MCU-based Piso WiFi Machine Prototype

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Executive Summary

Rationale

Piso Wifi Machines have become increasingly trendy in recent years, offering a convenient and affordable way for people to access the internet on the go[1]. A Piso WiFi Machine Prototype based on the PIC16F877A MCU is a self-service internet system that aims to provide affordable internet access to people who cannot afford a personal connection[3]. This system is designed to be small, energy-efficient, and low-cost, making it a suitable option for deployment in remote areas or public spaces where cellular data signals are low and internet access is limited.

The PIC16F877A microcontroller offers various features that make it appropriate for this application. Its low cost and low power consumption make it an affordable option for developing a Piso WiFi machine prototype, especially for extended periods of continuous operation. The real-time processing capability of the PIC16F877A enables quick and efficient handling of user requests within microseconds, and its connectivity options allow for easy integration of Wi-Fi modules and other peripherals, such as UART, SPI, and I2C. By utilizing the PIC16F877A MCU-based Embedded System, one can develop a Piso WiFi machine prototype that offers a fast and reliable internet connection, handles payments and data security, and manages network connections and user requests.

In conclusion, the PIC16F877A MCU-based Embedded System can be an affordable and energy-efficient option for developing a Piso WiFi machine prototype. Its real-time processing, connectivity options, and flexibility make it a suitable choice for building a system that offers fast and reliable internet access to people who cannot afford a personal connection to the internet.

Problem

How to give internet access time equivalent to the amount of the bill inserted using the PIC16F877A microcontroller?

Goals and Objectives

The goal of this project is to develop an MCU-based Piso WiFi Machine Prototype capable of providing affordable internet access to remote areas and weak cellular signal areas. Furthermore, the following objectives are to be met:

- study of the PIC16F877A and its capabilities towards an MCU-based Piso WiFi Machine Prototype;
- development of the instruments such as the microcontroller, beeper, LED to indicate that there is a wifi, and incorporating digital sensors;
- design & development of the electronic systems for the sensors (LED and beeper) and the display
- design & development of the software that will perform the task of reading and displaying data from the sensors.

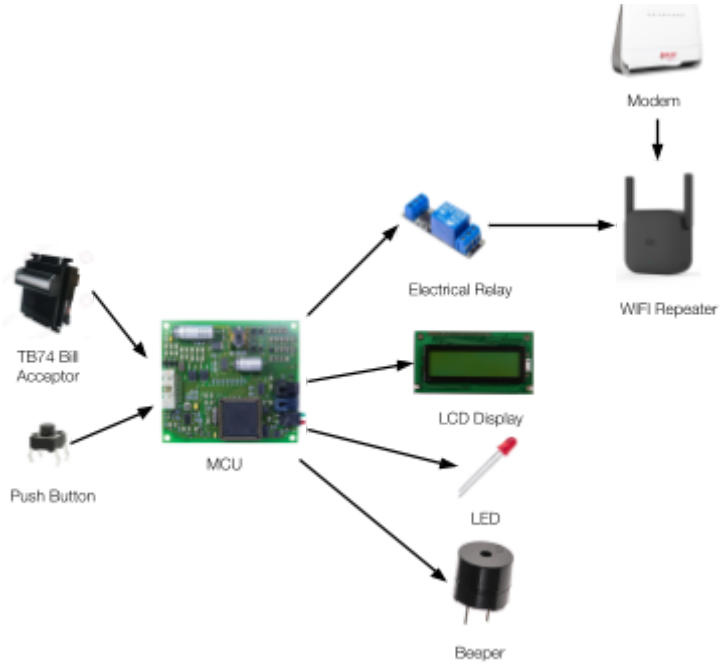
Scope & Limitation

The project scope includes the construction of a Piso WiFi prototype using the PIC16F877A microcontroller. It includes implementing a system that utilizes a TB74 bill acceptor to convert the bill amount to the number of minutes through pulses to determine the coin inserted and convert it to its number of minutes, powering a WiFi repeater through an electrical relay, displaying the remaining time and machine state on an LCD screen and also through LED for the status of machine, all of which will be programmed using PIC16F877A and C programming language.

The limitations include ensuring security by limiting access to the person who pays, and refreshing passwords. The study could not guarantee uninterrupted internet connection throughout the duration, and the timer does not automatically pause when internet access is unavailable. Furthermore, this could not determine whether the user is connected to the internet. This machine only accepts Philippine peso bills, and this project is specifically limited to accepting P20 to P500. Only a maximum total of P500-worth of WiFi access time is allowed, and does not refund bills in case of cancellations.

Conceptual Framework

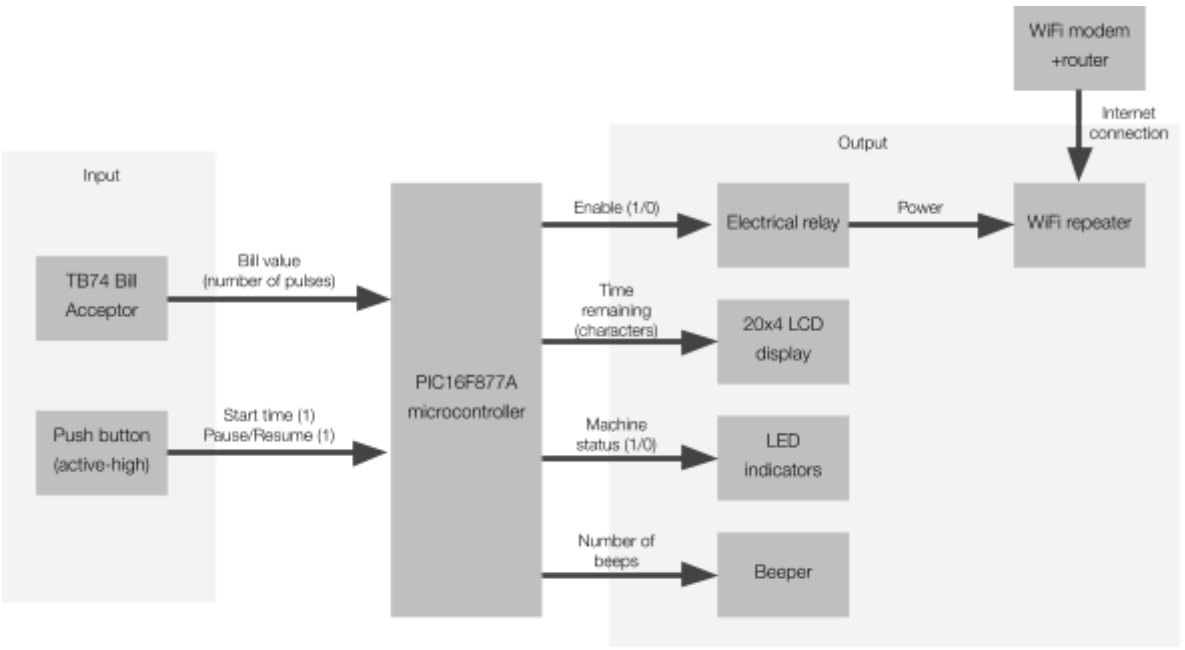
The following is the conceptual framework of the proposed project.



The TB74 bill acceptor, push button, electrical relay, LCD display, LED indicators, and beeper are directly interfaced to the PIC16F877a microcontroller. The TB74 bill acceptor accepts peso bills and reads the amount of the bill inserted and communicates the data to the MCU via pulses. The total amount of bills inserted is converted into time (in minutes) that the user could access the WiFi connection. The current total amount and time in minutes are displayed on the LCD. The push button must be pressed to indicate that the user has finished inserting bills and is ready to access the WiFi from the WiFi repeater. The WiFi repeater is powered within the paid WiFi access time and is controlled by the MCU via an electrical relay. WiFi access and the time remaining could be paused and resumed by pressing the push button. The LCD display, LED

indicators, and beeper are output interfaces that indicate the status of the machine for enhanced user experience (ex. remaining time, in-use, ready to use, and etc.).

System Block Diagram



Hardware Design

The hardware consists of the (input devices) TB74 bill acceptor, push button, (output devices) electrical relay, WiFi repeater, WiFi modem+router, 20x4 LCD display, LEDs, and beeper. The WiFi repeater provides the WiFi access to the user. The WiFi repeater gets internet connection from the ISP via the WiFi modem+router. The TB74 bill acceptor reads the amount of the bill inserted and communicates the data via pulses. The push button indicates that the user has finished inserting bills and that the timer could begin its countdown with the current WiFi access time computed from the total amount of bills inserted. When the countdown timer is initiated, the push button can be used to pause and resume the timer and WiFi access. The electrical relay serves as a switch to power the WiFi repeater according to the enable signal sent by the MCU. The 20x4 LCD displays the remaining time and the status of the machine when idle and paused. The LEDs indicate the machine status, whether it is “in-use” or “ready” for use. The beeper serves as an additional indicator to alert the user on the time remaining, indicated by the number of beeps.

Software Design

This system has seven (7) main functions: Read bill amount, Convert bill amount to WiFi access time in minutes, Toggle WiFi Repeater via electrical relay, Pause/Play remaining time via push button, Display machine status, and Display remaining time. All these functions are to be implemented using I/O interfacing, interrupt service routine, and timer functions of the PIC16F877A microcontroller, programmed in C language.

Project Management

Team Composition

Danica Marie Dumalagan (Team Leader/System Design Lead/All-around) - is responsible for the management of the project, development of the overall system design. As a team leader, represents the team to the instructor and actively participates in both hardware and software development.

Jhaycee Anthony Acain (Member/Hardware Lead) - Assists the team leader and is mainly in-charge of the procurement of materials and development of the hardware circuitry necessary for the peripherals to be properly interfaced to the PIC16F877A.

Thomas Lee Castro (Member/Software Lead/Documentation Lead) - Assists the team leader, is mainly in-charge of the implementation of the desired functionalities via software programming for the PIC16F877A, and in producing the necessary documentation materials for the project.

Task Assignment

1. Procuring of necessary hardware materials - Acain
2. Studying of the TB74 datasheet - Acain & Castro
3. Initial test interfacing of the TB74 bill acceptor to the PIC16F877A - All members
4. Initial test interfacing of the remaining peripherals to to the PIC16F877A - Castro
5. Initial breadboarding of circuit components - Acain & Dumalagan
6. Development of the foreground process - Castro & Dumalagan
7. Development of the interrupt service routine - Castro
8. Finalizing the layout of MCU and peripheral devices - Dumalagan & Acain
9. Integration testing and design validation - All members

Development Timeline

Task	April			May				June	
	2nd Week	3rd week	4th Week	1st Week	2nd Week	3rd Week	4th Week	1st Week	2nd Week
Project Propsal Approval									
Submission of Revised Project Proposal									
Procuring of necessary hardware materials									
Studying of the TB74 datasheet									

Initial test interfacing of the TB74 bill acceptor to the PIC16F877A									
Initial test interfacing of the remaining peripherals to to the PIC16F877A									
Initial breadboarding of circuit components									
Development of the foreground process									
Development of the interrupt service routine									
Finalizing the layout of MCU and peripheral devices									
Integration testing and design validation									
Submission of Project									

References

[1] TopBlogs.com.ph. Quick Piso WiFi Review, Description, Benefits, and FAQs (Philippines). Retrieved April 13, 2023 from https://www.topblogs.com.ph/tech/piso-wifi-review/.

[2] FabSuffrage Inc. About Piso Wifi Vending Machine: Is it For Franchising?. Retrieved April 13, 2023 from https://fab.ph/piso-wifi-vending-machine/.

[3] The Thrifty Pinay. How to Start a Piso WiFi Business: Everything You Need To Know. Retrieved April 13, 2023 from https://www.thethriftypinay.com/2023/03/15/how-to-start-a-piso-wifi-business-everything-you-need-to-know/.