Smart Hospital

By

Author's name

Department of Engineering Mathematics
University of Bristol

A dissertation submitted to the University of Bristol in accordance with the requirements of the degree of Doctor of Philosophy in the Faculty of Engineering.

April 2013

Word count: ten thousand and four

Abstract

Here write the abstract

Dedication and acknowledgements

Here goes the dedication.

Author's declaration

I declare that the work in this dissertation was carried out in accordance with the requirements of the University's Regulations and Code of Practice for Research Degree Programmes and that it has not been submitted for any other academic award. Except where indicated by specific reference in the text, the work is the candidate's own work. Work done in collaboration with, or with the assistance of, others, is indicated as such. Any views expressed in the dissertation are those of the author.

SIGNED: .... DATE: ....

Table of Contents

List of Tables

List of Figures

Chapter 1

Introduction

Begins a chapter. Example: When the beloved cellist (Christopher Walken - outstanding) of a world-renowned string quartet receives a life-changing diagnosis, the group's future suddenly hangs in the balance: suppressed emotions, competing egos and uncontrollable passions threaten to derail years of friendship and collaboration. Featuring a brilliant ensemble cast (including Philip Seymour Hoffman, Catherine Keener and Mark Ivanir as the three other quartet members), it is a fascinating look into the world of working musicians, and an elegant homage to chamber music and the cultural world of New York. The music, of course, is ravishing (the score is the work of regular David Lynch collaborator Angelo Badalamenti): A Late Quartet hits all the right notes.

1.1 Motivation

Begins a section.

1.1.1 Client Brief

Begins a subsection.

1.1.2 General
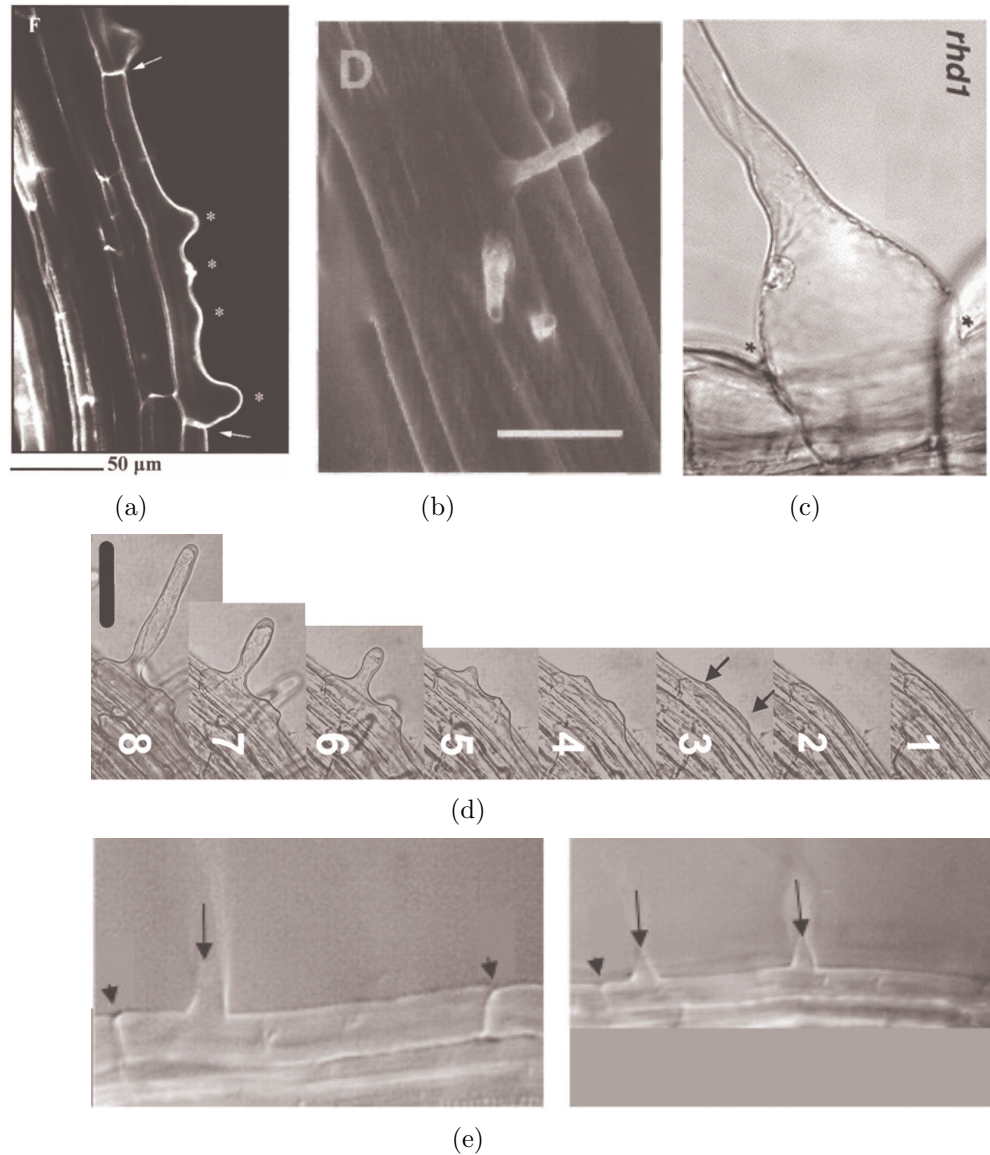
content

1.1.3 Specific

content

Figure 1.1: (a) A mutant RH cell. Asterisks show multiple sites of RH initiation in a single root hair cell (indicated by the arrows). Figure reproduced from [6]. (b) Hair-forming cell with three RH initiation locations. The bar represents $50\mu m$. Figure reproduced from [4]. (c) Large bump in mutant *rhd1*. Figure reproduced from [1]. (d) Mutant overexpressing gene *ROP2*; from right-hand to left-hand, numbers indicate progressive snapshots at different times. RH initiation sites are indicated by the arrows. The bar represents $75\mu m$. Figure reproduced from [3]. (e) Mutants affected by auxin. On the left-hand side, RH site is farther away from the apical end (left arrow cap); on the right-hand side, multiple RH locations (arrows). Figure reproduced from [5].
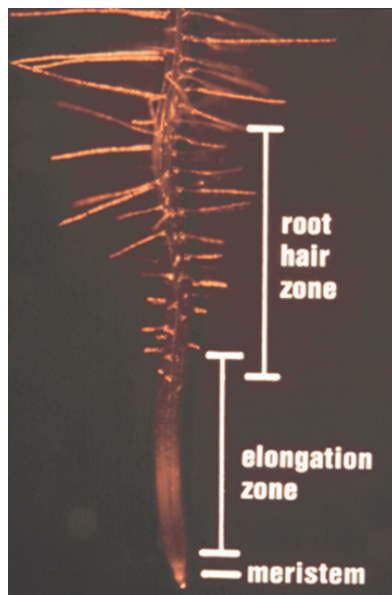
Figure 1.2: Developmental zones of an Arabidopsis root. Figure reproduced from [1].

Chapter 2

Background

2.1 Relative Work

In many hospitals, patients need to wait for a long time just to have a short consultation with a doctor. This can be exhausting, especially for people who are already sick. In some places like the countryside, the problem is worse because there are not enough doctors or clinics [2]. Some people need to travel very far to get help, which is hard for old people or people with long-term illness.

During COVID-19, many doctors started using phone or video to talk to patients. In the UK, it went from 15

Our Smart Hospital system also uses phone and video consultations. We also have Health QA, where people can ask simple health questions and get advice more easily. These help people who live far away or cannot go outside, and they also make the waiting time in hospitals shorter.

Our system supports the United Nations' SDG Goal 3, which is about helping people stay healthy and live well [8]. Among all the targets, Goal 3.8 and Goal 3.4 are especially important to our project. Goal 3.8 is about giving basic and affordable health services to everyone. Goal 3.4 is about helping people with long-term sickness, like heart disease or mental problems. Our system lets them contact doctors or get advice online more easily, so they can get help earlier before the problem becomes worse.

2.2 Existing Solutions

2.2.1 Teladoc Health

2.2.2 LINE Hospital Services

In Taiwan, many hospitals have their own official LINE accounts to provide online services. Patients can add the hospital's LINE to access booking and other basic functions. It is very

easy to use, since most people in Taiwan already use LINE in their daily life. This makes it a common way for hospitals to offer simple medical services without asking people to download another app.

Figure 2.1: Screenshot of the LINE system of Far Eastern Memorial Hospital, captured from the hospital's official LINE account. The menu offers basic features such as booking appointments, viewing announcements, and linking personal information for customized services [2].

These features are quite easy to use. However, each hospital has its own design and menu. Some functions even open in separate websites. There is no unified system, so it can be confusing for some patients, especially older people or those not familiar with technology.

2.2.3   Other Existing Solutions

2.3 Requirements

The system is primarily designed as a web-based platform for general hospital staff, specifically doctors and nurses, to facilitate interaction with patients. The core aim is to enable healthcare professionals to manage patient information, conduct remote consultations, and reduce the need for patients to visit the hospital in person. While patients are also considered stakeholders of the system, the focus of the design and development process was placed on the needs of doctors and nurses. The decision was driven by the goal of reducing the administrative and operational workload for hospital staff, thereby improving efficiency within clinical workflows.

To ensure a functional and effective experience for hospital staff and patients, the system was designed to support a core set of features. These include secure user login and authentication for doctors and nurses, the ability to record patient vitals and view historical data trends, and an interface for remote consultation to minimise unnecessary hospital visits. As the project was developed from scratch and targeted doctors, nurses, and patients, it required the collection of foundational requirements to support the intended clinical workflow. Based on input from our original client, Virtual Hospital Africa, we analysed their existing system and designed a new solution aligned with the vision of building a smart hospital.

Non-functional requirements were also considered throughout the development process. These included ensuring a responsive and mobile-friendly user interface, main- taining data privacy through secure authentication and role-based access control, and optimising performance for minimal load times to support real-time clinical usage. These system capabilities are closely aligned with the user stories presented blew.

As a...	I want...	So that...	Technical ability
Doctor	To record and view patient vitals history	I can make more accurate clinical decisions based on patient trends	3–5
Doctor	To view patient contact information	I can conduct online or follow-up appointments to discuss test results or treatments	3–5
Nurse	To input vitals data easily through a form interface	I can reduce manual paperwork and save time during rounds	2–4
Patient	To view my previous visits and vitals data online	I can better understand my health condition over time	2–3

Table 2.1: Smart Hospital User Stories Table

Chapter 3

Design and Implementations

Begins a chapter. Example: When the beloved cellist (Christopher Walken - outstanding) of a world-renowned string quartet receives a life-changing diagnosis, the group's future suddenly hangs in the balance: suppressed emotions, competing egos and uncontrollable passions threaten to derail years of friendship and collaboration. Featuring a brilliant ensemble cast (including Philip Seymour Hoffman, Catherine Keener and Mark Ivanir as the three other quartet members), it is a fascinating look into the world of working musicians, and an elegant homage to chamber music and the cultural world of New York. The music, of course, is ravishing (the score is the work of regular David Lynch collaborator Angelo Badalamenti): A Late Quartet hits all the right notes.

3.1 Methodology

3.1.1 Work Flow

3.1.2 Process

3.1.3 Front-end Tools

3.1.4 Back-end Tools

3.1.5 Testing Tools

3.2 Front-end Design and Implementations

3.2.1 Early Stage-Virtual Hospital Africa(VHA)

3.2.2 Smart Hospital

3.3 Back-end Design and Implementations

Chapter 4

Evaluation and Testing

Begins a chapter. Example: When the beloved cellist (Christopher Walken - outstanding) of a world-renowned string quartet receives a life-changing diagnosis, the group's future suddenly hangs in the balance: suppressed emotions, competing egos and uncontrollable passions threaten to derail years of friendship and collaboration. Featuring a brilliant ensemble cast (including Philip Seymour Hoffman, Catherine Keener and Mark Ivanir as the three other quartet members), it is a fascinating look into the world of working musicians, and an elegant homage to chamber music and the cultural world of New York. The music, of course, is ravishing (the score is the work of regular David Lynch collaborator Angelo Badalamenti): A Late Quartet hits all the right notes.

Chapter 5

Conclusion

Begins a chapter. Example: When the beloved cellist (Christopher Walken - outstanding) of a world-renowned string quartet receives a life-changing diagnosis, the group's future suddenly hangs in the balance: suppressed emotions, competing egos and uncontrollable passions threaten to derail years of friendship and collaboration. Featuring a brilliant ensemble cast (including Philip Seymour Hoffman, Catherine Keener and Mark Ivanir as the three other quartet members), it is a fascinating look into the world of working musicians, and an elegant homage to chamber music and the cultural world of New York. The music, of course, is ravishing (the score is the work of regular David Lynch collaborator Angelo Badalamenti): A Late Quartet hits all the right notes.

Chapter 6

Reference

Appendix A

Appendix A

Begins an appendix

Bibliography

[1] C. GRIERSON AND J. SCHIEFELBEIN, *The Arabidopsis Book*, American Society of Plant Biologist, 2002.

[2] F. E. M. HOSPITAL, *Official line account.*
`https://line.me/R/ti/p/@femh`, 2025.
Screenshot taken by the author.

[3] M. JONES AND N. SMIRNOFF, *Nuclear dynamics during the simultaneous and sustained tip growth of multiple root hairs arising from a single root epidermal cell*, J. of Exp. Bot., 57 (2006), pp. 4269–4275.

[4] J. D. MASUCCI AND J. W. SCHIEFELBEIN, *The rhd6 mutation of arabidopsis thaliana alters root-hair initiation trhough an auxin- and ethylene-associated process*, Plant. Physiol., 106 (1994), pp. 1335–1346.

[5] R. PAYNE AND C. GRIERSON, *A theoretical model for rop localisation by auxin in arabidopsis root hair cells*, PLoS ONE, 4 (2009), p. e8337. doi:10.1371/journal.pone.0008337.

[6] S. RIGAS, G. DEBROSSES, K. HARALAMPIDIS, F. VICENTE-ANGULO, K. A. FELDMAN, A. GRABOV, L. DOLAN, AND P. HATZPOULOS, *Trh1 encondes a potassium transporter required for tip growth in arabidopsis root hairs*, The Plant Cell, 13 (2001), pp. 139–151.