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Interoperability of Mobile Money Services for Illiterate Users in Zambia

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ABSTRACT: This paper presents the design and development of a mobile money solution that targets illiterate people**,** applying user-centered requirements gathered in a Zambian context. Existing mobile money platforms have text-based interfaces and target literate people. Illiterate people, without the assistance of literate individuals, cannot use such platforms. Emphasis is given to how illiterate users deal with hard cash in their everyday life and how such practices can be mapped into financial technology design. Given the ubiquity of mobile telephony the solution in this paper is based on the widely available, relatively inexpensive and open source Android mobile platforms.

Results of the proposed system show that illiterate individuals can now count money bills, while providing the facility to accept and make payments. In doing so, the mobile application provides an example of how a pervasive technology can empower a hitherto often neglected user category of illiterate users in Zambia.

KEYWORDS*:* Android, API, illiterate, Interoperability, Mobile money.

I. INTRODUCTION

The lack of access to basic financial services is a contributing factor to poverty throughout the world [1] . Many people live without access to basic banking services such as saving and electronic payments, simply because they live hours or days away from the nearest bank. Lack of these services makes it very difficult for the poor to send, receive funds and to save for future or prepare for unforeseen circumstances. Providing banking through mobile phone networks providers offers the promise of dramatically improving the lives of the world's poor. The M-Pesa system in Kenya [2] pioneered the mobile money service model, in which agents act as intermediaries for withdrawals, deposits, and registrations. Interaction of mobile money services by both agents and users is via USSD (Unstructured Supplementary Service Data) and SMS (Short Message Service) or mobile application, enabling users to send money, pay bills, buy airtime and check account balances. Mobile money systems are offering an alternative banking infrastructure in unserved and underserved areas where traditional banking is impractical.

Mobile money services are available to both mobile and non-mobile users. Statistics show that a high percentage of Zambia's populations are "unbanked" meaning they conduct their transactions outside the banking sector with no access to financial services due to various reasons. The use of mobile money services has enabled safe and secure money transfers without the use of a bank account. According to the 2019 annual Zambia information and communication technology (Zicta) report [3], the value of mobile money transactions more than doubled from ZMW 22.2 billion recorded at the end of 2018 to ZMW 49.6 billion at the end of 2019 reflecting an increase of 123.4 percent.

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Figure 1 Growth of Mobile Money Services [4]

II. RELATED WORKS

The evolution of banking paved way to using mobile phones to replace bank services that were carried out in the bank. Reaching the unbanked populations through mobile money transfers has led to a widespread of poor populations carrying out financial tasks despite difficulties related to using technology, poor infrastructure, illiteracy and inaccessibility to receive banking services.

A. Mobile Money Transfers in Africa

The actualization of mobile money in Africa and Asia is a significant progress to improving lives of people in the developing world. Despite the challenge of illiteracy in the rural African areas, mobile phones are more accessible and easier to use [5], therefore promoting the rapid spread of financial aptitude among users in the rural areas.
The ubiquity of technology in Africa is limited due to poverty and other factors limiting the effective use of technology. However, use of mobile money is not only evident among the poor populations in Kenya and South Africa but also in Tanzania, Zambia, Uganda, Zimbabwe, Nigeria, Democratic Republic of Congo (DRC) and many other more. The following are some of the other mobile money services in Africa [6];

- **M-Pesa**: - M-Pesa is a mobile phone-based money transfer, financing and microfinancing service, launched in 2007 by Vodafone for Safaricom and Vodacom, the largest mobile network operators in Kenya and Tanzania.
- **MTN mobile money**: - To mean Mobile Telephone Network is a service provider with its head office *in So*uth Africa. It operates in 21 countries across the Middle East and Africa.
- ***CelPay****:* - This is a mobile banking company operating in Zambia, Zimbabwe and Tanzania.
- ***Msente****:* - This is a mobile money transfer service like M-pesa operating in Uganda.
- ***Orange Money****:* Orange Money is the mobile money service of Orange S.A., available in most of the group's affiliates in Africa.

A. Existing Systems Across Africa

Orange Group and MTN Group, two of Africa's largest mobile operators and mobile money providers launched a joint venture called Mowali, to enable interoperable payments across the African continent. With over 338 million registered accounts, mobile money is the most widely held type of digital financial service account in Sub-Saharan Africa. The ambition of Mowali is to build on this success, helping Africans to gain access to best-in-class digital financial services through the convenience of their phone.

B. Existing Systems in Zambia

Mobile Money refers to a suite of financial services offered through mobile phones and other handheld mobile devices. These services can include: (1) person-to-person transfer of funds, such as domestic and international remittances; (2) person-to-business payments for the purchase of a range
of goods and services; and (3) mobile banking, through which customers can access their bank accounts, pay bills, or deposit and withdraw funds [7]-[9].

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i. Airtel money allows users to send money to other networks using the short code *778# then selecting the option send to other networks. The recipient receives a unique code which they must present to an airtel agent in order to withdraw the money [7]

ii. MTN money allows users to send money to other networks using the short code *303# then selecting the option send to other networks. The recipient receives a unique code called Token ID which they must present to an MTN agent in order to withdraw the money [8]

iii. Zamtel Kwacha allows users to send money to other networks using the short code *344# then selecting the option send to other networks. The recipient receives a unique code which they must present to Zamtel Kwacha agent in order to withdraw the money 9].

GSMA sub-Saharan [4] stipulated that USSD remains the dominant channel used for mobile money services. Over 90% of mobile transactions in sub Saharan African are still processed via USSD but in recent developments, there has been a drastic update in smart phone adoption and mobile internet is on the horizon with an estimation of 280 million new mobile internet subscribers coming online by 2025 in sub-Saharan

III. INTEROPERABILITYOF MOBILE MONEY SERVICES

Interoperability refers to the basic ability of computerised systems to connect and communicate with one another readily, even if they were developed by widely different manufacturers in different industries. Being able to exchange information between applications, databases, and other computer systems is crucial for the modern economy [10] FSD Zambia has been supporting the Bank of Zambia (BOZ) to implement interoperability [10] since 2016. This support has seen the formation of the Payment Association of Zambia (PAYZ) aimed at bringing together all MMOs. Zambia Electronic Clearing House Limited (ZECHL), the interoperability Project Manager will deal with non-bank participants in phase II and PAYZ will work at self-regulation within its membership similar to the Banker's Association of Zambia (BAZ). From the developments laid out above, it is clear that interoperability to ensure secure interconnectivity is in its advanced stage towards implementation of the NFS. Seeing that the first phase is almost completed, careful attention should be given to supporting non-bank participants in achieving connectivity into the NFS.

In countries like Tanzania, Kenya and Uganda, the wave of interoperability began with agents becoming interconnected, meaning a customer could transact at any other operators' agent without restriction. It is yet to be seen how mobile money interoperability will be rolled out and how quickly benefits will be seen but the prospects of having this interoperability happen is an exciting phenomenon for FSD Zambia in its quest to support increase in financial inclusion; and more so for mobile money users who will now have an opportunity to transact across different providers and wherever there is a mobile money agent. With this in place, we can expect Zambia to be well on its way towards a new wave of increasing financial inclusion through mobile money. Further, as the National Financial Inclusion Strategy (NFIS) targets an overall increase in financial inclusion from 59% to 80% by 2022, this can be achieved by government migrating key payment streams (notably government-to-person (G2P) and person-to-government (G2P) onto such mobile platforms in order to increase usage and demand. This is one step towards making this a reality**.**

Interoperability gives mobile money users the ability to send money directly from their wallet to the receiver's wallet in real-time thereby cutting out intermediary steps. This entails that a user can send money across mobile money networks seamlessly, making it very convenient and cost-effective. On the other hand, interoperability gives service providers the opportunity to increase digital transaction volumes, improve the sustainability of their mobile money services and to contribute towards an open digital ecosystem which promotes financial inclusion.

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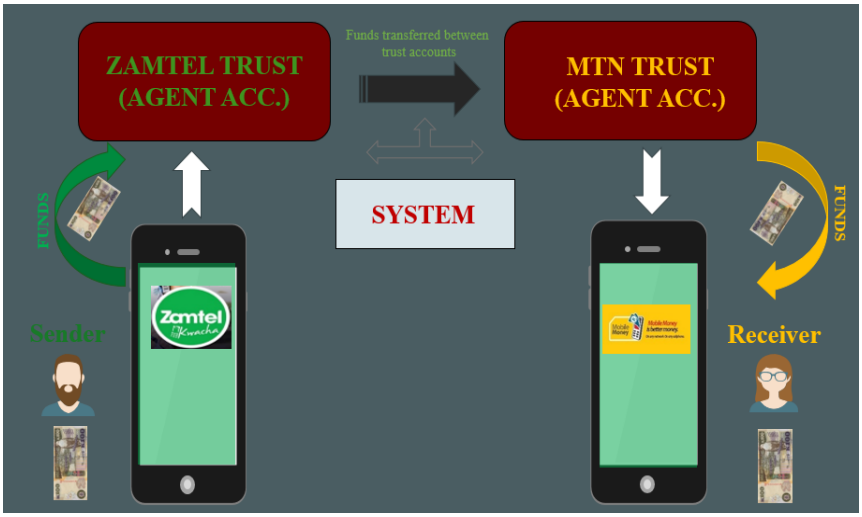

Figure 2: Conceptual Framework

A. Challenges of Mobile Money Applications in Zambia

Apart from financial insertion to large quantities of unbanked communities comprising the poor and people living in remote rural area and supporting capital accumulation and household savings, the mobile money services are changing money transmission policy and guidelines, financial transaction models and templates and rules and regulations of financial transaction environment. According to Christopher and Sébastien [11][central banks have uttered deep apprehension of the risk of mobile money transactions undermining conventional monetary control system, which are included financial sector development and price stability[11] The following are some other challenges being faced by mobile money applications in Zambia;

i. Smart phone market penetration - The fact that some people do not own a smart phone makes the use of mobile money applications limited. They can only use friends' and relatives' phones to send or receive money. This makes them nonregular users and they also can't use any value-added services such as purchase of utility bills and airtime.

ii. Poor network connectivity and unreliable services - The major factor that hindered large population of customers from using mobile money applications service was network or service failures. Some areas especially rural areas have network connectivity problems causing users to have several service drops rates or service hanging.

iii. Lack of information and understanding among non-users - In many cases, non-users were aware of mobile money applications but had only a very basic understanding of the uses and benefits. When asked to rate their level of understanding, often most of them said that their knowledge of mobile money application was limited to the names of the providers.

iv. Expensive to use due to internet connectivity needs - Most of the users were complaining of mobile applications being slow and expensive due to high charges on internet bundles by mobile service providers.

IV. METHODOLOGY

Development of the mobile application based on the functional model proposed and the basic features of the system interface was designed. This was designed based on the primary requirements gathered from the user and analysis of secondary data from proprietary reports.

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A. Kotlin Programming Language

The mobile application was programmed using Kotlin language and the integrated development environment (IDE) tool that was used is Android studio version 4.0. Kotlin was created by JetBrains in 2010 to improve the programming experience for the JVM [2]. It is a multi-paradigm language, supporting both object-oriented and functional programming paradigms, i.e., it allows developers to combine them, as with most modern languages nowadays [1]. Its support for non-nullable types might make applications less prone to null pointer exceptions. It also includes smart casting, higher-order functions, and extension functions [12], [13]. The documentation [39] also states that the language follows the principle of pragmatic evolution, according to three main aspects; to keep the language modern over time; (ii) to keep in constant feedback loop with the users, and (iii) to make updating to new versions comfortable for users.
Kotlin adoption rapidly increased after its v1.0 release in 2016 and there was an increase on Stack Overflow3 questions containing the kotlin tag, as well as on the number of GitHub4 repositories using Kotlin. This growth also follows Google's official Kotlin support announcement in 2017. A potential reason for such popularity is the full interoperability with Java, as both languages can be used interchangeably, and migration can be gradual. Developers can also take advantage of the Java environment using all its existing libraries and frameworks [6], [13], while taking advantage of modern language features [14]. Moreover, its adoption by the Android community [15], [16] was reinforced by the Stack Overflow developer survey, which showed Kotlin among the most loved programming languages in 2018 and 2019 [9], [17]. We also observe the growth of Stack Overflow questions about Android development with Kotlin.

B. Android Studio

The official integrated development environment (IDE) for Google's Android operating system is known as android studio, built on JetBrains Intelli IDEA software and designed specifically for Android Development and is available for download on Windows, macOS and Linux based operating systems or as subscription based service in 2020 [18]. It uses JAVA programming language

C. Software Development Algorithm

Figure 2 shows an algorithm demonstrating the operation of the developed application:

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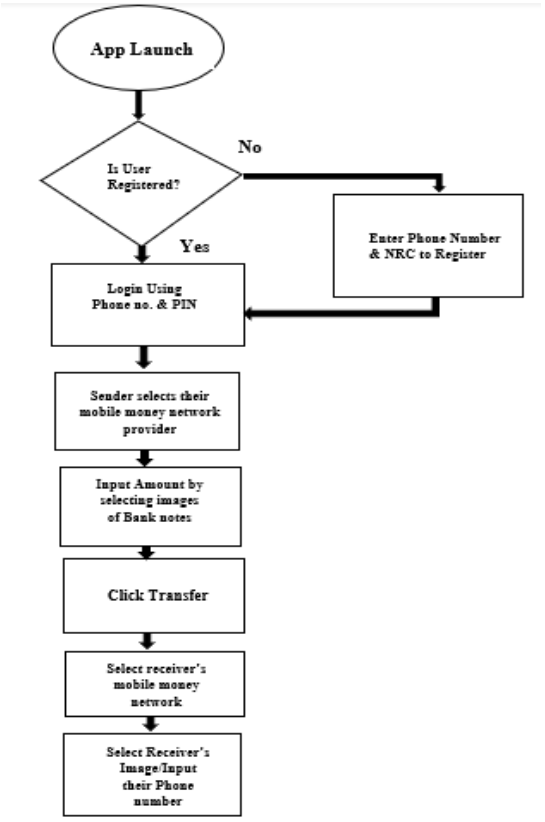

Figure 3: Flow Chart of the Mobile Application

When the app is launched it will ask the user if he/she is registered or not. If not, the user will be asked to register by entering his/her phone number of NRC. If the user is already registered, he will be asked to enter his PIN number or phone number. Next the sender will then select his mobile money network provider; three options are given Zamtel, MTN and Airtel. Immediately after, the sender will then be asked to input the amount by selecting the image of bank notes. Finally, he will select the receivers' mobile money network and image and phone number.

The following are some of the roles that the mobile money application developed plays in aiding users. Firstly, the mobile application gives users the ability to transfer funds from one service provider to another with ease and the receiver will have their account or wallet credited directly and instantly. Secondly, The mobile application has been integrated to operate between Zamtel Kwacha and MTN Zambia money therefore users can transact between the two mobile money service providers and thirdly, The mobile application has been designed with an interface to accommodate illiterate users because it uses pictography options and less text and digits. This gives the users a better experience and more realistic feeling when transacting.

V. RESULTS AND DISCUSSION

Figure 2 shows the screenshots of the home page of the mobile application that was developed for interoperability of mobile money services. The menu displays the three mobile money service providers in Zambia; Airtel Money, MTN Money and Zamtel Kwacha. For a user to have access to this home menu, they need to login using their phone number and their personal identification number (PIN).

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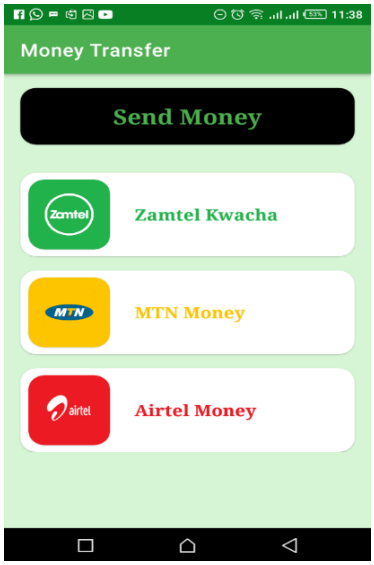

Figure 2 Mobile Application Home Page

The menu displays the three mobile money service providers in Zambia; Airtel Money, MTN Money and Zamtel Kwacha. For a user to have access to this home menu, they need to login using their phone number and their personal identification number (PIN).

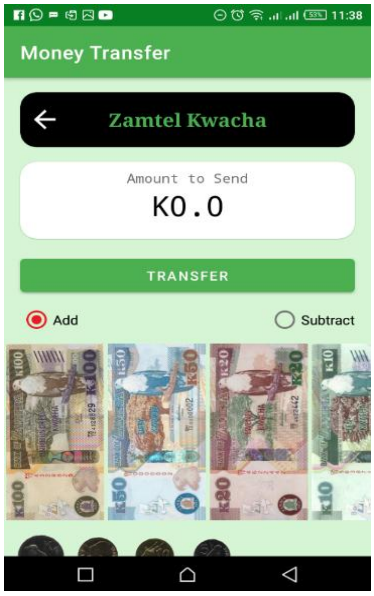

Figure 3 Mobile Application Main Menu

After a user logs into the mobile application, they have an option to choose what type of transfer service they want either intra-network transfer or inter-network transfer and this is done by simply selecting the logo of the service provider the user wants to transfer funds to. After this selection is done, the mobile application displays the interface shown in figure 3 above.

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The figure shows money in pictorial format and displays all Zambian kwacha bank notes including coins, the user can select the amount they intend to send by clicking the bank note of their choice. To subtract or remove an amount from the selected displayed figure, the user simply clicks the subtraction option and clicks the amount they intend to remove or subtract.

Coins are also incorporated in the mobile application and can also be added or subtracted in a similar manner as bank noted. The findings of this research are consistent with [4] who found that most important facet for the illiterate users is to be able to use an interface where the absence of text and numbers increase their ability to interact and perform activities. The interface relies conclusively on image for interaction elements. The user can confirm through their stack of digitally represented bills and inspect them separately.

The findings of this research are consistent with [4] who found that most important facet for the illiterate users is to be able to use an interface where the absence of text and numbers increase their ability to interact and perform activities. The interface relies conclusively on image for interaction elements. The user can confirm through their stack of digitally represented bills and inspect them separately.

VI.CONCLUSION

Results, of the proposed application, show that illiterate individuals can now count money bills, while providing the facility to accept and make payments. In doing so, the mobile application provides an example of how a pervasive technology can empower a hitherto often neglected user category of illiterate users in Zambia

The android mobile money application was developed using Kotlin language which is a multi-paradigm language supporting both object-oriented and functional programming paradigms. The integrated development environment (IDE) tool that was used is Android studio.

To achieve interoperability between Zamtel kwacha and MTN Zambia using the findings from the surveys, a mobile application was developed to meet the proposed features needed to satisfy the need for digital inclusion among all type of users in Zambia. The request to pay Application programming interface (APIs) were used and the interface of the mobile application that was developed was intuitive for illiterate users as it encompassed icons and pictography as opposed to number and text-based features currently on the Zambian market which hinders some users to operate efficiently.

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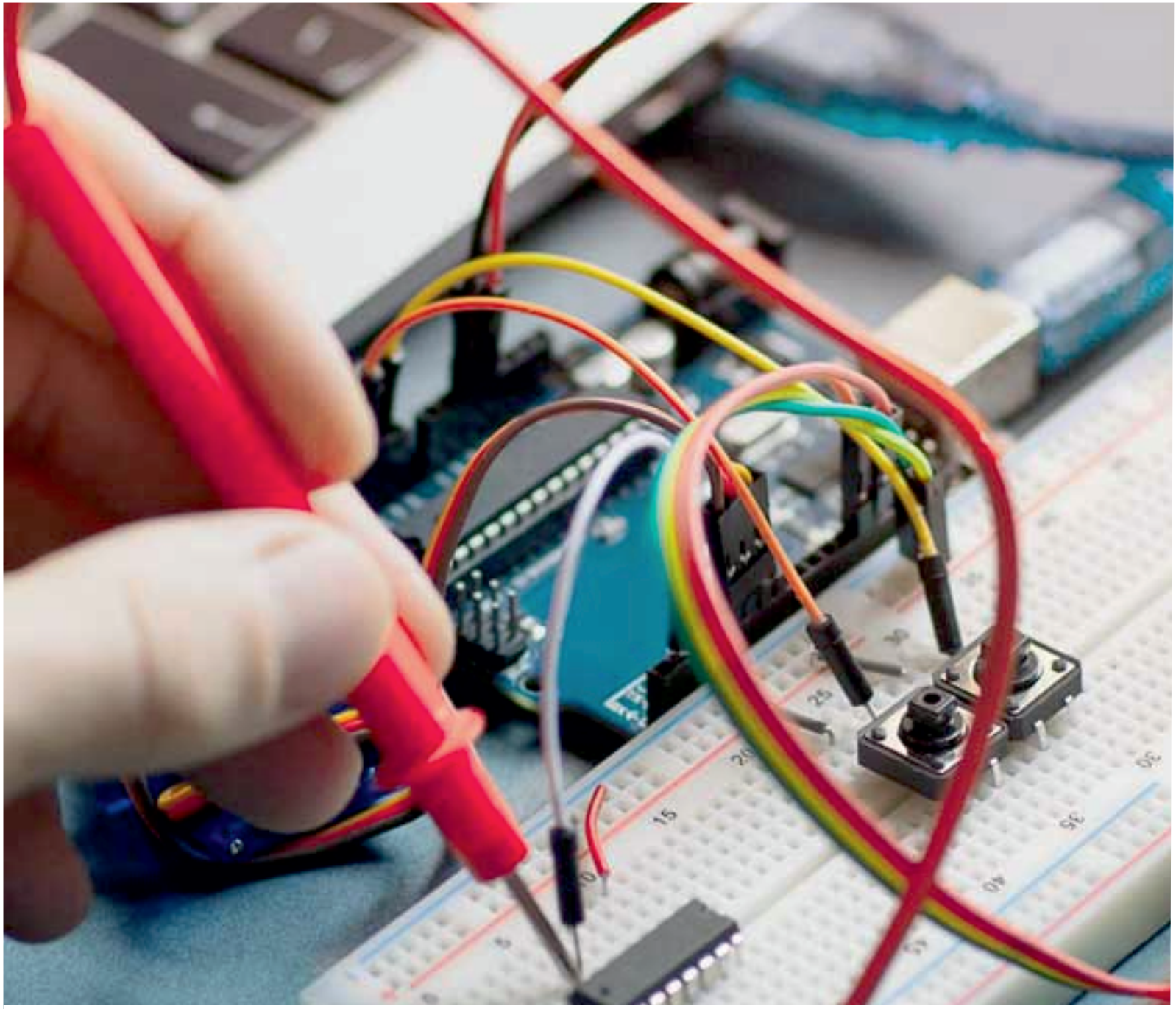

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