Khulna University of Engineering & Technology

Department of Mechatronics Engineering

Project Report

Project Name: Pressing Buttons with a Tap: Automating Digital Prepaid Keypad Energy Meters via Mobile App Interface

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Objectives

The objectives of this project are -

- To create an automated system that eliminates the need for manual button pressing in a specialized application.
- To create a mobile app for remote system control.
- Building a solution that scales while being cost-effective.
- To offer users increased control and flexibility over the system..

Introduction

Prepaid meters come with their own complications, such as the need to manually insert the printed prepaid energy token into the keypad meter by pressing keys.The main focus of this project is to automate the manual button pressing by integrating a module and mobile app interface.This system has a wide range of potential applications including home automation, security and industrial use.

Hardware Requirements

The components used in this project are :

1. **12V Stepper Motor Stroke 80Mm With Slider Motor:** It has 80 mm stroke length and operates at a maximum linear speed of 25mm per second.

Fig 1 : 12V Stepper Motor Stroke 80Mm With Slider Motor

2. **SG90 Tower Pro Servo Motor:**Micro Servo Motor SG90 is a tiny and lightweight servo motor with high output power. Servo can rotate approximately 180 degrees (90 in each direction).

Fig 2 : SG90 Tower Pro Servo Motor

3. **Arduino Uno R3:** Arduino UNO is a microcontroller board based on the ATmega328P. 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.

Fig 3 : Arduino Uno R3

4. **Bluetooth Module(HC 06):** This is a bluetooth module for use with any microcontroller. It uses the UART protocol to make it easy to send and receive data wirelessly. The HC-06 module is a slave only device.

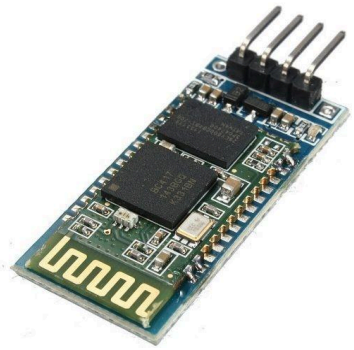

Fig 4: Bluetooth Module(HC 06)

5. **L298N Dual Motor Controller Module:** This driver module is made using L298N, a high current, high voltage dual full bridge driver.It is designed to accept standard TTL voltage levels and to drive inductive loads such as DC Motors, Stepper Motors, Relays, and Solenoids.

Fig 5: L298N Dual Motor Controller Module

Software Requirements

The software requirements for this project is :

1. **Arduino IDE:** It is an open-source software to program Arduino boards. Arduino IDE version 1.8.19.0 was used in this experiment.

2. **MIT App Inventor:** MIT App Inventor is an intuitive, visual programming environment that allows everyone – even children – to build fully functional apps for Android phones, iPhones, and Android/iOS tablets.

Methodology

The overall system is very simple.It is an Arduino based system that utilizes two linear stepper motor for x-axis and y-axis cartesian movement and one servo motor for z-axis up and down movement.Every operation is well-defined and moduled in the code so that further operations can be programmed easily.

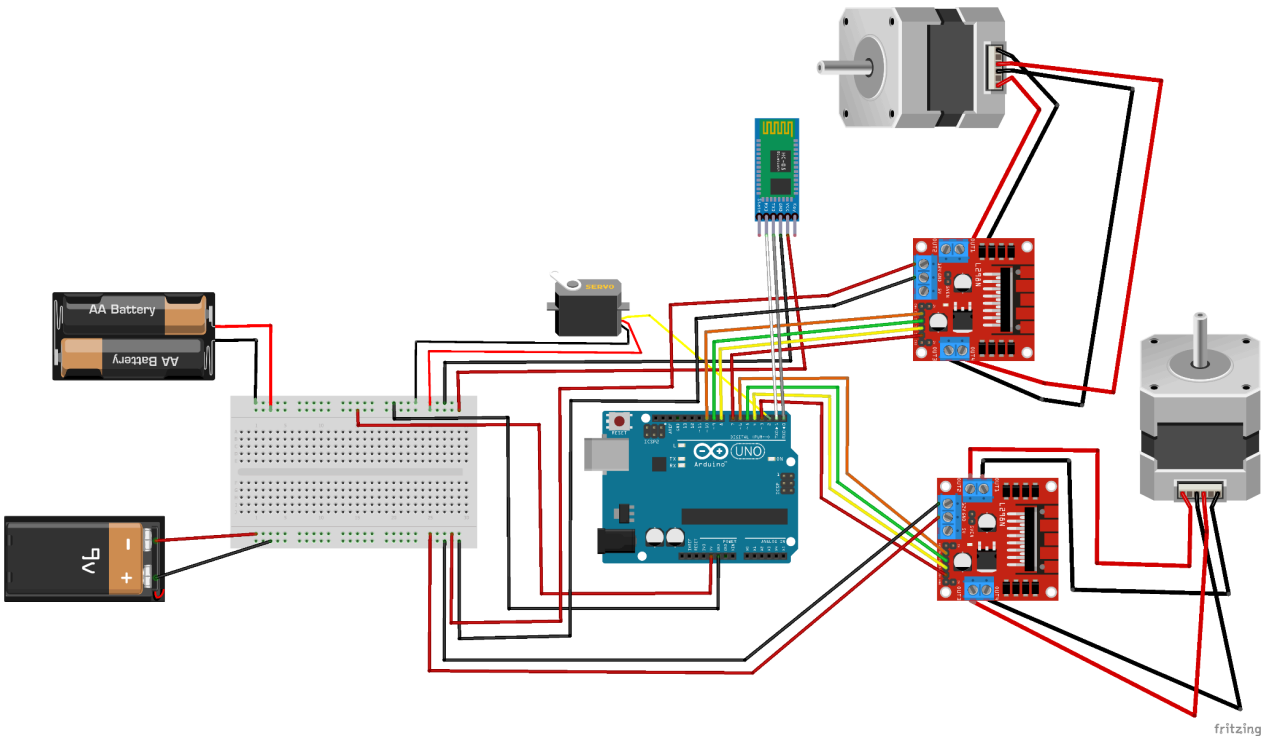

Fig 6: Circuit Diagram of the System

The user interface takes input in 5 digit integer and it is transmitted to the arduino via bluetooth module(HC-05) .According to the user input the linear stepper motor moves to the desired position of the keypad area in x-axis and y-axis.After reaching desired position the z-axis servo movement is initiated.The linear stepper motors goes to their initial position after pressing 5 input digits.

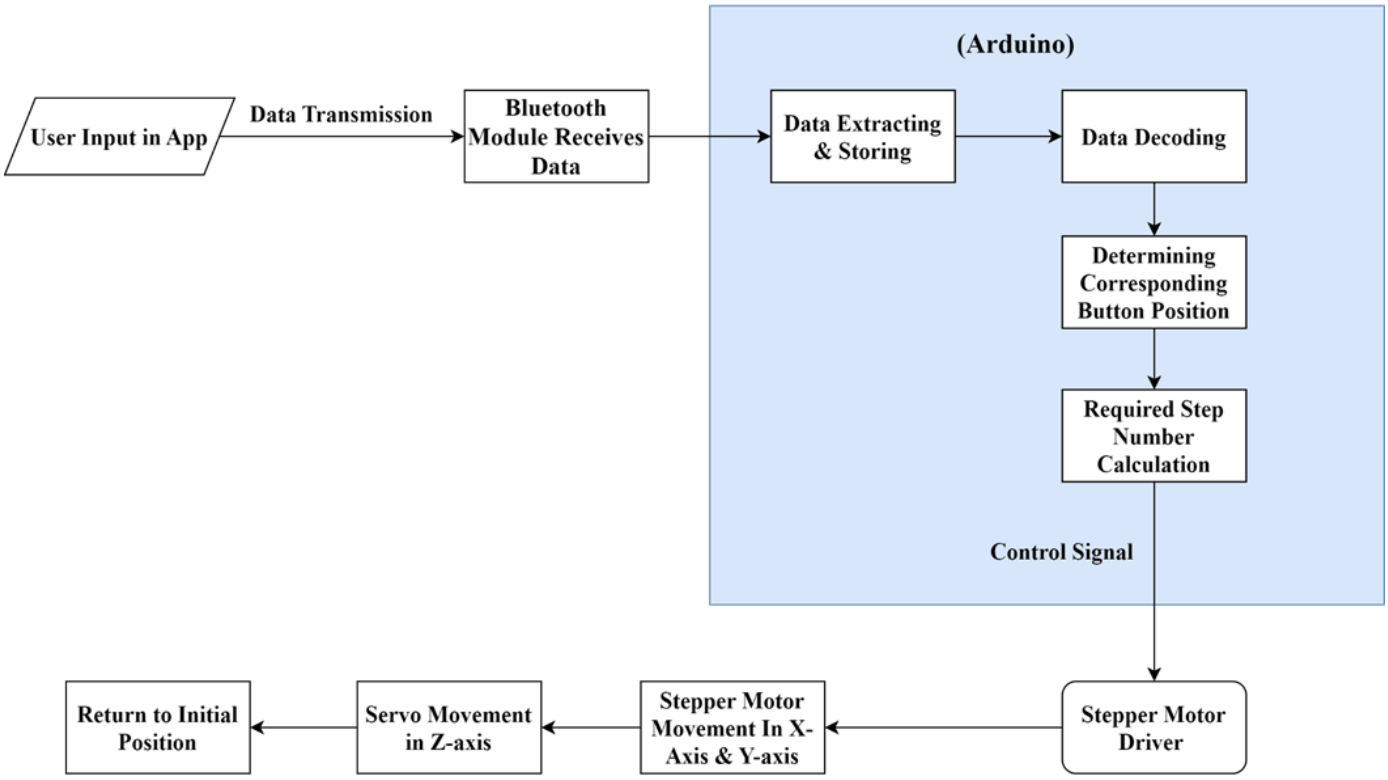

Fig 7: Flow Diagram of the System

Results & Discussion

The system is able to successfully press the right button based on the given input on the mobile app.The precision of the system falls if the size of the buttons are reduced.It can be compensated by introducing a feedback mechanism to the system. As one linear motor is mounted on another one,the load calculation is necessary.The extra load resulted in missed steps which was later considered for cartesian movement calculation of the system.Future enhancements that can be done on the system are:1)Explore Wi-Fi module for wider range and more reliable communication. 2)Implement feedback mechanism to compensate for missed steps in x, y-axis. 3)Use of more precise and compact linear movement components.

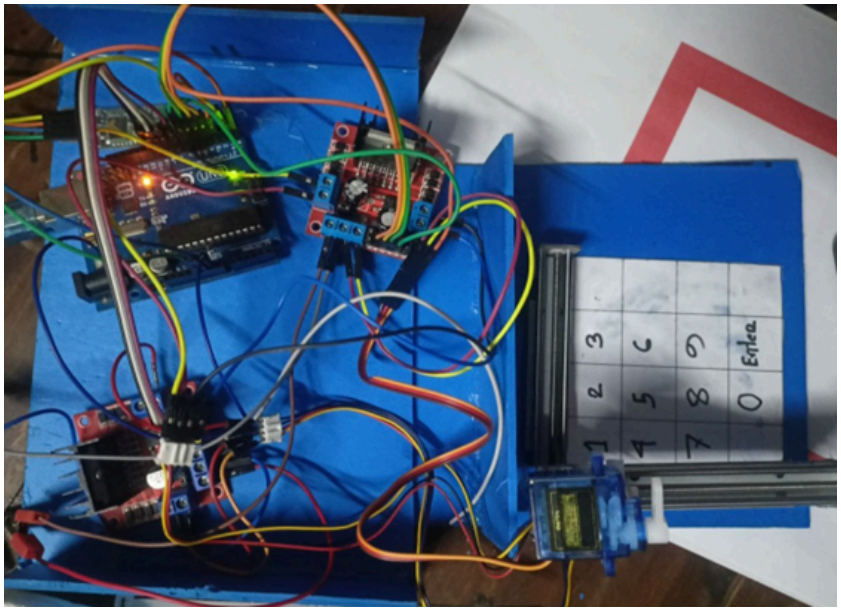

Fig 8: Complete Setup of the System

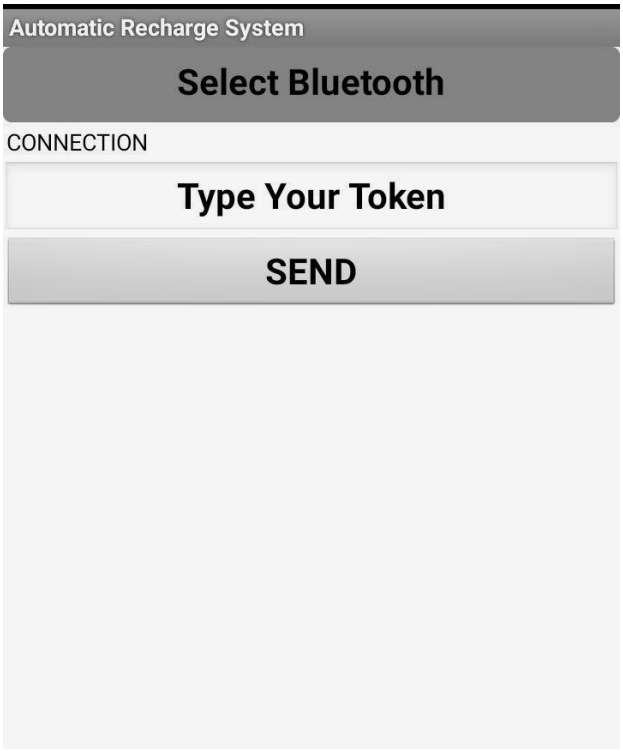

Fig 9: Mobile App Interface

Conclusions

In conclusion, this project will provide an automated solution to an existing system and offer the convenience of controlling the system from a mobile application ensuring the improved efficiency of the system and making it more accessible to users.

References

1. Nagib Mahfuz, Mehen Nigar & Nawshin Ulfat(2015).Smart Energy Meter and Digital Billing System for Bangladesh .IEEE - 49239.