HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY
FACULTY OF COMPUTER SCIENCE AND COMPUTER ENGINEERING

- LOGIC DESIGN PROJECT - SPRING 2019 -

Smart House with Micro:bit

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Contents

1 Introduction:

1.1 Topic

Simulating a smart-house with four rooms: living room, bed room, kitchen and garden.

1.2 Goal

- Creating a living room with passive infrared sensor (PIR), buzzer, button and leds.
- Simulating a bed room with lighting sensor (LDR) and real clock time (DS1307) to control the led.
- Building a kitchen with gas sensor (MQ2), buzzer, led and LCD screen.
- Demonstrating a smart-garden with temperature sensor (DHT11), soil moisture sensor and water pump.

1.3 Platform: Micro:bit

Figure 1: BBC Micro:bit

The Micro Bit (also referred to as BBC Micro Bit, stylized as micro:bit) is an open source hardware ARM-based embedded system.
The device is described as half the size of a credit card and has an ARM Cortex-M0 processor, accelerometer and magnetometer sensors, Bluetooth and USB connectivity, a display consisting of 25 LEDs, two programmable buttons, and can be powered by either USB or an external battery pack. The device inputs and outputs are through five ring connectors that form part of a larger 25-pin edge connector.

1.4 IDE: Arduino

Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module, Micro:bit, etc. The main code, also known as a sketch, created on the IDE platform will transfer and upload in the controller on the board. This environment supports both C and C++ languages.

1.5 Components

PIR: Detect people in a region using infrared light.

Figure 2: PIR

Buzzer: Used to warn users.

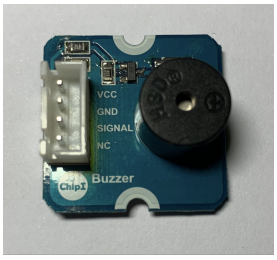

Figure 3: Buzzer

Button: Used to turn on / off led.

Figure 4: Button

Real Time Clock DS1307: Count time automatically.

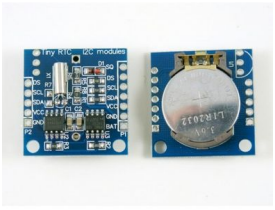

Figure 5: Real Time Clock DS1307

Light Sensor LDR LM393: Operate depending on light.

Figure 6: LDR LM393

DHT11: Measure temperature and humidity.

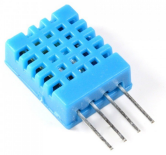

Figure 7: DHT11

MQ2 gas sensor: Measure gas level.

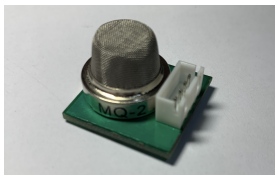

Figure 8: MQ2

LCD: Display the content.

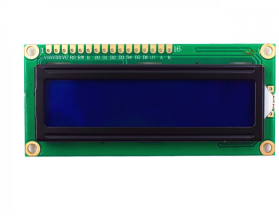

Figure 9: LCD

LM2596: Used to reduce the 12V Input Voltage to 4.6V Output Voltage.

Figure 10: LM2596

Moisture sensor: Measure humidity of soil.

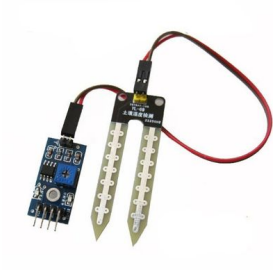

Figure 11: Moisture sensor

1. Water Pump: Pump water.

Figure 12: Water Pump mini

2. Relay: Control water pump.

Figure 13: Relay 12V

2 Design

2.1 Living Room

2.1.1 Board - Connection

Devices / Sensors	PINS	MICRO:BIT	Voltage
PIR	VCC		3.3V
	GND	GND	
	OUT	P8	
Buzzer	VCC		3.3 V
	GND	GND	
	Signal	P2	
Red LED	V+	P1	
	V-	GND	
Green LED	V+	P13	
	V-	GND	

Table 1. The voltage source of devices in Living Room and their connection to Micro:bit.

2.1.2 Design

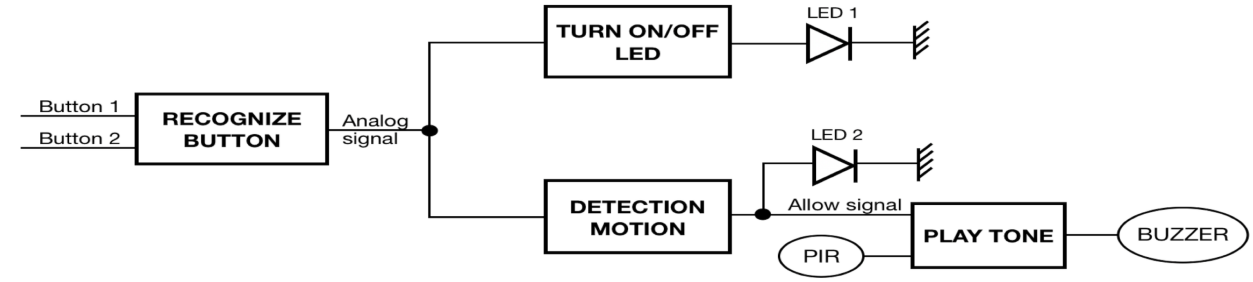

Figure 14: Design of living room

There are four main tasks.

- Recognize button: This task will identify which button is pressed from the user.
- Turn on/off led: When button 1 is pressed, the status of red led (LED 1) will change, from on to off, and vice versa.
- Detect motion: When button 2 is pressed, the status of green led (LED 2) will change like red led. Green led is on which means that the system is allowed detecting motion.
- Play tone: When detection motion is allowed, if there is a motion, buzzer will ring. The buzzer will stop when button 2 is pressed, green led is off.

2.2 Bed Room

2.2.1 Board - Connection

Devices / Sensors	PINS	MICRO:BIT	Voltage
LM393	VCC		3.3V
	GND	GND	
	D0	P8	
DS1307	VCC		3.3V
	GND	GND	
	SDA	SDA	
	SCL	SCL	
LED	V+	P0	
	V-	GND	

Table 2. The voltage source of devices in Bed Room and their connection to Micro:bit.

2.2.2 Design

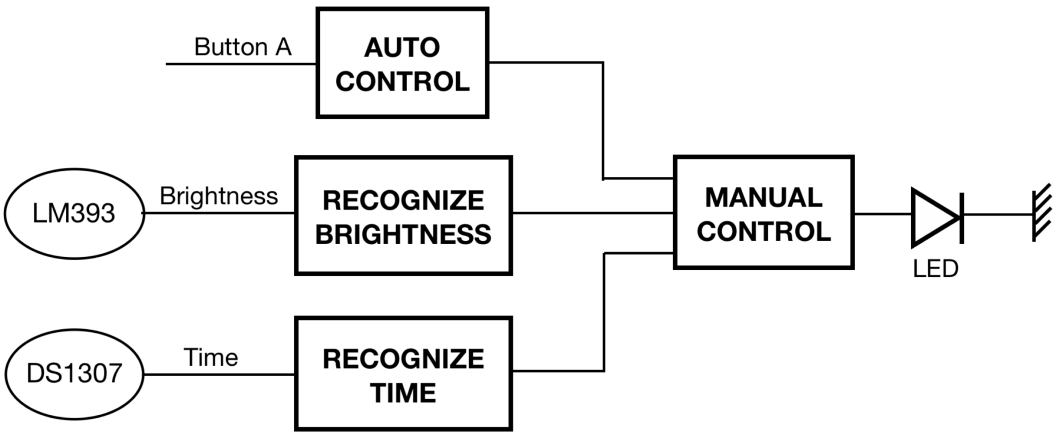

Figure 15: Design of bed room

There are four main tasks.

- Recognize the brightness: Sending signals if the room is dark or in light.
- Recognize the time: This allows us know whether it is day or night.
- Auto system: This system let the LED turn ON/OFF itself depends on the time and the light condition.
- Manual control: User can temporary stop the auto-system and control the LED themselves.

The auto-system is turn ON every 60 minute.

2.3 Kitchen

2.3.1 Board - Connection

Devices / Sensors	PINS	MICRO:BIT	Voltage
DHT11	VCC		5V
	GND	GND	
	Signal	P13	
MQ2	VCC		5V
	GND	GND	
	A0	P1	
Buzzer	VCC		3.3 V
	GND	GND	
	Signal	P0	
LCD I2C	VCC		5V
	GND	GND	
	SDA	SDA	
	SCL	SCL	
LED	V+	P8	
	V-	GND	

Table 3. The voltage source of devices in Kitchen and their connection to Micro:bit.

2.3.2 Design

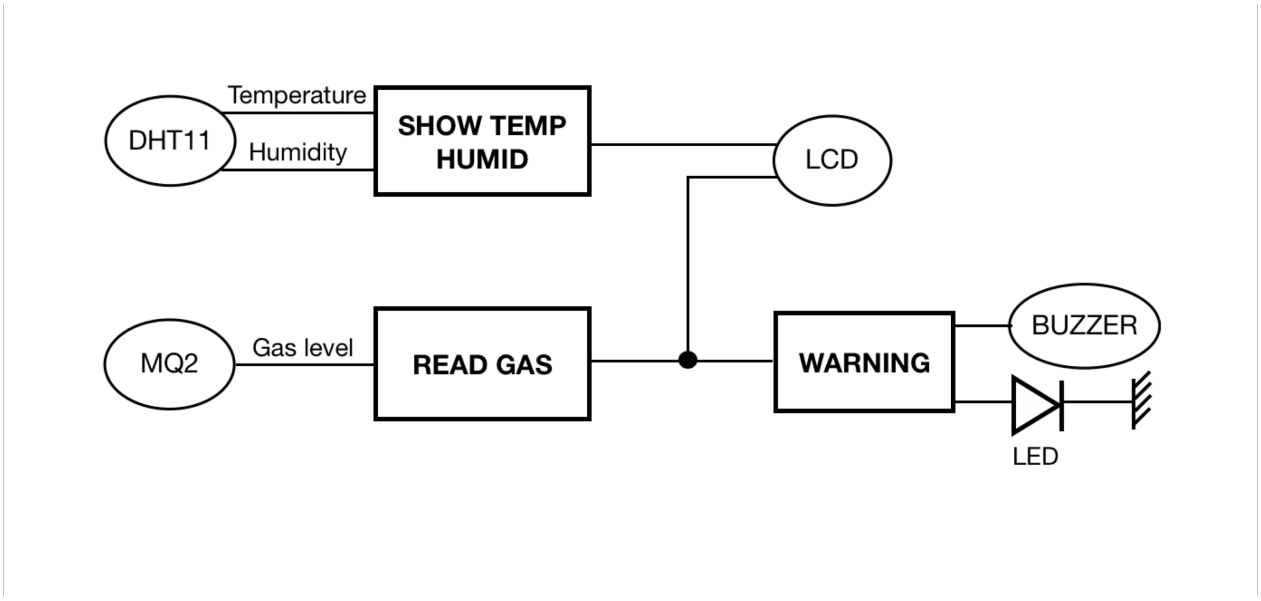

Figure 16: Design of kitchen

2.4 Garden

2.4.1 Board - Connection

Devices / Sensors	PINS	MICRO:BIT	Voltage
Soil Moisture	VCC		5V
	GND	GND	
	A1	P2	
DHT11	VCC		5V
	GND	GND	
	Signal	P0	
Relay	DC+		5V
	DC-	GND	
	IN	P1	
LCD I2C	VCC		5V
	GND	GND	
	SDA	SDA	
	SCL	SCL	

Table 4. The voltage source of devices in Garden and their connection to Micro:bit.

Relay	CO	5V
	NO	V+ (Pump)
Water Pump	V+	NO (Relay)
	V-	GND

Table 5. Connection between relay and water pump

2.4.2 Design

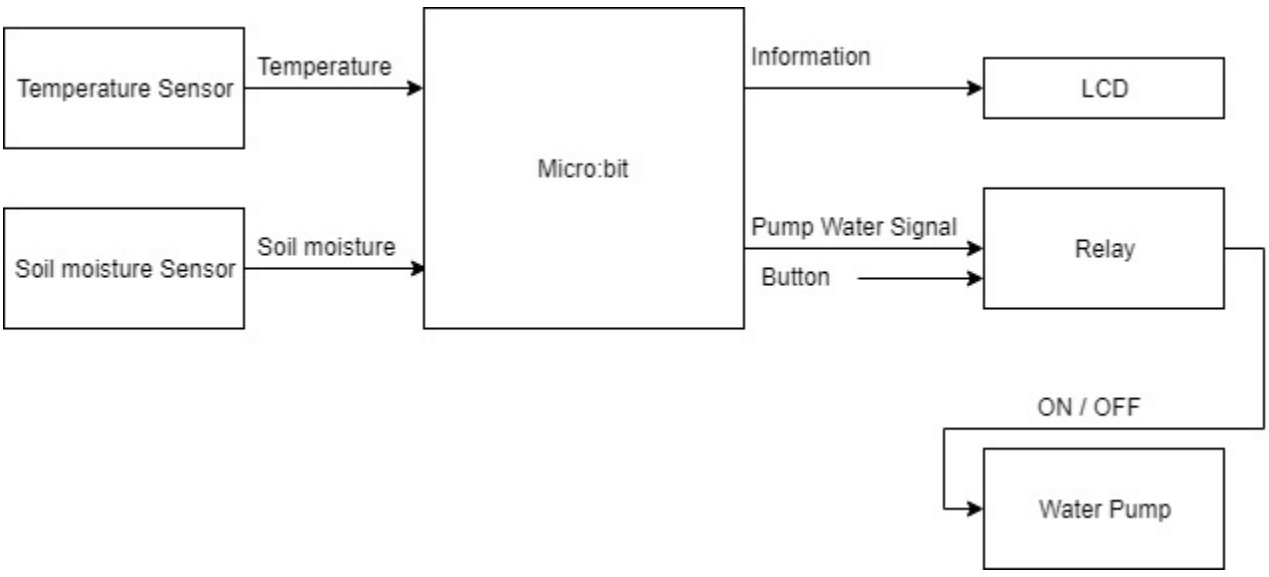

Figure 17: Design of garden

3 Implementation

3.1 Living Room

- Two buttons are connect as below.

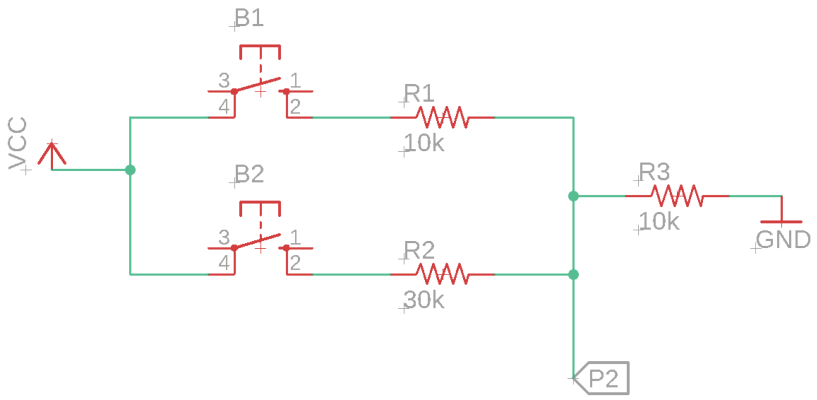

Figure 18: Button connection

- Because two resistors are different, the voltages that the micro:bit receives from two buttons will not be the same. The micro:bit can only receive signal by digital or analog signal. As a result, the voltages will be converted into analog value. Reading analog value received from two voltages through pin P0 will recognize which button is pressed.
- A flag is declared for each button to keep track on the status of the button. Whenever a button is pressed, a flag will be on and when a button is released, a flag will be off. If there is no flags, while the button is being pressed, the circuit will always receives signals and that affects the demonstration of the system.
- The “recognize button” task will identify and turn on the flag status when button 1 is pressed. If the flag is on, the circuit will change the status of red led.
- The control of green led with button 2 is similar to that of red led. The status of green led indicates whether the circuit detects motion or not. The signal HIGH or LOW for green led is sent through pin P13, while that for red led is pin P1.
- Furthermore, the "play tone" task rings the buzzer when there has a motion passing. When a motion go in a region of PIR, the output of PIR will be HIGH and it is received by pin P8 of Micro:bit.
- However, the buzzer only rings if green led is on which shows detection mode is on. Once buzzer has been on, it will be off only when button 2 is pressed, green led is off.

3.2 Bed Room

- The module LM393 sends the signals to the Micro:Bit to detect the brightness of the room.
- The same as module DS1307 gives the details from year to second.
- Taking information from two modules, we make an auto-system that turn ON/OFF the LED as follow:
  - When it is day and the room is bright: OFF
  - When it is day and the room is dark: ON
  - When it is evening: ON
  - When it is midnight: OFF
- However the user can press buttonA on the Micro:Bit board to switch the LED and also turn OFF the auto-system until next hour.

3.3 Kitchen

- At first, there has a parameter, called count, to choose what information is displayed on LCD. In a normal condition, it changed between 0 and 1 every two seconds. Otherwise, it equals to 2.
- The "Show temp humid" task receives information from DHT11 and then displays data, temperature and humidity, on LCD screen if count is 0.
- MQ2 sends a current level of gas under analog signal to the micro:bit. After that, the "Read gas" task reads that information and when count is 2, it will display on LCD.
- If the gas level exceeds safe limitation, buzzer will ring and LED will blink to make a warning to users. In this case, count equals to 2 and LCD will remain show gas level and its status.

3.4 Garden

- The soil moisture measure ground humidity from ground and DHT11 sensor measure environment's temperature.
- Soil moisture sensor will send an Analog Signal to Micro:bit. We assume that if the value is larger than 800 so ground is dry, otherwise if the value is less than 600 so ground is wet.
- The data is transfered to Micro:bit. If the temperature is less than 32 Celsius and the ground is dry then a HIGH signal from Micro:bit will be sent to the relay and it actives water pump. When the ground is wet, the water pump is stop.
- The temperature, soil moisture and water pump's status will be displayed on LCD.

4 Result

4.1 Living Room

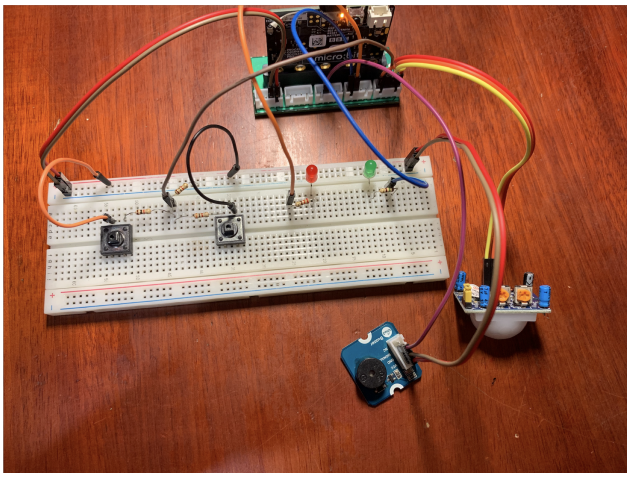

Figure 19: Result of living room on breadboard

4.2 Bed Room

4.3 Kitchen

4.4 Garden

5 Discussion

5.1 The goal achievement

5.1.1 Living Room

- Turning on/off the led corresponding to its button.
- Detecting whenever a motion passing in PIR region by playing tone for buzzer.
- Controlling detection mode and buzzer.

5.1.2 Garden

- Measuring temperature of environment and humidity from the ground.
- Showing the data to user by using LCD.
- Pumping the water to the garden based on the data collected from environment.
- Working automatically.

5.1.3 Bed Room

- Getting the current real time.
- Automatically turning on/off led depending to time and brightness.
- Using button to turn off auto mode and control led.

5.1.4 Kitchen

- Displaying temperature, humidity and gas level
- Showing on LCD whether level of gas is safe or not.
- Ringing buzzer and blinking led while level of gas exceeds safe limitation.

5.2 Future Work

- Combining four rooms in one since we has implemented each room separately.
- Making a PCB board for the whole smart house.

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