Contactless Clock-In Application for Workplaces

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B.Sc.(Hons) in Software Development

March 26, 2021

Final Year Project

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Abstract

Covid-19 has brought the world to a standstill for the past year and many workplaces have been forced to close down for fear of transmitting and contracting the virus. This virus can be spread easily by surface contact, which can be near impossible to avoid at many workplaces that are unable to work remotely.

A particular area that is regularly accessed by all the members of a workplace, usually at the same time on a daily basis, is the clock-in system. This can result in the transmission of Covid-19 between employees and managers, leading to them not being able to work, the business losing money and also possible deaths.

We are developing an app that will remove the need for employees to clock in to work at the same place and instead clock in and out using their own smartphone. The user of our app can only clock in when they enter the workplace, via their GPS location.

They will also have to confirm they are an employee of the workplace using a facial recognition system, via their front-facing camera. Employee clock-in times will be recorded for the manager to view, thus replacing the need for a physical clock in system. For employees that may not have access to a smartphone, a camera will be set up by reception to allow them to clock in safely.

Authors   The authors of this project are Ryan Higgins, Daniel Gallagher, Jack McNamee and Shane McCormack who are three fourth year students studying for a Bachelors of Science Honours Degree in Computing in Software Development in the GMIT Dublin Road campus

We would also like to thank the lectures and faculty of the GMIT Dublin Road Campus, in particular John Healy whom we found to be a constant source of useful information on programming practices and life in industry.

Important Project Documentation

1. https://github.com/ryanhiggins11/FINAL-YEAR-PROJECT/blob/master/Paperwork/Di

2. https://github.com/ryanhiggins11/FINAL-YEAR-PROJECT/tree/master/kotlin-app

3. https://github.com/ryanhiggins11/FINAL-YEAR-PROJECT/blob/master/README.md

4. (LINK TO SCREENCAST)

Chapter 1

Introduction

For our project, we wanted to make an application that allows employees to clock in via their smartphone to help prevent the transmission of Covid-19 in the workplace. The employee will only be able to clock in when they are in the workplace and will have to use their front-facing camera to confirm they are an employee. The clock in times will be recorded for the manager to view, thus removing the need for a physical clock-in system

1.1 Idea

At the beginning of 4th,the last year in software development we were given the task of coming up with an idea worthy and suitable for a level 8 final year project. We knew that whatever we needed to come up with must have certain requirements, use multiple different technologies, languages and it had to challenge our knowledge and skills that we had learned in previous years.

With this year being all remote learning it meant that we couldn't meet in person so we were advised at the start of the year to either work by ourselves or to form a team. To start off this project we decided to form a team which consists of four of us. When we decided our team we then had to start thinking of ideas and we done so much brainstorming of different ideas but we wanted to keep our idea topical to what is going on in the world. This is where the breakthrough happened early into our college year.

It was during a team meeting that we had came up with the idea of designing an application for workplaces that would stop big queues of people all using the same clock in machine especially with Covid 19. After many long discussions, research and teams calls we decided that we were going to pursue this idea.

We needed to find the right environment for this application. We had used angular and ionic in previous modules but we had never really delved into the environment in much detail and thus we were very intrigued in the environment and learning about the inner workings and its plugins. At the start of the project different ideas where talked about one was that we would use BLE beacon technology and an android application which employees would download and use to login.When the employee would pass the front door it would then clock them in or if they were leaving work it would clock them out. Although we liked this idea we felt that there wasn't enough to it and we felt by using facial recognition it would be better. When we then knew we could incorporate facial recognition into our app this was when we decided that this was the project we would be doing.

For the application we wanted to store everything in a database which includes user account information,clock in times and clock out times. We decided to use MongoDB which is a document-oriented database which stores data in a JSON-like format with dynamic schema. We learned about databases in previous years in our course but for the login we wanted to experiment with some technology that we hadn't previously used, therefore, the decision to connect an online database to the project came about.

1.1.1 Technologies we used

- Kotlin

- Android Studio

- Realm DB

- Mongo DB'

- Facial Recognition with ML kit

- Google Maps Location

1.2 The Application

The application we are developing is going to be able to use on mobile phones. The user will download this application onto there phone and then create an account using an email and password. When this account is created the user can then login to the application. The applications functionality is going to be clocking in or out for work, clocking in or out for breaks and also we decided to include a sickness feature in our application so if an employee

is feeling ill the manager will be notified of this. When the User either Clocks In or Out or takes a break this time will be sent to our database where it is stored. The managers will then have access to a website where we will then be displaying the names and all the times of each employee.

1.3   Objectives

The objectives of this project are:

- Deploy a working application on the Android Store.

- Design a user friendly application that will be easy to understand and use by any given person.

- Make an Application that will allow users to Clock in using there phone and prevent the spread of Covid 19 in the workplace.

- To work as a developing team, work as professionally as possible, set objectives and complete them. Meet weekly with our Supervisor and team members discussing Project development updates and discussions about the applications.

- Connect an application and display the information from a self developed server with our own database.

- For the application have a valid login and sign up connected to a database that stores the information and then displays it to a website.

- Allocate the work evenly and fairly between the four of us and set goals for each one of us.

- Constantly test the application which allows for error and bug detection as well as advance the development of this application. The application should be tested every time it is updated and documented on the results.

1.4   Chapter Summaries

1.4.1   Introduction

This chapter contains the context of the entire project what we set out to do our objectives for the future, the idea and where it came from technologies

we plan to use and the location of different elements of our GitHub Repository

1.4.2 Research

This is a chapter where we show all the research that we had carried out on all the different parts of the project from the beginning of clock in machines to different technology we would use in our project.

1.4.3 Methodology

This chapter describes the way the project was approached and managed. It also gives an outline of how the project was tested and the layout of the project development.

1.4.4 System Design

This chapter gives an insight into how the entire design of system architecture how it all works in conjunction and diagrams are provided for the explanation of each element of the system.

1.4.5 Conclusion

The conclusion is a section where we give a summary of our findings, results and our experiences while creating the development and deployment of this project.

Chapter 2

Research

2.1   Covid-19

In our research we really wanted to develop something that would have a genuinely helpful real-world use. As we were developing this application in a pandemic, we thought we would do something to play our part in trying to help people as much as we could during this hard time. At the time when we were researching and brainstorming what to do for this project meat factories in Ireland were on their knees [1] with many workers contracting the virus and factories having huge outbreak of the virus, This is when we as a team agreed that developing an application that helped both workers and business owners avoid this would be a great idea as it would both save business owners closing during the pandemic when they are already struggling and cannot afford to close while also helping those who are working in this pandemic to not contract the virus in work and spread it to family or friends. As we researched further it was clear that the clock in area of any business could easily become a spreading point for the virus. Nearly every family member or friend we spoke to about their clock in point in work said that all employees clock in using the one station which led us to develop our survey to analyze what other workplaces are like. In some cases, there were upwards of 50 people per day using the same machine to clock in. As medical research shows Covid-19 can survive on surfaces for a few days [2], this combined with multiple people touching the same surface is clearly a high-risk area for businesses. We as a team decided to make an application to help with this issue. We decided that the application should not just be employer focused but also focus on the employee and offer advantages to both parties. One key aspect of our design which we got from our research into Covid-19 is that every user must use their own device to stop others possibly spreading the virus

with others. If employees are using their own phone to clock in, they are not touching and contaminating an area which other employees use daily which in turn would dramatically cut the risk of catching Covid-19 in the workplace.

2.2 Our Survey

Once we as a team had agreed on our application idea and what it should feature, we decided to put a survey together to see other people's perspective on our idea. The survey was a simple one-minute survey answered by both business owners and working people which we shared through friends and through social media. We had a solid 41 responses from people which gave us good insights into what people thought of our idea. Firstly 64 per cent of people are currently working during the pandemic the majority of which fell between the age of 18-24. A great figure we got was that 58 per cent of people said ALL employees in their workplace used the exact same clock in station. A whopping 46 per cent of these people said that the fact they all use the same machine makes them worried about catching Covid-19 in the workplace. The best indication we got from our survey was that 95 per cent of people who answered our survey said that they would prefer a system used on their own device rather than the system they have already in their workplace. Another important question was regarding a photo being taken for facial recognition. 67.5 per cent of people said that having their photo taken was not an issue with them at all. This question alone led us to include a text login too so that the people who were not comfortable with a picture being taken could have this option to clock in instead. Six of the people who did our survey identified themselves as business owners. Of these 6 people we asked, "would you be open to switching to a clock in-system like ours". This question got a response of 100 per cent of business owners saying they would be open to switching. This alone shows how good an idea like this could prove to be in the working world nowadays.

The results and graphs showing the survey results can be found using the following link - https://www.surveymonkey.com/stories/SM-YZMFXF8C/

2.3 Clock-in Methods

While working together as our team we did some research into different ways which employees could clock into the workplace. The main way we wanted to do was using Bluetooth beacons which when an employee crossed a certain boundary it clocked them in or out automatically. Obviously down to the ongoing pandemic it would have been a hard way to develop our application as with travel and meeting restrictions it would have meant that we as a team could not meet up in person to develop and test using the physical hardware we would need. If the pandemic were not on going this is the way, we would have developed the application as we felt it offered a new and interesting dimension to development using code as in college we rarely if ever used our code on a hardware other than a pc or laptop. Due to these constraints, we changed our method of allowing employees to clock in and out. The method we decided on was a simple clock in and out button which appears once the user is logged in. Once pressed they are pushed to our database and shows who is clocked in, what time they clocked in and what time they clocked out. We decided on this simple system as we believe it offers easy usability and easy navigation without being overly complicated. This will allow users to navigate and use the application with ease without a large learning curve while also providing all the functionality a manager will need by being able to see what time people clock in and out. A good article we found and used is located here [3]. It offers great reasons why an application should be made simple and easy.

2.4 Privacy

When it comes to dealing with people's personal information it is important that privacy is put to the fore front of the research and planning as people need to know that their data is secure and who can view their sensitive material. As a team we have worked to reduce the amount of people able to view this data. Once the database is set up that data should only be accessible by managers and owners of the business. This could possibly be done using a secure web application using a password or by having manager permissions set up on the application. If data is unsecured it can lead to data breaches which can be extremely costly for businesses both financially and it can tarnish their reputation. Customers and employees should always know where their data goes and who can view it, why it's needed by the company and who to contact if they have any concerns. From our survey it was clear

to see some people don't like their photography being taken or used so as a team we decided to allow a text login too which will help these people who don't want a photo used.

2.5 Facial Recognition

To allow people to clock in we decided to try and implement facial recognition. This would consist of the users account being set up with a photograph and then the application once opened would access their camera allowing the system to check if the person is registered and if they are grant them access to the application logged in as themselves. Facial recognition is something very new and we thought it was a great idea to include this. It offers a unique way to interact with the application from a user point of view. It also means that we do not have to store every picture every time someone clocks in. Using facial recognition will allow us to compare the face in the camera to the face we have set up for the user.

Chapter 3

Frameworks

3.1 Kotlin

We decided to work with the programming language Kotlin for our final year project as it was best suited to developing our application. The Kotlin programming language was the most suited to making an Android App when comparing it to other possible languages that we could use. It also helped when we discovered that Google had said that Kotlin was the preferred language for Android App developers as it showed that the majority of app developers trusted this language to use on their application which cleared any doubts that we had about using this programming language. Even though we were unfamiliar with using this language before during our time in the course, we were excited about the prospect of working with a new language and it would also benefit us that we were learning something new and different from before and also that it was one that we could trust to get our application done to the best of our ability. We wanted to challenge ourselves as well with doing another language as we've been used to doing other languages for a period of time before undergoing assignments and we wanted to start off with Kotlin by learning it while doing our final year project as a practice tool for us working with other languages in the future This language was unveiled in 2011 as a new language for the Java Virtual Machine alongside Java which was the main and most worked with language for android apps at that time. Where this language differs to Java is that it does not have it's own built system or package manager as open source tools such as Gradle and Maven. We worked on Kotlin on Android Studio which is the official integrated development environment (IDE) for Google's Android System. We had to install a plugin for using Kotlin on our Android Studio in order for it to work. All the IDE features worked perfectly with Kotlin.

So good that you could work on an application using both Kotlin and Java on the same project and it would still come out well. The advantage that Kotlin has over Java in terms of code is there are less lines of code to be written in Kotlin to complete feature for the application as opposed to many lines of code that has to be written in Java just to complete a method. This language like any other language has not been the easiest to start off with but once we got our heads wrapped around with, we found it much easier to work with it.

3.2 Android Studio

Android Studio is the official integrated development environment (IDE) for Google's Android System. This is designed for android development specifically. It is used for working on code when developing an application usually using the Kotlin programming language and also other languages such as Java. Android Studio let's us users change our code and push it without having to restart the app our even the current activity that we would be working on. The code editor in Android Studio is impressive as well, as solutions would come up if you wanted to include a certain method or statement and you are able to press the tab button in order to insert the code automatically into the page that's been worked on. When working with Android Studio in regards to launching the compiled code, we would use an emulator to launch the code that we worked on or we could run it on our own smart devices by connecting it with a USB (Universal Serial Bus) cable. The role of the emulator is that the purpose of it is to run a totally different software system in the software system that they're already on so for example, running a mobile application on Android Studio. In terms of running our app with using our own smart devices, we have to be able to enable USB Debugging on the developer options feature in the settings of a smart device. Then the user will be able to launch their app on their own smart devices.

3.3 MongoDB

MongoDB is the database that we are using as the database for our final year project. The purpose of this database application that it stores data in a JSON like document. This is able to store information of details that a user has entered about themselves for example, if you were entering an

address, it would start of with either an ID or the name of the person and would then enter the address and possibly their phone number as well and then it is saved on the database. Then you could use a sort order for the people who logged in first for example having the people who logged in the earliest compared to the ones who logged in later on. This is one of the most popular databases that are used for websites and we have experience already with using this before with our react app project that we did last year. What we're exactly using this is for storing the information of the time when the employees in the workplace will be clocking in and out of their workplace so that the manager will be able to see if the employees will be coming into work on time. It will consist with having the username or name of the person being entered into the app in order for them to login and clock in and then be able to take a picture of themselves then as a form of saying they have signed themselves into the workplace. The exact details of when exactly the employee logged into the workplace should come into the database, with their name and email being shown on the database while also the exact time they clocked into work and when they clocked out as well from work. We will also try and have the facial recognition system to be able to recognise the person that is taking the photo of themselves as an easier way for them to be able to clock into the app then after their face has been recognised.

3.4 Firebase

3.5 MYSQL

3.6 Android

Chapter 4

Phones

In this section we will talk about phones and how we as a team used them to incorporate our application idea which in turn helped us to solve the main problem we set out with. As you are probably aware phones and mobile technology currently has essentially become another limb for many people. People will not leave the house without carrying a mobile phone nowadays. It was clear to us as a team of developers looking to make a change that phones would help play a key role in the development of this application.

When developing an application there are many factors, we as a team must take into consideration before making any decisions some of which regard how many customers our application will be able to reach. As technology advances with huge technological break throughs being made on a regular basis it comes as no surprise that the phone market can be a bit scattered with some people using iPhone 6's for example and others using the new latest Samsung S21. The clear difference in the technology in older and new phones meant that we had to try and develop an application that would run comfortably on both.

4.1 Phone users

According to research carried out by Irish Life [1] 90 per cent of Irish adults owned a smartphone. The top three uses phone by people surveyed were checking emails, checking social media platforms and checking the news and weather. As a development team this was a clear indication that our idea to have people clock into work using their own device was more than achievable.

4.2 Phone Cameras Different Phones

Firstly, regarding phones in the development side of our application we had to consider the camera quality which people had on their phone. Newer phones on the market such as the iPhone 11 [2] have a front facing camera with 12 megapixels (MP) whereas slightly older models like the iPhone 6 only have a front camera with 1.2 megapixels [3] (MP) As evident by the specifications outlined above older models would possibly struggle with uploading a clear picture that the facial recognition could use for a login. To combat this, we as a team felt we could solve two problems with one solution. As seen in our survey and in today's world in general some people do not like their photos being taken especially by technology companies who may store them. We as a team decided to include a text login option which would be a solution to people not wanting a photo being taken and for people who might not have a strong enough camera. We felt it unreasonable to cut out some people and have no option for them other to buy a new phone especially when this is a workplace feature.

We have developed our application and tried to accommodate most phone sizes to be compatible with our application. One of the short falls of using a completely new language and development environment for us was we were not used to android studio whatsoever and we have not used any platform similar in our time as developers. One of android studios many short fallings which we will discuss later in this document is that it can be extremely clunky and unhelpful to developers. In order to get the application working on different sized devices android studio does not offer auto scaling like other platforms and instead relies on the developer to implement separates pages which can be run on separate mobile devices. This alone is extremely frustrating to us as developers as it creates a lot of extra work and time but also makes our workspace and file system look like a complete mess and easily leads to getting lost in the endless amounts of pages you have to scavenge through in order to change something not to mention the fact it has to be changed on every page individually.

4.3 Facial Recognition

As outlined above we have included facial recognition in this application as we as a team felt it was the most advanced form of identify verification we could develop. Along with this we thought it would be best that we try new and exciting features to broaden our knowledge base and help us become

better developers by taking on features and subjects that would challenge us and make us must learn and research more.

Facial recognition will be used via the front facing camera of the customers phone to verify they are clocking in by comparing the image taken to an image stored on our database when their account was made. Facial recognition is relatively news and cutting edge and we all agreed as a team that this would be a great key feature in our application, we also think that people will be more likely to use our application in the workplace if it's as simple as a quick photo in the work place and then you are clocked in using your very own device.

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