1 Group Id

4

2 Project Title

Design & Implementation of Stock Aware shelves using Pervasive Computing.

3 Project Option

Internal project

4 Internal Guide

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5 Technical Keywords

Implicit HCI, IoT, Load sensing, Sensor Networks

6 Problem Statement

To develop a pervasive system to implicitly get stock levels on users mobile device. The system should also generate location based alerts and also predict the stock levels.

7 Abstract

Pervasive computing also called ubiquitous computing is the growing trend towards embedding microprocessors in everyday objects so they can communicate information. With the advancements in Internet technologies, a new trend in the era of ubiquity is being realized. Today, whenever we go out to buy grocery we may forget to buy any particular, which may cause inconvenience. This problem can be solved by using Pervasive Computing principles.

We utilize smart phones and wearable devices to make the world around us reachable, intractable and to keep us updated. Utilizing sensor and smart phone technology we target to embed a mind in kitchen which interacts with user and automatically generates ”To-buy” list and alerts depending upon the need of a particular item. Towards such a perspective, there is the need to continuously collect, elaborate, and present data, possibly deriving from smart objects. This can be achieved by the use of Sensor Networks, consisting of raspberry pi 3 development board along with HX711 load sensor interface to sense the weight of particular quantity and send it wireless over the network. This Raspberry pi can be programmed in Python to serve our purpose.

8 Goals and Objectives

- To use pervasive computing principles for implementing stock-aware shelves
- To sense the stock levels and uniquely identify the stock containers with the use of RFID.
- To send the stock level data to the users mobile device.
- Analyze the stock levels and predict the stock lasts.

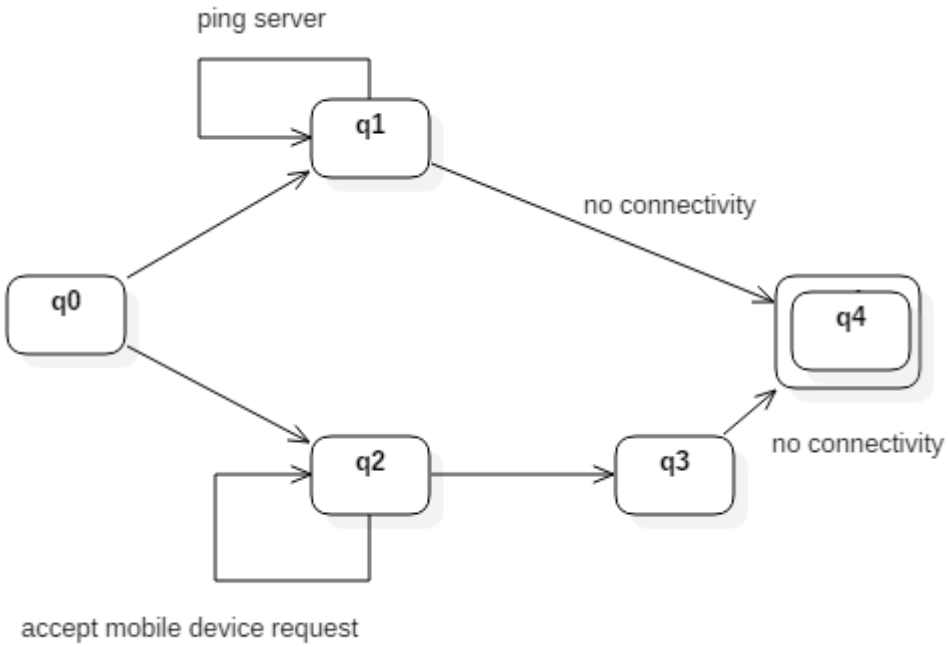
9 Relevant mathematics associated with the Project

System Description

The system can be divided into three parts

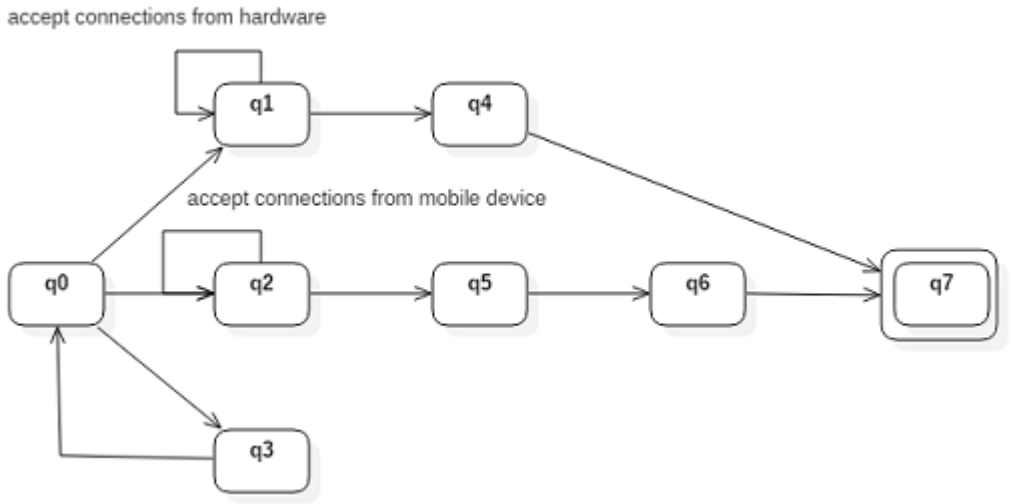
1. Hardware

```
Let H be the Hardware part of the system
H = {I,O,F,Q}
I = {sensor data, requests from phone}
O = {ipaddress,sensor data}
F = {pingServer(), acceptRequestFromMobile(), getSensorData(),
  sendSensorData()}
Q = {q0,q1,q2,q3,q4}
q0 - initial state
q1 - ping server
q2 - accept mobile device request
q3 - send data to mobile device
q4 - stop
```



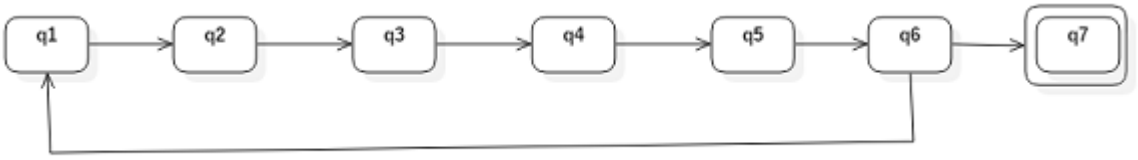
2. Server

```
Let S be the Server part of the system
S = {I,O,F,Q}
I = {hardware ip address, username, password,
     hardware id}
O = {hardware ip address, hardware status}
F = {acceptConnectionRequest(),authenticate(),
    checkHardwareReachability(),
    sendHardwareIPaddress()}
Q = {q0,q1,q2,q3,q4,q5,q6,q7}
q0 - intialize
q1 - accept connections from hardware
q2 - accept connections from mobile device
q3 - register hardware
q4 - update hardware IP address
q5 - autenticate
q6 - send hardware ip address to mobile device
q7 - stop
```



3. Mobile device

```
Let M be the Mobile device part of the system
M = {I,O,F,Q}
I = {hardware ip address, sensor data}
O = {username, password, alerts}
F = {authenticate(), requestData(), analyzeData()
     generateAlerts()}
Q = {q0,q1,q2,q3,q4,q5,q6,q7}
q0 - initalize
q1 - check session details
q2 - authenticate
q3 - request data
q4 - recieve data
q5 - analyze data
q6 - generate alerts
q7 - stop
```



where
I - set of inputs O - set of outputs F - set of functions Q - set of states

10 Names of Conferences/Journals where papers can be published

- IEEE Conference
- ACM Conference
- SPPU Conferences
- Open Access Journals

11 Review of Conference/Journal Papers supporting Project idea

1. Towards the Implementation of IoT for Environmental Condition Monitoring of Homes

   This paper begins with describing the surge in the number of internet users and how the internet of things phenomena is affecting human lives. It further takes on Home automation specifying the impact and usage. It states that future of computing deals with embedding the sensors etc with the everyday use devices, the encompass several domains such as e-Governance, health care, Transportation, Waste Management, Food Supply Chains, and Energy and Utilization. It also talks about different labs such as iDorm, Smart home Monitoring etc. It says about the ambient intelligence, how it is planted to at home to get the detail information about the people living.

2. Convergence of MANET and WSN in IoT Urban Scenarios

   This paper discusses the recent emergence of smart cities, envisioned as intelligent, wide-scale, and open environments able to facilitate citizens by increasing their everyday quality of life, is further boosting research in IoT technologies and related standards as a fundamental building block for these new scenarios. Toward such a perspective, there is the need to continuously collect, elaborate, and present data, possibly deriving from smart objects and integrated with participatory sensing: that activity requires significant standardization efforts, under different perspectives, to deal with dynamic, open, and not statically predictable deployment conditions.

3. Design of a WSN Platform for Long-term Environment Monitoring for IoT Applications

   This paper explains importance of WSN in IoT. WSNs bring IoT applications richer capabilities for both sensing and actuation. In fact, WSN solutions already cover a very broad range of applications, and research and technology advances continuously expand their application field. This trend also increases their use in IoT applications for versatile low-cost data acquisition and actuation.

4. Smart Shelfie : Internet of Shelves For higher on-shelf availability

   This paper discussed the issues which arise in retail store. Out of stock is a great concern for Consumer Packaged Goods and Retail organizations . They lose billions of dollars every year. If items of interest are not available on the shelves, 31% customers buy from somewhere else and 26% buy a different brand . This paper describes how the racks / shelves at a retail store can be made smarter such that they can raise alerts to replenish themselves. Smart alerts to workers in retail shop can avoid manual checks and alerts to CPG companies can expedite replenishment if retailers do not maintain the right quantity or replenishes within Service Level Agreement (SLA). While load sensors have been the most common practice, it has not succeeded as anything else on the shelves still meant available. This leaves us with a challenge to track not only the quantity but also the right brand, right variant in the right position with right visibility to shoppers on the right shelf. Internet of Things can help make this thing (shelves) smarter to required extent. We have enabled shelves to take its own selfie using a simple camera and then the image processing algorithms take over to do required analytics and raise alerts with the right person. This solution scores higher over other hardware and capital intensive IoT solutions being worked upon.

5. Human-object Interaction Reasoning using RFID-enabled Smart Shelf

   Radio Frequency Identification (RFID)-enabled smart shelves are becoming common place in pervasive retail. These devices provide real-time information about the item?s stock and location, but few efforts have been made to reliably detect human interaction with the items. We present a novel approach on real-time human-object interaction detection based on RFID using supervised machine learning techniques. By analyzing specific RFID features, we classified human interaction on a real smart shelf, achieving a performance over 84work aims to provide the first method to model RFID information as a source of human activity recognition, with application to context-aware industrial infrastructure, smart environments and Internet of Things.

6. Smart Kitchen Cabinet for Aware Home

   This paper explains that the kitchen is a very important place of a home and cooking is one of the day to day activities. The usual difficulty in a kitchen during cooking is finding the items to be out of stock. The growing

popularity of automated systems indicates the demand of the household devices to be smart and automated to support us in our daily activities. The kitchen is one ideal place where automation at various levels can be done. Daily kitchen activities include stocking kitchen cabinet in relation to necessary dietary regiment, likes, and needs, tastes etc

7. Smart Tupperware: Active Containers for Kitchen Automation

   This paper discusses about "Smart Tupperware" which is an exploratory research project in Personal Task Assistants (PTA) which is examining both devices and user interfaces for personal augmentation systems that can assist in such tasks as automatically maintaining kitchen foodstuffs inventory and integrating it with a shopping list application. Through sensor built in kitchen containers and various mnemonic methods, the system measures the fill status of the containers and maintains a distributed database that is uploaded to a personal device that is network-connected and user aware.

8. Manage Inventory Remotely with Smart Weighing *Web Reference*

   When managing inventory, problems such as supply shortages and material loss can cost time and induce frustration. However, the right inventory solution can have the opposite effect, speeding up processes and minimizing loss. It is easier than you think to get on top of your inventory issues for a more convenient and efficient process.Smart shelves fit into standard racking systems with integrated scales and an A/D board.

9. Monitoring Inventory by Weight *Web Reference*

   Every manufacturer, distributor or end-user of small parts, faces the challenge of monitoring and managing inventory of a large number of small parts. Certain valuable items are closely monitored using sophisticated RFID tag technologies. However, a vast majority of parts such as small metal stampings, injection molded parts, fasteners, medical products such as injections, syringes, masks or gloves etc. are managed manually today. A human being has to physically go and look at bins, boxes or other storage devices, see if there are enough parts in stock (or count them for updating inventory counts in the ERP system) and either enter an order into a system manually or use a bar code reader to scan in the parts that need to be ordered and then updated into a system.

12 Plan of Project Execution

Month	Phase
July, 2016	Requirement Engineering
August, 2016	Design & Modeling
September, 2016 - December, 2016	Implementation & testing
January, 2017	Deployment