DESIGN AND IMPLEMENTATION OF AUTONOMOUS PILL DISPENSER WITH IOT BASED PRESCRIPTION ACCESS

Arjun Ramu Ambat, Abhijith E M, Mohamed Risvan V, Nidhun Madhu

ABSTRACT

Individuals consuming several tablets always struggle to take the correct medicine at correct time. Even though medications are combating diseases their benefits are not realized because most patients do not consume their medicines as prescribed. The goal of this project is to design and fabricate a device which dispenses all the medicines to be consumed at a time as a single package and give the general instructions to the user. Each device will be assigned with a unique identification number which corresponds to a patient. With the help of an application program interface, digital copy of prescription will be shared with the device during consultation or purchase from medicine pharmacy. The purchased medicines are fed into the device by selecting the correct item. Thereafter the device will automatically allot each medicine to specific cartridges which are stacked inside the device. The stack design is in such a manner that the sorting mechanism can pick desired medicine from each cartridge. From the digital prescription, medicine to be dispensed is identified and packed into a single package. The upper part of the device will be having the rotating stack arrangement of medicine cartridges along with a single inlet to feed medicines. An attractive touch screen interface can be provided for interaction with the device, also smart phone connected to same network act as an interface. Below every cartridge there will be outlet through which medicine picker mechanism will pick required number of tablets from the required cartridge. The picked medicines are then collected into a plastic container. Power supply, battery and control unit will be in the bottom layer of the device. Atmega 328p-Au is the micro controller used, along with the Wi-Fi module, drives for different actuators and ports for other input output modules will be incorporated on the mother board. Servo motors are used for precise angular control at different parts of the design. The control board is designed in AutoCAD Eagle. Physical Structure design is completed using AutoCAD Fusion 360 and 3D printer in Fablab.

3.1 UNIT DOSAGE PICKER

Unit dosage picker is an integral part of autonomous pill dispenser. It contains a servomotor, feeder unit and roller, DC motor unit. The function of the unit dosage picker is to accept the medicines manually and pass the medicines in required number to the subsequent stage. For adjusting the passage according to the pills, a servomotor is used which gets the required data from the controller and adjusts the gap of the lower portion of the funnel. Counting the number of pills are made possible by the DC motor which controls the roller set by limiting the amount of pill passage and IR transmitter and reciever counts the pill passed to give necessary feedback.

3.1.1 MOTOR AND FEEDER UNIT

The basic motor and feeder set consists of a funnel shaped feeder that is designed so as to dispense optimal amount of medicines to the packing unit. Medicines are loaded in bunches and different set of medicines are of different sizes and in order to dispense flawlessly precise control of angular position is a requisite. This compelled to the se- lection of a SG90 servomotor and this cannot be done without a sensor for position feedback. A pair of IR sensor each having a transmitter and receiver hence serves the purpose. The receiver is primarily a photo diode with a filter attached to it so as to precisely monitor the transit of each of the pills. The size of the pill is determined by the dispenser using the data from IoT whereby digital prescription is directed by the doctor. The servomotor then adjusts the opening of the feeder through a set of rack and pinion gear drive.

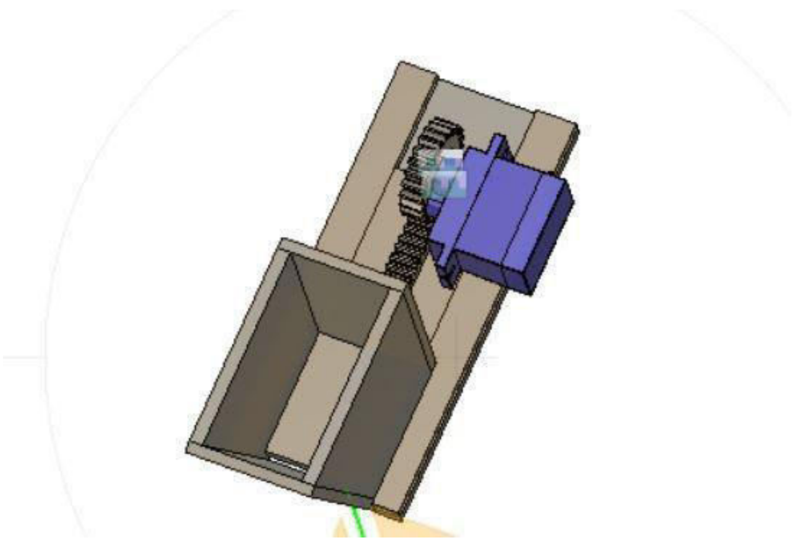


Figure 3.1: Motor and feeder unit

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 07 | July -2020 ISSN: 2582-3930

SERVO MOTOR(SG90)

A Servo Motor is a type of actuator that provides high precision control of linear or angular position.A simple servo motor consists of a small DC motor, a potentiometer for providing position feedback, a gear system for increased torque and a control system.As the motor rotates, the potentiometer's resistance changes, so the control circuit can precisely regulate how much movement there is and in which direction.

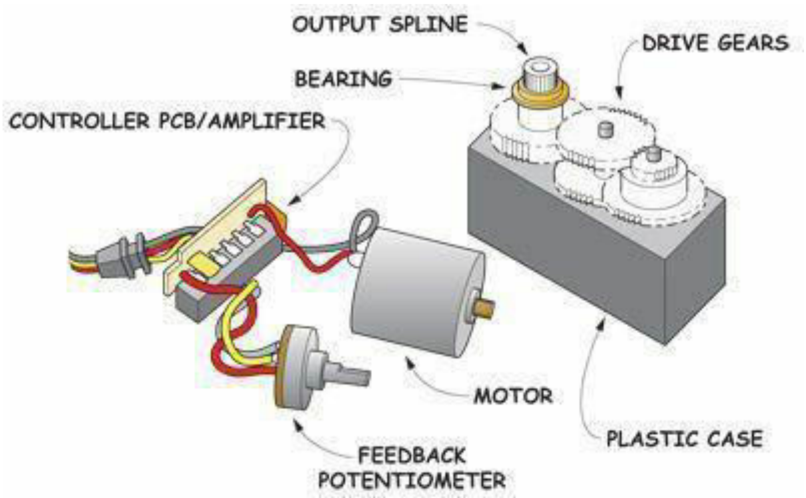
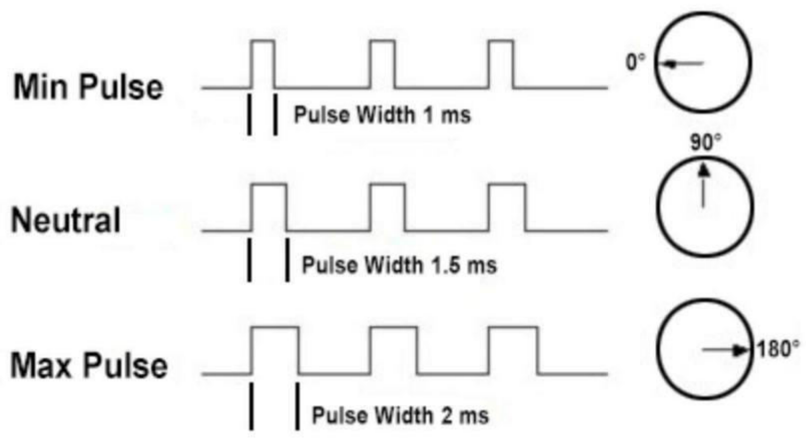


Figure 3.2: Servo motor

Servos are controlled by sending an electrical pulse of variable width, or pulse width modulation (PWM), through the control wire. There is a minimum pulse, a maximum pulse, and a repetition rate. A servo motor can usually only turn 90 in either direction for a total of 180 movement. The motor's neutral position is defined as the position where the servo has the same amount of potential rotation in the both the clockwise or counter-clockwise direction. The PWM sent to the motor determines position of the shaft, and based on the duration of the pulse sent via the control wire; the rotor will turn to the desired position. The servo motor expects to see a pulse every 20 milliseconds (ms) and the length of the pulse will determine how far the motor turns. For example, a 1.5 ms pulse will make the motor turn to the 90 position. Shorter than 1.5 ms moves it in the counter clockwise direction toward the 0 position, and any longer than 1.5 ms will turn the servo in a clockwise direction toward the 180 position. When the shaft of the motor is at the desired position, power supplied to the motor is stopped. If not, the motor is turned in the appropriate direction. The desired position is sent via electrical pulses through the signal wire. The motor's speed is proportional to the difference between its actual position and desired position. So if the motor is near the desired position, it will turn slowly, otherwise it will turn fast. This is called proportional control.There are two types of servo motors - AC and DC. AC servo can handle higher current surges and tend to be used in industrial machinery. DC servos are not designed for high current surges and are usually better suited for smaller applications. Generally speaking, DC motors are less expensive than their AC counterparts. When these servos are commanded to move, they will move to the position and hold that position. If an external force pushes against the servo while the servo is holding a position, the servo will resist from moving out of that position. The maximum amount of force the servo can exert is called the torque rating of the servo. Servos will not hold their position forever though; the position pulse must be repeated to instruct the servo to stay in position.

Figure 3.3: PWM timing control



3.1.2 ROLLER AND MOTOR UNIT

While the SG90 servomotor is used to control the parallel transit of pills to the packing unit, a DC m to control the series transit of pills whereby after one pill is dispensed, the DC motor reverses the d the forthcoming pill and thereby precisely measuring and controlling the passage of medicines. A DC very rugged and easy to use and control is possible with commonly available and wide range of volta rotate in either direction and speed control is also possible. Also this motor is rel- atively cheap ar motors. The motor used in the dispenser rotates at 100rpm and in order to control it to the required secured to the DC motor having a totality of 5 gears of which 3 gears handle the speed reduction ir two gears transmit power from the motor to the gear box and from the gear box to the roller.

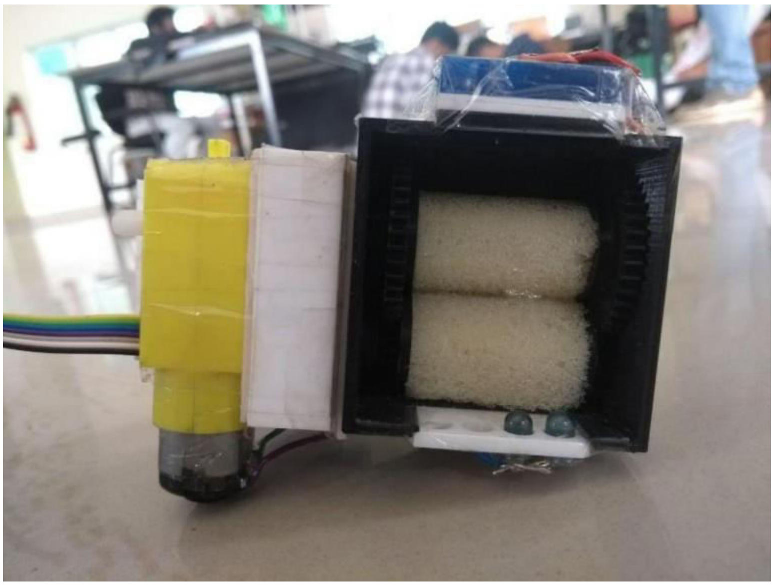


Figure 3.4: Roller and motor unit

IR TRANSMITTER AND RECIEVER

An infra-red sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion.These types of sensors measures only infra-red radiation, rather than emitting it that is called as a passive IR sensor. Usually in the infra-red spectrum, all the objects radiate some form of thermal radiations. These types of radiations are invisible to our eyes, that can be detected by an infra-red sensor.The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photo diode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photo diode, The resistances and these output voltages, change in proportion to the magnitude of the IR light received. The transmitter section includes an IR sensor, which transmits continuous IR rays to be received by an IR receiver module. An IR output terminal of the receiver varies depending upon its receiving of IR rays. Since this variation cannot be analysed as such, therefore this output can be fed to a comparator circuit. Here an operational amplifier (op-amp) of AD 8515 is used as comparator circuit.

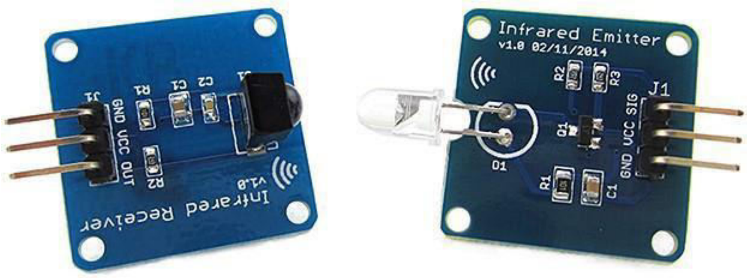


Figure 3.5: IR transmitter and reciever

When the IR receiver does not receive a signal, the potential at the inverting input goes higher than that non-inverting input of the comparator IC (AD8515). Thus the output of the comparator goes low, but the LED does not glow. When the IR receiver module receives signal to the potential at the inverting input goes low. Thus the output of the comparator (AD8515) goes high and the LED starts glowing. Resistor R1(100), R2(10k) and R3(330) are used to ensure that minimum 10 mA current passes through the IR LED Devices like Photo diode and normal LEDs respectively. Resistor VR1 (preset=10k) is used to set the sensitivity of the circuit Diagram.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 07 | July -2020 ISSN: 2582-3930

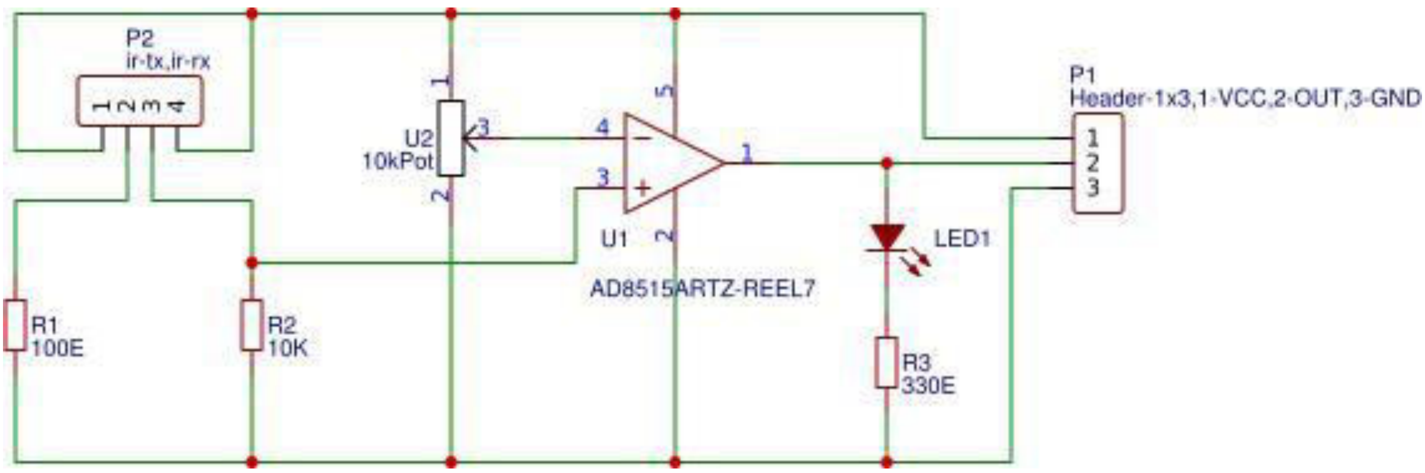


Figure 3.6: IR circuit diagram

Gear train

A series of gears are connected to form a gear train whose primary objective is the speed reduction and is connected between the DC motor and the roller unit such that the speed is reduced from 100 rpm to nearly 5 rpm which is in the ratio of 1:20. A set of 3 gears are used for speed reduction and one gear is used to transmit power from the DC motor shaft to gear train and one gear is used to transmit power from dc train to roller unit.

Figure 3.7: Gear train

DC MOTOR

RPM is one of the most important specifications of a DC motor. RPM, which stands for revolutions per minute, is the amount of times the shaft of a DC motor completes a full spin cycle per minute. A full spin cycle is when the shaft turns a full 360. The amount of 360 turns, or revolutions, a motor does in a minute is its RPM value. So a motor with an RPM of 24,000 is much more high speed than a motor which has 2400RPM. RPM is important when you need the motor to spin a certain number of times in a given time period. When speed is important, RPM is a crucial factor to look over when choosing a motor. In certain high-speed applications, it is imperative that motors that have high RPM are chosen. This may include applications such as washing machines with high-speed rinse cycles, treadmills that reach high speeds, and any such applications. Usually when the RPM value for a motor is specified, it normally is given with the voltage that will make it make that amount of turns per minute, such as 2400RPM @ 3V. Thus, the motor will spin 2400 times per minute when fed 3 volts DC into it. The no-load speed of a DC motor is the speed that the DC motor will turn when nothing is attached to its shaft. This is why it is called no load. The DC motor isn't loaded with an object. When a DC motor has nothing attached to its shaft, it is able to operate at its highest maximum speed. When it is then loaded with an object on its shaft, its speed will decrease. This is because it now has to bear with the weight

Conclusion

An autonomous pill dispenser is successfully made with an application interface which dispenses medicines as per Medication Schedule Specification(MSS) either in packed or ready to consume manner. The device now timely reminds on dosages, monitor response towards reminders and adjust medication schedule and send notifications. It has the facility to send alarms four times a day. In case patient doesn't take medicines even after alarm them system sends a message to the particular number fed in the system memory. It is possible to program in order to change the number of times dis- pensing the medicines as per requirement.The user interface is made primarily by block programming using Massachusetts Institute of Technology app inventor and is android based. It would now address problems faced by elderly individuals with complex and prolonged medication schedule and patients with chronic diseases. The administra- tion of medications now becomes easier and errors are substantially reduced. Also Full benefits will be realized due to timely medication. Its scope extends to adding a printing mechanism whereby patients could have their instructions printed on the package which would be particularly helpful while in transit. Another aspect to this autonomous pill dispenser is that when the medicine in the dispenser is exhausted the device could automatically alert its user and also it can opt for a fast delivery.
Artificial intelligence and machine learning could also be implemented in this autonomous pill dispenser whereby the device could itself adjust the medication schedule with the help of available databases especially when the patient forgets to have the medicine on time. The device could also produce a database or a spreadsheet so that doctor could get a printed format of the past medication timings the patient had had the medicines.

Volume: 04 Issue: 07 | July -2020 ISSN: 2582-3930

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 07 | July -2020 ISSN: 2582-3930