Project's website: http://StudentEng2016.github.io/

FarmBot

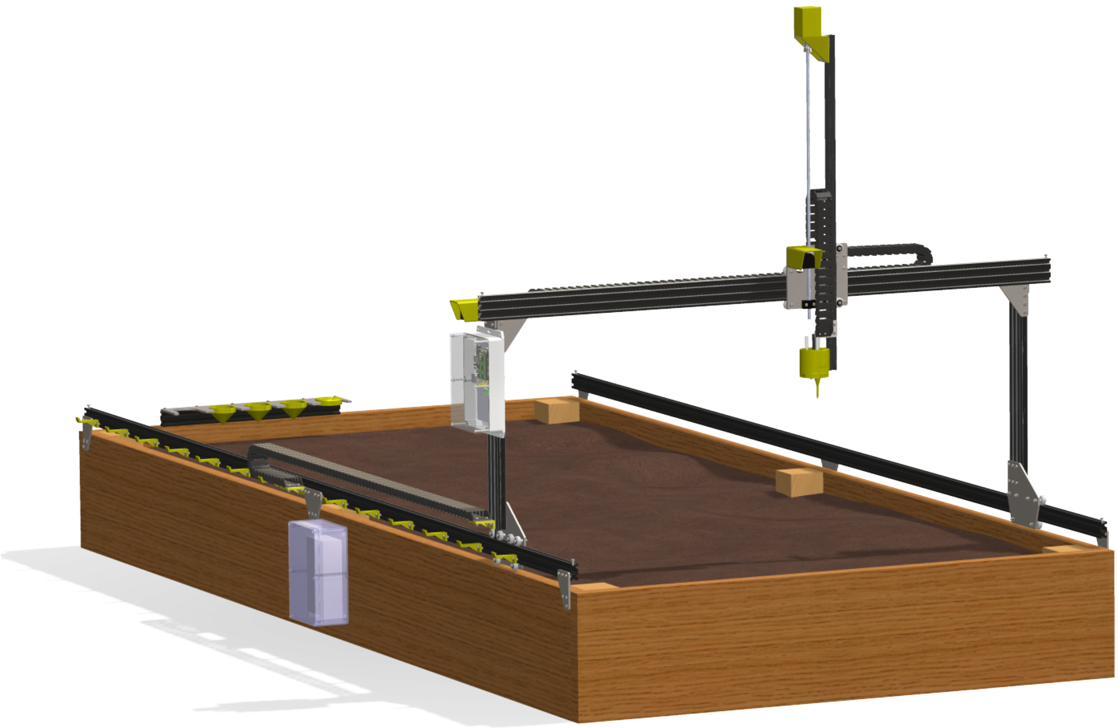

Figure 1:

Image source: (Day, 2016)

From: Alisha Singh Chauhan, Adanegbe Amadasun

Discipline: Computer Engineering Technology

Date Submitted: March 31,2017

Declaration of Joint Authorship

We, Alisha Singh Chauhan and Adanegbe Amadasun, students of the Applied Technology department hereby declare that the following technical report submitted for CENG 355 Computer Systems Project is expressed in our own words.
The research which has been used from various sources, such as words, numerical data, figures, tables etc. has been either paraphrased or cited separately. The original sources of cited work may be located using APA style in References page at the back.

Approved Proposal

Prepared by Adanegbe Amadasun, Alisha Singh Chauhan Computer Engineering Technology Students

Abstract

The Farmbot is basically CNC farming technique which has proved to be the great way for the production of small scale food. It has turned out to be a reliable and approachable source to accomplish the idea of integrating an artificial approach to take care of the cultivation. This project deals with the following hardware components, such as PCF8591 sensors, nozzels which an inject the substances controlled by axes with the software governed by Arduino/RAMPs stack and internet of Raspberry Pi. This project is designed to be completed under the time span of 3-4 months to put together everything.

It gives user the opportunity to customize their own farm using the web app. The software is also able to manipulate data maps, real-time logging and access an open plant data in the Open Farm database. All software is available under the MIT license and is available on GitHub. The hardware is designed around reproduce-ability and availability of components, it can be created using common tools and processes meaning it is not reliant on a single supplier.

Executive Summary

As students in the Computer Engineering Technology program, we will be integrating the knowledge and skills we have learned from our program into this Internet of Things themed capstone project. This proposal requests the approval to build the hardware portion that will connect to a database as well as to a mobile device application. The Internet connected hardware will include a custom PCB with sensors and actuators for an automated farming device. The mobile device functionality will include photo sensors, temperature sensors and moisture sensors, which will be further detailed in the mobile application proposal.

We will be collaborating with the following company/department. In the winter semester, we planned to form a group together as we both are building similar hardware this term and working on its mobile application. The hardware was completed in CENG 317 Hardware Production Techniques independently and the application was completed in CENG 319 Software Project. These will be integrated in CENG 355 Computer Systems Project.

Background

FarmBot is going to address some the problems the agricultural industry faces, such as loss of money, inefficiency of some equipment and exploitation of resources. FarmBot is going to be more economical and ecofriendly unlike other agricultural equipment being used. It incorporates precision farming, which happens to be a concept based on observing, measuring and responding to inter- and intra-field variability in crops. The device is going to be constructed in the FarmBot company.

It is going to be made of an Arduino Mega 2560, Raspberry Pi 3, disassembled hardware packages and other software sources. The FarmBot Genesis runs on custom built tracks and other supporting infrastructure which needs to be self assembled. The robot itself relies on a GUI platform which users can access through the FarmBot's web app. The physical robotic system is set in alignment with the crops that are plotted out in the virtual version on the web app.

This is how FarmBot can be efficient and reliably distribute water, fertilizer and other elements to keep the plants healthy and striving with minimun wastage. The device is going to be cheaper than conventional tools and cost-effective.

We have searched for prior art via Humber's IEEE subscription selecting "My Subscribed Content" (Billingsley, Oetomo, & Reid, 2009) and have found and read (Bergerman et al., 2015) which provides insight into similar efforts.

In the Computer Engineering Technology program, we have learned about the following topics from the respective relevant courses:

- Java Docs from CENG 212 Programming Techniques In Java,
- Construction of circuits from CENG 215 Digital And Interfacing Systems,

- Rapid application development and Gantt charts from CENG 216 Intro to Software Engineering,
- Micro computing from CENG 252 Embedded Systems,
- SQL from CENG 254 Database With Java,
- Web access of databases from CENG 256 Internet Scripting; and,
- Wireless protocols such as 802.11 from TECH152 Telecom Networks.

This knowledge and skill set will enable me to build the subsystems and integrate them together as my capstone project.

Methodology

This proposal is assigned in the first week of class and is due at the beginning of class in the second week of the fall semester. My coursework will focus on the first two of the 3 phases of this project:
Phase 1 Hardware build.
Phase 2 System integration.
Phase 3 Demonstration to future employers.

Phase 1 Hardware build

The hardware build will be completed in the fall term. It will fit within the CENG Project maximum dimensions of 12 13/16” x 6” x 2 7/8” (32.5cm x 15.25cm x 7.25cm) which represents the space below the tray in the parts kit. The highest AC voltage that will be used is 16Vrms from a wall adaptor from which +/- 15V or as high as 45 VDC can be obtained. Maximum power consumption will be 20 Watts.

Phase 2 System integration

The system integration will be completed in the fall term.

Phase 3 Demonstration to future employers

This project will showcase the knowledge and skills that we have learned to potential employers.

The tables below provide rough effort and non-labour estimates respectively for each phase. A Gantt chart will be added by week 3 to provide more project schedule details and a more complete budget will be added by week 4. It is important to start tasks as soon as possible to be able to meet deadlines.

Labour Estimates	**Hrs**	**Notes**
Phase 1		
Writing proposal.	9	Tech identification quiz.
Creating project schedule. Initial project team meeting.	9	Proposal due.
Creating budget. Status Meeting.	9	Project Schedule due.
Acquiring components and writing progress report.	9	Budget due.
Mechanical assembly and writing progress report. Status Meeting.	9	Progress Report due (components acquired milestone).
PCB fabrication.	9	Progress Report due (Mechanical Assembly milestone).
Interface wiring, Placard design, Status Meeting.	9	PCB Due (power up milestone).
Preparing for demonstration.	9	Placard due.
Writing progress report and demonstrating project.	9	Progress Report due (Demonstrations at Open House Saturday, November 7, 2015 from 10 a.m. - 2 p.m.).
Editing build video.	9	Peer grading of demonstrations due.
Incorporation of feedback from demonstration and writing progress report. Status Meeting.	9	30 second build video due.

Practice presentations	9	Progress Report due.
1st round of Presentations, Collaborators present.	9	Presentation PowerPoint file due.
2nd round of Presentations	9	Build instructions up due.
Project videos, Status Meeting.	9	30 second script due.
Phase 1 Total	**135**	
Phase 2		
Meet with collaborators	9	Status Meeting
Initial integration.	9	Progress Report
Meet with collaborators	9	Status Meeting
Testing.	9	Progress Report
Meet with collaborators	9	Status Meeting
Meet with collaborators	9	Status Meeting
Incorporation of feedback.	9	Progress Report
Meet with collaborators	9	Status Meeting
Testing.	9	Progress Report
Meet with collaborators	9	Status Meeting
Prepare for demonstration.	9	Progress Report
Complete presentation.	9	Demonstration at Open House Saturday, April 9, 2016 10 a.m. to 2 p.m.
Complete final report. 1st round of Presentations.	9	Presentation PowerPoint file due.
Write video script. 2nd round of Presentations, delivery of project.	9	Final written report including final budget and record of expenditures, covering both this semester and the previous semester.
Project videos.	9	Video script due
Phase 2 Total	**135**	
Phase 3		
Interviews	TBD	
Phase 3 Total	**TBD**	
Material Estimates	**Cost**	**Notes**
Phase 1		
A microcomputer composed of a quad-core Windows 10 IoT core compatible Broadcom BCM2836 SoC with a 900MHz Application ARM Cortex-A7 32 bit RISC v7-A processor core stacked under 1GB of 450MHz SDRAM, 10/100 Mbit/s Ethernet, GPIO, UART, I^{2}C bus, SPI bus, 8 GB of Secure Digital storage, a power supply, and a USB Wi-Fi adaptor.	>$80.00	An example of a retailer: [3].
Peripherals with cables		
Sensors		
Actuators		
Hardware, etc.		
Phase 1 Total	**>$200.00**	
Phase 2		
Materials to improve functionality, fit, and finish of project.		
Phase 2 Total	**TBD**	
Phase 3		
	<$100.00	An example: [4].
Shipping	*TBD*	
Tax	*TBD*	
Duty	*TBD*	
Phase 3 Total	**TBD**	

Concluding Remarks

This proposal presents a plan for providing an IoT solution for FarmBot This is an opportunity to integrate the knowledge and skills developed in our program to create a collaborative IoT capstone project demonstrating my ability to learn how to support projects. We request the approval of this project.

Table of Contents

List of Illustrations

1. Introduction

As we are stepping into the 21st century, industrialization is reaching new heights which indeed is giving birth to various problem that could be anywhere. For this reason technologist have being working to figure out all this technical issues and farmbot is one of that.

FarmBot is an open source automated farming device which operates like a 3D printer. But instead of extruding plastic, its tools are seed injectors, watering nozzles, sensors etc. The techincal report is going to address some the problems the agricultural industry faces, such as loss of money, inefficiency of some equipment and exploitation of resources. The device is going to be more economical and ecofriendly unlike other conventional agricultural equipment being used.

The FarmBot Genesis is able to plant over 30 different crops including potatoes, peas, squash, artichokes and chard in an area of 2.9 meters × 1.4 meters with a maximum plant height of 0.5 meters. It can cultivate a variety of crops within same area at the same time and is able to operate indoors, outdoors and covered areas. It is estimated that the FarmBot Genesis produces 25% fewer carbon dioxide emissions.

2. Project Description

2.1 Purpose

Farmers are faced with new challenges and opportunities every day from feeding an expanding global population while meeting strict new emissions requirements, to producing more food on fewer acres while minimizing their environmental footprint. FarmBot is going to address some of the problems the agricultural industry faces like loss of money, how ineffective some of their equipment are and how they waste resources.

The various issues are:

- Supplying the growing global demand for commodities arising from developing economies and world population growth.
- Availability and price of land for expansion.
- Development and use of bio-based fuels.
- Nearly 25 percent of respondents indicate that equipment dealers/experts will be one of the top advisors to influence their decision making, along with their financial advisor and agronomist advisors.

2.2 Hardware Specification

Figure 2:

Image source: (Krassenstein, 2014)

Image source: (Inc, 2017)

(Describe farmbot parts)

FarmBot will be able to perform the following task:

- Monitor the temperature around the plant,
- Provide light to the plant.

The hardware component for FarmBot that We have are:

- Raspberry pi 3 – : It is the third generation Raspberry Pi. It replaced the Raspberry Pi 2 Model B in February 2016.it is which are more useful for embedded projects, and projects which require very low power. Compared to the Raspberry Pi 2 it has:

  A 1.2GHz 64-bit quad-core ARMv8 CPU 802.11n Wireless LAN Bluetooth 4.1 Bluetooth Low Energy (BLE)


FarmBot
Seeder
Water
The Universal Tool Mount
Featuring 12 electrical connections, three liquid/gas lines, and magnetic coupling.
Seed Injection
Powered by a vacuum pump, the seeder sows with millimeter accuracy.
Watering
Precision water your plants with the gentle shower of this nozzle.
Soil Sensor
Weeder
The Soil Sensor
Measure moisture content to optimize for all soil types and environments.
Camera
FarmBot always keeps its eye on your garden to detect weeds and monitor plant health.
Weed Suppression
This tool physically disrupts and destroys the fragile root systems of infant weeds.

Figure 3:

Purpose - The Raspberry pi 3 would create its own Wi-Fi whenever a user can not connect to the internet.This will allow you to access the app credentials from your laptop, phone, or tablet, which means you never need to hook up a keyboard or monitor to the Raspberry Pi. Also, It will send the commands entered from the app to the Arduino

- Arduino mega 2560 - The Arduino Mega is a microcontroller board based on the ATmega1280. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started

  Purpose – The Arduino Mega 2560 is going to be used receive commands from the Raspberry pi 3 and send it to the stepper motor to perform a certain task.

- Sensor Hat (light and temperature) - The Sense HAT is an add-on board for Raspberry Pi, made especially for the Astro Pi mission. It launched to the International Space Station in December 2015 – and is now available to buy.

  Purpose – We are going to use it is to receive data about light and temperature from surrounding.

- Bi-polar Stepper motor - It is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any feedback sensor (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed

  Purpose - The Stepper motor is going to be used to move
  any moving parts of It controls the movement of the farmbot.

- 1.4 Ramp shield - Soldering RAMPS 1.4 includes both surface mount and through hole soldering. The surface mount can be done a few ways. Since all the SMT components on this board are large 2 pad parts you can do pin by pin soldering pretty easy with normal soldering equipment.

  Purpose - The ramp shield acts as a bridge between the Arduino, the stepper motor, and the power supply.

2.3 Software Specification FarmBot is going to operate in an order similar to that posted on diagram posted on farmbot arduino github page ("Farmbot-arduino-controller," 2017).

```
+--------------------------+
|farmbot_ app              |
+-----------+--------------+
            v
+--------------------------+
|farmbot_raspberry_pi3     |
+-----------+--------------+
            v
+--------------------------+
|farmbot_arduino_controller|
+-----------+--------------+
            v
+--------------------------+
|Command                   |
+-----------+--------------+
            v
+--------------------------+
|GCodeProcessor            |
+-----------+--------------+
            v
+--------------------------+
|***Handler                |
+-------+-----------+------+
```

```
         |            |
         |            +---+
         v                v
+--------------+   +-----------+
|StepperControl|   | PinControl|
```

Image source: ("Farmbot-arduino-controller," 2017)

2.3.1 Database work breakdown

Currently, We only have a local database for our FarmBot project. The database stores the plant number, date, and name locally. Once the app is deleted the users will lose access to all their data.

We plan on getting a server to so all users data can be stored in the cloud and can be accessed by them at any time.

(Developed by Adanegbe Amadasun)

2.3.2 Application work breakdown

FarmBot is going to be more economical and ecofriendly unlike other agricultural equipment being used. It incorporates precision farming, which happens to be a concept based on observing, measuring and responding to inter and intra-field variability in crops. The device is going to be constructed be the FarmBot company, it is going to be made of an Arduino Mega 2650, Raspberry Pi 3, Sensor hat (which can read temperature, light, and soil condition), and Bi-polar stepper motor.

We plan on using the an arduino mega 2560 to control the bi-polar stepper motor to make it move on its X-axis.

(Developed by Alisha Singh Chauhan)

2.3.3 Web and work breakdown

An app was created to use for the FarmBot, this app would be used to control the FarmBot to plant seed at desire position in the bed. Also, the user can choose the option of giving the FarmBot light for a duration of time, watering the plant etc.

After installing the app on your mobile phone, users will be prompt to create an account by choosing user name and password. This will then give them access to their FarmBot and its data stored in the cloud.

The user can then pick the seed of the crop they want to plant, and the care option they want to apply to the seed (i.e. The light duration, or how frequently they want to water the plant) and submit the options they picked

The user would be given the access to control the FarmBot and apply the option picked from the previous screen.

We plan on connecting FarmBot's app with raspberry pi, so that users can be able to send data to it.

We would both work on this.

(Developed by Adanegbe Amadasun and Alisha Singh Chauhan)

2.4 Build Instruction

2.4.1 Introduction

The Farmbot is designed in a such a way that it will work and execute the commands given by the user through software. The working is clearly explained with the design model given below.

2.4.2 Bill of Materials

- Raspberry Pi 3 Complete Starter Kit - 32 GB Edition - $74.35 (Corporation, 2017)
  Image source: (Pimoroni, 2017)
- Arduino Mega - $49.95 (Inc., 2017e)

  Image source: (Robotics & Electronics, 2017)

Figure 4:

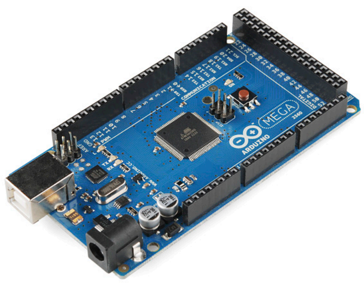

Figure 5:

Figure 6:

- 5v Switching Power Supply - $15 (**???**)
  Image source: (Inc., 2017c)
- Ramps 1.4 for 3D Printer – $35.95 (Inc., 2017h)

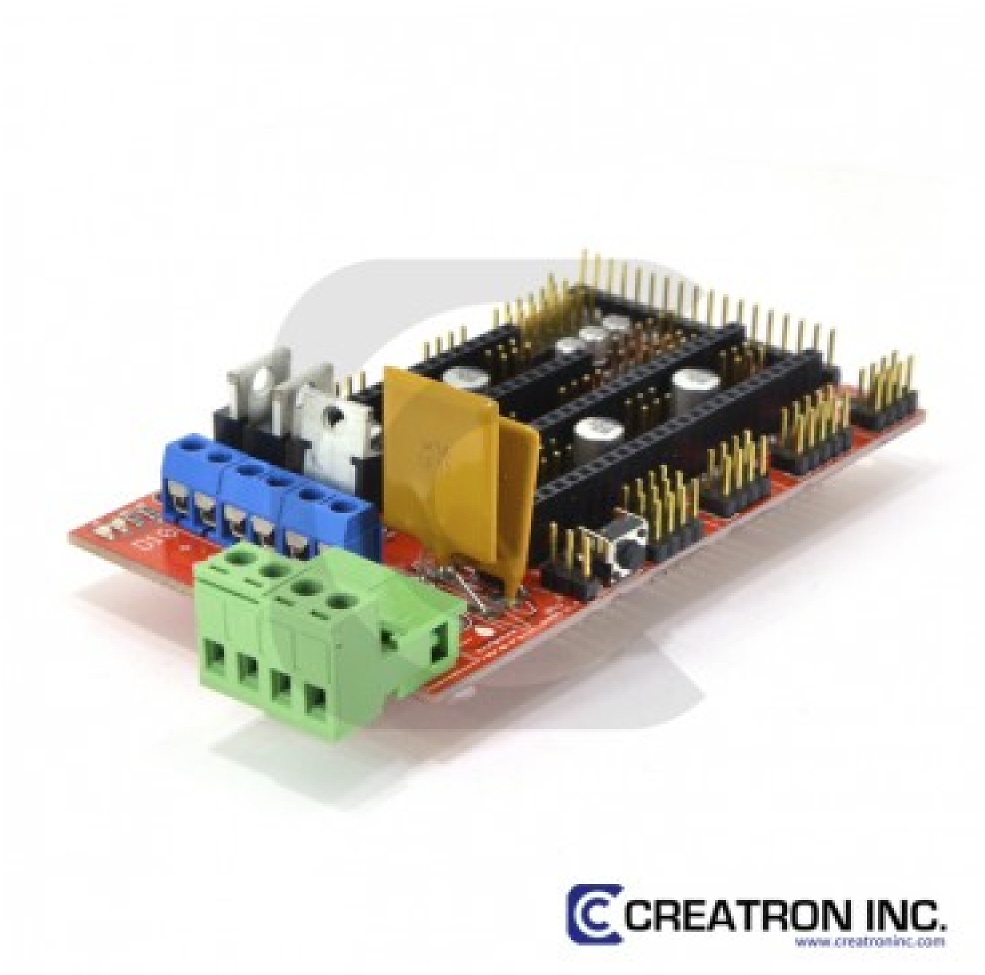

Figure 7:

  Image source: (Inc., 2017h)
- Stepper Motor Driver - $14.25 (Inc., 2017f)
  Image source: (Inc., 2017f)
- Bipolar Stepper Motor - $29.50 (Inc., 2017d)
  Image source: (Controls, 2017)
- Time Pulley - $9.00 (Inc., 2017b)
  Image source: (Inc., 2017b)
- Rotary - $4.95 (Inc., 2017g)
  Image source: (Inc., 2017g)
- Timing Belt - $19 (Inc., 2017a)
  Image source: (Inc., 2017a)

Figure 8:

Figure 9:

Figure 10:

Figure 11:

Figure 12:

- Total = $284.70 + HST

2.4.3 Time Commitment

The design model needs at least 5-6 hours to put everything all together. It includes the laser cutting of the outer cage and then soldiering all the components into the case appropriately.

Task	Estimated Time
Printing PCBs	30 mins
Soldering PCBs	2 hrs
Testing Sensors and motor	2 hrs
Designing and Laser-cutting Box	40 mins
Assemblying parts	1 hr
Uploading FarmBot firmware (Raspberry pi 3)	30 mins
Uploading FarmBot firmware (Arduino)	25 mins

2.4.4 FarmBot Raspberry Pi 3 OS

To upload FarmBot Firmware on Raspberry Pi 3 according to ("Raspberry-pi software," 2017)

The Raspberry Pi being used has the software in it to do the various functions: - It should have a communication channel to have a sync with the logs and sequences of data using the Ethernet or Wi-Fi.

- Another communication channel for the interconnection of Arduino and sensor data of G commands sent by the user.

This could be done using the FarmBot Firmware installed in it which would help to sync the data received to the OS.

The most important component that is Wi-Fi configurator which allows the Raspberry Pi to create its own network even in the absence of internet. This initiates the connection to the web application with any of your device such as laptop, phone or tablet.

Step 1: Download FarmBot Firmware

- Download the latest FarmBot Firmware image.

Step 2. Write FarmBot Firmware to the microSD card

- Install the FarmBot Firmware on the microSD card using any image writing tool and according to the operating system you have got which could be ether windows, Linux or Mac OS.

Step 3. Prepare the Raspberry Pi

- Plug your microSD card into the Raspberry Pi
- Plug your Arduino into the Raspberry Pi with a USB cable
- Optional: plug in a USB camera to the Raspberry Pi

Step 4. Turn on the Raspberry Pi

- When you plug in the power supply, the Raspberry Pi will get the power accordingly from the standard micro USB cable from a DC convertor. The power supplied must be rated to 5V and at least 1A, though 2A is recommended.

Step 5. Configure your FarmBot

- Using a phone, tablet or laptop, search for the Wi Fi network 'farmbot-xxxx'.
- Connect to that and open a web browser to http://192.168.24.1/
- Follow the on-screen instructions to configure your FarmBot. Once you save your configuration, FarmBot will connect to your home Wi Fi network and to the FarmBot web application

2.4.5 FarmBot Arduino Firmware

To upload FarmBot Firmware on Arduino Mega 2560 according to ("Arduino firmware," 2017) There are two methods

Using Web App Note: You can only use this method if you already have FarmBot Firmware installed on your Raspberry Pi 3.

- Connect your your Arduino to Raspberry using your USB cable
- Login to the FarmBot Web Application, if you already have already an account but if you don't create one. Then go to the Device page.
- In the Device widget, click the Update button next to the Firmware version. This will tell the Raspberry Pi to download the latest FarmBot Arduino firmware and install it onto the Arduino. Note: This may take a few minutes. Do not press the Update button more than once.
- Once the installation process is complete, the software widget on the web application should show that the latest firmware is installed. There is no need to 'start the firmware' because as long as the Arduino has power and a connection to the Raspberry Pi, the firmware will be running.

Using Arduino IDE

- Go to the website https://www.arduino.cc/en/main/software to download Arduino IDE.
- After downloading Arduino IDE install it on your computer, and Run it.
- Download and unzip the latest from FarmBot Arduino Firmware release.
- In the firmware folder, you just unzipped, go to the src sub-folder and open up src with the Arduino IDE. Note: this file is blank,
  but there are many other file tabs that should be automatically opened as well.
- Once that is complete, connect Arduino Mega 2560 to your computer using your USB cable (Note: Arduino Mega 2560 uses a printer USB cable).
- Click on the Tools tab, it shows a dropdown menu which you would then select Board and click on Arduino Mega 2560.
- After you are done with that, click on the upload button. This will then upload the FarmBot Arduino Firmware to your Arduino Mega 2560.

2.4.6 Teacup Firmware

Teacup Firmware

To upload Teacup firmware on Arduino Mega 2560 according to ("Teacup firmware," 2017) (Note: you will need Python 2.7.x or later, but not Python 3.x.)

- Download Teacup firmware from this website Teacup Firmware master branch package and unpack it.
- After downloading it, open just the unpackaged directory and double-click configtool.py to start it.
- Choose Menu -> File -> Load printer and select the one closest to the printer you want to operate.

- Choose Menu -> File -> Load board and again select the one closest to (or matching) your actual hardware.
- Choose Menu -> File -> Save config.h.
- Choose Menu -> Edit -> Settings like the Arduino directory, the port directory, baud rate etc. After editing the settings, click save.
- Now you need to build it so choose Menu -> Build -> Build.
- To upload the firmware into your Arduino, choose Menu -> Build -> Upload

2.4.7 Power Up and Testing

To test Teacup firmware, you would have to use pronterface. Pronterface

Pronterface is used to send g command or code to Arduino firmware.

- Download the latest version of pronterface for your PC, form this website http://kliment.kapsi.fi/printrun/
- Enter your baud rate and port
- Click connect and the grayed out X axis and Y axis should turn coloured
- You can either click on the X axis or Y axis to move the stepper motor, or enter the g command and click send to move the stepper motor

Powering up Arduino Mega 2560

Powering up your Arduino Mega 2560 and Stepper Motor

- Arduino Mega gets enough power to wok when it is connected to your computer through a USB cable.
- Tune the potentiometer on the stepper motor to limit the current to 0.6 amps
- Set the power supply to be 10V
- Make sure to connect the wires properly (Red to positive and black to ground).

2.4.8 Controlling Farmbot

An app was developed for this project to control the FarmBot, the app is called Gardernitor. The app was developed with android sudio, and it supports Android 4.4 KitKat and above. Upon launching the app, it displays a screen that ask the user to sign into their account, or sign up for a new account if they do not already have one.

This feature is for security reason to prevent intruders from gainning access to someone else’s FarmBot. The next screen would ask the user to pick the seeds they want their FarmBot to plant. After picking a seed, the user would pick a care option and the duration for which they want FarmBot to care for the plant.

2.5 Problems Encountered

Throughout the duration of our capusle project, we encountered different problems that required us to use not only our knowledge from Computer Engineering, but also knowledge we have gained from the outside world. The following are some of the problems we had:

2.5.1 Finding Parts

- We had a hard time finding parts appropriate for our project, because we were going to build a prototype. This made it difficult to determine where to start in assembly but this is providing an opportunity to rethink our original design plans from following a scaled-down FarmBot design to attempting a design that resembles a 3D printer and adjusting it appropriately for this project. We are thinking about this design change in order to have more than one axis for the robotic arm and to allow more useful functionality out of the FarmBot design. We might choose to return to the original design plan if this is not feasible.

2.5.2 Time Management

- Time management caused a lot of problems for us because we had poor time management skills. Our project requires a lot of time, so we tried to balance our time among all our courses which means coming to school on weekends to get some work done.

3. Progress Report

3.1 Report 1 (Week 5)

From: Adanegbe Amadasun Cc: Alisha Singh Chauhan

Dear Sir,

This is our email regarding progress report and the milestone we have covered so far on our project. We are still behind schedule because I did not make a case from last semester for our project. Last semester, I could not keep up with the schedule I created for myself because of my course load and some of the parts I was working with were new to me. But this semester, I have a better understanding of my project and how to do it. We are trying to come up with ideals on how on the stepper motor move different parts of the FarmBot. After we are done with that, we would start working on the code need to move the stepper motor. We have an android app working which we would use to connect to our FarmBot. We have built a case for our FarmBot and we are currently trying to create a pulley system.
Last week Friday, we had success in uploading teacup firmware into our Arduino for the pulley system. Our budget has changed because I have planning on purchasing new parts. I am first going to check the Alisha's parts to m Alisha project to know which of the we can use.

Sincerely, Adanegbe Amadasun

3.2 Report 2 (Week 6)

From: Adanegbe Amadasun Cc: Alisha Singh Chauhan

Dear Sir,

This is our email regarding progress report and the milestone we have covered so far on our project. We now have a better understanding on how to go about our project. We worked with Vlad last week Friday to accomplish various task for our project such as: - Tuning our stepper driver to allow 0.6 amps of current - Lasercut a hole through our case for the pulling system - We also learnt how to crimp wires, we crimp our stepper motor wire to make it easier to connect it to ramp shield. We have built a case for our FarmBot and are still working on creating our pulley system. Also, we had success in uploading teacup firmware into our Arduino for the pulley system, and we are currently trying to figure out the distance to use for stepper more to move.

Work breakdown: we have distributed the workload among us in the following way. Database Work Breakdown: Adanegbe will be working on the database part of the project. Currently, we only have a local database for our FarmBot project. The database stores the plant number, date, and name locally. Once the app is deleted the users will lose access to all their data. (Developed by Adanegbe Amadasun)

We plan on getting a server to so all users data can be stored in the cloud and can be accessed by them at any time

Application and work breakdown: Alisha will be proceeding with this. FarmBot is going to be more economical and ecofriendly unlike other agricultural equipment being used. It incorporates precision farming, which happens to be a concept based on observing, measuring and responding to inter and intra-field variability in crops. The device is going to be constructed be the FarmBot company, it is going to be made of an Arduino Mega 2650, Raspberry Pi 3, Sensor hat (which can read temperature, light, and soil condition), and Bi-polar stepper motor.

Hardware breakdown: We are working on the hardware together.

Sincerely, Adanegbe Amadasun

3.3 Report 3 (Week 11)

From: Alisha Singh Chauhan Cc: Adanegbe Amadasun

Dear Sir,

This is our email regarding progress report and the milestone we have covered so far on our project.

For Arduino Firmware

We opened the serial monitor on Arduino IDE to enter g codes to move the stepper motor, after entering the code, nothing happened. Then we loaded the teacup firmware into the Arduino and tested the g code, and the worked.

We opened putty, changed the connection type from ssh to serial, check Xloader to determine the baud rate because putty required it. Then we saved the session I made on putty as farmbot so next time, all we need to do is load the saved session. After saving the session, we proceeded to load it and I still encountered the similar issue. Putty did not allow us to enter the code.

When FarmBot Firmware is loaded and we test the g command, Arduino send the stat of the stepper motor position to my PC and we could see it through the serial monitor on Arduino IDE, but it doesn't accept command, because commands are suppose to be sent by the raspberry pi. We used the table below ("Farmbot-arduino-controller," 2017) to understand what the stats of the stepper that was sent by the Arduino.

Code type	Number	Parameters	Function
R			Report messages
R	01		Current command started
R	02		Current command finished successfully
R	03		Current command finished with error
R	04		Current command running
R	05		Report motor/axis state
R	06		Report calibration state during execution
R	21	P V	Report parameter value
R	31	P V	Report status value
R	41	P V	Report pin value
R	81	X1 X2 Y1 Y2 Z1 Z2	Reporting end stops - parameters: X1 (end stop x axis min) X2 (end stop x axis max) Y1 Y2 Z1 Z2
R	82	X Y Z	Report current position
R	83	C	Report software version
R	99	C	Debug message
Code type	Number	Parameters	Function
G			G-Code, the codes working the same as a 3D printer
G	00	X Y Z S	Move to location at given speed for axis (don't have to be a straight line), in absolute coordinates
G	01	X Y Z S	Move to location on a straight line
G	28		Move home all axis
F			Farm commands, commands specially added for the farmbot
F	01	T	Dose amount of water using time in millisecond
F	02	N	Dose amount of water using flow meter that measures pulses
F	11		Home X axis
F	12		Home Y axis
F	13		Home Z axis
F	14		Calibrate X axis
F	15		Calibrate Y axis
F	16		Calibrate Z axis
F	20		List all parameters and value
F	21	P	Read parameter
F	22	P V	Write parameter
F	23	P V	Update parameter (during calibration)
F	31	P	Read status
F	32	P V	Write status
F	41	P V M	Set a value V on an arduino pin in mode M (digital=0/analog=1)
F	42	P M	Read a value from an arduino pin P in mode M (digital=0/analog=1)

F	43	P M	Set the I/O mode M (input=0/output=1) of a pin P in arduino
F	44	P V W T M	Set the value V on an arduino pin P, wait for time T in milliseconds, set value W on the arduino pin P in mode M (digital=0/analog=1)
F	51	E P V	Set a value on the tool mount with I2C (not implemented)
F	52	E P	Read value from the tool mount with I2C (not implemented)
F	61	P V	Set the servo on the pin P (only pin 4 and 5) to the requested angle V
F	81		Report end stop
F	82		Report current position
F	83		Report software version
E			Emergency stop

We also create a text file on notepad ++, and wrote the command for the different positions for the stepper motor. The three position am using are: G0 X1 for home position, G0.6 X1 for measuring moisture position, and G1.2 for watering position. We then proceed to load the file but we notice the stepper motor did not pause between position, we went on the website ("G-code," 2017) which show us how to add pause to my command to make the stepper motor pause at each position.

For FarmBot Firmware

We were still kind of stuck troubleshooting for the FarmBot firmware to work. We were trying to figure out if the Raspberry pi could work with the ssh terminal because when we downloaded the firmware for farmbot as the raspberrian software was removed it stopped showing the display.

Then we tried finding the way out to have the interaction of the firmware with the internet using the IP address of the raspberry pi. We even tried using the website (Rigby, 2017) we couldn't get it working yet. We did not purchase anything extra till now for the project so our budget is still the same.

We got the router from the school but Mehdi could not help us configure the router because he is on vacation this week.

To Configure a Router

We had to configure a router for our Raspberry pi 3. The following instructions are how we configured the router.

- First, the you connect the router to the main network by having the connection to the Ethernet cable.
- Now the computer is connected to the router and it acts as an intermediate between the network and the machine.
- Then go on the web browser and type in the IP address of the router.
- If the IP address of the router is not known, we can figure it out using the manual schema.

Sincerely, Alisha Singh Chauhan

4. Conclusion

The making of this project will eliminate so many farming problems which have been faced by our technologists in the previous years. The kit is an autonomous machine which could be installed anywhere in the garden as it's not that huge. It will reduce the human labor for monitoring, and scheduling the farming process.

The following points shows the intrinsic benefits which we will be getting after the building up of this project:

- Free, open-source and accessible with proper documentation
- Capabilities to optimize the operations reducing human efforts for watering, seeding etc. by moving the axes.
- Fully- automated with no less time wastage
- Fragmentation of food production
- Broadens the horizons for designing the farmbots
- Scalable from a backyard system to an industrial operation
- Ability to compile and can be applicable for efficient layouts.

This project is made under the technical considerations of hardware and software of the farmbot genesis and is worthy to install to reduce the various hazards faced under the farming industry.

5. Recommendations

We recommend farmbot because of numerous reasons such as FarmBot is the first piece of technology that is an end-to-end soil-based food production system that is also 100% open source, focused on precision, controlled from the web, and accessible and appropriate for small-scale operations.It tends to plant variety of plants and indeed gives the opportunity to the users to customize it by themselves.

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