and an integrated circuit to send data to an RFID reader, also known as an interrogator. The radio waves are subsequently transformed into a more useable type of data by the reader. After being gathered from the tags, the data is sent to a host computer system via a communications interface, where it can be saved in a database and examined later.

Fig. 4: RFID Card Reader.

LCD Display

A liquid-crystal display (LCD) is an electronically manipulated optical device, such as a flat panel display, that makes advantage of liquid crystals' light-modulating capabilities.

Instead of directly emitting light, liquid crystals create color or monochrome pictures by reflecting light off of a backlight. LCDs can show fixed graphics with little information content that can be shown or hidden, like preset words, or they can show random images, such in a general-purpose computer display, like in a digital clock, with seven-segment displays and digits. They both employ the same fundamental technology, with the exception that some displays have larger components, whereas arbitrary images are composed of many tiny pixels.

LCD televisions, computer monitors, instrument panels, aircraft cockpit displays, and interior and outdoor signs are just a few of the many devices that use LCDs. Digital cameras, watches, calculators, and mobile phones, including Smartphone's, are examples of portable consumer electronics that frequently have small LCD panels. LCD screens are also seen in consumer gadgets like clocks, video game consoles, and DVD players.

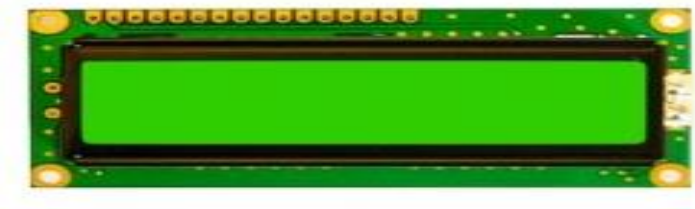

Fig. 5: LCD Display.

GSM Module

A mobile communication modem or GSM stands for global system for mobile. It is mostly utilized for global data transport in mobile communication. Similar to modern mobile phones, a GSM modem is a unique kind of modem that takes a SIM card and functions by registering with a mobile provider. Devices with GSM modems can send and receive SMS in full duplex mode. It is an open cellular technology that uses the 850MHz, 900MHz, 1800MHz, and 1900MHz frequency bands to transmit mobile voice and data services.

Fig. 6: GSM Module.

Stepper Motor

- Holding torque: 46 kg/cm, (4.6 Nm), steep angle: 1.8 ° per step The motor shaft's dimensions are 31 mm in length, 12 mm in diameter, 4 amps of rated current, 4.16 volts, and four wires. All 2-phase drivers can be used with a stepper motor.
- For 3D printers, DIY CNC, XY plotters, industrial automation, robotics, solar platform position, 3D printers, monitoring equipment, medical machinery, textile machinery, robotics automation, laboratory equipment, packaging machinery, and more, the motor mounting frame measures 86 x 86 mm and can be mounted both horizontally and vertically.

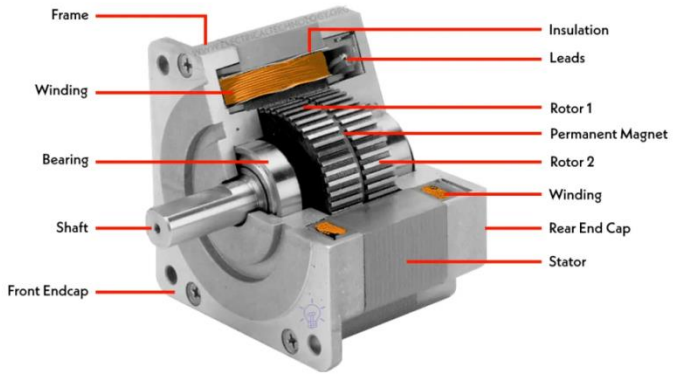

Fig. 7: Stepper Motor.

Arduino IDE

An open-source platform called Arduino is used to create electronic creations. Both an actual programmable circuit board, also known as a microcontroller, and software, or an IDE (Integrated Development Environment), that runs on your PC and is used to create and upload computer code to the actual board make up an Arduino.

For good reason, the Arduino platform has grown in popularity among those who are new to electronics. In contrast to the majority of earlier programmable circuit boards, the Arduino may be programmed using a USB cable instead of a separate piece of hardware known as a programmer. Also, the Arduino IDE makes programming simpler by using a simpler version of C++. Lastly, the Arduino offers a standard form factor that simplifies the microcontroller's capabilities into a more controllable container.

Fig. 8: Arduino IDE.

Embedded C-Language

Programming in C is a general-purpose language. Dennis Ritchie invented it in the 1970s, and it is still popular and significant today. The features of the standard CPU architecture, tailored for the target instruction set, are comparatively easily accessible to the programmer in C by design. Although its use in application software has been declining, it has been and still is utilized to implement operating systems, device drivers, and protocol stacks. The smallest microcontrollers and embedded devices, as well as the biggest supercomputers, all use C.

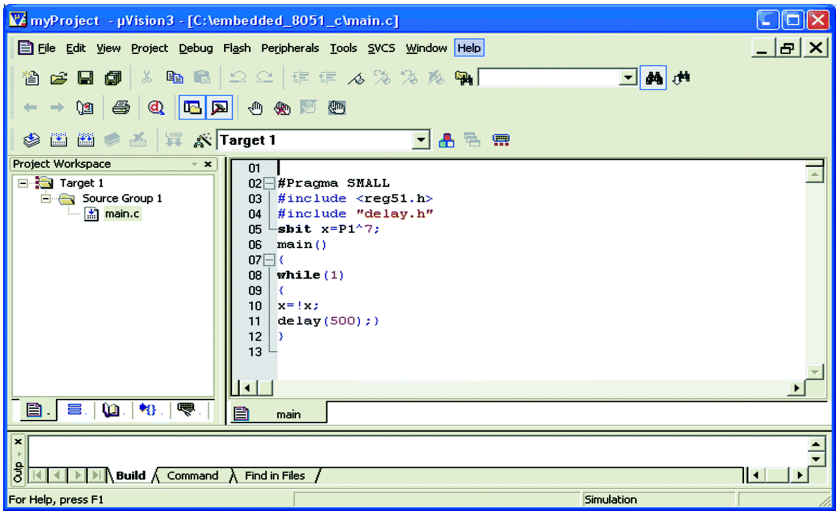

Fig. 9: Embedded C-Languages.

Working of Machine

- An Arduino board, one LCD display, an RFID reader, a GSM motor, and three motors are used in the automatic medication vending machine.
- Three parts make up the mechanical part, which stores three different kinds of medications.
- The display was programmed to indicate the various tablet kinds that were within.
- The motor turns and releases the medication whenever the user clicks the chosen tablet button.
- Messages are sent using GSM MODEM if the medication is not present in the machine.

Advantages

- It minimizes mistakes in dispensing the wrong medication or wrong dosage.
- It saves time and speeds up the process of medicine delivery compared to manual dispensing.
- Handles multiple prescriptions quickly and accurately, improving workflow in hospitals or pharmacies.
- 24/7 Availability, can dispense medicines even when pharmacy staff are unavailable.
- Can be installed in rural or remote areas where pharmacists are not available, improving medicine access.
- Allows pharmacists to focus on patient care and counseling instead of repetitive dispensing tasks.

Disadvantages

- High Initial Cost – Installation and setup require significant investment.
- Regular servicing and software updates are needed to prevent stoppage.
- Patients may miss counseling or advice from pharmacists.
- Training Requirement – Staff must be trained to operate and troubleshoot the machine.
- Lack of knowledge on computerized machine.

CONCLUSION

The Automated Medicine Dispensing Machine is an innovative solution designed to improve the efficiency, accuracy, and flexibility of medication distribution. By reducing human error, saving time, and ensuring proper dosage, it enhances patient safety and convenience. This technology represents a major step toward digital healthcare transformation, offering automation, transparency, and reliability in medicine management. It has the ability to completely transform the healthcare system by improving the intelligence and efficiency of pharmaceutical dispensing with more developments and integration with pharmacies and hospitals. Automated dispensing machines decentralized medication distribution systems that provide computer-controlled storage, dispensing of medicines.

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